College of Science & Technology

School of the Built Environment

Developing a Framework forIntegrated Community-Centered Early Warning System to Enhance Disaster Resilience in UAE

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LIST OF ACRONYMS

EWS	Early Warning Systems
EST	Estimates
FEMA	Federal Emergency Management Agency
GSOEWS	Global Survey of Early Warning Systems
ISDR	International Strategy for Disaster Reduction
IDNDR	International Decade for Natural Disaster Reduction
IFRC	International Federation of Red Cross
IPCC	Intergovernmental Panel on Climate Change
MENA	Middle East and North Africa
MOI	Ministry of Interior
NCEMA	National Crisis & Emergency Management Authority
NCMS	National Centre for Meteorology and Seismology
UAE	United Arab Emirates
UNESCO	United Nations Educational Scientific and Cultural Organization
UNPD	United Nations Procurement Divisions
USD	United States Dollar
UNISDR	United Nations International Strategy for Disaster Reduction
UN	United Nation
UK-DTI	United Kingdom Department of Trade and Industry
USGS	United States Geologic Survey
WMO	World Meteorological Organization

GLOSSARY OF TERMS

Early Warning Systems - can be described as the process for generating maximally accurate information about possible future harm and for ensuring that this information reaches the people threatened by this harm (Glantz, 2004). It is also the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss (UNISDR, 2009).

Elements of EWS – The four inter-related components of EWS i.e. risk knowledge, monitoring and warning, warning dissemination and communication and response capability that ensures the functionality and effectiveness of EWS (UN, 2009; Wiltshire, 2006).

Disaster - A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR, 2009).

Disaster Resilience – The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2009).

Hazard - A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009).

Natural hazard - Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009).

Stakeholders - Stakeholders are those who may be affected by or have an effect on disaster or emergency management efforts (Drabek, 1991). They may also include people who have a strong interest in emergency arrangements and effort for academic, philosophical, or political reasons, even though they and their families, friends, and associates are not directly affected by it (IAEM, 2007).

Community-centred – is a unique approach that enable individuals, families and communities to participate effectively in finding solutions to their own challenges especially impacts of natural hazards which disturb or subtract from their wellbeing, health and living full lives (Community-centred knowledge, 2015; Alhmoudi, 2014).

Emergency Management - The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps (UNISDR, 2009).

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DEDICATION

With All My Heart, I thank my God (Allah), because without His blessing, support, Guidance and Love, This Work Would Not Have Been Possible.

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ABSTRACT

The impacts and costs of natural disasters on people, properties and environment is often severe when they occur on a large scale or when not prepared for. Factors such as impacts of climate change, urban growth, poor planning to mention a few, have continued to significantly increase the frequencies and impacts of natural disasters across the world, the United Arab Emirates (UAE) inclusive. While the frequencies of natural disasters might not be controlled easily, the need for more effective early warning systems has become highly important. In recent years, existing researches and international organisations such as the United Nations (UN) have identified lack of Early Warning System (EWS) and the lack of integrated approach to disaster response as one of the reasons many deaths occur when natural disasters happen especially in developing countries. For instance, some communities in the (UAE) have suffered the impact of natural disasters in recent years due to lack of EWS deployment and lack of community knowledge of risks of natural disasters. These problems emphasises the importance of this research which aims to decrease the vulnerability of communities in the Emirates by developing a framework for integrated early warning systems in community in order to increase response capabilities against the risk of natural disasters in the United Arab Emirates.

This research used case study, semi-structure interview and questionnaire techniques to investigate deployment of EWS and current practice of EWS in the emirates of Abu Dhabi and Fujairah. The effectiveness of the EWS in the UAE was evaluated international best practice in EWS and ten principles which guides EWS deployment in seven countries. While this influenced the collection of secondary data, it also influenced the collection of primary data through semi-structured interviews with 12 strategic officers from organisations involved emergency, crisis and disaster management in the UAE from the Emirates of Fujairah and Abu Dhabi. Questionnaires were also administered to a total of 1,080 respondents from the two emirates. The research outcomes show that EWS in Abu Dhabi and Fujairah lacked the essential elements of EWS. The results also emphasised the need to promptly develop the specific elements which are lacking and to improve the ones which were ineffective. The conclusion of this research have emphasised that community-centred EWS can be applied in the UAE, but can only be effectively applied by using the framework developed in this research which captures areas for further development and areas of improvement.

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CHAPTER 1: INTRODUCTION

1.1 Introduction

A key objective of this research effort is to investigate development of a framework which integrates community-centred early warning systems (EWS) approaches with global best practices, in order to enhance disaster resilience in the United Arab Emirates (UAE). The EWS framework developed in this research focuses on increasing early warning capabilities in three types of natural hazard including Geophysical, Meteorological, and Hydrological. These hazards have been chosen due to their repeated occurrence and impact in the last ten years in the United Arab Emirate (UAE).The purpose of this introductory chapter is to set out the background of the research area, the aim, objectives and underlying research questions. The motivation for undertaking this study is also explained. Subsequent sections discuss scope of the research, methodology, research contribution and structure of thesis. The latter part of this chapter is devoted to sections on exclusion, constraints and limitations and summary of this first chapter.

1.2 Research Background

The frequency of natural disasters in the world has been steadily increasing over the years, occurring in unprecedented frequencies and with devastating impacts (Abe and Thangavelu, 2012). The principal reason for the continuing increase in natural disasters is related to population growth, particularly in developing countries, and to the increased concentration in urban growth, characterized by poor planning, climate change and limited infrastructure (Sqrensen*et al.*, 2006). The peculiarity with population growth in many developing countries is that majority of this growth is taking place in vulnerable areas, increasing exposure to various natural and man-made disasters.

Analysis of disaster data captured during the past thirty years indicate that whilst there has been an increase in natural disasters all around the world, the greatest increase has occurred in the Asia and Pacific region (Figure 1-1). This has been explained partly due to advancements in reporting and partly to increased exposure and vulnerability (UNESCO, 2013). Moreover,in

terms of people affected by disasters, between 2002 and 2011, most people were affected in the Asian and Pacific region, which was also where most people were killed, as a result of these disasters (UNESCO, 2013). Figure 1-1 indicate that frequency of natural disasters has increased much more in Asia Pacific region, when compared to Africa and Europe.

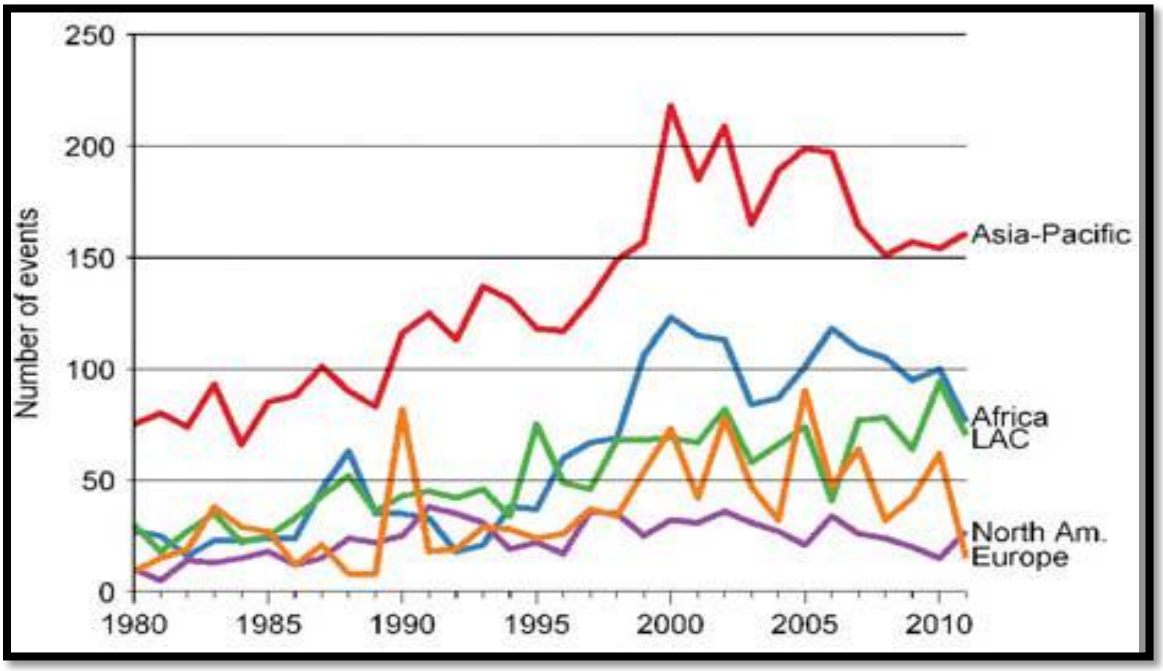

Figure 1- 1: Number of reported natural disasters (UNESCO, 2013)

In recent years, many deaths through disasters have been attributed to a lack of an effective Early Warning System (EWS) and lack of an integrated approach to disaster response, particularly within developing countries (Raimondi, 2010). For instance, Momani*etal.* (2011) investigated the response efforts to flood disaster that happened in Jeddah city in 2009 and highlighted the lack of EWS in place to inform the population in a timely manner. Lack of early warning left the population without water, electricity, food, and telecommunications, resulting in key challenges in the task for reconstruction and rehabilitation of the community and people (Albreiki, 2013).

Early warning (EWS) is defined as "the provision of timely and effective information, through identified Institutions, that allows individuals exposed to hazard to take action to avoid or reduce their risk and prepare for effective response" (UN-ISDR, 2005). People-Centered or Community

Based Early Warning Systems (CB-EWS) are recognised by institutions such as the UN as an effective and important strategy for disaster risk reduction (Londoño, 2011). According to UN/ISDR, the Asian Ocean Tsunami in December 2004 was probably the loudest wakeup call in recent history, indicating the urgent need to have effective CB-EWS in place, in all countries and regions, and for all types of hazards. Despite the broad destruction caused by the tsunami, local community-based initiatives, developed since before the event, proved to be successful (Subramanian, 2005). CB-EWS are designed to reduce the impact of a hazardous event and, if effective, can substantially increase the numbers of survivors. An example of how beneficial EWS can be is outlined in a review of deaths on the east coast of India from cyclones (ISDR, 2009).

It has been recognized that to be effective, EWS need to integrate scientific and technical abilities of hazard identification and forecasting with effective communication, commitment of public policy and understanding and active participation of local communities (Londoño, 2011). In March 2005, the United Nations International Strategy for Disaster Reduction (UNISDR) conducted a survey in over 23 countries with 20 international agencies, to identify existing capacities and gaps in EWS, with the intention of providing a wake-up call to governments and other agencies about the role of EWS in reducing human and economic loss from natural hazards (United Nations, 2006). To be effective, the report suggests that EWS must be people-centered (i.e. community based) and should be composed of four key elements (or subsystems) including knowledge of the risks being faced, warning service and technical monitoring, as well as dissemination and communication of meaningful warnings to people at risk and with response capability (Londoño, 2011). This discussion shows that human factors are critical in success of EWS and also highlight the need for effective engagement with local communities to understand their needs for EWS.

As a result of the location and proximity to various hazards, the Arab countries are particularly vulnerable to the cascading impacts or ripple effects of the many of the disasters in the Asia and Pacific region. As result of this, many countries in the Arab region have suffered 276 disasters in the last 25 years, in which 100,000 people have died and 1.5 million have been left homeless (Aburawa, 2011). The financial impact of these disasters are also significant and have been

observed to be on the rise (Aburawa, 2011), which is believed to be due to inadequate preparedness, lack of early warning systems, among many other factors.

The UAE is located in the Gulf region in the northern part of the Arabian Plate, which is moving towards the North and will collide with the Corrugated Euro Asian Plate in both Iran and Turkey (Dhanhani, 2010). This has the potential to generate earthquakes along the mountain chains: Zagros of Iran and Taurus in Turkey. The UAE is undergoing a high level of financial investments and has high densities of populations (Barakat *et al.,* 2008). In April, 2013, an 8.7 Richter scale earthquake occurred 650 km from Ras al Kamiah Emirate, raising threat of earthquakes in the region (Abdulla, 2013). The 25th April 2013 and several small earthquakes which have been recorded since, represent sufficient evidence of the existence of considerable seismic activity within the UAE (Abdulla, 2013).

In addition, the UAE is vulnerable to the possibility of tsunami activity (Kumar, 2009). Most natural hazards within UAE have occurred in Fujairah, such as the Al Qurayah flood of 1995, the Masafi earthquake of 2002, the Al Tawaian landslide of 2005, the Tropical Gonu storm of 2007 and the Sharm flood in 2009 (Dhanhani, 2010). The UAE have suffered various levels of impacts in terms of social, economic and environmental losses. For instance, intense tropical cyclones like Gonu over the Arabian Sea caused 78 fatalities, 37 missing people and a major costs of $4.4 billion (USD) spreading over Iran, Pakistan, Oman and UAE (UP International, 2007). While Oman declared a state of emergency, closing offices and restricting movement of people in the country to prevent further losses, there was no official warning in the UAE (Swan, 2010). This highlights lack of preparedness in the region. Besides cyclone Gonu, other cyclones which have occurred in this region which impacted the UAE are illustrated in Table 1-1.

While Table 1-1 only shows the record of cyclones in the UAE, there are other natural hazards such as flooding, tsunamis etc. which have equally caused damage in the UAE. Therefore as a result of the impacts of these natural hazards within the UAE context, Dhanhani (2010) has identified weaknesses in the EWS and response systems. Literature review indicate paucity of published literature in the context of EWS deployment within UAE context. Implementation of CB-EWS requires a holistic bottom up approach and a good understanding of socio-technical

issues, which is currently lacking in existing applications. This is evident in response to various events (e.g. Cyclone Gonu). This gap and weak EWS has motivated this research into this topic. The impact of these natural hazards have also motivated the research focus on developing a framework to enhance Community Based Early Warning Systems (CB-EWS) against the risk of natural disasters in the UAE, using the emirates of Fujairah and Abu Dhabi as case studies. The next two sections briefly explain the research motivation and justification for the research.

Table 1- 1: Cyclone information for the last 15 years (Meteorological department, 2011)

S/N	CYCLONE	YEAR	PRESSURE	
			hPa	inHg
1	ARB 01	2001	932	27.52
2	Sidr	2007	944	27.88
3	Gonu	2007	920	27.17
4	Giri	2010	950	28.05

1.3 Research Motivation

This research has been motivated by the continued impact of natural disasters in the UAE. The Author has previously worked as an Emergency Management Administrator for natural disaster management at the Ministry of Interior. This experience provided an opportunity to identify problems with disaster and risk planning. A lot of failings in disaster preparedness can be attributed to lack of availability of EWS and in some emirates, where there has EWS has been deployed, ineffective and ad-hoc EWS deployments. While natural hazards continue to occur in the country, various initiatives were launched by UAE Government, in particular National Emergency Crisis and Disasters Management Authority (NECMA, 2015). However, there is scope to better integrate community and other stakeholders in order to improve preparedness activities, especially EWS. UN-ISDR (2005) identify four building blocks of EWS, including Risk Knowledge (i.e. effective risk assessment to set priorities for mitigation and design of

EWS), Monitoring and Predicting (i.e. to undertake timely estimates of risks faced by communities), Dissemination information (i.e. communication systems for delivering warning messages) and Response capabilities (i.e. co-ordination, good governance, and appropriate action plans). All blocks are intertwined and failure in one dimension could lead to failure of the entire system. Author's personal experience of observing the level of inactivity in the area of community involvement within emergency/disaster management in UAE, has motivated this research topic. It is hypothesised that a better understanding of EWS, its effective application and sustained involvement of community and other stakeholders in EWS will enable the country to be disaster resilient.

The approach taken by this research is expected to create a collaborative effort which will help to mitigate the impact of disasters and the impact of challenges which result in rapid urbanisation within UAE. According to Ozerdem (2003), disasters can influence development and vice versa, therefore another motivation of this research is to take advantage of available technology and utilise this to serve the community. Inevitably this approach will help to strengthen cooperation between all institutions at all levels of government and the community. This is expected to be done by drawing best practice from countries that have good track record of effectively implementing EWS. All these factors, possibilities and potential impact of effective EWS in the UAE have contributed to the researcher selecting the subject of this study.

1.4 Justification for the Research

There are a number of reasons that make this study a valuable area to investigate. These reasons are classified based on the importance of the concept, lack of community engagement in EWS, hazard and safety concerns and lack of empirical studies. These sets of justifications are explained in the following subsections.

1.4.1 The Importance of the Effective Disaster Preparedness

The importance of studying natural disaster originates from the importance of managing disaster risk in any country, and from the fact that all individuals and communities are susceptible to hazards. According to the Global Survey of EWS (2006), approximately 2.5 billion people were

affected and the lives of nearly 900,000 were claimed as a result of disasters. Therefore, many authors argued that disasters should be focused on, and that intensity and impact of hydro-meteorological disasters is on the rise because of global warming (Jarraud, 2006). Natural variations in the frequency and intensity of hurricanes are also believed to be a contributing factor (Than, 2005). Hydro-meteorological disasters often have a sudden on-set, with limited time for preparedness (Jarraud, 2006), thus, requiring effective preparedness to make best use of limited time window available.

1.4.2 Lack of Community Engagement

Engaging the community in EWS is an important starting point to avoid or minimize the risks of disasters. Even though there is paucity of published literature in terms of community engagement in EWS within UAE context, the authors' experience and primary research undertaken as part of this research effort indicates that the role of communities within EWS is not clearly defined in UAE. Even though National Emergency Crisis and Disasters Management Authority (NCEMA, 2013) was established in UAE and federal plans were devised, general public and members of the vulnerable communities are uninformed and unaware of such plans. As a result, there is a lack of awareness on procedures to be carried out in the event of the arrival of early warning signals. This requires an in-depth analysis into the role of communities and stake-holders within EWS, to enhance disaster resilience within UAE.

Secondly, implementing, and sustaining EWS in communities is essential. The existence of a EWS, containing such data, will reduce the loss of life and economic losses by allowing alerts to be made and preparations to take place. The challenge for countries is therefore to empower each community to engage in the EWS, through networking and partnerships (Jarraud, 2006). Another major area of improvement of EWS deployment within UAE include lack of clear definition of responsibilities of the parties involved in the management of the disaster, in the Federal Plan of Emergency. Often warning messages issued are not clear for the community, with no standard mechanisms for dissemination, as well as a lack of training and awareness among the community.

Thirdly, the recommendations of this research will help to enhance community engagement in early warning response capabilities against the risk of natural disasters in the United Arab Emirates. Lastly, the UAE is undergoing a high level of financial investments and has high densities of population including a huge expatriate population who do not speak Arabic. The presence of other languages such as English, Persian, Hindi, and Urdu create significant communication challenges. As identified by Al ameri (2010), there are significant weaknesses in the transfer of understandable warning messages and preparedness information to those at risk and there is no networking or communication among stakeholders.

1.4.3 Hazards and Safety Concerns

The UAE faces natural hazards such as landslides, earthquakes, and tropical storms. Although it is accepted that not every natural hazard can be predicted or prevented, it should be acknowledged that if there is a certain level of preparedness and the ability to respond quickly, then the number of people who suffer as well as the amount of damage done to properties and infrastructure, could be significantly reduced. Thus, it is important to have a plan of action for dealing with situations that occur in the event of natural disasters and ensure this is regularly updated.

Secondly, the occurrence of natural disasters especially in the last ten years, have exposed weaknesses of UAE EWS. Natural disasters such as; the Cyclone Gonu in 2007 in Fujairah; the floods that swept through the village of Sharm in 2009; the Cyclone Nilofar, 2014 in the city of Kalba; Al Samkha floods in Abu Dhabi in 2013; and the heavy thunderstorm in the Ruwais Area of Abu Dhabi in 2013 (Dhanhani, 2010) all exposed the ineffectiveness as well as lack of EWS in the UAE. Lastly, the geographical nature of the UAE varies from one city to another, which contributes to the diversity and variation of natural disasters by each emirate. For example, the emirate of Fujairah, with coastal views over the Indian Ocean, is in danger of exposure to disasters such as tsunamis, floods and landslides. While the emirate of Abu Dhabi, the capital of the United Arab Emirates, has a dry climate and is more exposed to risk of floods, earthquakes and storms (Al Ameri, 2010).

1.4.4 The Lack of Empirical Studies

There is a lack of published empirical studies into EWS deployment within Arab countries. To the best of the author's knowledge, there is no published study within UAE context. The dearth of empirical research into the practices of disaster risk in the UAE is a principal motive for conducting this study. Therefore, this study represents an attempt to narrow the gap that this represents by contributing new knowledge concerning natural disasters in Arabic countries, and will provide deeper and better understanding of the natural disaster hazard in the UAE.

1.5 Research Questions

From the research aim the following questions emerge as being essential to achieve the research aim:

1) What is the best practice in deployment of Early Warning Systems to enhance disaster resilience?
2) What is the current EWS practice used in the UAE for emergency Planning and response?
3) What are the EWS requirements of stakeholders and community for effective emergency planning and response in the UAE?
4) What additional measures are required to improve EWS and how can EWS be improved in order to enhance disasters resilience in the UAE?
5) How an integrated approach can be taken across different Emirates within UAE using an EWS framework?
6) How can developed framework be validated with concerned stakeholders in the UAE?

1.5.1 Research Aim and Objectives

The aim of this research is to develop a framework for integrated community-centred early warning system in the United Arab Emirates, in order to increase response capabilities against the risk of natural disasters.

Key research objectives include:

1) To critically examine best practice in Early Warning Systems (EWS) for disasters resilience.
2) To undertake an investigation into the existing deployment of EWS in the UAE.
3) To evaluate the EWS requirements for community and stakeholders in the UAE.
4) To develop a framework that will facilitate successful and effective community integration in EWS in the UAE.
5) To validate the developed framework with concerned stakeholders.
6) To develop guidelines for emergency management stakeholders, in order to ensure effective community based Early Warning Systems deployment within UAE.

1.6 Scope of Research

This research study was aimed at developing a frameworkfor an integrated community-centered early warning system to enhance disaster resilience in the United Arab Emirates, using the Emirates of Fujairah and Abu Dhabi for a detailed case study analysis. The reason behind choosing these two Emirates was that the emirate of Abu Dhabi is the capital of the UAE and all Government organisations are based there, making it vulnerable to various types of disasters, while the Emirate of Fujairah has a recent history of natural disasters.

Man-made disasters were excluded from this research. This was because the frequency of natural disasters has been steadily increasing globally, especially in the Asian region and in the UAE, with its current weak Early Warning system (EWS). In addition, the geographical nature of the UAE varies from one city to another, which contributes to the diversity and variation of natural disasters by each Emirate. The man-made disasters are quite complex and variant and were excluded from scope of this research.

The scope of this research is limited to the effective integration of communities within EWS. EWS is a broad area of research and technology is one key component of EWS. However, in this research, technology related aspects of EWS are not addressed. By reviewing the relevant

literature the theoretical framework was initially developed. The empirical work was carried out by collecting the data required for the research via interview and questionnaire survey in the case study. The interviewees mainly represented general directors and senior staff in each case. The researcher decided to include all these levels in order to gain in-depth information and a full picture of all people within the Emirates. After collecting the data, it was analysed qualitatively and quantitatively to identify and explore the key factors that enhance the engagement of individuals in a community in early warning response in the two selected cases. The findings of the research have been discussed, using many tools for triangulation. Then, the initial theoretical framework is revised accordingly to reflect the case studies' findings, and the final framework was developed and validated.

1.7 Outline Research Methodology

This section provides a brief overview of the research methodology adopted in this work. More detailed analysis is provided within the research methodology chapter. There is no definite rule as to which methodological paradigm to select when doing research, as the most suitable one will depend on the nature and scope of the study (Hussey and Hussey, 1997; Easterby-Smith et al., 2004). Based on the aim and objectives of this study, the researcher adopted mainly a qualitative method, while a quantitative approach was also used to validate and confirm the collected data, as well as to enhance the research quality.

Research philosophy used is interpretivism. The approach used is both deductive and inductive, and the strategy used was case study. The data collected from the case studies was analysed according to suitable methods, which are discussed in more detail in Chapter 4. All these methods are used in order to collect relevant data from Emirate of Fujairah and the Emirate of Abu Dhabi, in order to enhance the engagement of individuals in a community, to bolster EWS response capabilities against the risk of natural disasters in the UAE.

1.8 Research Contribution

This research enhances our understanding of the EWS deployment challenges faced by the communities in the UAE. It provides a framework that describes Early Warning System

requirements, activities, processes, information and technology support that are necessary for communities to work together in a disaster situation. The research contributes as well to discovering the requirements of the society of EWS and to benefit from the experiences of countries that have succeeded in the EWS deployment.

This is the first empirical study that identifies and addresses the Early Warning System (EWS) implementation against the risk of natural disasters in the United Arab Emirates context in particular and in Arabic countries in general. Thus, this study has attempted to narrow the gap in knowledge within natural disaster management by providing an empirical understanding of the phenomenon within this environment.

1.9 Thesis Structure

Figure 1-2 illustrates the thesis research structure. The research starts with chapter one, which includes the research problem, aim and objectives, details of the research focus and the scope and limitations of the study. Figure 1-2 illustrates the interaction and relationships between each chapter and how they contribute towards achieving the research aim i.e. to develop a community-centred EWS, which will be effective for responding and mitigating the impacts of natural disasters in the UAE

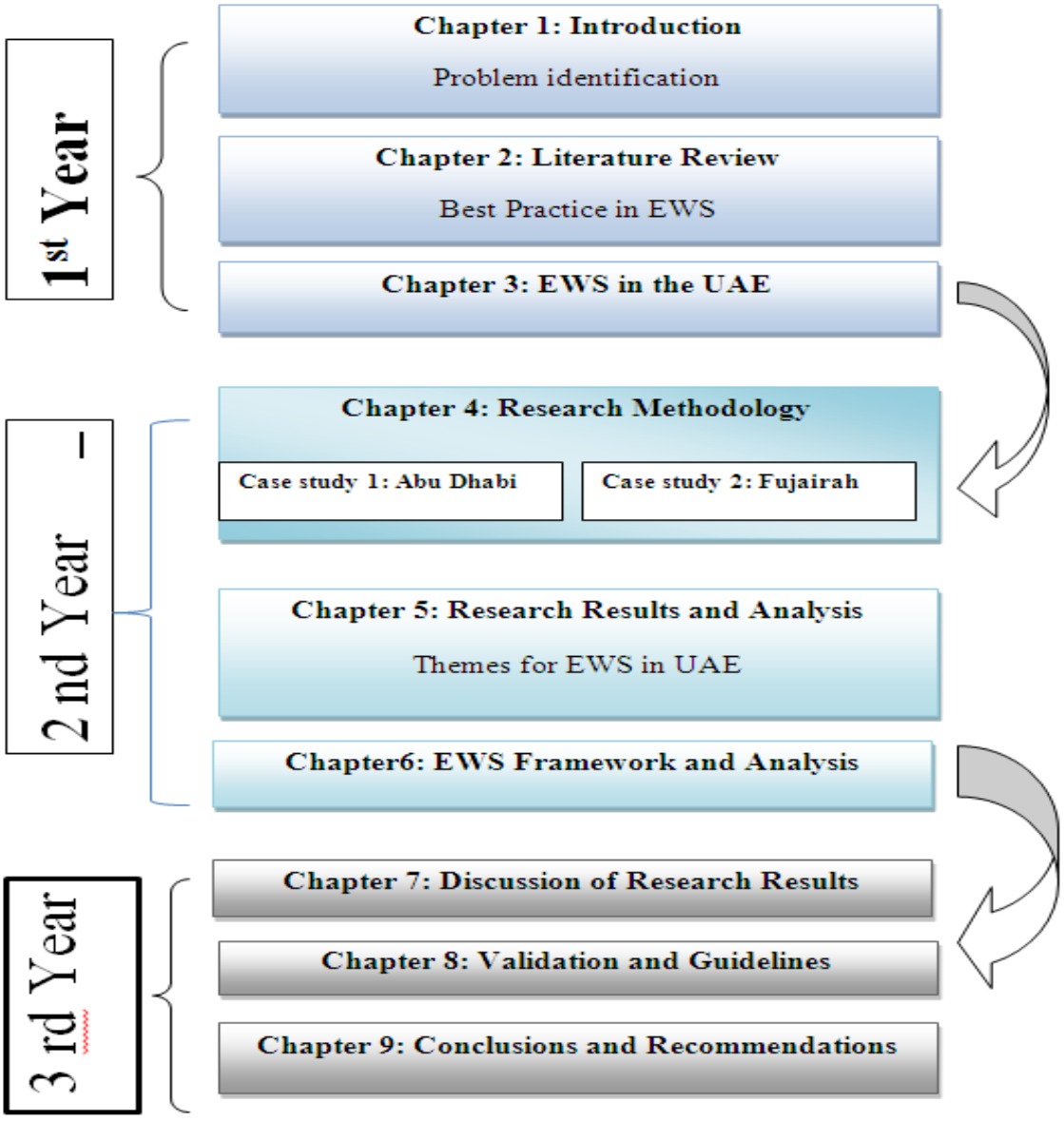

Figure 1- 2: Thesis Structure

1.10 Research Limitations

Interviews done as part of this research were not recorded. Government officials and public in general are reluctant to have a candid discussion whilst being tape recorded. This can be attributed to cultural factors. Inability to voice record interviews is recognized as a limitation, as it may lead to important information being missed and less accuracy in the interview data. In order to tackle this limitation the researcher, as suggested by Yin (2009), tried to write as much information as possible during the interview, and then immediately on the same day after each interview, allowed time to transcribe all pieces of information and ideas and converted them into a form of written record, while they were quite easy to remember. These records were then confirmed by the interviewees.

Some of the case study documents were considered private e.g. minutes of meetings and, therefore, the researcher was not able to obtain copies. Moreover, there were cases encountered with lack of available documents within the case study and clarification in triangulation of evidence was not always available. This has reduced the ability to confirm or refute responses from participants.

1.11 Chapter Summary

This introductory chapter has offered an insight into the research study, highlighted the reason why this study is valuable for the UAE, and hence why it should be conducted. It has outlined the aim, research questions, and objectives which need to be achieved in order to justify the motivation for this research. The expected contributions to knowledge have been identified. The indication of the methodology adopted for this research was also briefly discussed in this Chapter. Finally, an outline of the structure of the thesis was written which provides guidance for the progression of this research process.

CHAPTER 2: STATE OF THE ART REVIEW ON EARLY WARNING SYSTEMS FOR NATURAL DISASTERS

2.1 Introduction

The aim of this chapter is to achieve the first and second research objective by examining disaster concept and definitions relevant to this research area. It examines, evaluates and discusses issues such as concept of Early Warning Systems (EWS), models of EWS, dissemination of EWS. Other sections in this chapter also provide context and critical analysis of key lessons and best practice in EWS, review of principles and pillars of EWS, which informed the critical evaluation of the existing deployment of EWS in the UAE. The relevance and the importance of all these sections were drawn together to provide a potential conceptual framework for EWS which will be subject to further evaluation in this research. A section which summarises this entire chapter complete this chapter.

2.2 Background and Concept of Early Warning Systems

EWS can be described as the process for generating maximally accurate information about possible future harm and for ensuring that this information reaches the people threatened by this harm (Glantz, 2004).While early warning is restricted to the timely emission of a warning before an impending crisis, EWS include not only the warning itself, but as a system, it includes an integrated set of elements that interact long before the crisis starts, with the main goal of achieving risk reduction (Londoño, 2011). However, Grasso (2007) states that the importance of EWS is its appropriate use to set up measures which can enable the community potentially in danger to avoid or reduce the impacts of hazards such as storms, cyclones, fires, floods, to mention a few. To ensure that EWS are effective, UN (2006) outlines the use of technologies to forecast potential hazards. While the use of technologies for forecasting and even disseminating EWS cannot be denied, Wiltshire (2006) argued that for EWS to be effective, it must include the active involvement of communities, who are at risk. Furthermore, the importance of public education, risk awareness and ability to disseminate warnings and information about the state of

preparedness must be constant (Grasso, 2007; Wiltshire, 2006). However, UN (2006) states that a complete and effective EWS must comprise four inter-related elements shown in Figure 2-1.

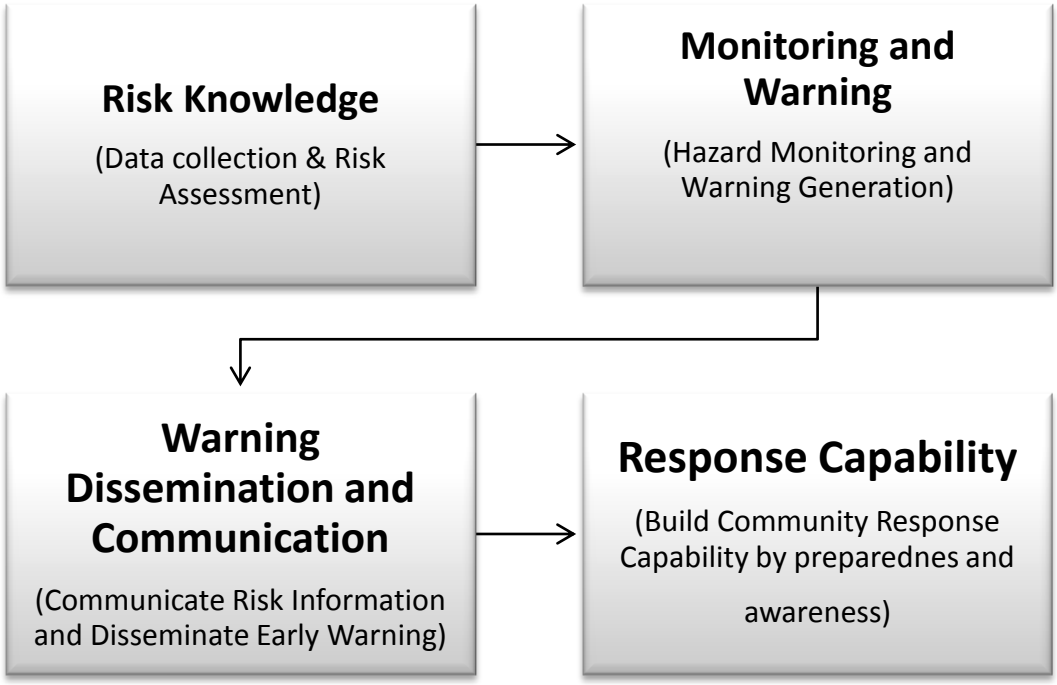

Figure 2- 1: Four elements of community-centred EWS (UN, 2006)

Figure 2-1 shows that risk knowledge is important for monitoring and warning, as well as for dissemination and communication. While these four elements are depicted in Figure 2-1 as elements with specific components, these are also interrelated elements as shown by the flow of arrows indicting the interactions between the four elements required for community-centred EWS. According to Haddow, Bullock and Coppola (2011), the knowledge of risk determines the data that will be collected and risk assessment for vulnerable communities. The risk knowledge also informs the response capability required for responding to the natural hazard when it happens and to determine required resources to protect communities. Therefore, EWS are well recognized as a critical, life-saving tool against hazards such as floods, droughts, storms and bushfires (Abdulla, 2013). The existence of EWS, containing such data, will reduce the loss of life and economic losses by allowing alerts to be made and preparations to take place (WMO, 2013).

At the World Conference on Disaster Reduction in 2005, in Hyogo, Japan (UNISDR, 2005), 168 governments, which were supported by numerous organizations, adopted the Hyogo Framework (HFA) for Action 2005-2015 (Figure 2-2). The Hyogo Framework sets out a number of strategic goals, priority areas of action and institutional responsibilities, which can lead to significantly reducing disaster risks. It recognises the need to develop EWS capabilities and improve preparedness and responses, as part of a comprehensive approach involving the integration of disaster risk reduction into development planning and practices and by building a culture of prevention and capacities for resilience (UN, 2007). This has been associated with the development of EWS and emergency preparedness and planning at national to local levels (UN, 2009). Also, the World Conference in Hyogo emphasizes the importance of follow-up EWS measures and approaches developed by different countries in collaboration with communities during the period 2005–2015, due to the substantial reduction of disaster, loss of lives and of the social, economic and environmental assets of communities and countries.

Hyogo Framework (HFA) for Action 2005-2015 (Figure 2-2) identified five priority areas for actions stemming from the strategic goals. This research also looks at priorities 2, 3 and 5, which are part of the EWS, including: people-centeredness; information systems; public policy; scientific and technological development; data sharing, space based earth observation, climate modelling and forecasting; early warning regional and emerging risks in the context of EWSs, including information sharing and cooperation; training and learning on DRR at community level, local authorities, targeted sectors; equal access public awareness and media disaster management capacities: policy, technical and institutional capacities.

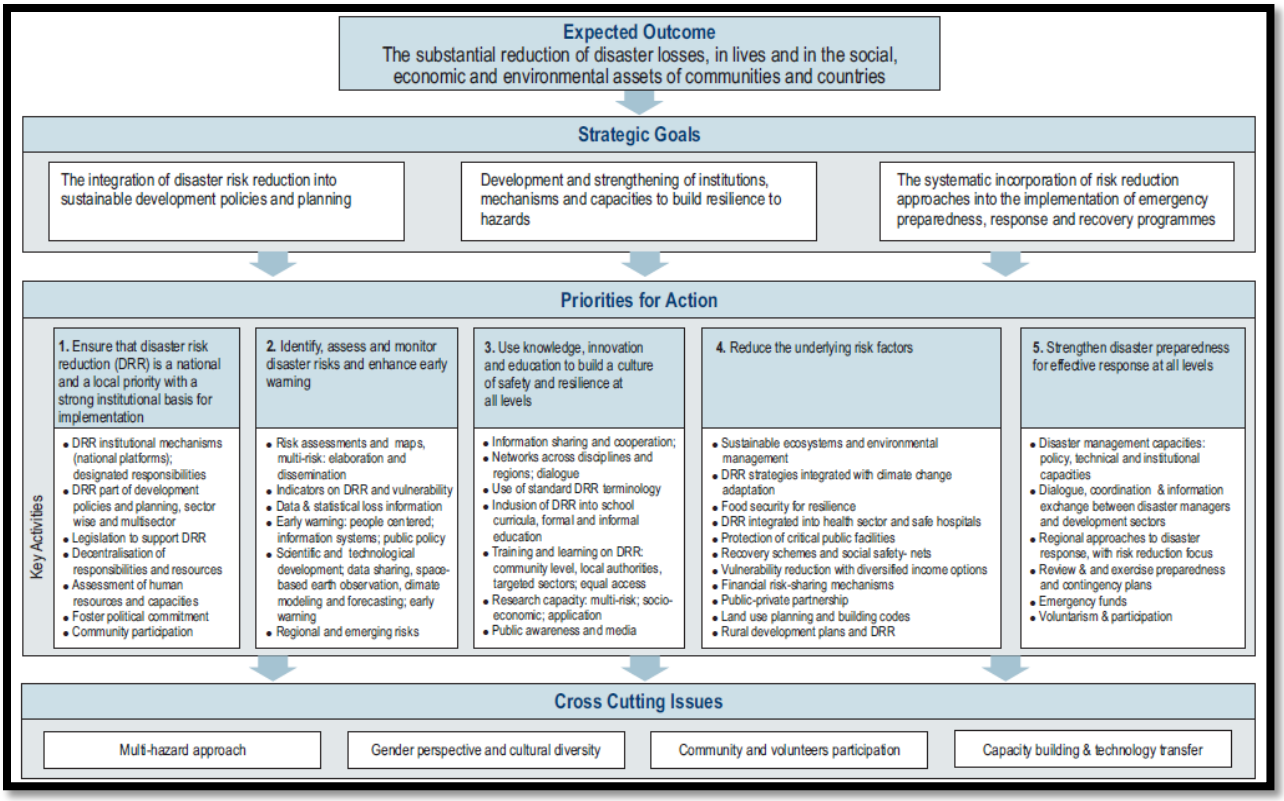

Figure 2- 2: Building the Resilience of Nations and Communities to Disasters (UNISDR, 2005)

HFA as seen in Figure 2-2 also provides clues to the main impediments that exist in EWS development that need to be tackled in order to fill existing gaps. For example, the most frequently reported impediment to EWS development is lack of funding, followed by inadequate coordination between local, national, and regional actors, lack of human resources and of EWS infrastructure (Grasso, 2014). Thus, it is very important that EWS be integrated into policies for disaster resilience. Clearly, natural disasters can in no way be prevented; however, a community and environment can be destroyed by them and thus, governments have a responsibility to create policies that will involve at least attempts to reduce the risks of disaster to communities (UNEP, 2010).

Furthermore, good EWS have strong linkages between the four elements (UN, 2009). If hazards, vulnerabilities and ways of reducing risk are considered beforehand, then levels of effectiveness within institutions could be increased as well as the efficiency of outgoing actions and public

preparedness for EWS to be effective (Haddow *et al.*, 2011). Moreover, people will need to be more aware of potential risks and the warning systems must increase support of forecasts of impacts so that those at risk can better comprehend the consequences and actions that might need to be taken (Rogers and Tsirkunov, 2010). However, Regester and Larkin (2008) emphasized that risk perception can potentially influence the actions people take to reduce the impacts of hazards, while it can also influence their decision not to act because the hazard is not considered a major risk. This argument indicate that it is not the strong linkages between the four elements that is the critical factor for effective community-centered EWS, but how community and all stakeholders perceive and define what risk is to them.

Consequently, while the weakness or failure in any element or linkage could result in failure of the whole system (Steinberg and Steinberg, 2006), it also means that risk perception can completely influence whether people are taking action to avoid or reduce the impacts of natural disasters (McEntire and Myers, 2004). For instance, accurate warnings will have little or no impact if people are not prepared to take actions, or do not consider the issue as risk or if the alerts are not properly disseminated (Grasso, 2007). Ultimately, as a system, EWS should be judged not by the quality of its individual components, but by its effectiveness at achieving the desired result, which can only be attained if the elements and the linkages are well-understood, well-designed and well-operated (Basher, 2006). However, all this can be challenging to achieve when there is limited risk knowledge or lack of public education to educate people about risk impacts in order to improve their risk perception (Kapucu, 2006). In addition to these factors, Kapucu (2006) included that inadequate warning dissemination and without defining the appropriate method of communicating EWS between all stakeholders can also hinder the effectiveness of EWS especially the community-centred EWS.

Therefore, the occurrence of disasters which lacks the existence of effective EWS will lead to severe impact on the community at risk since natural disasters do not happen in isolation (Jacks *et al.*, 2010). Recognition of this cause and effect on a global and regional scale is stirring interests in the area of EWS, but emphasising the gaps in existing theories and practice of EWS that risk perception of the community at risk is crucial to successful implementation and

effective EWS. Global efforts and regional measures across the world have emphasised the importance of ensuring that the four elements are interrelated as seen in Figure 2-1, and should be applied as such for community-cantered EWS to be effective. However, the argument by Regester and Larkin (2008) brought to light the role of risk perception in determining whether stakeholders or communities will cooperate to ensure that the four-elements of EWS will be effective. This means that if a community at risk do not consider or believe themselves to be at risk of the impact of any natural hazard, it will affected the ability of emergency agencies to collect data and conduct effective risk assessment, thereby influencing risk knowledge. The interrelated nature of the four elements also means that monitoring and warning will be wrong or difficult and so will be warning dissemination and communication as well as response capability. To further understand the relevance of this argument and the gaps in the existing theoretical explanation of community-centred EWS, the next section examines various models of EWS.

2.2.1 Models and Application of EWS

The model in Figure 2-1 is one of the recommended models of EWS. However, there are other models which are commonly used because of their elements and their recommendations for ensuring sustainable EWS. While the ISDR promotes the same elements in Figure 2-1, they emphasise that the elements should involve continuous interactions between all elements as seen in Figure 2-3. The elements in this Figure 2-3 have two-way arrows between each element which shows back and forth interactions and communication to emphasise they are interrelated.

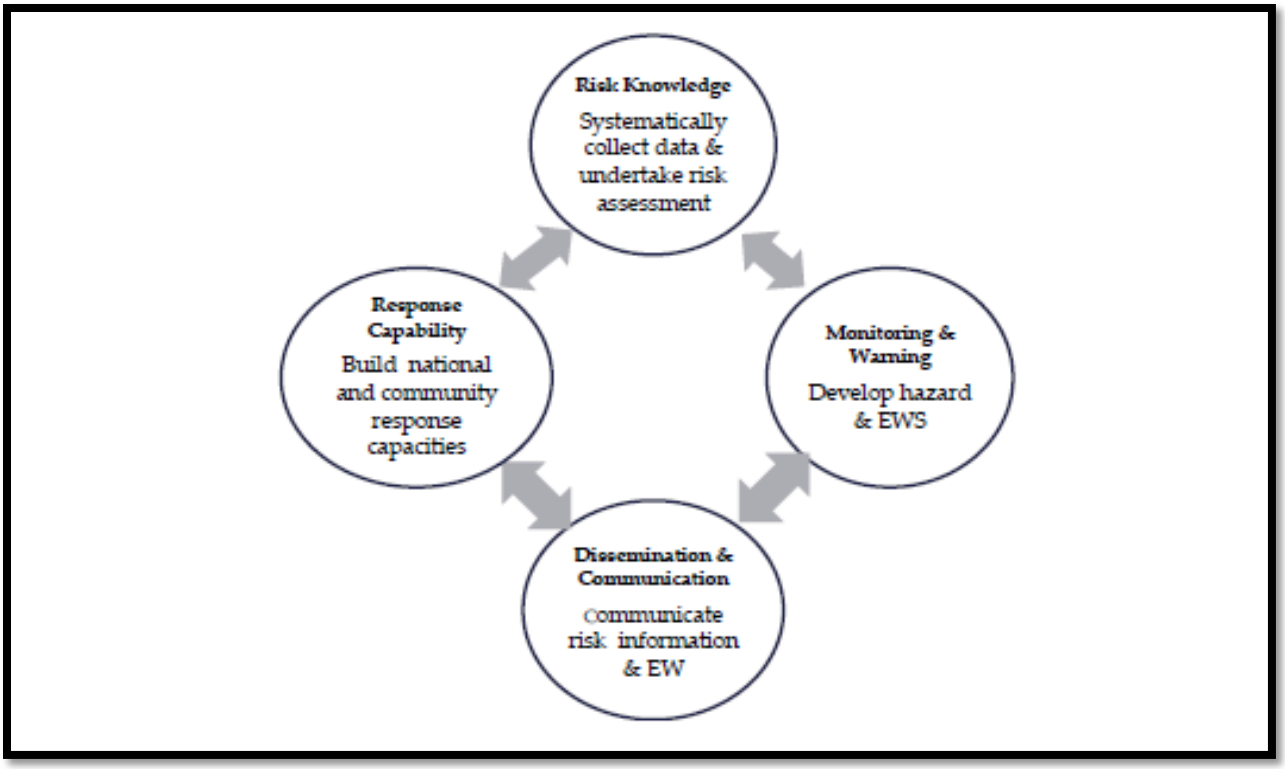

Figure 2- 3: The Four Elements for an Effective People-Centred EWS Framework (IEWP, 2006).

While this model in Figure 2-3 reaffirms the importance of EWS in Figure 2-1, it also fails to make provision for community engagement in order to educate the community at risk about imminent dangers and to improve their perception about risk. The importance of risk perception, and identification have been emphasized by Regester and Larkin (2008) as key to undertaking effective risk assessment for potential, or foreseen risk. Risk perception and identification are vital to effective risk mitigation, reduction and management (Regester and Larkin, 2008). While this model in Figure 2-3 is an improvement on Figure 2-1 by including interactive arrows, it also lacks the provision for educating and ensuring that community at risk have the appropriate perception of risks. This shows the gap in the existing models and theories of EWS, which this research will examine so that the research outcomes can contribute to knowledge.

Basher (2006) provided an integrated model which includes the main warning system elements, but with the addition of two extra key points. As seen in Figure 2-4, the first in the integrated model provided by Basher (2006) is the inclusion of stakeholders that often goes unrecognized as

being part of the system, and most notably, the political-administrative supporting entities, the district and community actors, and the research community. The second feature is the explicit inclusion of multiple linkages and feedback paths, particularly from those populations affected through their organizations to the political and technical actors (Villangran de Leon, 2012).

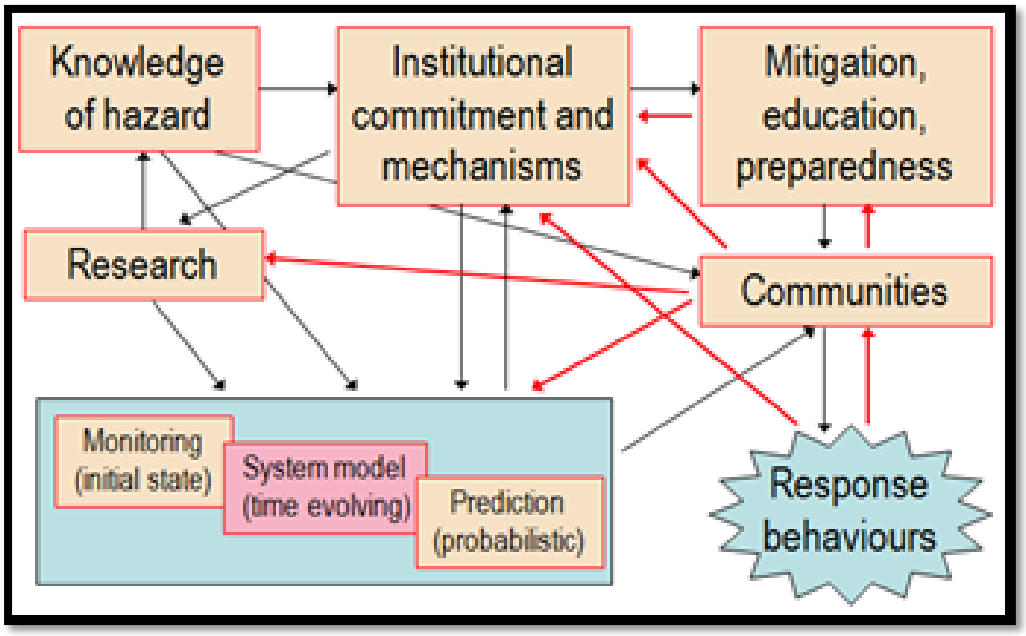

Figure 2- 4: Integrated EWS (Basher, 2006)

As seen in Figure 2-4, there are several interactions between all stakeholders of EWS. It also shows that communities are influenced by mitigation, education, preparedness, knowledge of hazard, prediction, system model and monitoring of risks or hazards. All these in reality influence their response behaviors, and response behaviors influence the commitments of institutions and mechanisms (Basher, 2006). Although this model is a major improvement on the model in Figure 2-1 and Figure 2-3,complex interaction between all elements can be difficult to understand and apply within real life scenario. Thus, while the EWS model by Basher (2006) brings to light the importance of education, mitigation and preparedness as equally important as risk knowledge, it fails to illustrate the means of dissemination and communication as an essential element in the model. This gap made what would have been a more effective model less sufficient.

Another model of EWS was proposed by Paton (2008), which suggested that quantitative measurements should be used as incentive structures for a sustainable EWS including indicators of governance and institutions, community knowledge, and economic and human development all extracted from WMO (2006) KAM database. It also suggests qualitative measures for examining micro level EWS using the concepts of efficiency, effectiveness, equity and legitimacy (Villangran de Leon, 2012). However, these models are prone to be insufficient if the modes, medium and methods of dissemination are not determined or included. Thus the section is devoted to discussion on the importance of EWS dissemination.

2.2.2 EWS Dissemination and Communication

Existing theories and models in EWS indicates dissemination and communication as a vital element of EWS, especially for effective community-centred EWS. While this is an important aspect of EWS, the element only focused on the ranges of different methods of disseminating warning. For example, Table 2-1 shows the range of different methods used for disseminating warning.

Table 2- 1: Methods of disseminating warnings (Tang and Zou 2009)

No	Issuing methods	Receivers
1	File Transmission Protocol (FTP)	The public
2	BGU transmitting system	Community supervisors
3	Cell-Phone Dissemination System	Municipal decision makers, various government agencies, residential community managers, basic response units managers (i.e. school, hospital, park, construction sites) and the public
4	FM Subsidiary Communication Authorization (SCA)	Special users
5	Radio Broadcasting	The public
6	Public Electronic Billboards	The public
7	Mobile Media TV	Passengers in taxis, buses and subway
8	Warning Calls	basic response units office
9	Dedicated Lines	Municipal decision makers, city affairs management departments, and special users

As observed, many of these warning issuing methods are very technology based and only focused on disseminating warnings without consideration of inter and intra communication between community and emergency organisations. Furthermore, warning during emergency can be problematic due to the impact and interruption caused by the disasters and especially in many developing countries where infrastructures are fragile. Therefore, overreliance on technology for communicating emergency warning, informing and educating can be limited, which means some of these methods can be limited in their use. Despite the advance in technology for the dissemination of the message, the lack of understanding of the warning and the lack of knowledge of how to properly react remain some of the biggest shortcomings of the system (UN, 2006; WMO, 2006). While this reflect the need for including human factor as means of communicating risk mitigation measures and EWS in general (Glantz, 2004), the issuing methods and dissemination of EWS fail to outline communication models or theories for effective EWS.

According to Coombs (2007) there are crisis communication theories and strategies which guide and help to explain how pre, during and post crisis situation can be communicated to and between all stakeholders. His theory which is called Situational Crisis Communication Theory (SCCT) can be used to evaluate crisis type, history and prior relationship reputation of the crisis and to determine how crisis is communicated. The SCCT is used to understand how stakeholders will respond to the crisis and in turn use this information to communicate pre and during crisis risk or danger to stakeholders. Although the SCCT draws inspiration from communicating organization crisis, the SCCT crisis response strategy guidelines explores the best strategy for communicating with potential victims and stakeholders who are likely to be affected by the impact of a harmful incidents (Coombs, 2007). This makes the theory relevant to the context of EWS discussed in chapter one and in this chapter. For example, the crisis type by attribution of crisis responsibility explains communication responsibilities between the potential victims of crisis and the organizations responsible for safety and protecting the potential victims from danger. The shared responsibilities for communication is outlined in Figure 2-5

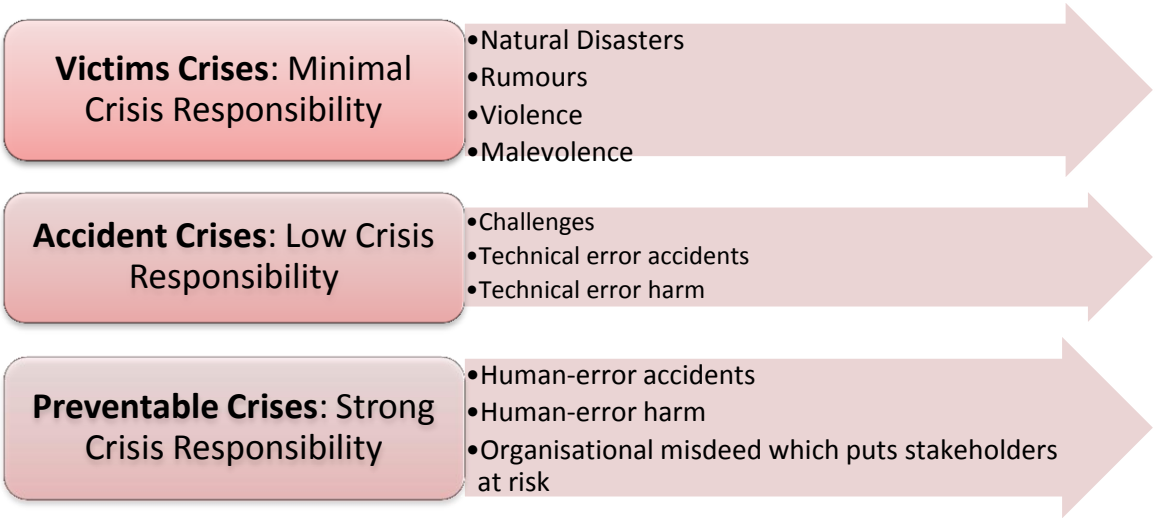

Figure 2- 5: SCCT Types by responsibilities (Coombs, 2007)

This communication theory shows that communication pre, during and post crisis is a shared responsibility between the victims and the organisation responsible for safety (Coombs, 2007). It also shows the classification of crisis and who has minimal and low responsibility for communication. As seen in Figure 2.5, the crises which will affect victims the most such as natural disasters, violence etc. shows that victims will have minimal responsibility for communication. Hence emphasising that the stronger responsibility for communicating risks, informing and warning is the responsibility of the emergency organisations (WMO, 2006). In addition to this, preven table crisis also shows that the emergency organisations have stronger crisis responsibility for communication (Fearn-Banks, 2007).

According to Coombs (2007), understanding these responsibilities and the cluster of impacts and crisis types are crucial to determining the communication method and medium for disseminating preventive and response strategies for managing the crisis. Although the SCCT was developing from an organisational perspective, it relates to the public communication timeline recommended as standard guidelines by the CCA (2004) for public awareness, public warning and informing and advising the public for emergencies. Therefore, while the existing models and theories in EWS lacks communication theories which explains dissemination of warning messages, the SCCT theory can be adopted as theoretical explanations for communicating EWS between

stakeholders and organisations responsible for EWS. Thus, while this communication theory can potentially fill the gap in the current theories, models and explanations for EWS, the effectiveness and sustainability will be examined against the concepts of EWS.

2.2.3 Evaluation of EWS Elements and Concepts

The examination of EWS models, theories and application in this section have helped to identify four main elements of EWS. These elements being risk knowledge, monitoring and warning, warning dissemination and communication and response capability have been examined from critically from risk management perspective. It was discovered that an essential element such as communication responsibility were both missing from the main EWS models recommended by the UN and Basher (2006). Although the model by Basher (2006) included the community at risk and the need for collaborative efforts of stakeholders in influencing the response behaviors of community at risk, the model failed to explain how knowledge or hazard, research, institutional commitments and mechanism, education and mitigation can be communicated to community at risk. This led to examining the communication methods used in EWS across the world. An examination of this indicated that communication methods were too technology based, without much consideration of developing countries where infrastructures might be insufficient, because of the impacts of disasters and other factors.

Disasters are known to affect development and development on the other hand can influence the impacts of disasters (Ozerdem, 2003). This is so because the severe impacts of disasters can affect development activities, infrastructures and economy in the immediate and long term. The projects and funding for development projects is often diverted to manage the impacts of disasters when they occur in large scale (Ozerdem, 2003). Meanwhile when development projects and urban planning is not well carried with consideration for the impacts of disasters, such development projects or results can also cause impact of disasters to be severe, hence the relationship between disasters and development (Wiltshire, 2006; Ozerdem, 2003). The concepts of EWS can be drawn from the development concerns and societal needs (Glantz, 2004). Even though in many instances, scientists and technologists have typically been the core actors in

EWS the role of the population is fundamental to developing and sustaining warning capabilities, especially for the mitigation and preparedness components (Wisner, 2011 and Basher, 2006).

Using this explanation, society can be represented graphically by a pyramid, the base of which represents sustainable development as shown in Figure 2-6. This Figure provides a graphic representation of how governments tend to look at EWS of all kinds, including those for climate, water and weather. The pyramid suggests that governments view societies as stable entities resting on firm foundations (Glantz, 2009). In fact, the reality of EWS in society can be portrayed graphically as a pyramid resting on its apex in a position of unstable equilibrium, as in pyramid (b). Societies and the government that lead them are actually dependent on a wide array of EWS (Glantz, 2009).

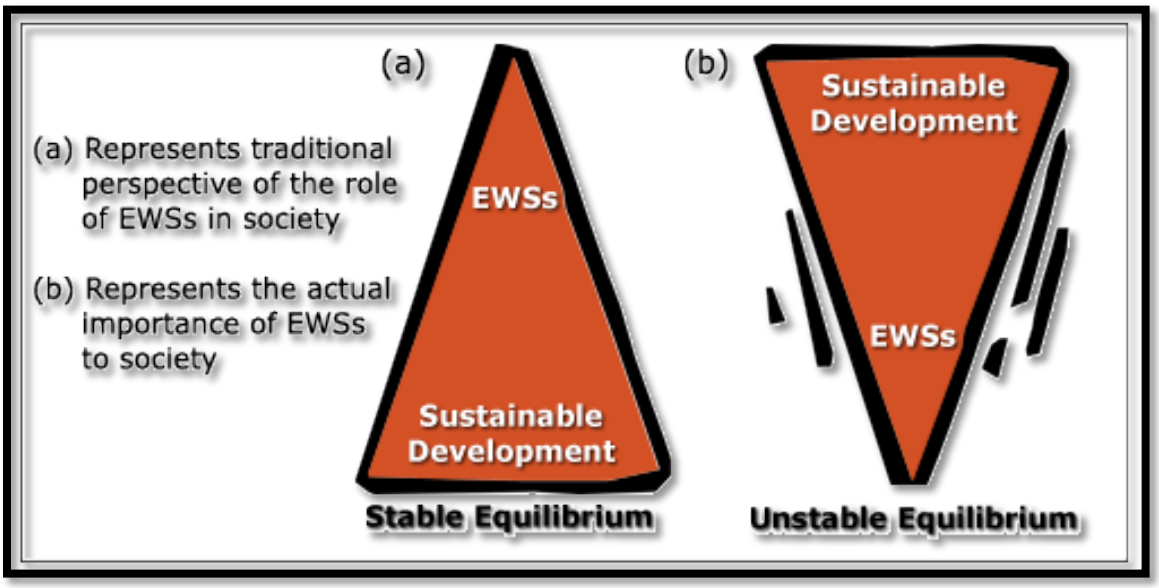

Figure 2- 6: Traditional Perspective and Actual Importance of EWS in Society (Glantz, 2009)

The traditional perspective as seen in (a) is considered Table because it represents a bottom-up approach which incorporates the involvement of community at risk of natural hazard (Smith and Fischabacher, 2009). However, sustaining the interests of traditional perspective of EWS and creating a synergy between them and technology methods can be challenging (Smith and Fischabacher, 2009). As seen in the SCCT model in Figure 2-5, the effectiveness and concept of EWS should be based on shared responsibilities and communication for crisis or natural disasters should be aligned based on the risk knowledge, dissemination and communication, stakeholders,

monitoring and warning and response capability. Furthermore, Figure 2-6 emphasises the importance of sustainability of EWS in relation to development and the need to employ stable approach and elements for EWS.

However, the challenges of EWS such as accuracy of warning make it difficult to provide information that can contribute to stable and sustainable concept of EWS. According to McEntire and Myers (2004), ability to consistently provide stable EWS with consideration of all hazards can be challenging. For example, 75 per cent of all tsunami warnings in the Pacific Ocean are false alarms, making it very difficult to maintain the credibility of the warning systems (Gupta and Sharma, 2006). As a result of the increase in information and communication technologies (ICT) and the difficulty in ensuring that only one, authoritative voice issues warnings, further increases the risk of false alarms (UN, 2009). This suggests that for EWS to be effective and sustainable it must involve the community at risks, adopts the appropriate communication method and responsibility.

Despite technological advances that enable the quick dissemination of warnings to the target population at risk, the community not understanding the warning and the lack of knowledge of how to properly react remains one of the biggest shortcomings of EWS (UN, 2006; WMO, 2006). There is consensus that delivering information and disseminating a warning is not effective unless firmly accompanied by strategies to engage the community members in ways that facilitate the adoption of protective actions, including educational campaigns, in order to assure that the warning message is well understood (Paton, 2008; Villangran de Leon, 2012, WMO, 2006; Matthew and Kapucu, 2008).This section has provided background to EWS and its essential concepts. It has also evaluated and discussed models of EWS, dissemination of EWS and communication theory, sustainable EWS as well as challenges of EWS. Subsequent sections in this chapter will evaluate some EWS practiced across the world and identify the essential principles which make them sustainable and engage community. Thus the factors which make such EWS effectively communicate risk knowledge, warning and monitoring, disseminate and ensure adequate response capability are identified in the process.

2.3 Evaluation of Best Practice in EWS

The critical evaluation of EWS elements, models and application have helped to identify existing models, concepts and theories in EWS. It has also helped to examine current practice of EWS and identify gaps which can potentially hinder the successful engagement of community at risk in EWS deployment and implementation. To better understand the role these gaps play and the ability of the four main elements of EWS to ensure disaster resilience, best practice in EWS across the world will be evaluated in this section and later cross examined with the existing deployment of EWS in the UAE. In this Section, five EWS will be evaluated and essential features which enable its successful deployment and implementation will be identified. There are many countries in different parts of the world exposed to various natural disasters. Some of these countries have developed EWS peculiar to the scenario they face, the available resources and capability focused on the community at risk.

2.3.1 Tropical EWS

A country such as Cuba is known for its comprehensive EWS called Tropical EWS, developed for coping with natural disasters which have saved thousands of lives, even with short notice about imminent dangers (Aguirre, 2005). Cuba´s EWS focus on monitoring both meteorological and hydrological threats as a result of significant environmental hazards arising from tropical cyclones and other natural events. The key component centers on the technological capacity of the meteorological service to predict likely environmental hazards and provide specialized alerts to civil defense agencies and comprehensible information to the population (Torres and Puig, 2012).

The key components for monitoring are established in high risk areas, so that vital information which can reduce risk can be provided to the community at risk (Aguirre, 2005). To make the Tropical EWS work effectively, a comprehensive legal framework is used which mandate all levels of government in Cuba to ensure that all organisations imbibe the warning procedures, engage in researches for improving metrological and climatic forecasting (Torres and Puig,

2012). To ensure that this EWS is effective, the community takes part in improving and protecting the environment, while UNESCO-associated schools in Cuba are involved in creating risk maps and evacuation plans for disaster prevention which the community themselves understand (Selby, 2012).

Specific subjects in the school curriculum are dedicated to teaching and dealing with the topics of disaster and risk management (Hasegawa *et al*. 2012). This EWS model and application shows collaboration efforts between the government and the community showing that the communities have adequate risk knowledge and perception about the danger they are exposed to. It also demonstrate the ability of all stakeholders to engage in monitoring and warning, dissemination and communication and ensure that evacuation is carried out when needed, showing understanding and joint involvement in response capability. Although some of these elements are present in the model recommended by the UN and Basher (2006), the tropical EWS also engages the active participation of community at risk through the schools to participate in warning and monitoring.

2.3.2 EWS in preparedness program

Bangladesh is a country vulnerable to the impacts of several disasters all-round the year because of its geophysical position (Bass and Ramasamy, 2008). Due to this proximity to natural hazards, farming, communities and most sources of livelihoods suffer from the impact of natural disasters (Selby, 2012). The impacts of disasters are often so severe that it destroys everything in its path, leaving communities and business without anything (Garibay *et al.*, 2010). This led to mobilizing strong institutional networking and commitments to engage in the development of flood forecasting schemes and engage in its application. The institutional partnership to connect all stakeholders with communities at risk is shown in Figure 2-7.This EWS model and application have adopted the four main elements of EWS model, but included in the engagement of community at risk as well as elements of SCCT communication responsibility outlined in Figure 2-5 in the last section.

Most people prefer microphones as the method for dissemination as against technology gadgets (Habib *et al.*, 2012). The source for communicating warning message could be a school teacher or religious leader (Imam) or Union Parishad member who is given the responsibility to inform people at school, college or mosques or bazaars (Fakhruddin, 2014). Evidently, this EWS model have adopted a community-centered approach, with shared responsibility for communicating warning, monitoring and dissemination and communicating danger of natural hazards.

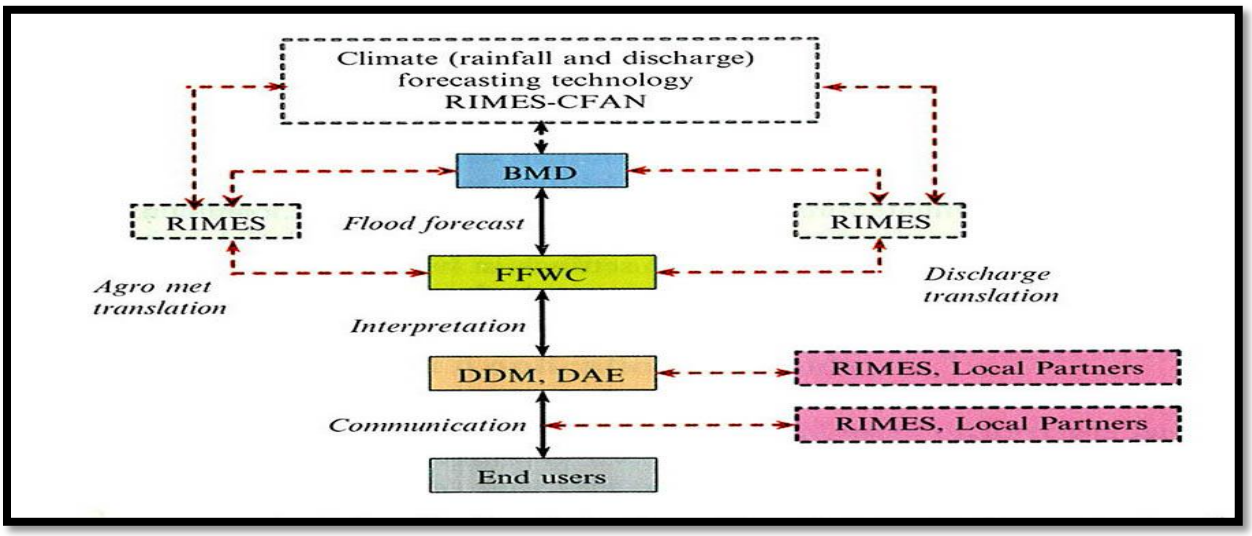

Figure 2- 7: Institutional collaboration for piloting the end-to-end generation, feedback and application of flood forecasts application from national to the community level (Fakhruddin, 2014)

Figure 2-7 shows that effective EWS involves the active participation of community at risk with shared responsibility for communicating danger of natural hazards. In addition to this, organizational roles and responsibilities for dissemination and communication EWS are outlined in Table 2-2, which draws from the explanation, provided using SCCT crisis communication theory.

Table 2- 2: Organizational roles and responsibilities of each organization (Fakhruddin, 2014)

Organization	Activities
RIMES-CFAN	Generation of 1-10 day discharge in three major ricer stations (Ganges Brahmaputra and Meghna) using hydrological model.
BMD	Support local observed rainfall as well as ECMWF rainfall forecasts.
FFWC	Generation of 1-10 day flood forecasts in 18 locations using RIMES-CFAN model and MIKE-11 hydrodynamic model.
DDW	Interpret forecasts and disseminate to community.
DAE	Interpret and translate flood forecasts to agricultural outlook and send to local representatives and farmers groups.
End Users	Union Disaster Management Committee and local volunteers who are aware of the local community people.

Due to this EWS and model involving community participation, Bangladesh has significantly improved the functioning of its EWS as a result of substantial loss of human life from tropical cyclones (Habib *et al.,* 2012). A pivotal component is the creation and development of the Cyclone Preparedness Programme (CPP) in conjunction with international agencies such as the United Nations, the Bangladesh Red Crescent Society and the International Red Cross (Habib *et al.,* 2012).

The CPP focuses on utilising a 42,000 strong nationwide community-based volunteer network to rapidly disseminate warning messages from the Bangladesh Meteorological Department to populations in danger. The practice enables alerts and evacuation orders to be communicated to relevant agencies and the populace within fifteen minutes. Volunteers at a highly local level are additionally organised and prepared to ensure endangered citizens are evacuated to over 2,000 storm shelters around the country (Wenzel and Zschau, 2014). Although this volunteer strategy or community-centered approach for communicating warning is effective, it is also supported by technological component using a transceiver telecommunications network which expedites information diffusion among volunteers and agencies (Wenzel and Zschau, 2014). Similarly to the approach used in Cuba, the Bangladeshi EWS also teach disaster education in the shelters homes, schools, colleges, offices, and community centres, so that people are familiar with

warning procedures (Habib*et al.*, 2012). This has greatly helped to reduce the impact of disasters in the country, although its sustainability is yet to be examined.

2.3.3 Vigilance EWS

Disasters might not be prominent in Europe like in Asia, but some countries do suffer from the impacts of natural hazards such as earthquakes, flooding etc. France was compelled to improve its EWS in order to provide the citizens with better information following significant impacts from the storms in 1999. This decision can be seen to mirror the fact stated earlier that communication and shared responsibility for ensuring that information is understood is an important aspect of effective EWS, not just dissemination of warning and monitoring. For example, the number of actors and people involved in EWS in France has grown rapidly over the last 30 years (Wenzel and Zschau, 2014). The core focus of the EWS used in France is the policy which emphasises that the mechanism for communicating different levels of hazard risks and weather must be done in a common language (Borretti, 2012).

A four colour-coded "Vigilance map" transmits threat risks linked to meteorological criteria which can be deployed within 24 hours. This aims to combine accurate weather prediction with adequate warnings for high winds, rain and floods, storms, snow/ice, avalanches, heat waves and intense cold, but ensuring that message is simple, clear and unified (Selby, 2012). Similar to Cuba and Bangladesh, hazard and risk knowledge are improved through public education in schools. Technical students disseminate lessons directly to local community to improve risk perception and understanding of disaster prevention, so that culture of safety can be encouraged in the community at risk (UNISDR, 2007). The vigilance EWS model have communication responsibilities shared between all stakeholders and community at risk, it also seems to cover a range of hazards and not just focused on a particular hazard, using the four main elements and communication responsibilities from SCCT well. However, there is no record of level of community engagement and networks of stakeholders like seen in Bangladesh and nor the evacuation procedures like the EWS in Cuba.

2.3.4 Multi-hazard EWS

Countries that are exposed to several hazards as seen in France often device a generic EWS which can be used to communicate warning and danger in order to avoid confusion. For example, China, United States (US), and Japan all have long history for experiencing natural disasters (Xu et al., 2014; Keeney *et al.*, 2012; Hasegawa *et al.*, 2012). To this end, China developed a Multi-Hazard EWS (MHEWS) in reaction to improve response to natural disasters. A significant component of MHEWS is the cooperation and coordination among multiple agencies at all levels in order to build regional capabilities and jointly decide to provide an optimal joint response to hazards (Tang *et al.*, 2012). The system integrates diverse technologies to provide an advanced early warning hazard process and enables multiple agencies including emergency response and rescue to communicate and coordinate across a common communication platform. The MHEWS focuses on response capabilities and communication mechanisms. For example, the "4+1" technical platforms comprise: Multi-Hazard Detection and Monitoring; Forecast and Warning Information Generation; Multi-Agency Coordination and Cooperation Support; Dissemination and User Application Platforms, and a Multi-Hazard Information database. This is shown in Figure 2-8.

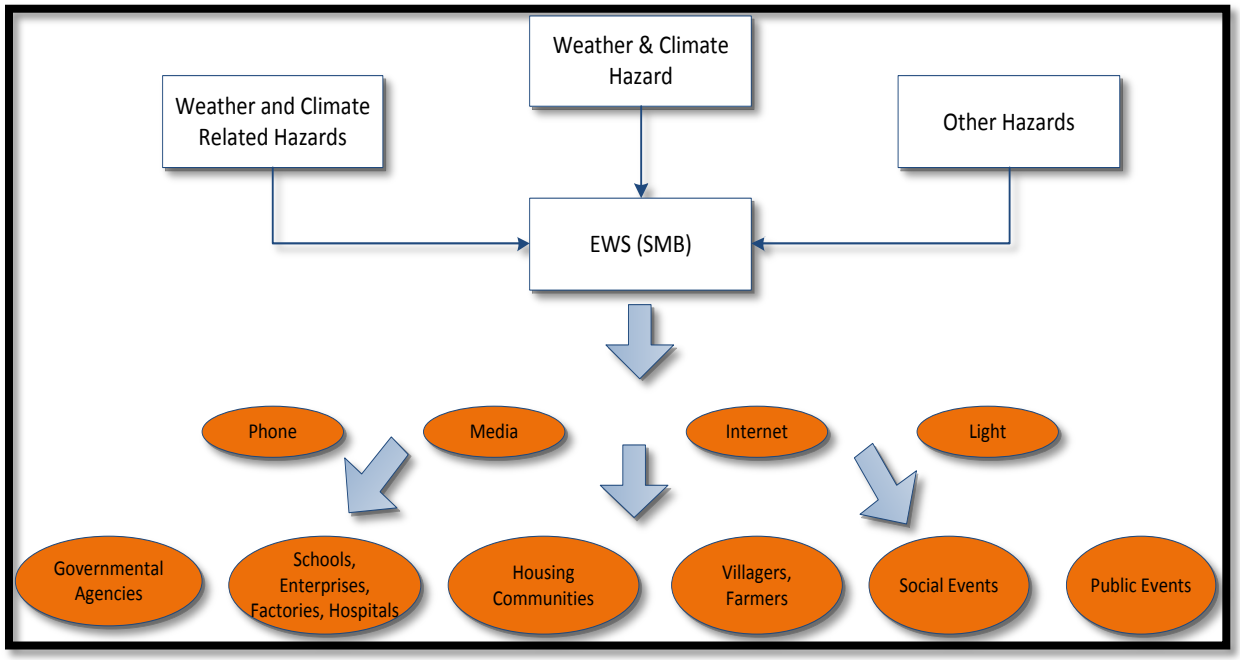

Figure 2- 8: Readiness Levels Communication Flow (Tang *et al.*, 2012)

While the MHEWS shows platforms which are integrated as a three-level standard system for coordination between agencies, even though it is still undergoing refinement (Xu et al., 2014), it lacks indicative arrows to show interactions between all stakeholders. Regardless of this one-way communication, the MHEWS is known to increase effectiveness between agencies involved in delivering warning at local level and extends communication flows for readiness as illustrates in Figure 2-8.

The Multi-Hazard EWS in the US is created to respond to a range of natural hazards such as drought, tsunamis, flooding, storms, hurricanes etc. Unlike the Chinese MHEWS, the US EWS system is a multiple EWS each intended to monitor and warn against specific threats (Barnes *et al*. 2007). The EWS is also embedded into the National Response Framework, into the Incident Command System and as an Emergency Alert System which functions across multiple channels. The model is designed to be scalable, adaptable and flexible, but the service operates in partnership with other agencies such as the Federal Emergency Management Agency (FEMA) and the US Geological Survey to take advantage of the expertise and infrastructure within the federal government (Keeney *et al.,* 2012). While collaboration is considered as a key component for facilitating the multi-hazard EWS in the US, it lacks clear assigned roles of community at risk in the disseminating and communicating the warning. Figure 2-9 shows the close interactions between agencies, but none with community at risk.

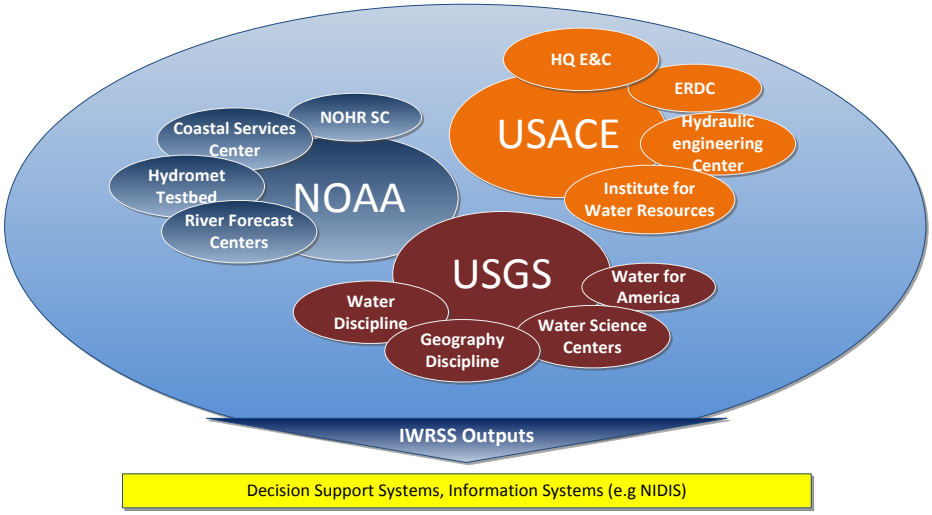

Figure 2- 9: Hydrologic Services Collaboration Partners (Keeney*et al.*, 2012)

Although not integrated, the systems have common elements and all are connected to national emergency response systems which are disseminated through an "integrated public alert warning system" (Keeney *et al.*, 2012). While the warnings are disseminated through single alerts across multi-channels during the stages of incidents and under all conditions (Barnes *et al*. 2007). However, this EWS model does not make provision for preparedness activities, risk knowledge, warning and monitoring which involves community at risks. Furthermore, Simmons and Sutter (2009) found that a higher, false alarm rate for tornadoes in the USA have also significantly increased casualties of tornadoes when it actually occur in that area. This suggest that frequent false alarms for tornadoes or any hazard do make people less inclined to react to subsequent or serious warnings. This problem shows another limitation and flaws in the EWS used in the US.

However, the EWS used in Japan focused on disaster prevention and on early protection against the destructive effects of uncontrollable severe events (Hasegawa *et al.*, 2012). The scheme relies on strong meteorological forecast technologies and an extensive communications infrastructure to transmit disaster prevention information. The EWS which is also considered as multi-hazard focuses on essence of communication using enhanced observation systems which precisely identifies real-time disaster risks, so that early warnings can be provided promptly This in turn expedites prompt evacuation and triggers response actions from disaster management agencies

which diminish the damage from calamities (Hasegawa *et al.*, 2012). The EWS implements a disaster specific warning and response process, which varies according to the disaster type.

The responsibility for the issuance of hazard warnings is contingent on the type of hazard. The Japan Meteorological Agency (JMA) is vested with the legal mandate for monitoring, forecasting and development warnings for all high risk natural hazards and severe weather conditions. It has sole mandate for Type I hazard warnings, a joint mandate with other bodies for Type II hazards and it is mandated to assume an informational role for Type III hazards (HfaIrides Review Report, 2014). This approach for dissemination resembles the communication responsibilities in SCCT model, ensuring that all stakeholders are involved in hazard warning and communication. The goal is for EWS to trigger the people to evacuate or take mitigating action (HfaIrides Review Report, 2014). However, the timeframe between earthquake and tsunami as seen in 2011 Tohoku was short giving people little or no time to evacuate or take actions even when the warning was issued (HfaIrides Review Report, 2014).Thus, while the multi-hazard seems to be one of the best practices in EWS, it also have its own limitations especially as seen in the US and Japan model.

2.3.5 Three-Tier Orientated EWS

Like the other countries examined in this section, Germany also have EWS designed called the three-tier time orientated warning system (the Detacher Wetterdienst) used to define 5 levels of risks (Steinhorst and Vogelgesand, 2012). Disaster management authorities in Germany are responsible for managing the EWS system, while communication is made by the National Meteorological Service and are legitimised for disaster management responses (Steinberg and Steinberg, 2006). The three-tier EWS draws its name from the organisational structure which defines multiple levels of warnings such as Early warning (level 1); Pre-Warning (level 2); and Warnings (level 3) with each level associated with specific timeframes and response (Gaeater, 2013). Figure 2-10 illustrates the flow and relationship between central forecasting, regional warning plan and the pre-warning, weather warning and severe weather warning.

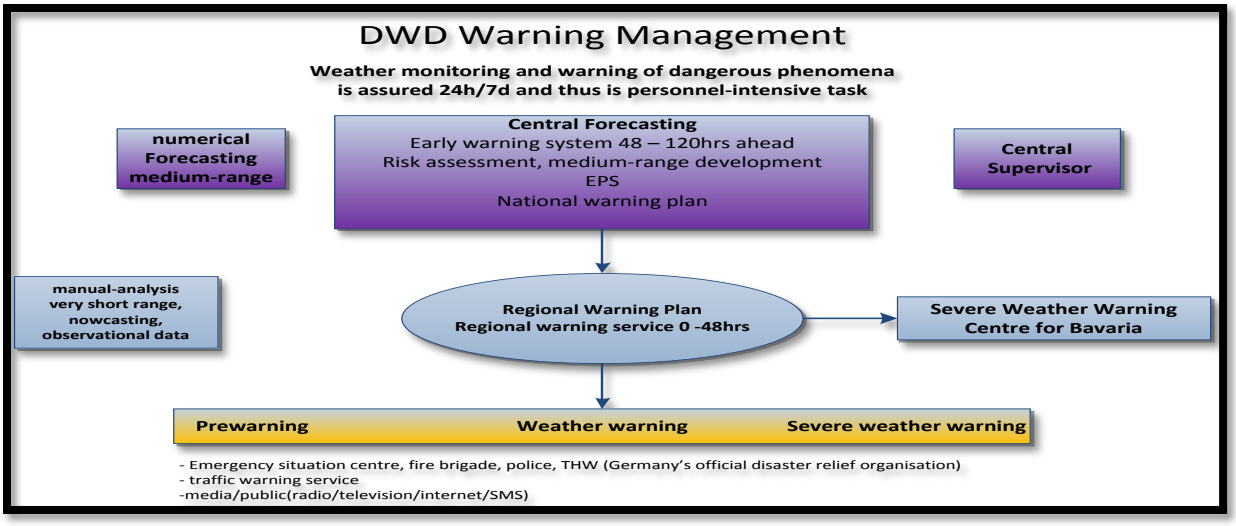

Figure 2- 10: Warning management of the DWD-The flow of warning information (Steinhorst and Vogelgesand, 2012)

While this structure seems to be well established and specifies the variation of timeframes for each level, it fails to outlines the communication, warning, monitoring, dissemination and response capability or responsibilities of the community at risk.

Effective EWS which involves community at risk can be challenging as observed from evaluating several EWS in Cuba, France, Bangladesh, China, US, Japan and Germany. While some have been successful in engaging community at risk, others have experienced challenges with communication or approaches used. It is also clear that EWS used in US, Japan, China and Germany did not explain how they engage community at risk like the EWS model used in Cuba, Bangladesh and France. The EWS in Cuba, Bangladesh and France shows best practice by maximizing the use of schools and other community institutions to improve risk knowledge and educate the public about the risk ahead of their occurrence. Through this means, they were also able to evaluate the effectiveness of the EWS by identifying the increase in community involvement in EWS activities. Regardless, other EWS used in China, US, Japan and Germany demonstrated good practice by having structured process of communicating risks, warning and monitoring of hazards between disaster and government agencies. The only limitation is lack of shared communication between them and the community at risk and no record of attempt to

improve risk knowledge of the community at risks or provide education about hazards the community is facing, so they can take informed actions for mitigation. Through this evaluation, the next section will outline the basic principles of EWS derived from the main models and the best practices evaluated in the seven countries.

2.4 Knowledge Gap and Essential Principles of EWS

Previous section have examined EWS used in different countries which constitute to best practice. However, a critical evaluation of existing EWS models and what is considered best practices used in Cuba, Bangladesh, France, China, US, Japan and Germany has shown that the four main elements of EWS recommended by the UN provides a good basis for operating any EWS. While it was noticed that different countries prioritise certain elements and others included elements suggested in the model by Basher (2006), the overall evaluation indicate that gaps exists in each element. For instance, the tropical EWS used in Cuba is considered as comprehensive, but fails to involve community in risk monitoring. As explained by Selby (2012) community takes part in improving and protecting the environment, thus suggesting that community is not the centre or focal point of the EWS. It also indicate that while the EWS may be effective within the Cuba environment with less built environment as the UAE, it might be challenging to engage community if the community is not involved in all aspect of EWS elements.

Similarly, the preparedness program in Bangladesh focuses on multi-layer of stakeholders and engagement as shown in Figure 2.7. This can pose communication challenge and ability to maintain both vertical and horizontal communication required for every element of EWS can be challenging to implement in a built and modern environment in the UAE. The vigilance map is also another EWS that tend to possess communication challenge since it places major responsibility for communication on specific members of the community who may have other daily and regular duties and survival responsibilities. Although there are communities in the UAE that are nomads engaging them to share responsibility for communicating warning, monitoring and dissemination of natural hazards with people living in cities like Abu Dhabi may pose a major challenge. This is due to the differences in needs, parallel lifestyles and transient existence the nomads live compared to the city dwellers.

The gap presented by the Bangladeshi, French and Cuban EWS makes it less likely to provide optimal result in the UAE. However, the multi-hazard EWS appears to be a system that places more responsibilities on the emergency management organisation, but lack specific engagement and responsibility assigned to the community at risk. In addition to this, the communication flow in this EWS is top-down rather than both top-down and bottom-up. This shows that the EWS is one-way and if there is breakdown in communication, EWS will fail woefully. Lastly, the three-tier EWS in Germany which focuses on risk of hazards borrows its structure from systems in organisation by having levels of warning, however its limitation is that is fails to focus on other elements of EWS such as communication, warning, monitoring and dissemination and response capability for community at risk.

Therefore, the gaps in knowledge and in the EWS examined in previous section emphasise that while there are best practice to learn from all the EWS, they also have limitations that may make their complete and effective implementation in the UAE challenging or impossible. Thus, this section identifies best practice in each EWS and combines them as principles of EWS and requirements for having effective and community-focused EWS. A total of ten key principles have been identified from all the five EWS evaluated as well as from evaluation of elements and concepts of EWS. These principles are:

Principle 1: Effectiveness of EWS is founded on some key elements. Risk knowledge and management, warning, forecasting and monitoring, dissemination and communication, response capability, integration and involvement of community at risk and stakeholders in EWS.

Principle 2: Political support is vital to Success of EWS. This was evident in the evaluation of EWS used in Cuba, Bangladesh, US, France etc. although some allowed political support to be more prominent while others emphasised joint or collaborative responsibilities for communication hazards.

Principle 3: Clarity of roles and responsibilities in EWS. Through the explanation provided using the SCCT model, it was evident that few countries such as Bangladesh, France and Cuba have shared responsibilities for communicating and monitoring hazards as well as providing disaster education to improve risk knowledge. Although other countries such as US, Japan, China and Germany have clear roles and responsibilities between disaster and government

agencies about monitoring, forecasting and dissemination warning, there was no clarity of roles for community at risks.

Principle 4: Allocation of sufficient resources for EWS. This was evident across all countries especially with the EWS design, activities and means of dissemination outlined. Although it is not clear which resources had the most impact and more sustainable, the allocation of sufficient resources shows commitment to EWS.

Principle 5: Emergency Planning warnings incorporated into risk information. This was the evident in the Bangladeshi EWS, where risk information is embedded in preparedness programme to mitigate disaster risks. It is also seen in the Cuba and France EWS where risk and hazard knowledge are taught in schools and many community platforms to improve risk perception and orientate the public about safety and risk, so that they can take actions to mitigate the impacts of hazards.

Principle 6: Effective, Authoritative and Actionable Warning Messages. Except for the US where false alarm have been resulting in reluctance of the public to act during tornado warnings, other EWS seems to have messages and warnings disseminated in ways that results in actions been taken for evacuation. Although in the case of Japan, time factors seems to be a limiting factor, such that there is no sufficient time for people to evacuate before disasters such as tsunami overwhelm them. Regardless, most of the EWS seems to possess effective, authoritative warning messages which lead to actionable measures being taken by the public or disaster or government agencies.

Principle 7: Dissemination of warnings must provide sufficient time for response of community at risk. This suggests the importance of using multiple means of communication as seen in the US model. It also means that people are aware of the actions they need to take and what each message means. For example, the Bangladeshi system disseminates warning through six regional offices and over the radio and they also use volunteers who are able to reach people directly. All these combined efforts and means of communication ensures that community at risk can receive warnings and act quickly.

Principle 8: EWS must place emphasises on disaster preparedness, response planning and capability as well as community at risk. This principle ensures that community and all

stakeholders communicate and understand the risk of hazards they are exposed to, so that they can plan and understand the mitigating actions to be taken. This emphasises the shared role of disaster and government agencies to document plans at the preparedness stage and rehearse how they will evacuate people who need support for evaluation.

Principle 9: Training is pivotal to operational readiness. Training is an essential factor in understanding and increasing confidence for action during disaster event. This is seen in the France and Bangladeshi EWS which promote risk knowledge and evacuation procedures in schools, offices and community places, so that people train and practice how they will evacuate. In addition to this, training is also key for disaster and government agencies who will respond during disaster events (Wiltshire, 2006).

Principle 10: Prioritisation of Continuous Improvement through Feedback. Feedback, evaluation and improvement mechanisms should exist at all levels of the system and pertain to all areas of the overall system (Golnaraghi, 2012). Across the seven cases studies a range of different practices are evident, but which nevertheless embody this principle. In Japan, its history of experiences has culminated in the formation of a Technical Investigation Group on Inheritance of Lessons from Disasters with the specific purpose of identifying lessons from historical events, which can be used to inform improvements.

Therefore, the evaluating of best practices in EWS used in some of these countries and other existing EWS models and applications, have provided background understanding as well as helped to identify gaps in existing EWS. It has also helped to identify these common principles and guidelines for effective and sustainable EWS, while identifying that community involvement and shared communication responsibilities is mission in many of the EWS. Above all, the principles are useful in evaluating the existing deployment of EWS in the UAE which will be done in the next section.

2.5 Existing deployment of EWS in the UAE

The existing deployment of EWS in the UAE is largely the responsibility of the emergency organisations. The emergency organisations responsible for this are National Emergency Crisis and Disasters Management Authority (NCEMA, 2013), who work in collaboration with theNCMS, Police and the Civil Defence to create awareness about hazards. The deployment of

EWS is carried out using technology, through published materials on emergencies and emergency guides and in partnership with the media (Dhanhani et al., 2010). However, it is uncertain if these means and methods of dissemination of EWS are effective or to what extent it is effective or sustainable. But the continued occurrence of natural hazards and the impact they have on the public, business and livelihood in the country especially in cities like Dubai, Abu Dhabi and Al Ain are significant (Dhanhani et al., 2010). For example, the natural hazards which have been recurring in the last five years are; thick fog, sand storms, earthquakes and rain floods (NCEMA, 2013).

The awareness and information about these hazards are available on NCEMA website and their landfalls are communicated through the media and social media such as twitter and face book (Swan, 2010). Although these models of EWS are sometimes effective, they have not been effective enough to warn people in advance to avoid danger. For instance, natural hazards have caused various levels of suffering and disruption of services and damages of cars and properties since 2008. Some of these hazards include but not limited to cyclones Gonu and Cyclone Sidr in 2007 (Swan, 2010), flooding in 2008; 2013 and 2014respectively, earthquake in 2013, sandstorm annually and thick fog annually (NCEMA, 2013).

The thick fog is notorious for causing multiple collisions on the motorway as a result from low visibility and lack of EWS to prevent people from danger. While the impact shows that the EWS system used in the UAE by NCEMA, NCMS, Civil Defence and the police traffic control might not be effective, there have been more success with EWS during response to warn many foreign nationals living in the UAE. The meteorological department play a major role in sending messages live through the media and since the UAE adapted the UK emergency management standard and model, the emergency organisations have signed Memorandum of Understanding (MOU) with the media as done in the UK (Dhanhani et al., 2010).

In addition to this, there have been successes in tradition EWS using the mosque public address system to inform and warn the public of imminent danger in order to prevent the local from

danger (AlAmeri, 2012). This shows success with the indigenous EWS approach to disseminate warning which maximises the benefit of the UAE being an Islamic country. However, the limitation of this is that the UAE has more percentage of foreign nationalities than local people, so this approach is not inclusive of all stakeholders. In addition, it also excludes people who do not understand Arabic and what the message connotes. Hence, this approach does not include any of the principles of emergency/disaster management. The stakeholders given the responsibilities of managing, coordinating and disseminating EWS are also limited and excludes community, private sectors and not collaborative.

Furthermore, the EWS fail to state the specific requirements of all stakeholders and community for effective emergency planning and response in the UAE. These limitations and gaps in the EWS in the UAE, emphasises the importance and relevance of this research to improve the EWS by developing a EWS framework which is based on best practices of EWS from across the world. However, this will be better done with more understanding of the system and areas which require improvement in order to enhance resilience to disasters in the UAE. In order to better understand the context of implementation of current practices of EWS in the UAE which will be examined further in the next chapter, the next section outlines some performance indicators which will be adopted as measures to evaluate the EWS in the UAE against.

2.6 EWS Performance Indicators

Based on the components of the People Centred Model defined by UNISDR – PPEW (2005) and a thorough analysis of the different methodologies presented above, detailed Tables of Capability assessment Tool which can be adopted as EWS and warning methods have been created as shown in Table 2-3.

This Table is the result of combining and structuring suggestions and methodological steps from multiple references above mentioned, in particular Londono, (2011); Golnaraghi, (2012); CDEM, Capability Assessment Report, (2010); Palliyaguru, (2010); Training workshop on

Multi-Hazard Early Warning Systems Final Report, (2010);UN/ISDRChecklist, (2006);Glantz, (2009); Nuruzzaman, (2010); Fearnley, (2012) and Fakhruddin, (2014), which have all been made reference to in this chapter.

The aim of the Table is to group and organize the multiple tasks necessary for the development of a EWS, showing the complexity of the kind of systems which will be required for people and most types of hazards. The elements in this Table will be referred to as required in subsequent chapters of this research.

Table 2- 3: Key Performance Indicators for EWS

EWS COMPONENTS	EWS Principles	Key Performance Indicators
Risk knowledge	Preparedness Response Planning Roles Responsibilities Resource Adequacy	• Identify all actors and organizations involved at different territorial levels • Define responsibilities for each actor/organization in every single part of the process, and if possible, define a coordinator of each phase of EWS • Create a network for sharing data, information and lessons learnt from previous experiences. • Analyze legal frameworks, standards and policy regarding risk assessment and risk management • Determine a baseline about the quantitative and qualitative status of the community before the establishment of the EWS. This is essential in order to measure

		progress • Public information manager is appointed and resourced to be able to do the job • Information on hazards and risks is readily available to the public • Hazards, vulnerabilities and risks are identified and documented • Public education programmed on hazards and risks is planned, coordinated and given priority by the organisation • Learn from other warning systems can improve the general education of the public.
Monitoring, and forecasting	Operational Capacity Political Support	• Highlight to senior government and political leaders the economic benefits of early warning. • Selection of appropriate monitoring parameters (according to specific hazards) • Received data routinely processed and made available in meaningful formats in real time, or near-real time • Involve the community in the monitoring by defining a network of volunteers who observe monitoring devices and then deliver this information to the crisis intervention centre or monitoring

		responsible • Elaborate forecasting models with sound scientific basis: local and regional • Technical advisory Groups are utilised • Hazards, vulnerabilities and risks are monitored on an ongoing basis • Improved coordination of regional data collection and monitoring (e.g gauges, buoys). • Response to the forecast
Dissemination and Communication	Warning Messages Warning Dissemination Mechanisms	• Establish vertical and horizontal communication networks among all stakeholders, promoting the mutual consultation which is essential for an effective and sustainable system • The preparedness message is disseminated using multiple methods • Content of the message: • WHY: Current and forecasted situation, possible consequences of the event • WHEN: Expected time of potentially harmful event occurrence and time of evacuation • WHERE: Places/areas at risk and safe places

		• WHAT: Suggested actions to take • local language and English (more languages when possible) to facilitate that the message be understood by the transient population • Warning alerts and messages should be geographically-specific to ensure warnings are targeted only to those at risk • Warning alerts and risk communication messages should be locally tailored, developed on the basis of an assessment of information needs of multiple social groups at risk (diverse cultural, social, gender, linguistic and educational backgrounds) • Definition of a dissemination method/s tailored to the needs of individual communities or end users • Communication technology used should assure that the warning reaches all those at risk, including seasonal populations and remote locations. • System established to verify that warnings have reached the intended recipients. Communication must be interactive, two-way between transmitters and recipients to allow to verify that warnings have been received

		• Inform the community when the threat has ended emitting a message of return to normal conditions • Test coverage, timing and clarity of the warning at least once a year • Use of local mass media to disseminate information and improve public awareness • Communication with partner agencies is able to be maintained in an emergency • Integrated warning and response systems. • Standardization of protocols for warning dissemination (colours formats) • Decision taking (why took that decision?)
Response Capability	Risk Information Integration Training Feedback and Improvement	• To predict community responses to a warning it is fundamental to assess the levels of perceived risk, information needs levels of trust and preparedness. This could be performed with surveys, such as questionnaires and interviews, preferably combining close ended questions, face to face interviews and direct observation in the field. • Use the results of the risk assessment and the assessment of needs, preparedness and response capability to improve the emergency plan so it is targeted to the individual needs of the vulnerable

		communities • Disaster preparedness and response plans must be updated • Emergency plans should be regularly tested • Work with the schools and existing social, religious and cultural associations to reach a larger audience • Include public awareness and risks education programs into the school curricula from primary schools to university • Emplace visible signs that indicate the location of the strategic emergency zones, such as meeting points, shelters, evacuation routes, etc. • Develop regular and systematic training and drilling programs for emergency personnel and population, preferably before the hazard season (e.g. rainy-season), to test the effectiveness of the early warning dissemination processes and the response • False alarms should be minimized and must be honestly and openly explained every time they occurred • Continuous collaboration and constant

		feedback and communication among all stakeholders including a constant interaction with social and natural scientists and academic institutions • Professional development strategy and programmes are developed according to organisational needs • Logistics processes are in place to manage resources effectively in an emergency • Lifeline utilities are coordinated in response • Community engagement in training and education /awareness programmers.

Table 2-3 outlines the four components of EWS identified in Section 2.2 and the corresponding principles to each components which were identified from examining case studies from seven countries, which implemented best practice in EWS. The table shows the indicators for determining the impact and to the extent to which each component is implemented. The performance indicators in Table 2-3 emphasise how evidence of each EWS component can be identified in a system, their level of effectiveness or deficiency if not present. The table also shows that every component of EWS have performance indicators that link with community that can be affected by the impact of natural hazards.

The reference to community in Table 2-3 is crucial for developing disaster resilience which is the main reason for a framework that emphasises or one that makes community a focal point for each EWS component. For instance, resilience have been explained by Wisner et al (2004) and Pelling (2003) from a sustainable livelihood dimension emphasising the crucial role of adjustment and preparation especially preparing for adverse effect of natural hazards as

examined in this research. Wisner et al (2004) explained resilience as the ability of a household to secure livelihood through human capital (skills, knowledge, health etc.), social capital (networks, groups, and institutions), physical capital (infrastructure, equipment), financial capital (savings, credit) and natural capital (natural resources, land water).

Pelling (2003) however, explained resilience as the societal ability to adjust to the environmental conditions which a community is exposed to. He further emphasised that the importance of this perspective of resilience is to ensure that adequate preparation is in place in relation to the hazard the community is exposed to. Therefore, this narrative table is key in forging ahead in this research especially in helping to evaluate the current deployment of EWS in Abu Dhabi and Fujairah.

2.7 Conceptual Framework for EWS and Justification

This section suggests possible design and development of EWS in the UAE based on the best practice and lessons learned from EWS in the seven countries examined in this chapter. The framework presented in this section is also based on theoretical underpinnings that explain emergency and disaster management models, principles, and practice. Collis and Hussey (2009) state that, a theoretical framework is a collection of theories and models from the literature and it is an essential part of positivistic research as it aims to explain the research questions or hypotheses. However, for a phenomenological study, it might be of lesser importance or structurally less clear. Some researchers have attempted to research areas for which no previous theories exist. This section provides the theoretical framework for the EWS in the UAE, which was developed by the researcher from the literature review. The theoretical framework is based on the EWS concept, where a number of themes are identified. The successfully identifying, managed, and explanation of EWS depends on these basic elements (themes).

These themes include: Risk Knowledge (Preparedness and Response Planning, Roles and Responsibilities, Resource Adequacy); Dissemination and Communication (Warning Messages, Warning Dissemination Mechanism); Response Capability (Feedback and Improvement,

Training, Risk Information Integration); Monitoring and Warning (Operational Capacity, Political Support).These elements will be used as a guide in collecting the relevant data for this research. The elements are created according to the information revealed through a detailed review of the literature, as discussed in the previous sections and sub-sections. It is synthesizing best practices in regards to multi-hazard EWS. The ten principles and the inherent elements are reflected strongly in all the cases reviewed.

A key conclusion is notably that the best practices across the seven countries represent varied approaches in applying the ten principles for the design and implementation of MHWS. Ultimately, all the countries share the major elements in the design of EWS, which provides the basis for the theoretical model in the design and development of EWS in the UAE. Figure (2-11) illustrates the theoretical framework developed for the purpose of this research. However, all themes are considered interrelated, interconnected, and equally in their importance. The development of the theoretical framework will play a significant role in the process of selecting the appropriate methodology. The conceptual (theoretical) framework for EWS for the UAE is contextual and contingent on integration and alignment with national, legal, institutional, organisational social and economic dimensions and stakeholders.

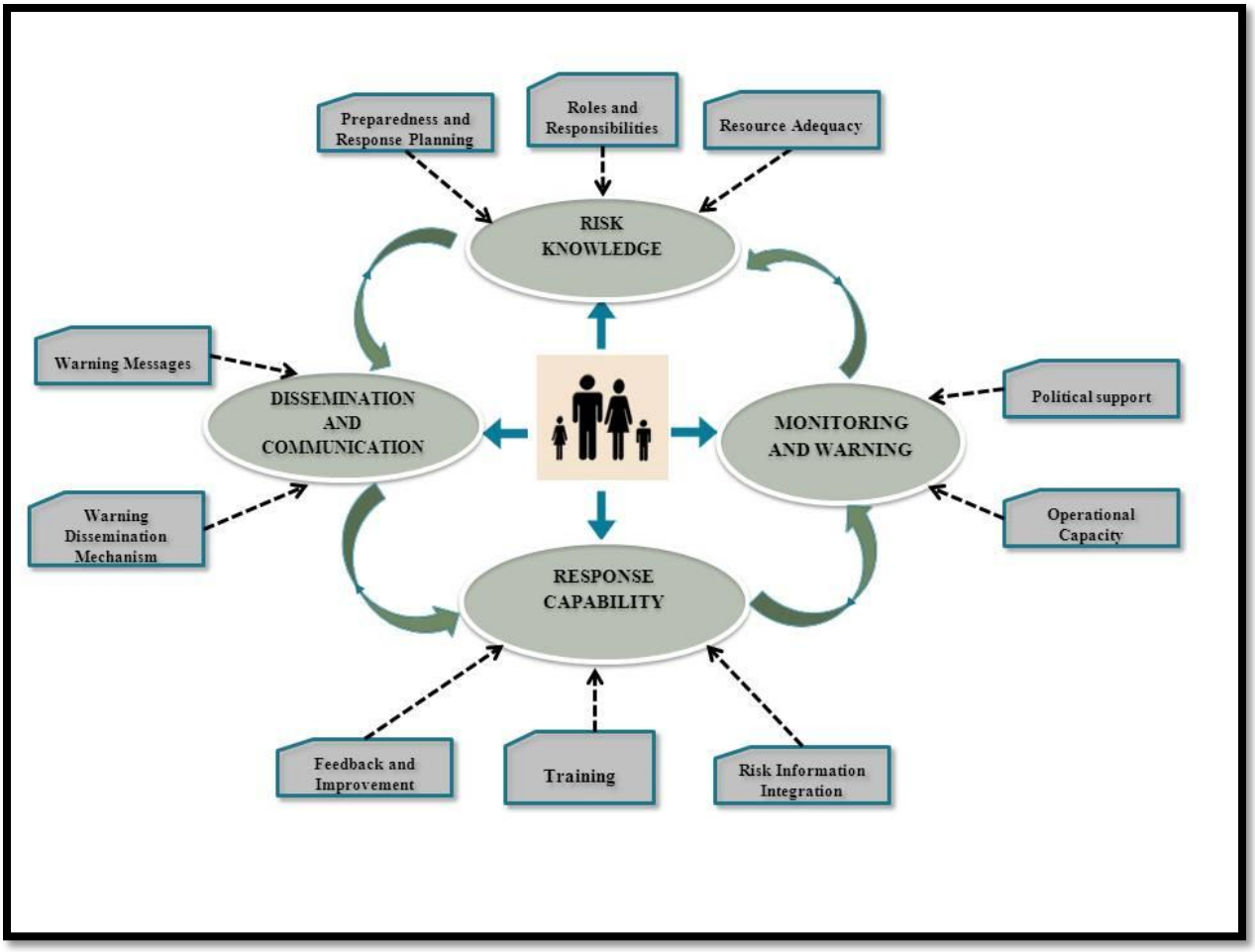

Figure 2- 11: The Conceptual Framework for EWS

Figure 2-11 justifies the focus of this research on community-centred engagement at centre of the conceptual framework. The phrase community-centred according to this framework means the involvement of community at risk and people that can be affected by the impact of natural hazards in the process of early warning. As seen in this diagram, the involvement of community is not just emphasised (as explained by Glantz, 2009; Basher, 2006 and Fakhruddin, 2014), but community is made the focal point of determining early warning measures and key indicators. Thus, having community involvement, participation and being the focus of EWS is the emphasis of this research, which provides motivation for the title of the framework developed for more effective deployment of EWS in the UAE. Furthermore, Figure 2-11 is also the conceptual framework for this research which fuses the concepts, assumptions derived from this chapter i.e. essential components of EWS and the theories that informs this study area (Robson, 2011). Thus,

as this research progresses from this chapter, it draws focus from the four essential components of EWS and the principles of best practice in EWS that links with the implementation of each element.

2.8 Chapter Summary

This chapter discussed a review of early warning systems and the concept used for natural disasters and the related issues. These include the definition, general typology, designs and frameworks of natural hazard- EWS. The traditional three-phase EWS framework, framework for sustainability assessment for EWS, and integrated system model for EWS have been discussed. Furthermore, this chapter presented a review of the current weaknesses and gaps, of the governance context and framework conditions, warning dissemination, challenges in technical warning services and general understanding of how to improve EWS. Also, it provides a description of the international best practices in multi-hazard EWS, as well as identifying the principles and pillars of early warning system. Due to the gaps and limitations identified in section 2.7 and the impacts of natural hazards, the next chapter (3) will provide a more in-depth analysis of the early warning system in the United Arab Emirates in order to identify and evaluate the exact situation and the precise context in which EWS is used.

CHAPTER 3: EARLY WARNING SYSTEM DEPLOYMENT IN THE UNITED ARAB EMIRATES CONTEXT

3.1 Introduction

The aim of this chapter is to consolidate the content and background to EWS which had been discussed in Chapter two. This chapter then focuses on achieving the second, third and fourth objectives respectively. While objective one and part of objective two had been achieved in chapter two, this chapter aims to fully address the pending issues of objective two as well as achieving the other research objectives. To ensure that this chapter achieves its aim, the chapter had been divided into six main sections. The first section provides an overview of emergency and disaster management in the UAE, while subsequent chapters examined the EWS in the emirates, evaluated the natural hazard and early warning response in the different emirates in the UAE and analyses the EWS identified. The fifth section then identified and justified the EWS requirements in the UAE while the last section provided a summary of the entire chapter in view of determining to what extent the chapter has achieved its aim.

3.2 Overview Emergency and Disaster Management in the UAE

Emergency and Disaster Management in the UAE is still in its infancy and can be said to be an evolving field. This means that there are limited documented materials and literature in this field. However, this limitation was managed through a rigorous review and examination of reports and procedures used in practice as guidance for the operational field of disaster management in the country. Secondly, published literatures written on emergency management in the UK was also used, because the UAE adopted the emergency management standard used in the UK, thus, there are similarity of procedures for emergency and disaster management between the two countries.

In the 1990s, emergency management in the UAE was underdeveloped, lacking any plan and documented operational procedures (Dhanhani et al., 2010). Despite this, there was a designated organization i.e. Ministry of Interior (MOI), assigned to be responsible for emergency management in general. However, in 2006, there was the development of strategic plans governing mechanisms to deal with all the possibilities of risk and disaster were a requirement

stipulated by the national Federal Law No."23". Prior to this, the national or federal plan stipulated the civil defence in the Federal Law No."3" since 1979.

As the world began to experience unprecedented scale and magnitudes of disasters, preparation began in the UAE in 2000 with respect to developing a "plan of the Federal disaster". This process motivated the active participation of all stakeholders in the state, which was approved by the civil defence Council on 4 February2002. This joint arrangement was also approved by the Council of Ministers in its meeting No (3) that was held in2003and issued its resolution55/1for the year2003. The Federal Disaster Plan for 2003 in the United Arab Emirates identified the plan participants, and those related to activating the early warning (see Figure 3-1).

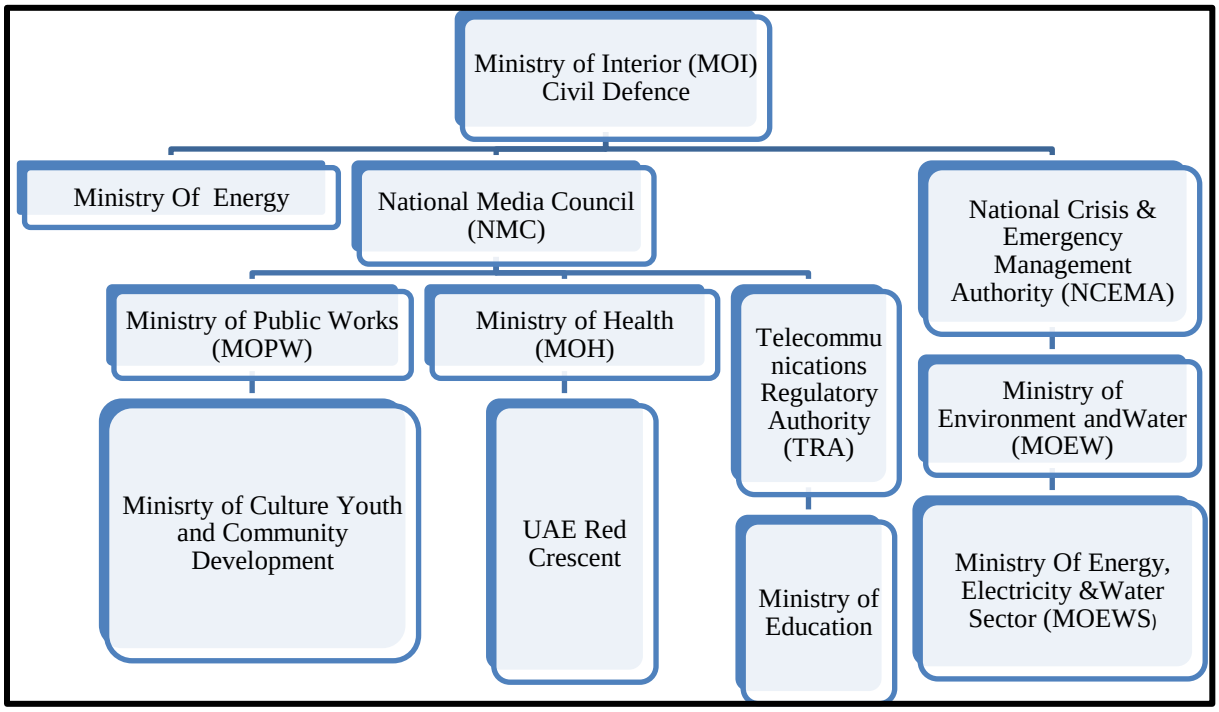

Figure 3- 1: Institutions that fall under the Federal Plan in the UAE(MOI, 2014)

Although the MOI still coordinate emergency and public safety issues in general in the UAE till date, the organization directly given the responsibility of emergency, crisis and disaster management at the moment in the UAE is now called National Crisis and Emergency Management Authority (NCEMA). In addition to this, there are other organisations such as the Civil Defence, Red Crescent, media to mention a few who have different responsibilities during

disaster to support NCEMA and the Police. The Police have primacy at any incident and they coordinate response just as done in the UK.

3.2.1 Federal Disaster Plan in the UAE

Unlike the UK, official policies and documents are not publicly available either in print or on the website of any emergency stakeholders in the UAE. The national response plan or disaster plan is only available for the use of emergency managers working in NCEMA, Civil Defence, MOI and the Police (Dhanhani et al., 2010). These organisations can then share information about response procedures with any stakeholder working in partnership with them to manage any imminent incident or hazard. In addition to this, there are no published academic work on NCEMA and their role as the authority in charge of emergency, crisis and disaster management in the UAE. Regardless, through the use of internally available documents provided by NCEMA staffs during this study, the strategic, tactical and operational responsibilities of NCEMA and other stakeholders who work with them to mitigate, prepare for, respond to and recover from the impact of any hazard.

Similar to the Civil Contingency Act (CCA), the formation of NCEMA was due to the global efforts to improve disaster and emergency management (NCEMA, 2014). Nationally in the UAE, NCEMA works with other agencies to conduct continuous evaluation and assessment of security and its stability so that national assets and resources can be protected as much as possible (Dhanhani et al ., 2010). Based on its institutional structure, NCEMA is accountable to the National Supreme Security Council (NSSC) and operates under Federal Law No.2 of 2011. This means that NCEMA is a major force in the UAE and has the support of law reinforcing its activities. Furthermore, NCEMA in partnership with other emergency organisation such as the Civil Defence and Police coordinate all emergency, crisis and disaster management efforts in the UAE. The organisation is also responsible for developing and maintaining the national plan for responding to emergencies.

Therefore, the main focus and functions of NCEMA is to develop, consolidate and maintain the laws, national policies and procedures which relates to emergency and disaster management in the country. This is done using the four pillars (internationally known as the phases of emergency or disaster management). These pillars are illustrated in Figure 3-2.

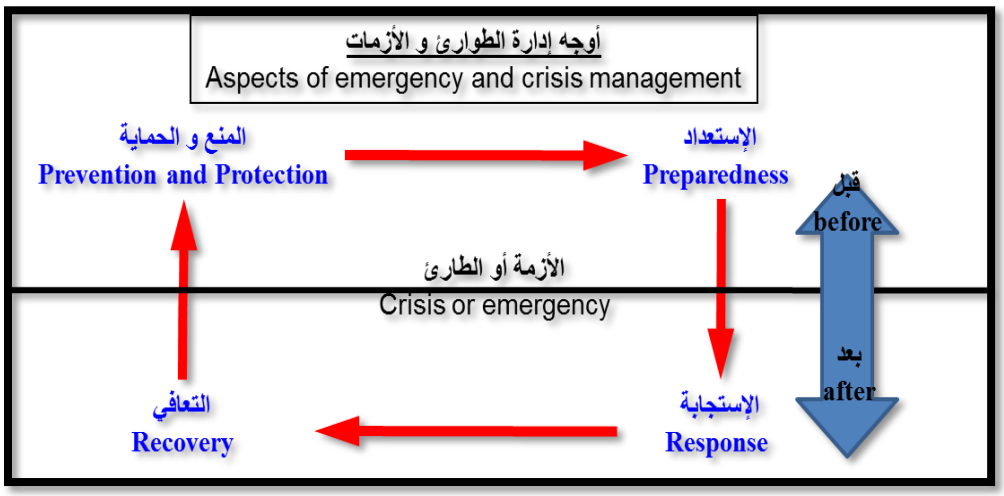

Figure 3- 2: The Four Pillars of NCEMA(NCEMA, 2014)

Evidently, the UAE adopted the UK model; however, NCEMA is an independent authority whose concept was borrowed from the United States (US) as there is no direct equivalent of NCEMA in the UK. Regardless, attempts are made to follow the legal framework used for emergency management in the UK.

As stated by NCEMA, in terms of informing and communicating with the public, responsibilities regarding this are shared between NCEMA and the Civil Defence and other organisation involved in public safety in the UAE. To ensure that there is good coordination between all stakeholders; NCEMA ensures that there is agreeable level of cooperation between everyone involved through joint training and partnership which is consented to through the signing of memoranda of understanding (MoU). Thus, in terms of EWS, in principle, the UAE modelled the

UK timeline for maintaining arrangements to warn, inform and advise the public. This timeline is called public communication timeline (CCA, 2004). The timeline is:

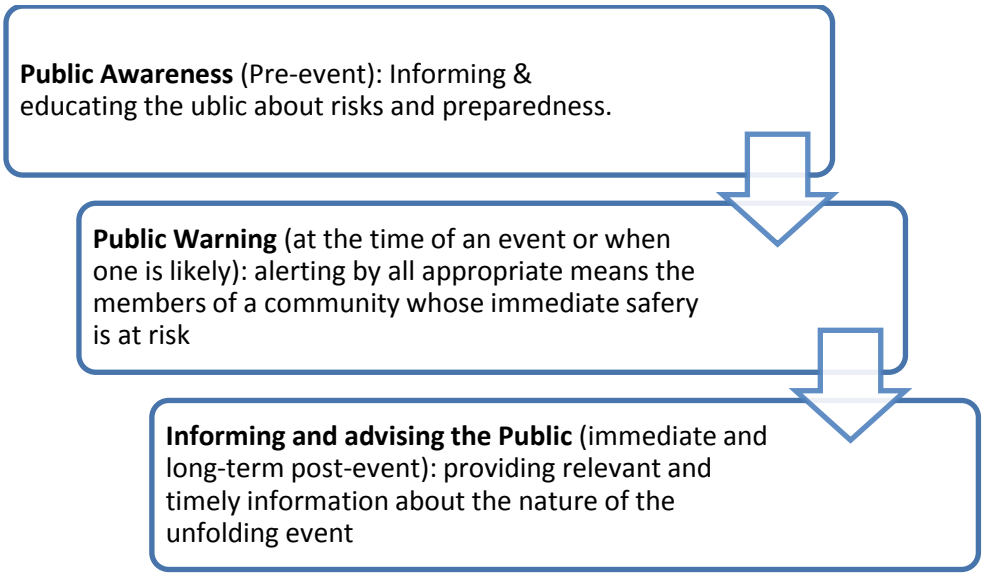

Figure 3- 3: Public communication and EWS timeline (CCA, 2004)

The public communication timeline for EWS shows that there is specific description of information provided and disseminated at each stage. It also shows that contrary to many general perception, warning messages does not end during the event, it is provided post-event so that emergency responders will know the immediate actions to take to minimise the risk of the event to health and welfare of people, animals, environment and property (Keeney, 2007). The informing and advising the public stage also involve the actions the public needs to take to minimise the impact of the emergency on them as well as the actions the responders need to take to assist with recovery phase (Oliver, 2010).

According to Perry (2007), a comprehensive EWS include dissemination of information to the public so that the public will know how to obtain further information should they require it. Lastly, such information and good dissemination of EWS help the responders to know the end of emergency and when to return to normal public safety arrangement (Reason, 2008). After reviewing the plan, the federal response to natural disasters in the United Arab Emirates and the Government measures and the parties participating in the plan, the scope of this research will be

restricted to how EWS is activated and deployed. An evaluation of the EWS in the UAE in all the seven emirates will also help to determine the requirements for successful and effective EWS in the UAE.

3.3 Overview of Early Warning System in United Arab Emirates

As briefly mentioned in section 2.7, the UAE faces natural hazards such as thick fog, landslides, earthquakes, and tropical storms. While not all natural hazards can be predicted and prevented, a state of preparedness and an ability to respond to an early warning of a natural disaster can considerably help to mitigate the impact of disaster and reduce human casualties and damage to property and infrastructure (Al Dhanhani, 2010). However, for undocumented reasons, the application of an early warning in the federal plan encountered many challenges and difficulties. These limiting factors have also made it difficult for the civil defence to be activated without the cooperation and coordination of NCEMA in the United Arab Emirates. The current state of each component of the EWS in the UAE takes into account some of the main elements defined by the UN/ISDR – PPEW (2005). Regardless, several challenges, limitations and shortcomings, which show the requirements of the civil defence, stakeholders, and community in early warning response in the United Arab Emirates is inadequate. This indicates the importance and relevance of this research which aims to develop a framework which can guide the integration of EWS in community. Inevitably, this framework will also increase response capabilities, which maximises the public education timeline to warn against risk of natural disasters in the UAE. Therefore, to determine the appropriateness and relevance of the framework this research proposes, section 3.3.1, 3.3.2, 3.3.3 and 3.3.4 will adopt the key performance indicator outlined in Table 2.3 in chapter two to review the current EWS practices in the UAE.

3.3.1 Risk Knowledge

Risk assessment can help to increase motivation levels, give priority to the implementation of EWS and also drive the preparation for the prevention of disasters and responses to them (Rogers and Tsirkunov, 2011). In the UAE there is a trend of increasing risk assessments caused by intense coastal urbanization, population movements, and environmental pressures as explained by UNISDR (2006). In addition, resilience of community to disasters is low and there is lack of awareness of how it can be enhanced which in turn influence understanding of preparedness for disasters and hazard risk assessment (Al Dhanhani, 2010).For many reasons, education about disaster is not in the curriculum, and there is no public education programme on hazards and risks, nor any educational and cultural community channels dedicated to teaching or creating awareness of disaster risks such as floods and hurricanes (NCMS, 2013).Thus it shows that even though the UAE have adopted the UK emergency management standards in principle, the practice is different, because there is no record or reference to the use of the public education and warning timeline. This shows a gap in EWS and warning approach in the UAE.

3.3.2 Monitoring and Warning Service

This element refers to the adequacy of the monitored parameters, the strength of the scientific basis of the forecast and the capacity to generate accurate and timely warnings ((Londoño, 2011). In the UAE, the body responsible for monitoring natural disasters and issuing their own warnings is the National Centre of Meteorology and Seismology (NCMS, 2013). NCMS carries out its responsibilities in the framework of WMO activities and through regional and worldwide cooperation with WMO members. One of the main tasks of the centre is the monitoring of seismic activities in and around the UAE and carrying out seismological studies. While this depicts good practice in public warning in the event of any disaster, there is no record of NCEMA or any emergency agency in the UAE as being responsible for public warning (pre-event) and informing and advising the public (immediate and long-term warning). This again emphasises the gap in the EWS in the UAE as well as emphasising the importance of this research.

3.3.3 Dissemination and Communication

EWS typically focus on dissemination of risk information and communication of imminent danger; the transfer of understandable warnings and preparedness information to those at risk (Wenzel and Zschau, 2014). UAE being a country with many foreign and diverse nationalities, where natives only account for 20% of the total population (Al Ameri, 2010), the ability to effectively communicate EWS is very important. This also means that the dissemination of EWS using traditional methods can be challenging. The traditional methods of warning and alerting the natives is through the use of loudspeakers in mosques (see Figure 3-4) and schools in times of disaster (Al Ameri, 2010), but unfortunately there is no public education on levels of warnings or danger and how the public can be alerted when a disaster risk has escalated.

Figure 3- 4: Loudspeaker in mosques used for warning the community in the UAE (AlAmeri, 2010)

The evidence of warning at community level represents the willingness to engage with the community. It also shows best practice in using method which the community is familiar with and indigenous practice of EWS. The limitation of this method however is that the target audience who can benefit from this information are few compared to the entire population size in the UAE. Hence, the need for additional method of dissemination which can complement this indigenous method.

3.3.4 Assessment of Response Capability

In the UAE, there is an emergency plan for each local emirate falling within the application of federal plan (Dhanhani, 2010). This arrangement is coordinated by the ministry of interior in partnership with local stakeholders (Dhanhani, 2010). However, this arrangement often results in confusion due to poor coordination between local partners, especially when responsibilities are not well laid out (Phelps, 2010). There is also misconception that risk of natural hazards or disasters and early warnings to them are only the responsibilities of the police and the Civil Defence (Paton and Jackson, 2002). Hence continued disengagement from community prone to disaster and risk which eventually affect the preparedness level of the community (Perry, 2007). The lack of access to timely public education and evidence of a lack of adequate early warning system in the state, as well as weakness existing in educating community members, suggest the need for improvement. While this subsections show some gaps in the current EWS practices in the UAE using the key performance indicators, the next section is devoted to a critical review of response capabilities across the entire seven emirates in the UAE.

3.4 Analysis of EWS in the Emirates

While it is commendable that some emirates (cities) in the UAE have systems for monitoring hazards and their risk, it is evident that these monitoring systems do not provide EWS functions to the stakeholders and community. The background and concept of EWS evaluated in section 2.3 shows that EWS include warning ability, integrated sets of elements which emergency managers can use to interact with stakeholders and communities before crisis starts so that risk reduction can be achieved (Londoño, 2011). The review of the current deployment of EWS in all the UAE cities does not reflect this process neither does it show any specific nor generic EWS model used in each city or provided by NCEMA for the general use of EWS in the UAE.

The model used to disseminate and communicate warning shown in Figure 3-4 i.e. use of loudspeaker in mosques for warning the community in the UAE (AlAmeri, 2012), reflect the knowledge of hazard and warning and dissemination and communication. However, this model of EWS lacks monitoring and warning capability as well as response capability which are both the requirements of emergency managers, stakeholders and community. This model of EWS only

provides information of the hazard to people without actually stating how this EWS and information translate into response capability. The impact of this gap resulted in several flooding impact which were mentioned in each city that has experienced natural hazard. Thus, besides the use of loudspeakers in mosques, the warning provided by meteorology office and the use of technology (such as twitter, face book, text messages) to communicate warning of hazard, there are no other EWS models identified in the UAE similar to any of the seven countries examined in section 2-4.

Furthermore, it can also be inferred that the fact that these dissemination approach for warning is not effective because they did not lead to risk reduction as explained by (Londoño, 2011) and emphasised in the four elements for effective people-centre EWS framework. Therefore, it can be said that the EWS or dissemination of warning for natural hazard in UAE is not effective or sustainable because it fails to disseminate warnings in timely and appropriate manner to help those at risk make decisions (Lassa, 2008). While no challenges to determining, developing and implementing effective and sustainable EWS were documented, it can only be assumed that the current deployment of EWS in the UAE lack foundations in best practice principles and understanding of essential concept of EWS. For example, in the impact of flooding, impact of thick fog, sandstorm and earthquake situation in Abu Dhabi, Dubai, Umm Al Quwain, Arjman, Ras Al Khaimah and Fujairah, were significant because the practice of EWS had not been based on any principle of EM as examined in section 2.2.1 and as observed to be applied in all the seven countries examined in section 2-4.

This gap or lack of effective EWS in the UAE emphasises the need and importance of a framework which can be used to integrate EWS in the community and in disaster risk prone areas in order to increase response capabilities to natural disasters risk in the UAE. This framework will form the basis of EWS development and implementation in the UAE and it can also be utilised by emergency managers, stakeholders and communities to improve the general understanding of the concept of EWS in the UAE. Therefore, the next section will cross-examine the current deployment of EWS in the UAE using the ten principles and best practices outlined in section 2.6 which were derived from the seven countries reviewed in section 2.5. This is done in

order to determine the EWS requirements for stakeholders, community and emergency managers for effective emergency planning and response in the UAE.

3.5 EWS Requirements in the UAE

To identify and determine the EWS requirements especially for all stakeholders and community based on the analysis of the EWS examined in sections leading to this, this section applies the principles of EWS discussed in section 2.6 in chapter two. This cross-examination of the principles and pillars of EWS against the current deployment of early warning in the UAE will help to identify areas which need to be improved and to determine the appropriate framework which can lead to integrated EWS in the UAE. This cross-examination is done using Table 3-1

Table 3- 1: EWS Requirements for stakeholders and community in the UAE

Principles/Pillars	**Evidence in UAE**	**Requirement**
Principle 1: Political Support	Not mentioned or identified	Require strong political and policy support. This will reflect in a cohesive framework of policies linking together national and local entities for risk management, planning, legislation and finance (Golnaraghi, 2012).
Principle 2: Effective EWS is founded on 4 key elements: 1. Detection, forecasting and monitoring of hazards; 2. Risk analysis and integration of risk information in emergency planning and warnings; 3. Timely and authoritative dissemination of warnings; 4. Community planning and preparedness with ability	Only part of element-1 was identified in the current system	Require the understanding and application of all the four key elements (Golnaraghi, 2012).

to initiate emergency preparedness and response plans coordinated with national and local agencies.		
Principle 3: Clarity of roles and responsibilities in EWS	Not identified	Require clarity of roles and responsibilities in EWS through exercise and training (Alexander, 2002)
Principle 4: Allocation of sufficient resources for EWS	There was no indication that current resources were insufficient for EWS	Require allocation of sufficient resources for EWS. Since this was vague in the documents reviewed, it will be verified if there are sufficient resources that can be allocated for effective EWS in the UAE
Principle 5: Emergency planning warning incorporate risk information	No reference to if or how emergency planning incorporated risk information	Require that emergency planning warning incorporates risk information. But this will be verified because no reference was made to this, and requirement will be applied as deem fit for stakeholders and community. According to Phelps (2010), this arrangement can also be tested through exercise.
Principle 6: effective, authoritative and actionable warning messages	Not evident in the current deployment of EWS	Require effective, authoritative and actionable warning messages, using all the common best practices outlined in section 2.6.6. in chapter two.
Principle 7: Warnings must be disseminated to allow time for those at risk to respond	Case studies and pictures suggest otherwise	Require dissemination of warnings that allow at risk people to take appropriate actions (Golnaraghi, 2012).
Principle 8: Place emphasised on disaster preparedness and response planning	Not specified	Require that effective emergency response planning addresses hazard and risk levels, characteristics of vulnerabilities and high risk regions, vulnerable groups, stakeholders and coordination of procedures (Golnaraghi, 2012)
Principle 9: Training is pivotal to operational readiness	No mention of training for EWS	Require training measures which reflect local, regional and national characteristics as well as organisational, government and institutional dimensions to EWS (Golnaraghi, 2012)
Principle 10: Prioritisation of continuous improvement through feedback	Lacking in the current system	Require feedback on the effectiveness of EWS so that evaluation for improvement mechanisms can be determined for all

		levels of the system and the overall system for EWS (Golnaraghi, 2012) in the UAE.

Table 3-1 has shown that EWS in the UAE needs input of all the ten principles and pillars of EWS which had been discussed in previous chapter. While some of these principles were not identified in the response capabilities reviewed in this chapter, it is possible that they exist in practice but lacking adequate documentations. Thus, these principles has informed some of the questions asked during the primary data collection process in order to whether these principles exist within the current practice or if they are included in future plans for implementation. This approach is taken so that data analysed for recommendations are valid and reliable based on ontology's and concepts of emergency management and EWS. Furthermore, since the UAE is a developing country and the emergency sector is at its infantry, many concepts might not have been documented yet as discovered that literatures were lacking about emergency management field in the UAE. It is expected that this tactical approach to this research going forward will make the research more robust and rigorous, simultaneously helping to address the issue of reliability and validity of data and results.

3.6 Chapter Summary

In this chapter, an overview of emergency and disaster management the United Arab Emirates context has been discussed in order to create an understanding of the environment where the research took place. Overview of the Emirates' EWS, its components and The Federal Plan which is used to manage disasters were also discussed and the application of this was examined as applied in the different emirates in the UAE. EWS in all the emirates were analysed in order to determine the implications for the limitations identified in the system. On the basis of this analysis, the section leading to this provided an overview of EWS requirement in the UAE informed by best practice and principles of EWS examined in Chapter. However, some of these requirements will be confirmed during the fieldwork where primary data will be collected through interview and the use of questionnaire data collection tools. The next chapter discusses the methodology adapted to for this research process and for achieving the aim and objectives of this research.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

The aim of this chapter is to explain the methods and approach used to achieve the research aim and objectives as well as answer the research questions as described in Chapter1. This chapter explains the research methods design chosen for this study area and the justification for their selection. The researcher has adopted Saunders et al. (2009) recommended research 'onion' to explain the methods used for this research. In view of this, this chapter in written in sections devoted to explaining the philosophical views appropriate for this research, research approach and research strategy adopted for answering the research questions. In addition to this, a section explains the data collection process and the suitable data collection methods used in order to increase the validity and reliability of the research findings.

This process is informed by the argument of Gardner and Lehmann (2002), that within every research project there is a need to develop a logical approach to undertake the research, and a set of activities or methods employed to facilitate the data collection. Saunders et al., (2009) also emphasised that this logical process is central to data analysis in relation to the issue under investigation. However, while there are no restrictions to the tools to use for a research, the choice of tool, methods and approaches are always influenced the by scope, nature and requirements for the study area and hypothesis which needs to be tested (Yin, 2009). Based on this understanding, the research methodology can be described as the methods, approaches and process used to carry out a research (Sekaran, 2009), which is what explains how this research was actually carried out.

4.2 Research Methodological framework

Research methodology has been explained from different perspective, but with similar meanings. According to Antony and Banuelas, (2002), research methodology is considered as steps or the logical process adopted by a researcher as guide in order to achieve research objectives. Similarly, Sekaran(2009) argued that even though the word research can be an intimidating term, it is simply the process of finding solutions to a problem by subjecting the problem to a thorough study and analysis of the situational or causal factors (Sekaran, 2009).

To complement these sets of arguments on research methodology, (Kagioglou et al., 2000) highlighted that research methodology incorporates three major dimensions which are:

a) Research philosophy (i.e. forms the basis of the research).

b) The reasoning of the research taken in approaching the research problem.

c) The methods needed to collect data for the research.

According to Kagioglou et al. (2000), it is important for researchers to know and understand the components of each major dimension and be able to integrate the relationships within the research process. In order to establish and ensure that the relationship between the steps and process in a research is logical, Saunders *et al.*(2009) developed the research model which is displayed in Figure 4-1, and which was adopted in this study.

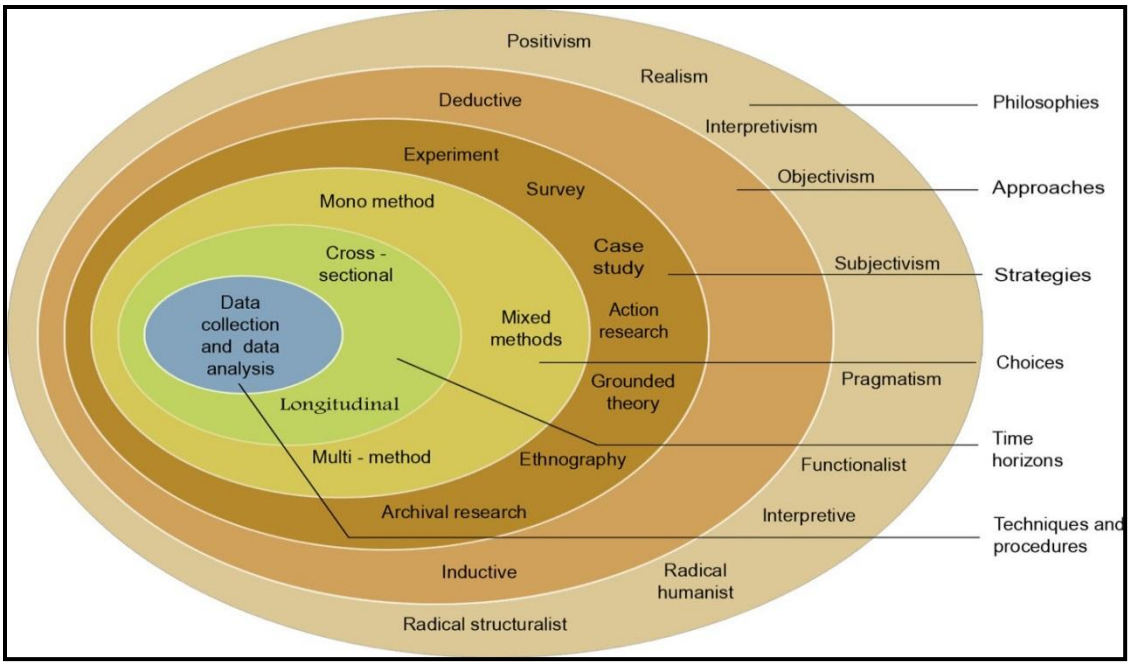

Figure 4- 1: The research 'onion' method (Saunders et al., 2009)

The research 'onion' recommended by Saunders et al., 2009) suggests that all layers must be designed and carefully planned in order to lead to valid and reliable data collection. According to Punch, (2005) the'research design'means all the issues involved in planning and executing a research project must be taken into consideration. As peculiar to this research, the research design is influenced by the research problems which had been identified by the research during work experience in the field of emergency/disaster management in the UAE. However, Punch (2005) emphasized that in addition to identifying research problems, research design also deals with four main questions; what strategy to use; the conceptual framework; who or what will be studied; and what tools and procedures are to be used for collecting and analysing (Punch, 2005).The initial stimulus for this research and a research design modeled after the four main questions emphasized by Punch (2005) have influenced the overall research process, which is discussed in the next subsection.

4.2.1 Overall Research Process and Stimulus

There are two major ways of establishing a research topic. One way of doing this is by analysing several literature relating to the subject area and then using gaps identified in literature to formally state and justify the problem, the research aims to solve. Questions can also be formed

from as a result of this to initiate a process for seeking answers to questions with the hope to fill the gaps. Another way to choose a topic is for students to be allocated a research topic (Gill and Johnson, 2002).However; this research had been initiated based on personal interest, observation and experience in emergency/disaster sector which provided opportunity to identify problems and gaps directly in the practice of emergency management. While this approach was not discussed by Gill and Johnson (2002), Palliyaguru(2010) explained that research topics can be formed through interest in the subject area based on several reasons.

Therefore based on the research problems and interests, a key focus of this research is to develop a decision support framework which can be adopted to enhance engagement of community in early warning response in order to mitigate the impact and risk of natural disasters in the UAE. It goes through reviewing the available literature about the Response Capabilities of Disaster Resilience in the UAE and the available International Best Practices in Multi-Hazard EWS all over the world. Key concepts and potential problems in existing practice as highlighted in the literature. The key concepts and principles have been central to the framework proposed for deploying EWS in an effective way to enhance stakeholders Response Capabilities and Community Disaster Resilience in the UAE. Finally, it ends by validity testing for insuring the effectiveness of the research findings and outcomes.The process of this research is showed in Figure 4-2.

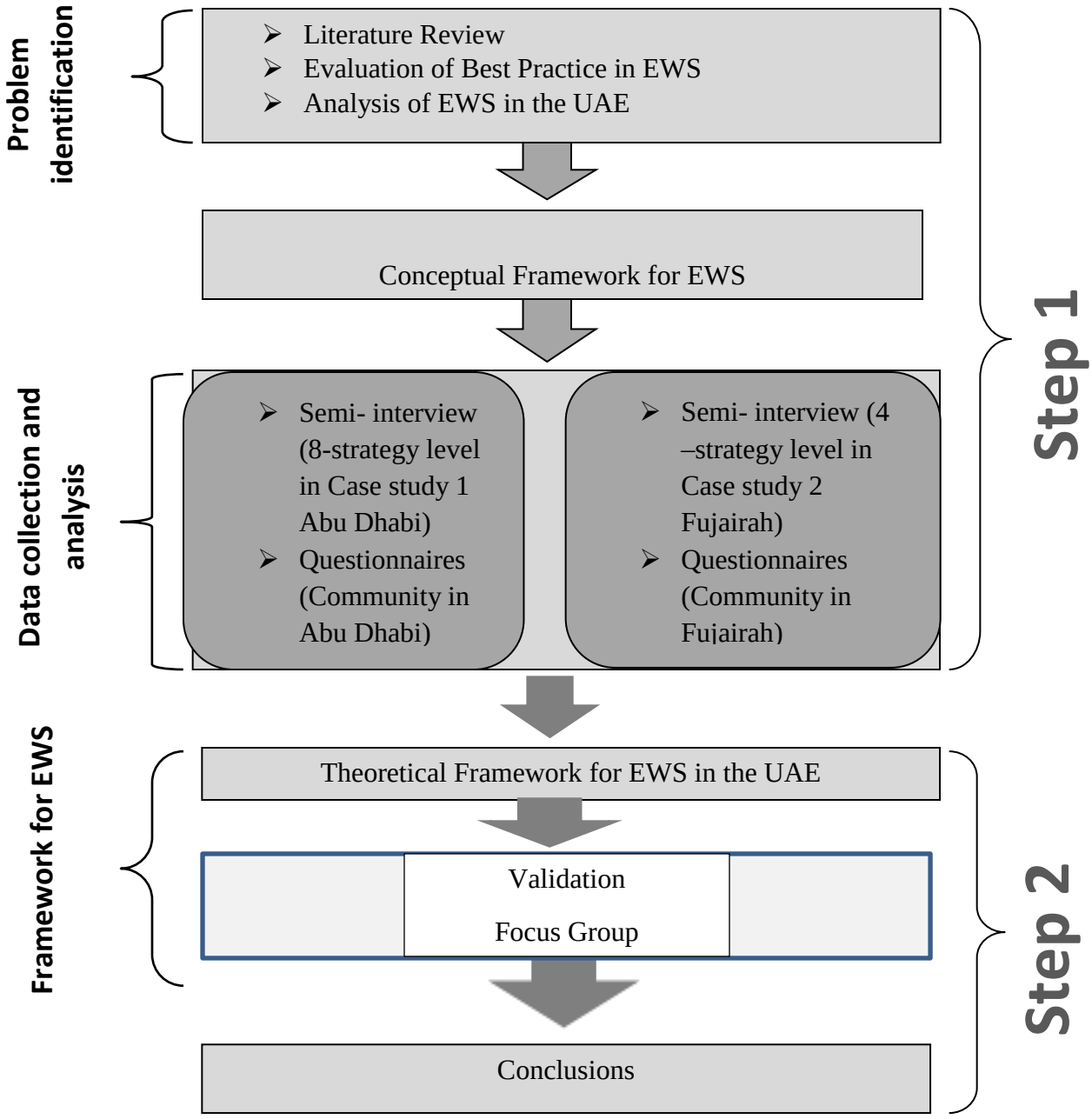

Figure 4- 2: The overall research process

As seen in Figure 4-2, there are eight stages, in which a variety of research methods have been employed to achieve the defined research objectives. Using this process and the research onion proposed bySaunders et al. (2009), further details are used to justify the reasons for selecting suitable methods for this research. Based on this rationale this research adopts an interpretivists philosophical position influenced by mixed inductive and deductive approach. In line with interpretivist philosophy, this research adopts qualitative strategy using multiple case study methodology to collect valid data. The data collection tools used to ensure high validity and good reliability were semi structured interview; survey questionnaires and documentary evidence. The rationale for this choice is justified in subsequent sections in this chapter.

4.3 Research Philosophy

It is essential for researchers to considerate the research philosophy when determining on the research design. (Saunders et al., 2012) mentioned that research philosophy reflects "the way we think" about the development of knowledge, which in sequence affects "the way we go about doing research". However, Yin, (2009) and Collis and Hussey (2009) declare that there is no definite rule which specify the philosophy selected for carrying out every research. This infers that research philosophy depends on the scope of the thesis, research aim, objectives, research questions or hypotheses, and available source of data collection (Yin, 2009; Collis and Hussey, 2009).

Hence, (Easterby-Smith *et al.,* 2004) emphasised the importance of understanding philosophical matters since it supports and helps to clarify the research design appropriate for carrying out the research. However several authors on research methodology such as; Saunders et al., (2009); Collis and Hussey, (2009); and Hussey and Hussey, (1997) have specified that there are two main research philosophies applicable in social sciences; positivist and interpretivism. The main differences between the two philosophical are summarised in Table (4-1).

Table 4- 1: The main differences between Positivism and interpretivism philosophies (Easterby-Smith *et al.*, 2004)

	Positivism	**Interpretivism**
The observer	Must be independent	Is part of what is being observed
Human interests	Should be irrelevant	Are the main drivers of science
Explanations	Must demonstrate causality	Aim to increase general understanding of the situation
Research progress through	Hypotheses and deduction	Gathering rich data from which ideas are induced
Concepts	Need to be operationalised so that they can be measured	Should incorporate the stakeholders perspectives
Units of analysis	Should be reduced to simple terms	May include the complexity of 'whole' situations
Generalisation through	Statistical probability	Theoretical abstraction
Sampling requires	Large numbers selected randomly	Small numbers of cases chosen for specific reason

However, all philosophy has main philosophical assumptions which are ontological; epistemological; axiological; and methodological assumption (Saunders *et al.*, 2007). While Collis and Hussey, (2009) provided a summary description of the philosophical assumptions that support the two main philosophies (Table 4-2), it is important to understand what these philosophical assumptions mean.

4.3.1 The ontological assumption

In principle, Collis and Hussey, (2009) explained that the ontological assumption in any research relates to the nature of reality (of being). Meaning that it is a general set of assumptions around what constitute knowledge in reality (Aouad, 2011).Therefore, with respect to ontology in Positivists philosophy, it is believe that reality is objective, structured and external to the researcher, which is peculiar with the natural sciences (Collis and Hussey, 2009). Consequently, they believe that there is one reality experienced by all of us and which can be verified through scientific means (Sutrisna, 2009).

In contrast, interpretivists believe that the world holds an unknowable reality (Collis and Hussey, 2009).This philosophical views are strongly held ones in the social sciences, where each person has his own sense of reality influenced by activities in the social world (Aouad, 2010). According to Collis and Hussey, (2009) the best way to understand the social world is from the point of view of investigated participants and not just take things at surface value. Hence, interpretivists believe that there are multiple realities because reality is constructed by people differently (Sutrisna 2009).

4.3.2 The epistemological assumption

Epistemology is a general set of assumptions about how we obtain and accept knowledge (reality) about the world (Sexton, 2008). It examines the theory of knowledge, and its methods, 'validation' and the possible ways of achieving knowledge (Sutrisna, 2009). With respect to interpret visits philosophy, there is focus on the meaning of knowledge, rather than the measurement of social reality (Sexton, 2008).This is because they concentrate on understanding the phenomena (reality) in order to find answers to the questions such as what, why and how(Sutrisna, 2009). Furthermore, in the interpretivism philosophy, the researcher is a part of what is being researched and is not independent of it (Remenyi et al., 1998); Collis and Hussey, 2009). Thus, interpretivists believe that reality and what constitute to knowledge can only be interpreted in the most appropriate way when the researcher is involved in the investigation process.

In positivism research however, the epistemological assumption is that the social world exists externally and that its properties should be measured through objective methods, rather than being inferred subjectively through sensation, reflection or intuition (Easterby-Smith et al., 2008).

4.3.3 The axiological assumption

Axiology is the branch that studies judgments about value (Saunders et al., 2007). This philosophical assumption is concerned with what constitute to value or what is generally valued in the world (Collis and Hussey, 2009).

In positivist research, the researcher acknowledges that research is value-free and unbiased, because positivists consider that they are independent from what they are researching (Collis and Hussey, 2009).

On the other hand, interpretivists believe that the process of research is value laden (Collis and Hussey, 2009). This means that value is a central aspect of human existence as explained by Heron (1996) who argue that values are the guiding reason of all human action. He further argues that researchers demonstrate axiological skill by being able to articulate their values as a basis for making judgements about the topic being researched on and how the research will be conducted. Therefore, this philosophical assumption emphasises that, what the researcher and people value all play a critical role in arriving at the conclusions of the study. The summary of the explanations and philosophical assumptions of ontology, epistemology and axiology are all outlined in Table 4-2.

Table 4- 2: Assumptions of the main philosophies (Collis and Hussey, 2009)

Philosophical assumption	**Positivism**	**Interpretivism**
Ontological assumption (the nature of reality)	Reality is objective and singular, separate from the research	Reality is subjective and multiple, as seen by the participants
Epistemological assumption (what constitutes valid knowledge)	Researcher is independent of that being researched	Researcher interacts with that being researched
Axiological assumption (the role of values)	Research is value-free and unbiased	Researcher acknowledges that research is value laden and biases are present
Methodological assumption (the process of research)	Process is deductive Study of cause and effect with a static design (categories are isolated beforehand)	Process is inductive Study of mutual simultaneous shaping of factors with an emerging design (categories are identified during the

	Research is context free Generalisations lead to prediction, explanation and understanding Results are accurate and reliable through validity and reliability	process) Research is context bound Patterns and/or theories are developed for understanding Findings are accurate and reliable through verification

Therefore, the decision to adopt the interpretivism have been influenced by the ontological assumption of reality in emergency and disaster management, epistemological assumption that constitute to the best practice and principles of EWS and the roles effective EWS play in mitigating the impact of natural hazards as well as increasing disaster resilience, which is the axiological position emphasised in this research.

Hence, in order to address the objectives and answer the research questions the researcher adopted a qualitative approach as the main approach for achieving this. While a quantitative approach was also used to validate and confirm the numeric data collected, as well as to enhance the research validity, qualitative is approach is used because it is also consistent with interpretivism approach. Since the scope of the study lies in the field of social sciences; and the nature of this study is rooted in the concept of real-world experience, therefore, the main part of this research was qualitative and interpretivism.

Thus, the ontological assumption that reality is socially constructed, the epistemological assumption that knowledge is collected by examining the views of the individuals about EWS against the risk of natural disasters in the United Arab Emirates are influenced by these philosophical elements. Furthermore, the axiological assumption that the research maybe influenced by biases presented by participants or/and the researcher, is negated by using quantitative approach to validate the data. This combined approaches and methods both increase validity and reliability of this research. Therefore, the way this combined philosophical assumptions have helped to bring to light the peculiar ontology, epistemology and axiology for EWS and research process are all discussed in the subsequent sections.

4.4 Research Approach

According to Saunders *et al., (*2009) there are two central research approaches, the deductive and inductive approaches. The deductive approach is a theory testing process which begins with an established theory and seeks to establish an explanation of the theory and to test the theory. This approach is mainly used in any research grounded in the positivism philosophy. Whereas, the inductive approach is a theory building process (Saunders et al., 2009). It process commences with direct observation of specific case and then moves towards establishing generalisations about the phenomenon under investigation, and is more suitable for a phenomenological or interpretivism research philosophy (Hyde, 2000).

Sutrisna (2009) states that the differences between these two approaches refers to the logic of the research, the role of the existing body of knowledge as gathered in the literature study, the way researchers utilise the data collected and subsequent data analysis. In other words, deductive approach is when the study begins with developing hypothesis/hypotheses or theory and then leads the theory or hypothesis through a critical process or test which then ends with either acceptance or rejection of the hypothesis/hypotheses. Whereas inductive approach is when the research begins with generalisation and then ends in developing a theory from the pattern of generalisation (Sutrisna, 2009). Table 4-3 illustrates the main differences between inductive and deductive approaches according to (Saunders *et al.*, 2009).

Table 4- 3: Major differences between deductive and inductive approach (Saunders*et al.,* 2009)

Deduction	Induction
Moving from theory to data	Moving from data to theory
Common with natural sciences	Common with social sciences
A highly structured approach	Flexible structure to permit changes
Explain causal relationships between variables	Understanding of meanings humans attach to events
Select samples of sufficient size to generalise conclusions	Less concern with the need to generalise

Although, Martin and Cepeda, (2005), debate that there is no theory-free research and that all empirical work is based on some fundamental ideas, however, Sekaran, (2003) and Saunders *et al.,* (2009) recommended a combination of deduction and induction as it is an advantageous way of conducting a valid and reliable research. Consequently, the researcher has chosen to combine both the deductive and inductive approaches for undertaking this research. In other words this research will use the deductive at the initial stage of the research. This will be achieved by developing research questions and a conceptual framework based on literature. Then, the inductive approach will be adopted in the remainder of the study to achieve the research aim and the strategy for conducting this process is explained in the next section.

4.5 Research Strategy

The main purpose of the research strategy is to ensure that the research aim and objectives are achieved. According to Yin (2009) there are many strategies in social science research which include: surveys, historical analysis of archival information, experiments, and case studies. Thus, care needs to be taken since the choice of strategy is critical as each of these strategies in social science have both advantages and disadvantages. For instance, experiment is a typical method of research that is used mainly in the natural sciences; it is used to study causal links; whether a change in one independent variable creates a change in another dependent variable (Collis and Hussey, 2009). The survey strategy is generally associated with the deductive approach. It is used to collect large amount of data from a large population, and is often obtained by using a questionnaire (Saunders et al., 2009). However, historical analysis of archival information used to study secretarial records and documents as the main source of data. It is mention to recent plus historical documents (Saunders et al., 2009).

Among all these strategies, the case study could be used effectively in organisational and management studies; in the academic disciplines; and professional fields such as management science and social work. Furthermore, it is used in conducting research for dissertations and thesis in the social sciences (Yin, 2009). The case study strategy is defined by Yin, (2009) as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context,

especially when the margins between phenomenon and context are not obviously apparent". However, Yin, (2009) mentioned three conditions which can be used to select the appropriate strategy for a research and these are:

- the type of research question posed;
- the extent of control an investigator has over actual behavioural events;
- the degree of focus on contemporary as opposed to historical events

The relationship between form of research question, control of behavioural aspects and focus on contemporary events are all shown in Table (4-4).

Table 4- 4: Different Research Strategies (Yin, 2009)

Strategy	Form of Research Question	Requires Control of Behavioural Aspects?	Focuses on Contemporary Events?
Experimental	How, Why?	Yes	Yes
Survey	Who, What, Where, How many, How much?	No	Yes
Archival analysis	Who, What, Where, How many, How much?	No	Yes/No
History	How, Why?	No	No
Case study	How, Why?	No	Yes

As shown in Table 4-4, the four strategies explained by Yin (2009) show the form of research questions that needs to be answered. However, experiment, survey, archival analysis and case study all have the potential to focus on contemporary issues as considered in this research. Given the peculiarity of this research which requires that current EWS practices and requirements of stakeholders and community for effective emergency planning and response are examined, the experiment and archival strategy will not be suitable for this research. However, the main strengths of the case study strategy are thatit allows the researcher to use a variety of sources of data in the investigation (Denscombe, 2007) makes it suitable for this research area. Furthermore, since the case study strategy is appropriate if the researcher requests a rich

understanding of the context of the research and the process being used (Saunders *et al.,* 2009; Velde*et al.,* 2004), this research has adopted case study as the most suitable strategy for this research because of these two main advantages.

The important application of a case study methodology is that it describes a situation and the real-life context in which it occurred and is used to explain the causal links in real-life involvements that are too complex for survey or experimental strategy (Yin. 2009). Consequently, a case study can be used for exploratory, descriptive or explanatory purposes. In this research the case study strategy has been selected to gain depth understanding of the information necessary to investigate the process of developing EWS in the UAE (the contemporary phenomenon in a real life). In this way, this research particularly focuses on a contemporary phenomenon, where an in-depth study and analysis of on-going natural disasters resiliencies in the UAE need to be carried out and therefore the case study approach is proved to be the most appropriate approach. In general, case study are the preferred approach when how or why questions are being posed, when the researcher has little control over the events and in examining contemporary events (Yin, 2009).

In summary and based on the above discussion, the case study strategy has been adopted as a result of the judgement that it is the most appropriate research strategy as this research consists of both what (exploratory) and how (descriptively or explanatory) types of research questions. Thus, this research has to be carried out as a descriptive case study and requires undertaking an in–depth investigation of the EWS and Capabilities in the Emirate of Abu Dhabi and Emirate of Fujairah in the UAE to develop a framework to enhance community engagement against the risk of natural disasters in the United Arab Emirates. Because the research seeks to answer what, why and how questions relating to the research problem, the event also is contemporary and the researcher has no control over the phenomenon.

4.5.1 Single Case or Multiple Cases

The primary distinction when implementing a case study design is between single case (conducted in one organisation or one social context) and multiple case (more than one organisation or social context) (Yin, 2009). The single case study offers greater depth of

understanding and is an appropriate strategy to use when the case describes an extreme or unique case, representative, or longitudinal case. However, single case study has limitations on the general is ability of conclusions drawn (Yin, 2009). However, Lee, (1991) and Yin, (2009) admitted that multiple case studies are more common, reliable, over the single case studies, and are generally used to replicate findings or support theoretical generalisations. Certainly, multiple case study research increases external validity and it helps to protect against bias (Voss *et al.*, 2002).

On the other hand, according to Yin (2009) there are four major types of case study design namely: single holistic; multiple holistic; single embedded; and multiple embedded which are illustrated in Figure 4-3. The case study types are selected for a research area based on the defined unit of analysis relevant to the research being investigated.

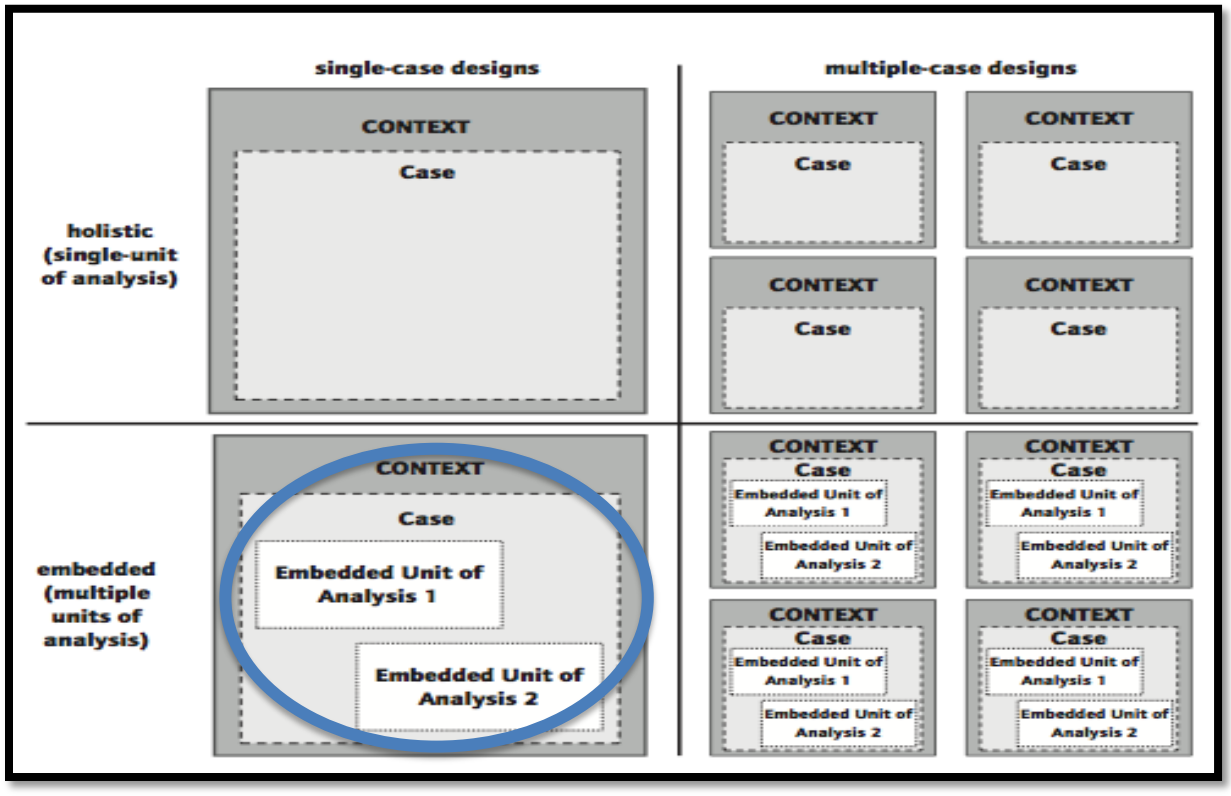

Figure 4- 3: Basic types of designs for case studies (Yin, 2009)

The research under consideration consists of both what (exploratory) and how (explanatory) types of research questions. Therefore, due to the overall nature of the research questions, this research adopts the exploratory, multiple case study where the context is the Abu Dhabi and Fujairah in the UAE as the case. It investigates the existing EWS and Capabilities for EWS in the UAE and what is requirement of stakeholders and the community for EWS. Also investigated is how the new framework solves this issue and enhances disasters resiliencies in the UAE.

The Emirate of Fujairah and Emirate of Abu Dhabi in the UAE can be used as effective case studies and has sufficient scale for the study. This is the best choice and will provide answers to the research questions, and will give a rich picture regarding the existing EWS and Capabilities for EWS in the UAE. This will guarantee the best sources of data which are relevant to the current researcher collected for analysis. Further justification for this choice of case studies is also discussed in the next subsection.

4.5.2 Justification of the Choice of Emirate of Fujairah and Abu Dhabi as a Case Study

The section of Fujairah and Abu Dhabi as the case studies for this research is informed by the severe impacts of natural hazards in the two emirates. While other emirates experience adverse weather or natural hazards, the impacts of natural hazards in both Fujairah and Abu Dhabi have more severe and devastating than the other emirates, hence the selection. For example, Fujairah was selected for this research because of its proximity to the Gulf of Oman which gives Fujairah its unique and important strategic location. However, this proximity exposes Fujairah to the direct impact of any water-related hazard amongst other natural hazards.

Another reason for selecting Emirates of Fujairah is due to its recent history of natural disasters. Most UAE natural hazards such as the Al Qurayah flood of 1995, the Masafi earthquake of 2002, the Al Tawaian landslide of 2005, the Tropical Gonu storm of 2007 and the Sharm flood in 2009 (Dhanhani, 2010), have occurred in this Emirate. Emirate of Abu Dhabi on the other hand was selected for this research because it is the largest emirate by area and the largest population of the seven emirates. Abu Dhabi is exposed to a lot of hurricanes and monsoons during the year and some earthquakes in the past periods. The vast amount of modern and 21st century buildings and facilities in Abu Dhabi increases the risk when natural hazard impact the city. As

engineering materials are displaced due to strong winds and severe weather, it complicates response and exposes residents in the city to greater impact of the natural hazards and its cascading effects (Alexander, 2002).

Thus, selecting these two case studies is informed by the need to embed their unit of analysis in order to make objective and credible evaluation of exposure to hazard and the EWS suitable for mitigating the impacts of natural hazards which cannot be prevented from occurring. Furthermore, engaging different stakeholders in the two cities in semi-structure interviews to collect primary qualitative data and quantitative data from questionnaire ensured that triangulation is possible. In addition, disseminating questionnaires in the two emirates which generated 80% response facilitated the ability to use multiple units of analysis provided by stakeholders from the two emirates, thus increasing the validity and reliability of data and research outcomes. Therefore, the justification for selecting two case studies; Emirate of Fujairah and Emirate of Abu Dhabi, has helped to validate whether the proposed framework can be applied to engage community at risk in Early Warning system as investigated in this research. While the goal of this is to enhance Disaster Resilience in the UAE using the framework developed through this research, it is important that the framework also advances and ensure effective EWS in the two emirates and across other emirates in the UAE. Selecting these two case studies have thus facilitated the process of embedding unit of analysis in Fujairah with the unit of analysis in Abu Dhabi to ensure that a holistic and applicable framework for the modern and built environment in the UAE is effective.

However, from the research point of view, no other researchers have had access in the past to investigate issues relating to the EWS in UAE. This infers that the proposed framework can be applied to other Emirates in the UAE via the development of strategic EWS, since all emirates have similar emergency management structure, and administrative systems. Thus, the lessons and knowledge that could be obtained from these case studies would be vital and significant for future implements of EWS in other Emiratis in UAE.

4.6. Data Collection Methods

As emphasised in the sections leading to this one, there are several methods which can be used to draw out information from people. Some of these methods include, but not limited to questionnaires, interviews, observations or archival material (Easterby-Smith et al., 2004). However, there is no singular method that fits all studies, the specific necessities; the research philosophy, the research approach, the research strategy, and the aim of research usually determine the appropriate method or methods to use (Yin, 2009).

According to EPSRC (2013) research data is defined as recorded factual material commonly retained by and accepted in the scientific community as necessary to validate research findings. Two types of the research data could be collected and analysed; Quantitative and Qualitative data types. Bawden (1990) defines qualitative data as**:** studying the behaviour of individuals in all the complexity of their real-life situations. However, Silverman (2010) emphasised that qualitative data cannot solve problems of causal connections, and so it is particularly relevant where there is ambiguity about terms and variables. Irrespective of the types of research data, Collis and Hussey, (2009) argued that research data collection is broadly classified into two major types; primary data and secondary data.

Primary data is the data collected specially for the purpose of a study directly from people, materials and sources (Silverman, 2010). Whereas, the **Secondary data** is the data collected from existing sources which were collected for the purpose of other researches or relevant area of study (Silverman, 2010). According to Collis and Hussey (2009), secondary data are important because they are derived to build theoretical base for a study. Therefore in this research, the bases of secondary data were mainly: reference books, articles, papers, research, theses, magazines and the internet, while primary data were data collected through interviews and questionnaires. Therefore in this research both primary data and secondary data were used in different but complementary capacity to ensure that the research aim is achieved.

Though, many authors such as Denzin and Lincoln, (1998) and Collis and Hussey, (2009) recommend researchers to use multiple methods for collecting data to avoid the possibility of bias associated with any single method, in order to improve the research validity and enhancing the reliability of the study. The decision to use multiple methods of data collection in this research is influenced by the types of research questions which need to be answered and the methods which is most suitable to help answer them. In addition, the use of multiple sources which leads to triangulation of evidence can help in clarifying the real meaning of the phenomena being studied (Yin, 2009) as well as increase validity of data. Since this research adopts the case study strategy, Yin (2009) explained that there are six major sources of evidence which can be used in the case study approach, on condition that they are relevant to the study. These methods are all listed and compared based on their strengths and weaknesses in Table 4-5.

Table 4- 5: Strengths and weaknesses of data collection methods (Yin, 2009)

Source of evidence	Strengths	Weakness
Documentation	Stable: Can be reviewed repeatedly; Exact: contains exact names, references and details	Irretrievability: can be low; Biased selectivity, if collection is incomplete Reporting bias: reflects bias of the author Access: may be blocked for privacy
Archival Records	Same as above, Precise and quantitative	Same as above, accessibility may be limited for privacy reasons
Interviews	Targeted: focuses studies directly on case, provides apparent causal associations	Bias due to bad constructed questions, Response bias, interviewees say what they think interviewer wants to hear
Direct observation	Reality: covers events in real time Contextual: covers context of event	Time consuming Selectivity: poor, unless broad coverage Reflexivity: events may be processed differently
Participation / direct observation	Same as for direct observation, Insightful into interpersonal behaviour and motives	Same as for direct observation, Bias due to investigator's management of events
Physical Artefacts	Insightful into cultural features, Insightful into technical operations	Selectivity, Availability

As observed in Table 4-5, physical artefacts, participation/direct observation and archival records are all based on conditions of availability or timing in order to use them for a research area. Since waiting for a natural disaster to occur before observation can take place is not an option in this research and the lack of extended literature on EWS in the UAE also made archival and physical artefacts unsuitable for this research, the choice of interview and documentation have been further justified. In case studies, the interview technique is helpful way to access people's perceptions, their deep insights into the matter in discussion, meanings and problem definitions. However, the questionnaire survey technique is an effective way of collecting data from a large sample of respondents (Saunders *et al.,* 2007), which is also a type of interview in a case study (Yin, 2009). Based on the discussion leading to this section, this research uses questionnaire and interviews as the main methods of gathering information, while the document review are used as support technique for enhancing the validity of the research.

4.6.1 Interviews as a research technique for data collection

Interviews are a generic and central form of data collection technique used in most of the research approaches. Face-to-face interviews have long been the dominant interview technique in the field of qualitative research **(**Opdenakker, 2006). Also because of the direct contact between the interviewer and interviewee, an interview allows the researcher to explain the purpose of the study and clarify any misunderstanding or confusion (Oppenheim, 2005). In this regard Hussey and Hussey (1997) mention that the typical response rate for a personal interview is about 95%, whereas for a mailed questionnaire it is between 20-40%. However, Saunders *et al.,* (2009) thought that interviews can be categorised into three kinds:

- Unstructured interviews.
- Structured interviews;
- Semi-structured interviews;

For unstructured interviews the interviewer expresses questions unpredictably during an interview (Sekaran, 2003). So it is essentials that the interviewer in this situation has a clear idea about the aspects that are wanted to be explored, since there are no determined questions to work through (Saunders *et al.,* 2009). Besides, the interviewee in this style of interview feels free to

talk about their perspective, opinions, point of view, and attitudes associated to the subject of the research. It is therefore expected that in the case of structured interviews the researcher should prepare a set of questions considered as the 'interview schedule', where a similar phrasing, wording and order of questions are used (Oppenheim, 2005). Also, using this type of interviews could contribute to obtaining uniform information, which confirms the comparability of data.

However, despite what both structured and unstructured interviews offer as research methods, the semi-structured interview includes many advantages of both methods (Yates, 2004). It is remain the most widely used interviewing format for qualitative research and can occur either with an individual or in groups. The benefits of semi-structured interviews include that can avoid many disadvantages such as "the questions asked to participants may change due to the experience obtained by the interviewer during the interviews, therefore the type of information gained from those who are interviewed at the beginning may be noticeably different from that gained from those interviewed on the way to the finish" (Oppenheim, 2005). In general, according to many authors such as Santiago, (2009); Yin, (2009); Easterby-Smith et al., (2008); Yates, (2004); and Hussey and Hussey, (1997) the semi-structured interview has many advantages and disadvantages as any other method.

The Advantages of Semi-Structured Interview: The main advantage of semi-structured interview is that it is a worthy way of exploring respondents' subjective meanings. This gives the interviewer the chance to tailor questions to the on-going concerns of the participants who can talk about things the interviewer might not have thought about, especially information which may help the research (Yates, 2004). Furthermore, it allows the researcher to explore ambiguity, or inadequate answers which may be met by the interviewees, while a restricted structured interview or questionnaire does not allow this (Easterby-Smith et al., 2008). Semi-structured interview also provide large freedom to the interviewer so deeper understanding of responses can be explored. Ability to gain rapport and participants' trust, as well as flexibility in providing information similar to that provided by structured interviews are all main strengths of semi-structured interviews (Easterby-Smith et al., 2008). This is done with flexibility and freedom but with focus on the research themes and research aim. According to Yin, (2009) ability to do this will lead to collection of uniform information for the purpose of data analysis.

The Disadvantages of Interview: The main disadvantages of the interview are that it is more time-consuming and expensive, especially if there is a large number of participants to be interviewed (Yates, 2004). Furthermore, the problem of the accessibility to participants who are willing to participate may arise (Yin, 2009). The interviewers may influence the validity and reliability of the questions as the mood of the researcher can play a major role in determining the flow of interaction with the interviewees and, therefore influence the interview process (Saunders *et al.,* 2009). Knowing this disadvantage helped to prevent them from negatively impacting this research by using multiple methods of data collection (Silverman, 2010), by defining the research boundaries and themes specific to this research area (Collis and Hussey, 2009) and by conducting the research process based using the university ethics guidelines. Regardless of the limitations, the justifications for choosing the semi-structured interview is further emphasised in the next section.

4.6.2 Justification of Choosing Semi-structured Interview in Data Collection

The semi-structured interview method was chosen based on the reasons provided by Sekaran (2003) who argued that semi-structured interview method is a powerful data collection technique that would allow the researcher to conduct in-depth investigation. In addition, this method is defined as the most principled of all qualitative research (Easterby-Smith et al., 2004). Thus, it enables the researcher as done in this research to collect rich qualitative data about the phenomenon under investigation (Hussey and Hussey, 1997). In addition to this, semi-structured interviews are popular means of conducting quality research in the Arab world which also attracts the best engagement of participants. For instance, Arab researchers, such as Al-Bahussain, (2000) and Al-Faleh, (1987) used semi-structured interviews to conduct empirical work. These researchers found that such interviews were an appropriate method in Arab organisations and societies where individuals prefer to talk instead of complete a questionnaire. Thus, the interview technique was aimed to give interviewees every chance to explain their own experiences from their own perception, in that line supporting the inductive nature of the study. Regardless of the rich quality of interview data collected in this research, the data provided by the participants were still subjected to analysis using ontology and epistemology in emergency

and disaster management. However, this was only possible because of the interview design which was made with flexibility to accommodate both discovery of new knowledge and critical evaluation of the data provided by the research participants (Saunders *et al.*, 2009).

4.6.3 Designing the Interview Questions and Protocol

As the aim of this research is to develop a framework for implementing EWS in order to enhance engagement of individuals in a community in early warning response against the risk of natural disasters in the UAE. Thus there was a necessity to identify common practices and principles that are essential to the effectiveness of early warning systems which are supposed to exist before the establishment of the EWS. These principles include: political, economic, social, legal systems. Accordingly, this research was subjected to the interview process that the researcher has taken into consideration before conducting the interviews. Each interviewee was given a brief introduction based on aim of the study and the purpose of the interview as explained by Yin (2009). Saunders et al., (2009) debate that the internal validity and reliability of the data depends on the structure and design of questions, as well as the strictness of the pilot testing. So, having this information and facts in mind, the research protocol was carried out using the following guidelines or steps:

i. Formation of the first draft of the questions from a literature review and according to the theoretical framework for EWS implementation (Figure 4-4) ;

ii. Revising the questions after a meeting with 5Emirati PhD students(First pilot study);

iii. Conducting a second pilot study with 4strategic level in Emirates of Abu Dhabi (urban) and (4) from emirates of Fujairah (rural) (second pilot study);

iv. Modifying questions based on feedback from the two pilot studies;

v. Administering the final modified questions.

This step was combined into the process which ensured that this research is carried out as objectively as possible. This process is illustrated in Figure 4-4 to show the development of the interview process.

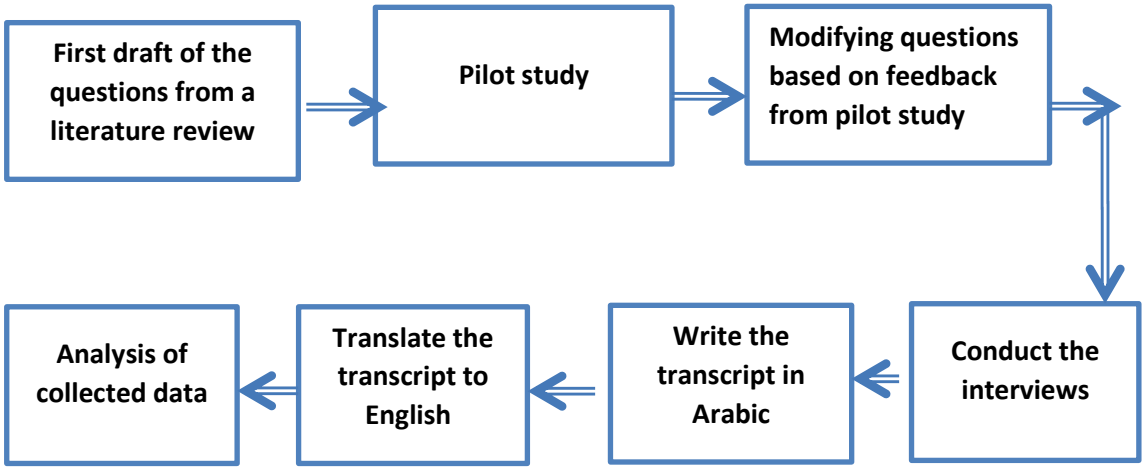

Figure 4- 4: Interview process

Using this process, the researcher was able to identify the appropriate interviewees who are able to provide quality data relevant to this research area. The process for selecting them in terms of research sample is discussed in section 4.6.4.

4.6.4 The Research Sample (interviewees)

A sample is a subgroup of the population that a researcher interested in especially in terms of the research area (Kumar, 2014). This research focuses on the population in the Emirate of Abu Dhabi and Emirate of Fujairah which are the selected case study for this research. However, through the process of sampling an estimate of the total number of people to interview was made using the available information of the situation in the total study population. The context for the population sampling unit from study population is shown in Figure 4-5.

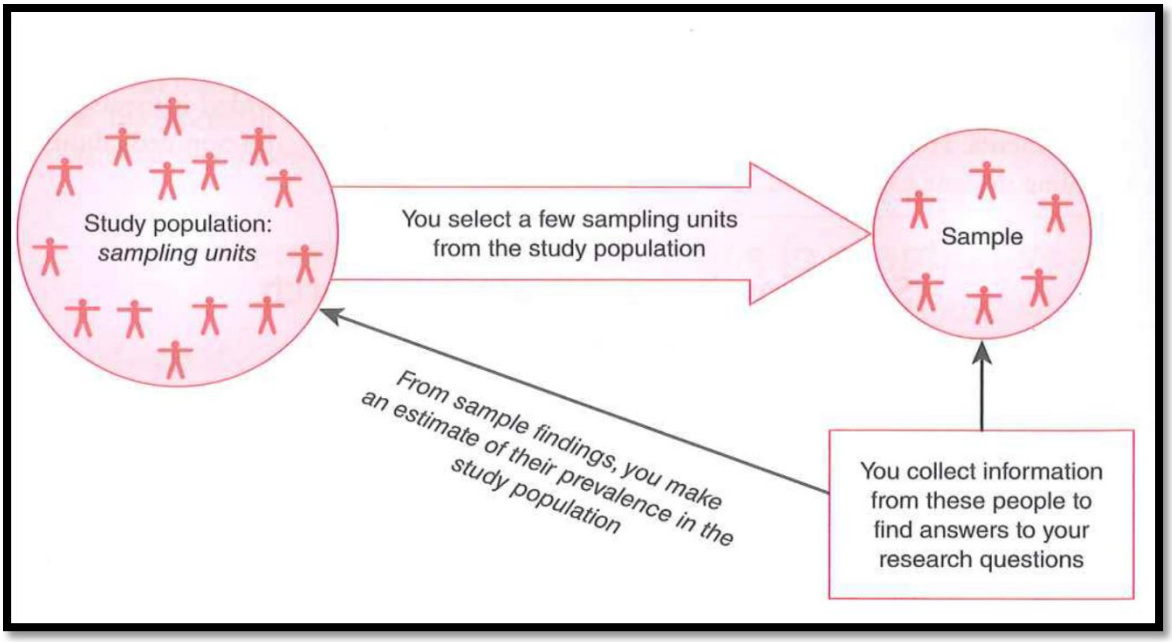

Figure 4- 5: The concept of sampling (Kumar, 2014)

In this research, the most reliable data are derived from sets of people who have the responsibility as stated in the federal plan for disaster management in the UAE especially in the two case studies. Therefore, through the interview protocol which uses EWS concept reviewed and analysed in the literature review, the interviewees were engaged to provide answers to some set of questions. Using the requirements and standard practice in emergency/disaster management, the interviewees for this research include:

1) Emergency practitioners from Emirate of Fujairah and Emirate of Abu Dhabi who are expected to be informed about Early Warning to natural Disaster.
2) Senior staffs in the National Centre of Meteorology and Seismology (NCMS).
3) Senior management at the General Authority of Islamic Affairs and Endowments.
4) Middle management in the Educational Council.
5) Staffs in Water and Electricity Authority.
6) Staffs in Municipality.

7) Senior officials in National Emergency Crisis and Disasters Management Authority (NCEMA).

8) Staffs in National Media Council.

9) Senior officials in Civil Defence.

10) Middle management in the Ministry of environment and water.

It was determined to include all of these different sectors in order to gain in-depth information and clear perceptions about different aspects of EWS, these are the potential people who are expected to be involved in administering, coordinating and facilitating EWS in communities at risks of natural disasters in the UAE. These were the prerequisites for selecting the interviewees for this research so that the current practices of EWS in the UAE can be verified, examined and their suitability can be examined in view of their ability to increase disaster resilience. Also engaging the senior and strategic level people among case studies enhances the validity of the study by getting different points of view from people who are experienced in the organisation. The majority of the interviewees in the case study were general directors, who have sufficient knowledge of the emirate, future plans etc., to be able to provide an insight into current practices in the emirate.

Kvale (1996) affirms that there is no fixed number of interview subjects; it all depends on availability of participants, willingness to participate and level of knowledge about the area being research. In this respect, Taylor and Bogdan, (1984) describe qualitative interviewing as flexible and it is not necessary to fix the number of participants before starting the research. Based on this, the researcher developed the interview protocol without knowing how many participants will respond positively to be interviewed and provide satisfactory information sufficient for achieving the research aim and objectives. Furthermore, Yin, (2009) argued that in order to reduce the problems that are associated with the interview, such as bias amongst other factors, the researcher used triangulation to strengthened the information from interviews. The interviewee's information was triangulated with other sources such as questionnaire, literatures and documents.

A total of 12 interviewees (8 interviewees from Abu Dhabi and 4 interviewees from Fujairah) were interviewed. The decision to interview 12 people were based on the numbers of available participants who are informed, experienced and have legal responsibility to perform duties relating to emergency management in Fujairah and Abu Dhabi. While it is possible to interview more people, unfortunately, their responses will not provide quality answers because these senior level officers are usually the most informed and usually more aware of the correct situation of affairs in their organisation and in the public sector. This decision relates to the argument by Kumar (2014), which emphasizes the importance of identifying sample size that are experienced in the research area. Getting quality response from experienced and informed participants for interview is important to get a true and accurate reflection and understanding of the situation and problems experienced.

Furthermore, experience from past interactions with staffs in the public sector show that middle level or junior officers are usually unwilling to say much or participate in research for fear of being queried for their comments. Therefore, researchers who have been successful in conducting interview research, are ones who recruited the participation of directors and managers who are the bosses and willing to participate in addition to having the more detailed information about the operations of their organization.

With this is mind, the full details and overview of the interviewees in Abu Dhabi are outlined in Table 4-6.

Table 4- 6: Interviewees of Emirates of Abu Dhabi: Case Study (1)

The Government bodies	The interviewees positions	Number of Interviewees
National Centre of Meteorology and Seismology (NCMS)	General Director	1
Water & Electricity Authority - ADWEA	Senior staff	1
Abu Dhabi City Municipality	General Director	1
National Emergency Crisis and Disasters Management	General Director	1

Authority		
National Media Council	Executive Director	1
Abu Dhabi Civil Defence	General Director	1
Ministry of environment and water	General Director	1
Ministry of Education	Head of Emergency and Safety	1

As explained earlier, Table 4.6, shows the level and description of the participants indicating their level of experience and status in their various organisations. It also indicate the quality of response provided to questions asked during the interview sessions. For example, directors in the organisations that take a lead on emergency and disaster management were interviewed which helped to provide answers to the gaps identified in the literature review. This was also replicated for the second case study; Fujairah.

Table 4-7 presents the details of the 4 interviewees interviewed for the second case study in Fujairah. In compliance with the ethical approval for this research which is included in Appendix.

Table 4- 7: Interviewees of Emirates of Fujairah: Case Study (2)

The Government bodies	**The interviewees positions**	**Number of Interviewees**
Civil Defence / Fujairah	General Director	1
Fujairah Municipality	Senior staff	1
Federal Electricity and water Authority	Senior staff	1
Ministry of Education	Head of Emergency and Safety	1

Table 4-7 confirms that senior staffs and officers were interviewed in Fujairah so that quality data are collected for this research. Furthermore, to encourage participation and maintain privacy, all interviewees were interviewed with the option of being anonymous. Further details about the methods of data collection such as questionnaire is provided in section 4.6.6 and explanations of other methods are also explained further in this chapter.

4.6.5 Questionnaire surveys as a method for data collection

A questionnaire survey was conducted within this study using the case studies and as a supplementary technique to semi-structured interviews within the case studies. The questionnaire survey was used to investigate the opinion of the community and operations levels regarding the importance and actual level of implementation of EWS for natural disaster in UAE. Saunders et al. (2007) argued that the questionnaire survey technique is an effective way of collecting data from large of respondents.

Surveys questionnaires are a very traditional way of conducting research and they are particularly useful for non-experimental descriptive designs that seek to describe reality (Mathers, 2009), as this research. According to Oppenheim (2000) and Saunders et al., (2009), there are several advantages of using a questionnaire over other forms of surveys. The questionnaire do not require as much effort in gathering responses as does a verbal or telephone survey (Saunders et al., 2009). Questionnaire is also economical, and they often have standardized answers that make it easy to compile answers (Andersen and Taylor, 2009) and analyse. Even though, there are many disadvantages, such as the difficulty of designing questions which can provide accurate data to answer research questions.

4.6.6 Sample Size

The total population for the two emirates is 485,446. Given the large total population figure, the sample size was determined by put this figure into statistical calculating medium (Creative research systems) which then showed that a total of 1,065 from the two emirates need to be given questionnaires to complete. However the researcher in order to gather more opinions about the

early warning system, a further 15 respondents were participated in the survey, so the total sample of participant in the questionnaires becomes a 1080 respondents. Afterward, the 1,080 questionnaires despatched randomly to male and female and were all returned. The statistics measure of the reliability shows that a confidence level of 95% which means that at least 95% result is reliable.

Although Andersen and Taylor (2009) argued that there could be problem of low response rates, or people who complete the questionnaires might not be expert in the field of research. However, this problem was managed by interviewing the experts, while the general information which the public needs to complete was administered using questionnaire. Furthermore, the aim of this study is to develop framework which can enhance disaster resilience in community who are at risk of natural disasters by improving the effectiveness of EWS. This questionnaire survey was conducted with a community at risk on the two case studies Figure 4-6

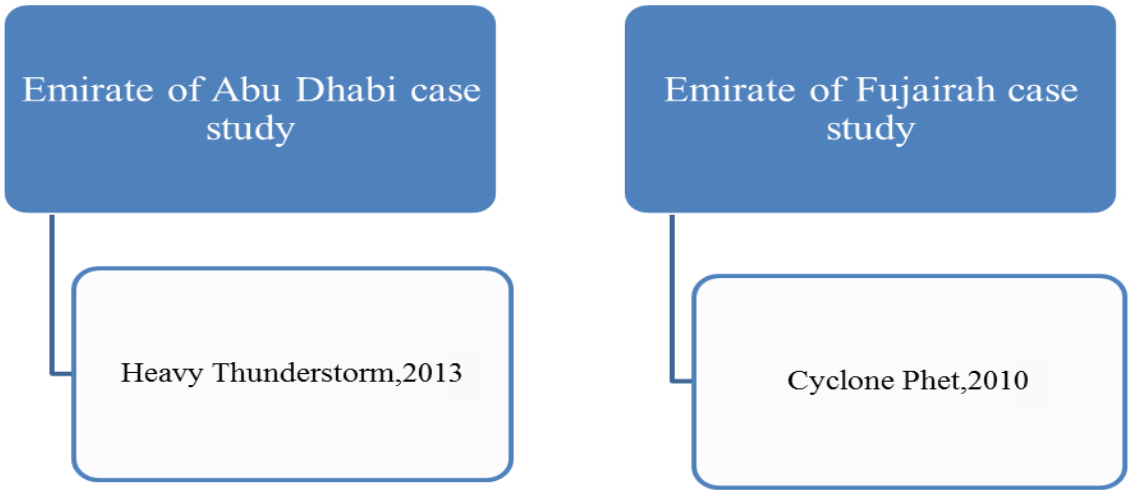

Figure 4- 6: Risk in the Emirate of Fujairah and Abu Dhabi

This understanding and classification made it clear who to approach, what information to request in order to achieve the research aim. Therefore a survey in form of a questionnaire was used to collect and ascertain the perspective of community (the public) about EWS and the effectiveness of the current EWS (if any). Furthermore, questionnaire survey was selected in this research to obtain data on attitudes and perceptions for the general public and stakeholders in order measure

risk awareness and requirements for EWS. It was issued to general public in order to obtain a descriptive and general picture.

Due to the large volume of questionnaires required for this research, the questionnaires were administered by mail, telephone, using face-to-face interaction, and electronically via email. These data collection techniques are based on the guidance and explanations by Marshall (2005), stating large quantities of questionnaire can be administered using mails, telephones and face-to-face interviews. Questionnaires were left in the mall at information desks, in offices that provide different service support to people such as telecommunication kiosk, vendors and supermarkets with management or frontline attendants that people are familiar with. The purpose of this is to increase response rate and engagement of people in participating in the questionnaire by completing it. Questionnaires were also given out in offices and in public sector organisations, while other questionnaires were given to professional colleagues and their families to complete.

4.6.7 Questionnaire design

The effective questionnaires may be designed in such a way that the questions are "short and focussed" and have at least less than "12 words" (Marshall, 2005). Questionnaire design is essential to put relevant questions which should give the information required from the questionnaire. Saunders *et al.*, (2009) added that reviewing relevant literature is required to have an idea for designing the questionnaire. Overall, the achievement of good questionnaire is based on the strength of the questions it asks. The Figure (4-7) illustrates factors which were considered when designing the questionnaire.

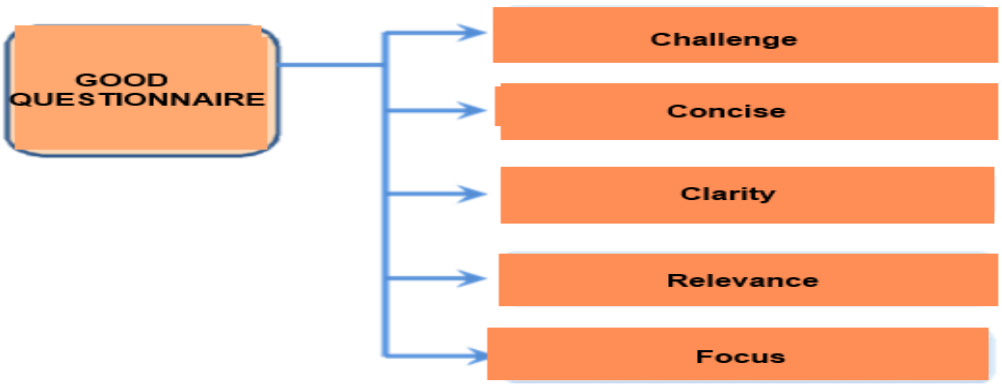

Figure 4- 7: The main factors involved in asking a good question (Fonseca, 2012)

In this study, the questionnaire was divided into five parts, each using close-ended, open-ended, leading, and linker questions. The first part of the questionnaire was designed to gather some basic demographic details about the participants. The second part was about defining the dangers. It included questions relate to: readiness and response plans; duties and responsibilities, and resource adequacy. The third part of the questionnaire concerned with the forecasting and surveillance. It included questions about the operational capability and political support. The forth part discussed the publicity and communication, while the fifth part dealing with response capability. It included questions regarding training; Unifying risk information; and feedback and improvement. Using this layer as guide for designing the questionnaire, and one thousand and eighty (1080) questionnaires were distributed in Emirate of Fujairah and Emirate of Abu Dhabi which are the two case studies.

4.6.8 Documentation

Documentation review is a research technique that many qualitative researchers consider as significant and valuable in the context of their research strategy (Mason, 2004). It is one of the most critical ways of supporting evidence collected from other sources (Yin, 2009). To achieve reliable data, the researcher uses documentary evidence as triangulation for the data obtained from the interviews and questionnaires. Documents that were used in this research included: Annual Reports from National Centre of Meteorology and Seismology, National Emergency Crisis and Disasters Management Authority, City Municipality, Civil Defence, Ministry of environment and water and National Media Council of Emirate of Abu Dhabi. In addition to annual reports from these organisations, reports and correspondence from the Federal Electricity and water Authority, and Civil Defence of Emirate of Fujairah and documents related to recent natural disasters in Emirate of Fujairah were reviewed and critically analysed for use in this research.

These types of data were used in this study to provide contextual information in order to achieve a deep understanding of the EWS in UAE. All of these documentary sources are reviewed in detail in the two case studies. The data collection methods of this research was discussed; the

next section intends to explain the relationship between data collection tools and research objectives, and the next section after that discusses the data analysis techniques used within the study.

4.6.9 Relationship between data collection tools and research objectives

The aim of this section is to map the research objectives against how they were achieved through various research techniques discussed in Sections 4.6. This is important in order to determine which objective has been achieved and to what extent they have been achieved. Therefore, Table 4-8 presents the research objective and their relevant data collection techniques in a summary form.

Table 4- 8: Research objective and their relevant data collection techniques

Research objectives	Data collection technique/s used			
	Literature review	Documentation	Case study	
			Semi-structured interviews	Questionnaire
To examine best practice in Early Warning Systems (EWS) for disasters resilience.	x	x		
To investigate the existing deployment of EWS in the UAE	x	x	x	x
To evaluate the EWS requirements for community and stakeholders in the UAE	x	x	x	x
To develop a framework that will facilitate successful and effective EWS in the UAE	x	x	x	x

To validate the developed framework with concerned stakeholders			x	x
To develop guidelines based on validation of framework for emergency management stakeholders in order to ensure effective Early Warning Systems in the UAE			x	

Furthermore Table 4-8 shows the types of data collected for each objective and which combination of methods had been triangulated, analysed to arrive at a valid result for each objective. Section 4.7 explains the data analysis techniques and the process of triangulating the data to achieve valid results.

4.7 Data Analysis Techniques

According to Yin (2009) data analysis can be defined as investigating, categorising, organising, tabulating, testing or otherwise recombining evidence, to draw empirically based conclusions. Without an understanding of how data can be analysed, fieldwork can generate an enormous data from different sources of data collection if caution is not taken (Easterby-Smith et al., 2004). For example content analysis which also called thematic analysis is used to analyse data collected during this research.

4.7.1 Content analysis

Content analysis is one of the common methods in analysing qualitative data. Krippendorff (2004) defines content analysis as a research technique which allows replication and permits valid inferences from text to the context of their use, which is more qualitative in nature. Collis and Hussy (2009) explained that content analysis has two types: conceptual analysis and relational analysis. According to Stemler and Steve (2001), conceptual analysis generally has a number of steps to be undertaken. The first step as explained by Stemler and Steve (2001) is to decide the level of analysis, whether to code for single word or for sets of words. Once this is decided, the second step is to determine how many concepts should be coded, while the third step is to decide whether to code existence or frequency of concept. These steps then help to

determine the level of generalisation which will be carried out in relation to the research aim, objectives and/or questions (Collis and Hussy, 2009).

Therefore data analysis for this research has two parts using an adapted version of the steps required for content analysis. The first part involves the analysis of quantitative data collected through interview case study and text words in questionnaire, which were all triangulated with ontology of emergency and disaster management as examined in literature review. The second part involves the analysis of qualitative data which has been grouped based on themes and patterns of responses created using the research questions and objectives. This approach is in line with what Saunders et al., (2009) emphasised that, one of the most common data analysis method for qualitative data is through thematic analysis which include categorising or coding of data, commencing from interview transcripts from the fieldwork.

Using the transcripts or notes of qualitative interviews through thorough reading, themes or word which has been coded can be selected and analysed (Saunders, *et al.,* 2009). Furthermore, Silverman (2010) also explained that qualitative research can be analysed using content analysis similar in concept to thematic analysis using classification of themes and collating pattern of answers to research questions or objectives. Regardless of the preferred word adopted for analysing qualitative research, the following steps were introduced by Leedy and Ormrod (2001) as guidance to analyse the collected data through qualitative case study research:

1. **Categorization of data**: data should be categorized and classified into meaningful groups.
2. **Interpretation of each issue**: documents, responses and any data elements should be carefully examined for exact meaning in relation to the case study.
3. **Identification of designs and patterns**: the interpretations of data should be analysed for underlying themes.
4. **Grouping and generalization**: an overall description of the cases. Conclusions are drawn that may have implications outside the specific case study under study.

This research has adopted these steps to analyse the data collected through the interview, documentation, literature review, but more importantly, the questionnaire words and interview data. The actual software used to further verify the data collected during this research is explained in section 4.7.2.

4.7.2 Using computer software for data analysis

According to Kumar (2005) there are indications that the computer programs can accelerate, handle complicated statistical techniques, display the analysed data and present them in graphically way. While many of such computer programs are more commonly used for quantitative data analysis, there also are also some computer programs that can be used in analysis of quantitative and qualitative data. Eriksson and Kovalainen (2008) emphasised that using computer programs help the researcher to deal with analysing qualitative data such as; writing up or transliterating notes, coding interviews, editing, attaching key words and data linking, and report writing. Software program such as Nvivo is one of the most common packages used for qualitative data analysis. It has many benefits which enables the software to manage and analyse a variety of data source from different type such as video, audio, images; revise the text without affecting the coding; review and recode coded data; allows quick modification to coding.

According to Bazeley (2008), Nvivo can assist in analysing qualitative data in terms of managing and organising data. Nvivo provides rapid access to conceptual and theoretical knowledge; graphically model that built from the data concepts and shows the relationships between the data concept before reporting the data (Bazeley, 2008). This encouraged the use of Nvivo in this research in order to ensure that the results are as objective as possible. In addition to this, there are a number of statistical tools and tests which were used in order to achieve the objectives of this research. The statistical package for social scientists (SPSS) software is known to be particularly useful for quantitative analysis research in psychology, sociology, psychiatry, and other behavioural sciences (Landau and Everett, 2004). SPSS allows performing descriptive and inferential statistics (Sawalha, 2011), which is crucial for this research based on the inductive approach adopted for analysing interpretivsim philosophy research like this one. Based on the above description and discussion of different techniques for data analysis, the researcher used content analysis (conceptual analysis) for qualitative data (semi-structured interview) where the oral notes were transferred into written records then classified and coded using NVivo 10. The rational for this is to explore the respondents' views about the concept of EWS among professionals in the emergency and disaster management sector in the UAE. Whereas, the

quantitative data collected from questionnaire was analysed using SPSS software version 16. The analysis of questionnaire helped the researcher to design a framework which can potentially enhance EWS and capabilities for increasing disaster resilience in the UAE.

4.8 Data Validity, Reliability and Generalizability

It is important to establish issues such as reliability and validity of research to ensure objectivity and quality of data collected, analysed and generated as result in any empirical study. Yin, (2009) explained that validity and reliability for qualitative research as important because one of the weakness of qualitative research is the possibility of the researcher influencing the research too much. Likewise, Cavana *et al.,* (2001) explain that validity is concerned with whether the research measures the right concept, while reliability is concerned with stability and consistency in measurements and data. However, Yin, (2009) state that reliability means "demonstrating that the operations of study, such as data collection procedures, by ensuring that the procedure can be repeated and still lead to the same results".

To achieve reliability and validity in this study the researcher has tried to be consistent at all times so that if another researcher followed the same processes similar finding would be produced. This is done by providing logical flow and steps for carrying out the research as well as triangulating the data to verify content of information provided by the interviewees. The researcher has built a clear research method and has adopted appropriate techniques that give high internal reliability. Also, in collecting the data, consideration was given to the most proper strategy for each data type, objective and the most suitable data collection tools for the investigation. According to Yin, (2009) the common way of approaching the reliability is to make as many steps as operational as possible and then to conduct the research. Following this rule, this research has ensured that all the case studies procedures and methods have been properly documented, which also contribute to generalizability of the results.

Generalizability which also relates to transferability emphasises the importance of external validity which is concerned with the extent to which the outcome or findings of one case study can be applied to another situation (Yin, 2009). Generalizability is important in any research

because some findings of qualitative research may be specific to a limited environment and individuals which makes it impossible to replicate and to demonstrate that the research findings may be applicable to other situations and population (Silverman, 2010). For example, Collis and Hussey (2009) argued that the researcher ought to contextualise data, case study location(s) and how their environment compares with other environments to ensure high level of generalizability or transferability.

In line with this, the researcher ensured that the criteria for selecting Fujairah as one of the case studies is due to its proximity to and exposure to impact of natural hazards. Thus indicating that transferability of this research result will be possible in the context of another city that has similar proximity to impact of natural hazards. In addition to this, the people engaged in the semi-structured interviews are stakeholders and professional in emergency management, town planning and education sector who have responsibilities for maintaining the environment in peacetime and during severe incidents caused by natural hazards. As such, this distinct characteristics makes it possible to engage similar research participants for future related research to this topic or facilitates generalizability. Thus, the following have been considered in this research to ensure transferability or generalizability as recommended by Collis and Hussey (2009), Yin (2009) and Silverman (2010):

i. The number of case studies - communities selected as case studies have features that can be found in many hazard prone communities or built environment like Abu Dhabi which has many features of any modern city anywhere in the world
ii. Restrictions – there are no restrictions on the type of people who contributed to data, since emergency management professionals, directors of education and municipality can be found in any modern city. In addition to this, the questionnaire participants are also members of the public living and working in the case study cities.
iii. Data collection methods – data collection methods employed are similar to many researches in the field of emergency management and public safety because they encourage participation and flexibility to probe further for in-depth explanations for certain practices and why some practices are not operational.

iv. Time period of data collection – time horizon have been discussed in this research as cross-sectional which encouraged both qualitative and quantitative data to be collected simultaneously. The period of data collection also supports generalizability.

v. Number and length of data collection – this is also clearly stated in the research ensuring that similar number and length of data collection can be replicated and transferable.

The above listed have been strictly considered and adhered to by the researcher in order to develop a preoccupation with transferability. Particularly, generalizability is key in this research since qualitative study is involved, but the importance of validity and reliability is also understood hence the rationale for using multiple strategies for triangulation and cross referencing of unit analysis. Furthermore, Saunders *et al.,* (2009) mentioned that reliability of interviews is also related to bias and this is why triangulation of data and information was crucial in this research in order to minimise all biases and increase reliability, validity and generalizability.

4.9 Ethical Consideration

Thus, this was all achieved by subjecting this research to a rigorous process in terms of ethical procedures. In accordance with the university ethical requirements for PhD research, the participants had been recruited with caution. The research area had been introduced to all research participants, and the issue of voluntary participation was emphasised to them before their engagement. The participants were recruited through the researchers existing network in the UAE. Potential participants were contacted through emails and phone calls to recruit their interest in this research. Once consent to participate is given, the research in agreement with the participants fixes a date for the interview session at an agreed location in the interviewees' office. This was the process for recruiting all interview participants. The questionnaire participants were recruited through a slightly different means. The people who completed the questionnaires were recruited through public service outlets and government offices which support or provide services to the public both in Abu Dhabi and Fujairah. Regardless of the manner of recruitment, the ethics, policy of anonymity and voluntary participation and withdrawal were all emphasised to all participants at the two locations.

4.10 Chapter Summary

The research methodological framework was explained under three main headings: research philosophy, research approach and techniques which were selected in order to address the research problem of the study. Research strategy and data collection methods which were considered appropriate for this study area were justified all through this chapter emphasising the relationship between each methodology component. All the research techniques, interview questions and protocol, research sample, questionnaire method of data collection and questionnaire design were all explained as used in this research. It was also established that data was collected through semi-structured interviews and questionnaire survey within the two selected case studies; Emirate of Abu Dhabi and Emirate of Fujairah. Furthermore, a range of semi-structured interviews was conducted among experts, senior staffs and experienced peoples in the public sector and emergency/disaster management sector as stated in the Federal plan for disaster management in the UAE. Another category of people who were engaged in this research process, especially for completing the questionnaires were the community (members of the public) in Abu Dhabi and Fujairah. A section on data analysis explained how the semi-structured interviews were analysed using content analysis (conceptual analysis) then classified and coded using NVivo 10. The questionnaire survey on the other hand was analysed using Statistical Package for the Social Sciences (SPSS) software version 16. Once these were done, data were triangulated, combined, coded and analysed in a manner which favoured data validity and reliability. While this research process had been undertaken based on ethical consideration and requirements of the University of Salford, the next chapter presents the research findings which these methods were crucial to its results.

CHAPTER 5: RESEARCH RESULTS AND ANALYSIS

5.1 Introduction

This chapter presents and analyses the results of data collected from the case study, semi-structured interviews and questionnairein Abu Dhabi and Fujairah Emirates. The aim of this chapter is to ensure that the research objectives are achieved. For this purpose, this chapter has been divided into several sections with each section devoted to presenting the data collected through the case study, interview and questionnaireprocess for the purpose of explaining the gaps identified in the literature review. To use the information from the case study and interviews, this chapter draws relevance from the data collected and links them with the research objectives as well as ontological explanations for EWS as analysed in the literature chapters in chapter two. The inferences and results from the data are then analysed and discussed in later sections, while the last section provides a general summary of the entire chapter and the implication for the study.

5.2 Overview of Results

The justification for selecting two case studies; Emirate of Fujairah and Emirate of Abu Dhabi is to validate whether the proposed framework can be applied to integrate Early Warning system. The goal of this is to enhance Disaster Resilience in the UAE using the framework developed through this research to advance and ensure effective EWS in Fujairah, Abu Dhabi and across other emirates in the UAE. This will be possible through the approach taken in this research to make comparison between the two case studies. The primary distinction when implementing a case study design is between single case and multiple cases (Yin, 2009). The single case study offers greater depth of understanding and is an appropriate strategy to use when the case describes an extreme or unique case, representative, or longitudinal case. However, single case study has limitations on the general is ability of conclusions drawn (Yin, 2009).

However, Neuman (2000) and Yin, (2009) admitted that multiple case studies are more common, reliable, over the single case studies, and are generally used to replicate findings or support theoretical generalisations. Certainly, multiple case study research increases external validity and it helps to protect against bias (Flyjberg, 2004).

Therefore, Abu Dhabi and Fujairah have been selected as the case studies for this research because of their proximity to impacts of natural hazards and history of impactful natural hazards. Subsequent sections examine, identify and analyses problems encountered during past incidents especially with EWS in the two case study locations. Each section on the case study also links the qualitative data from the interview to explain the current deployment of EWS, requirements for EWS and challenges to the deployment of EWS. Therefore, this chapter uses interview to achieve the following objectives:

- Objective 2: To investigate the existing deployment of Early Warning Systems in the UAE.
- Objective 3: To evaluate the EWS requirements for community and stakeholders in the UAE

The result from these two objectives is then used to achieve objectives 4 and 5 which are;

- Objective 4: To develop a framework that will facilitate successful and effective EWS in the UAE
- Objective 5: To validate the developed framework with concerned stakeholders

Therefore, this chapter uses the results from the case study, interview and questionnaire to examine the extent to which the research objectives have been achieved.

5.3 Case study 1: Abu Dhabi

The Emirate of Abu Dhabi which is the capital city of the UAE. It is the largest emirate by area and has the second largest population of the seven emirates (Dhanhani et al ., 2010). Abu Dhabi is located in the far west and southwest part of the UAE; it adjoins the Saudi Arabia and Oman (see Figure 5-1). This location exposes Abu Dhabi to lots of hurricanes and cyclones during the year. The city has also experienced the impacts of some earthquakes and tremors in the past (Dhanhani et al., 2010). However, being the capital city, there are many people with diverse

backgrounds and nationalities residing and working in the city, posing a slight challenge for communicating EWS in the UAE.

Figure 5- 1: The map shows the location of the Emirate of Abu Dhabi (Dhanhani, 2010)

As seen in Figure 5-1, the location of Abu Dhabi and a community such as Ruwais is at the edge of the Arabian Gulf and Gulf of Oman, thus making them vulnerable to the impact of natural hazards such as flooding, storm, to mention a few. Despite the recurring incident of natural disasters and hazards, there are no literatures on the deployment of EWS in the UAE as this is the first research to investigate the deployment of early warning for natural disasters in the Abu Dhabi. Therefore, information was obtained from documents and reports from the Abu Dhabi Police (ADP) who are given the lead responsibility to respond and managing disasters (natural and manmade).

5.3.1 Evaluation of EWS during past incidents

Series of natural hazards have posed a threat to Abu Dhabi city and its environs in the last few years due to the impact of rapid urbanisation and climate change. For instance, the storm that hit Ruwais on 21st and 22nd November 2013 was one of the largest and most dangerous storms that have occurred in Abu Dhabi over the past years (Abu Dhabi Police reports, 2013). Nearly all streets were blocked by uprooted and displaced trees and palms (see Figure 5-2). The main entrance to Ruwais was not passable due to high water levels. Unfortunately, there are no public warning devices available in Ruwais, thus, community members did not know how to react to storms (Abu Dhabi Police reports, 2013).

Figure 5- 2: The pictures show damage caused by the storm in Ruwais (Abu Dhabi Police reports, 2013)

As explained and observed in the pictures above, this location of Ruwais exposes it to the direct impacts of storms on an ongoing basis. Despite this, EWS is yet to take a prominent role, emphasising the importance of this research. These pictures also indicate that while EWS is particularly important in Ruwais, because it has one of the most modern industrial complexes in the Middle East, the deployment might be problematic or inefficient. The implication of this is that there will be higher risks for the large number of people residing and working at the location and major economic and social impact for the UAE as a whole (Abu Dhabi Police reports, 2013). As examined, analysed and discussed in the literature review, these pictures also shows that all the ten principles of EWS are lacking in the UAE emphasising the absence of best practice.

Therefore, this case study has confirmed that there was no deployment of EWS even recently when a major storm occurred in Abu Dhabi area of the UAE. It also means that gaps have been identified which justifies the research objectives which is investigating the existing deployment of EWS in the UAE is valid. Having emphasized the importance of this objective in Abu Dhabi context, the next section seeks to investigate into the reasons responsible for this evidence of lack of deployment.

5.3.2 Qualitative Data from Abu Dhabi

As mentioned in chapter three in the research methodology, 8 semi-structured interviews have been conducted with strategic personnel involved in the management of natural disasters in the Emirates of Abu Dhabi. Each interviewee has been given the code “S” in addition to a numeric serial number. The coding and description is outlined in Table 5-1.

Table 5- 1: Profile of interviewees in Abu Dhabi

The Government Organization	Current Job Title	Emirates	Code
National Centre for Meteorology and Seismology(NCMS)	General Director	Abu Dhabi	S1
Abu Dhabi Municipality	General Director	Abu Dhabi	S2
National Media Council	Executive Director	Abu Dhabi	S3
Water & Electricity Authority (ADWEA)	Senior staff	Abu Dhabi	S4
Ministry of environment and water	General Director	Abu Dhabi	S5
Abu Dhabi Civil Defense	General Director	Abu Dhabi	S6
National Crisis & Emergency Management Authority (NCEMA)	General Director	Abu Dhabi	S7
Ministry of Education	Head of Emergency and Safety	Abu Dhabi	S8

Using these codes and profile, the qualitative data have been derived from the interview sessions in a systematic way by asking questions relating to the research objectives and gaps identified in the literature review chapter. Furthermore, the responses from the interviewees have been classified under themes identified in chapter two to help to ensure that the research questions are answered and the objectives are achieved as much as possible. Therefore, the main themes for this research are; **risk knowledge**, **monitoring and warning**, **dissemination and communication**, **response capability, and community (stakeholder) involvement** which are vital to assessing the EWS in Abu Dhabi and Fujairah according to best practice identified in the literature review. However, other themes which might have been identified during the data analysis process will be discussed in the latter part of this chapter.

A. Risk Knowledge

Regarding risk knowledge the questions asked were;

Q1:*Does any Early Warning System (a system to give an alert before and event starts based on certain indicators) for natural disasters such as local storm, tropical cyclone, flood, earthquakes and landslides) exist in the UAE*?

Response to this question by the interviewees varied. While S1, S2, S3, and S4, all responded and confirmed the availability of early warning in their Emirates, S5 responded by saying "I don't know". However, pattern of responses were divided between S6, S7 and S8, who either said work was in progress or there was no early warning in place at all. It can be inferred that with this divided pattern of answers, where half of the interviewees said there is early warning while others said there was no EWS or "don't Know", indicate that if there was EWS at all, "Principle 3" which is clarify of roles and responsibilities in EWS was lacking.

This confirmed the gaps identified in the literature review. Furthermore, in critical evaluation of the answers provided by interviewees who confirm the availability of early warning, it can be said that what they called early warning does not completely fit into best practice and EWS principles. This is because their description of early warning was limited to dissemination of information through television, radios, phones, siren, alarm and the use of operation centers to communicate preventive measures. Based on this review carried out in chapter two, these are dissemination methods which are linked to the second theme within EWS. To probe further into who is responsible for the EWS and understand how EWS works in the Emirates, the next question was asked.

Q2: Can you explain your roles and responsibilities with respect to EWS?

All interviewees explained the roles and responsibilities for early warning in the way they understood it to function in Abu Dhabi Emirates. However, it was observed that the roles and responsibilities as explained varied. For example, S1, S2, S3, S6, and S8 pointed out that their responsibility lies in monitoring the natural hazard and warning the other authorities. Other roles as explained by these interviewees included delivering information to specified people or organization, disseminating the warning information through the news, providing logistics for evacuation, heavy equipment etc. However, S4 and S5 emphasized that their roles and responsibilities were limited to providing support only where necessary or needed.

Furthermore, S7 used the opportunity to explain and clarify the functionality of roles and responsibilities for crisis and disasters in the UAE. They explained that roles and responsibilities for warning can either be local authority or federal authority depending on where the disaster occurred. The local authority or federal authority then communicate the warning to the appropriate organization usually the civil defense who can then disseminate the information to the public directly or through the media.

Therefore, it can be inferred from this results that roles and responsibilities of organisations and authorities are clear, but the impacts of past disasters in the two emirates indicate that something might be wrong with the implementation of those roles and responsibilities because warning is yet to be effective. Furthermore, this result contradicts the gaps identified in literature review especially "Principle 3" clarity of roles and responsibilities in EWS. From the responses provided to question 1, it was inferred that this principle might be lacking. Perhaps the problem with deployment of EWS is can be associated with inadequate resources, which made the next question important.

Q3: What is the resource adequacy to reduce risk from natural hazards?

Responses to this question shows that, generally, resources are available at different levels and in various authorities based on the response from S1, S3, S4, S5, S6, and S7. However, S2, and S8 explained that they lack human and technical staffs. These pattern of answers shows that resources are reasonably adequate in Abu Dhabi Emirates since 75% said there are adequate resources by explaining the resources in place, their location, classification and process of using them. The answers by S2, and S8 might indicate uneven distribution of resources or prioritising of resources for those directly responsible for EWS.

B. Monitoring, warning and Forecasting

Questions in this section relates to the second theme which is monitoring and forecasting.

Q4: Do you have any support (financial or otherwise) from the government to monitor, warn and forecast for EWS?

It can be observed from the answers provided by the interviewees varied. While some organisations or authorities such as S1, S2, S4, and S7 claim to receive support from the government, S6 claim they receive partial support. However, S3, S5 and S8, claim there is no government support for their organisation or authority for EWS. While this divided level of support shows that some organisations/authorities in Abu Dhabi do not receive support from the government for EWS, having S1, S2, S4 and S7 say they receive support shows that there are specific organisations the government have chosen to support for EWS. However, there seems to be problems with the allocation of resources for EWS monitoring, warning and forecasting. This is because the answer to previous question about roles and responsibilities states that S1, S2, S3, S6, and S8 are all responsible for "monitoring the natural hazard and warning the other authorities", but S3 and S8 do not get any support at all, while S6 who is responsible for disseminating warning to the public only gets partial support. The implication of this answers shows lack of "Principles 1, 2, 4, 5, and 6", which will potentially affect "Principles 7, 8, 9 and 10" respectively. While this is only an assumption, the pattern of answers and themes from the entire data results shows inconsistency of information specific to monitoring and forecasting which makes the evaluation of dissemination and communication important in order to further identify other areas of ineffectiveness.

C. Dissemination and Communication

This section is devoted to examining data collected which relates to the theme of dissemination and communication.

Q5: Do you release or receive the warning messages?

With regards to receiving and sending warning messages for natural disasters, S1, S2, S3, S4, S6, and S7 all claim they receive or/and send warning messages. Although S6 claim they send

warning message concerning hazards such as fire and accidents to community and businesses, they also receive warning message from national meteorological and earthquakes centre. This means that S6 organisation is responsible for warning regarding to man-made hazards and not natural hazards as researched in this research. However, S5 emphasised that their ministry has no jurisdiction to launch warning messages, but they get warning bulletins from the national meteorological and earthquakes centre also.

However, the explanation by S8 provide more in-depth understanding for possible reasons for the pattern of EWS dissemination and communication by saying; "there is no unified data access mechanism….." which means that while some will have direct access to EWS information to communicate, others can only wait and hope to receive such information. More importantly, this question and the answer have helped to identify the problem with deployment of EWS in the UAE. It has raised the question that if S7 receives support from the government, but is not the organisation responsible for EWS dissemination, and S6 is responsible for dissemination warning and monitoring for EWS, but only the dissemination of man-made hazards such as fire and accidents, it means that in the actual sense, no organisation is disseminating warning, monitoring and forecasting of EWS for natural disasters/hazards in Abu Dhabi.

This assumption then emphasizes the importance of the next question.

D. Response Capability

This section presents questions which relates to the theme of response capability.

Q6: Do you have a process for assessing the response capability through feedback or other means so that you can learn from your ability to respond to natural hazards?

The pattern of responses from S1, S2, S3, S5, S6, S7, and S8 shows that there are feedback processes for response capability. Although the feedback process vary from joint participation with other organisations involved in response, learning direct lessons from incidents after they have occurred, to procedures by NCEMA to review disaster response and use of software to transfer knowledge of lessons learnt. Despite this, S4 claimed that Abu Dhabi is yet to experience any disaster, but lessons have been learnt from incidents such as incident in Kalba. While the answers from S4 seem to contradict the reply from others claiming that they access response capability, it can be inferred that both are current. This is because by the definition of disaster, S4 is correct to say the natural hazards experienced so far in the UAE are not disasters, but emergencies. So this variation of answers to this question is more about the meanings and interpretations of the word "disaster" in the UAE. However, the next question was asked in order to understand the assessment process for response capability put in place for dealing with any emergency, disaster or crisis as used in the UAE.

Q7: Does your institution hold emergency exercise for preparation and to test EWS in case of an emergency in the community?

The interviewees provided information which indicates that exercise is carried out by some organisations for EWS, while others do not do any form of exercise for EWS. For example,S1, S2, and S5 explained that, they partner with other organisations to carry out EWS exercise. S6, and S8 states that they conduct exercise for evacuation internally for their employees and in their organisations, but not for EWS. This answer is similar to that provided by S3, and S4 who all said they never exercise for early warning. While S8 said they are responsible for only one section of the society in terms of exercise, S7 explained that their duties and responsibilities for exercise are to prepare for disasters plans and procedures and oversee training and exercise. All these answers indicate good knowledge about what each organisation is doing, what their responsibilities are, but also expose the lack of assessment of response capability for EWS and exercise to test any form of warning system in place in Abu Dhabi.

This answers show that the fourth main element of EWS which is response capability and assessment of capability for EWS is missing. This also shows that while "Principles 1, 3, 4 and evidence of Principle 7" are evident in the EWS in Abu Dhabi, other principles which emphasise best practice in deploying EWS in Abu Dhabi are missing. Therefore, the implication of this answers means that the gaps identified in chapter two were true and valid, and that essential elements like monitoring, warning and forecasting as well as response capability are completely lacking. While part of communication and dissemination and risk knowledge are insufficient in Abu Dhabi. The emirates of Fujairah will also be subjected to similar process to identify and confirm the status of EWS in Fujairah.

5.4 Case study 2: Fujairah

Fujairah is located along the Arabian Gulf and Indian Ocean (see Figure 5-3) which makes the emirates vulnerable to the impact of severe natural hazards. The history and impacts of natural disasters such as the Al Qurayah flood of 1995, the Masafi earthquake of 2002, the Al Tawaian landslide of 2005, the Tropical Gonu storm of 2007 and the Sharm flood in 2009 (Dhanhani, 2010) to mention a few continue to impact development activities in the Emirates.

Figure 5- 3: The map shows Emirate of Fujairah location (Dhanhani, 2010)

Despite the frequency and impacts of hazards, there are no documented evidence of EWS, and the impact of EWS deployment. However, case study of one of the past disasters is evaluated to determine the deployment, requirements for community and stakeholders and the problems that plague the system.

5.4.1 Evaluation of EWS during past incidents

As seen in Figure 5-3, the location of Fujairah Emirates makes it vulnerable to the impact of natural hazards. For example, one of the worst cyclones to hit Fujairah was Cyclone Phet which occurred early morning on 4th June 2010. The Cyclone hit Sharm village in Dibba Fujairah.Tropical Cyclone Phet is the second strongest tropical cyclone ever recorded in the Arabian Sea (Haggag and Badry, 2011). The cyclone's heavy rainfall triggered flash floods causing enormous damage to the infrastructure in Sharm town. Cyclone Phet created serious problems as people lost their land, their crops and their boats. Around 30 houses, 2 mosques and 10 farms, and more than 10 cars were damaged (Dhanhani, 2010). The cyclone affected more than 50 families in different parts of Sharm (see Figure 5-4) as the resultant high waves of the Indian Ocean caused flooding in the city of Sharm.

Figure 5- 4: The pictures show the Phet storm, which hit the town of Sharm and caused considerable material damage (Haggag and Badry, 2011)

According to Haggag and Badry (2011), during Cyclone Phet, there were problems due to the lack of hazard warning for the community of Sharm, and there being no clear mechanism for disseminating warning in Fujairah. As result of this, community members did not know how to react to hazard. Some turned to the streets and the others remained in their houses. The lack of coordination between the authorities and the lack of clarity of responsibilities and roles to warn the community was evident (Dhanhani, 2010). Therefore, this case study has emphasized the need to investigate the weakness and implication of EWS in the Emirate of Fujairah.

Using the scenario of real disasters in Fujairah, it is established that the rationale for this research is justified and the importance of the objectives have also been emphasized. Thus, interviews are used to examine the weakness and lack of best practice in the EWS in the emirates of Fujairah. These data collection tools are also used specifically "to evaluate the EWS requirements for

community and stakeholders in the UAE" which is the second objective of this research. To do this, the researcher conducted 4 semi-structured interviews with persons at strategic level of responsibilities (refer to Table 5-2 for details and codes of interviewees), while the next section presents the results from these semi-structured interview sessions.

5.4.2 Qualitative Data from Fujairah

The importance of the semi-structure interview is key to understanding the current situation of EWS in the Emirates of Fujairah. The semi-structured interviews were conducted with strategic personnel involved in the management of natural disasters in the Emirates of Fujairah. Each interviewee has been given the code "S" in addition to a numeric serial number. The coding and description is outlined in Table 5-2.

Table 5- 2: Profile of interviewees in Fujairah

The Government Organization	Current Job Title	Emirates	Code
Federal Electricity and water Authority	Senior staff	Fujairah	S9
Fujairah Civil Defense	Senior staff	Fujairah	S10
Fujairah Municipality	Senior staff	Fujairah	S11
Ministry of Education	Head of Emergency and Safety	Fujairah	S12

Using these codes and profile, the qualitative data derived from the interview sessions in a systematic way are presented below using the themes identified in Chapter two.

A. Risk Knowledge

Regarding risk knowledge the question asked was;

Q1:*Does any Early Warning System (a system to give an alert before and event starts based on certain indicators) for natural disasters such as local storm, tropical cyclone, flood, earthquakes and landslides) exist in the UAE*?

To answer this question, S9 and S11 both responded that, there are EWS available in Fujairah. However, S10 and S12 said; work was in progress and there was no early warning in place at all respectively. This divided answer suggests that it is possible that EWS exists, while it is also possible that it does not exist in sufficient or quality manner. This divided views encouraged a further probe into the answers provided, and it was realised that the description of EWS, especially for risk knowledge is actually dissemination of information according to the EWS principles evaluated in chapter two. The description of early warning risk knowledge and system by the interviewees was limited to dissemination of information through television, radios, phones, siren, alarm and the use of operation centers to communicate preventive measures. Based on this review carried out in chapter two, these are dissemination and communication methods which are not risk knowledge patterning to EWS.

However, the next question was asked in order to better understand the roles and responsibilities for EWS.

Q2: Can you explain your roles and responsibilities with respect to EWS?

All interviewees explained the roles and responsibilities for early warning in the way they understood it to be operational in Fujairah. However, it was observed that the roles and responsibilities as explained varied even in the same emirates. For example, S11 and S12 pointed out that their responsibility lies in monitoring the natural hazard and warning the other authorities. Other roles as explained by these interviewees included delivering information to specified people or organization, disseminating the warning information through the news, providing logistics for evacuation, heavy equipment etc. However, S9 and S10 used the opportunity to explain and clarify the functionality of roles and responsibilities for crisis and disasters in the UAE. They explained that roles and responsibilities for warning can either be local authority or federal authority depending on where the disaster occurred. The local authority or federal authority then communicate the warning to the appropriate organization usually the civil defense who can then disseminate the information to the public directly or through the

media. It was noticed that both S9 and S10 only explained the requirements for EWS deployment, but not their roles and responsibility in the deployment process.

Therefore, it can be inferred from these answers that while the interviews understand and are clear about the roles and responsibilities of organisations and authorities, the continued impacts of past disasters in the Fujairah indicate that the deployment of EWS is insufficient and ineffective. Perhaps this can be as a result of inadequate resources, which made the next question important.

Q3: What is the resource adequacy to reduce risk from natural hazards?

The interviewees confirmed that generally, resources are available in various authorities especially S10 and S11 who were very clear on the issue of resource. However, S12 explained that they have lack of human and technical staffs, while S9 answered by saying; "I don't know". These patterns of answers both indicate uncertainty about resources as well as limited resources. While it is uncertain which is the case, it can be argued that the resources are either not well used for EWS for those who have them or not effective to the extent of reducing the impact of disasters in the community.

B. Monitoring, warning and Forecasting

Question in this section relates to the second theme which is monitoring and forecasting.

Q4: Do you have any support (financial or otherwise) from the government to monitor, warn and forecast for EWS?

It can be observed from the answers provided by the interviewees that while S10 claim to receive support from the government, S9, S11 and S12 claim there is no government support for their organisation or authority for EWS. It also emphasised in Fujairah, as in Abu Dhabi, that only the Civil Defence receive government support and resources for improving risk knowledge, monitoring, warning and forecasting of EWS

It was however noticed that the sources and reference to words relating to the theme; "Monitoring and Warning" focuses more on words such as "coordination", "participate". These are the words which recurred and were used by the interviewees to emphasise how they function as organisation and authorities responsible for crisis, emergency and disaster management, but with minimal or no support or resources to carry out effective EWS. This potential problem of operational capacity for EWS stirred interests in understanding how dissemination and communication is carried out in a vulnerable community with limited resources and support, which makes the next question important.

C. Dissemination and Communication

This section examines data collected which relates to the theme of dissemination and communication.

Q5: Do you release or receive the warning messages?

With regards to receiving and sending warning messages, S10 and S11 all claim they receive or/and send warning messages. Although S9 and S12 said they do not launch warning messages, it means that similar to the information provided by interviewees in Abu Dhabi, it is similar organisations also responsible for disseminating EWS in Fujairah. It also means that the dissemination does not utilise specific communication model as explained in chapter two, hence the lack of effectiveness in communicating and disseminating EWS.

This assumption is verified by asking questions relating to response capability in the emirates of Fujairah.

D. Response Capability

This section presents questions which relates to response capability theme.

Q6: Do you have a process for assessing the response capability through feedback or other means so that you can learn from your ability to respond to natural hazards?

The answers provided by S8, S9, S10 and S12 shows that there are feedback processes for response capability. Although the feedback process vary from joint participation with other organisations involved in response, learning direct lessons from incidents after they have occurred, to procedures provided by NCEMA at federal level to review disaster response. Despite this arrangement for getting feedback on EWS response capability, S11 claimed that Fujairah is yet to experience any disaster, but lessons have been learnt from past incidents. While S11 might seem correct based on the definition of disasters, the impacts of series of natural hazards in Fujairah shows otherwise. Due to this evidence of lack of EWS, the next question was asked as key to understanding response capability and to determine the assessment process for measuring how EWS to emergency, disaster or crisis in Fujairah are determined.

Q7: Does your institution hold emergency exercise for preparation and to test EWS in case of an emergency in the community?

The interviewees provided information which indicates that exercise is carried out by some organisations for EWS, while others do not do any form of exercise for EWS. For example,S10 and S11 explained their organisations partner with other organisations to carry out EWS exercise. S9 states that they conduct exercise for evacuation internally for their employees and in their organisations, but not for EWS, but S12 emphasised that, they never exercise for early warning. All these answers indicate good knowledge about what each organisation is doing, what their responsibilities are, but also indicate the insufficient level of EWS exercise and response capability in Fujairah despite the frequency of natural hazards.

Therefore the answers provided by interviewees during this interviews shows that essential elements of EWS is limited Fujairah even though natural disasters occur there frequently and past ones have had severe impacts. It shows that risk knowledge is limited, monitoring and warning is insufficient while response capability and dissemination and communication is almost non-existence. This emphasises the gaps identified in the literature review, and further shows that there is lack of most of the best practice principles for EWS in Fujairah; a natural hazard

prone emirates. Based on the answers provided by interviewees in Abu Dhabi and Fujairah, the next section analyses and compares the results.

5.5 Analysis of Qualitative Results from Abu Dhabi and Fujairah

This section analyses the results from both Abu Dhabi and Fujairah to determine the main gaps in the two emirates, in order to determine the framework which will be effective in each emirates. This section specifically examine and compares the replies to specific questions in the two emirates relating to risk knowledge, monitoring and warning, dissemination and communication, response capability and community/stakeholder involvement.

A. Risk knowledge, monitoring and warning

Q8:Are hazards, vulnerabilities and risks monitored on an ongoing basis?

The answers provided by the interviewees in the two emirates to this question, further stresses the point that the EWS principles and best practice were missing. For example, none of the interviewees in Abu Dhabi and Fujairah actually answered the question clearly by stating that hazards, vulnerabilities and risks are all monitored on an ongoing basis. The emphasis in this question is on the underlined words which none of the interviewees addressed. While S1, S2, S3,S4, S5, S6, S7, S9 and S10 all claimed risk are monitored and that there is risk register, none emphasized the monitoring of vulnerabilities and hazards as well as risks on an ongoing basis. Documenting risks does not actually mean monitoring is done on an ongoing basis. Amidst this, S8, S11 and S12 actually said there is no risk assessment record, and failed to also mention anything about vulnerabilities and hazards. This pattern of answer shows a major problem with the element of risk knowledge, monitoring of hazards, and warning in the two emirates. However, the next question was asked in an attempt to identify what the roles of the organisation are in terms of EWS if risk knowledge, monitoring and warning are all lacking.

B. Dissemination and communication

Q9: In your opinion, what is the best media or medium to use to deliver early warning to the community?

The response to this question is illustrated by using a chart (Figure 5-5) to show the pattern of responses and the types of mediums the interviewees selected as best and most appropriate for disseminating early warning information.

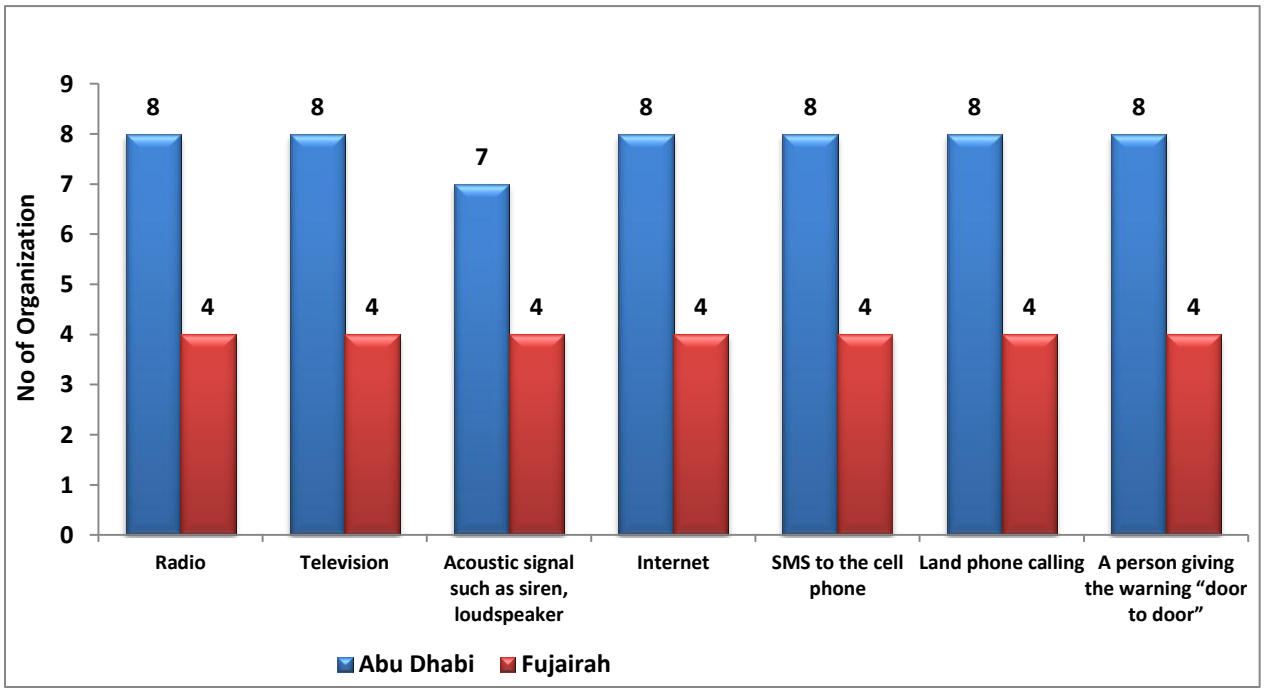

Figure 5- 5: Kinds of the media used for Warning Dissemination for the community at risk

It can be seen that all the interviewees indicated that all mediums are best for communicating EWS, except for one interviewee who said SMS was more important. This accounts for the less number in acoustic signal such as siren and loudspeaker, which is because SMS will allow the message to be sent in different languages instead of one language through loudspeakers. In addition to this, each of S1, S3, S4, S5 and S11 added that it is important to use social media such as Face book, Twitter and Instagram to disseminate early warning to the community since

all these social media have many users in the two Emirates. Furthermore, S2 and S6 emphasized that using social media will also be beneficial if it is disseminated in different languages since the two emirates and UAE as a whole is a multiple nationality and languages.

C. Response Capability

Q10: What type of information on natural hazards do you think is needed the most to respond appropriately after receiving EWS?

All interviewees answered this question by stating that maps, statistics and reports are all used to combine risk information about natural hazards. The information in this format and through these mediums is considered as types of information needed. Figure 5-6 shows the responses from the interviewees.

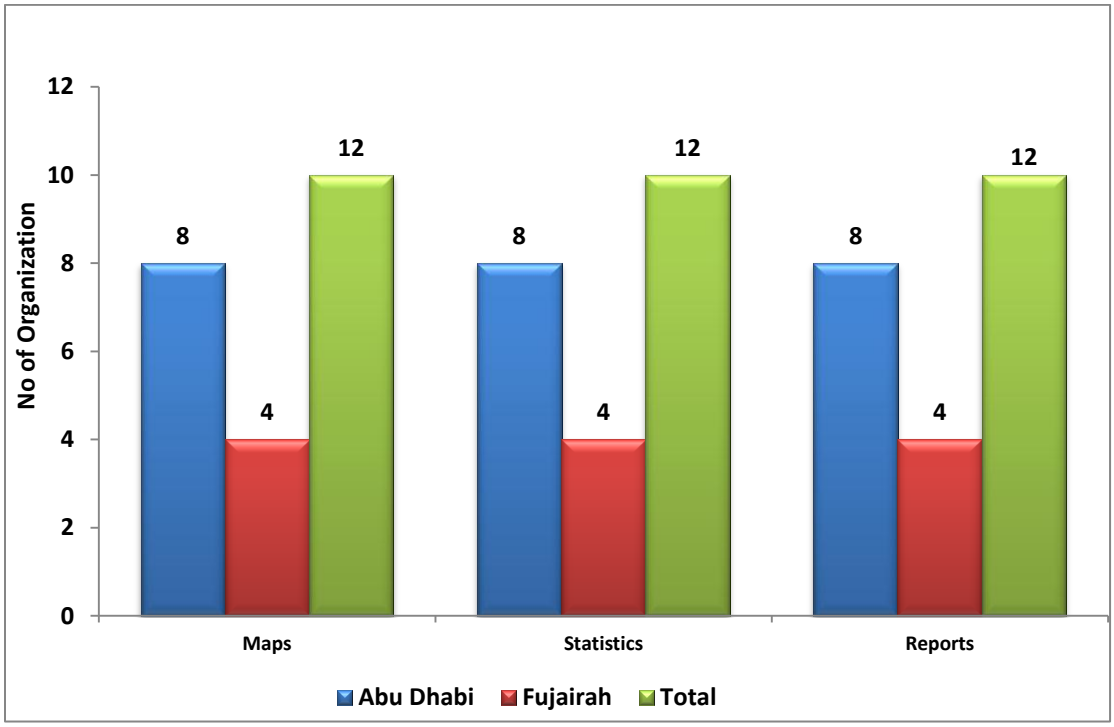

Figure 5- 6: The most information needed for response to natural hazards

In addition to this, S1 added that aerial photographs and radar are needed to monitor weather conditions which can help for both the preparedness phase of EWS and EWS during the occurrence of any natural hazard. Although these responses are commendable, the next question was asked in order to confirm the level of commitment to this research themes and principles of EWS.

D. Community/Stakeholder involvement

Q11: In the present, can people in the community obtain information about natural risks and hazards from your organization?

It is evident from the responses provided by the interviewees that NCEMA, Civil Defense, Media and Meteorology department are all responsible for providing information about natural disasters. However, all interviewees who answered in the affirmative only mentioned that information is provided to the people, but did not state how and if the people can actually obtain information about natural risks and hazards. Therefore it means that the people in the community are unable to obtain information if disasters do not occur and if the organisations responsible for disseminating hazard information to organisations and people. Furthermore, this shows that natural hazard communication and information is only one way which is; "from the issuing or response organisations/authorities to the public".

This main section has presented the data from the interview sessions which were conducted with organisations/authorities responsible and involved in supporting capacity for preparedness and response to emergency, crisis and disaster in the UAE. It has also shown different results and pattern of responses in each emirate by identifying the gaps in each emirate, while also comparing the similarities between answers provided by interviewees in the two emirates. However, the summary of themes derived from the literature and from the interviewees' responses was further analysed using Nvivo software is represented in Figure 5-7.

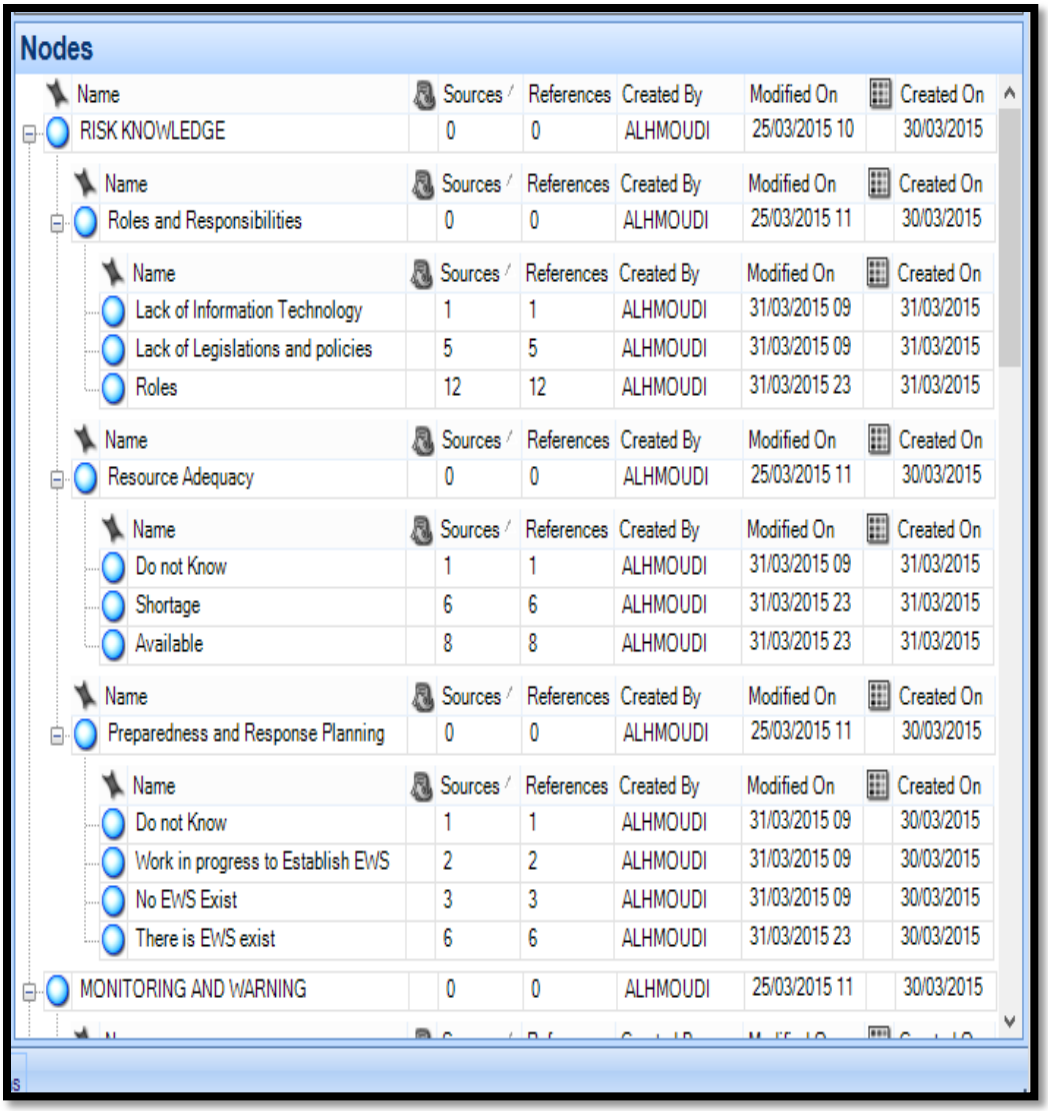

Figure 5- 7: Nvivo analysis of themes and interviewee responses

The Nvivo summary shows that some themes such as risk knowledge, roles and responsibilities, resource adequacy, preparedness and response planning, monitoring and warning did not have any reference and sources for them in the interviewee sessions. However, there were references or sources or both for words like lack of information technology, lack of legislations and policies, roles, do not know, shortage, available, work in progress to establish EWS, no EWS exist and there is EWS exist. Although words like “there is EWS exist”, “available”, “shortage”, “roles”, and “lack of legislations and policies”, are all words which occurred more than 5 times, it can be seen that words which are in the negative are equal to words which are in the

affirmative. This observation shows that the frequency of words are for negative and positive used in the interview sessions are equal indicating that the current practice is neither good nor bad. Regardless of the use of words, it is evident from the interpretation of interviewee data that there are gaps in the practice and deployment of EWS in the Abu Dhabi and Fujairah emirates. While some gaps and limitations in the system have been identified through the presentation and analysis of these results, the next section focuses on the result of the questionnaire.

5.6 Questionnaire Results

This section uses the research themes to further investigate the existing deployment of EWS in the UAE from the community perspective as well as evaluate the EWS requirements for community and stakeholders in the UAE.

5.6.1 The Total Response Rate

Although, the sample size for this phase of the data collection is (section 4.6.6), this phase has got 1080 responses from two emirates Abu Dhabi and Fujairah in the UAE. To calculate the total response rate for this phase , the researcher has used a formula from Saunders et al., book (2012). The total response rate is (100 %) see table (5-3).

Table 5- 3: Active Response Rate (Saunders et al., 2012).

Formula

$$\text{Active Response Rate} = \frac{\text{Total Number of Responses}}{\text{Total Number of Sample \_ (ineligible)}}$$

Result

$$\text{Active Response Rate} = \frac{1080}{1065-(0)} = 100\%$$

Charts and graphs are used to illustrate the pattern of responses provided by the questionnaire participants because of the large numbers of participants.

A. Risk Knowledge

The first question asked in relation to risk knowledge from the community was:

Q1: How concerns do you feel when you think about natural hazards in your community?

Everyone answered this question by emphasising which hazard they are more concerned about. Fig (5-8) shows the way everyone responded and which hazard each Emirate considered as dangerous.

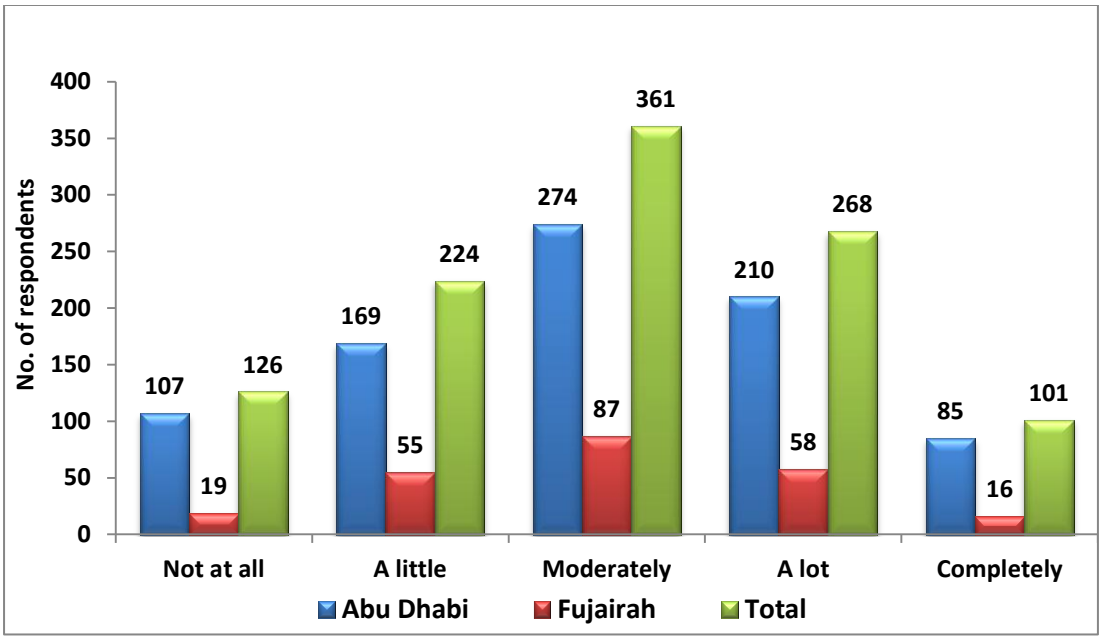

Figure 5- 8: Level of concern about natural hazards in AD and Fujairah

This pattern of answer shows that people in the two Emirates are moderately concerned about natural hazards in general since a total of 361 which is the highest claim to be moderately concerned as individuals. However, the second question shows the reason for this moderate concern about natural hazards.

Q2: Have you or family ever experienced the effects of natural hazards?

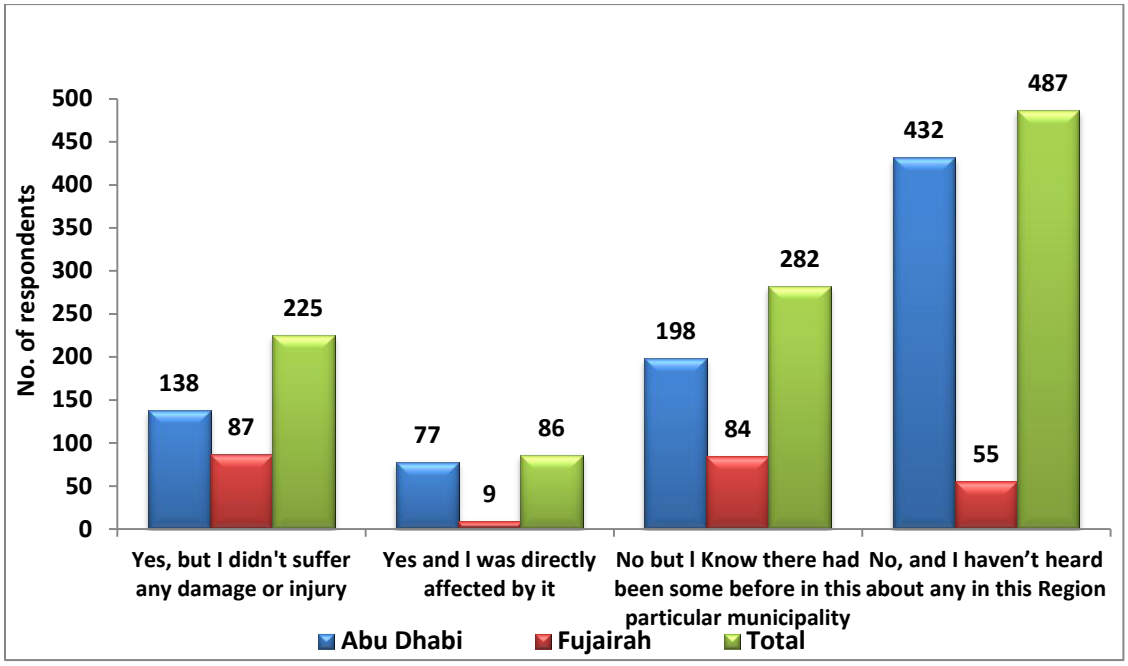

Figure 5- 9: Numbers of people who have experienced the effects of natural hazards

In response to this question, it can be seen that more people claimed they are yet to hear about natural hazard in their region. This means they might be moderately concerned about the effects of natural hazards which is probably the reason more people answered that they were moderately concerned in question 1. Regardless, it can be observed that a grand total of 507 are aware of that natural hazards have occurred before in their region even though they did not suffer any damage of injury from the impact of the hazard. This number is more than the people who claim to be unaware of any natural in their region, showing the widespread knowledge of the impact of natural hazards in the two emirates. Therefore, the next question was asked to confirm which of the natural hazards is considered most dangerous in order to determine the risk knowledge and perception which is one of the themes identified in the course of this research.

Q3: How dangerous do you think the following hazards are in your region?

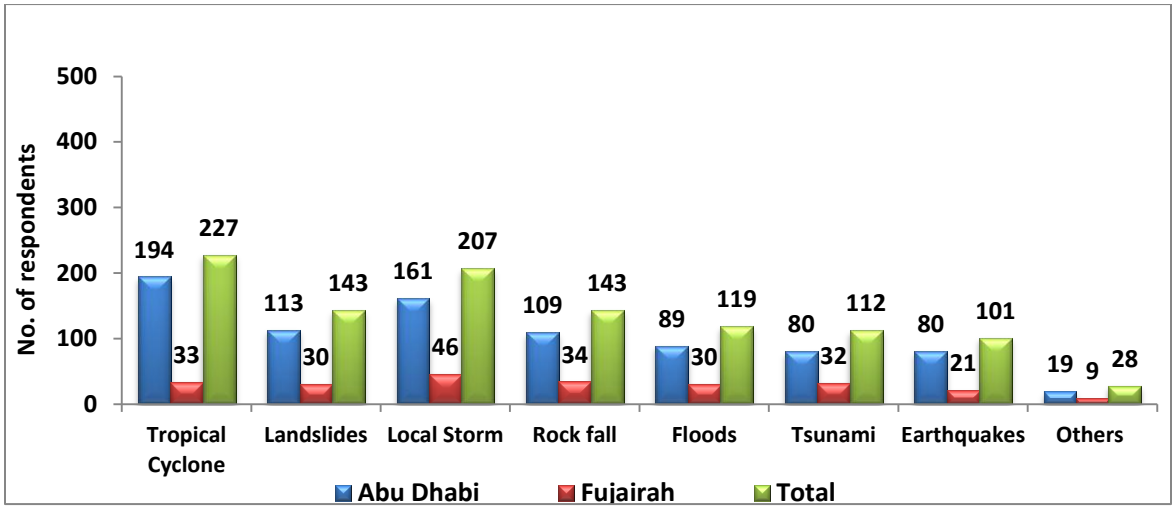

Figure 5- 10: Hazard considered by community as most dangerous

In response to this question, Tropical cyclone and local storm were generally considered as more dangerous than other hazards. The selection of these hazards might be due to past incidents which have occurred in the two emirates. However, this is not to say other hazards are not dangerous, but it means that these hazards might be prioritised as high risks once a proper risk assessment is conducted. Question four was asked to determine the impact of previous hazards in influencing risk knowledge and perception of the community.

Q4: which of the previous hazard scare you the most?

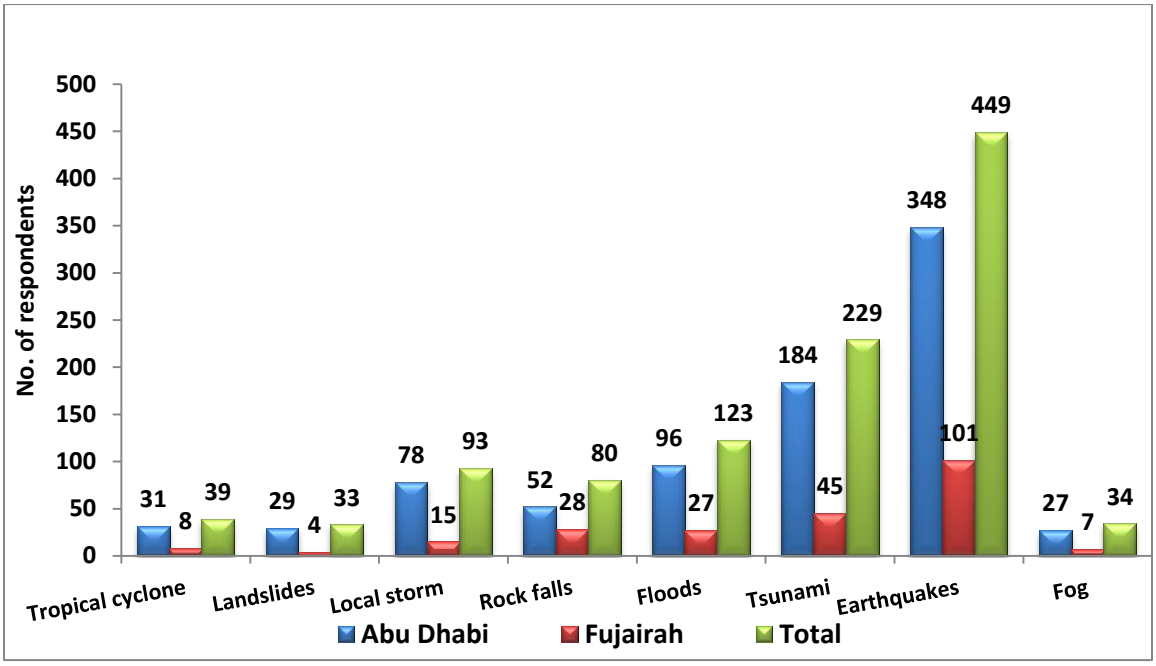

Figure 5- 11: The scariest hazards

While the respondents considered tropical cyclone as dangerous, they indicated as shown in fig. (5-11) that earthquakes are most scary for them. This might be due to the drastic nature of earthquakes or level of knowledge about the hazard.

Q5: How likely do you think climate change can influence the frequency and magnitude of hazards?

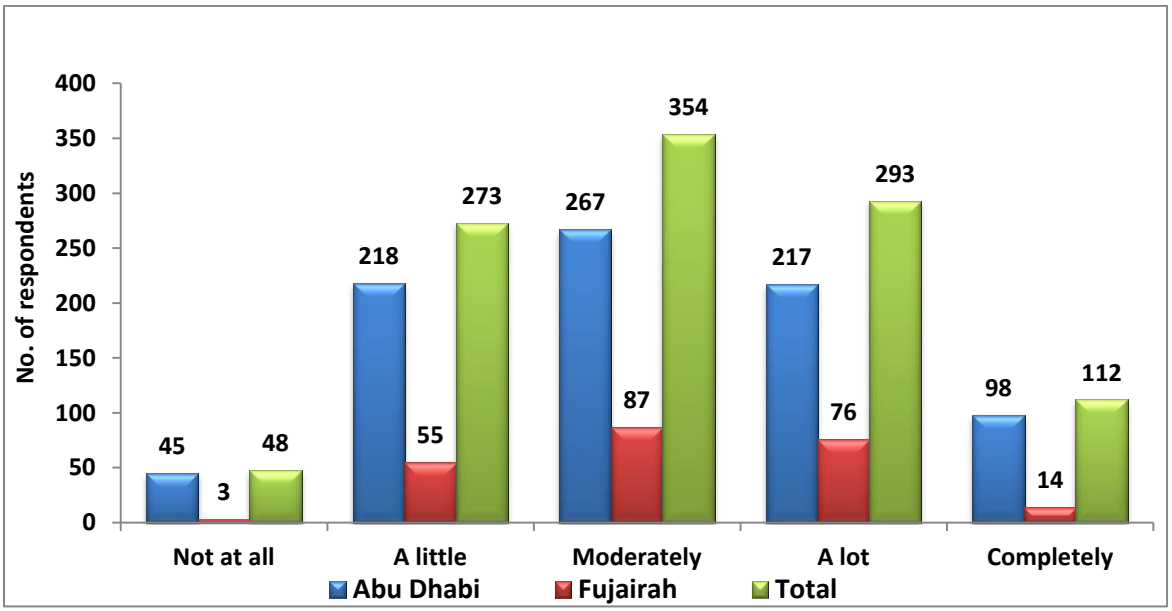

Figure 5- 12: Level of impact of Climate change

It can be observed that the risk knowledge is only relative because while a total of 293 consider impact of climate change to be a lot, 354 consider it to have a moderate impact. However, it can be noticed that the grand total number of people who believe climate change have impact are more than those who think it has no impact at all. Therefore it can be inferred that the risk knowledge and perception of the community is quite high. Which leads to the next question about what people do in order to translate the risk knowledge to preparedness and EWS for action in case of any emergency or disaster.

Q6: How often do you use weather forecast?

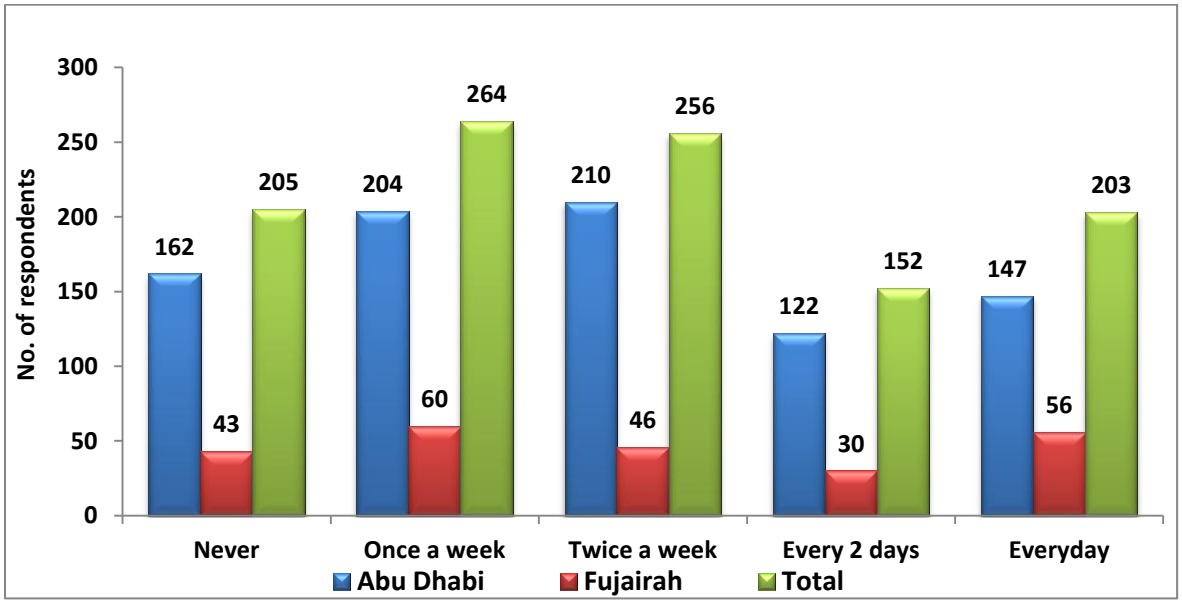

Figure 5- 13: Frequency of use of weather forecast

Fig (5-13) shows that people in both Abu Dhabi and Fujairah have the culture of using weather forecast regularly. Although a total of 203 use weather forecast every day, a total of 205 also claim they never use it, while 264 uses it once a week and 256 use it twice a week. However, the most important thing is what people do with information they get and not just having the information. Therefore the next question is important to understand the actions people take or will take when they get warning about hazards.

Q7: after receiving warning, how do you respond to warning, do you still stay at home to save your properties?

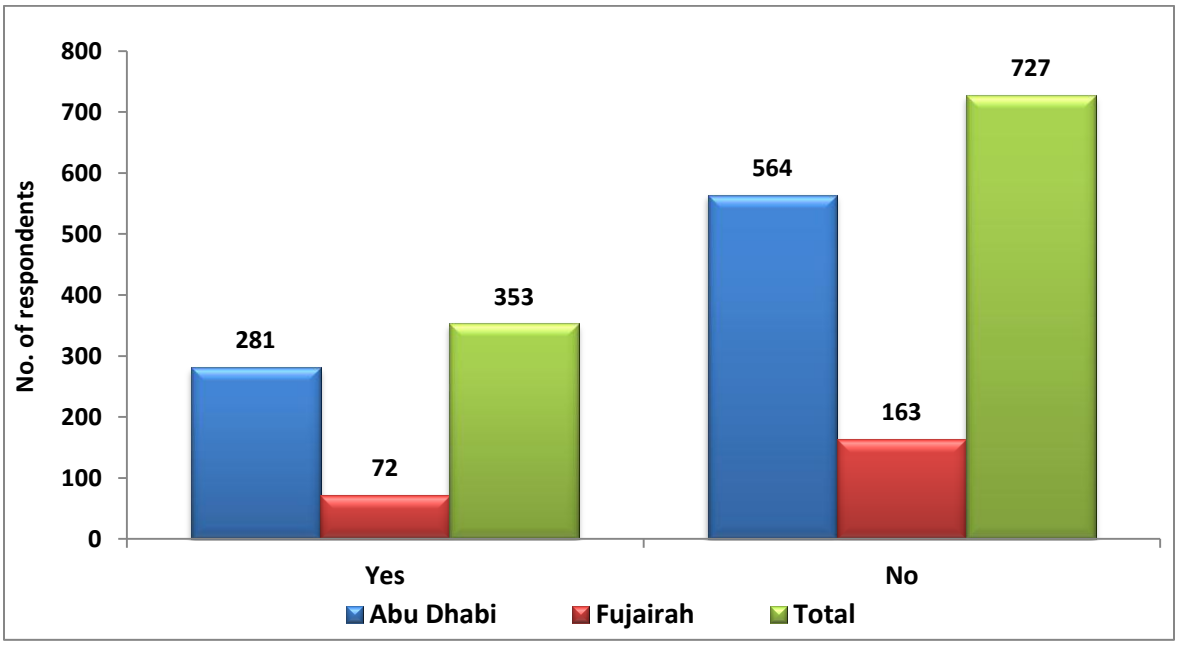

Figure 5- 14: Actions taken after receiving warning information

A total of 727 said no to, staying behind to save their properties, but 353 said yes. This means that for this much people to say "Yes" the level of risk knowledge and potential impact of hazard on their lives is low. Or it is possible that they lack understanding of how risk of natural hazard can impact them and their family or unaware of emergency procedures. This makes question 8 important in order to understand what the actual reason is.

Q8: Do you know the emergency procedures for your emirates in case there is any disaster?

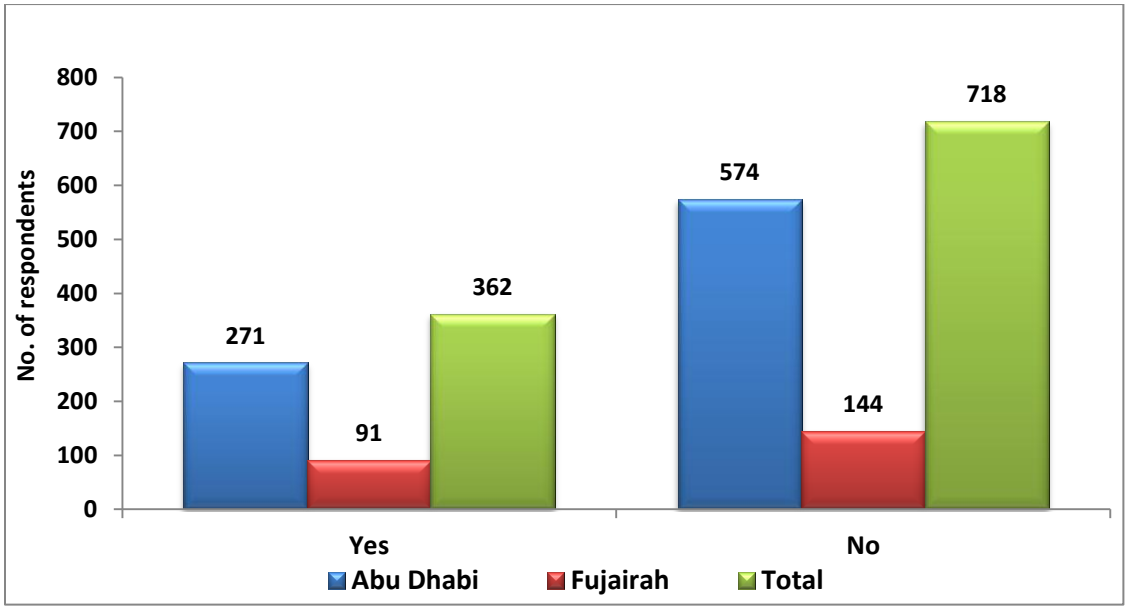

Figure 5- 15: Knowledge of emergency procedures

The answer in Fig (5-15) Shows that majority do not know the emergency procedures in their Emirates. While this is the case, the next question was asked to determine if people attempt to participate or get information through civic activities.

Q9: Have you or anyone in your family participated in civic protection exercise, volunteered for the civil defense of any emergency community groups before?

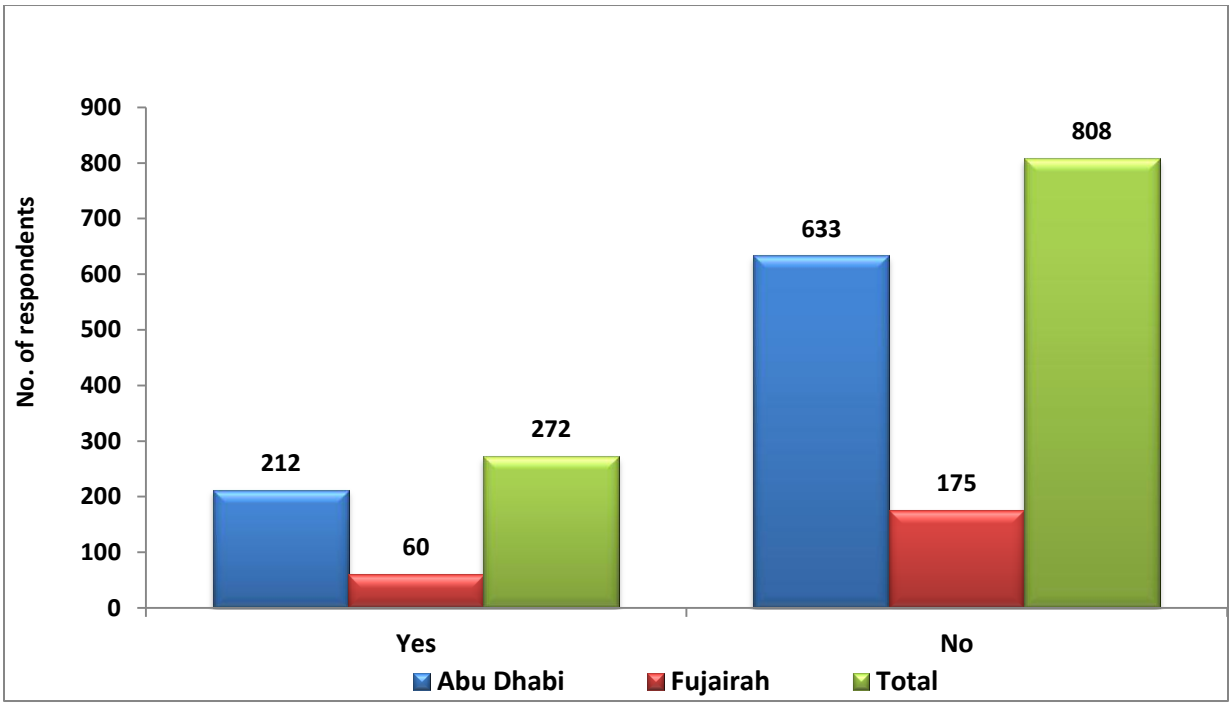

Figure 5- 16: Participation in civic activities

The answers to this question also show that the level of civic participation in emergency procedure activities are low compared to the level of risk knowledge exhibited by the community. But it is important to know if this low of participation is due to lack of information about such activities or lack of interest. This need motivated question 10.

Q10: Would you like to attend any public meetings or forums for your region which informs the community about natural hazards and emergency procedures?

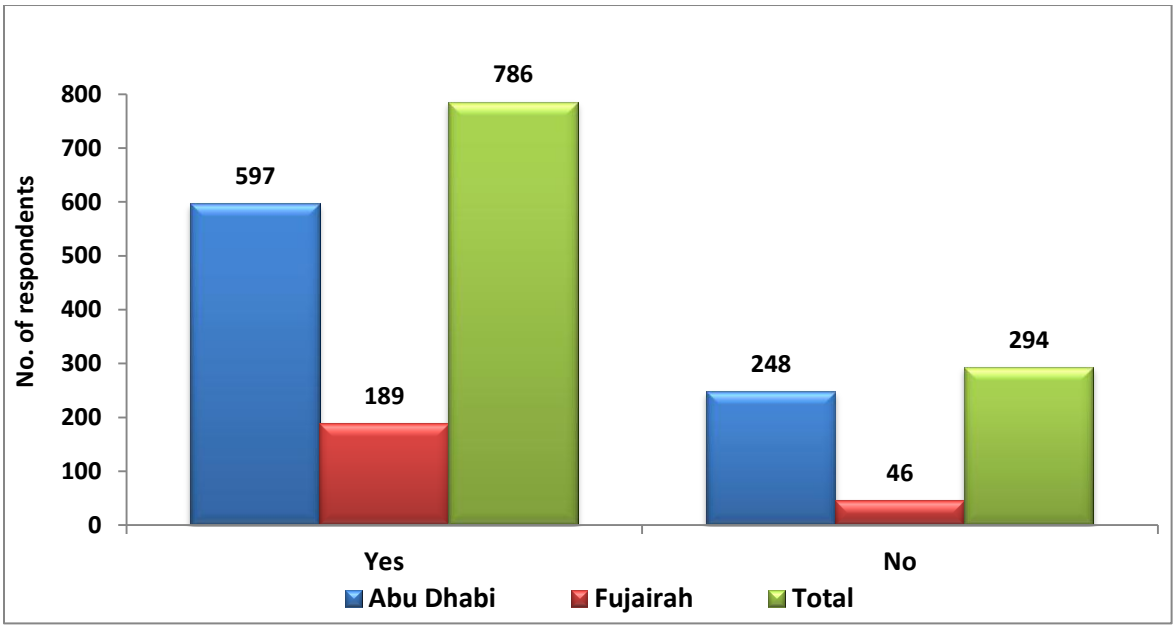

Figure 5- 17: Community interests in participating in emergency procedure exercise

The answer to this question shows that there is interests form the community to be involved which means that the government through the emergency organisations and departments should engage the community more to teach emergency procedures at community levels. The next question shows how important such education and community teaching opportunity is to people in the community.

Q11: How important do you think an educational public meeting about natural hazards would be for your region?

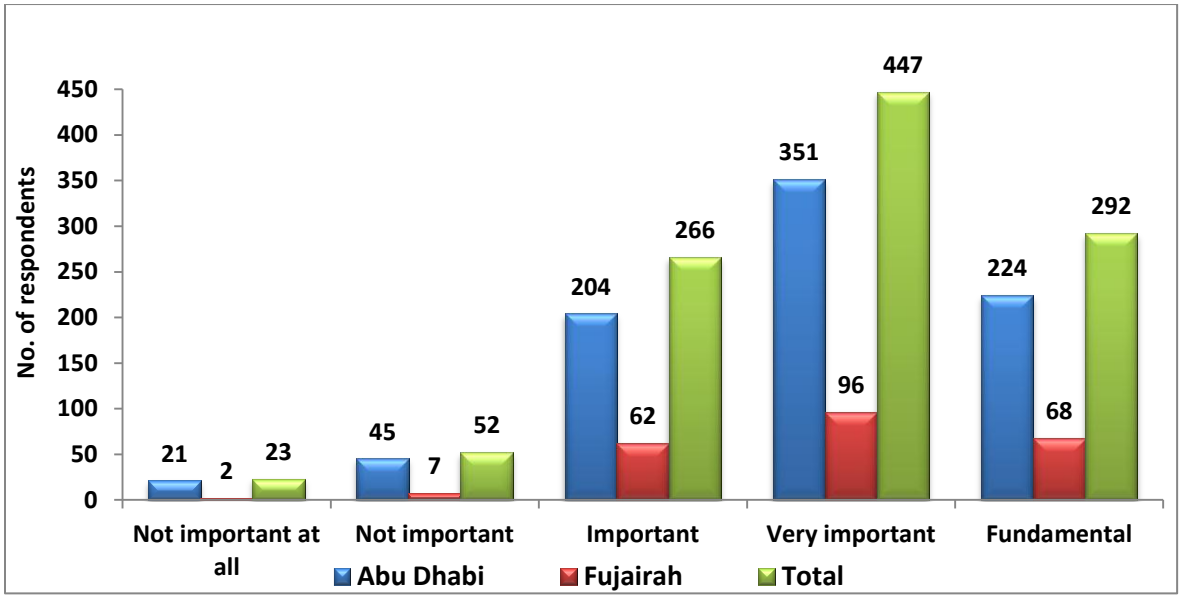

Figure 5- 18: Importance of public education meeting about natural hazards

The pattern of responses from all questionnaire respondents shows the importance of safety education and public meetings about natural hazards to the people. Therefore, it is important to determine the roles and responsibilities of communities and government in ensuring effective EWS and principles of EWS. To determine this next question is asked to confirm who the community thinks should be responsible for EWS.

Q12: Who do you think should be responsible for issuing early warning for natural hazards?

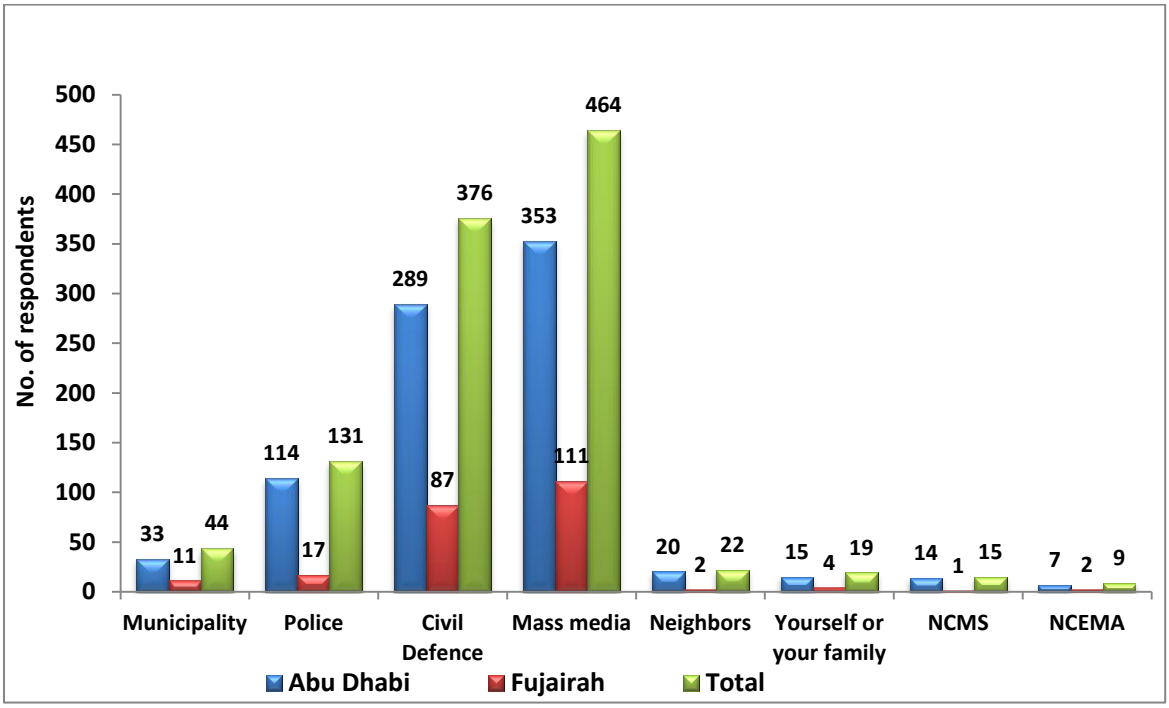

Figure 5- 19: Roles and Responsibilities for EWS

It can be seen in Fig. (5-19) that most people think the media and civil defense should be responsible for EWS. Based on the current legal arrangement in the UAE, NCEMA and the Civil defense are responsible for EWS especially to prepare the public for what to do when any emergency eventually occur.

B. Monitoring and Forecasting

This section addresses issues that relate to monitoring and forecasting theme. The only question in this section is asked to identify what is most important to the community.

Q13: What is more important to you; early warning/accurate forecasting or both?

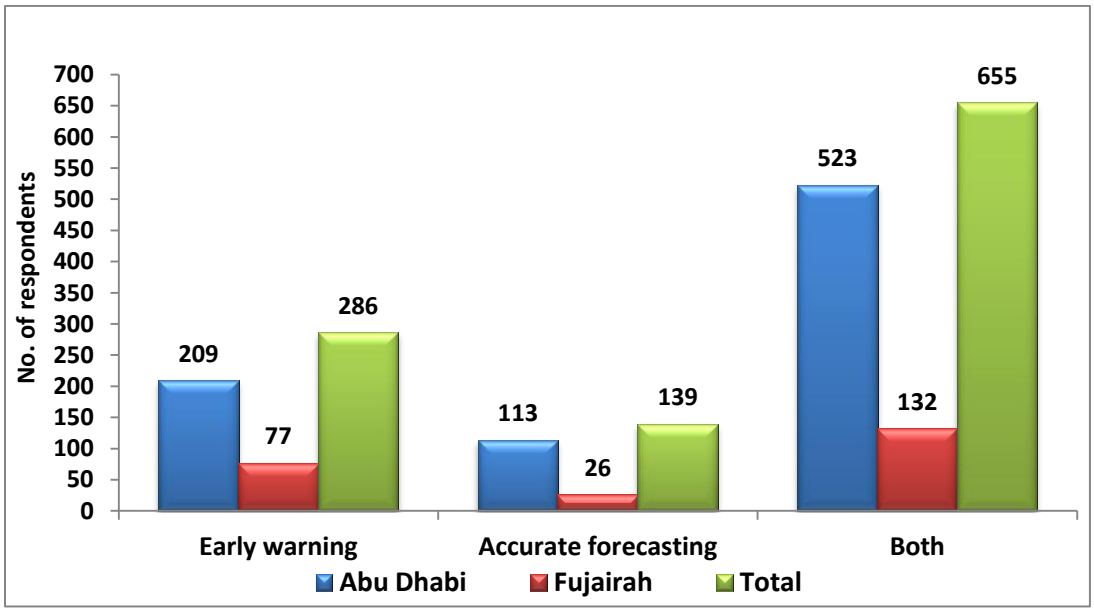

Figure 5- 20: Importance of early warning and accurate forecasting

According to Fig (5-20), many of the respondents believe both early warning and accurate forecasting are important.

C. Dissemination and Communication

This section addresses the next research theme which aims to understand principles of EWS in relation to dissemination and communication from the perspective of the community.

Q14: Have you ever received early warning messages prior to the occurrence of a natural hazard in your area?

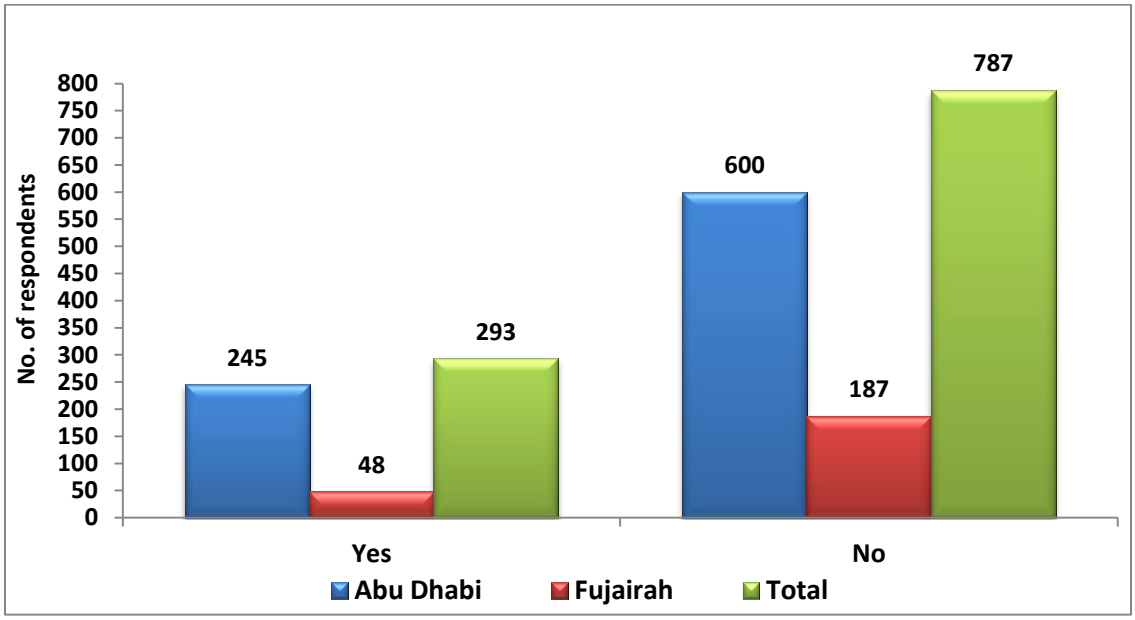

Figure 5- 21: Receipt of early warning messages

The reply to this question shows that majority have not been receiving early warning messages in the community despite the comments from government organisations who were interviewed in this research. This shows that there is a gap between the information disseminated by the organisations and ability of the community to receive the message. Or maybe the communities do not consider the messages being sent by emergency organisations as early warning messages.

Q15: How would you like to receive the information about natural hazards?

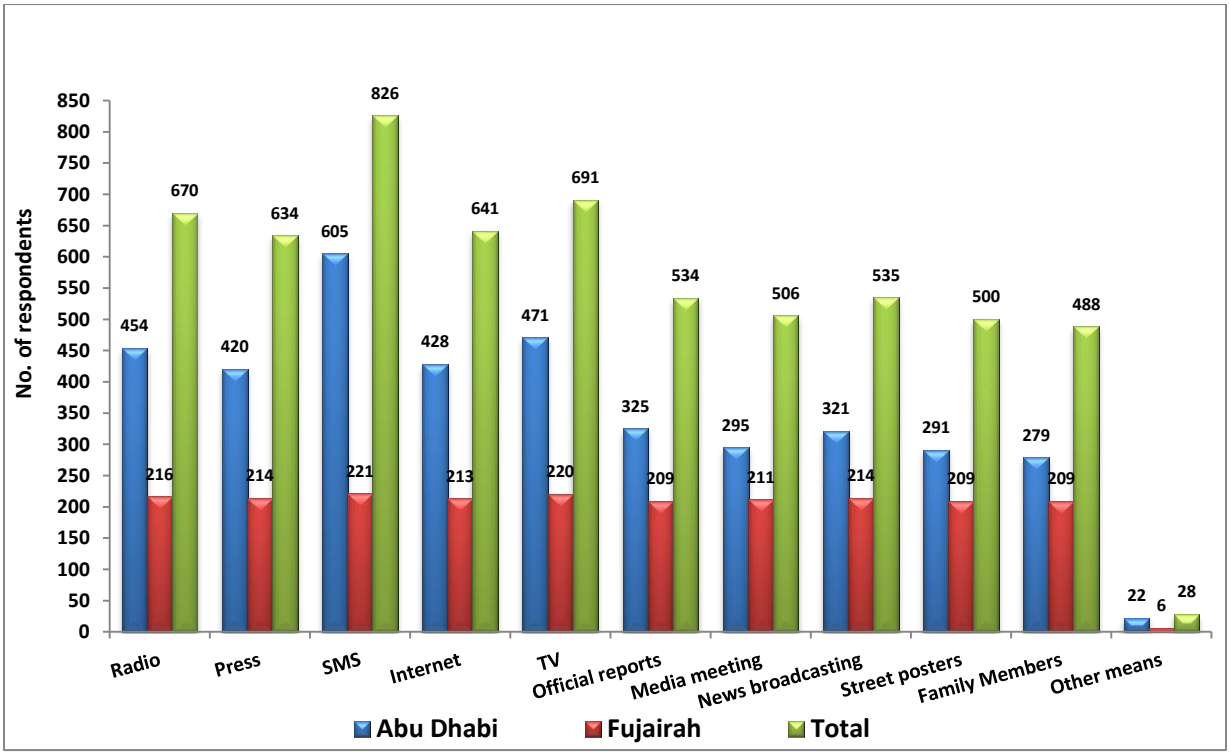

Figure 5- 22: Preferred medium for early warning messages

This answer indicate that the people will prefer to receive messages through SMS, TV, radio, internet, press, and other mediums shown in Fig. (5-22). All the mediums mentioned in this Figure are all convenient mediums which people can use or have access to.

Q16: Do you think a web-based warning and forecasting system could be helpful in delivering warning and forecasting warning to reach more people?

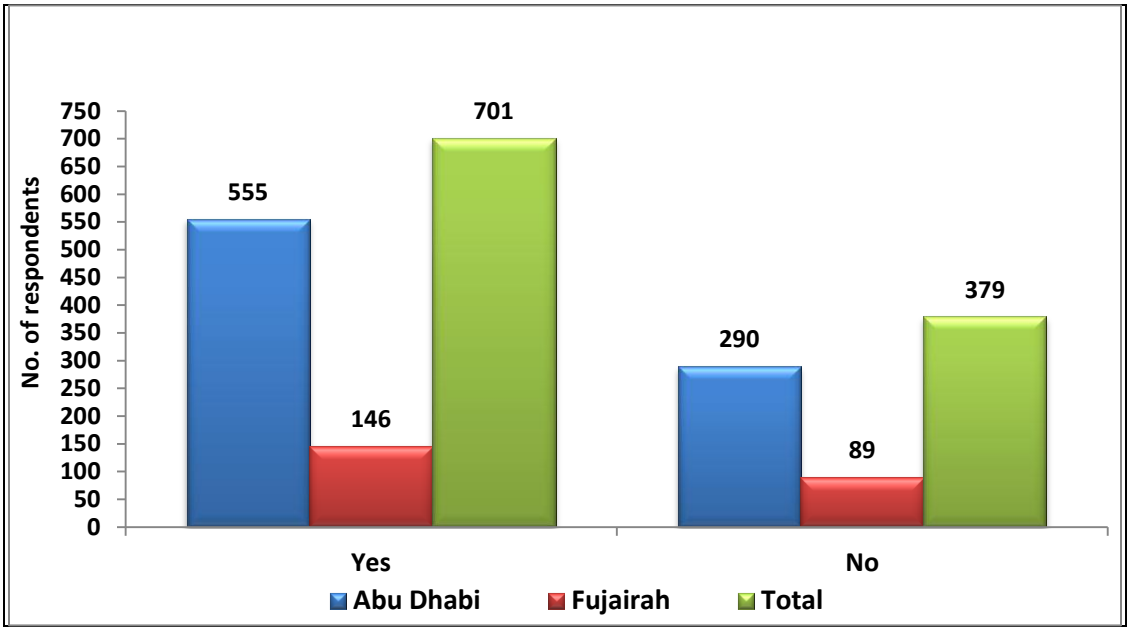

Figure 5- 23: Effectiveness of web-based warning and forecasting system

As seen in the chart, majority believe that web-based warning and forecasting systems could be effective in disseminating information to them and for them to access information.

D. Response Capability

This section addresses the theme on response capability and there are four questions in this section.

Q17: Do you know if there has ever been any workshop, forums or informing meetings or discussion about risk related to natural hazards in the emirates or area where you are living?

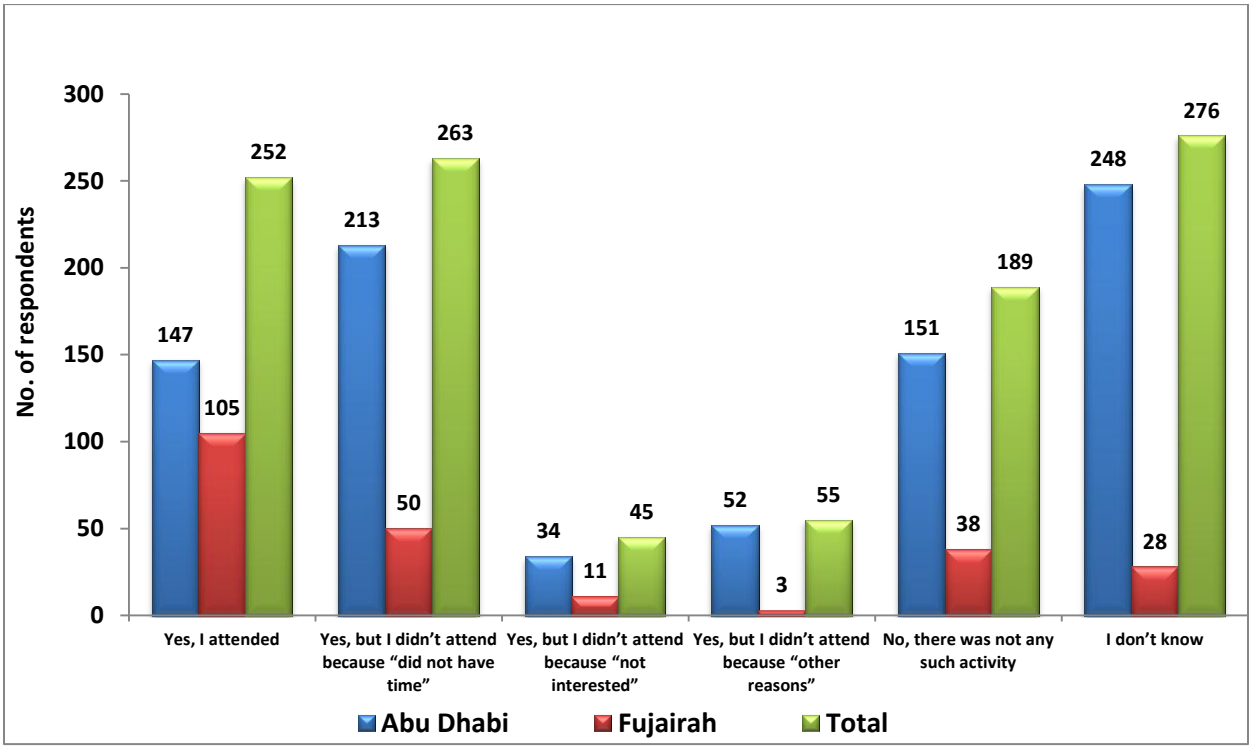

Figure 5- 24: Level of awareness about preparedness and EWS meeting

Majority of people who answered this question said they don't know, but it is also important to note that a total of 252 said they have attended such meetings. More importantly it is good to note that a grand total of 363 said they were aware of such meetings but unable to attend due to time constraints, lack of interests or other reasons. This means that the emergency organisations

need to explore options of ways to engage the community in activities which can help them to be better prepared for natural hazards.

Q18: Do you know if there has been any emergency exercise for preparation and evacuation in case of emergency related to natural hazards in your emirates?

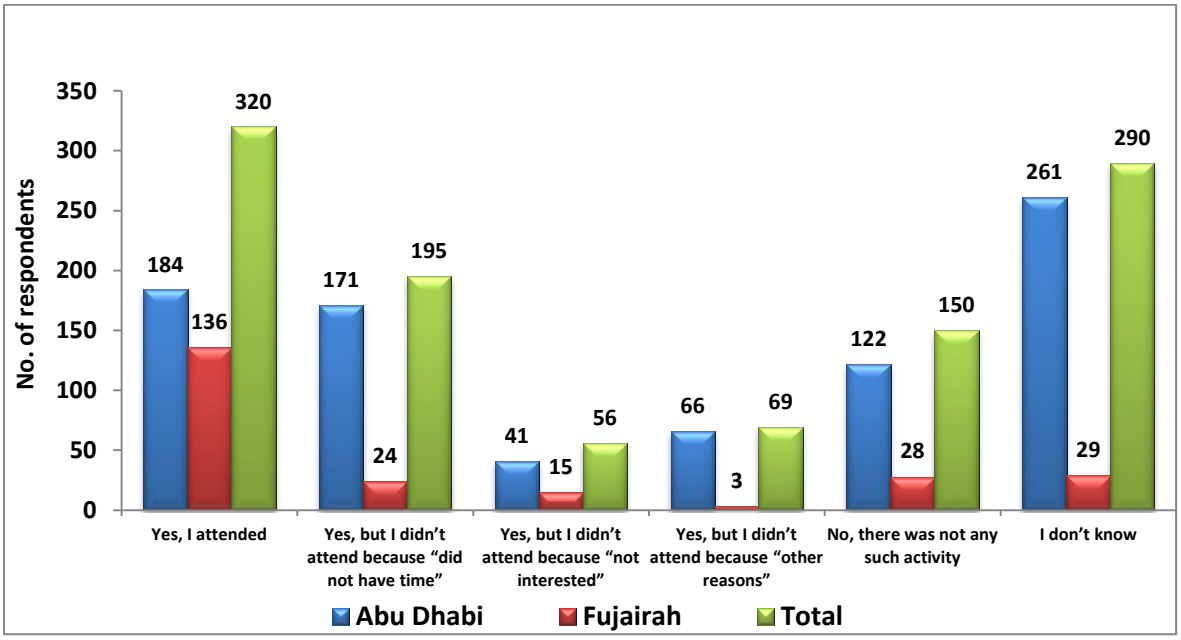

Figure 5- 25: Awareness about emergency exercise

The response to this question is similar to the previous one. This emphasises the willingness and level of awareness of people in the community with respect to early warning meetings and forums which can help to prepare the community for natural hazards.

Q19: Do you think public authorities must provide the required training for improving disaster management and early warning systems?

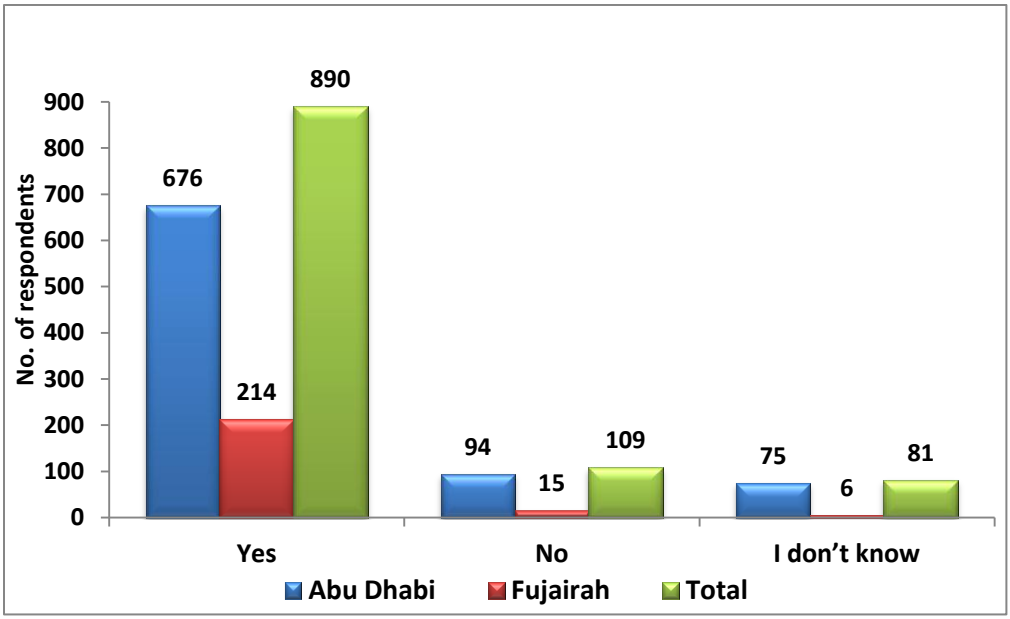

Figure 5- 26: Training for improving disaster management and EWS

Respondents consider improvement training important to them and in the emirates where they live.

Q20: Do you think the UAE should learn from the experience and experiments of countries using best practice in early warning systems?

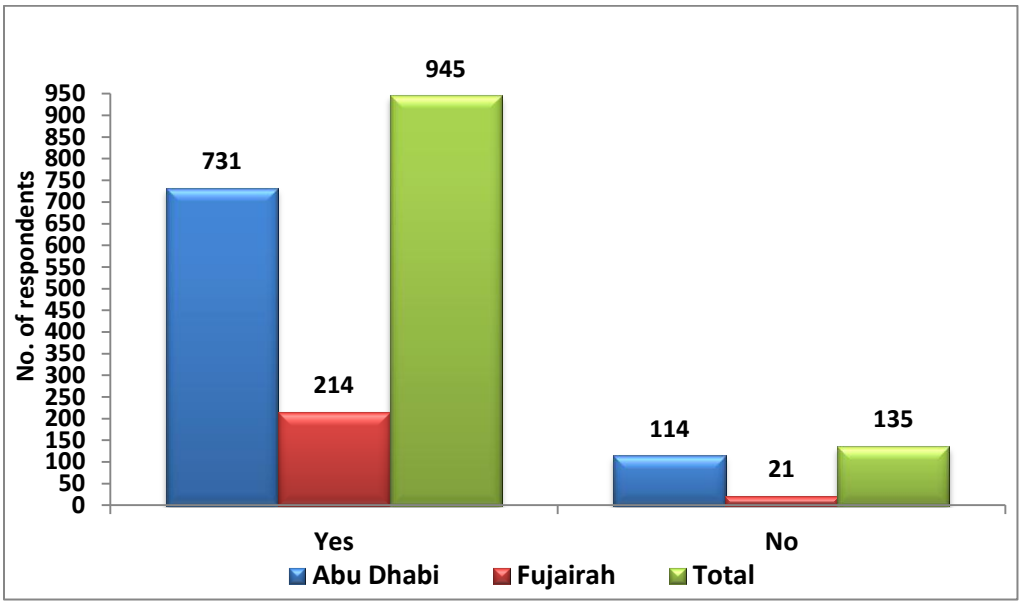

Figure 5- 27: Adopting best practice and lessons from other countries

The answers to this question shows that majority in the community are in favour of the UAE learning from other countries and adopting best practice which can help to improve the EWS their Emirates and in the country as a whole.

This section completes the main themes which have been used to explain the research questions and to achieve the research objectives. However, during the investigation process for this research, joint work, collaboration, partnership and sharing of roles and responsibilities of early warning and crisis, emergency and disaster management have been recurring. Based on this, the risk information integrated is used to determine how best to apply principles and best practice of EWS assessed in the literature review chapter.

Q21: Have you ever received risk information about natural hazards in your region?

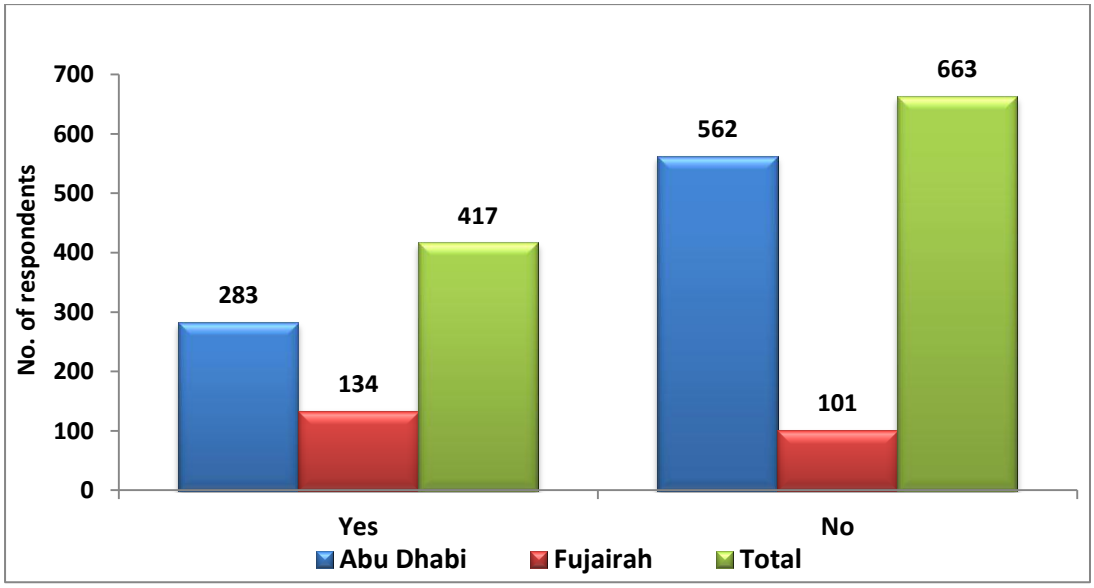

Figure 5- 28: Risk Information about natural hazards

Majority have shown that they have not received information about risks of natural hazards. However, it is important to note that 283 out of the 845 people who completed the questionnaire have received information about risk. While 134 out of the 235 in Fujairah have also received information about risk. This shows fair level of engagement, but more needs to be done to reach more people living in the Emirates and other Emirates in the UAE.

Q22: How would you describe the quality of risk information you reviewed about natural hazards?

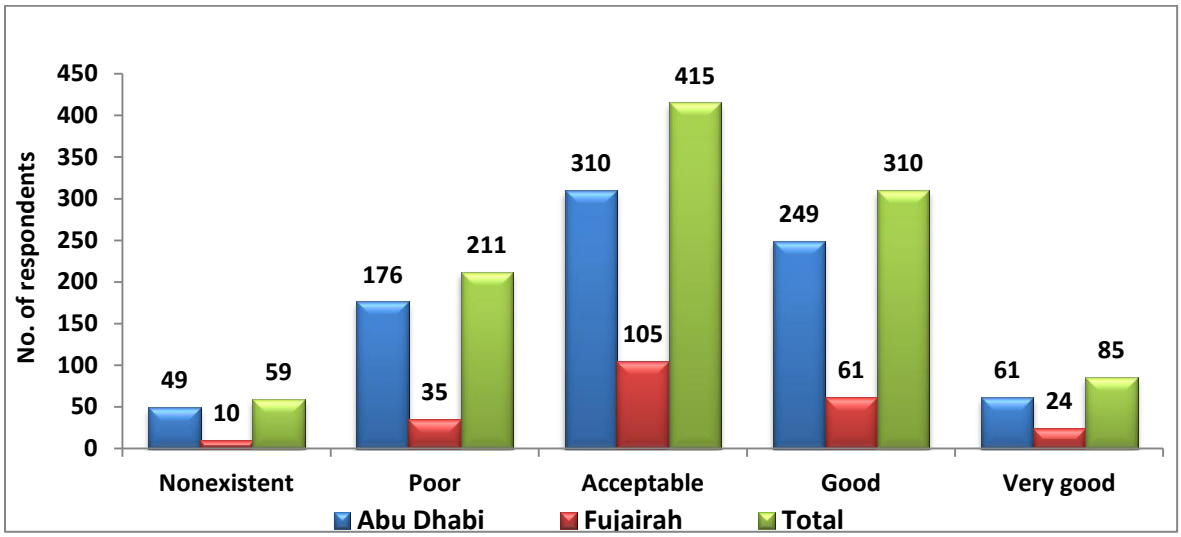

Figure 5- 29: Quality of risk Information

The answer to this shows divided views about the quality of information about risk. Although majority said it is acceptable quality, it neither qualify the impact and usefulness of the information received. Since few numbers of claimed that the information was very good, it means that there is room for improvement.

Q23: Would you look for new risk information about natural hazards? For example, attend a public meeting, look for specific website, and/or consult public or scientific documents?

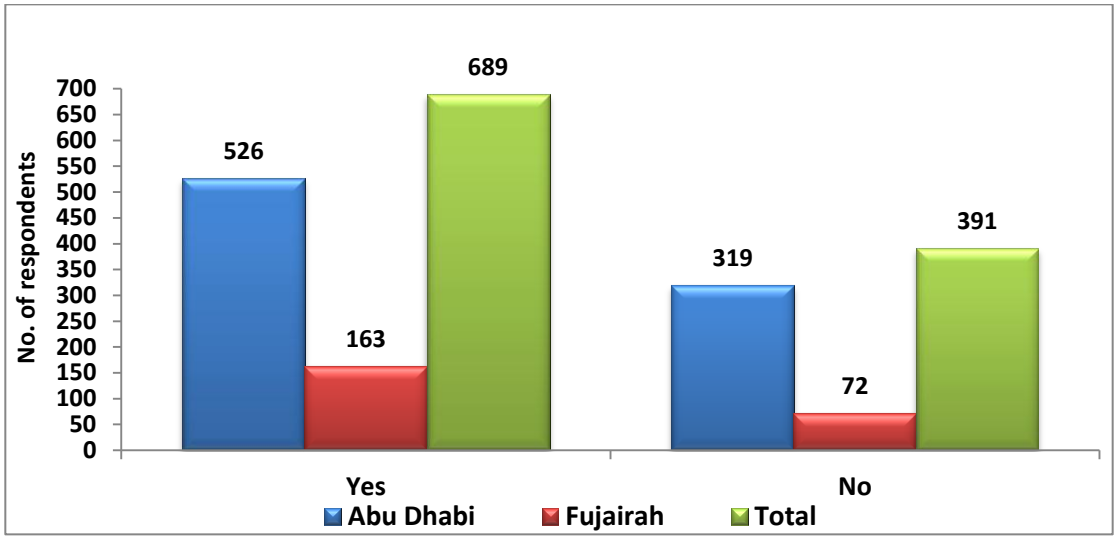

Figure 5- 30: Interest in risk information

This shows that a huge number of people in the community are interested in risk information, thus risk information needs to be better integrated with existing community activities or to use the most preferred mediums indicated earlier in this chapter in Fig. (5-30).

Q24: Who do you think should provide risk information about natural hazards?

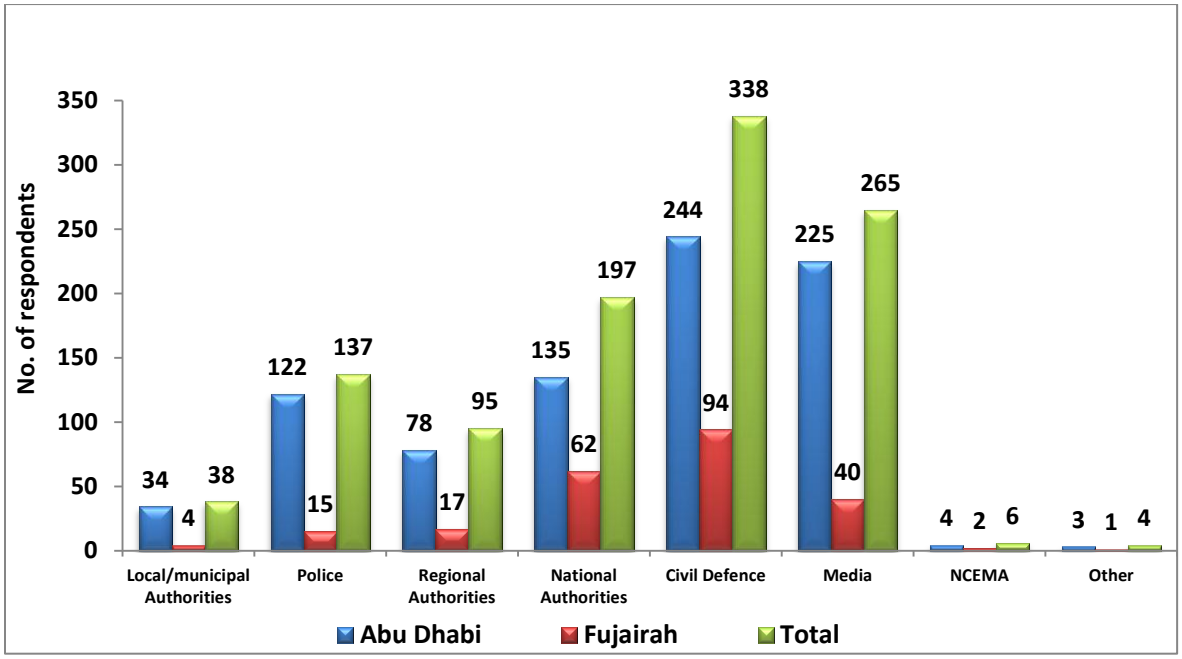

Figure 5- 31: Preferred organisation for providing risk information

Contrary to the answers provided in fig. (5-31), the respondents believe the Civil Defense should be responsible for providing risk information about natural hazards in order to better prepare them for natural hazards when they occur. The next preferred organization is the media and the national authorities. It is important for risk information to be integrated between these organisations which are the most preferred by the community. It is also advisable for the government of these two emirates to note these preferred organisations because it is likely that the community will more likely engage with them and go to them for risk information.

Q25: How concern does you feel about natural hazards after completing this questionnaire?

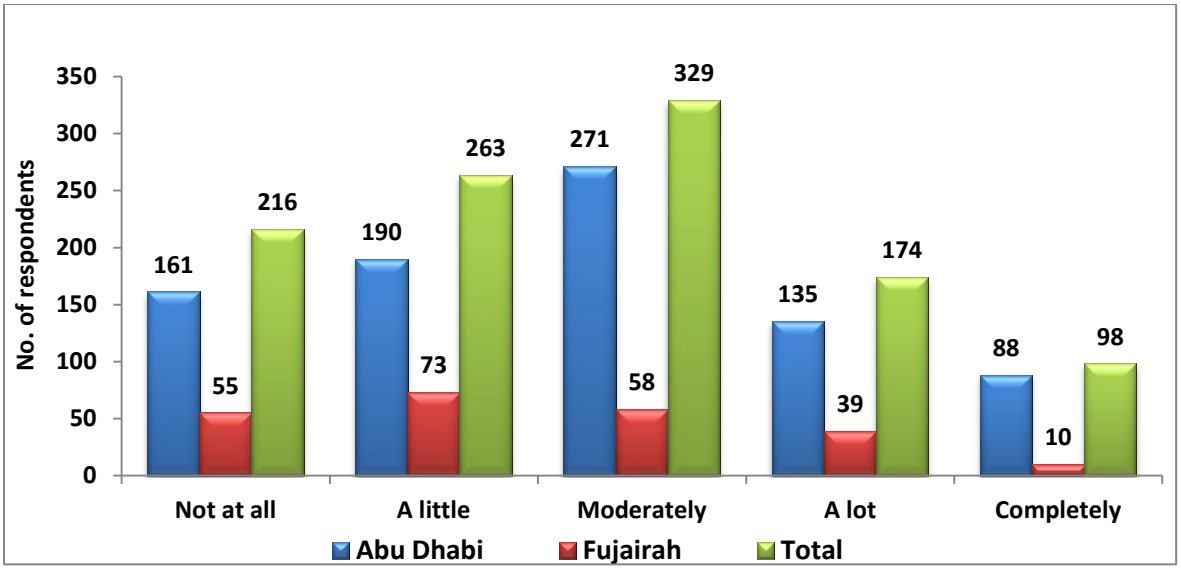

Figure 5- 32: General perception of risk of natural hazards

Unfortunately, after completing the questionnaire, about 216 claimed it did not change their perception at all about natural hazards. Although other said it changed their perception of risk of natural hazards; "a little", "moderately", "a lot" and "completely", it means that more investigation, researches and community engagement for improving awareness about EWS and emergency and disaster preparedness in the two Emirates and in UAE as a whole. Therefore the next section is a discussion of the implication of the data realised from interviews and questionnaires. This section is also helps to determine the extent to which the research objectives have been achieved.

5.7 Summary and Analysis of Results

The semi-structure interviews and questionnaire data have been key in investigating the situation and existing practice of EWS in Abu Dhabi and Fujairah. The deficiencies and insufficiencies of the components of emergency preparedness have rendered the current deployment of EWS in Fujairah and Abu Dhabi ineffective. The lack of many of the principles of EWS identified in chapter two have also shown lack of best practice in the system for early warning in general in the two emirates. Although the case study analysis helped to show evidence of these deficiencies,

the interviews further helped to identify the specific areas such as risk knowledge, response capability and community involvement as the areas which are completely lacking. However, elements such as warning, monitoring and forecasting and dissemination and communication are deficient in their deployment. The international best practices in EWS adapted from practice of EWS in chapter two were crucial to identifying the gaps in the current practice in Fujairah and Abu Dhabi. Furthermore, the ten principles of the success of early warning such as; Preparedness and Response Planning, Roles and Responsibilities, Resource Adequacy, Warning Messages, Feedback and Improvement, Training ,Operational Capacity, Warning Dissemination Mechanisms, Risk Information Integration, Political Support were also instrumental in identifying principles which were lacking. Therefore, section 5.7.1 discusses the primary ideas which were derived from the results as well as the summary of the results.

5.7.1 Analysis of Primary Ideas from results

Risk Knowledge: no early warning system in place and therefore the risk knowledge varied from Emirates to Emirates and among organisations responsible for emergency preparedness and response in both Abu Dhabi and Fujairah. The community also have limited awareness and knowledge about natural hazards, risk information and preventive measures necessary for their safety and that of their family, business and environment. In terms of roles and responsibilities, the organisations are clear about their roles, however, with the information provided by the interviewee, it seems no organisation is actually deploying EWS for natural hazards and the community is also unsure who is responsible for EWS in their Emirates.

Monitoring and Forecasting: according to the interviewees many organisations are unsure about who is responsible for monitoring and forecasting especially before natural hazards occur. Although the meteorological centre plays a major role in forecasting and disseminating the information to the public, media and Civil Defence, the warning messages disseminated are during disaster events, without warning actually getting to the public. Despite this limitation, there is a mechanism used by the meteorological centre which seems to be widely known by all organisations, but only disseminate warnings to specific organisations. From the community's perspective, they believe early warning is more important for them than accurate forecasting, although majority emphasised that both are important. This means that despite the existing

monitoring and forecasting system in place in the UAE, there is need to have integrated approach which involves all elements of EWS.

Warning Dissemination and Communication: dissemination mechanism is a unified mechanism between the various establishments, and the loudspeakers are currently used in the mosques to warn the residents of natural hazards as pointed out by S7 in answering the first question. This mechanism might be limited to a few aspect of the community, but nonetheless a mechanism that relates to best practice and ought to be further developed for more effective use of EWS to the community. This is a project is similar to the literary theory used in the UAE and peculiar to them being an Islamic country. This is the use of religious platform via the use of mosques loudspeakers to communicate warning to the community. Despite the effectiveness of this medium to communicate warning during the event of natural hazards, the researcher believes this is limited and bound to face many challenges. This is because of language barriers since UAE is a country with people who speak different languages different from Arabic which is the language used for communicating such warning from the mosques. Furthermore, people who are not Muslims will feel left out in warning message, because 787 out of all the questionnaire participants claimed they have never received any early warning message before. Although views varied about the preferred medium for receiving messages, majority of the community participants in this research still believe SMS is a good way of being reached.

Response Capability: while the interview sessions fail to mention the level of engagement and involvement of community in testing response capability, the organisations seems to be have knowledge and processes for exercise and training within their organisations. While many organisations provide supportive roles they are still involved in exercise with organisations who are involved in response and rescue of people during natural disasters. However, some people who participated in the questionnaire claimed to have attended their community emergency evacuation procedure relating to their emirates. Regardless, it seems most of the questionnaire participants believe that public authorities must provide the training required for improving disaster management and EWS. Lastly, the data collected from the interviewees and questionnaires have shown that there is basic understanding about the research themes and elements of best practice and principles of EWS. However, there is a major gap in the

understanding and deployment of all the main elements of EWS as well as the implementation of effective EWS for the community at risk.

5.7.2 Essential elements of Theoretical Framework for EWS in the UAE

The case study have been vital in helping to expose the gaps about the lack of effective EWS and failure of the community to access important information which can help them prepare adequately for natural hazards. The comparison done in section 5.5 and the interview all confirm the gaps identified in the literature review and that there is deficiency in the system. In Table 5-3, different colours are used to indicate the specific deficiencies identified in the two emirates and which specific themes and the principles of EWS have the deficiency or which ones are completely lacking.

Table 5- 4: Summary of themes and their indicators in the two Emirates

EWS Components	EWS principles & best practice	Abu Dhabi	Fujairah
Risk Knowledge	Preparedness & response planning		
	Roles & Responsibilities		
	Resource adequacy		
Monitoring & Forecasting	Operational capacity		
	Political support		
Dissemination & Communication	Warning messages		
	Warning dissemination mechanisms		
Response capability	Feedback & improvement		
	Training		
Risk information and community involvement			

Key	
	Poor (Not available)
	Fair (available in some organizations)

Table 5-3 clarifies that most of the establishments in the Emirate of Abu Dhabi and Fujairah have obtained a poor rating. This means that some elements of the early warning are available at some establishments, while these elements of the early warning are not available at other establishments in the same emirate. This implication of this is that there is need to consolidate and provide the elements of EWS and deployment of principles of EWS in all establishments in the emirates. On the other hand, it is clarified that in the Emirate of Fujairah and Abu Dhabi that there are weakness in all the elements, although some components have evidence of some principles of EWS.

Regardless of the some evidence of two elements of EWS, the implication of these deficiencies and limitations is that the conceptual framework for EWS implementation developed in chapter two will be ineffective in the two emirates if principles of EWS for response capability and risk knowledge are not developed quickly. It also means that for the elements of EWS which have some evidence of existence, they need to be improved quickly in order to enhance the effectiveness of EWS in the two emirates and the entire UAE in general.

5.8 Summary of Chapter

This chapter has presented results of the data collected through the case studies, semi-structured interview and questionnaire. The first section used the case studies and the findings from it to emphasise the importance and need for more effective deployment of EWS in Abu Dhabi and Fujairah. Re-confirming this gap again through the case study analysis emphasised the importance of this research as well as the need to address the gaps identified. The interpretation of the interview sessions in Abu Dhabi and Fujairah respectively showed that the two emirates have similar problems and lack effective EWS. The main areas which were lacking principles of effective EWS were identified and the model for improvement and for ensuring effective deployment of EWS in the UAE has been drawn based on the needs.

Therefore the second objective; “to investigate the existing deployment of EWS in the UAE” and the third objective; “to evaluate the EWS requirements for community and stakeholders in the UAE” have been achieved through the data presented, analysed and discussed in this chapter. The interview and questionnaire results have used the main research themes which are; risk knowledge, monitoring and forecasting, dissemination and communication and response capability to achieve the second and third objectives respectively. All these themes and the implications of the data presented have been briefly discussed in this chapter which have also helped to develop the EWS framework that can facilitate successful and effective EWS in the UAE.

CHAPTER 6: EWS FRAMEWORK AND ANALYSIS

6.1 Introduction

The framework chapter focuses on the main emphasis of this research which is to EWS framework designed to as process for improving EWS in the UAE. This chapter evaluates by explaining the difference between the conceptual framework for EWS in chapter two and the recommended EWS framework proffered in this chapter for facilitating the deployment of EWS in Abu Dhabi, Fujairah and UAE in general. Other sections in this chapter analyses the components of the recommended EWS framework and their connection to disaster resilience which is the ultimate goal of developing the framework for EWS. Section 6.4 is the summary of the chapter which provides an overview of this chapter and its importance to the next chapter.

6.2 Evaluation of EWS Frameworks

The EWS framework in chapter two (Figure 2-11) had been drawn as the conceptual framework for EWS, but more importantly as the defined scope for conducting this research. A conceptual framework as defined by Miles and Huberman (1994) is the theoretical structure of assumptions, principles and norms that holds together ideas or network of linked concepts. As observed in in Figure 2-11 in chapter two, the framework was drawn after identifying components of EWS, principles for best practice in EWS as well as performance indicators that helps to determine the impact and elements to engage for each component of EWS. By drawing the conceptual framework in chapter two, it was easier to define the scope of this research and establish the important factors to investigate in the UAE system, gaps to examine during the fieldwork and areas to focus on during primary data collection.

The research results have provided outcomes that demonstrated the importance of having the conceptual framework at the end of chapter two, since it helped to focus investigation in subsequent chapters on the four main components identified from the literature review. Robson (2011) also argued that conceptual framework is a key part of the research design; design made

from key factors and concepts of a research. Therefore, the result have shown the significance of the conceptual framework in that it was used as a standard for critiquing the UAE system and deployment of EWS. For example, when any of the research participants (questionnaire participants and interviewees) claimed that EWS is practiced well enough in the two emirates, the best practice and key performance were useful in assessing the evidence of the practice. Thus, using the conceptual framework as standard for assessing the deployment of EWS in the two emirates helped to identify the two components which need improvement and the couple that require major development.

Therefore, the conceptual framework for EWS helped to increase the validity of the research results as well as for triangulating responses provided by the research participants. Within this context, the conceptual framework also ensured that focus is retained on the epistemology of the research area, scope, aim and objectives. This explanation and evaluation of the results in chapter five emphasise the importance of ensuring that risk knowledge and response capability in the two emirates are developed with a focus on natural hazards the two cities are exposed to. Similarly, the result in chapter five also indicate that monitoring and warning, and dissemination and communication exists, they do so in limited and at times confusing capacity. Thus, it is important to improve these component of EWS in the two emirates, but that such improvement should be done based on better understanding of EWS, its components, principles of best practice and performance indicators.

The combination of research results and evaluation in this chapter have informed the review of the conceptual framework to incorporate the deficiency in the UAE system that require improvement and development. As explained by Becker (2007), frameworks are not descriptive, but also critical to communicate problems, existing views and original contribution that covers the areas that need to be improved. Using the explanation on conceptual framework and outcomes of using them, a reviewed framework in Figure 6-1 is drawn as recommendation for improving both the deployment and development of EWS in the two case study cities examined in this research.

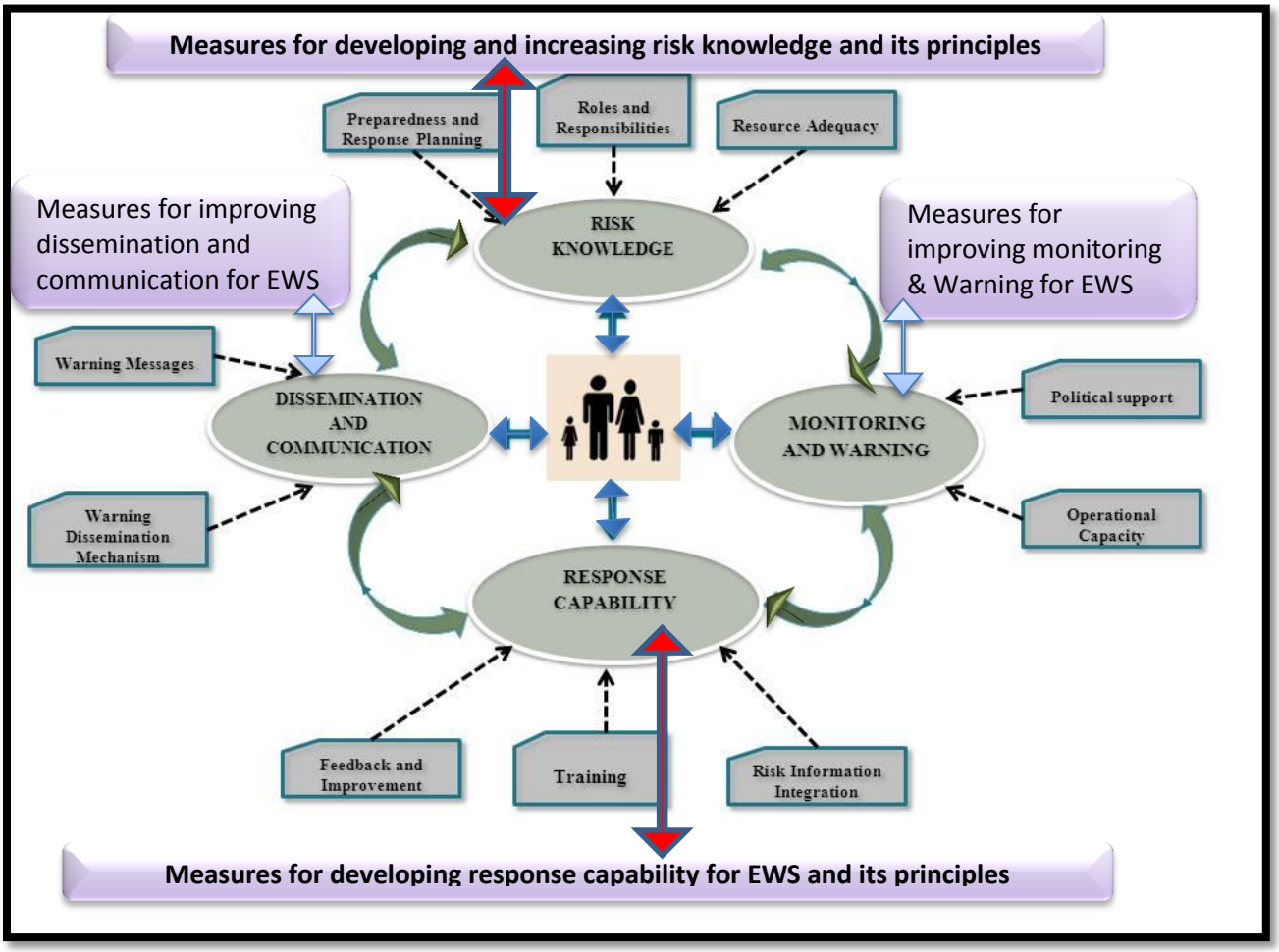

Figure 6- 1:Recommended Framework for effective EWS in Abu Dhabi and Fujairah

Accordingly, frameworks such as recommended in Figure 6-1 integrates theoretical concepts from literatures and best practices with different approaches for ensuring a better and more effective system. Figure 6-1 shows the holes that have been found in the current deployment of EWS in the UAE and the specific component that has major holes and ones with minor problems, but problems which can have significant impacts. The result shown in the recommended framework for Abu Dhabi and Fujairah is similar to what Robson (2011) explained as being able to use conceptual framework to make original contribution to the

understanding of a concept and a model constructed to reflect pieces of information the reader ought to pay attention to, information that informs the research study.

Using all the explanation on framework from Robson (2011), Miles and Huberman (1994) and Becker (2007), an analysis of the recommended framework for effective EWS in Abu Dhabi and Fujairah carried out in the next section.

6.3 Analysis of recommended Framework for EWS

Thus far, the research investigation process have focused on EWS and the main components that every EWS system must have. Chapter two was devoted to providing a critical evaluation of existing EWS identified across the world and the principles that make the all the models that were examined best practice with tangible and good outcomes that led to disaster resilience. While it is important to understand EWS as the process for generating maximally accurate information about possible harm from natural hazard and for ensuring that information reaches people who are threatened by the identified harm, it is also important to understand how EWS can be better deployed in the UAE.

Rather than adopting or 'copying' EWS or models used in another country, it is important to design one that can be adopted for use in the UAE, one which incorporates the dynamics and concepts that are peculiar to the operations of emergency management in the UAE. Given that figure 6.1 already incorporates gaps identified during this research process with the conceptual framework in chapter two, this section focuses more on analysing the components of EWS in relation to disaster resilience. The significance of other elements identified from the research results that makes the conceptual framework different from the recommended framework are also analysed.

As it can be noticed that in Figure 6.1 that there are two red double sided arrows and two blue double sided arrows that lead to elements that are either measures for developing or measures for improving. In addition to this, the arrows linking community at the centre of the framework now have arrows which are both ways, and not one sided like the conceptual framework. The significance of these changes to the framework or addition to the framework are outlined in sections 6.3.1, 6.3.2 and 6.3.3 respectively.

6.3.1 Red double sided arrows

These arrows indicate components of EWS and principles which are lacking in the UAE system. It therefore means that with these lacking components, the entire EWS framework recommended cannot be effectively implemented, practiced or deployed without the major improvement of both the risk knowledge component and response capability component. When the result and addition to the framework is considered in reference to the explanation in section 2.6, it means that without the development of the lacking components, disaster resilience cannot be developed in the communities at risk.

As explained by Pelling (2003), disaster resilience is the ability of a society (community) to build capacity for adjusting and dealing with environmental conditions that can affect the community. In this sense, preparation in form of EWS and other hazard mitigation measures are important in order to achieve this goal. However, this is impossible without developing and enhancing risk knowledge as well as response capability of all stakeholders including the community at risk. Measures for developing and increasing risk knowledge and response capability as well as their principles are all included in the explanation by Wisner et al (2004), which all emphasise joint or stakeholder efforts for disaster resilience.

6.3.2 Blue double sided arrows

The blue double sided arrows show indication of the components of EWS that are existing in limited capacity, but which needs improvement based on understanding of best practice in EWS as identified in this research. Although it might seem that the impacts of these limited components might not be significant, however, as examined in chapter two, effective EWS are known to operate by fusing the four components together and ensuring that they generate the key performance indicators. The key performance indicators are ones which show that the EWS component have been properly implemented with each component focusing on community at risk.

It is also important to take the deficiency with the components of monitoring and warning, and dissemination and communication as seriously as those that link with the red double sided arrows. Due to the explanations and critique in chapter two, it was established that all components of EWS must work together and are linked as shown in Figure 2-3 and Figure 2-4 (section 2.2.1). This connection contributes to disaster resilience as explained by (Paton, 2006) which emphasises the ability to build capacity to co-exist with natural hazards and their consequences through better risk knowledge of their existence, monitoring and warning of their activities, and communication with community prone to their impact so that response can be better informed and coordinated. Similarly, it relates to the explanations by Wisner et al (2004) that focuses on the resources that ensure that all these component of EWS are well integrated and deployed when necessary within and by community. Since the blue double sided arrows are integral part of the EWS components, the components they point to need to be improved with disaster resilience in mind.

6.3.3 Double sided arrows between community and the four components of EWS

These arrows represent communication flow between the community at risk and stakeholders responsible for implementing EWS. As examined in chapter two sections 2.2.1 and 2.2.2, the importance of initiating and maintaining continuous communication with community cannot be

overemphasised. Communication with community at risk and involving them in the design and deployment of EWS is very significant and these were identified in the seven countries where EWS best practice exists across the world. Thus, it is important for the UAE to involve community in its deployment and decisions for EWS, in order to ensure its effectiveness and result that will show the key performance indicators.

The result that emphasise the need for a 2-way communication between community and stakeholders for the deployment of all components of EWS is perhaps one of the most significant findings of this research. The role of communication is important and cannot be overlooked since it is key to ensuing that risk are well communicated for other components to be mobilised. As emphasised in chapter section 2.2.2 communication is very important, and not the mechanism for communication, but the theories and strategies that guide communication for EWS. Irrespective of community at risk, the diversity of the community as identified in Abu Dhabi being the capital city of UAE, communication for all types of natural hazards must be decided ahead of their occurrence.

In addition to this, Coombs (2007) used SCCT communication theory and strategy to explain the responsibilities for communicating crisis pre, during and post the crisis period which can be adopted by community at risk and stakeholders for safety. Communication between emergency management stakeholders and community is important for emergency management in general, but more significant for EWS components due to its ability to ensure that community build capacity to cope with impacts of natural hazards when they occur. This was explained by Pelling (2003) to show that importance disaster resilience is being able to adequately prepare for harm that is likely to occur, thus emphasising the relationship between communication, preparation and disaster resilience.

Therefore, the EWS framework for recommendation in Abu Dhabi and Fujairah in Figure 6-1 is significant for building disaster resilience in the two emirates, but also in UAE as a whole. Thus, while the conceptual framework in Figure 2-11 enabled the researcher to conduct investigate the

UAE deployment of EWS as objectively as possible, the recommended framework in Figure 6-1 is key in ensuring that EWS is improved and better developed for current threats and future natural hazards will occur in the UAE. The recommended framework is also strategic and key to building disaster resilience in addition to ensuring that the deployment of EWS is more effective in the two emirates researched to be prone to the impact of natural hazards in the UAE.

6.4 Summary of Chapter

This chapter has critically discussed and analysed the framework recommended for improving and further developing EWS in the UAE. Sections in this chapter have established the difference between the conceptual framework in chapter two and the recommended framework for improving EWS shown in this chapter. The significance of the recommended framework have also been analysed in relation to building disaster resilience in Abu Dhabi and Fujairah emirates. While the importance of communication was also further emphasised in this chapter, the purpose and justification for designing a community-centred framework for EWS was explained while establishing the role of communication its deployment. With this done, the next chapter discusses the entire research result in relation to the research objectives.

CHAPTER 7: DISCUSSION OF RESEARCH RESULTS

7.1 Introduction

The purpose of this chapter is to discuss the research result and its implication and barriers to effective implementation of the EWS framework. It aims to discuss the findings from each objective and how its results fits into the research aim and objectives. To achieve this, this chapter is divided into two main part, a part which discusses the research results and the second part which evaluates the implication of the research result. A recommended EWS model is drawn based on the findings in this chapter which uses the elements of best practice in EWS in the most feasible way which can be implemented. Section 6.3 discusses the implication of the research findings using the research objectives, ensuring that the next chapter focuses on validating the EWS model as well as providing guidelines for implementing the framework.

7.2 Discussion of Results

EWS has been described in chapter two as the process for generating maximally accurate information about possible future harm and for ensuring that information reaches people who are threatened by harm and danger (Glantz, 2004). This understanding informed the research aim which is to develop a model for integrated early warning systems in community in order to increase response capabilities against the risk of natural disasters in the UAE. As a result of this, the research have been subjected to rigorous process of investigation, examination and review of literatures and primary data in order to achieve the objective of this research.

The data collected from secondary sources in Chapter Two shows that best practice in early warning exists across the world and that best practice in EWS have certain elements that make them effective in countries where they are being practiced. The elements of best practice identified through the critical review of literatures in chapter two helped in evaluating the current practice of EWS for dealing with natural hazards in the UAE. Through the critical review of existing literatures and documented reports in the UAE, it was discovered that gaps exists in the

practice of emergency management especially in the implementation of EWS (Section 3.4 in Chapter Three).

By using the best practice collated from different countries across the world to evaluate the current practice of EWS in the UAE, it was also discovered that adequate monitoring and warning as operated in the seven countries examined for best practice were lacking in the UAE context. Although the only form of monitoring and warning service available in the UAE is conducted by the NCMS, it is insufficient and does not bear any information on preventive actions (Londoño, 2011). Therefore, the practice of EWS in the UAE only provides information about hazard for people without engaging the affected community in the decision for and the practice of EWS as seen in other countries where EWS have been effective for mitigating the impacts of natural hazards (Section 2.3 in Chapter Two).

Furthermore, risk knowledge is low in communities and in emirates such as Fujairah. This low risk knowledge influence the ability to better prepare for eminent hazards, which makes them more vulnerable to the impact of natural hazards when they occur (Al Dhanhani, 2010). Subsequently, dissemination and communication are also limited, although communication of risks of natural hazards are disseminated through the media and traditional methods of warning. However, the traditional methods are limited because communication of warning is transmitted through loudspeakers in mosques which are in Arabic (Al Ameri, 2010).

While this is good method of communicating warning to people who might have limited access to media, it is less effective in a country with many foreign nationals (Al Ameri, 2010). Therefore, the purpose of dissemination and communicating EWS is negated since risk information and communication of imminent danger, the transfer of warning which can be understood in order to inform preparedness is not possible or widespread (Wenzel and Zschau, 2014). The gaps within every elements of EWS shows that a thorough investigation of the UAE system was required which determined the focus of the primary data collection which was

conducted using questionnaire and interview sessions. Therefore subsequent subsections in this section discusses results of each objective as investigated in this research.

7.2.1 Objective 1 - "To examine best practice in EWS for disaster resilience"

This objective set out to identify best practice in EWS from across the world and countries who have succeeded in reducing the impacts of natural hazards in their communities. This objective used literature review and documentation to achieve its outcome. The result of achieving this objective showed that there are four interrelated elements which are main component of any early warning system. This objective was also key in identifying best practices in EWS which have been contributing to disaster resilience in countries such as Cuba, Bangladesh, France, Germany, Japan, US and China. The result of this objective also identified five different types of EWS, which are practiced in seven countries and from which best practice and principles can be learned. The five EWS are:

1. Tropical EWS (Torres and Puig, 2012)
2. Preparedness Program EWS (Fakhruddin, 2014)
3. Vigilance EWS (Borretti, 2012)
4. Multi-Hazard EWS (Hasegawa *et al.,* 2012; Keeney*et al.,* 2012; Xu et al., 2014)
5. Three-tier Time orientated EWS (Steinhorst and Vogelgesand, 2012)

While some of these EWS had experienced some limitations, it was discovered that some factors are common to all of them, while the most effective ones had factors which increases the level of effectiveness. A further examination of these EWS used on the seven countries identified, shows that cooperation and involvement of community at risk is critical to the deployment and maintenance of EWS.

Although the level of involvement and the roles community at risk play in all the countries differ, it was clear from the result this objective provided that stakeholder and community involvement is important for effective EWS. Other essential factors that contributed to identifying these EWS as ones which are operated based on best practice are factors such as;

support of government, without necessary owning the EWS, clarity of roles and responsibilities, defined dissemination and communication mechanisms and risk information, training and feedback platform for improvement (Glantz, 2009;UN, 2006; Basher, 2006). All these factors are embedded as part of principles of emergency management explained by EMI (2007) and by Alexander (2002) as essential for effective practice and implementation of phases of emergency and disaster management. All these factors were combined into what this research outlined as "Ten principles" of effective EWS which are:

Table 7- 1 : Principles of effective EWS derived from best practice

EWS PRINCIPLES	Principle 1 - Political Support
	Principle 2 - Four interrelated Elements
	Principle 3 - Clarity of Roles and Responsibilities in EWS
	Principle 4 - Allocation of sufficient resources for EWS
	Principle 5 - Emergency Planning warning incorporate risk information
	Principle 6 - Effective, authoritative and actionable warning messages
	Principle 7 - Warning must be disseminated to allow time for those at risk to respond
	Principle 8 - Place emphasis on disaster preparedness and response planning
	Principle 9 - Training is pivotal to operational readiness
	Principle 10 - Prioritisation of continuous improvement through feedback

These ten principles which also include the four interrelated elements of EWS recommended by the UN are the results of objective. By achieving objective 1 in the literature review, the entire research was given proper scope and context for achieving the second objective, the third objective and other research objectives.

Therefore, the current practice of EWS in the UAE was examined based on the understanding of the EWS principles and four interrelated elements. This was done through triangulation of secondary data from literature review and primary data from questionnaire and interviews. The result from this process and for this objective shows that the following were not available in both Abu Dhabi and Fujairah Emirates:

- preparedness and response planning
- Resource adequacy
- Operational capacity
- Warning dissemination mechanisms
- Feedback and improvement
- Training

Others such as roles and responsibilities and political support existed in the two emirates while warning messages only existed in Abu Dhabi and not in Fujairah. This result confirmed the gaps identified in the literature review, emphasising the significance of this research as well as its ability to improve EWS practice in the UAE should recommendations and guidelines be provided. This result therefore indicate that the existing deployment of EWS in the UAE will tend to be problematic or ineffective based on the poor implementation or non-existence of these principles. It also be inferred from this result that communities or Emirates prone to the impact of natural hazards in the UAE are not resilient to the impact of disaster if these best practice are non-existence or insufficiently practiced. Such an outcome stresses the importance of this research as well as the need for strong recommendations that can improve practice of EWS in the UAE.

7.2.2 Objective 2 - “To investigate the existing deployment of EWS in the UAE”

The results from achieving objective 2 was helpful in investigating the existing deployment of EWS in the UAE which is the second research objective. This objective was achieved using a combination of methods of literature review, documentation, semi-structured interviews and questionnaires. The result of this objective shows that some principles of effective EWS were

present in the UAE system, while others were absent. Furthermore, the investigation of existing deployment of EWS has key performance indicators which shows that certain elements of EWS were more functional than the others. For instance, the result of objective 2 shows that the ten principles of effective EWS had various levels of deficiencies when evaluated using the four interrelated elements, which is also part of the ten principles. As a result, the investigation shows that the deployment in the UAE are:

Risk Knowledge: the principles peculiar to risk knowledge are; preparedness, response planning, roles and responsibilities and resources adequacy. The result of this objective shows that risk knowledge element in the two emirates does not sufficiently translate into effective deployment of EWS during occurrence of natural hazards events. Even though actors and organisations are involved in the two emirates in different capacities (*Section 5.4.2 - A*), the community at risk are not involved in EWS as seen in the best practice countries (*Section 5.6 – A*). It also shows that risk knowledge within organisations and community are limited, low and contradictory even though risk are documented. A result such as this is insufficient compared to requirements for risk knowledge which influence risk management process in emergency and disaster management (Regester and Larkin, 2008).

According to Salter (1997), understanding of risk, knowledge of imminent risk influence the risk management process. The risk management process include establishing the context of risk, identifying hazard and threats, risk analysis and risk evaluation (CCA, 2004). These process are important to determining whether to accept risk or not and whether to threat the risk or not and what needs to be monitored (Salter, 1997). Regardless of the decision taken based on risk knowledge, risk knowledge will inevitably influence monitoring and review process and communication and consult process which are always continuous process (Ball and Ball-King, 2013). Therefore, the result of this objective indicate the origin of the problems associated with deployment of EWS in the UAE.

Monitoring and forecasting: the principles under this element are; operational capacity and political support. The result from this elements shows that there is need for improvement, even though there are organisations who are monitoring and forecasting natural hazards and their activities. Despite this, the result also show that government support is minimal, while operational capacity is just sufficient for the level of risk. This means that operational capacity is not at the same operational level as the countries that have best practice in EWS. This infers that limited operational capacity, limits planning at the preparedness phase to the extent that EWS is not adequately or sufficiently deployed when it is needed. An explanation which account for the current level and nature of deployment of EWS in the UAE which is insufficient in planning to mobilise people and resources. According to Haddow et al. (2011), planning is the ongoing, but systematic process which helps organisations to prepare for response to emergencies. Therefore, failure of EWS deployment as observed in the case studies, interview and questionnaire analysis also means failure of effective planning for EWS.

Dissemination and communication: the principles for these elements are warning messages, and warning dissemination mechanisms. The result from investigating this element shows that the meteorological department is responsible for forecasting, monitoring, dissemination and communicating early warning messages. It shows that they forecast weather for the purpose of informing the public through the media. Although this shows that this element is functioning, it lacks the key performance indicators in table 2-3 in chapter two. According to this key performance indicators, the principles of warning messages and warning dissemination mechanisms need to meet the following criteria:

- WHY – current and forecasted situation, with possible consequences of the event. This was found to be limited. There is also no established mechanisms for disseminating warning to the emergency organisations before and during natural hazards, who can then evaluate the consequences from emergency or disaster management perspectives. According to Smith and Fischbacher (2009) risk communication is important and should be used to ensure safety of those at risk. It is the emergency organisations that have documentation of community at risk of any hazard and not the meteorological department or the media.

- WHEN – this relates to expected time of potentially harmful event occurrence and time of evacuation. The result for this objective shows that no evacuation took place and community did not receive any instructions about the need to evacuate and the procedures for it.
- WHERE – the places or areas at risk and the ones which are safe. The result also show that communication for disseminating warning messages did not cover any of this.
- WHAT – the actions that needs to be taken. This also relates to evacuation which was obviously lacking during the event of natural hazards examined through the case studies and from the interview and questionnaire results.
-

Response capability: this element involves principles such as risk information integration, training, feedback and improvement. Unfortunately, the result only revealed that training were conducted regularly by the emergency organisations, but none involved community risk. However, this does not conform to concepts of emergency management, especially planning processes which McEntire and Myers (2004) argued that is very important for preparing communities for disasters.

There was also no feedback and improvement neither does the current practice show that risk information is integrated. The implication of this result shows that community responses to warning is not assessed as required by the principles of EWS (Glantz, 2009). The perception of risk, level of information and understanding of understanding about risk in the two emirates are insufficient to help them cope with the dangers, threats and hazards of natural hazards.

Therefore, the result of objective two shows that the current deployment of EWS in the UAE is insufficient and almost non-existence in the case of some elements. It emphasises the importance and relevance of a EWS framework in order to improve deployment of EWS and the procedure for ensuring effective EWS. Results of this nature also emphasise the relevance of the next objective which aims to evaluate the EWS requirements for community and stakeholders in the UAE.

7.2.3 Objective 3 - "To evaluate the EWS requirements for community and stakeholders in the UAE"

The results from objective 1 and 2 have shown that effective EWS cannot be achieved by one person. Partnership or collaboration as emphasised in this research indicate that there are requirements for community at risk and the entire society and all stakeholders to ensure that EWS is effective to the extent that it mitigates the impact of natural hazard in a place. This forms the basis for this objective which was achieved through literature review, documentation, semi-structured interview and questionnaires. The result shows that community are important and the roles of stakeholders are significant as identified in the EWS best practice and principles. As part of the essential components of planning for emergencies or disasters, Alexander (2005) argued that planning must clarify the resources which are available as well as the roles of responders and stakeholders in response arrangements. However, all these are influenced by risk knowledge which have been identified to be low or limited in the UAE at the moment.

Examining best practice in EWS which is the first objective was key in identifying that countries where EWS is effective had defined and integrated roles and responsibilities for EWS. For instance, the ability to mobilise institutional networks and commitments for flood forecasting schemes in Bangladesh is key to the application of its EWS (Fakhruddin, 2014). The institutional partnership which is part of the requirement for effectively disseminating warning and communicating early warning messages (Habib *et al.,* 2012). This has turned out as seen in the literature review as reliable even when technology gadgets are not available or even they fail.

From the results in section 5.6, it can be seen that the involvement of community in every element of EWS is limited especially in Fujairah. In both emirates, the perception of risks of natural hazards is low as compared to the numbers of events that have occurred in each emirates. Although number of people who have experienced natural hazards varied, those who have been victims of the impact of natural hazards do not seem to have change of perception in terms of EWS and increase their involvement in the same (*Figure 5-14 and 5-16*). In addition to this, the

knowledge of emergency procedures or what to do in the event of emergency situation is also low (*Figure 5-15*). This result emphasize the need for better community engagement strategies in involving communities prone to the impact of natural hazards in EWS practice. This is important because from the results, it was identified that community are interested in decisions that involve their safety as well as participating in emergency procedures for EWS (*Figure 5-17*).

Therefore, the result from this objective emphasizes that institutional and community partnership are a required in order to ensure more effective EWS. Institutional partnership in this case means the responsibility to inform and share information about risk of natural hazards in schools, colleges, mosques, public places, any institutional level and community in general. Institutional requirements for community and stakeholders as achieved from this objective means engagement is important, thus emphasizing the relevance of community engagement and well as the importance of placing community at the centre of any framework for EWS. The result of this objective then mandates the need for a framework that can guide the effective and successful practice of EWS in the UAE.

7.2.4 Objective 4 - "To develop a framework that will facilitate successful and effective EWS in the UAE"

Achieving objective 4 have been at the heart of this research from the beginning of this research. Developing a framework that will facilitate successful and effective EWS in the UAE is very important in translating the research outcomes into significant contribution to EWS practice and theoretical context. The gaps identified in evaluating and investigating elements of EWS have provided indications for areas which needs improvement and the ones which require development. Based on the research results from both secondary and primary data, a EWS framework is drawn as Figure 6-1. The elements of the framework have been derived from the best practice elements identified and evaluated as essential in the literature review as well as the findings from the primary data. This background provides a strong basis for the EWS framework designed to facilitate a more effective practice and deployment of EWS in the UAE. Figure (7-1) illustrates the framework developed as the result of this conducting this research and for the implementation of better EWS in the UAE, not only Abu Dhabi and Fujairah.

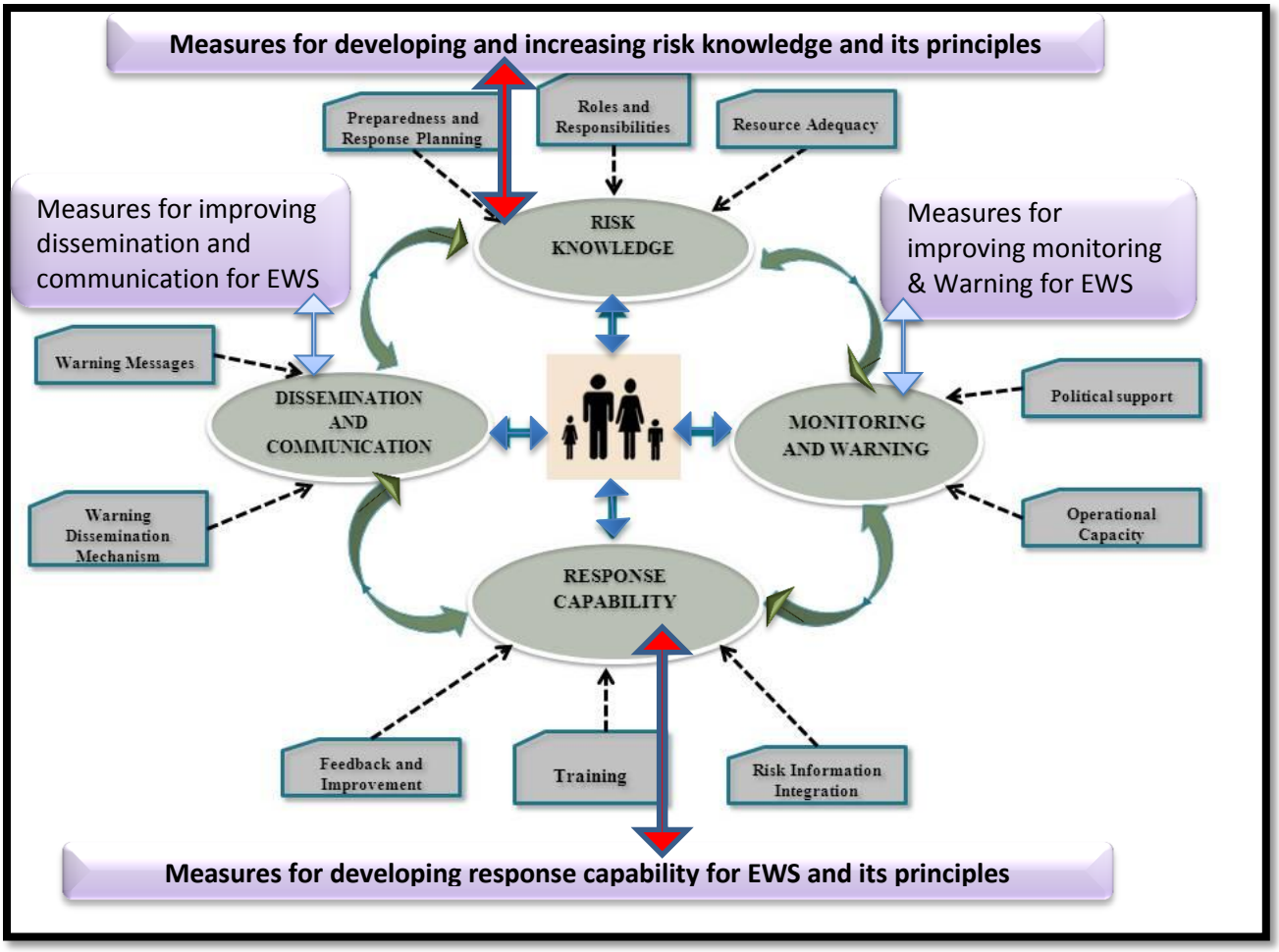

Figure 7- 12: Recommended Framework for effective EWS implementation in UAE

As seen in Figure 7-1, community is involved in improving risk knowledge, monitoring and warning of natural hazard, response capacity development and dissemination and communication of warning. It is by so doing that other principles associated with each element of effective EWS can be achieved and developed. This is because, the involvement of community have also been emphasised by Glantz, (2009) Basher (2006) and Fakhruddin, (2014) in the literature review, through which it was discovered that community is made the focal point of determining early warning measures and key indicators in disaster resilient communities.

Thus, having community involvement, participation and for community to be the focus of EWS is highly key for achieving disaster resilience. While the role of community in EWS as the main deciding factor motivated the research title and framework design, it is however more important to ensure the effective deployment of EWS in the UAE. As seen in the framework, all themes are interrelated, interconnected, and equal in importance, if EWS is to be effectively practiced and deployed. Furthermore, the model for EWS for the UAE is necessary for integration of practice. It is also necessary in order for all existing emergency management procedure to align with national, legal, institutional and organisational procedures for emergency management in the UAE.

However, the results from literature and data analysis show that Abu Dhabi and Fujairah some elements of EWS, some of which require immediate action for development, while others require improvement strategies. The results show that response capability and risk knowledge in both Abu Dhabi and Fujairah require development because they are lacking. The result also show that monitoring and warning, as well as dissemination and communication exist in the two emirates, but very limited, therefore suggesting improvement rather than development. It was gathered from the interview that monitoring and warning as well as dissemination and communication were insufficient, ineffective or not specific to EWS for natural hazards (*Section 5.3.2 B & C and 5.4.2 B & C*). Therefore, recommendations are ideal for improving the deployment of elements which are insufficient or ineffective, while action need to be taken to develop the ones which are almost non-existent.

Risk Knowledge require measures that will help to further develop principles associated with these elements of EWS. While response capability will require that capability for EWS and principles are increased beyond the current state of operations in the UAE. Monitoring and warning require that measures are put in place for improvement, and so does dissemination and communication. While the result from objective 1, 2 and 3 shows that gaps exist in the current situation in the UAE regarding practice of EWS and the outright neglect of two elements of EWS emphasises the importance of including this objective in the research.

By discussing this objective, reference is also made to the findings from the interview sessions and questions which helped to identify that measures need to be taken to develop, and increase risk knowledge and its principles. Furthermore, measures are required in order to develop response capability for EWS and its principles. According to the results, measures are also required by the UAE government and emergency management sector to tactically improve the two remaining components i.e. dissemination and communication and monitoring and warning. While the literature review have helped to identify how this can be potentially through the case studies examined through the first and second objectives, validating the framework is also important. However, the elements and principles which made up this framework for effective EWS in the UAE is yet to be validated, thus emphasising the relevance of objective 5.

7.2.5 Objective 5 - "To validate the developed framework with concerned stakeholders"

The explanations, evaluation and results on EWS as seen in this research shows that it is a system that requires collaborative arrangement to implement. According to the UN (2006), good EWS have strong linkages between risk knowledge, monitoring and warning, dissemination and communication and response capability. Thus, emphasising the need for an interrelated, functional and effective process for EWS to be able to mitigate the impact of natural hazard and minimise loss. Therefore, it is important to validate the framework with stakeholders in order to determine its effectiveness and reliability for use. An in-depth validation is conducted in the next chapter to show the relationship between the elements of the framework from literature review and research findings. On the basis of this, guidelines are also provided for ensuring that the framework is adequately implemented.

7.2.6 Objective 6 - "To develop guidelines based on validation of framework for emergency management stakeholders in order to ensure effective Early Warning Systems in the UAE"

The outcome of the framework of EWS model provides indication for areas which require guidance. Based on the research findings and investigation process, it is important that guidelines are provided for stakeholders of emergency management in the UAE to ensure that the framework is appropriately used in the most effective way. The role of guidelines as indicated in this objective is to ensure a positive and result-driven outcome is achievable that will translate in risk impact reduction and disaster resilience. EWS as seen in the literature review shows that

EWS has interconnected elements that needs to be coordinated and implemented together, provided each stakeholder play their part. The literature review also indicated from the seven countries examined that community who will be affected by the impact of a hazard also needs to be involved in the process of deciding the most suitable EWS for them. Thus, it is more reassuring that the guidelines for UAE to implement the EWS framework designed as a result of this research will not only benefit community, but also contribute to disaster resilience.

7.3 Implication of Research Findings

The implication of this research findings is that strong recommendations are required to ensure that the framework can be implemented as effectively and efficiently as possible in the UAE. While this research could have presented the framework as a self-directed model, not validating or benchmarking its effectiveness will mean that the ability to mitigate the impacts of future natural hazards is uncertain. Validating the framework is also important in order to correspond the perception of emergency practitioners and those responsible for public safety in the UAE with epistemology of the same. Thus, validating the framework presented in this chapter is important and necessary in ensuring that impacts of natural hazards are better mitigated in the UAE henceforth. Using triangulation and mixed methods for conducting this research has helped to increase the validity, and reliability of the results as well as the likelihood of ensuring that the framework is effectively utilised when used. Due to the results and discussion in this chapter, the implication of the research findings have become clearer emphasising that it is important to validate the EWS framework designed and providing guidelines for implementing the framework effectively. Furthermore, emphasising community-centre framework will require detailed guidelines as involving community in emergency management procedure is rather new in the UAE. Therefore, in order to ensure improvement in the deployment of EWS and for the EWS framework to be adopted for use, the validation of framework is important as well as guidelines for implementing the same. Lastly, the implication of this research results further emphasise the need to have recommendations which will inform practice and future research which are provided in the concluding chapter of this thesis.

7.4 Summary of Chapter

This chapter provided introduction to the discussion of results that focused on each objective. Outlining the principles of EWS that were identified from the literature review and confirmed during the fieldwork were also important aspect of this chapter. However, some of the principles and elements of EWS were found to be lacking in the UAE system. The investigation carried out through the fieldwork further confirmed the gaps identified in the literature review and case study analysis. In addition to this, other areas of improvement were also identified through the fieldwork, confirming that the fieldwork was useful in conducting a thorough investigation of EWS deployment in the UAE. Ability to identify best practice from the literature review also proved useful in achieving all the research objectives as well as evaluating the UAE system. As seen in this chapter, evaluation of EWS requirements for community and stakeholders in the UAE revealed that there is need for a model that will include both stakeholders and community at risk. Based on this, the community-centred model was designed and developed which places community at the core process of EWS mobilization and implementation. This led to the discussion of the last objective which is to provide guidelines for effective implementation of the community-centred framework. The implication of this research results and discussion is that validation, guidelines and recommendations are required in order to improve practice of EWS in the UAE.

CHAPTER 8: EWS FRAMEWORK VALIDATION AND GUIDELINES

8.1 Introduction

This section aims to validate the framework recommended for effective EWS in the UAE by assessing the capacity for all elements and factors that can facilitate or hinder successful deployment of all elements in an interrelated process. The four interrelated elements i.e. risk knowledge, monitoring and forecasting, dissemination and communication and response capacity have been identified and ten principles that emanated from the best practice of EWS identified from seven countries have all been used to develop a framework. These are all used as criteria for validating the framework with concerned stakeholders in the UAE.

8.2 Justification for Validation

Validation of the EWS framework developed in the last chapter is important in order to determine the extent to which the framework can be put to predictive use in the UAE. As explained by Hodges (1991), validation of framework is to help determine the appropriate form in which a framework can be quality assured and its usage for real life scenarios. Therefore, it is important to determine in this chapter whether the EWS framework meets the following prerequisites:

1. Is the framework observable, measurable and assessable?
2. Can the framework be exhibited in a constant manner based on time and situation?
3. Does the framework have a structure?
4. Can the framework be maintained and monitored across various conditions? Otherwise is the framework flexible enough to be used for various conditions that relate to its purpose?
5. Can theframework permit the collection of ample data to predict efficiency and determine deficiency?
6. How efficacious is the framework? (Hodges and Dewar, 1992)

These set of questions by Hodges and Dewar (1992) justifies the rationale for validating the EWS framework and for which the validation outcome is determined at the end of this chapter.

For instance using this questions to assess the current state of the EWS framework in Figure 7-1 will generate a gap that further emphasises the need for validation as shown in Table 8-1.

Table 8- 1:Justification for validating EWS framework for UAE

Questions	**Current status of EWS framework**	**Need for Validation**
1. Is the framework observable, measurable or assessable?	Observable over time, and performance indicators of EWS assessed through the interview & questionnaire.	Validation will help to confirm deficiency identified already
2. Can the framework be exhibited in a constant manner based on time and situation?	Yes, the framework is a guide and can be referred any time and for any natural hazard situation	No
3. Does the framework have a structure?	Yes the framework have a structure	No
4. Can the framework be maintained and monitored across various conditions? Otherwise is the framework flexible enough to be used for various conditions that relate to its purpose?	Yes, the framework is multi-hazard and can be used for providing EWS for any natural hazard and the conditions for each hazard	Yes – because this its understanding for use needs to be confirmed with stakeholders
5. Can the framework permit the collection of ample data to predict efficiency and determine deficiency?	Yes, based the research investigation process	Yes – its efficiency for use needs to be determined, even though deficiency have been identified already
6. How efficacious is the framework?	Not sure, it is yet to be used	Yes – needs to be confirmed with stakeholders

It can be seen that based on the evaluation conducted in Table 8-1, there are three reasons out of six to validate the EWS framework developed from the results of this research. While it can be said that the way forward for Abu Dhabi and Fujairah is to adopt the EWS framework in Figure 7-1 in order to develop means of making community-centred EWS achievable in the UAE, it is

also important to validate the framework with stakeholders who are central to the ensuring the implementation of the process.

For instance, there is only one recommended framework for the Abu Dhabi and Fujairah, because similar problems with EWS are evident in both Abu Dhabi and Fujairah. The two emirates both lack most of the principles of EWS as identified in table 3-1. Furthermore, Fujairah and other emirates rely largely on allocations and directives from Abu Dhabi for crisis, emergency and disaster issues since Abu Dhabi is the capital of the UAE. This means that any solution to the problem pertaining to EWS in Abu Dhabi will potentially benefit other emirates in the UAE. This understanding further justify the need to validate the framework that is drawn with the aim of guiding either development strategies or improvement measures for EWS in the UAE.

8.3 Validation of EWS Framework

For the validation process, the concerned stakeholders refer to organisations responsible for responding to crisis, emergency and disasters in the UAE. Or in many cases, organisations and agencies involved in and responsible for emergency management (Alexander, 2009). According to the semi-structured interviews conducted in the Abu Dhabi which is the capital of the UAE, three of the interviewees said their organisations only perform in supporting roles. Two organisations claim their roles are more directly with monitoring, forecasting and disseminating information about imminent adverse weather to the media and then to the public.

However, three organisations i.e. municipality, Civil Defence and NCEMA all claim to be responsible for either planning or responding to hazard incidents that can harm to community. In view of this, validation will be done with these three organisations to verify and assess their capability for deploying effective EWS as recommended by the model. However, the National Response Framework (NRF) also identified and mandate the police to be responsible for

response to all incidents either natural or man-made. Therefore, the framework is validated with the following emergency management organisations and departments:

1. Emirates fire and rescue company
2. Emergency and public safety department
3. Police ambulance
4. NCEMA – National Emergency, Crisis and Disasters Management Authority

To avoid repetition, the framework is validated with all these organisations in Abu Dhabi only being the capital city that coordinates and supports the operations of other emirates. Senior officials in the planning, operations and public safety department were requested to validate the framework, because these are the departments responsible for developing, coordinating, managing and using document procedures to respond to crisis, emergencies and disasters when they occur in the UAE. Based on this background to the validation process, the next subsection validate each element of the EWS Framework.

8.3.1 Validation of Risk Knowledge

The validation is aimed at the four main elements of EWS identified in this research. Therefore, for validation on best practice and principles pertaining to Risk Knowledge, the respondents claimed that their various organisations have or regularly utilise the elements indicated in Figure 8.1.

Figure 8- 1: The most used and validated Risk Knowledge principles and components

It can be observed from Figure 8-1 that the most utilised element of risk knowledge is clear roles and responsibilities of organisations involved in managing natural hazards. The top three elements validated in this figure shows that clear roles and responsibilities, preparedness and response planning and resources adequacy are considered top priority among the six organisations and departments.

A. Validation outcome for Risk Knowledge

It can be seen that the highest three elements selected are some of the essential principles of risk knowledge identified from the literature review in Chapter Two in Table 2-3. However, seeing that information on hazard and risk as well as legal framework, standards and policy were validated as low, it shows areas that need guidelines to be strengthened in order to improve practice of EWS in the UAE. This is because the literature review emphasised that all performance indicators for risk knowledge are important and not that some are more important that the others (*Chapter Two, section 2.6*). This is because they are all key to determining the extent to which preparedness, response planning, roles and responsibilities and resource adequacy are determined and effective (*Section 2.4*). However, it is not surprising to see this

outcome of validating the risk knowledge element of the EWS, because the analysis of data collected from the fieldwork showed that there is deficiency in the risk knowledge (*Section 5.5 and section 5.7.1*). The validation of risk knowledge element of the EWS Framework further emphasise the need for recommendation as stated in the previous chapter. As examined and analysed in countries where best practice were identified, risk knowledge had all five principles identified as key performance indicators under risk knowledge. Therefore, this validation process further identify the specific area which needs guidelines for the EWS Framework to be effective for mitigating the impacts of natural hazards.

8.3.2 Validation of Monitoring and Warning

Regarding best practice and principles associated with monitoring and warning in the UAE, it was validated as shown in Figure 8-2.

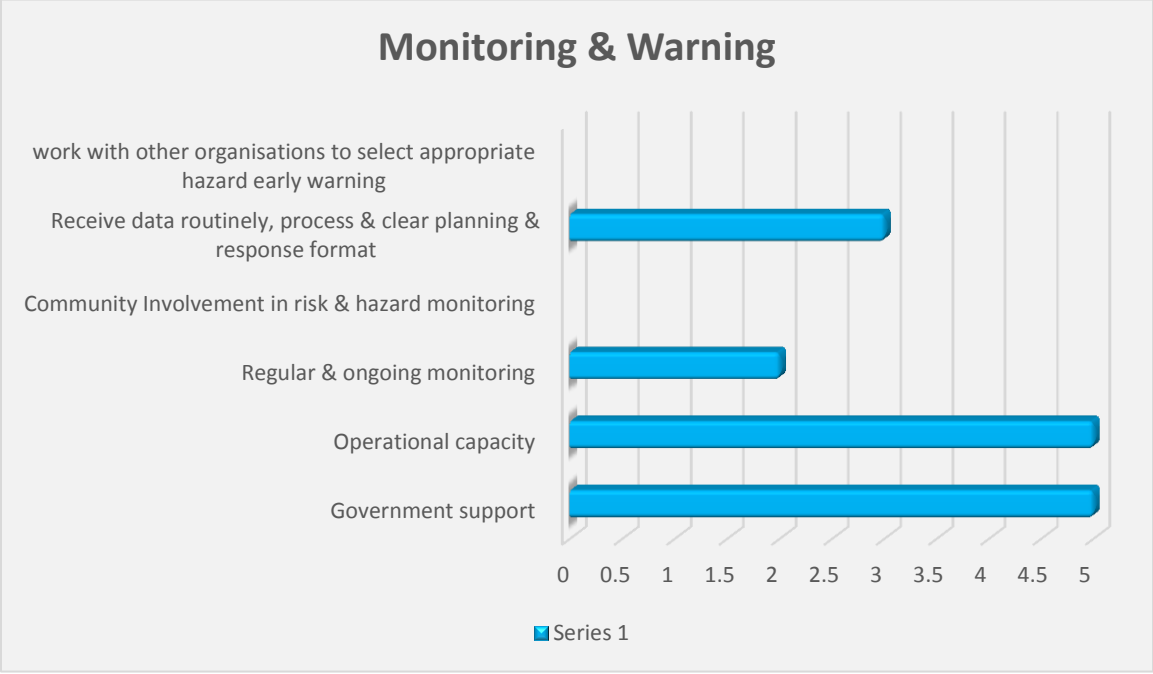

Figure 8- 2: The most used and validated monitoring and warning principles and components

Figure 8.2 shows that government support, operational capacity and ability to receive data routinely, the process and clear planning and response format were all validated as the most prominent in the UAE.

B. Validation outcome for monitoring and warning

Government support and operational capacity were the highest ranked in the validation process, which also relates to the principles identified under monitoring and forecasting in Table 2-3. Unfortunately, the validation shows that community involvement in risk and hazard monitoring are not even considered in the minimal capacity as key performance indicators. Although working with other organisations to select appropriate hazard early warning was also not ranked, the validation shows that recommendations are required as guidelines to improve understanding regarding community involvement in EWS. The literature review emphasised that operational capacity and political support are required for monitoring and forecasting to be effective, while the performance indicators vary but are based on the premise that government support is important (*Section 2.6*). However, the evaluation of several EWS framework in Chapter two suggest that the ones most effective are those which focus on community or involve community in EWS (*Section 2.4*). Therefore, not acknowledging or identifying the importance of community in the EWS in the validation of monitoring and warning gives cause for concern about the understanding of EWS in the UAE. Although the results from primary data collected through questionnaire and interview show that this element of EWS exists, the analysis of results show that they are insufficient and ineffective (*Section 5.3.2 B and C*). It can be said that the outcome of the validation explains the reason for their insufficiency and lack of effectiveness in reducing the impacts of natural hazards on the community at risk.

8.3.3 Validation of Dissemination and communication

Since the focus of this research is on implementing community-centred EWS for mitigating the impacts of natural hazards, it is important to involve community in EWS as shown in the framework.

As for dissemination and communication, Figure 8-3 shows the result of the validation.

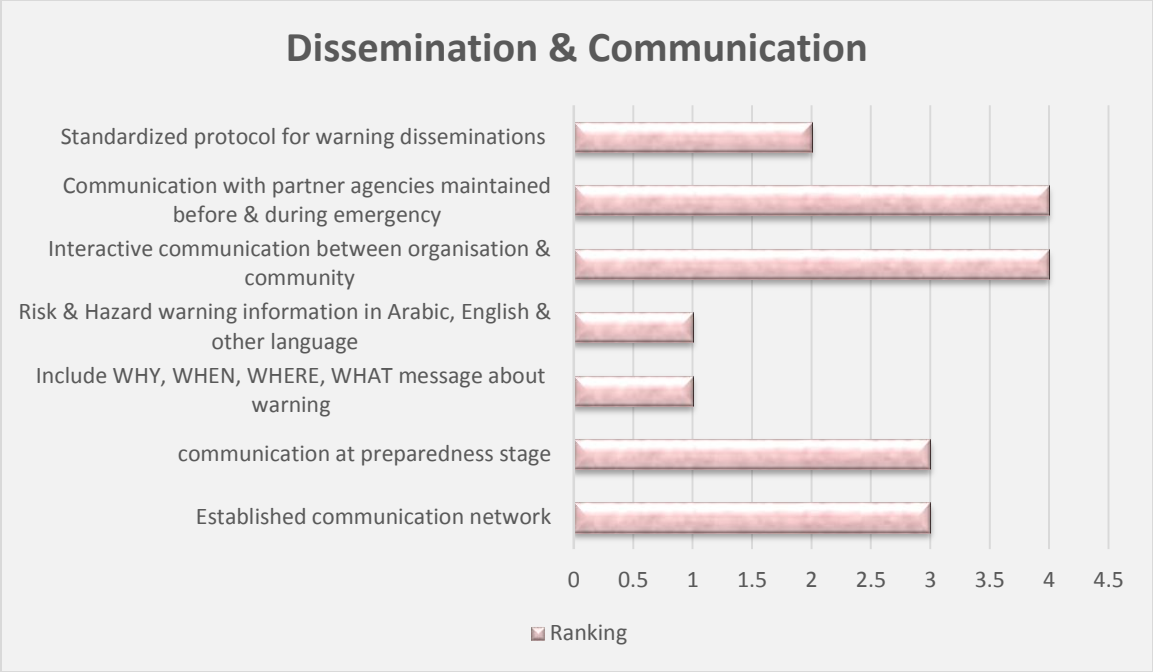

Figure 8- 3: The most used and validated Dissemination and communication principles and components

The validation process for this component of EWS, shows that communication with partner agencies maintained before and during emergency as well as interactive communication between organisation and community were ranked the highest. This is a contradictory outcome, because the ranking for monitoring and warning showed that working with other organisations for warning and monitoring is not considered at all.

C. Validation outcome for dissemination and communication

The result in Figure 8-3 shows that communication with partner agencies and interactive communication between organisations and community are important. A pattern of result such as this shows that there is limited understanding or some confusion about these two EWS components. This result is consistent with the result from the primary data collected through questionnaire and interview which indicated that dissemination and communication are insufficient in the two emirates (*Section 5.4.2 B & C*). However, the literature review stressed that warning messages, warning dissemination mechanisms and performance indicators are very important (*Section 2.6*). Emphasising that recommendation for improvement is needed.

Therefore, recommendations will be made to educate organisations responsible for emergency management about the differences but complementary roles of these two EWS components. In addition to this problem, the validation of this component also shows that principles such as warning messages, warning, and dissemination mechanisms were considered the least. These three principles are considered as essential principles of dissemination and communication from best practice in Table 2-3 in Chapter two. Hence, identifying and confirming the specific component of EWS that could have hindered the effective implementation of the framework for community centred EWS in the UAE.

8.3.4 Validation of Response Capability

The validation for response capability is presented in Figure 8-4, to show which principles were identified as operational in emergency organisations responsible for planning and responding to natural hazards.

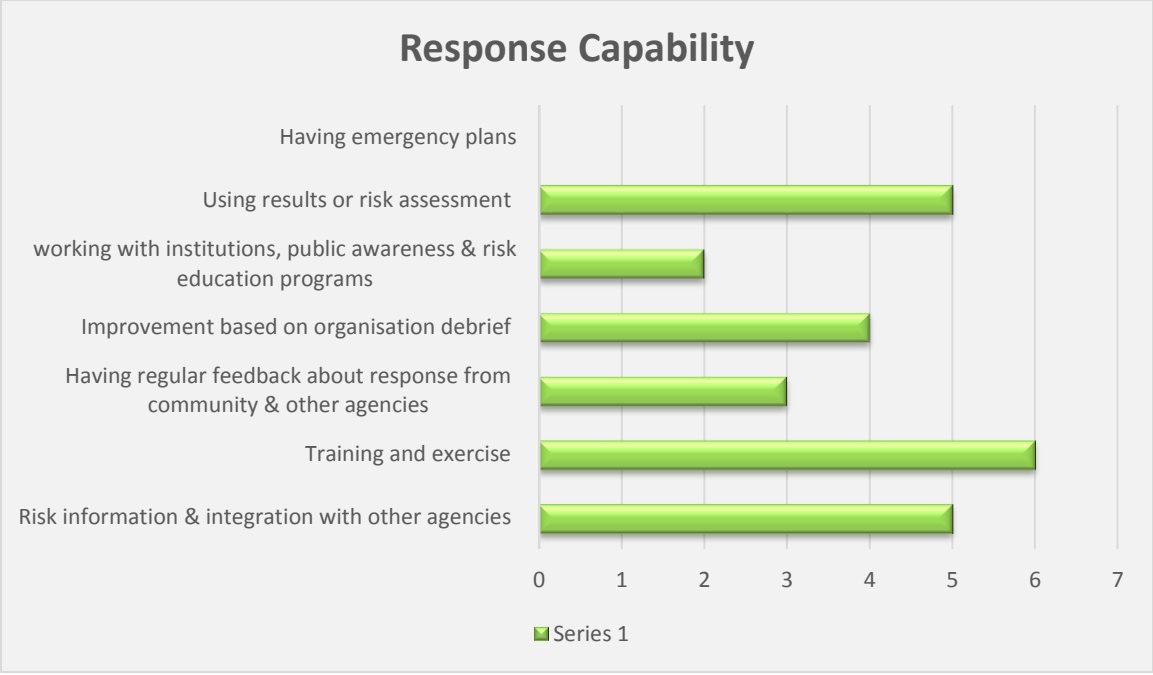

Figure 8- 4: The most used and validated Response Capability principles and components

The validation for response capability shows that training and exercise, using results or risk assessment and risk information and integration with other agencies are ranked the top three highest. Validating these EWS component shows that two of the three essential principles identified in Table 2-3 in Chapter two were ranked in this process. Therefore, emphasising that the lacking essential principle identified through this ranking is feedback and improvement.

D. Validation outcome for Response Capability

Although improvement based on organisation debrief was identified, it was not included in the top three ranked, and having regular feedback about response from community and other agencies as ranked low. Recommendations aimed at improving this EWS component will focus on this lacking principle. The outcome of this validation shows that the implementation of this element of EWS model might be problematic due to the outcome of this validation. Response capability was identified in the data result to be lacking (*Section 5.3.2 B & C*), although this validation shows that some of the performance indicator are present. Since risk integration, training and feedback and improvement are important (Section 2.6 in chapter two), it is important to enhance and further develop the response capability element of EWS. This is because this element of EWS is responsibility for the deployment of other elements as well as ensuring that safety is achieved during the onset of any natural hazard.

Therefore, to conclude the validation process, all the elements and components of EWS were evaluated to determine their current state of functionality and performance. In view of this, Figure 8-5 shows how all elements are qualified and ranked using scales such as very poor, poor, average, good and very good.

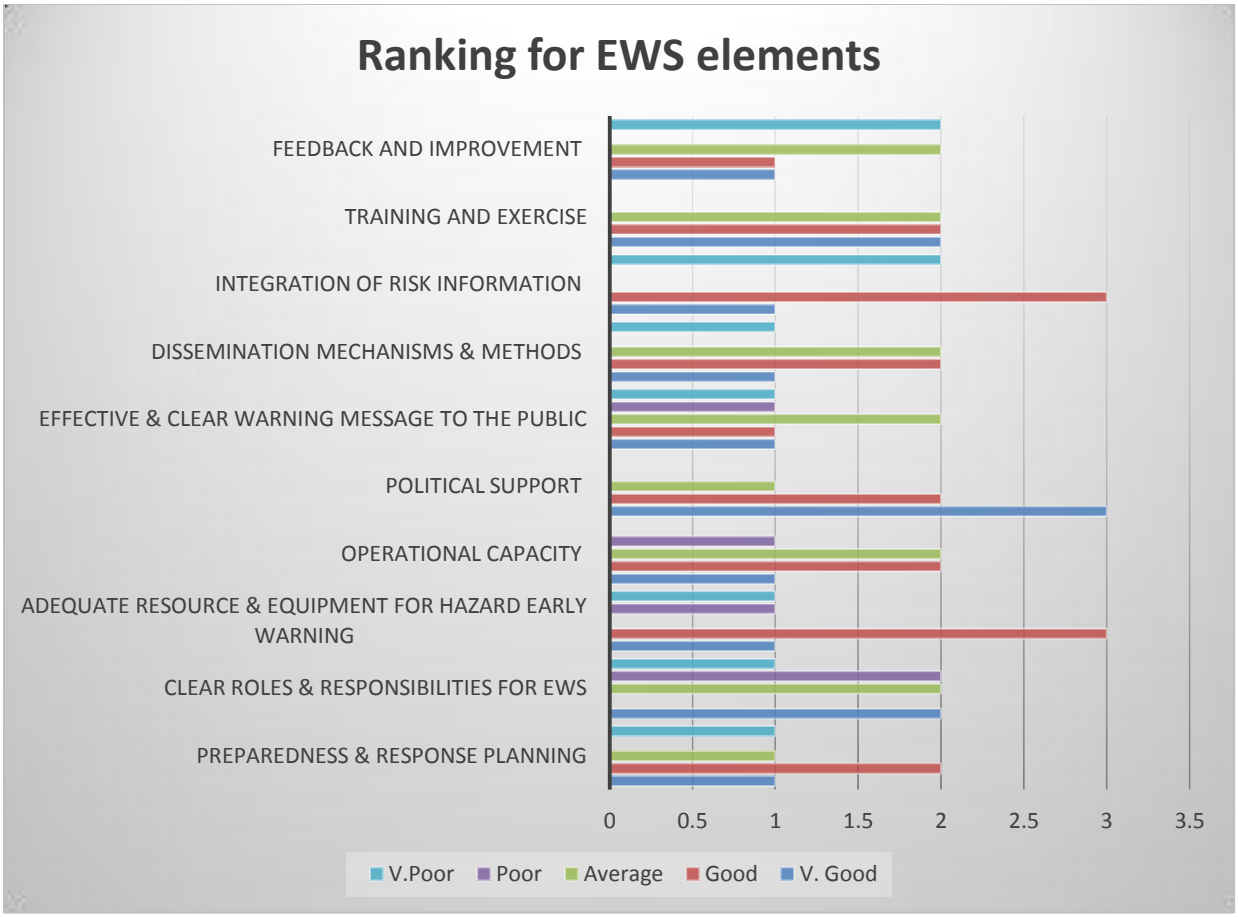

Figure 8- 5: Ranking for EWS Elements

This ranking shows that it was only political support that is ranked as very good. Integration of risk information, adequate resource and equipment for hazard early warning were the ranked as good. Other elements were ranked as good or average did not have high score as seen in the chart. This means that fundamental evaluation and assessment of EWS is needed in the emergency management sector in the UAE. While it is obvious that all these elements and components exists in the system, they are ranked and validated as low. This shows that the implementation of the community-centred framework developed in this research will experience difficulty if an evaluation is not conducted.

It also means that education and awareness training is required on the principles validated as very good and good to ensure their sustainability and continued enhancement (Basher, 2006). This conclusion about the validation process fits into the explanation and critical evaluation done in Chapter two, which particularly relates to the explanations provided by Basher (2006), Paton (2008), Glantz (2004) and Villangran de Leon (2012). Based on this result of the validation process, the next objective focuses on developing sets of guidelines based on the validation of the framework as identified in this section and under this objective for enhancing EWS in the UAE.

8.4 Discussion of Validation

Based on the validation of EWS framework, it is evident that guidelines are required in the UAE for the community-centred framework designed is to be effective. As a result of the validation process, it is evident that for the implementation of the EWS community-centred framework to be effective in the UAE, it is important that the limitations identified in the current UAE system is addressed. To do this, focus needs to be given to risk knowledge, monitoring and warning, dissemination and communication and response capability explained as thus:

Risk Knowledge: to improve risk knowledge, there is need to improve legal framework, standards and policy for EWS in UAE. This will help to strengthen the practice, because the result from risk knowledge and from the validation process shows limitation in this area which can hinder the effective implementation of community-centered framework.

Monitoring and Warning: there is need to educate all emergency management stakeholders in order to emphasize the need for community involvement in risk and hazard monitoring which is one of the key performance indicators of effective EWS (Basher, 2006). Evidently, there is need to improve understanding regarding the importance of community involvement in EWS, because this principle was missing in the validation process, but important as identified in the best practice (Paton, 2008).

Dissemination and communication: there is also need to educate about the difference between monitoring and warning activities and duties and that of dissemination and communication in

other to avoid further confusion. There is also need to use the potential consequences of hazard and implementation strategies to determine warning messages, warning and dissemination mechanisms. This is because during the validation process, these three principles of EWS were considered as the least, whereas they were identified as important principles of EWS in the literature review.

Response capability: the validation shows that no form of feedback on response capability involves community at risk. This means that the EWS monitoring and evaluation stage will focus on identifying this principle as one of the indicators and as one of the positive outcomes of effective EWS framework.

Thus, this validation process have demonstrated that the EWS framework developed from this research result can be maintained and monitored, thereby confirming the fourth validation question in table 8-1. Given that each element have been evaluated in view of determining their 'fit for purpose' and adaptability for use in the UAE. The fifth question have also been answered through the validation process showing that the framework allow data to be collected in view of determining and predicting the efficiency and deficiency of elements of the framework. With the validation process, it can then be inferred that without guidelines to support the use of the EWS framework, it can be less efficacious. Therefore, all questions in Table 8-1 have been answered which supported the justification for the validation process. It is also observed that as a result of this validation process that guidelines are necessary for the EWS framework to efficacious and effective.

8.5 Guidelines for EWS Framework

As a result of the validation process, it is established that guidelines are required for the EWS framework to be effective and efficacious especially with the focus on community as the centre of EWS as required in the UAE. Thus, in view of advancing and ensuring that community-centred EWS framework is effectively implemented, the following guidelines are necessary:

1. Early Warning System agenda setting: entails defining and establishing the **parameters of EWS in the UAE as community-centred EWS**. Setting of agenda in this step will also include forming policy that encourages the application of community-centred EWS framework.

2. EWS Development: this second step is based on good education and raising of awareness about component and principles of EWS as identified in this research. This step also includes risk assessment, assessment of emergency responders' capabilities and educating all stakeholders about the components, principles and key performance of EWS. This step is very important because the validation process shows that emergency management stakeholders in the UAE are not well informed or consider the principles, components or key performance of community-centred EWS as high priority. There is no way the implementation of the framework developed in this research will be possible with such perspective about EWS that involves community involvement as emphasised by Basher (2006).
3. EWS Review: includes the process of evaluation and further research into geological and hazard scope of UAE to identify risks of natural hazards in order to develop a comprehensive risk plan (Alexander, 2005). This will also include need to include feedback in policy making that can correct all limited, wrong and ineffective measures used.
4. EWS Implementation: A process which includes definition of roles of all stakeholders include and especially community. Tasks should be assigned where and when necessary so that coordination with applicable sectors will be possible. This stage will also include development and enforcement of dissemination and communication mechanisms to raise public awareness of EWS before any hazard.
5. EWS monitoring and evaluation: This guidelines include setting up transparent and independent framework for monitoring and evaluating warning systems and mechanisms for communication. Measureable and key indicators will be defined as strengthened monitoring and forecasting, increased risk knowledge, established communication mechanisms and action informed messages and response capability that involves community at risk. It is by so doing, that positive process, outputs and outcomes are identifiable when they occur (Golnaraghi, 2012). In order to determine this, the minimal base level indicator needs to be established so that EWS implementation process are regularly monitored and evaluated to determine impacts of EWS. This process also includes feedback from all stakeholders to identify problems and prioritise actions for solving them.

These five main guidelines are further designed as simple steps to illustrate their progression and application using Figure 8-6.

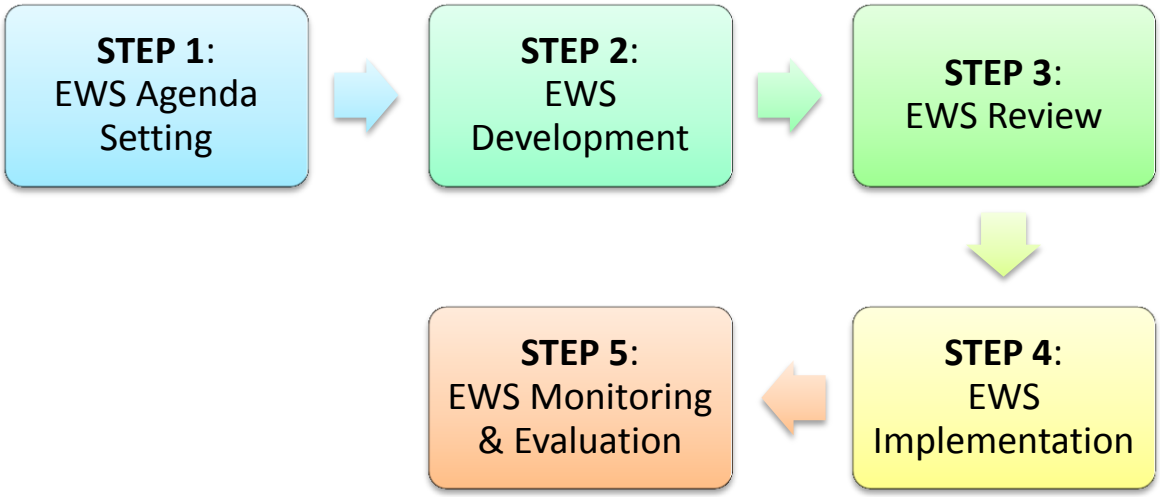

Figure 8- 6: Guidelines for effective implementation of framework

These five steps show the guidelines which can help emergency management stakeholders in the UAE to effectively implement community-centred framework developed as a result of undertaking this research. Every objective of this research has helped to examine, critique, identify and determine best practice, components, key indicators and performance that helped to design the EWS. These guidelines are essential in ensuring that the limitations identified from the validation do not hinder the effective implementation of the community-centred EWS framework.

8.6 Summary of Chapter

This chapter has justified the need to validate the EWS framework designed from the research result. Based on the justification, a validation of the EWS framework was conducted using as assessment process that involved six experts and professionals from organisations responsible for emergency management in the UAE.

The result of the validation shows that all elements of EWS require improvement and development. The validation outcome also show that guidelines are necessary in order for the implementation of EWS to be effective and efficacious. Thus, this necessity resulted in section 8.5 which emphasises the role the guidelines aim to play in implementation of the EWS framework designed as a result of this research. Therefore, this chapter have been key in achieving objective five and objective six respectively. This means that this chapter is significant as it helps to achieve the pending research objectives. Since all research objectives have been achieved, the next section is devoted to recommendations and conclusion.

CHAPTER 9: CONCLUSIONS AND RECOMMENDATIONS

9.1 Introduction

The aim of this chapter is to conclude this research as well as outline the recommendations for improving the EWS in the UAE. This chapter is divided into three sections, with the first outlining the main findings of this research. The last two sections are both the recommendation section, and the limitation and conclusion sections respectively. The last section summarises the outcome of each research objective by indicating the findings for each objective and its indication for what is required. Recommendation section builds on the information provided in the conclusion section as well as discussion and implication of findings in the last chapter. The recommendation chapter is important in emphasising the way forward in the UAE in terms of improving and ensuring that EWS deployment is effective in the UAE. Therefore, the recommendations outlining the areas that require further research and action plans that will ensure that community-centred EWS framework is effectively implemented in the UAE. The last section of this chapter and research identifies the research limitations and measures taken to successfully conclude this research.

9.2 Conclusions of objectives and Key findings

As part of the research conclusions, this section presents the main findings of this research by identifying the focal point of the discussion chapter and the main outcomes of each objective. As observed throughout this research, there are specific findings and outcomes which are:

1. The identification of EWS best practice, components, principles and key performance indicators that were used to develop the community-centred EWS framework recommended for use as effective deployment of EWS in UAE. These were the outcomes of objective 1 and is crossed referenced to sections 2.4, 2.6, 5.7 and 6.2 respectively.
2. The existing deployment of EWS in UAE is ineffective, insufficient and not according to best practice of EWS identified in countries with resilience to disasters. After examining EWS principles and key indicators used in countries such as Bangladesh, France, Cuba, Germany, Japan, US and China, the essential components of EWS were identified. The

concept of EWS explained by Basher (2006) and the UN were also key in identifying the gaps and problems in the current practice in UAE. This was the outcome and findings of objective 2 and findings can be crossed referenced to sections 3.3, 3.4, 3.5, 5.7 and 6.2.

3. It was also discovered that due to the demands, characteristics and requirements for managing natural hazards, it is impossible for emergency management organisations and government organisations to manage EWS alone. Therefore the outcome of objective 3 which was "to evaluate the EWS requirements for community and stakeholders in the UAE", showed that there is need for partnership or collaboration between community and all stakeholders. The outcome of objective 1 and 2 also contributed to this results of objective 3 because the countries examined for best practice in EWS showed that all successful early warning mechanisms were done in partnership. According to Fakhruddin, (2014), ability to mobilize institutions and partners is important for more successful implementation of early warning messages and for saving lives. Therefore, the requirements for community and stakeholders in the UAE is to work in partnership for improving risk knowledge, forecasting and monitoring, dissemination and communication as well as response capability. This finding can be cross referenced with sections 2.3 and 2.4 respectively in chapter two which emphasizes the importance of engaging stakeholders.
4. The outcome of objectives 1, 2 and 3 played an important role in developing the community-centred framework that can be used to facilitate successful and effective EWS in the UAE. Since this is the main aim of this research a comprehensive framework was developed that can be used to increase response capabilities against the risk of natural disasters in the UAE. This framework in Figure 5-33 in chapter five shows all the essential areas, components and factors necessary for improving the deployment of EWS in the UAE. However, it became pertinent to validate this framework and its components beyond just stating it as a requirement, which led to the achievement of objective 5. This finding is justified in section 5.7 which shows the limitations in the current arrangements in the UAE and the need for validation conducted and explained in section 6.2, 6.3, 8.2 and 8.3 respectively.
5. The findings from objective 5 shows that community involvement in EWS is not currently considered as a priority and as an important strategy for improving EWS in the

UAE. This outcome and other issues identified from the validation process strongly suggest the need to educate emergency management stakeholders in the UAE on the relevance, benefits and importance of community involvement in EWS. Moreover, it will be challenging, if not impossible to implement a community-centred framework in a system that does not prioritise the involvement of community at risk in EWS. This major issue led to the careful design of guidelines that can ensure the adoption, and successful implementation of the framework designed in this research for improving EWS. This finding takes clue from section 8.2, 8.3, 8.4 and 8.5, all discussed and justified the relationship between the framework and guidelines designed.

6. The sixth objective ensured that a 5-step guidelines focus on the issues identified that can hinder the implementation and sustainability of community-centred framework developed in this research. The 5-step guidelines have important instructions for agenda setting, education and awareness, risk and capability assessments, development and implementation based on defined measureable and tangible indicators as well as monitoring and evaluation process for feedback. Section 8.5 is devoted to this findings which illustrates the steps to be taken should EWS framework designed and developed in this research is to be effectively implemented.

These main findings and outcomes has helped to ensure that the research aim which is "to develop a framework for integrated community-based early warning system in the United Arab Emirates, in order to increase response capabilities against the risk of natural disasters" is achieved. In addition to this, the above listed findings which links to the research objectives further confirmed the achievement of the research objectives and the findings from each objective. These set of results both distinguishes this research as well as demonstrate the contribution to knowledge in emergency management. Regardless of the research findings, recommendations are provided in the next section to ensure that all findings and outcomes of this research are taken on board and applied as required.

9.3 Recommendations

This section on recommendations is divided into two main parts; recommendation for future research and recommendation for practice in the field of emergency management in the UAE. This decision is to ensure that some of the issues identified in this research, but which are outside

of this research aim and objectives can be examined further as a major research area. Also, it is important that the findings of this research are appropriately taken on board and into implementation in the best suitable way in the UAE or any country with similar problems as the UAE.

9.3.1 Future Research Recommendation

Some specific areas have been identified during this research as requiring further investigation. This is because while this research investigates EWS in general, it focuses on the research aim which is "to develop a framework for integrated early warning systems in community in order to increase response capabilities against the risk of natural disasters in the UAE". However, it is evident that community-centred EWS is a new and developing area of EWS. Therefore, the following are recommended as topics for future research:

a) Investigation on theories in community engagement that can be used for enhancing community-centred EWS.
b) Relevance of academic models and theories that can be used for promoting awareness and education on hazard specific EWS as well as generic hazard EWS.
c) Academic explanations and limitations of EWS principles, best practice, components and indicators as a means of identifying sustainability challenges for implementing early warning mechanisms in developing countries.
d) Critical contrast between EWS used in developing countries and more economically developed countries.
e) Investigation into multidisciplinary approaches in EWS that can be adopted for ensuring disaster resilience and communication mechanisms of warning messages in disaster prone communities.

These five recommendations for future research such the focal areas that can be further investigated within academic context.

9.3.2 Recommendation for practice

The recommendation for practice as explained in this section combines the importance of the framework and the guidelines developed as a result of the research outcomes. For

implementation of the framework developed it is important that the specific steps designed as guidelines are followed by government in the UAE and the emergency management stakeholders. Thus, the recommendation for practice are required in two main stages.

Stage 1: adopt guidelines which comprises of 5-steps. The steps combine policy formation, implementation, education and awareness, and agenda setting to determine the parameters of EWS in the UAE. This stage will have the community-centre EWS framework developed in this research as the focal point for policy formation, education and implementation. All principles, components and performance indicators should be embedded in this stage.

Stage 2: includes the adoption of recommendations made in this section to ensure sustainability of framework. Recommendations for this stage includes:

a) Annual collection of data to evaluate risk of natural hazards and assess institutional networks for the purpose of EWS in the UAE (Fakhruddin, 2014). The purpose of this is to analyze the system and level of community involvement.
b) Increase knowledge and capacity which entails determining the level of risk knowledge in the community and ability to prioritize action plans for reducing the risk of natural hazards through community-centered EWS. This recommendation also include defining how to strengthen capacity and knowledge of community and emergency management stakeholders. The implementation of this recommendation will be based on the data collected in (a).
c) Increase response capacity and communication mechanism so that best approaches for each community and locality can be identified and determined. This will ensure that warning messages translate into proactive actions.

The fusion of stage 1 and 2 is presented in Figure 9.1

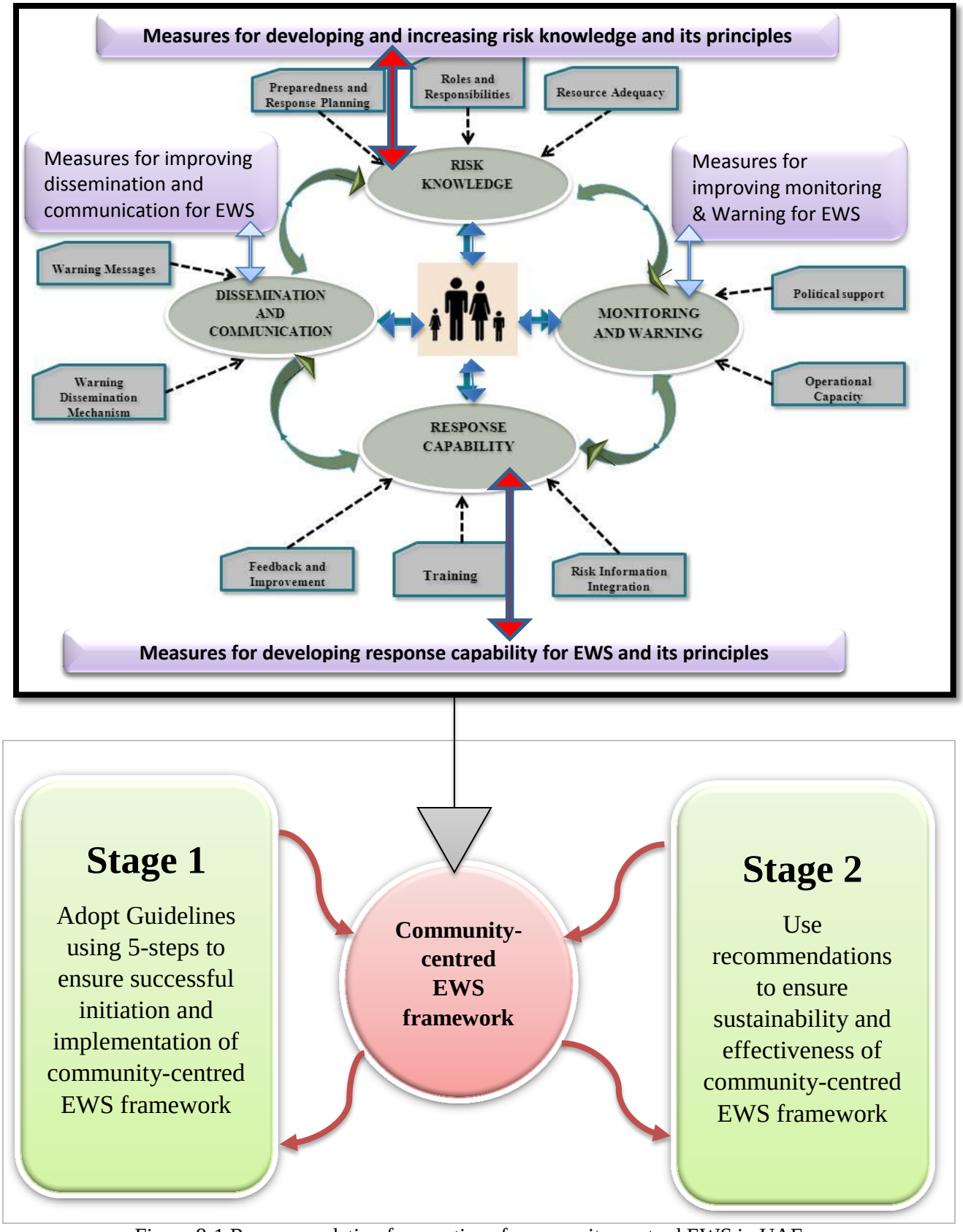

Figure 9-1 Recommendation for practice of community-centred EWS in UAE

With these recommendations provided, it is believed that community-centred EWS will both be successfully implemented in the UAE as well as sustainable in the long-term.

Based on the recommendation for future research and practice as done in this section, it can be seen that this research has contributed to both knowledge and practice in the field of emergency management. It also shows the possible advancement that can be made in theory and practice of EWS in view of developing the field in order to increase resilience to disasters.

9.4 Contribution to Knowledge

This research contributes to knowledge by providing in-depth understanding of EWS and the essential principles, best practice and elements required for ensuring effective application of EWS in any country. It also contributed to understanding of effective disaster preparedness under which EWS is embedded to ensure that communities at risk and emergency organisations are better prepared to deal with the onset and impacts of natural hazards. Another contribution to knowledge in this research is the explanations and provision of EWS that incorporates the roles and responsibilities of community at risk to cover all elements of EWS. This contribution is unique and distinguishes this research among any existing research on disaster preparedness and early warning system.

Like many PhD research, this one has provided clarity on the problems existing in the UAE in cities prone to the impacts of natural hazards and the explanations for why the problems exists. In addition to this, the contribution to knowledge in this research have also provide solutions through the development of an EWS framework that can be used in the UAE context, but also contain best practice and essential principles of EWS that can be applied in any context related to the ones described in this research. But more importantly, the PhD contribution have emphasized the relevance of community involvement in ensuring effective EWS. Through this research most community leaders and stakeholders have indicated their interest in being part of community consultation process for EWS in their respective cities. During this process, this PhD has also contributed to knowledge through all the publication made and increased awareness of EWS

issues in the UAE, and the need for community involvement in EWS planning and implementation.

9.5 Limitation of Research and Conclusion

This research has posed some challenges as experienced in many researches. Although all objectives were achieved, it was still challenging to achieve them. There were the problems with limited literatures on the topic in the UAE. There were also problems of accessibility to government reports and data which could have helped to make this research more robust. Regardless, being able to examine EWS in seven other countries helps to manage this research limitations and to ensure that objective outcomes were achieved. The persistence of the research thus ensured that this research is thoroughly carried out so that this research content can constitute as literature for future researches in this area.

In conclusion, this research has served as learning curve for the researcher and the UAE in identifying the scope and the status of deployment of EWS in the country. While some elements exists in minimal capacity, others are not operational within the required context for best practice in EWS. Therefore, adequate recommendations have been made in this research to both develop and improve areas that require specific and urgent actions. It is the role of government, and emergency management stakeholders to ensure that the recommendations provided in this chapter are adopted so that the community-centred framework can be successfully implemented. By so doing, the cooperation and collaboration of community at risk and other communities will be obtainable.

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Appendix A: Ethical Approval

Participant Information Sheet

Title of Study: Developing a Framework to Integrated Early Warning Response Capabilities to Enhance Disaster Resilience in the UAE.

Study Subjects

You are being invited to participate in this research which study on the current situation of the Early Warning Response Capabilities to Enhance Disaster Resilience in the UAE. Before you decide to take part, it is important for you to understand why the research is being done and what it will involve. Please take your time to read the following information carefully. You may also wish to talk to others about the study. Please ask if there is anything that is not clear or if you would like to have more information and please take time to decide whether or not you wish to take part in this study. Thank you for reading this.

What is the purpose of this study?

The aim of this studyis to develop a framework to integrated early warning response capabilities against the risk of natural disasters in the United Arab Emiratesby understand of end user government, stockholders and community requirement for EWS and map capabilities of existing EWS against user requirements. The findings will direct the development of early warning responses against the risk of natural disasters in the UAE. This will enable the UAE to better prepare for disasters resilience.

Do I have to take part in the study?

Participating in this study is completely voluntary and you may withdraw at any time. Also, even after agreeing to participate in our study, you are still free to withdraw at any time and without giving a reason.

What will happen to me if I take part?

You will be interviewed at a location of your preference. The whole interview will take approximately 60 minutes to complete. The transcribed data will be sent to you for confirmation. With your permission, the interview will be recorded. The recorded interview and information will only be used anonymously and for academic purposes. It will not be possible for any participants be personally identified. Information on individuals (such as name, gender, age, ethnicity, religion and so on) will not be revealed under any circumstances.

Meanwhile, we would like to indicate to you the following points for which your consent is needed. This is completely up to you. We will only use the records in ways that you agree to:

1. In any use of these records, your personal information will not be identified.
2. The anonymized records can be studied, transcribed and analysed by the interviewer only according to the research aims.
3. The anonymized records can be used for scientific publications and/or meetings.
4. The anonymized records can be shown in presentations to scientific or non-scientific groups.

   Please be assured that confidentiality is highly protected for this survey. The transcribed interviews will be kept with no identifying information. The personal information collected about you in the beginning of the interview is only for discerning patterns in the data collected and could never be used to identify you personally. All data collected will be kept and accessed only by the researcher and the supervisor of this research and will never be made available for other parties or be made public.

What do I need to do?

If you decide that you would like to take part in the study, please contact the researcher (Abdulla Ali Ahmad Al hmoudi, e-mail:A.A.Hammoudi@edu.Salford.ac.uk), who will arrange a convenient appointment time for you to participate and for us to answer any questions you may have. If you consent to the information on this sheet, you need to sign a consent form. Please be ensured that you can withdraw at any time even after signing the consent form.

What are the potential benefits from taking part?

Whilst there are no immediate benefits, i.e. monetary benefit, for those people participating in the project, it is hoped that this work will help to provide first hand evidence of the current situation. The study will also give us an opportunity to deepen our knowledge related to shortcomings in current of the Early Warning Response Capabilities in the UAE. And contribute to the Developing a Framework to Integrated Enhance Early Warning Response Capabilities to Enhance Disaster Resilience in the UAE.

What are the potential risks, discomforts and inconveniences from taking part?

There will be no possible disadvantages and risks of whatsoever for participating in this study. There are no risks of severe injury or discomforts that might occurred. This is because the research study only deals with limited respondents and only deals with the technical issues. As participation is voluntary, you may wish to discontinue the interview at any time or choose not to answer any particular question or not to participate at all.

Will I be paid for taking part?

You will not be paid for your participation in this research.

What will happen if I don't want to carry on with the study?

You are free to withdraw from the study at any time without giving a reason.

What if there is a problem?

If you have any concerns about any aspect of this study, you may want to speak with the main researcher (see contact details below), who will answer your questions. If you remain unhappy and wish to complain formally, you can do this by either contacting the main supervisor (DrZeeshan Aziz; Email:**Azizz.aziz@salford.ac.uk**).

Will my participation in this study be kept confidential?

All information obtained in connection with this study will be treated as privileged and confidential. All information will be anonymous so that you cannot be identified, except by a single Participant Identification Form, which will be saved electronically on a password protected computer. The results obtained from this study will be kept for possible use in future

studies, whereby all personal data will be deleted in three year from the time completion of the research.

What will happen to the results of the study?

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

Who is organising and funding the study?

This is a post-graduate research in fulfilling the requirements of PhD in Developing a Framework to Integrated Enhance Early Warning Response Capabilities to Enhance Disaster Resilience in the UAE. The research is organised by the School of the Built Environment at The University of Salford and funded by Ministry of Interior Affairs, United Arab Emirates. It is being led by Abdulla Ali Ahmad Al hmoudi (a PhD Candidate at The University of Salford) and supervised by Dr Zeeshan Azizat The University of Salford.

Who has reviewed the study?

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

Contact for further information

For further information, please contact:

Name: Abdulla Ali Ahmad Al hmoudi
Address: Room 413, School of the Built Environment, 4th Floor, Maxwell Building, the University of Salford, M5 4WT, Manchester, United Kingdom.

Tel:00447776536604 _00971502386690
E-mail:A.A.Hammoudi@edu.Salford.ac.uk

Supervisors contact details:

1. Name: Zeeshan Aziz
   Address: University of Salford Maxwell Building Room 508b.
   E-mail:Azizz.aziz@salford.ac.uk

Appendix B: Case Study Strategic Level Interview Guide Line

Research Title:

DEVELOPING A FRAMEWORK TO ENHANCE EARLY WARNING RESPONSE CAPABILITIES OF DISASTER RESILIENCE IN THE UAE

Dear Participant,

You are being invited to take part in a research project. Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask if anything is unclear or if you would like more information.

Aim of the interview

This interview is conducted based on an on-going PhD research that aims to develop a framework to integrated early warning response capabilities against the risk of natural disasters in the United Arab Emirates. Hence, the study focuses on investigate the existing deployment of EWS in the UAE; understand the community and stakeholders requirements for EWS. So the interview covered the four section ,which includes 10 main areas: (1) Preparedness and Response Planning(2)Roles and Responsibilities(3) Resource Adequacy(4) Warning Messages(5) Feedback and Improvement(6)Training(7)Operational Capacity(8) Warning Dissemination Mechanisms (9) Risk Information Integration (10) Political Support.

Confidentiality

The data collected will be treated with strict confidentiality. If you decide to participate in this study, your participation and any information collected from you will be strictly confidential, and only available to the research team. There are no right or wrong answers for the provided questionnaires. Please do not hesitate to ask any questions if anything is unclear to you.

Can I pull out of the study at any time ?

You can pull out of the study at any time you like .No questions will be asked as to why you want to pull out, and any information you have given will be destroyed.

What will happen to me if I take part ?

If you do decide to take part, you will be given this information sheet to keep and you will be asked to sign a consent form for participation. To participate in this research project, you will be provided with questionnaires.

Time of the interview

It will take 40-60 minutes to complete the provided questionnaires. The instructions for these questionnaires will be given to you in writing and verbally to make sure that you have understood and accept the research

Personnel information about the interviewee

Name of interviewee:

Job title:

Type / Name of organization:

Contact information

Telephone:

E-mail:

Date of interview:

Section 1: Risk Knowledge

1- Does any Early Warning System (a system to give an alert before and event starts based on certain indicators) for natural disasters such as local storm, tropical cyclone, flood, earthquakes and landslides) exist in the UAE?

2- Can you explain your roles and responsibilities with respect to EWS?

3- What is the resource adequacy to reduce risk from natural hazards?

Section 2: Monitoring and forecasting

4- Do you have any support (financial or otherwise) from the government to monitor, warn and forecast for EWS?

Section 3: Dissemination and Communication

5- Do you release or receive the warning messages?

6- In your opinion, what is the best media or medium to use to deliver early warning to the community?

A. Radio. B. Television

C. Acoustic signal such as siren, loudspeaker D. Internet.

E. SMS to the cell phone F. Land phone calling.

G. A person giving the warning “door to door” H. Other, please specify

Section 4: Response Capability

7- Do you have a process for assessing the response capability through feedback or other means so that you can learn from your ability to respond to natural hazards?

8-Does your institution hold emergency exercise for preparation and to test EWS in case of an emergency in the community?

9-What type of information on natural hazards do you think is needed the most to respond appropriately after receiving EWS?

a. Maps B. statistics C. Reports D. Others, please specify

10- Are hazards, vulnerabilities and risks monitored on an ongoing basis?

11- In the present, can people in the community obtain information about natural risks and hazards from your organization?

Appendix C: Questionnaire

Research Title:

DEVELOPING A FRAMEWORK TO ENHANCE EARLY WARNING RESPONSE CAPABILITIES OF DISASTER RESILIENCE IN THE UAE

Dear Participant,

Depending on your experiences and caring of our society safety and security, I am pleased and honoured to invite you to participate in this survey. Please take time to read the following information carefully and discuss it with others if you wish. Ask if anything is unclear or if you would like more information.

Aim of the interview

This survey is conducted based on an on-going PhD research that aims to develop a framework to integrated early warning response capabilities against the risk of natural disasters in the United Arab Emirates. Hence, the study focuses on investigate the existing deployment of EWS in the UAE; understand the community and stakeholders requirements for EWS. So the survey covered the four section ,which includes 7 main areas: (1) Preparedness and Response Planning(2)Roles and Responsibilities(3) Warning Messages(4) Warning Dissemination Mechanisms (5) Training(6)Operational Capacity(7) Risk Information Integration

Confidentiality

The data collected will be treated with strict confidentiality. If you decide to participate in this study, your participation and any information collected from you will be strictly confidential, and only available to the research team. There are no right or wrong answers for the provided questionnaires. Please do not hesitate to ask any questions if anything is unclear to you.

Can I pull out of the study at any time ?

You can pull out of the study at any time you like .No questions will be asked as to why you want to pull out, and any information you have given will be destroyed**.**

What will happen to me if I take part ?

If you do decide to take part, you will be given this information sheet to keep and you will be asked to sign a consent form for participation. To participate in this research project, you will be provided with questionnaires.

Time of the survey

It will take 30-35 minutes to complete the provided questionnaires.

How to fill the questionnaire

I hope you objectively and clearly answer the questions of the survey by inserting the sign (X) inside the circle consistent with your opinions.

basic definitions (survey keywords)

Natural disasters: natural disasters are sudden strong events resulted from climatic factors, which might occur any time without early warning. The natural disasters can result in serious injuries for people and damage for properties. They include; earthquakes, floods, storms and wind, hurricanes.

Early Warning System: it is known as providing the information at the appropriate and effective time through the designated authority, which allows the endangered people to take the required procedures to avoid or minimize the risks and be prepared for affective reaction (The International Strategy of reducing disasters, 2004).

Tropical hurricanes: tropical hurricane is a storm distinguished by low-pressure centre and many thunderstorms, which create a very strong spiral wind, heavy rainfall and floods.

Tsunamis: a group of high waves resulted from large area of water, the tsunami caused by earthquakes, volcanoes or nuclear explosions under the sea water.

Demographic Factors

- **Date:** ……..
- **Emirate:**

◯ Abu Dhabi ◯ Fujairah

- **Sex:** ◯ Male ◯ Female
- **Nationality (origin country):**
- **Age:** years.

- **Education:**

◯ Less than High school ◯ high school
◯ Intermediate college ◯ University graduate

- **field of work:**

◯ Agriculture ◯ Industry ◯ Education ◯ unemployed
◯ Police ◯ Army ◯ banks ◯ housewife
◯ Retired (previous job) ◯ others (please specify) ……

Section 1: Risk Knowledge:

1. How concerns do you feel when you think about natural hazards in your community?

1. Not at all 2. A little 3. Moderately 4. A lot 5. Completely

2. Can you explain your roles and responsibilities with respect to EWS?

A. Yes, but l didn't suffer any damage or injury

B. Yes and l was directly affected by it

C. No but l Know there had been some before in this particular municipality

D. No, and I haven't heard about any in this Region.

If yes, please specify briefly which Hazard WHEN, WHERE AND WHAT happen and if there were any injured or damages

……
…….

3. How dangerous do you think the following hazards are in your region?

Use a scale from 1= without consequence to 5= Very dangerous.

	Without consequence	Lightly dangerous	Dangerous	Highly Dangerous	Extremely dangerous
Tropical cyclone	1	2	3	4	5
B.Landslides (downward movement of amass of rock, earth)	1	2	3	4	5
C. Local storm	1	2	3	4	5

D. Rock falls	1	2	3	4	5
E. Floods	1	2	3	4	5
F. Tsunami	1	2	3	4	5
G. Earthquakes	1	2	3	4	5
H. other, specify…….	1	2	3	4	5

4. Which of the previous hazards scare you the most? ……..

5. How do you think climate change influence the frequency and magnitude of hazards?

1. Not at all 2. A little 3. Moderately 4. A lot 5. Completely

6. How often do you use weather forecast?

Frequency	Value	Remarks
Everyday	5	
Every 2 days	4	
Twice a week	3	
Once a week	2	
Never	1	

7. After receiving warning, how do you respond to warning, do you still stay at home to save your properties?

8. Do you know the emergency procedures for your emirates in case there is any disaster?

9. Have you or anyone in your family participated in civic protection exercise, volunteered for the civil defense of any emergency community groups before?

A. Yes B. No, if yes please specify which group

10. Would you like to attend any public meetings or forums for your region which informs the community about natural hazards and emergency procedures?

A. Yes B. No

11. How important do you think an educational public meeting about natural hazards would be for your region?

1. Not important at all 2. Not important 3. Important

4. Very important 5. Fundamental

12- Who do you think should be responsible for issuing early warning for natural hazards?

A. Municipality B. police

C. Civil Defence D. Mass media

E. Neighbors F. Yourself or your family

G . Others, please specify

Section 2: Monitoring and forecasting

13. What is more important to you; early warning/accurate forecasting or both?

Section 3: Dissemination and Communication

14. Have you ever received early warning messages prior to the occurrence of a natural hazard in your area?

OYes ONo

15. How would you like to receive the information about natural hazards?

ORadio	OPress
OSMS to you mobile	OInternet
OTV	OOfficial reports
OMedia meeting	ONews broadcasting
O Street posters	OFamily Members

O Other means.....

16. Do you think a web-based warning and forecasting system could be helpful in delivering warning and forecasting warning to reach more people?

Section 4: Response Capability

17. Do you know if there has ever been any workshop, forums or informing meetings or discussion about risk related to natural hazards in the emirates or area where you are living?

1. Yes, I attended.
2. Yes, but I didn't attend
3. No, there was not any such activity
4. I don't know

a. Did not have time.
b. didn't have time
c. not interested
d. Other reasons.

18- Do you know if there has been any emergency exercise for preparation and evacuation in case of emergency related to natural hazards in your emirates?

5. Yes, I attended.
6. Yes, but I didn't attend
7. No, there was not any such activity
8. I don't know

e. Did not have time.
f. didn't have time
g. not interested
h. Other reasons.

19- Do you think public authorities must provide the required training for improving disaster management and early warning systems?

Oyes ONo OI don't know

20- Do you think the UAE should learn from the experience and experiments of countries using best practice in early warning systems?

Yes. Explain how? …….....

No. Explain why not? .....

21- Have you ever received risk information about natural hazards in your region?

A. Yes B. No

22- How would you describe the quality of risk information you reviewed about natural hazards?

Nonexistent	Poor	Acceptable	Good	Really good
1	2	3	4	5

23 - Would you look for new risk information about natural hazards? For example, attend a public meeting, look for specific website, and/or consult public or scientific documents?

A. Yes B. No

24- Who do you think should provide risk information about natural hazards?

A. Local/municipal Authorities B. police

C. Regional Authorities D. National Authorities

E. Civil Defence F. Media (Journalist)

H. Other, please specify

25-How concern does you feel about natural hazards after completing this questionnaire?

1. Not at all 2. A little 3. Moderately 4. A lot 5. Completely

Thank you so much for your participation! Is there anything else you would like to add?

United Arab Emirates
Ministry of Interior
Abu Dhabi Police GHQ
The Gen. Directorate of Central Operations
Emergency and Public Safety Department
Office of the Director

القيادة العامة لشرطة أبوظبي
Abu Dhabi Police GHQ.

No. ; 57326/8/7-2000
Date ; 15/12/2014 AD
Corresponding to ; 22 Safar 1436 AH

Messrs. National Centre for Meteorology and Seismology

Peace and Allah's mercy and blessings be upon you

Sub. ; Facilitate a Mission

Onset, The Gen. Directorate of Central Operations of Abu Dhabi Police GHQ expresses its gratitude to you and appreciate your efforts to build up basis and fruitful cooperation between us to realize the wise leadership vision, in the circle of this partnership relation between Abu Dhabi Police GHQ and your honorable Authority, kindly facilitate the mission of **Major. Abdullah Ali Alsagheiry**, No. (46854), to interview your managers and employees and to make field survey for the purposes of Ph.D. searches for the mentioned major, entitled ; (Activation of Early Alarm System to face Natural Hazardous Within United Arab Emirates)

For further enquiries, feel free to contact Major. Abdullah Ali Saghir, mobile no. (0502386690)

For your kind consideration and the actions you deems fit.

Regards

Brigadier / Ismail Hajy Serkal
For/ Manager of General Directorate of Central Operations

Cc;

- Manager of Emergency Management and Public Safety, for your kind information.
- Manager of General Directorate of Central Operations
- 15-12-2014, 162888.

Our vision ;

- To ensure continuity of Abu Dhabi emirate as community enjoys security and safety through the provision of high quality police services to citizens , residents of the emirate and its visitors.

17-12-2014, 46854

Ministry of Presidential Affairs
National Center for Metrology & Seismology
P.O. Box: 4815, Abu Dhabi
United Arab Emirates
No. : CMS/2015/348
Date : June 3, 2015

Brigadier/ Ismail Haji Al Sarkal
For/ Director General of Central Operations
Directorate General of Central Operations

Dear sir,

With reference to your letter No. 57326/8/7-2000 dated Dec. 15, 2014 related to the interview of Major (No. 46854), **Abdulla Ali Alsagheiry**, we would like to inform you that the interview of the above mentioned has been done and provided him with the necessary information for the **doctoral dissertation** under the title " **activating the role of early warning in the United Arab Emirates in case of natural disasters from the National Center for Metrology & Seismology"**.

Note:
We have no objection to use and provide the research scholar with the data and information for the above mentioned research.

Regards,

/signed & stamped/
Ali Al Jafari Al Hashmi
Director, Support Services Department
(Jn/3822-15)

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