VGTU LEIDYKLA TECHNIKA

DISASTER KNOWLEDGE FACTORS IN MANAGING DISASTERS SUCCESSFULLY

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ABSTRACT. The number of reported natural disasters has increased steadily over the past century and risen very sharply during the past decade. These bring about the loss of lives, property, employment and damage to the physical infrastructure and the environment. Disaster management efforts aim to reduce or avoid the potential losses from hazards, assure prompt and appropriate assistance to victims of disaster, and achieve rapid and effective recovery. While knowledge management can enhance the process of disaster management, there is a perceived gap in information coordination and sharing within the context of disaster management. Identifying key success factors will be an enabler to manage the disasters successfully. In this context, this study aims to identify and map key knowledge success factors for managing disasters successfully through capturing the good practices and lessons learned. The objective of this paper is to present the literature findings on factors which support successful disaster management. Accordingly the identified factors were classified into eight main categories as technological, social, legal, environmental, economic, functional, institutional and political.

KEYWORDS: Disasters; Disaster management; Knowledge management; Disaster knowledge success factors

1. INTRODUCTION

Billions of people in more than 100 countries are periodically exposed to at least one natural disaster (Moe et al., 2007) and there are around 30 identified natural disasters worldwide (Deshmukh et al., 2008). Each disaster has devastating impacts on human life, economy and environment. For example, in a quarter of the century since 1967, floods affected 30 percent of 2.8 billion people who suffered from weather-related disasters (Bayrak, 2009). There is evidence that the frequency and extent of natural disasters are increasing on a global scale (Warren, 2010a). In the decade 1900-1909, natural disasters occurred 73 times, but in the period 2000-2005 the number of occurrences rose to 2,788 (Kusumasari et al., 2010). Furthermore, though 80 percent of tsunamis occur in Pacific Ocean (Kong, 2004 cited in Camilleri, 2006), it is now identified that most other regions are prone to tsunamis. The Indian region is subject to increased seis-

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mic activity and the Mediterranean region too is active with earthquakes and volcanoes and some of these can generate tsunamis (Camilleri, 2006).

Natural disasters claim many human lives and damage a great deal of property (Louhisuo et al., 2007). On December 2004, a massive earthquake of magnitude 9.0 struck the coastal area of northern Sumatra in Indonesia and this triggered the tsunami that affected Indonesia, Thailand, Sri Lanka, India, Maldives, Bangladesh, Malaysia, Myanmar and Somalia (Pheng et al., 2006; Sonak et al., 2008; Srinivas and Nakagawa, 2008; Wijetunga, 2010). It is identified as one of the deadliest and costliest disasters in history (Hansen, 2005; Oloruntoba, 2005; Rodriguez et al., 2006; Morin et al., 2008) which caused an estimated US$ 9.9 billion worth of damages (Koria, 2009). The death toll is estimated to be between 200,000 and 300,000 (Poisson et al., 2009). Hurricane Katrina was another large natural disaster which caused extensive human suffering and physical damage (Koria, 2009). During the previous century, over a thousand earthquakes have occurred in seventy countries worldwide, taking the lives of 1.53 million people and leaving behind great financial loss (Valizadeh and Elmi, 2010). Haiti earthquake and Pakistan floods in 2010 record the latest deadliest disasters. The total cost of natural disasters in 2008 was US$ 181 billion (Warren, 2010b).

Less economically developed countries are prone to higher proportion of disasters and attendant deaths due to their inability to plan for and react effectively to the many disasters which face them, lack of infrastructure and emergency services, the high population densities of unplanned settlements and low economic capacities to withstand the impacts (Atmanand, 2003; Oloruntoba, 2005; Rodriguez et al., 2006; Louhisuo et al., 2007; Moe et al., 2007; Srinivas and Nakagawa, 2008). As an example, the most recent 7.0 magnitude earthquake which struck Haiti on 12 January 2010 is considered as the strongest earthquake in more than two centuries rocked the Caribbean nation. According to the officials and witnesses, it caused dozens of buildings to collapse, huge damage to infrastructure in the impoverished and crowded capital of Port-au-Prince (Cordoba and Luchnow, 2010). Authorities had estimated a total of 200,000 deaths and up to 3 million people are estimated to need aid following this earthquake (Carroll, 2010).

With the increased frequency and extent of natural disasters, there is an increase in the numbers of deaths, the numbers of people affected by disasters and their devastating impacts on human life, economy and environment (Bayrak, 2009). As worldwide communities have been facing an increasing frequency and variety of disasters which can cause direct and indirect effects (Haigh and Amaratunga 2010; Oloruntoba, 2005; Kovacs and Spens, 2007; Moe et al., 2007) the urgent need to reduce disaster risk (Moe et al., 2007) and develop a resilient community capable of recovering from disasters (Rotimi et al., 2009) is of increasing concern in many countries.

Therefore efforts need to be made in order to reduce their impacts. In this context knowledge management can play a vital role through ensuring the availability and accessibility of accurate and reliable disaster risk information when required and through effective lesson learning. Despite this it is observed that a perceived gap in knowledge management exists within the context of disaster management (Mohanty et al., 2006; Otim, 2006). This research aims to identify and map key success factors in managing disasters through good practices and lessons learned and to enhance the knowledge of disaster management. With regard to this study, this paper presents the literature findings on factors which support successful disaster management.

2. DISASTER MANAGEMENT

Moe et al. (2007, pp. 787) define a disaster as " a situation which overwhelms local capacity, necessitating a request to the national and international level for external assistance, or is recognised by a multilateral agency or by at least two sources, such as national, regional or international assistance groups and the media". Disaster is derived from Greek meaning, 'bad star' (Konoorayar, 2006). Disasters are classified in various ways. The Emergency Disasters Database classified disasters as natural or technological. Accordingly, technological disasters consist of industrial accidents, transport accidents and miscellaneous accidents. The United Nations (UN, 2006 cited in Moe et al., 2007) further classified natural disasters into three as hydro-meteorological disasters (floods, wave surges, storms droughts, forest fire and extreme temperature), geophysical disasters (earthquakes, tsunamis and volcanic eruptions) and biological disasters (epidemics and insect infestations).

Disaster management efforts aim to reduce or avoid the potential losses from hazards, promote prompt and appropriate assistance to victims of disaster, and seek to achieve rapid and effective recovery (Warfield, 2004). Phases in natural disaster management are identified in different terms which give similar insights. Figure 1 shows the disaster management spiral which illustrates the two main phases of disaster management as pre-disaster risk reduction and post disaster recovery.

Accordingly, risk and vulnerability assessment involves identifying the nature and magnitude of current and future risks from hazards to people, infrastructure and buildings (RICS et al., 2009; McEntire, 2010). Through vulnerability analysis it is possible to identify which public and private buildings should be reinforced or relocated and which buildings are likely to contain large numbers of trapped survivors. It would be unrealistic to prevent or limit building and occupation of the coastal environment and reinforce every building within the tsunami flood hazard zone due to the economic costs.

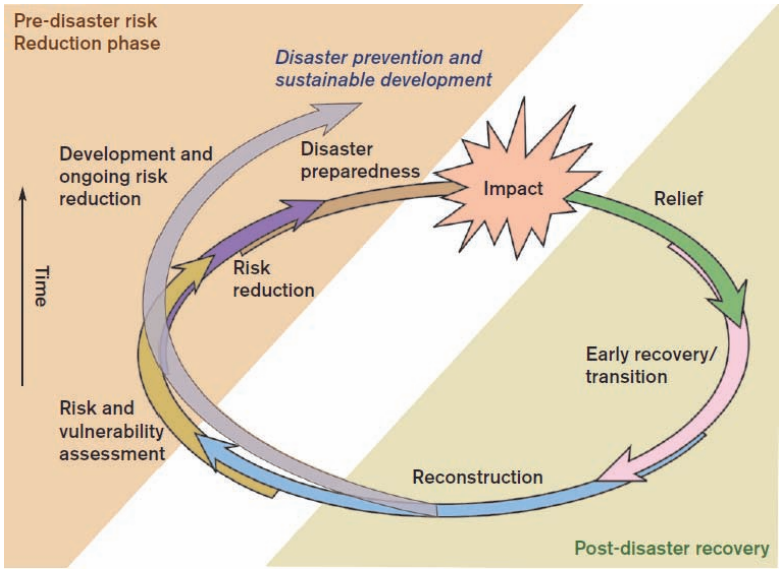

Figure 1. The risk management and response spiral
Source: RICS et al., 2009

Also it would not always possible to construct large and hard engineered coastal barriers such as breakwaters, walls and revetments. Therefore detailed information on which buildings, structures and group of people are vulnerable to tsunami impacts helps to develop cost effective mitigation measures. Mitigation or risk reduction activities include structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards (Atmanand, 2003; Bosher et al., 2007; Moe et al., 2007; RICS et al., 2009). Preparedness deals with the activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations (Atmanand, 2003; Moe et al., 2007).

Provision of assistance or intervention during or after a disaster to meet the life preservation and basic subsistence needs of those people affected is made during the relief phase (Moe et al., 2007). Relief activities include medical attention, body identification, clearing away rubble, debris, providing transport access, providing survival requirements, water purification kits, cooking utensils, foods, safe areas, relocation, shelter and general living and psychological support (Perry, 2007). Transition phase involves the activities of community surveys, needs assessment, land survey and acquisition and provision of transitional shelter (RICS et al., 2009). Care and maintenance of transitional shelter is required till permanent housing construction is provided. Reconstruction refers to the rebuilding of damaged living conditions of the stricken community with the aim of long term sustainability (Moe et al., 2007). The commencement of the recovery phase begins with the restoration of essential buildings and infrastructure services destroyed in the disaster and rehabilitation to assist the victims in returning to their pre-disaster livelihood (Pheng et al., 2006) or until the community's capacity for self-help has been restored (Rotimi et al., 2009). Recovery is usually identified as slow, expensive and complex in terms of coordination and management (Koria, 2009). However it may present an opportunity for improvement in the functioning of the community, so that risk from future events can be reduced while the community becomes more resilient (Rotimi et al., 2009).

Activities of vulnerability assessment, mitigation and preparedness are conducted as a proactive approach while the activities conducted after the disasters are called a reactive approach. Lack of a proactive approach to disaster management can result in more damage and higher level of a proactive behaviour is required for successful disaster management (Moe and Pathranarakul, 2006). However some natural disasters (droughts, floods and volcanic eruptions) are slow-onset and provide a lead-time for a proactive approach, while others (flash floods, earthquakes, tsunamis and cyclones) provide little or no lead-time for proactive measures (Moe and Pathranarakul, 2006). Therefore an integrated approach which includes both proactive and reactive strategies is important for managing disasters successfully.

3. KNOWLEDGE MANAGEMENT IN CONTEXT OF DISASTER MANAGEMENT

Mohanty et al. (2006) define knowledge as "the fact or condition of knowing something with a considerable degree of familiarity through experience, association or contact". Basically three forms of knowledge are identified as explicit, tacit and implicit. Explicit knowledge is that which is stated in detail and is termed as codified or formal knowledge. Tacit knowledge is that which is understood, implied and exists without being stated. It is housed in the human brain. Implicit knowledge is that

which could be expressed, but has not been. Knowledge management is all about providing the right knowledge, in the right place, at the right time. From organisations perspective, knowledge management is about applying the collective knowledge of the entire workforce to achieve specific organizational goals. It is about facilitating the process by which knowledge is created, shared and utilised.

Though there is no way of neutralizing all negative impacts resulting from disasters, efforts can be made in order to reduce their consequences. Knowledge on disaster management strategies, together with good practices and lessons learned, can undoubtedly support this effort through well-informed mitigative measures and preparedness planning. RICS et al. (2009) emphasize the feeding back of recovery experience to inform the disaster management process to reduce the future risks and improve the resilience of vulnerable communities. According to Moe et al. (2007) it is essential for practitioners in the disaster management field to be innovative and learn from lessons in order to adopt best practices throughout the disaster management cycle. Practitioners in disaster management should improve their skills and increase their level of knowledge, which requires investments in systems, databases and network structures so as to build a culture of learning from previous lessons and the adoption of best practices (Moe et al., 2007).

Despite this, knowledge on disaster management strategies appears fragmented, emphasising a perceived gap in information coordination and sharing (Mohanty et al., 2006). Accordingly, the knowledge and experiences of disaster practitioners are remain in individual or institutional domains. As an example, a case study conducted in Sri Lanka, revealed that organisations have not been able to capture, retain and/or re-use the learning from similar operations except through the tacit knowledge of individuals that have worked in various operations (Koria, 2009). Therefore the experiences, approaches and adopted modalities for disaster management remain with individuals as tacit knowledge. This resulted in re-inventing the wheel in terms of setting up and managing the construction programmes and projects within the tsunami recovery operation. This requires not only a great amount of work to establish but also result in a lack of incremental learning which constrained the strategic decision making. As Mohanty et al. (2006) point out, though information about disaster management has been available from various domains from decades, millions of people are still severely affected by disasters every year due to lack of adequate coping mechanisms as a result of un-coordinated information not being transformed into the life saving knowledge for the communities at risk. Kaklauskas et al. (2009) indicates that in the countries affected by Asian tsunami the lack of knowledge management is apparent. Therefore the lack of effective information and knowledge sharing, and knowledge creation on disaster management strategies can thereby be identified as one of major reasons behind the unsatisfactory performance levels of current disaster management practices.

4. METHODOLOGY

Identification of key success factors within the disaster management cycle will be delivered based on interviews with experts who are involved in the disaster management process, supported by an extensive questionnaire survey. This paper is based on a comprehensive literature survey and review carried out, with special focus on Asian Tsunami and case examples from Sri Lanka, to identify the factors which support successful disaster management. As a result of this detailed literature synthesis, a list of success factors within the disaster management cycle is identified and provided in succeeding section.

5. SUCCESS FACTORS IN DISASTER KNOWLEDGE MANAGEMENT

Success factors are truly important matters that must be considered for the performance of an operation. In the context of disaster knowledge management, success factors can be defined as; circumstances, facts, or influences that are input into the knowledge of disaster management and can directly or indirectly affect the outcomes of disaster management. This study aims to identify key disaster knowledge factors for managing disasters successfully through capturing the good practices and lessons learned and to map them against the disaster management cycle. It is currently underway and this section provides the literature findings on factors to be considered in managing disasters successfully. Identified factors are classified into several categories as; Technological, Social, Environmental, Legal, Economical, Functional, Institutional and Political based on their characteristics. These factors are common for all types of disasters and considered the three phases; mitigation/preparedness, relief/recovery and reconstruction/rehabilitation, by covering many countries affected.

5.1. Technological factors

This includes aspects relating to or involving the application of scientific advances including any tool, technique, product, process and method to benefit disaster management. Information and communication technology and other scientific advances are applicable to the mitigation of natural hazards (WCDR, 2005 cited in Oloruntoba, 2005) which consequently helps to save lives and property while reducing the loss of livelihoods (UNDP, 2005 cited in Oloruntoba, 2005). Under this main category, three sub-categories are identified as warning systems, communication systems and structural measures.

Warning systems

Though it might be impossible to predict an earthquake it is possible to predict a tsunami and warn people in its path in order to move them to a safer location. The Indian Ocean tsunami of 2004 made people aware of the lack of a tsunami early warning system (Camilleri, 2006; Moe and Pathranarakul, 2006). Therefore it is not only recommended to set up an Indian Ocean tsunami early warning system, but also to integrate it with Pacific Ocean tsunami early warning systems. For the total coverage of the world a similar early warning system should be set up in the Mediterranean and the Atlantic (Oloruntoba, 2005). Further it emphasized that a warning should be as inclusive as possible to raise the awareness amongst public officials in the region and globally (Oloruntoba, 2005). In other words warning systems should be integrated with communication, education and awareness raising of the population (Rodriguez et al., 2006). As an example, The Pacific Ocean tsunami early warning system was reported to have had knowledge about the earthquake of Sumatra which triggered the 2004 tsunami and only selectively communicated a warning which would otherwise have reduced the loss of lives (Martin, 2004 cited in Oloruntoba, 2005). Reasons for the failure to warn at the Indian Ocean tsunami are found as slow or non-existent flows of information.

Communication systems

The media is able to fulfil the strategic roll of information distribution, mass communications and the education of people on how to evacuate, locate and relocate (Oloruntoba, 2005). Mass communication systems such as the use of emergency public sirens and warning broadcasts using radios, televisions and print media should be put in place. Public presentations, notices and pamphlets, sign and posters too have been used to communicate mitigation and protective measures.

Geographic information systems and remote sensing tools are proposed to use for effective logistics management among organisations during relief (Moe and Pathranarakul, 2006). Communication between stakeholders is vital important for successful reconstruction. Therefore effective communication mechanism should be established among key stakeholders (Moe and Pathranarakul, 2006). Computer networks and decision support systems can enhance the disaster communication during reconstruction (Ozceylan and Coskun, 2008).

Structural measures

Strengthening of buildings and infrastructure exposed to hazards via engineering design and construction practices come under this sub-category. According to Allotey et al. (2010) effective application of science and engineering principles to the development of the built environment has reduced the risks faced by earthquake-threatened cities of the developed world. Designing of houses and buildings in coastal areas which could withstand a tsunami is important. For example, engineers and researchers could design a 40 m^2 house for the coastal areas of Sri Lanka that they believe could withstand a tsunami and which would cost between $1,000 to $1,500 at 2005 prices (Hansen, 2005). It is simply designed with gaps between walls that will enable water to flow through the structure without destroying it. Designers suggest that these houses would be approximately five times stronger than a conventional house of the same size.

Presence of protective structures could reduce the vulnerability of people and structures. Studies have shown that $1 spent on prevention can save $40 of damage (Pheng et al., 2006). Flood defences (dams, levees) and sea walls are considered as physical preventive measures while raised roads, resilient infrastructure, raised platforms with latrines and drinking water, resilient water supply systems such as boreholes and building design with escape roads are considered as physical coping measures (DFID, 2005).

5.2. Social factors

This category includes the aspects relating to human society and its members in managing disasters Initiatives to increase the population's level of education, increase employment opportunity, reduce poverty, enhance the role and participation in decision making including women that would support preparations for future disasters (Rodriguez et al., 2006).

Lack of awareness and knowledge regarding tsunamis was apparent among the community members and government officials in Sri Lanka (Rodriguez et al., 2006). As lack of knowledge increases the vulnerability of people, strengthening communities against disasters is effective to reduce damage (Shiwaku and Shaw, 2008). Education is considered to be a key tool for the development of coastal communities' resilience (Morin et al., 2008). Education involves the enhancement and use of indigenous knowledge for protecting people, habitat, livelihoods, and cultural heritage from natural hazards. Educational practices can be conducted through direct learning, information technology, staff training, electronic and print media and other innovative actions to facilitate and manage and transfer of knowledge and information to citizens, professionals, organisations, community stakeholders and policy makers (Kaklauskas et al., 2009). Preparation through education is accepted as less costly than learning through tragedy (Kaklauskas et al., 2009). According to UN/ISDR, awareness about risks and dangers need to start in early education before abilities to address them can become part of growing civic and professional responsibilities as people mature (UN/ISDR, 2004 cited in Shiwaku and Shaw, 2008). Therefore the value of education of school children cannot be underestimated and it indirectly raises the awareness of communities (Sonak et al., 2008).

While there should be effective early warning systems, it must also make public officials and populace aware of evacuation plans (Olo-

runtoba, 2005; Rodriguez et al., 2006). These will support the promotion of a culture of preparedness.

The tsunami swept away the tourism resorts and fishing industry (Moe and Pathranarakul, 2006). Rehabilitation of the fisheries sector is essential and can be done through the provision of equipment and restoration of infrastructure facilities. Apart from that it is important to diversify the livelihood opportunities for improved management of natural resources.

Differing needs in the various affected countries, coupled with differing socio-economic and cultural conditions, need to be considered during relief and reconstruction (Oloruntoba, 2005). It is necessary to consider short and long term demographic and socio-economic implications of affected regions and how they impact the population in general and women in particular. Some of these points are:

- More children have orphaned.
- Traditional gender roles are being challenged by disasters.
- Women are differently affected by the tsunami, causing more deaths, sexual abuse in refugee settings, impact of role as an economic provider (Oxfam, 2005; Rodriguez et al., 2006; Sonak et al., 2008). following the high death rate of women, men are facing the challenge of raising and educating their children, therefore issues related to land tenure, property rights, economic sustainability of widows and primarily patriarchal societies must be addressed (Rodriguez et al., 2006).

5.3. Environmental factors

Aspects relating to the natural environment in managing disasters are considered here. Natural barriers such as sand dunes, coral reefs, mangroves, can provide protection from tsunami as they can reduce the flow velocity. As an example, in Sri Lanka, Yala and Bundala National Parks were protected due to these natural barriers. The mangroves' complicated root systems help to bind the shore together and shield against destructive waves (Sonak et al., 2008) the absence of which is a factor that determine vulnerability to coastal hazards. Therefore it is necessary to emphasize the importance of maintaining the protective features of the natural environment such as sand dunes, forests and vegetated areas (Arya et al., 2006; Bosher et al., 2007). Re-forestation of watersheds helps to minimise the effects of droughts.

The tsunami created tonnes of waste, comprising hazardous waste, vegetation, soil, sediment, demolition debris and municipal waste. These wastes pose threats to human health, ground water supplies and the marine environment (Sonak et al., 2008). Management of waste created by natural hazards is highly important and highlights the need for clear guidelines. It is important to explore ways of recycling and reusing of debris, and the need for proper sewerage systems and cost-effective sewerage treatment plants is emphasized.

Rehabilitation of saline soils needs to be performed through assessment and monitoring operations by trained staff. Development of a proper and adequate drainage system is also critical to minimise the harm to the ground.

Remediation of ground water supplies that have been polluted is likely to take several years. Therefore it is necessary to provide drinking water for affected people to avoid the risks of diseases (Sonak et al., 2008).

5.4. Legal factors

These include aspects relating to law, accepted rules, and regulations for managing disasters. The various regulations that apply to routine construction provide for the safe development of infrastructure, capital improvements and land use, ensuring preservation and environmental protection (Wilkinson et al., 2006). Accordingly if the regulation proc-

esses are well formulated they should not only to be an effective means of reducing vulnerability to disasters, but also a means of facilitating reconstruction projects. As an example, legislative and policy factors are found as a major determinant of resource availability in post conflict reconstruction (Chang et al., 2010). According to Moe and Pathranarakul (2006), disaster management supporting laws and regulations must be established and enforced so as to create an enabling environment so that suitable laws and regulations can be enacted based on professional hazard and vulnerability assessment (Pheng et al., 2006). However it is claimed that much of the existing legislation was not drafted to cope with an emergency situation and was not developed to operate under the conditions that will inevitably prevail in the aftermath of a disaster (Rotimi et al., 2009). The process of attaining building consent is identified as a bottleneck which hinders the achievement of reconstruction objectives.

On the other hand, poor construction quality is found to be a major reason for a higher level of destruction and deaths in developing countries. This could be as a result of lax building codes, weak enforcement of construction standards and corrupt procurement practices (Pheng et al., 2006). Therefore laws relating to these areas should be strengthened and enforced.

5.5. Economic factors

Economic factors can be classified into two: long term economic planning measures and financial. Economic planning measures include aspects relating to production, distribution and consumption of goods and services in a society. Aspects relating to money and management of monetary assets are covered under the financial sub-category.

Economic planning measures

1. Destruction of infrastructure during a disaster directly affects the economy of a country. As an example the fisheries sector, agricultural sector, livestock, tourism and micro-enterprises were dramatically affected by the Asian tsunami. Therefore the design of roads, railways, pipelines and cables needs careful location planning to reduce the risk of widespread failure (Bosher et al., 2007). Providers of energy in hurricane-prone areas can put their connections underground to minimise the risk of power shortages (Longo, 2005 cited in Kovacs and Spens, 2007).
2. Incentives such as tax breaks could include for resilient building design. Incentives can even be used to attract qualified professionals to manage large and complex projects successfully (Koria, 2009).
3. Insurance of properties against disasters must be made compulsory as an initiative to survive after disasters (Atmanand, 2003). This will indirectly improve the quality of construction as insurance companies will insist on certain minimum standards being met.
4. Introducing appropriate crops, breeds of livestock and drought resistant practices can reduce the agricultural losses due to disasters (Jayaraj, 2007).

Financial

Donors are known to make financial pledges which are not fulfilled (Oloruntoba, 2005). Lack of funds for long term reconstruction in excess of short term relief operations is another issue of reconstruction (RICS, 2006; Koria, 2009). Apart from that they should endeavour to invest in measures that reduce the impact of disasters. Donor administration and financial policies are usually not suited for rapid release of funds for disaster response and can cause delays in reconstruction.

5.6. Functional factors

Functional factors can be classified as technical and operational. Technical aspects

include factors relating to the skills and competence needed to accomplish desired works. Operational aspects include factors relating to a process or series of actions for achieving a result.

Technical

Participants lack of skills and knowledge in disaster risk management initiatives is identified as a major issue of reconstruction. For cost effective mitigation measures to be developed and applied, detailed information should be available on which buildings, infrastructural works and groups of people are particularly vulnerable to hazards. For these to be achieved, vulnerability assessments should be carried out.

Managing complex, large and demanding type of projects requires competent and experienced staffs, which are often found to be lacking in disaster reconstruction projects which may lead to unsuccessful project delivery (Koria, 2009). Therefore reconstruction demands project management competencies, and networking with international partners is suggested as one way of achieving these.

Inadequate planning and resources will inevitably hamper the reconstruction. Rotimi et al. (2009) indicate that the effectiveness of the reconstruction process will depend on how much planning has been carried out and which contingencies are provided for in preparing for the disaster. For instance, common protocols and industry standard project management and planning tools have not been widely used in Sri Lanka (Koria, 2009). Therefore late starts, delays in delivery and inflation lead to cost overruns of reconstruction projects.

Operational

Challenges of logistics and access are found to cause bottlenecks in aid flows. Disaster logistics include people, expertise and technology. The field of humanitarian logistics is relatively new and it is different from business logistics due to various characteristics: disaster relief operations are carried out in an environment with destabilised infrastructures ranging from a lack of electricity supplies to limited transport infrastructure. As most disasters are unpredictable, the demand for goods is also unpredictable (Kovacs and Spens, 2007), although the basic principles of business logistics can be applied to humanitarian logistics.

Coordination of recovery is usually accepted as slow, expensive and complex (Koria, 2009). The extent of effective collaboration and coordination between national authorities, local actors and international actors appear to be insufficient to achieve effective planning, damage assessment and public information management (Oloruntoba, 2005). Coordination should be considered at different levels including international, national, regional, organisational and project level (Moe and Pathranarakul, 2006).

Local groups should be engaged in decision making and local skills should be utilised (Oloruntoba, 2005; Moe and Pathranarakul, 2006). If the relocation efforts are to be succeeded, it should involve the communities in the decision making process (Rodriguez et al., 2006). It is claimed that recognition was not effective so that some important groups were entirely excluded in Sri Lanka (Koria, 2009). Further it should be appreciated that local participation in recovery efforts include the distribution of relief aid and cleaning up of debris.

After a disaster, information is the most valuable and often most elusive asset (Paul et al., 2006). Information is vital for early warning, planning, rehabilitation and reconstruction. Lack of information complicates the efficient management of catastrophes and makes the decision making process a difficult task (Puras and Iglesias, 2009). Sobel and Leeson (2007) found that the inability to overcome the information problem is the root cause of a government's failure to manage natural disaster relief effectively. Therefore an effective information management system is important.

For example, swift access to building plans and schematics of key services in the event of fires and floods would benefit the operational level of emergency management (Bosher et al., 2007). During reconstruction timely, accurate, and useful operational information must be disseminated amongst responding organisations for effective coordination (Oloruntoba, 2005).

5.7. Institutional factors

This includes aspects relating to an organisation founded and dedicated to disaster management and related activities.

An effective institutional arrangement is essential for managing disasters successfully. While a principal responsible unit must be specified, other units should be specified at various levels including provincial, district and village level. Unclear line of authorities, coupled with a slow decision making process caused delays in activities (Moe and Pathranarakul, 2006). These units should be fully authorised for disaster management and have developed a disaster management master plan.

Though warning systems may facilitate the saving of lives, they are not useful in minimising damage to property and infrastructure. Therefore development of land use plans and regulations is necessary to direct new development away from known hazard locations, relocate existing developments to safer areas and maintain protective features of the natural environment. However these policies should be created with wider consultation to make them effective and consistent. As an example, the 200 m coastal buffer zone was later revised to a significantly less wide zone as a result of creating it without geomorphologic consideration (Koria, 2009). Further the issues of land acquisition, community acceptance and impact on livelihoods were neglected. For example some communities were planned to relate to a region where they would be impacted by floods and some fishermen and their families were planned to be relocated to high-rise apartment type housing which is not conceivable to them. It is essential to plan the coastal zone developments of harbours, buildings and other infrastructure with coastal zone management strategies whilst restoring coastal ecosystems to enhance the level of resilience (Srinivas and Nakagawa, 2008). Necessary building codes must be developed which are informed by these risks.

Lack of appropriate technical and managerial expertise and knowledge of participants is widely acknowledged (Koria, 2009). Professional institutions need to carry out training programmes and disaster management courses to disseminate the knowledge about disaster risk management initiatives and of which stages these must be addressed, including their roles and responsibilities. For example it is found that the pre-construction phase emerges as the most critical phase for integrating disaster risk management into the construction and designers, civil engineers, structural engineers, specialist contractors, engineering consultants and developers should be involved (Bosher et al., 2007). Further it is identified that the stakeholders involved in the preliminary phase should consider what materials to use, where to build and what to build. It is emphasized there is a need to develop an accreditation scheme and a training programme for the context of recovery work (Koria, 2009).

The strengthening of networks among disaster experts, managers and planners across sectors and between regions is needed (Kaklauskas et al., 2009). This is supported by Mohanty et al. (2006) and indicated that linkages among all agencies working on disaster management need to be strengthened in order to derive the regional best practices and coping mechanisms. In order to enhance the information sharing and management of the knowledge generated in these institutions, it is highly essential to closely knit together

the organisations/institutions. The network of these institutions will create a common platform and enable its stakeholders and people to capture, organise, share and reuse the knowledge generated in the area of disaster management. Education on disaster management should be institutionalised and a curriculum should be developed to include disaster management modules to educate school children and university students. Further educational programmes can be introduced to carry out research in the field. Designing and constructing a resilient built environment demands an in-depth knowledge on avoiding the effects of hazards and therefore research should be done on how disaster risk reduction can be effectively mainstreamed into construction (Bosher et al., 2007).

5.8. Political factors

These include aspects related to politics or parties or politicians in the context of disaster management. The political situation in a region may not be supportive of immediate distribution of relief materials or longer term reconstruction and the safety and security of the relief workers may be affected (Oloruntoba, 2005).

Deep rooted political unrest complicated relief and reconstruction in Sri Lanka and Indonesia (Paul et al., 2006). For example, due to lack of access all recovery work in the north of Sri Lanka was stopped (EC, 2007 cited in Koria, 2009). Rodriguez et al. (2006) indicated that the conflict between the government and the Liberation Tigers of Tamil Eelam generated a variety of concerns regarding how aid was distributed.

The volatile stakeholder map and conflicting internal political agendas too contributed to additional delays in reconstruction (Koria, 2009). In some cases, internal political agendas superseded the technical agenda in Sri Lanka (Koria, 2009).

6. SUMMARY

This study has identified a list of factors to be considered in disaster management and classified them into several categories based on their characteristics. It is clear from the literature review that most factors are identified within one or more phases of the disaster management cycle. As an example, communication comes under mitigation, preparedness, relief and reconstruction. Some of other factors as well follow this pattern and these factors may be critical for some particular phase or phases and general for other phases. At the same time it will depend upon the type of disaster and country.

The need for disaster risk reduction is widely acknowledged against the increasing frequency and variety of disasters which can cause direct and indirect effects. In this context, knowledge of disaster management strategies, together with recognised good practices and lessons learned, can undoubtedly support this effort through well-informed mitigative measures and preparedness planning. In this context, this research aims to identify key success factors for managing disasters and maps them against the disaster management cycle. This paper identified and categorised factors which must be considered for successful disaster management through a comprehensive literature survey. Major categories derived are; technological, social, legal, environmental, economical, functional, institutional and political. Identified factors were classified into these main categories based on their characteristics.

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SANTRAUKA

INFORMACIJOS APIE NELAIMES VEIKSNIAI, LEIDŽIANTYS SĖKMINGAI VALDYTI NELAIMES

Krisanthi SENEVIRATNE, David BALDRY, Chaminda PATHIRAGE

Pastarąjį amžių pranešimų apie stichines nelaimes nuolat daugėjo, o pastarąjį dešimtmetį ypač. Per nelaimes žūsta žmonės, prarandama nuosavybė ir darbo vietos, suniokojama fizinė infrastruktūra ir aplinka. Valdant nelaimes siekiama sumažinti arba išvengti potencialių nuostolių dėl pavojų, užtikrinti greitą ir tinkamą pagalbą nelaimės aukoms, viską greitai bei efektyviai atkurti. Nors žinių vadyba nelaimių valdymo procesui gali padėti, nelaimių valdymo kontekste pastebima spraga tarp informacijos koordinavimo ir dalijimosi ja. Nustačius pagrindinius sėkmės veiksnius, tai leis sėkmingai valdyti nelaimes. Šiame kontekste tyrimu siekiama nustatyti ir surūšiuoti pagrindinius žinių sėkmės veiksnius, leidžiančius sėkmingai valdyti nelaimes, užfiksuojant gerąją patirtį ir išmoktas pamokas. Šio darbo tikslas – pateikti literatūros išvadas apie veiksnius, kurie prisideda prie sėkmingo nelaimių valdymo. Nustatyti veiksniai atitinkamai suklasifikuoti į aštuonias pagrindines kategorijas: technologiniai, socialiniai, teisiniai, aplinkos, ekonominiai, funkciniai, instituciniai ir politiniai.