# Building Disaster Resilience within the Emirati Energy Sector through a Comprehensive Strategic Mitigation Plan

Khalifa Al Khaili,
School of the Built Environment, University of Salford, UK
(email:K.S.K.H.B.AL-khaili@edu.salford.ac.uk )
Dr Chaminda Pathirage
School of the Built Environment, University of Salford, UK
(email:C.P.Pathirage@salford.ac.uk )
Prof Dilanthi Amaratunga
School of the Built Environment, University of Salford, UK
(email:r.d.g.amaratunga@salford.ac.uk )

## Abstract

Disasters, both natural and man-made, have been occurring with increasing frequency and effect in recent decades in many countries around the world. Such threats have been shown to result in a loss of life, property and income and all of which have an impact on the country's socio-economic structure and geo-political positioning. The UAE is steadily adapting its policies and practices to manage any potential disaster, whether natural or man-made. However, evidently the UAE is exposed and vulnerable to tectonic activity from a number of sources and yet there is little in the form of seismic detection, protection, resistance or design for some of the newest and tallest structures in the world. The paper highlights the importance of the strategic mitigation planning for disaster resilience within the Emirati Energy sector. It discusses the issue of disaster globally and then specifically with regards to the UAE, forming a critical analysis on crisis and its management. A broad literature review of the problems readily associated within the discourse is undertaken so that the definition, classification and the application of the disaster and its management cycle are appropriately contextualised in regards to the Emirati problem. The window of opportunity that the UAE has for improvement is emphasised by the findings of this paper.

**Keywords:** United Arab Emirates, Disaster Resilience, Mitigation Planning, Energy Sector

# 1. Introduction

Hazards are converted into disasters by a complex mix of the environment with external factors. In 2011, a total of 332 natural disasters were registered, killing a total of 30,773 people and causing 244.7 million victims worldwide (Guha-Sapir *et al*, 2012). It is important that any potential disaster or threat of disaster is managed in an appropriate manner to protect those who may have to suffer it, regardless of type or magnitude. The disasters that have frequented the United Arab Emirates (UAE), or at least have the potential to do so, are complex and diverse in origin as they are in effect. Recent developments in the field of disaster management have progressed towards the concept of disaster resilience and resilient communities. Disaster mitigation and strategic planning can improve infrastructure and the recovery period, particularly critical infrastructure, such as that of electricity and energy generally.

This paper explores the vulnerability of Emeriti energy sector and examines the application of disaster resilience theory. It also investigates how strategic mitigation planning can be applied to the UAE energy context, in order to improve the national response, whilst lowering the potential impact a given disaster may have on the local/global socio-economic and political spheres.

# 2. Disaster Theory

Disaster is as complex as it is subjective. No person is left indifferent to disaster and as the population grows, more and more people are affected by it (Smith and Petley, 2009), with as of 2005, 50 percent of the world´s population exposed to one or more natural hazards (Dilley *et al*, 2005). As the developed world grows richer, the cost to protect populations against disaster also grows (Hallegatte, 2012). To navigate through it is, however, the only way to build resilience against it and to build resilience is to learn from it and re-learn from it. The disaster cycle (refer to Figure 1) in its identification of disaster as a cyclic process is one way which facilitates learning. It is composed of various stages, and is a way of processing information during an event. It is also a tool which can help an individual, organisation or government identify the key components of a disaster and its management steps. Learning is also made possible because similarities among disasters do exist and these similarities can enhance strategic planning and subsequently disaster mitigation and emergency response, which form two components of the disaster cycle (Miththapala, 2008).

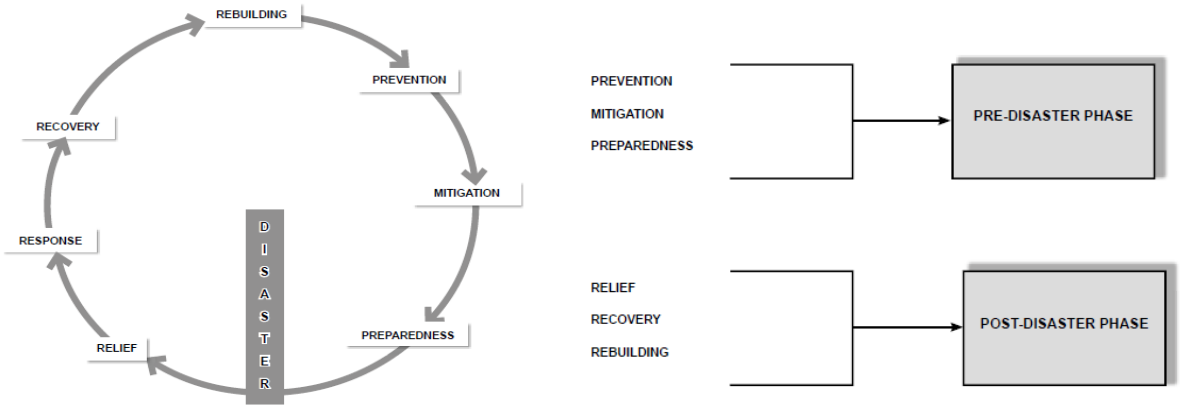


*Figure 1: The Disaster Management Cycle and Phases Source: Miththapala (IUCN) 2008*

Disaster classification is also considered critical for those involved in disaster management on the basis of the inter-relationships that exist, even if many disasters and their causes may defy simplistic classification (Alexander, 1993). Some on the other hand, may be far easier to distinguish as simple or compound, "natural" or "manmade" (Gad-el-Hak, 2008). They may even be classified relative to anticipated response (Gunn 1990) or the timescales involved in adequately managing a given natural hazard (Burton *et al,* 1978)**.** Regardless of the classification, however, the disaster cycle can still be applied.

*The ultimate goal of disaster risk management is to break the disaster life cycle* (Frumkin, 2010), but this can be challenging as a major issue relating to the concept is the identification of stages. The number of stages for the purpose of this paper is not, however, relevant as it focuses solely on the pre-disaster phase of disaster mitigation and strategic planning in order to build resilience. The term "Pre-Disaster" refers to the *extensive data collection, maintaining directories of resource, development of action plans, capacity building, training and community awareness activities* (Sundar and Sezhiyan, 2007) required to prevent, prepare and mitigate. In which case, it is essential that all natural and socio-economic resources are mapped in order to ascertain resource dependence and fully understand their function from an infrastructural and ecosystem service perspective (Miththapala, 2008). Disaster preparedness should always be guided in a manner which adequately protects community interests due to its comprehensive, multi-sector, grass root based and culturally sensitive approach (Cittone, 2006). In line with such actions, recent developments in the field of disaster management generally have progressed towards the concept of disaster resilience and resilient communities.

## 3. Resilience and strategic planning

Bruneau *et al.,* (2003) express "disaster resilience" in terms of the definition coined by Multidisciplinary Center for Earthquake Engineering researchers

"*the ability of social units (e.g. organisations, communities) to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimise social disruption and mitigate the effects of future disasters." [Emphasis added]*

These effects can be related to the acronym TOSE which stands for the four measures of resilience as mentioned by Chang and Shinozuka (2004) in reference to an earthquake:

- **Technical** resilience refers to how well physical systems perform
- **Organisational** resilience refers to the ability of organisations to respond to emergencies and carry out critical functions.
- **Social** resilience refers to the capacity to reduce the negative societal consequences of loss of critical services.
- **Economic** resilience refers to the capacity to reduce both direct and indirect economic losses.

Each must be managed in a way which builds what Hay (2013a; b) terms the "Five Pillars of Resilience":

- **Preparedness:** This involves identification of potential hazards and vulnerabilities through risk assessments, development of forecast and warning systems, modelling and training for a number of disaster scenarios of different hazards and at different magnitudes, development of insurance infrastructure and the growth of an intelligent community.
- **Protection:** This can be done through the implementation of improved building codes and standards, site-specific design and performance norms/standards for critical and essential facilities and infrastructures such as the power plants considered in this report.
- **Early Warning:** A provision of advance warning: models, sensors, communication networks and protocols, evacuation protocols and the assignation of "safe havens" and transportation/ road network tests to ensure that they really are safe havens and are accessible at the pre-, post and during emergency stages i.e. Logistic evaluation of the journey to and back to homes or temporary constructions, in the event that homes have been destroyed.
- **Emergency response:** The development of an emergency evacuation programme, training and tests of a "search and rescue" for those individuals who were unable to reach the safe zone. Provision of emergency personnel and medical assistance, investigation of road network under an emergency scenario (pre, post and during). Testing and the creating of networks to support the affected area in obtaining local, regional and international assistance.
- **Recovery and reconstruction:** The development of insurance and indemnification to facilitate the re-initiation of the "business as usual" in terms of commerce and day-to-day operations. This would typical involve undertaken post-disaster studies to improve pre-disaster preparedness in a similar event.

The success in building these pillars can be better represented and evaluated by the resilience triangle (refer to Figure 2), whereby the quality of performance is plotted after suffering a 50 percent loss followed by the pattern of restoration and recovery (Tierney and Bruneau, 2007). Disaster mitigation and strategic planning can improve infrastructure and the recovery period. The latter can be shortened by improving the disaster measures required in the disaster management cycle to restore and replace damaged infrastructure. This, in turn, increases the resilience of a given community which if deemed "resilient" is *better able to withstand a crisis event and have an enhanced ability to recover from residual impacts* (ICOA, 2008). Performance can be represented graphically, with the longer the

length of the hypotenuse, the more vulnerable a community to a given natural or manmade event and the longer the transition period between critical and normal operating conditions.

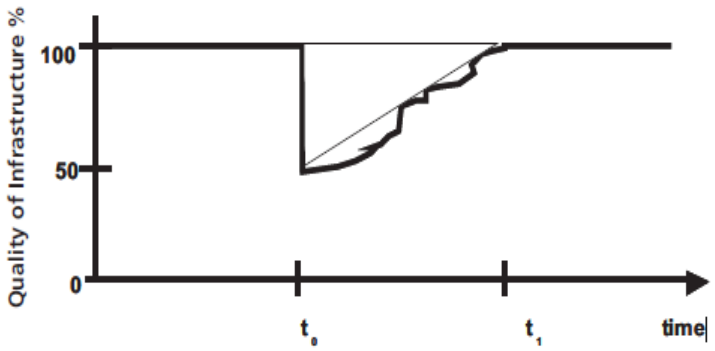


*Figure 2: The Resilience Triangle Source: Tierney and Bruneau (2007)*

A strategy is one way to promote and maintain resilience building. Chandler (1962) defined "strategy" as the *formulation of long term goals followed by the marshalling and allocation of resources to achieve those goals.* Goodstein *et al* (1993) developed the idea further by stating that it is a coherent unifying and integrative pattern of decisions with the means of establishing an organisation's or nation´s long-term objectives, action plans and allocation of resources. Others such as Minzberg (1987) liken it to a *position.* Strategy becomes strategic planning when there is a *basic direction and rationale for determining where an organisation should head, i.e. what it should to do and how to do it. It is the basis for creating and describing a better future in measurable terms and the selection of the best means to achieve the results desired* (Kaufman, 2003).

Successful strategic thinking, planning and action thus leads to various benefits, including improved organisational performance, the development of teamwork and expertise, the amendment of inherent organisational issues and the establishment of clarified norms and priorities - all of which clearly serve to advance disaster management and emergency response (Bryson and Delbecq, 1979).

"*Hence, applying strategic planning to disaster management can reduce the impact of catastrophe on the community" – (Sadeghi, 2006).*

A limited, or absent, national strategy and its resulting plan will inhibit a country's ability to cope with disaster (Penuel *et al.,* 2011) and any intervention, as with any ad-hoc response, without comprehensive and fundamental planning, will have unpredictable, random, unexpected and subsequently unacceptable consequences to services. There may well be, for example, electricity cuts at the time when it is most needed (Chiba, 2011).

Given the numerous hazards, manmade and natural, to which the UAE is exposed to, the government must act in a proactive manner and must subsequently develop an appropriate disaster management strategy before any disaster event occurs. In order to view the level of resilience in this (or any) country it is important to have a comprehensive understanding of all the disasters it may face and it is to this the author now turns.

# 4. Overview of Disasters in UAE

## 4.1 Earthquakes

There are 25 seismogenic source zones in the Arabian Peninsula (Al-Amri, 2005) including the Zagros Thrust fault which readily generates earthquakes measuring 5 on the Richter Scale such as the Masafi Earthquake (magnitude ~5) and its accompanying shocks felt throughout the northern Emirates (Rogers et al 2006). This fault defines the western coastline, running from Abu Dhabi through Dubai and Sharjah to Al Khaimah (Wyss and Al-Homoud, 2004). Other potential threats come from the Hurmuz Straits, north of which is one of the most notoriously seismic active zones in the world (refer to Figure 3).

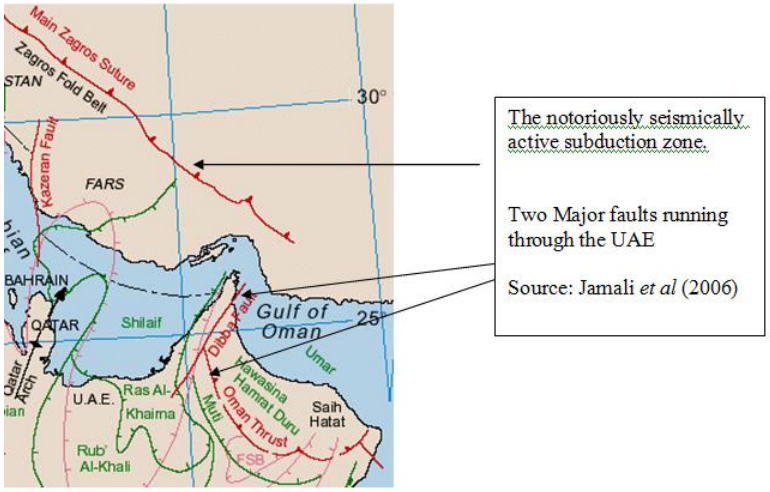


*Figure 3: Fault line in the Gulf Region (Jamali et al, 2006)*

Evidently the UAE is exposed and vulnerable to tectonic activity from a number of sources and yet there is little in the form of seismic detection, protection, resistance or design for some of the newest and tallest structures in the world. In fact it is clear that with its rapid progress the UAE's seismic risk is increasing as dramatically as its skyline. This danger is particularly acute for tall buildings located on reclaimed land because little is known about the underlying or nearby fracture zones whilst such land is potentially more susceptible to liquefaction and slope failure.

## 4.2 Tsunami

Abu Dhabi, Dubai and Sharjah are all vulnerable to the possibility of tsunami activity (Kumar, 2009). The 1945 Makran earthquake generated a tsunami of 11.5-17 metres (Murty *et al*, 1999; Pararas-Carayan, 2006), affected the UAE's large sand bar at Ras al-Khaimah (Chadha, 2007; Jordan, 2008). Such activity also needs to be considered in light of the nuclear development which will bring four reactors (5600 MWe) to the coastal site of Braka (WNA 2011).

## 4.3 Shamal

As an atmospheric phenomenon the *Shamal,* a wind that brings with it a wave of high pressure lasting between three to forty days, is thought to be a concern to the UAE's super tall structures as its velocity differs at heights surpassing 400 m (Samarai and Quadah, 2007). As a yearly recurrent storm event (Hellebrand *et al,* 2004) it also presents a major and frequent disaster risk to the coastal region (Jordan *et al* 2005) which is also the most heavily populated area where most of the construction occurs (Gulfnews, 2005; Khaleej Times, 2008).

## 4.4 Climate Change

The anticipated sea level rise resulting from global warming is also expected to increase the severity and frequency of disasters resulting from oceanic and coastal hazards. According to Kumar (2009) the expected sea level augmentation of 5mm/yr as is expected seriously to impact low-lying coastlines which due to the high degree of infrastructural development pose a serious issue for cities such as Abu Dhabi and any energy infrastructure lying only a few miles off the coast.

## 4.5 Terrorism

Despite the fact that only the UAE and Oman have been free of terrorist incidents; manmade threats remain a possibility (Clark, 2010; Shaheen and Dajani, 2010). The cause for concern is increased in light of the lack of national preparation for manmade disasters (Swan, 2011).

The UK *Foreign and Commonwealth Office* state (October 2012) that the threat of terrorism is "high" and that "terrorists may be planning to carry out attacks (FCO 2012). The US also remains concerned about the close proximity of Iran for both nuclear and terrorist activity (Katzman, 2012). Potential threats to national stability stemming from regional uprising since the Arab Spring 2011, terrorist activity and nuclear associated issues are also a national concern. The latter two are particularly important in light of the new nuclear development at Braqa which is planned to consist of four APR1400 reactor units designed to produce up to 1400 MWe each for a total capacity of 5600 MWe (Al Farra and Abu-Jijleh, 2012).

## 4.6 Additional Needs for Consideration

Recent uncontrolled and uncoordinated urban growth has been shown to cause a lot of different ecological and socio-economic issues and risks in the UAE. The Dubai World Centre, for example, has already impacted the pre-existing 140 $km^2$ sand dune and sabka ecosystem and has threatened *nine species of mammals, diverse resident and visiting bird species, seventeen reptile species, a wide range of invertebrates and 43 species of plants* (Gardner and Aspinall 2006). Any new infrastructure for the energy sector should involve careful and considerate planning to avoid making the same mistakes. In addition, construction safety has not been seriously considered (Al Kaabi 2001) and the size with the complexity inherent in UAE construction projects, including those of the energy sector, adding to the multitude of risks that normally occur with a temporary and multi-national team of workers. This but all makes the elimination of all risks in construction impossible (El-Sayegh 2007).

# 5. Critical Infrastructure and Energy Facilities

The energy sector and its facilities provide a critical service in normal operations and especially in crisis. Failure must therefore be prevented at all costs through strong contingency planning. This is because if it were destroyed, degraded or rendered unavailable for an extended period, there would be a significant impact on the nation and its ability to ensure national security (AG, 2010). Any government therefore is duty bound to ensure that the energy sector, as with all sectors deemed critical (see the US Patriot Act for the full list), becomes increasingly resilient to a multitude of potential threats and/or disasters. Resilience building can occur through vulnerability assessments, continuity of operations planning, and deliberate investment in cost-effective technologies which improve the capacity of service providers and public authorities to maintain those critical functions (Auerswald *et al*., 2005). Specific to the energy sector:

*"Resilience is the capacity of an energy system to tolerate disturbance and to continue to deliver affordable energy services to consumers. A resilient energy system can speedily recover from shocks and can provide alternative means of satisfying energy service needs in the event of changed external circumstances."(Chaudry et al, 2009).*

The protection of energy systems and assets especially, the safeguarding of oil and gas infrastructure from any and all internal and external threats, should become the top priority of any oil-providing nations, including the UAE (Bi, 2006). One important, if not the most important, issue to the long-security of a national or even a regional energy system is the failure of international supply, whether on technical or political grounds. Any resilient energy network requires cooperation and the shared interests of all involved to work towards protection from "shocks". This is especially the case if long term resilience is regarded as a secure supply. Natural or even manmade disasters, as seen above, which attack an energy supply infrastructure pose an equality of hazard, or threat to suppliers and consumers alike. It is thus important that both forge a strong relationship which recognises the symmetrical nature of the risks which may later lead to disaster. In short they must be adequately addressed in the planning, mitigation and preparation stages of pre-disaster as much as that of the post-disaster (Minullin and Schrattenholzer, 2011). A weak management team and poor planning throughout the process would arguably only serve to amplify any failures during the immediate and longer term post disaster period.

# 6. UAE in Context: Energy Sector Infrastructure Resilience and Vulnerability

The energy sector dominates in the UAE and the Gulf Region generally. The Emirati economy is the second biggest regionally after Saudi Arabia and remains on course for five percent growth protection within the next four years –largely due to rising oil prices (Kawach, 2011). Added to this, 2010 saw the total value of construction contracts awarded in the UAE in the energy sector almost triple to $8.8 billion (Dh32.32bn) for the period of January to May, from $3bn against the same period in 2009 (Nambier, 2010). The energy sector is therefore very much an economic powerhouse responsible for the positive development of the nation. Some OPEC nations and many non-OPEC nations have seen

production decline over the last five years, but the UAE has increased its total production of crude oil by approximately 31 *percent* and thus plays a highly significant role in global energy markets (EUAEW 2011). One can only imagine the disastrous effect on the local/ global financial and political security should the 4th largest exporter of oil (at the rate of 2,395 million bbl/day) suddenly be unable to provide to the export market (CIA 2011). Any cuts of natural gas or electricity supply in an increasingly energy hungry nation would also spell certain disaster. The electricity infrastructure is already strained by a lack of spare capacity at peak seasonal times due to the lack of natural gas. This situation is unlikely to get any better due to the high sulphur fuel content. Capital costs also make development unlikely at the current time (EIA 2011).

Energy security and supply are thus a priority for a country that has built its reputation as the region's most stable country, both politically and economically with attractive business opportunities that are not found elsewhere (Dalli and Wilcox, 2006). The new development of nuclear power at Braqa, 33 miles from the coast provides another prime reason for comprehensive strategic planning in the mitigation of disaster. This is particularly key given the UAE's significance in the world´s economy given its natural resources and its key role politically – often it is seen as an ally in the West and has a political stability that is not currently readily found in the Islamic World (*i.e.* revolutions in Egypt, Tunisia, Libya *etc*) and it should have strong national interests in protecting its assets and security from any natural or terrorist based threat.

# 7. Conclusions and the way forward

The UAE is prone to various natural hazards including those atmospheric, geological and anthropogenic in origin. It is also considered to be vulnerable to terrorist activity, especially now with the addition of nuclear power. As development continues in the nation the country and its people become even more vulnerable to the effects of those hazards. Preparations for any impending disaster as have been slow and in fact due to the country's recent establishment large scale disaster preparation has featured on a national scene at an appropriate scale only recently. In short, it has only been part of UAE political focus and policy within the last few years and the country as a whole has only just begun to take advantage of designing purpose built areas.

As development continues, the country and its people become even more vulnerable to the effects of hazards. Ill-planned urban development has, rather than abated disaster, intensified it. Preparations for any impending disaster have been slow and in fact, due to the country's recent establishment, large scale disaster preparation has featured on a national scene at an appropriate scale only recently (Al Ghanim 2010; Al Kindi 2007).

It is important that UAE policy, its government and its emergency services are properly equipped, enabled and prepared to deal with hazards and so to minimise the catastrophe. As identified by Yodmani (2001) in support of this, the UAE must undertake community profiling to correctly identify key individuals that can aid with the risk assessment and identify specific vulnerabilities within its proper context i.e. members of the energy sector must be those to identify vulnerabilities and subsequently build resilience into the energy sector. This is because pre-disaster preparation underpins the success of the immediate emergency response and post-disaster relief and recovery.

The UAE, unlike most other nations, who would have to retrofit disaster mitigation mechanisms into the city, has a "window of opportunity" before a disaster takes place with its new builds that dominate the city. This is particularly advantageous given the numerous potential disasters that threaten the nation, its stability and its energy.

This research attempts to develop a comprehensive strategic disaster mitigation plan for Emirati energy sector, based on identified vulnerabilities of energy infrastructure.

## References


AG- Australian Government (2010) Critical Infrastructure Resilience Strategy Commonwealth of Australia

Al-Amri, A. (2005) Seismic source zones of the Arabian Peninsula and adjacent countries. Gulf Seismic Forum, UAE University, Al-Ain, UAE,

Alexander, D (1993) Natural disasters Springer Science & Business

Al Farra, H and Abu-Hijleh, B (2012) The potential role of nuclear energy in mitigating CO2 emissions in the United Arab Emirates Energy Policy 42 p 272–285

Al Ghanim, M (2010) TRA announces details of the National Emergency Plan for the telecom sector UAE Interact 14/01/2010 http://www.uaeinteract.com/docs/TRA_announces_details_of_the_National_Emergency_Plan_for_the_telecom_sector/39178.htm

Al-Kaabi (2001) Improving Safety Performance in Construction Site Operations in United Arab Emirates Ohio State University

Al Kindi, M (2007) UAE gears up to tackle any potential disaster UAE Interact 23/05/2007 http://www.uaeinteract.com/docs/UAE_gears_up_to_tackle_any_potential_disaster/25446.htm

Auerswald, P, Brancomb, L, Porte, T and Michel-Kerjan (2005) The Challenge of Protecting Critical Infrastructure Center for Risk Management and Decision Processes – The Wharton School of the University of Pennsylvania

Bi, J (2006) CCISS Critical Energy Infrastructure Protection Policy Research Series The Quest for the Oil and Gas Infrastructure Protection in Central Asia: Time Bombs and Policy Options Carleton University [Accessed 27/12/11] http://www3.carleton.ca/cciss/res_docs/ceip/bi.pdf

Boin and Hart (2007) [Within] Rodriguez, H (2007) Handbook of Disaster Research

Bruneau, M., S. E. Chang, R. T. Eguchi, G. C. et al (2003). A Framework to Quantitatively Assess and Enhance the Seismic Resilience of Communities. Earthquake Spectra, Vol. 19, No. 4, p. 733–752.

Bryson, J and Delbecq, A (1979) A Contingent Approach to Strategy and Tactics in Project Planning Journal of the American Planning Association Volume 45, Issue 2 p 167 - 179

Burton, I, Kates, R and. White, G (1978) The Environment As Hazard. Oxford University Press

Chadha, R (2007) Tsunamiginic Sources in the Indian Ocean: Factors and Impact on the Indian Landmass [Within] Murty, T, Aswathanarayana, U and Nirupama, N: The Indian Ocean Tsunami Taylor and Francis p 33-48

Chandler, A (1962) Strategy and Structure: Chapters in the History of the Industrial Enterprise MIT Press

Chang, S and Shinozuka, M (2004) Measuring Improvements in the Disaster Resilience of Communities Southern Methodist University http://lyle.smu.edu/emis/cmmi5/Ibarra/DeskTop/2004_Phd_041406/Dissertation/Papers/Paper_CI/Incomplete_Paper_Disaster_Resilience.pdf

Chaudry, M, Ekins, P Ramachandran, K, Shakoor, A, Skea, J, Strbac,G, Wang, X and Whitaker, J (2009) Building a Resilient UK EnergySystem Working Paper UKERC p iv

Chiba, Y (2011) Big aftershock rattles Japan disaster zone Google News 2/4/2011

CIA (2011) CIA Factbook United Arab Emirates 10/11/11

Ciottone, G (2006) Disaster medicine Elsevier Health Sciences

Clark, R (2010) [Within] Shaheen, K and Dajani, H (2010) UAE counter-terrorism efforts praised by experts The National 13/1/2010 http://www.thenational.ae/news/uae-news/uae-counter-terrorism-efforts-praised-by-experts

Dalli, E and Wilcox, G (2006) Punching Above Its Weight GB Reports

Dilley, M, Chen, R, Deichmann, U, Lernerlam, A and Arnold, M (2005) Natural Disaster Hotspots: A Global Risk Analysis World Bank Publications

EIA U.S Energy Information Administration (2011) United Arab Emirates Energy Data, Statistics and Analysis- Oil, Gas, Electricity and Coal http://www.eia.gov/cabs/UAE/Full.html [Accessed 26/12/11]

El-Sayegh, S.M., (2007) Risk assessment and allocation in the UAE construction industry, International Journal of Project Management 26 (4), pp. 431-438.

EUAEW – Embassy of the United Arab Emirates in Washington DC (2011) Energy in the UAE http://www.uae-embassy.org/uae/energy [Accessed 27/12/11]

Frumkin, H (2010) Environmental Health: From Global to Local John Wiley and Sons

Gad-el-Hak, M (2008) Large-scale disasters: prediction, control, and mitigation Cambridge University Press

Gardner AS, Aspinall S (2006) Baseline Ecological Survey of the Jebel Ali Airport City site, for Dome International., Dubai.

Goodstein, L, Nolan, T and Pffeiffer, S (1993) Applied Strategic Planning: A Comprehensive Guide McGraw-Hill Professional

Guha -Sapir D, Vos F, Below R and Ponserre, S (2012) Annual Disaster Statistical Review 2011: The Numbers and Trends. *Brussels: CRED*

Gulfnews (2005) Rough seas lash UAE coast. Gulf News Online 11 January 2005. http://gulfnews.com/news/gulf/uae/environment/rough-seas-lash-uae-coast-1.273626

Gunn, S. (1990) Multilingual Dictionary of Disaster Medicine and International Relief Kluwer Academic Publishers

Hallegatte, S (2012) Toward a world of larger disasters? Ideas for risk-management policies Vox 14/4/12 http://www.voxeu.org/article/toward-world-larger-disasters-ideas-risk-management-policies

Hellebrand, S, Fernandez, J and Stive, R (2004) Case Study: Design of Palm Island No. 1 Dubai Terre et Agua Number 96

ICOA – Insurance Council of Australia (2008), Improving Community Resilience to Extreme Weather Events [Within] COAG National Strategy for Disaster Resilience http://www.emergency.qld.gov.au/publications/pdf/national_strategy_disaster_resilience.pdf [Accessed November 2012]

Jordan, B (2008) Tsunamis of the Arabian Peninsula, a Guide of Historic Events Science Tsunami Hazards 27 p 31-46

Jordan, B, Baker, H & Howari, F (2005) Tsunami Hazards along the Coasts of the United Arab Emirates 1st International Conference on Coastal Zone Management and Engineering in the Middle East 27-29th November 2005, Habtoor Gran Jumeirah Beach, Dubai http://www.iahr.net/site/e_library/ConfPro/ArabianCoast2005/ArabianCoast2005_ToC.pdf

Karach, N (2011) UAE economy seen sharply up in 2011-15 GDP to rise by 3.6% in 2011 Emirates 24/7 http://www.emirates247.com/business/uae-economy-seen-sharply-up-in-2011-15-2011-06-23-1.404214 [Accessed 27/12/11]

Katzman, K (2012) The United Arab Emirates (UAE): Issues for U.S. Policy Congressional Research Service http://www.fas.org/sgp/crs/mideast/RS21852.pdf [Accessed October 2012]

Kaufman, R (2003) Strategic planning for success: aligning people, performance, and payoffs John Wiley and Sons

Khaleej Times (2008) Shamal has UAE in knots; residents 'chilled' Khaleej Times 1 February 2008 http://www.khaleejtimes.com/DisplayArticleNew.asp?col=&section=theuae&xfile=data/theuae/2008/February/theuae_February27.xml

Kumar, M (2009) Natural and Anthropogenic Disasters: Vulnerability, Preparedness and Mitigation Springer

Minullin, Y and Schrattenholzer, L (2011) Lessons Learned for Regional and Global Energy Security [Within] Gheorghe, A and Muresan, L, International and Local Issues, Theoretical Perspectives, and Critical Energy Infrastructures Springer

Mintzberg, H (1987) The Strategy Concept I: Five Ps for Strategy [Online] http://blsciblogs.baruch.cuny.edu/comstrategy/files/2010/01/definingstrategy.pdf

Miththapala, S (2008) Integrating environmental safeguards into Disaster Management: a field manual IUCN

Murty, T, Bapat, A and Prasad, V (1999) Tsunamis on Coastlines of India Science Tsunami Hazards 17, p 167-172

Nambier, S (2010) UAE energy sector contracts triple to $8.8bn Emirates 24/7 14/6/10 http://www.emirates247.com/eb247/companies-markets/construction/uae-energy-sector-contracts-triple-to-8-8bn-2010-06-14-1.255051 [Accessed 27/12/11]

Pararas-Carayan, G (2006) The Potential of Tsunami Generation along the Makran Subduction Zone in the Northern Arabian Sea: Case Study: The Earthquake and Tsunami of November 28, 1945 Science Tsunami Hazards 24 p 358-384

Penuel, K, Statler, M and Golson, J (2011) Encyclopaedia of Disaster Relief SAGE

Rogers, A, Fowler, AR, Al-Amri, A and Al-Enezi, A (2006) The March 11, 2002 Masafi, United Arab Emirates earthquake: Insights into the seismotectonics of the northern Oman Mountains Tectonophysics 415 (2006) 57–64

Sadeghi, N (2006) Strategic Planning in Disaster Management: How to Face the Unexpected in Natural Disasters IIEES

Samarai, M and Quadah, L (2007) Planning Sustainable Mega Projects in UAE World Housing Congress 2007 Affordable Quality Housing 1 July-5 July 2007 Malaysia Publishing Company

Shaheen, K and Dajani, H (2010) UAE counter-terrorism efforts praised by experts The National 13/1/2010 http://www.thenational.ae/news/uae-news/uae-counter-terrorism-efforts-praised-by-experts

Shanableh, A, Barakat, S and Malkawi, A (2005) A Framework for Comparative Risk Assessment of Earthquakes Consequences in the United Arab Emirates Disaster Reduction on Coasts Conference, Monash University, Melbourne, Australia, 14-16 November 2005

Smith, K and Petley, D (2009) Environmental hazards: assessing risk and reducing disaster Taylor & Francis

Sundar, I and Sezhiyan, I (2007) Disaster Management Sarup & Sons

Swan, M (2011) New civil security programme a first in UAE The National 17/4/11 http://www.thenational.ae/news/uae-news/education/new-civil-security-programme-a-first-in-uae [Accessed November 2012]

Tierney, K and Bruneau, M (2007) Conceptualizing and Measuring Resilience A Key to Disaster Loss Reduction TR News 250

WNA- World Nuclear Association (2011) Nuclear Power in the United Arab Emirates http://www.world-nuclear.org/info/UAE_nuclear_power_inf123.html [Accessed 18/8/11]

Wyss, M and Al-Homoud, A (2004) Scenarios of Seismic Risk in the United Arab Emirates, an Approximate Estimate Natural Hazards 32: 375–393, 2004. Kluwer Academic Publishers.

Yodmani, S (2001) Chapter 13, Disaster Preparedness and Management [Within] Social Protection In Asia and The Pacific, Asia Development Bank http://www.adb.org/documents/books/social_protection/chapter_13.pdf

Zane, N (2009) Ethics for disaster Rowman & Littlefiel