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KNOWLEDGE FACTORS AND ASSOCIATED CHALLENGES FOR SUCCESSFUL DISASTER KNOWLEDGE SHARING

Dr Chaminda Pathirage, Dr Krisanthi Seneviratne, Prof Dilanthi Amaratunga and Prof Richard Haigh

Centre for Disaster Resilience, University of Salford

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Executive Summary

Frequency and extent of natural disasters are increasing on a global scale. Natural disasters claim many human lives and damage a great deal of property. The urgent need to reduce disaster risk and develop a resilient community capable of recovering from disasters is of increasing concern in many countries. 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. 'ISLAND-II' (Inspiring Sri- LankAn reNewal and Development – Phase II) research project set out to identify key disaster knowledge factors pertaining to disaster management and incorporate appropriate knowledge and good practices relating to different types of disasters. A list of disaster knowledge factors was first identified through a comprehensive literature review and later semi-structured interviews were conducted among few disaster management practitioners to explore the influence and challenges relating to knowledge factors.

Disaster knowledge factors are classified into several categories based on their characteristics: Technological, Social, Environmental, Legal, Economical, Operational/ Managerial, Institutional and Political. These factors are common for all types of disasters and across three phases of disaster cycle; mitigation/ preparedness, relief/ recovery and reconstruction/ rehabilitation. Social factors have a very high influence level in managing disasters successfully. Technological, operational/ managerial, economic, social, legal and environmental factors seem to have direct influence over the disaster management cycle, while the influence of institutional and political factors seemed indirect and it is through other factors identified. The mitigation/preparedness phase seemed influenced by almost all the disaster knowledge factors. Among key challenges, the lack of detection and warning systems, the need for effective education, training and awareness raising programmes, the need for regular updating of disaster related laws, lack of funds for economic planning measures, poor planning, poor communication, poor leadership, and poor institutional arrangement were highlighted. Peoples' attitudes and perceptions hinder their involvement in disaster management; hence, in order to manage disasters successfully it is important to overcome these attitudes and perceptions.

Owing to paucity of literature and inadequate empirical research done, this paper provides the basis for more empirical research on disaster knowledge factors and sharing of lessons learned. In order to enhance the management of disasters in future, challenges identified needs to be addressed.

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). There is evidence that the frequency and extent of natural disasters are increasing on a global scale (Warren, 2010). For instance, 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). This increase is as a result of more frequent disasters; the growth of global populations located in increasingly vulnerable areas; and continued environmental degradation (Deshmukh et al., 2008). As communities worldwide have been facing an increasing frequency and variety of disasters which can cause direct and indirect effects, 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. 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.

Knowledge management can play a vital role through ensuring the availability and accessibility of accurate and reliable disaster related information when required and through effective lesson learning (Seneviratne et al., 2010). Despite this, knowledge on disaster management appears fragmented, emphasising a perceived gap in information coordination and sharing (Mohanty et al., 2006; Seneviratne et al., 2010). 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". Two forms of knowledge could be identified: explicit and tacit. Explicit knowledge is codifiable knowledge inherent in non-human storehouses including organisational manuals, documents and databases. Tacit knowledge represents knowledge based on the experience of individuals, expressed in human actions in the form of evaluation, attitudes, points of view, commitments and motivation (Nonaka et al., 2000). The knowledge and experiences of disaster practitioners remain in the individual or institutional domain. As an example, a research (Koria, 2009) revealed that many organisations have not been able to capture, retain and/or re-use the learning from disaster management operations except through the tacit knowledge of individuals that have worked in various operations. Furthermore the UK Higher Education Disaster Relief Report (University of Gloucestershire, 2007) highlighted the lack of mechanisms at a national level in the UK to link expertise, skills and knowledge that reside in higher education, with that of the practitioners working in humanitarian agencies. Therefore the lack of effective knowledge sharing, and knowledge creation on disaster management can thereby be identified as one of the reasons behind the unsatisfactory performance levels of current disaster management practices.

The research project reported in this paper, the 'ISLAND-II' (Inspiring Sri- LankAn reNewal and Development – Phase II), aimed at increasing the effectiveness of disaster management by facilitating the sharing of appropriate knowledge and good practices. Due to the broad scope of disaster-management related activities, the study focused on the post-tsunami response, with specific reference to situation in Sri Lanka. Specifically it identified key disaster knowledge factors pertaining to disaster management cycle and examined associated key gaps and challenges. Further the project focused on natural disasters, such

as floods, tsunami, earthquakes, hurricanes etc. This paper aims to present and discuss key knowledge factors relating to disaster management cycle, and explore a few challenges relating to identified disaster knowledge factors.

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 the Greek meaning, 'bad star' (Konoorayar, 2006). Disasters are classified in various ways. The Emergency Disasters Database classified disasters as natural or technological. The United Nations (2006 cited in Moe et al., 2007) further classified natural disasters into three categories: 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). Technological disasters consist of industrial accidents, transport accidents and miscellaneous accidents.

Disaster management is an integrated process of planning, organising, coordinating and implementing measures that are needed for effectively dealing with its impact on people. This includes prevention, mitigation, capacity building, preparedness, response, assessment, rescue and rehabilitation (Deshmukh et al., 2008). According to Warfield (2004), 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.

The disaster management cycle illustrates the ongoing process by which various stakeholders in a society plan for and reduce the impact of disasters, react during and immediately following a disaster, and take steps to recover from the impact (Clerveaux et al., 2010). Phases in natural disaster management are frequently identified using different terms, but give similar insights. Figure 1 shows the disaster management spiral, which illustrates the two main phases of disaster management: pre-disaster risk reduction and post disaster recovery.

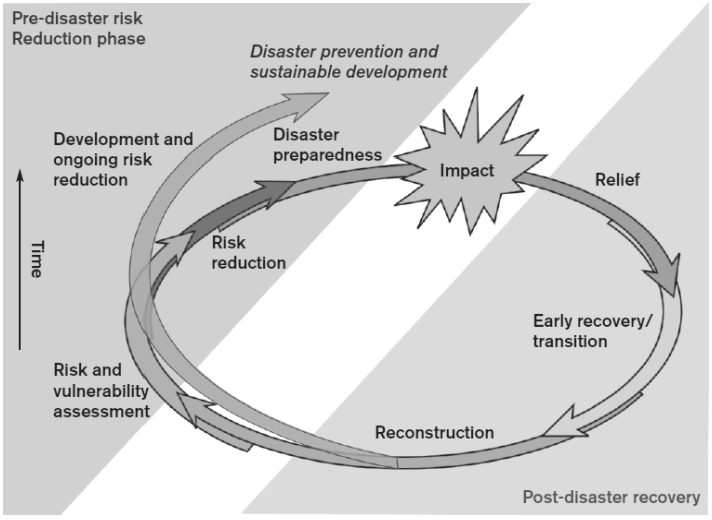


Figure 1: The risk management and response spiral

Source: RICS, 2009

Risk and vulnerability assessment involves identifying the nature and magnitude of current and future risks from hazards to people, infrastructure and buildings (RICS, 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. For example, it would be unrealistic to prevent or limit building and occupation of the coastal environment and reinforce every building within a tsunami flood hazard zone due to the economic costs involved. Also it would not always be 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). *Preparedness* deals with the activities and measures taken in advance to ensure an 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).

The 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, survival requirements, water purification kits, cooking utensils, foods, safe areas, relocation, shelter and general living and psychological support (Perry, 2007). The transition phase involves community surveys, needs assessment, land survey, and acquisition and provision of transitional shelters (RICS, 2009). Care and maintenance of transitional shelters is required until permanent housing construction is provided. *Reconstruction* refers to the rebuilding of the 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 facilities 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 its coordination and management (Koria, 2009). However it may present an opportunity for improvement in the functioning of the community, so that the risk from future events can be reduced while the community becomes more resilient (Rotimi et al., 2009).

The 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. The lack of a proactive approach to disaster management can result in more damage and a higher level of 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.

Disaster Knowledge 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". Three forms of knowledge are identified: explicit, tacit and implicit. Explicit knowledge is that which is stated in detail and is termed as codified or formal knowledge (Tatham and Spens, 2011). Explicit knowledge can be accessed by anyone, for example, books, pictures, or recording clips. According to Nonaka et al., (2000), tacit knowledge represents knowledge based on the experience of individuals, expressed in human actions in the form of evaluation, attitudes, points of view, commitments and motivation. Tacit knowledge is lost with the person who possesses it. Implicit knowledge is that which could be expressed, but has not been (Mohanty et al., 2006). In other words implicit knowledge is that body of knowledge which exists without being stated.

Knowledge management is a process by which knowledge is created, shared and utilized (Deshmukh et al., 2008). According to Tatham and Spens (2011), knowledge management is generally seen as a strategy to collect, store and retrieve knowledge in a systematic way, and then distribute the results to those who need it in a timely manner (Tatham and Spens, 2011). In simple terms, knowledge management is all about providing the right knowledge, in the right place, at the right time. However, it should be borne in mind that knowledge management systems can only provide decision support and it is the people in emergency situations that deal with the actual emergency or disaster. As a result, exact actions and responsibilities of individuals cannot be predetermined due to some unforeseen events occurring during the disaster (Otim, 2006).

Though there is no way of neutralizing all of the 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. The RICS (2009) emphasises the feeding back of recovery experience to inform the disaster management process in order to reduce 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 (Seneviratne et al., 2010; Mohanty et al., 2006). Accordingly, the knowledge and experiences of disaster practitioners remain in individual or institutional domains. According to UNESCO (2005),

while abundant knowledge about risk and vulnerability to hazards exists, its access and utilization at the community, national, regional and international levels, to empower or protect, is yet to reach its full potential. Kaklauskas et al. (2009) indicate that in the countries affected by the Asian tsunami, the lack of knowledge management is apparent. By reinforcing this fact, Koria (2009), finds that in Sri Lanka, 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. This resulted in re-inventing the wheel in terms of setting up and managing the construction programmes and projects within the tsunami recovery operation (Koria, 2009). According to Pourezzat et al. (2010), disaster response is dynamic and therefore decision makers need to receive updated information on the current emergency situation. Disaster response is also time-sensitive, with little allowance for a delay in decision making and response operations. Therefore, any problem or delay in data collection, access, usage, and dissemination has a negative impact on the quality of decisions and hence, the quality of disaster response (Pourezzat et al., 2010).

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. All these highlight the importance of embracing knowledge management within the context of disaster management.

Disaster Knowledge Factors

Within this study disaster knowledge factors are defined as facts that enhance knowledge of managing disasters successfully. Therefore disaster knowledge factors can directly or indirectly affect the process and outcomes of disaster management. This study aimed to identify key disaster knowledge factors in managing disasters successfully through capturing good practices and lessons learned, and to map them against the disaster management cycle. Identified factors are classified into several categories based on their characteristics: Technological, Social, Environmental, Legal, Economical, Operational/ Managerial, Institutional and Political. These factors are common for all types of disasters and across three phases; mitigation/ preparedness, relief/ recovery and reconstruction/ rehabilitation.

Technological factors

This includes aspects relating to or involving the application of scientific advances including any tool, technique, product, process and method benefiting 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: warning systems, communication systems and structural measures.

Warning systems

Though it might be difficult 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 Sumatra earthquake and subsequent tsunami in 2004 exposed the lack of a tsunami early warning system in the

Indian Ocean (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). 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 issue warnings about the Indian Ocean tsunami are found as slow or non-existent flows of information. Said et al. (2011) assert that having an appropriate infrastructure such as early warning system in place does not guarantee the masses will respond accordingly to a disaster unless they are aware of the tsunami risk and what the warning is for. The high death toll that occurred has been attributed to the absence of an Indian Ocean early warning system similar to that which exists in the Pacific Ocean and a lack of knowledge about tsunamis (Kurita et al., 2006). People learned that nature is a powerful force, but also that a simple warning system could have saved many lives (McEntire, 2010).

Communication systems

The media is able to fulfil the strategic role 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, signs and posters too have been used to communicate mitigation and protective measures.

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

Structural measures

The strengthening of buildings and infrastructure exposed to hazards via engineering design and construction practices come under this sub-category. As Allotey et al. (2010) emphasise, effective application of science and engineering principles in the development of the built environment has reduced the risks faced by earthquake-threatened cities of the developed world. The design of houses and buildings in coastal areas which could withstand a tsunami is important. For example, engineers and researchers could design a 40m2 house for the coastal areas of Sri Lanka that they believe could withstand a tsunami, which would cost between $1,000 and $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.

The presence of protective structures can also 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). For example, 40% of Japan's 28,000km coastline is protected by massive concrete seawalls (Harrison, 2011), though they proved ineffective during the 2011 tsunami disaster.

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).

Awareness of disaster impact is necessary in inculcating into the citizen's culture of disaster preparedness, prevention and mitigation. Therefore, both formal and informal approaches to disaster education are advocated. Public information and enlightenment campaigns in print and electronic media, and through community-based organisations (e.g. women and youth associations, neighbourhood organizations, market/trade and religious organizations) should be vigorously pursued. Also, disaster management studies should be incorporated into the educational curriculum at all levels, with an emphasis on disaster vulnerability reduction. This will, among other benefits, produce the qualified professionals, policy makers and managers required to meet the human resources needed for disaster management organisations, and enhance the capacity of agencies to formulate the right policies needed for effective vulnerability reduction strategies (Ibem, 2011). Lack of awareness and knowledge regarding tsunamis was apparent among the community members and government officials in Sri Lanka (Rodriguez et al., 2006). As the lack of knowledge increases the vulnerability of people, strengthening communities against disasters is effective to reduce damage (Shiwaku and Shaw, 2008). On a global scale, it is natural disasters that have the most significant and most diverse effect on human beings (Ocal and Topkaya, 2011). A culture of safety and resilience requires people's awareness and understanding, which in turn leads to actions for reducing risk and vulnerability to disasters (UNESCO, 2005). Education for disaster risk reduction is an interactive process of mutual learning among people and institutions. Promotion of awareness among children not only represents future investment in disaster loss-reduction, but in addition, children are recognised as an important link of risk information between schools and households (Clerveaux et al., 2010). It encompasses far more than formal education at schools and universities. Indigenous information and experience, training and the use of technology and media, all contribute means to manage valuable knowledge on disaster risk for the benefit of citizens, professionals, organizations, community stakeholders and policymakers (UNESCO, 2005).

Clerveaux et al. (2010), claim that although it is almost impossible to fully recoup the damage caused by a disaster, it is possible to minimise the potential risks among people.

The challenge however is in the design of educational tools that can effectively transfer and transmit knowledge across a broad spectrum of social groups (Clerveaux et al., 2010). A study conducted in Sri Lanka revealed that approximately 94 percent of residents had never heard about tsunamis before the disaster that took place in 2004 (Kurita et al., 2006). Furthermore, most residents indicated that damage in the affected area could have been reduced, had they known more about tsunamis. Many people consider disaster education in the schools to be the most effective. 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 printed 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 needs to start in early education before the ability to address them becomes part of growing civic and professional responsibilities as people mature (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).

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 the 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 been orphaned.
- Traditional gender roles are being challenged by disasters.
- Women are affected differently by the tsunami, causing more deaths, sexual abuse in refugee settings, and the impact of the 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).

Environmental factors

Aspects relating to the natural environment in managing disasters are considered here. Natural barriers such as sand dunes, coral reefs, and mangroves can provide protection from a 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 determines 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.

Disasters create tonnes of waste, comprising hazardous waste, vegetation, soil, sediment, demolition debris and municipal waste. This waste poses a threat to human health, ground water supplies and the marine environment (Sonak et al., 2008). As an example, the volume of disaster waste from the 2010 Haiti Earthquake was estimated at 20 to 25 million cubic yards (Moelloer, 2010). Management of waste created by natural hazards is important, with a 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).

Legal factors

These include aspects relating to law, accepted rules, and regulations for managing disasters. 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 processes are well formulated, they should not only 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 supportive laws and regulations must be established and enforced so as to create an enabling environment. These laws and regulations can be enacted based on hazard and vulnerability assessment (Pheng et al., 2006). 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 a lack of 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. New Zealand is well known as having adopted stricter building codes on earthquakes, though the recent earthquake in Christchurch resulted in some damage to buildings.

Economic factors

Economic factors can be classified into two areas: long term economic planning measures and financial aspects. 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

Destruction of infrastructure during a disaster directly affects the economy of a country. Papathoma et al. (2003) claim that destruction of property and engineered structures, and coastal infrastructure had resulted in countries experiencing major losses due to economic and business interruption. Therefore the design of roads, railways, pipelines and cables need careful location planning to reduce the risk of widespread failure (Bosher et al., 2007). As good practice, 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). Incentives such as tax breaks could be offered for resilient building designs. Incentives can also be used to attract qualified disaster management professionals to manage large and complex projects successfully (Koria, 2009). Insurance of properties against disasters must be made compulsory as an initiative to survive after disasters (Atmanand, 2003). Thomas and Leichenko (2011), claim that in many industrialised countries, flood insurance, much like earthquake insurance, is provided by the state. This will indirectly improve the quality of construction as insurance companies will insist on certain minimum standards being met. Introducing appropriate crops, breeds of livestock and drought resistant practices can also reduce agricultural losses due to disasters (Jayaraj, 2007).

Financial

The lack of funds for long term reconstruction after short term relief operations is another frequently cited problem (RICS, 2006). Authorities should also endeavour to invest in measures that reduce the impact of disasters. As an example, Curry (2011) contends that it is vital for countries to make the financial investment to create a culture of preparedness, to help lessen property damage from natural disasters. Donors are known to make financial pledges which are not fulfilled (Oloruntoba, 2005). Particularly when subsequent disasters occur, financial resources, personnel and political attention may soon be moved to other disasters. In addition, donor administration and financial policies are usually not suited for rapid release of funds for disaster response and can cause delays in reconstruction work.

Operational/managerial factors

This category includes factors relating to the planning, coordination and management of disaster related activities.

Participants' lack of skills and knowledge in disaster risk management initiatives is identified as a major issue of reconstruction. For example, the Sri Lankan government is not adequately prepared for managing natural disasters, as it is not considered as a disaster-prone country. A major disaster like the 2004 tsunami was definitely not anticipated. Thus, there was inadequate information management when the disaster struck, as well as coordination problems during the relief and rehabilitation phases after the disaster. Although officials did their best to perform their duties, the lack of experience and the lack of a disaster management system kept them from achieving productive results (Kurita et al., 2006). For cost effective mitigation measures to be developed and applied, detailed information must be made available, including those buildings, infrastructural works and groups of people who are particularly vulnerable to hazards. Managing complex, large and demanding types of projects require competent and experienced staff; these 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.

Challenges of logistics and access to affected areas 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. The generation of risk information and its timely and effective communication to stakeholders of disaster management is the essence of strategies for hazard/disaster loss reduction. However, the latter is a major challenge for disaster managers, especially in an increasingly globalised world, characterised by higher levels of multiculturalism, as more and more people migrate to locations outside their cultural zones (Martin, 2003 cited Cleveaux, et al., 2010). 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 (Moe and Pathranarakul, 2006).

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). Another important aspect considered under this theme is community engagement. Local groups should be given the opportunity to engage in the decision making process and local skills should be utilised (Oloruntoba, 2005; Moe and Pathranarakul, 2006). If the relocation efforts are to be successful, it should involve the local communities in the decision making process (Rodriguez et al., 2006). Koria (2009)

also emphasized the importance of stakeholder participation and ownership of projects during reconstruction. Further, it should be appreciated that local participation in recovery efforts includes the distribution of relief aid and cleaning up of debris.

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 identified at various levels including provincial, district and village level. Unclear lines of authorities coupled with slow decision making processes, cause delays in activities (Moe and Pathranarakul, 2006). These units should be fully authorised and empowered for disaster management, and should 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. Development of land use plans and regulations to direct new development away from known hazard locations, relocate existing developments to safer areas and maintain protective features of the natural environment, should be performed by the relevant institutions. However, these policies should be created with a wider consultation to make them effective and consistent. As an example, the 200m coastal buffer zone introduced in Sri Lanka after the tsunami disaster was later revised to a significantly lesser zone as a result of creating it without geomorphologic consideration (Koria, 2009). Further issues such as land acquisition, community acceptance and impact on livelihoods were neglected by the institutions that were responsible for reconstruction. For example some communities were relocated to a region where they would be impacted by floods and some fishermen and their families relocated to high-rise apartments which were unsuitable for their way of life. Furthermore, 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). Institutions must develop necessary building codes informed by these risks.

Professional institutions need to carry out training programmes and disaster management courses to enhance capacity and disseminate knowledge on disaster risk management initiatives. For example it is found that the pre-construction phase is considered as the most critical phase for integrating disaster risk management into the construction; hence, designers, civil engineers, structural engineers, specialist contractors, engineering consultants and developers should be actively 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 that there is a need to develop accreditation schemes and training programmes relating to disaster management efforts (Koria, 2009).

The strengthening of networks among disaster experts across sectors and between regions is needed (Kaklauskas et al., 2009). This is supported by Mohanty et al. (2006) who argued 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 essential to closely knit together these organisations/institutions. A 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 of avoiding the effects of hazards; therefore research should support finding how disaster risk reduction can effectively be mainstreamed into construction (Bosher et al., 2007).

Political factors

These include aspects relating to politics, 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 long term reconstruction and the safety and security of the disaster management practitioners can be affected (Oloruntoba, 2005). Deeply rooted political unrest complicated relief and reconstruction in Sri Lanka and Indonesia (Paul et al., 2006). For example, due to a lack of access and ongoing civil war, 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. Maditinos and Vassiliadis (2011), affirm the political commitment for a more effective management of mega fires in the USA. Provision of adequate budget, the adoption of proactive rather than reactive responses, the amendment of conflicting policies and legislations and the definition of clear responsibilities for fire management are among the highlighted political commitments (Maditinos and Vassiliadis, 2011).

Methodology: ISLAND Project

In view of addressing the perceived need to capture and share disaster management knowledge, the School of the Built Environment, at the University of Salford, UK, undertook the research project titled 'ISLAND' (Inspiring Sri-LankAn reNewal and Development). ISLAND aimed at increasing the effectiveness of disaster management by facilitating the sharing of appropriate knowledge and good practices in land, property and construction. Due to the broad scope of disaster-management related activities, this initial study focused on creating a knowledgebase on the post-tsunami response, with specific reference to case materials in Sri Lanka. Research proposed through ISLAND-II aimed at further extending the scope of ISLAND, by incorporating appropriate knowledge and good practices relating to the three key phases/ stages of disaster management cycle, namely: mitigation/ preparedness, relief/ recovery and reconstruction/ rehabilitation. Specifically it identified key disaster knowledge factors pertaining to disaster management cycle, evaluated the existing knowledgebase and expanded the knowledgebase to include good practice case studies associated with managing the different types of disasters. The research project was carried out according to four work packages (WPs) and this paper is based on WP 2, which aimed at identifying key disaster knowledge factors within the disaster management cycle.

Table I: Profile of interviewees

Profile of the Interviewees	Interviewee A	Interviewee B	Interviewee C	Interviewee D	Interviewee E
Age range	41-50	31-40	31-40	31-40	31-40
Gender	Male	Male	Male	Male	Male
Experience in dealing with disaster issues	4	7 (Research)	4	4	4 (Research)
Types of disasters dealt	Flood Railway	Tsunami Hurricane	Hurricane Outbreaks	Flood	Earthquakes
Disaster related training programmes undergone	Literal raining in terms of CPD workshops	-	-	First aid and coordination	Simulation

A comprehensive literature survey and review was first carried out to identify the disaster knowledge factors which support successful disaster management. Based on these findings semi-structured interviews were conducted with a few disaster management experts to explore the level and how these factors influence managing disasters successfully and any pertaining challenges. In total five experts were interviewed using a semi-structured interview guidelines. Their age ranged from 31 to 50, experiences dealing with disasters ranged between 4 and 7 years, and some had both industry and research experiences. Table 1 presents the profile of interviewees. Interviews lasted between 40 to 90 minutes, with an average of 70 minutes. Semi-structured interview data was analysed through content analysis. Nvivo (version 6) was used to carry out content analysis. Succeeding section provides a brief introduction to disaster knowledge factors identified through literature review and section after presents interview findings.

Influence of knowledge factors on disaster cycle

This section presents a discussion on how disaster knowledge factors influence different phases of the disaster management cycle based on interview findings.

Influence of technological factors in different phases of the disaster management cycle

Most of respondents agreed that technology plays a major role in almost all phases of a disaster. But technologies that could be used during immediate relief stage are quite different from the technologies that could be used during long term recovery and the preparedness stages.

A technological focus in the immediate relief stage is very much on transport as a means to get to places very quickly and to recover people effectively and efficiently through ground vehicles to helicopters. In addition, sensing technology supports gathering of real time data on the scale of the disaster, what has being destroyed, and what is being left through satellite images. As this real time data supports much of the subsequent decision making on resource planning and allocation, it can have a big impact on the disaster management cycle. During long term recovery and preparedness, technology tends to be used to enhance the resilience of communities and safeguard existing communities. Effective methods of reconstruction or product modelling play a major role during long term reconstruction. In

addition, product modelling helps to analyse the strength of the buildings after a disaster and to remodel better. As perceived by respondents, the maximum impact of technology is likely seen during the preparedness stage as this stage allows maximum time to plan for technologies to improve the resilience of communities to face further disasters. Most of the measures that a country takes to avoid disasters in preparedness stage are technology based. However, the usefulness or ability to make an impact will depend on numerous factors, including the key parties in the disaster management cycle, who uses the technology, competencies that they have on the use of that technology, and the environment in which it is being used. Therefore, technological factors are integrated with operational/ managerial factors and social factors through institutions.

Influence of social factors in different phases of the disaster management cycle

One of the key success factors of disaster management is to what extent humans are part of disaster management or to what extent the disaster management is connected with the day to day lives and the operations of a society. Whether a society as a whole is well aware of the impending disaster but is also ready to take up and live with it, is considered as a key success factor. For example though Japan is a country which is prone to frequent earthquakes, it is considered as one of the world's most resilient countries because it is embedded into peoples' lives and people have a level of preparedness and resilience, despite recent 2011 tsunami devastation. Disaster related training, education and awareness raising are helpful to enhance the peoples' preparedness and resilience to disasters. When it comes to immediate relief and reconstruction, the extent of peoples' network can either help or hinder the operation. If it is a society that helps each other, it can tremendously improve the ability of the social network to withstand the effect of the disaster.

Influence of environmental factors in different phases of the disaster management cycle

As natural factors can sometimes prevent or promote disasters, the influence of natural factors on the disaster management cycle can be identified as follows.

When environmental factors have an effect in preventing disasters, measures should be taken to ameliorate and protect such natural factors. For example, planting trees may be used to prevent landslides, or planting of shelterbelts and mangroves along coastal areas may be used to minimise the effects from waves. On the other hand if there are already natural barriers in place, measures should be taken to protect them. For instance, if mangroves and vegetation are already present in coastal areas, necessary planning measures should be taken to avoid any interventions that damage those barriers. When natural factors promote disasters, careful consideration, through building and town planning, should be given as to whether people should be allowed to live in those areas. If people are allowed to live there, then the necessary man-made barriers should be used to minimise the possible effects. For example in the Netherlands, protective walls are built around the sea as the Netherlands lies below the sea level.

The influence of environmental factors can be clearly identified during the mitigation/ preparedness phase of the disaster management cycle. The interview findings suggest that natural environmental factors can promote or prevent disasters. Also it is clear from the findings that, when natural factors promote disasters, the built environment has a big role to

play in minimising any negative effects. In addition, institutions are responsible in developing necessary planning and regulations to enhance and protect the existing natural barriers and to minimise the damages to the structures and people when natural factors promote disasters.

Influence of the legal factors in different phases of the disaster management cycle

Most respondents felt that the highest impact of legal measures or legal factors will be at the prevention and mitigation stages. As disaster management policies have a high possibility of being very effective at the prevention and mitigation stages, there should be a legal backing to support these policies. In other words, the law can help to implement some of the disaster mitigation measures by incorporating them into codes, standards, and statutes. In addition, emergency regulations and laws related to civic duties might influence when responding to a disaster during the immediate relief. As an example, when hurricane Katrina hit New Orleans, a state of emergency was declared in that part of America. This was partly because of human unrest. The other reason was to give central government the power to use the resources of other states. Because America has very strong state governmental system, one state or even the federal government or central government cannot straight away intervene and use resources allocated to one state. But by declaring state of an emergency it gives central government the power to do that.

Influence of the economic factors in different phases of the disaster management cycle

As disasters can affect a country's wealth generation mechanism, economic planning measures are accepted as very important. The focus of economic planning measures in mitigation/ preparedness stages is on protecting the country's wealth generation mechanism and looking for alternatives during the reconstruction stage.

For example as Sri Lanka's paddy rice production is mainly based in Polonnaruwa, Anuradhapura and Kurunegala districts, a proper disaster risk assessment should be carried out in those areas to know the risks, mainly from floods, affecting the production and take actions to prevent them during the disaster mitigation stage. Similarly, risk assessments should be carried out to assess the risk to infrastructure facilities. During the disaster recovery/ reconstruction stage, actions should be taken to recover/ reconstruct damaged infrastructure and alternatives for such infrastructure can be identified. For instance, as Sri Lanka has only one international airport and seaport, any disruption on them due to a disaster could be crucial. With regard to financial factors, respondents highlighted the importance of financial management in the immediate relief stage as it may have filtered out the impact on other stages. However, a few emphasized the aspects of rigid policies and financial allocations throughout the disaster management cycle that may hinder efforts.

Influence of operational/managerial factors in different phases of the disaster management cycle

It was highlighted that most of operational/ managerial factors are interconnected and these factors remain important throughout the disaster management system. It was widely agreed that the management of technology is very important and therefore there is a strong link between and technological factors and managerial/ operational factors. In addition

operational/ managerial factors are linked with institutional factors as institutions are responsible for enhancing disaster related competencies and skills.

Influence of the institutional factors in different phases of the disaster management cycle

It was felt that the role of the institutional factors or the role of institutions remained the same throughout the disaster management cycle. One reason given was that institutions tend to safeguard the implementation of all the other factors. Therefore, institutions are looking at those factors at different times, yet dealing with the same issue.

Influence of the political factors in different phases of the disaster management cycle

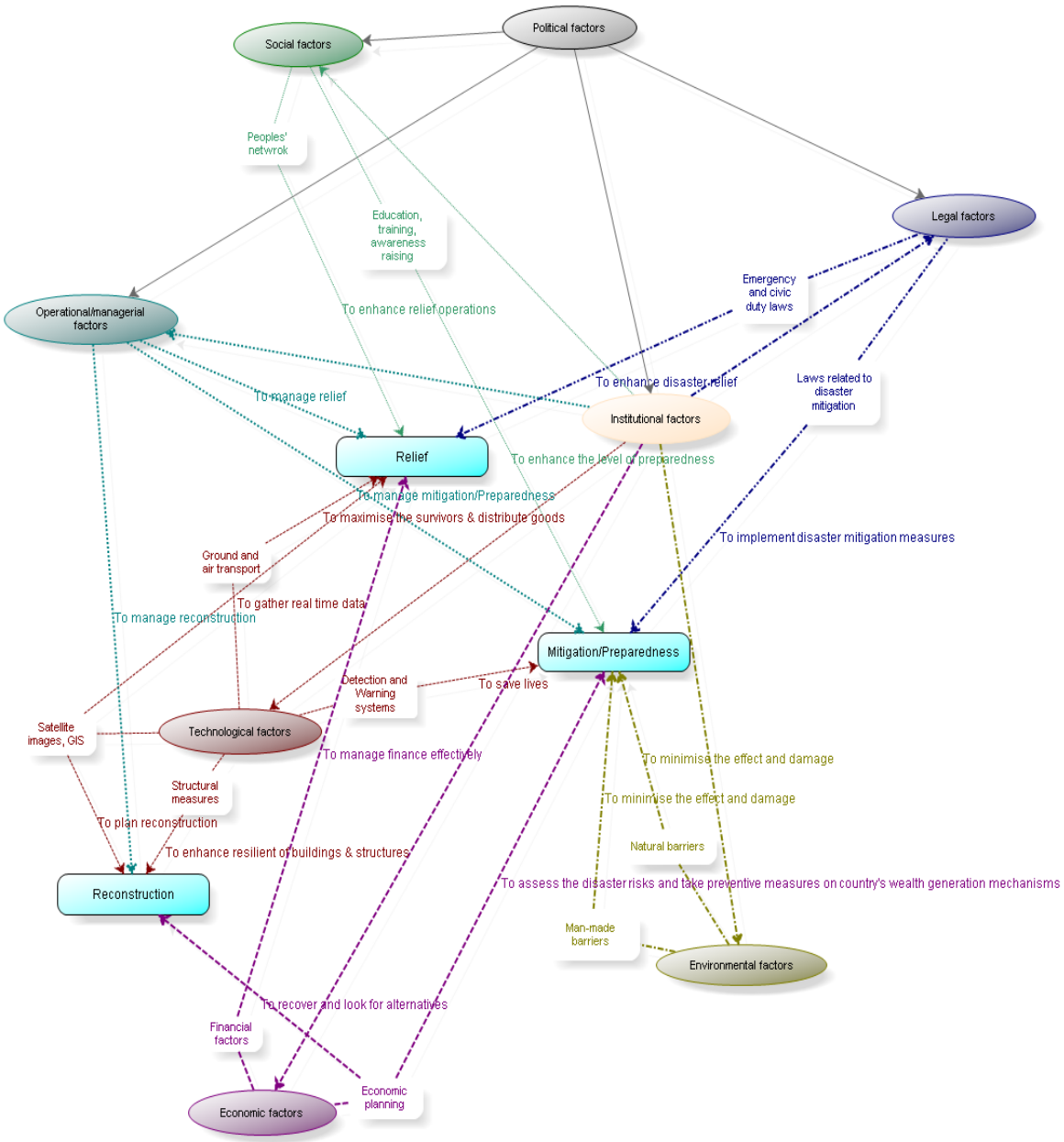
As politics include activities associated with the governance of a country and factors like, legal, institutional, social and operational/ management have politics embedded in them. Politics have some implications not necessarily on disasters, but on the way institutions are formed, the way operations and things are managed, and the way the law is formed. Therefore, the level at which political factors affect disaster management will depend on how it affects the institutional arrangement, the legal framework and the operational/ managerial aspects. The implications of political factors on disaster management appeared to be indirect through institutional, legal, social and operational/ managerial aspects.

Summary

Figure 2 shows how disaster knowledge success factors are linked with different phases of the disaster management cycle. It also illustrates the links within different disaster knowledge factors themselves. It is clear from the above findings and discussion that technological, operational/managerial, economic, social, legal and environmental factors have direct influence over the disaster management cycle, while the influence of institutional factors is indirect and it is through other factors identified. The influence of political factors is also indirect and it influences through institutional, operational/managerial, and social and legal factors.

In terms of influence on disaster knowledge factors in different phases of disaster management, the influence of operational/managerial factors appeared throughout the disaster management cycle. Influence of institutional factors was identified within all other factors including technology, social, environmental, legal, economic and operational/ managerial. Influence of political factors was noticed as indirect through institutional, operational/managerial, legal and social factors. While implications of technological and economic factors were also evident in all three phases of the disaster management cycle in different ways, the influence of legal and social factors were most noticeable in the mitigation/preparedness phase. Environmental factors also appeared to influence during the mitigation/preparedness phase. Hence the mitigation/preparedness phase is influenced by almost all the factors discussed. The relief phase is mostly influenced by technological, social, legal, economic, operational/managerial, institutional and political factors. The long term reconstruction phase is mainly influenced by technological, economical, operational/managerial, institutional and political factors.

A summary of these influences is shown in Figure 2.



Oval shapes – disaster knowledge factors
Rectangular shapes – phases of the disaster management cycle
Lines and arrows – links
Please refer to the middle of the lines to the relevant text.

Figure 2: Influence of disaster knowledge factors on different phases of the disaster management cycle

Challenges

Experts identified a number of challenges related to disaster knowledge factors. These challenges are described below and a summary could be found in Appendix I. Challenges recognise those areas which are lacking and need to be improved further in order to deal future disasters successfully.

Technological factors

In relation to technological factors, the need for cost effective and proactive technologies is highlighted by the respondents. Respondents identified communication as one of the areas that needs technological support. As an example, they elaborated the experiences of the Kashmir earthquake, which highlighted the importance of speed of communication as many people had died by the time the government realised the scale of the disaster and started the relief operations. Also proper use of the technology and having the necessary skills was recognised as highly important by the respondents. Effective technology will not cause a positive impact unless the people who use them have the required competency and knowledge. Respondents stressed that the key issue related to this aspect is lack of training. Knowing the strengths and weaknesses of the technology was another factor identified during the interviews. In addition, respondents identified a gap in the implementation of technology. They indicated that political institutions or bureaucratic structures hamper the uptake of technology. The need to address the social, political, institutional and behavioural barriers in the implementation of the required technology was highlighted during the interviews. The effective use of technology to create networks among communities and across networks between the policy makers and the communities was noted by the respondents as an area that is lacking and that needs further improvement.

Social factors

Interviewees indicated that people need to be educated and trained properly to engage in overall disaster management cycle. Accordingly, people should be made aware of any potential disasters and their collective responsibility in preventing or minimising the effects of disasters. Respondents view that these will help to make preparedness part of their lives or enhance their culture of preparedness. As an example, they pointed out that even though vulnerability is increased in many third world countries due to unsafe power lines and closed running sewers and water lines, the aggravating effects of these are not known by many of the people of these countries. Respondents highlighted that the success of training depends on several factors, including the knowledge of the person who delivers the training, the environment in which the training is delivered, the level of resources needed to support the training and the absorptive capacity of the people who receive training. Therefore, a thorough understanding of the context was emphasized by them.

Issues related to people's attitudes and perceptions were the next challenge identified by the respondents. Respondents admitted that, as civilians of a country, people should know their strengths and weaknesses and anticipate certain disasters. Respondents were of the view that while some people believe disasters can be prevented, some people do not learn lessons from previous disasters as they struggle for life which takes their focus away. For example, one respondent stated that even after the 2005 earthquake in Kashmir, people have started constructing their houses in hilly places where there are massive power lines running above the land. According to the respondent, in some countries behavioural structure has taken over the legal structure through bribery and corruptions. Therefore, these socially embedded issues need to be addressed for successful implementation of laws. Respondents agreed that social factors should be given a thorough consideration throughout the disaster management cycle. However, social factors are less concerned during the long term reconstruction and preparedness/ mitigation phases and much more attention is paid during the relief stage. Accordingly, people's needs and requirements are not considered in long term

reconstruction. As an example, they highlighted the fact that many resettlement programmes do not consider people's livelihood needs. In order to minimise these effects the detachment between policy makers and the affected community should be minimised. Building networks among people and between people and policy makers was viewed as vital if this challenge is to be addressed.

Environmental factors

It is reported that similar scale of hazards cause different effects in different countries due to different environmental factors, different population densities and different planning and building regulation standards. A thorough understanding of the environmental factors and their influence is needed by policy makers, professionals and communities. A broader understanding of the forces of nature and the forces of environment is proposed to be highly important by the respondents. it was acknowledged that Indian Ocean is the least studied Ocean which led to a huge devastation by 2004 tsunami. A possible reasoning for this might be that the countries around the Indian Ocean are less economically developed. Finally the respondents indicated that building regulations should be based on proper vulnerability analysis of the environment.

Legal factors

Implementation of the law was identified as a major shortcoming by most of the respondents. The laws which do not address the humanitarian aspect of disaster management have become unsuccessful and ineffective. For instance the 200m buffer zone which was regulated after the 2004 tsunami in Sri Lanka was unsuccessful as it was not taken into consideration the livelihood needs of the affected community. As a result, the fishing community re-constructed their houses within the buffer zone in order to safeguard their livelihood needs. Within a disaster context, it is highly unlikely that laws can be developed which cover the every aspect of disasters, as communities sometimes face new circumstances which they have not encountered before. It is also contended that disaster related laws should be updated regularly.

Economical factors

Economic planning measures: Risk assessment or vulnerability analysis of a country's wealth generation mechanism is accepted as a more prominent part of long term economic planning by the respondents. However, it was found that a lack of investment hampers this process. For example, though many developing countries' infrastructure facilities are instrumental to communities, governments do not invest enough in them. As a result the impact could be magnified if a disaster strikes. Therefore interviewees suggested that the vulnerability assessment of a country's wealth generation mechanism should be an integral part of the country's financial model. At the same time they argued that long term reconstruction should focus on both recovering the damaged infrastructure and looking for alternatives, rather than focusing only on repairing the existing facilities.

Financial aspect: As the relief stage attracts more funding, the management of finance during the relief stage was considered as vitally important by the respondents. Rigid policies in handling money hinder rapid decision making in the aftermath of disasters. Therefore, respondents highlighted the need for more flexible systems which allow fluid decision

making. They also highlighted that the reconstruction and preparedness/ mitigation phases tend to attract less finance. One reason given by respondents was that disaster management does not get priority in the allocation of finance. However as proactive approaches to disaster management could bring much benefit, they felt investments in reconstruction and preparedness/ mitigation phases should be prioritised. Financial mismanagement is another issue experienced during reconstruction stage. Respondents indicated that the disconnection between investment or insurance companies and public sector has prevented public sector learning from insurance companies on how to manage finance effectively. As respondents stated, the accountability of post disaster reconstruction should be improved, yet not adhering to the conventional financial accounting systems, as conventional financing accounting systems are developed on the basis that there are very well defined requirements and outputs. Nonetheless, in a disaster situation things are not certain and it needs much more flexible accounting system.

Operational/managerial factors

Experts argued that improvement is needed in decision making process of disaster management. Parties to the decision making process, speed of the decision making and innovativeness of decisions are some of the areas considered by the respondents. Community participation in decision making process is highly promoted in disaster context as it helps to identify their real needs. Slow decision making is identified as a main reason for delay in reconstruction work. As an example, despite the urgency, it is reported that most of government institutions still follow the traditional tendering system by giving priority to the lowest bid. As every disaster brings some uniqueness, the role of innovative decision making is highlighted.

As viewed by the respondents, reasons for some failures in disaster management were down to the quality of leadership. Choosing the correct leadership style is one aspect which needs more attention. Respondents described that participatory style of leadership may be appropriate for certain contexts while autocratic style may convenient for certain contexts. Also the communication among affected communities and between the affected communities and policy makers should be enhanced. In order to avoid receiving inappropriate relief goods, the process of collecting goods should be driven by the requirements. For instance, the Disaster Emergency Committee (DEC) which operates in UK sends money in a disaster emergency instead of goods which may be not appropriate or useful. Moreover, providing the required training and necessary resources including financial, time and manpower were identified as essentials in managing the disasters successfully by the respondents. Though people have knowledge and know the best practices in managing disasters, transfer of knowledge to the right person at the right time is identified as lacking and training could facilitate this transfer of knowledge. A considerable gap exists between what is known and what is done in practice. Another area which needs attention is developing a common vocabulary that could bring together various disciplines in the disaster management field. As an example, terminologies used by engineers are different from GIS specialists or public officials and this may hamper the communication between them.

Institutional factors

Interviewees claimed that proper institutional formation and integration are vitally important in managing disasters successfully. Hence they indicated that the capacity of these institutions need be reviewed and empowered according to the needs. Particularly the disaster related knowledge and skills need to be improved. In addition a centralised institution which monitors and oversees all the other institutions need to be formed. For example once hurricane Katrina hit New Orleans, for a couple of weeks it was not known who should be responded, whether it is the state of Luciana or the federal government.

Political factors

Studies on political expectations in the context of disaster management are recommended to minimise the mismatches between political agendas and disaster management agendas. Most importantly it is highlighted that the long term perspectives of disaster management should not be dominated by the short term political perspectives.

Summary

A summary of identified challenges are shown in Table II. Respondents viewed the detection and warning systems and resilient built structures as key influences of technological factors. While detection and warning systems help to save lives, resilient built structures support to minimise the effects of disasters. With regard to the social factors, respondents indicated that technology can provide only the information and it would be the human beings who would have to react to disasters. Hence they highlighted the influence of education, training and awareness raising to enhance the level of preparedness. The influence of existing natural environmental barriers is highly recognised by all respondents. Support of legal factors to implement disaster mitigation measures is also highlighted by the respondents. In terms of economic factors, influence of long term economic planning measures was stressed by the respondents. In addition they viewed the financial, operational/managerial and institutional factors as essentials to manage disasters.

Table II: Challenges in related to disaster knowledge factors

Disaster Knowledge Factors	Challenges
Technological	– The need for proactive technologies – Poor communication – Lack of necessary skills for proper use of technology – Gaps in implementation of technology – The need for effective use of technology to create networks among communities and between communities and policy makers
Social	– The need for effective education, training and awareness raising programmes to enhance culture of preparedness – Addressing the issues related to peoples' attitudes and perceptions – Lack of consideration of social factors during long term reconstruction and mitigation/preparedness phase
Environmental	– Lack of understanding of the environmental related factors
Legal	– Challenges related to implementation of laws – Lack of consideration of social factors when making laws – The need for regular updating
Economic	Long term economic planning

	– Lack of investment on risk and vulnerability assessment of country's wealth generation mechanism – Long term recovery is only focused on reconstruction of damaged infrastructure. Looking for alternatives is neglected Financial – Poor management of finance – Rigid policies – Lack of funds for reconstruction and mitigation/preparedness – Not learning from investment or insurance companies – Financial mismanagement and poor accountability
Operational/Managerial	– Poor decision making – Poor communication – Participatory approach to decision making – Aspects related to leadership – Poor humanitarian logistics management – Lack of knowledge management
Institutional	– The need for proper institutional formation and integration – The need for a centralised institution to overlook and monitor all other institutions
Political	– The need for studies on political expectations in context of disaster management – Domination of short-term political perspectives over long term perspectives of disaster management

Among key challenges, the lack of detection and warning systems, the need for effective education, training and awareness raising programmes, the need for regular updating of disaster related laws, lack of funds for economic planning measures, poor planning, poor communication, poor leadership, lack of knowledge management and poor institutional arrangement were highlighted by most of the respondents. These clearly show that most of the challenges are related to operational/managerial factors. In order to enhance the management of disasters, these challenges need to be addressed.

Conclusion

This paper presented key knowledge factors within disaster management cycle and challenges relating to identified knowledge factors. Technological, operational/ managerial, economic, social, legal and environmental factors seem to have direct influence over the disaster management cycle, while the influence of institutional and political factors seemed indirect and it is through other factors identified. Certain overlaps among knowledge factors are identified, e.g. political measures hamper the uptake of technology. Mitigation/ preparedness phase seemed influenced by almost all the factors discussed. Among key challenges, the lack of detection and warning systems, the need for effective education, training and awareness raising programmes, the need for regular updating of disaster related laws, lack of funds for economic planning measures, poor planning, poor communication, poor leadership, and poor institutional arrangement were highlighted by most of the respondents. Most of these challenges are apparently related to the operational/managerial factors. Though these findings are based on a limited number of exploratory interviews, future research can focus on these identified areas and examine how the challenges identified could be overcome to enhance the management of future disasters.

Particularly more attention could be given to share good practices and lessons learned in identified areas. Further, peoples' attitudes and perceptions hinder their involvement in disaster management. As an example some people believe that disasters are act of 'God' which cannot be prevented, some are not involved due to their economic hardship. Also some people put the blame on others and refrain from contributing to management of disasters. Hence, in order to manage disasters successfully it is important to overcome these attitudes and perceptions. Therefore, future research could be conducted to study how these attitudes and perceptions could be changed to manage disasters successfully.

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