RESEARCH REPORT

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ISLAND – INSPIRING SRI LANKAN RENEWAL AND DEVELOPMENT.

INCREASING THE EFFECTIVENESS OF DISASTER MANAGEMENT STRATEGIES BY SHARING KNOWLEDGE AND GOOD PRACTICES ABOUT POST-TSUNAMI PROGRAMMES IN SRI LANKA.

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Contents

About this report

This report represents the final report for 'ISLAND' (Inspiring Sri-Lankan reNewal and Development), a research project led by the University of Salford's School of the Built Environment (formerly School of Construction and Property Management). The project was partly funded by the RICS Education Trust.

This report presents an overview of the project: the background and rationale; the project aims and objectives; the research methodology and project evaluation; a summary of the activities undertaken, including a literature survey on disaster management and knowledge management, development of project web site and collation of case material on good practices; consideration of challenges and problems encountered; and, reflection on the transferability of the project outcomes and way forward.

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01 Introduction and rationale

In addition to commercial and non-commercial property damage, the number of deaths apportioned to the Indian Ocean Tsunami is estimated to be in excess of 250,000, with at least 40,000 of those in Sri Lanka (UNDP, 2005). A lack of awareness has been identified as a major reason behind the huge loss of life (Banerjee, 2005). Indeed, the term "tsunami" was heard by most of the ordinary Sri Lankans only after this devastation. Many of the direct victims were affected at the scene as they were curiously observing the pre-warnings of the tsunami, without knowing the nature or the scale of the disaster to come. Both awareness and preventive steps are needed to prevent such huge loss of human life in future. As Briceno (2005) states, for prevention in the future, the first and foremost step is to sensitise people at large and create awareness through different media and text on various natural hazards, including the tsunami and the preventive measures to be adopted. The problem continues beyond the pre– disaster stage into recovery, where Sri Lanka has again demonstrated the need for proper information and knowledge dissemination, as this has often been highlighted as the reason behind unsuccessful post–tsunami recovery activities. A lack of prior knowledge and proper points of reference have made most of the recovery plans guessing games, eventually failing without adding appropriate values to the recovery attempts (RICS, 2006).

The importance of improving the construction industries of developing nations is widely recognised, highlighting a need to equip them to manage the post-disaster scenario. Construction is typically engaged in a range of critical activities: temporary shelter before and after the disaster; restoration of public services such as hospitals, schools, water supply, power, communications, and environmental infrastructure, and state administration; and securing income earning opportunities for vulnerable people in the affected areas (World Bank, 2001).

There is growing recognition that the engineering community has a valuable role to play in finding and promoting rational, balanced solutions to what remains an unbounded threat and that the construction industry has a much broader role to anticipate, assess, prevent, prepare, respond and recover from disruptive challenges (Sevin and Little, 1998). Construction professionals have a key role to play because they are involved in the construction of the infrastructure, and therefore should also be involved when an event destroys that infrastructure. Construction engineers possess valuable information about their projects, and that information can be critical in disaster mitigation, as well as response and recovery (Pena-Mora, 2005). Construction professions are in the best position to frame the discussion of the cost-benefit tradeoffs that occur in the risk management process, for example the need for risk avoidance against the cost of implementing mitigation strategies.

It is clear that much work has been done and is ongoing, relating to disaster management and construction's role specifically. Despite this, knowledge appears fragmented, although there are undoubtedly many successful practices and lessons to be learnt, most significantly from major disasters such as the 2004 tsunami (Mohanty et al, 2006). A lack of effective information and knowledge dissemination can be identified as one of the major reasons behind the unsatisfactory performance levels of current disaster management practices. Therefore, this project is in response to such requirements, and is aimed at facilitating sharing and dissemination of appropriate knowledge relating to disaster management strategies. Due to the broad scope of the subject, particular emphasis was given to case material on the post-tsunami response in Sri Lanka.

A lack of effective information and knowledge dissemination can be identified as one of the major reasons behind the unsatisfactory performance levels of current disaster management practices.

02 Project evaluation

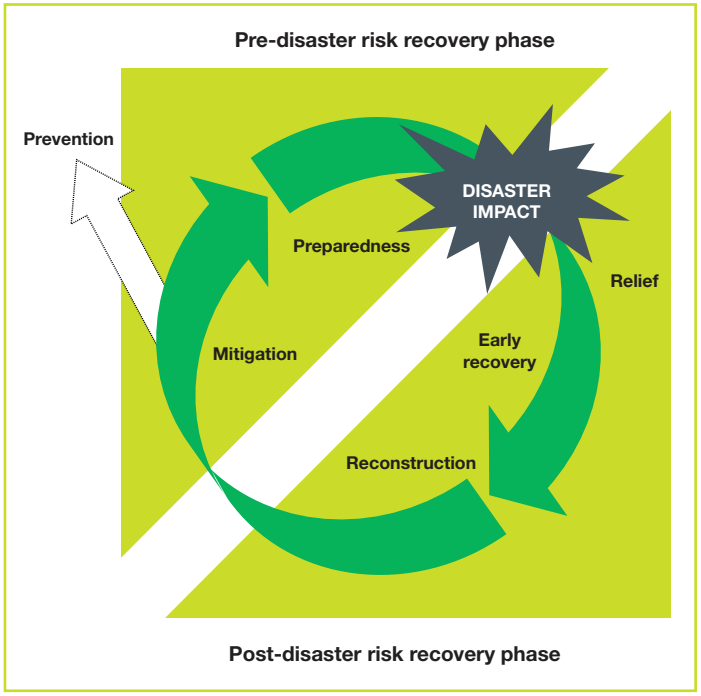
This section summarises the outcomes of the major activities undertaken during the project;

- A review of existing literature on disaster management and knowledge management, particularly within the context of tsunami and Sri Lanka; disaster management cycle (section 2.1); tsunami disaster in the context of Sri Lanka (sections 2.2 and 2.3); knowledge management in general (Appendix 5); and the need to share knowledge (section 2.4)
- Development of the knowledge base facilitating sharing and dissemination of good practices, and lessons learned (section 2.5 and Appendix 3)
- An analysis of lessons learned and good practices from the tsunami disaster, based on case material collated from Sri Lanka (section 2.6)
- An exploration of challenges faced during the project (section 2.7)

2.1 Disaster management cycle

Disasters, both natural and man-made, have been occurring with increasing frequency and impact in recent decades in many countries around the world. As such, 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 (Warfield, 2004). As shown in Figure 1, the process of disaster management is commonly visualised as a two-phase cycle, with a post-disaster recovery informing pre-disaster risk reduction and vice versa. As Warfield (2004) states, the disaster management cycle illustrates the ongoing process by which governments, businesses and civil society plan for and reduce the impact of disasters, react during and immediately following a disaster, and take steps to recover after a disaster has occurred. The significance of this concept is in its ability to promote the holistic approach to disaster management as well as to demonstrate the relationship of disasters and development (de Guzman, 2001). Recovery and reconstruction are commonly identified within the post-disaster phase, that is the period that immediately follows after the occurrence of the disaster. However, the terminology of disaster relief and recovery, rehabilitation and reconstruction is used without precise and commonly agreed definitions, although in practice, a distinction is drawn between the emergency relief phase and the subsequent non-emergency recovery (RICS, 2006). Once a disaster has taken place, the first concern is effective 'recovery' – helping all those affected to recover from the immediate effects of the disaster. 'Reconstruction' involves helping to restore the basic infrastructure and services which the people need so that they can return to the pattern of life which they had before the disaster (Davis, 2005). The importance of the 'transitional phase', linking immediate recovery and long-term reconstruction, is also stressed by a number of publications (de Guzman, 2001; RICS, 2006). With the recovery of social institutions, the economy and the main infrastructure, the transition to the longer-term recovery and reconstruction process can be implemented.

Figure 1:
Disaster Management Cycle (adopted from RICS, 2006)



Project evaluation

The pre-disaster phase of the disaster management cycle includes both mitigation and preparedness. As RICS (2006) defines it, disaster mitigation refers to any structural and non-structural measures undertaken to limit the adverse impacts of natural hazards, environmental degradation and technological hazards. 'Mitigation' measures may eliminate or reduce the probability of disaster occurrence, or reduce the effects of unavoidable disasters. As such, these measures include building codes; vulnerability analyses updates; zoning and land use management; building use regulations and safety codes; preventive health care; and public education (Warfield, 2004). In the ideal case, mitigation eliminates the risk of future disasters by effective sharing of lessons learned through 'preparedness' planning. Hence, the attention to disaster mitigation and risk reduction, which comprises the development portion, is equally important as disaster recovery and reconstruction, and rehabilitation. Greater attention to pre-disaster planning and preparedness, and sharing the lessons from previous disasters, could considerably reduce the risk associated with disasters. Thereby, the mitigation phase, and indeed the whole disaster management cycle, includes the shaping of public policies and plans that either modify the causes of disasters or mitigate their effects on people, property, and infrastructure. Appropriate actions at all points in the cycle lead to greater preparedness, better warnings, reduced vulnerability or the prevention of disasters during the next iteration of the cycle (Warfield, 2004).

However, natural events only become potential hazards when they threaten people or property (Davis, 2005). As de Guzman (2001) states, natural hazards themselves do not necessarily lead to disasters. Natural hazards like earthquakes, however intense, inevitable or unpredictable, translate to disasters only to the extent that the population is unprepared to respond, unable to cope, and consequently, severely affected. An earthquake will cause little damage if it takes place in an empty desert. It may also cause little damage if it takes place where people can afford to be well protected. Hence, a natural event only causes serious damage when it affects an area where the people are at risk and poorly protected. Disasters occur when these two factors are brought together (as shown in Figure 2):

- people living in unsafe conditions
- a natural hazard such as a flood, Tsunami, hurricane or earthquake.

Thereby, the threat from natural hazards can only be minimized through the elimination of unsafe conditions, as much as possible, in terms of people, property and infrastructure. The role of the pre-disaster risk reduction phase, also referred to as the development portion, is considered to be vital in bringing unsafe conditions to controlled safe environment, through mitigation and preparedness.

Figure 2: Components of a Disaster

2.2 The tsunami disaster – the Sri Lankan context

According to the World Disaster Report 2005, the number of reported disasters has increased steadily over the past century and risen very sharply during the past decade. An average of 354 disasters per year of natural origin occurred in the period 1991 to 1999. From 2000 to 2004, this rose to an average of 728 per year. The Asia-Pacific region has experienced the greatest loss of life both in absolute terms and as a proportion of the population, due to earthquakes, floods and tropical cyclones. In economic terms, the World Disaster Report 2002 assesses the average estimated damage due to natural disasters at US$69 billion. Asia shows the highest reported losses but those in Europe are considerably greater than those in Africa. This reflects the high value of the infrastructure and assets at risk. The Asian region is highly prone to natural disasters. These bring about the loss of lives, property, employment, and damage to the physical infrastructure and the environment.

In Sri Lanka, the tsunami that struck on the morning of December 26, 2004 left behind widespread destruction, killed over 31,000 people, and damaged natural ecosystems and coastal infrastructure. The 2004 tsunami is widely acknowledged as the largest, most devastating natural catastrophe in the history of Sri Lanka. According to the UNEP report of 2005, the tsunami affected two-thirds of the coastline of Sri Lanka. It also resulted in the destruction of nearly 100,000 houses. The destruction of houses not only impacted on the existing housing stock, but also resulted in the discontinuance of several types of livelihood in the coastal areas, such as fishing, farming and tourism related activities. The UNEP report also highlights the context in which the current post-tsunami rehabilitation is operating. Among the most important factors is the pre-existence of very high densities of unplanned settlements in Sri Lanka, with the majority of the construction not observing some of the critical building standards. To add to this, the post-tsunami rehabilitation operation has been affected due to weak local government institutions with poor response capacities to address the needs of a disaster of such magnitude as the tsunami. This is mainly because, before the tsunami, Sri Lanka was known to be a safe haven where outrages of nature scarcely occurred except for occasional floods and landslides during the rainy seasons. Vulnerable groups, such as poor fishermen living close to the shore in simple houses and shelters, have borne the brunt of the negative impacts (ADB, 2005). Therefore, a lack of awareness, preparedness and mitigation measures has resulted in widespread devastation in Sri Lanka due to the tsunami.

“The destruction of houses not only impacted on the existing housing stock, but also resulted in the discontinuance of several types of livelihood in the coastal areas, such as fishing, farming and tourism related activities.

Project evaluation

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The recovery process is, however, making notable progress. The increase of natural and man-made disasters over the last two decades affecting Sri Lanka's economy, its people and the environment has compelled the government to introduce the Sri Lankan Disaster Management Bill. In addition to creating a council for disaster management, the bill also provides for the establishment of a natural and human disaster management centre, the appointment of technical advisory committees, the preparation of disaster management plans, the declaration of a state of disaster and the award of compensation to victims. Resulting from the formation of a task force known as the Task Force for Rebuilding the Nation (TAFREN), the Tsunami Housing Reconstruction Unit (THRU), The Ministry of Environment and Natural Resources (MENR), the Southern Provincial Council (SPC), the Central Environmental Authority (CEA) and the Coast Conservation Department (CCD) have initiated several important tasks and activities to meet the needs of the post-tsunami rehabilitation and reconstruction.

However, within the recovery strategy for post-tsunami reconstruction, ADB (2005) stress the need for a coordinated approach to better manage the post-tsunami reconstruction efforts. A coordinated approach is critical to share knowledge and best practice, and to prevent duplication or overlap in activities. A suitable mechanism would need to be created at the local level for such coordination and dissemination of knowledge. Cooperation between the European Union and Sri Lanka has traditionally focused on poverty alleviation through rural development, irrigation and farming. This has now shifted towards economic cooperation as Sri Lanka's economy develops, and in order to react to the tsunami disaster.

According to the United Nations' Sri Lanka report on Post-tsunami Recovery and Reconstruction (December 2004 – December 2006), the need to strengthen national capacities, for the recovery and reconstruction process, including disaster preparedness and long term disaster risk management, is one of the major strategic objectives. This can be achieved by developing the capacities and providing support for institutions, both governmental (national and local), non-governmental (NGOs and CBOs, private sector and other civil society organisations), in the form of knowledge inputs, technical support, institutional building and systems development.

2.3 Disaster mitigation measures

Prior to the tsunami disaster, the risks from natural hazards to Sri Lanka were considered low. Sri Lanka experiences mainly weather-related hazards, resulting in localised and seasonal floods, landslides, cyclones and droughts. Post-tsunami reconstruction represents a major investment in rebuilding the country. The opportunity to protect this investment from future disasters that Sri Lanka may face is one that should not be missed. Lessons from the tsunami combined with findings from the rapid multi hazard risk assessment should be fed into reconstruction planning and future risks reduced through improved building standards and design considerations (ADB, 2005). The importance of improving the construction industries of developing nations is widely recognized, highlighting a need to equip them to manage the post-disaster scenario. There is growing recognition that the engineering community has a valuable role to play in finding and promoting rational, balanced solutions to what remains an unbounded threat and that the construction industry has a much broader role to anticipate, assess, prevent, prepare, respond and recover from disruptive challenges. However, best practice improvements are likely to be required by the community in order to guarantee long-term sustainability of the reconstruction (Ofori, 2002) to ensure safe conditions for future disasters. Recognizing the challenges exposed by the recent tsunami, the Asian Development Bank (2005) stresses that Sri Lanka should develop a risk management approach, based on the principles that:

- The post-tsunami reconstruction programme, and in general, all development programmes, should be guided by multi hazard risk considerations;
- Improved institutional capacities are required for improved management of emergency response, particularly at the local level;
- Risk transfer mechanisms should be considered to mitigate the financial impact of disasters on the economy and future development activities.

A significant number of ordinances, acts and laws exist in Sri Lanka that relate to land use planning, human settlements, development and conservation of natural resources. A review of existing legislation and standards from a risk reduction perspective, the simplification of procedures for their implementation and clarification of institutional arrangements for their enforcement should go hand in hand with reconstruction and development efforts (ADB, 2005). The lessons and experiences of the tsunami relief and recovery coordination should be distilled into developing an appropriate disaster management mechanism and an authority that reflects the risks faced by Sri Lanka. A National Disaster Management Plan would clarify roles and responsibilities, and would streamline coordination across administrative levels and various stakeholders. Mitigation will depend on incorporating appropriate measures in national and regional development planning. Its effectiveness will also depend on the availability of information and knowledge on hazards, emergency risks and the countermeasures to be taken. Hence, post-disaster housing reconstruction requires a variety of interventions that go beyond the construction of houses (Lizarralde, 2002). International exchange of best practice and knowledge sharing among practitioners, authorities and NGOs, particularly those from the region, can significantly contribute to reconstruction at all levels. Further, the importance of training and education is well recognised. This need is all the more important in disaster situations (Yasemin, 1995). The scope of a training and education programme must include the identification of areas of vulnerability, mitigation measures (social, physical and organisational) that can be employed to reduce vulnerability and awareness of plans developed to manage post-disaster risk reduction activities (Jigyasu, 2002).

2.4 The need to share knowledge

As a consequence of knowledge becoming a valuable organisational resource within the business community, organisations have increased their efforts to deliberately manage knowledge in a systematic manner. When synthesised, definitions of knowledge range from the practical to the conceptual to the philosophical, and from narrow to broad in scope. Knowledge is built from data, which is first processed into information. Researchers like Simon (1957), Galbraith (1974) and Tushman and Nadler (1978) perceived organisations as essentially information processing entities, which accounted for the 'information age' of the 1980s and early 1990s. However, information processing across organisational boundaries presents significant barriers to effectiveness, mainly due to the absence of a cognitive dimension. Thereby, the various definitions of knowledge suggest that it is much more than information. According to Nonaka and Takeuchi (1995), knowledge could be defined as a dynamic human process of justifying personal belief towards the truth. As Beveren (2002) asserts "Even though some argue knowledge can be acquired, stored and used outside of the human brain, knowledge cannot exist outside of the human brain and that only information and data can exist outside of the brain". Please see Appendix 5 for more detail of the supporting literature analysis on knowledge management in general.

There is a conscious effort for disaster management at national, provincial and sub-provincial level. Despite this, knowledge appears fragmented, although there are undoubtedly many successful practices and lessons to be learned (Mohanty *et al*, 2006). Hence, there is a perceived gap in information coordination and sharing particularly relating to disaster mitigation. A lack of prior knowledge and a proper point of reference have made most of the recovery plans into guessing games, eventually failing without adding appropriate values to the recovery attempts (RICS, 2006). The lack of effective information and knowledge sharing, and dissemination on disaster mitigation measures can thereby be identified as one of the major reasons behind the unsatisfactory performance levels of current disaster management practices.

Knowledge can be differentiated between explicit, tacit and implicit forms of knowledge. In an organisational context, knowledge management is about applying the collective knowledge of the entire workforce to achieve specific organisational goals and facilitating the process, by which knowledge is created, shared and utilised (Nonaka and Takeuchi, 1995). However, within the disaster management context, knowledge management is all about getting the right knowledge, in the right place, at the right time (Mohanty et al, 2006). As a strategic approach to achieve disaster management objectives, knowledge management will play a valuable role in leveraging existing knowledge and converting new knowledge into action through the knowledge management cycle. In essence, knowledge organisation and human knowledge conversion processes can bring a comprehensive foundation to the common operating picture, interoperability, intelligence, training and acquisition (UNDP, 2005). In the light of this, it can be perceived that valuable knowledge on disaster mitigation is present at three different levels: institutional, group and individual, in the forms of both tacit and explicit knowledge.

Thousands of organisations and institutions have been supporting the efforts on disaster management over last few decades. The linkages between all agencies working on disaster management need to be strengthened in order to derive the regional best practice and coping mechanisms (RICS, 2006). In order to enhance the information sharing and management of the knowledge generated in institutions, it is essential to knit more closely together these organisations and institutions, and moreover groups and people working within these institutions (UNDP, 2005). There are many gaps that could be bridged by the appropriate use of professional skills, but access to these by the local organisations on the front line of the recovery effort is highly constrained by lack of recognition of their existence. Therefore, recognition needs to be given to the institutions and organisations operating not only at international and national level, but at the local level too. In addition, this local knowledge can reside among the groups operating within different communities; hence, the recognition can be extended to the existence of these formal and informal groups involved with the disaster management process.

The knowledge and experiences of disaster management practitioners remain mainly in the individual domain. Due to its large geography, the experiences, approaches and adopted modalities for disaster management is not codified and remains with individuals as a tacit knowledge (Mohanty *et al*, 2006). Acknowledging the need for a disaster knowledge networking platform to facilitate interaction and have simultaneous dialogue with all related expertise dealing with disaster management, the knowledge management initiative developed in the ISLAND project was envisaged as a tool to store, retrieve, disseminate and manage information related to disaster management, particularly relating to disaster mitigation and preparedness.

“There are many gaps that could be bridged by the appropriate use of professional skills, but access to these by the local organisations on the front line of the recovery effort is highly constrained by lack of recognition of their existence.

Project evaluation

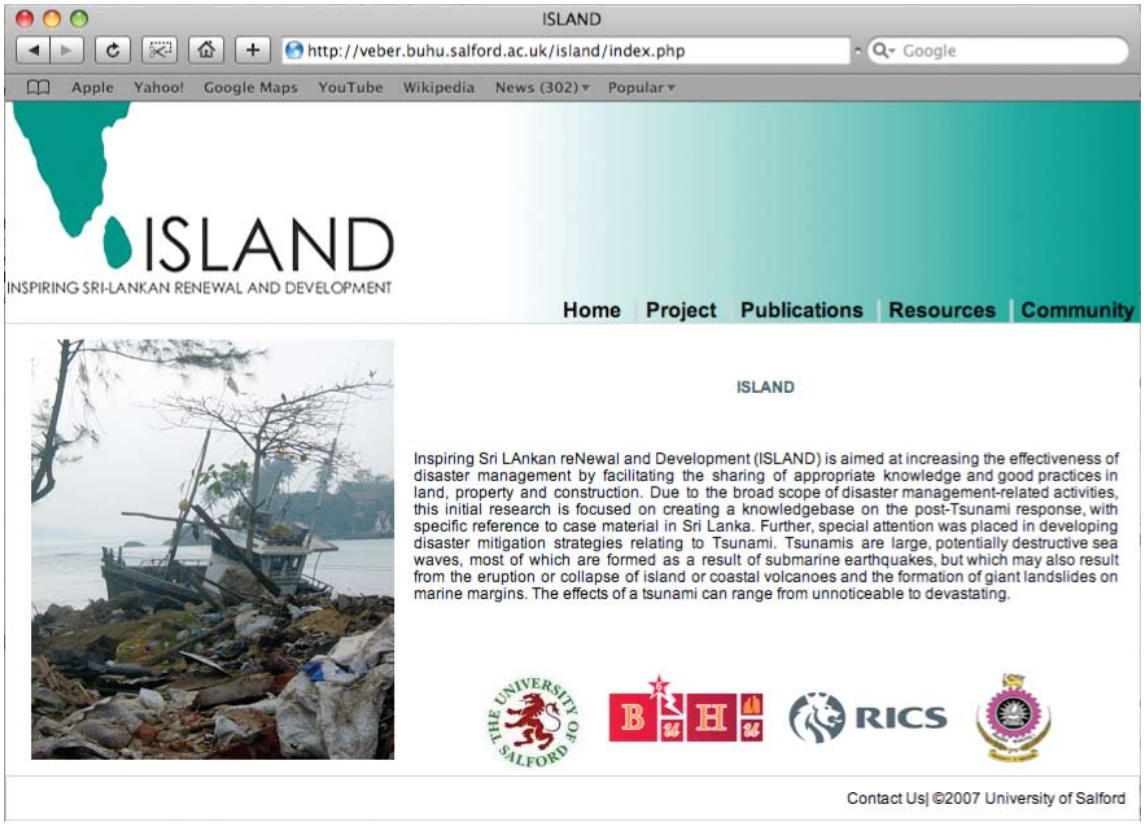
2.5 The ISLAND website

The ISLAND web portal and knowledge base was developed to capture, process, and disseminate the lessons learnt from the Indian Ocean tsunami in the form of policy advice and good practices to guide future post-disaster interventions. Hence, the web portal provides an organised common platform to capture, organise and share the knowledge on disaster management strategies and to create a versatile interface among users from Government, professional bodies, research groups, funding bodies and local communities (visit http:/veber.buhu.salford.ac.uk/island/index.php).

The knowledge base was created to address several themes of disaster management based on published case study material collected on the 2004 tsunami, particularly cases from the Sri Lankan context. Case studies are organised according to: type of disaster, phase, country, source, research methodology followed, scope and access to the study. The information is stored in a MySQL database using a PHP-Database interface. With the usage of SQL queries, simple and advanced searches are provided to retrieve and view the data. Separate descriptions were developed for each and every case study to provide an overview on the article, which is then linked to their respective original source. The original case study material was not uploaded to the knowledge base due to copyright limitations. The article descriptions included the title, author, year, an overview, keywords and the link to the original article. A key word search function is also provided to search for relevant keywords in the descriptions of the case materials.

In addition, the website provides an introduction to the ISLAND project and project outputs, together with the publications of the project. The web portal acts as the public interface to share and disseminate the lessons learned, and good practice on disaster management. Furthermore, the portal provides tools to capture, acquire and organise knowledge, through which the knowledge base will be kept up to date and live with disaster management strategies. Appendix 2 provides examples of pages and windows of the ISLAND website.

Figure 3: ISLAND website - Home page



2.6 Analysis of good practices and lessons learned

This section presents an analysis of good practice and lessons learned from tsunami disaster, based on case material collated, particularly from Sri Lanka. Good practices and lessons learned are summarised according to a number of themes that emerged from the case study material: social; technical; operational; legal; and environmental.

2.6.1 Social issues

The importance of community participation within reconstruction process, public awareness and education, and job creation programmes like Cash for Work (CFW) are emphasised in most of case material collated. Within the last decade, a growing recognition of the necessity of community participation for sustainable disaster reduction was translated into actions to realise community based disaster management. Major benefits of the community based risk assessment, mitigation planning and implementation processes underscored include; building confidence, pride in being able to make a difference, and enhanced capabilities to pursue disaster preparedness, mitigation as well as bigger development responsibilities at the local level (Houghton, 2005; Adams et al., 2005). Additionally, individual and community ownership, commitment and concerted actions in disaster mitigation, including resource mobilisation produce a wide range of appropriate and innovative mitigation solutions, which can be cost-effective and sustainable.

As Doocy *et al*. (2006) state, job creation programmes have been used to provide aid to less well-off citizens, and can be considered as antecedents to CFW, which are an increasingly common element of humanitarian assistance in food-insecure settings, disaster-affected areas and post-conflict environments. The 2004 tsunami caused massive devastation and hundreds of thousands of people were no longer able to participate in their routine employment activities. Considering the benefits of harnessing idle labour in the immediate post-disaster period, CFW programmes can be recognised as a logical response that provide a structured mechanism to engage people in low-skilled constructive activities while injecting cash into the economy and promoting decision-making at the community and individual level.

Experiences in implementing large-scale CFW programmes (Doocy *et al*., 2006; Houghton, 2005) in the post-tsunami phase in Asia have led to the following set of recommendations for CFW programmes:

- Communities need to be informed of benefits and limitations of CFW
- It is helpful to identify potential community coordinators as well as be aware of what other agencies are doing
- Adequate attention should be paid early on to procurement, warehousing and the delivery of supplies and equipment in order to expedite CFW activities
- Cash for planning is seen as a good way of working, aiding participation in the planning process and promoting informed choice
- CFW implementers should either limit the need for technical expertise by providing simple project design or should ensure the availability of skilled labour needed to complete CFW activities
- Local staff should be trained to lead these programmes, and should be trained in community leadership
- Monitoring through unannounced visits to work groups is an effective way of guaranteeing compliance and pinpointing problems. In cases of repeat problems, the only solution may be to stop CFW activities so as to maintain the credibility of CFW in the local area
- Weekly or less regular payments may be more workable from a management perspective once the immediate crisis is over and there is no longer a daily need for cash
- Consider work groups with no more than 25 workers and a ratio of no more than four work groups to one supervisor (overall maximum ratio of 100 workers: 4 group leaders: 1 area supervisor) to ensure quality and efficient work
- Slowing CFW activities as the programme nears completion rather than abruptly curtailing them is an option to consider, as CFW programmes transition to more development-oriented activities
- There is a need for synergy in communication/ coordination between organisers and the community.

Project evaluation

Public awareness and education are essential to protect people and property from disasters. A lack of awareness has been identified as a major reason behind the huge loss of lives and property from the 2004 tsunami. Indeed, most Sri Lankans first heard the term "Tsunami" after this devastation. As Briceno (2005) states, more than 1,800 people were saved in Thailand because a tribal chief recognised that there was something wrong and decided to evacuate his people up to the hills. A 10-year-old girl from England saved 100 tourists on a beach in Phuket, Thailand after alerting her mother of the imminent tidal wave and prompting a speedy evacuation to safety. She recognised the signs after learning about tsunamis in her geography class. Knowing what to do and when to do it is the key to saving lives. The media also have a social responsibility to promote prevention. Journalists need to be sensitised and maintain an ongoing focus on prevention aspects of disasters (Briceno, 2005). Disasters are happening on an almost daily basis around the world. The role of the media as an early warning system should not be overlooked. The Asian tsunami disaster could be a trigger for the media to play a more active role in improving lines of regional and global awareness, and communication using new media technologies.

2.6.2 Technical know-how

The tsunami affected two-thirds of the coastline of Sri Lanka, and it resulted in the destruction of nearly 100,000 houses and infrastructure such as roads, bridges etc (UNDP, 2005). Depending on the wave height, various types of structures were affected. Waves of up to 2 metres in height caused 1–2 metre high boundary walls to collapse. As wave heights increased, single-storey masonry structures were significantly damaged and were completely swept off their foundations at wave heights of around 4 metres. Buildings of two storeys and higher, especially those with concrete frames, had their infill masonry walls that were perpendicular to the waves knocked down by waves of up to 4 metres, but waves of even 5 metres did not cause the complete collapse of such buildings (Dias *et al*., 2006). Partial collapse occurred, however, if foundations were undermined by waves of 3–5 metres in height.

According to Dias *et al*. (2006), there are two common threads that run through the structural failures. The first is that structures have to be tied down, in addition to being held up. The latter is obviously the focus of everyday attention, since gravity loads will assert themselves almost immediately otherwise. However, when natural disasters such as cyclones and tsunamis occur they have the effect of trying to lift up or push aside structures. Such actions can be resisted only by having a continuous chain of tying down from the roof to the foundation, and also by having a sufficient gravity load to resist the overall upward or lateral forces. The second thread is that soil scouring has to be accounted for, or anticipated (Dias *et al*., 2006). This can be done by improving the soil properties, especially soil that has been backfilled; deepening foundations, whether for buildings or bridges; and also by providing sufficient structural redundancy to prevent catastrophic collapse even if some foundations fail. The strategic use of natural features such as sand dunes and provision of vegetation barriers are also ways of mitigating potential tsunami damage (University of Washington, 2007). In Sri Lanka, newly published national guidelines for reconstruction emphasise the importance of tying down structures against upward and lateral loads as well as the need to anticipate and reduce soil scour around foundations, especially of backfilled earth.

However, not only buildings got destroyed due to the tsunami. Civil engineering structures like roads and bridges were also damaged. An investigation (Kusakabe et al., 2005) on infrastructural damage in Sri Lanka due to the tsunami revealed the following:

- Damage to roads induced by the tsunami included erosion of embankments, erosion of abutment backfills, and collapse of bridges following the loss of stability of the abutments
- Erosion of embankments tended to have occurred at locations where the land was relatively low, presumably because the backflow of the tsunami concentrated on those parts of the land
- No bridge girders were washed away by the direct impact force of tsunami. However, it is too optimistic to conclude that bridges are always safe against impact force of the tsunami
- The socio-economic impact of the damage was weakened in places where there were alternative exit routes and where there was speedy restoration of damaged structures.

2.6.3 Operational issues

Coordination is often a scarce resource in disasters, yet it remains the key operational principle for effective response. It is important in order to avoid duplication of effort so that resources are directed to those most severely affected by the disaster. Good coordination can also facilitate lesson learning. The importance of effective coordination of disaster management work at the international, regional, national, organisational, group and individual level is overwhelmingly highlighted by the case-study material. Reducing risk depends on communication and information exchange between the scientific community and politicians. The tsunami showed that in the absence of an open dialogue, valuable information and research from the technical sectors is not made use of and is, in effect, redundant. As Senanayake (2005) argued, there was a striking absence of expertise and professionals, from the region in the post-tsunami operation in Sri Lanka, despite a number of agencies having the stated aim of developing regional disaster response capacity in the Asia Pacific region. As a consequence, it is necessary to strengthen the link between scientific institutions and national and local authorities charged with action to avoid human, economic and social losses from disasters.

International, regional and national organisations should work better together and be better coordinated. Coordination between the entire UN system and governments and non-governmental organisations is an essential element of disaster prevention, mitigation, preparedness and response. Efforts need to be made to promote complementarity and to avoid duplication (Briceno, 2005). A number of reports (Senanayake, 2005; Briceno, 2005; UNDP, 2005) emphasise the primary role of national authorities in coordinating and directing national and international assistance. Existing inter-agency coordination arrangements should be further strengthened, particularly concerning the sharing of information and knowledge in the early phases of disaster response. Coordination mechanisms should be devised to ensure the participation of smaller organisations and institutions with less international experience. Further, governments need to demonstrate their political will and commitment to disaster risk reduction through concrete measures e.g. reserve national budget line for disaster reduction, strategic donor funds to support and build capacity for disaster risk management.

2.6.4 Legal concerns

Coastal zones and small islands are often densely populated areas and, as a result, their population are at increased risk from natural disasters. Nearly 3 billion people, or almost half the world's population, live in coastal zones which in many cases are prone to hazards including tropical cyclones, floods, storms and tsunamis (Briceno, 2005). Coastal populations are often dependent on the sea for their livelihoods (e.g. fishing villages) and do not have the choice to live elsewhere. Small island countries such as the Nicobar and Andaman islands are barely a few metres above sea level, which means that evacuation to higher land is almost impossible. Governments and local authorities need to take human habitats into consideration in long-term development planning, ensuring that risks are minimised.

Beyond preparing for evacuation and emergency response, communities can reduce their tsunami risk by modifying their land use planning and development approval practices. Although planning for tsunamis will not be a top priority for most coastal communities, there are some relatively simple and straightforward initiatives that can be taken which can significantly increase community safety. The US National Tsunami Hazard Mitigation Program's publication 'Designing for Tsunamis' stresses the importance of understanding site planning. Through zoning, creation of open space and not allowing new development in potential tsunami areas, safer land use will be better able to protect people and buildings. Specific site planning strategies to reduce tsunami risk can include (University of Washington, 2007):

- Avoiding inundation areas: site buildings or infrastructure away from hazard areas or locate on higher land
- Slowing water: Forests, ditches, slopes, or berms can slow down waves and filter out debris. The success of this method depends on correctly estimating the force of the tsunami
- Steering: water can be steered towards strategically placed angled walls, ditches and paved roads. Theoretically, porous dykes can reduce the impact of violent waves
- Blocking: walls, hardened terraces, berms and parking structures can be built to block waves.

Project evaluation

Several reports (Government of Sri Lanka and UN, 2005; Government of Indonesia and UN, 2005; Briceno, 2005) emphasise the necessity for a national and institutional level legislative framework governing disaster management efforts. From the institutional point of view, there should be reform of the entire national institutional arrangement for disaster management, to provide for the allocation of resources for preparedness and emergency response at all levels of governance, and to create a permanent liaison mechanism with the international humanitarian community. Decentralisation of decision-making authority should feature prominently in the new arrangements. Administratively, such new legislative structures should promote the development of detailed contingency plans at the local level. Such plans should include (Government of Indonesia and UN, 2005):

- Risk analysis, zoning and mapping
- Comprehensive air, sea and road transportation arrangements (including stand-by agreements with the national air carrier and ship companies)
- The pre-positioning of relief supplies and – notably – of fuel; and
- Backup emergency communications arrangements, notably assigning an institutional role to amateur radio communications.

It is also recommended that there should be a National Disaster Management Bill, which should:

- Deal with the creation of policies/provisions/regulations at sectoral level to enable special conditions applicable for emergency response
- Formulate operating policies for the mobilization of military assets in disaster management and emergency response
- Regulate the role of NGOs in the national arrangements for disaster response; and
- Specify provisions for the request and reception of international assistance.

2.6.5 Environmental concerns

The tsunami reduced some coastal communities to piles of bricks, tin and wood mixed with car and boat parts, construction materials, ocean mud and dead bodies. While the tsunami killed more than 250,000 people in 12 countries and left millions of homes and businesses in ruin, it was actually the environmental aftermath that officials were most worried about. In many cases, the tsunami worsened pre-existing environmental management problems on the inhabited islands. The Joint United Nations Environment Programme (UNEP)/ United Nations Office for the Coordination of Humanitarian Affairs (OCHA) Environment Unit (Joint Unit), integrated in the Emergency Services Branch of the OCHA, is the principal United Nations mechanism mandated to assist countries facing environmental emergencies.

As Casey *et al*. (2005) argue, a common best practice approach to debris removal should be developed to minimise negative environmental impacts. Related guidance material should be translated into local languages and effectively disseminated. Re-mapping affected areas before redevelopment begins can ensure the identification of hazardous areas created by tsunami-induced changes, such as mass graves and locations vulnerable to flooding. Re-mapping is therefore an important tool to help to ensure that tsunami victims do not face new dangers when they resettle, and can also reassure affected populations of the safety of the locations where they rebuild. In this regard, local expertise and capacities in recycling, composting and environmental management can play a key part in clearing efforts. However, as Pasche and Kelly (2005) argued, immediately following the tsunami, the inclusion of environmental issues into disaster management efforts at the national level was limited. Another revelation that has emerged from several studies is the fact that many operational agencies of the United Nations system have very little awareness of the potential environmental threats in the aftermath of disasters.

In Sri Lanka, the key environmental findings from the Rapid Environmental Assessment (REA) carried out on the tsunami disaster included the following (Casey *et al*., 2005):

- While there was considerable damage to the natural and built environment in affected coastal areas, there were no major life-threatening environmental emergencies as a result of the tsunami
- Specific coordination needs to enhance environmental risk mitigation efforts
- Re-mapping needed to be carried out to ensure effective reconstruction efforts
- Areas of acute environmental concern requiring immediate attention include management of tsunami waste and debris, and sanitation and sewage issues in settlements.

Calvi-Parisetti and Pasche (2005) prescribes the process to be followed when assessing environmental impacts after a tsunami disaster.

Assessments carried out in the first 48-72 hours after a major disaster should aim at identifying major secondary risks through a relatively simple checklist that should become a standard feature of the overall emergency assessments. If such risks are identified, specialised expertise should be quickly mobilised for further assessments and quick response. The initial environmental assessment should also look at those issues that are not immediately life-threatening but may become so at a later stage if not dealt with immediately. Once the most acute phase of the response is over, the environmental consequences of the disaster on the livelihoods of the affected population should be assessed and programmes should be designed to address them. Finally, the environmental consequences of the disaster on ecosystems and habitats should be assessed in order to be addressed through programmes in the reconstruction/rehabilitation phase.

“Once the most acute phase of the response is over, the environmental consequences of the disaster on the livelihoods of the affected population should be assessed and programmes should be designed to address them.

Project evaluation

2.7 Challenges faced

Table 1: The challenges faced during the execution and completion of ISLAND project

Challenge	Description
Scope Identification	Due to the broad scope of disaster management-related activities, the initial challenge was to determine the exact scope of the project based on time and resource availability. Three distinct phases, within disaster management process, and different types of disasters were taken into consideration. Accordingly, this research focused on creating a knowledge base on the post-tsunami response, with specific reference to case material in Sri Lanka and good practices relating to reconstruction phase addressing disaster mitigation measures. In this context, Sri Lanka provided a good base for data collection due to its recent experiences associated with the tsunami.
Process Mapping	Although the initial research focused on tsunami mitigation strategies and Sri Lanka in particular, the infrastructure to be developed during he project had to permit growth in the knowledge base to address other aspects of disaster management. Therefore, a generic knowledge capturing and disseminating process was identified and developed, without being specific to the scope determined. This process map is described in Appendix 3.
Collection of Data	The project aimed to collect both primary and secondary data as case material to populate the website. Although published secondary data was collected via document search techniques, primary data collection was constrained due to time and resource limitations. However, the project partner from Sri Lanka, the University of Moratuwa, undertook to collect primary data from relevant individuals, groups and institutions in Sri Lanka. The resultant good practices and lessons learned will be organised and incorporated into the ISLAND website.
Presentation of Data	The mode and format of presenting case material, collected for the project, had to be given due consideration due to copyright limitations. Although initially it was decided to upload relevant case material to the project knowledge database, it was subsequently decided to link case materials to their original source, facilitating users to access reports directly from websites. However, in order to provide an overview on case materials, a description was provided (see Appendix 4 for an example) for each article before directing users to the original source. This facilitated sharing knowledge without infringing copyright law.

03 Reflections and way forward

The fact remains that reconstruction activities involving large amounts of investment and the resultant opportunities for change represent significant chances to carry out mitigation. The techniques learned and the expertise developed will be applicable elsewhere in the country or region. It is important that the mitigation actions are promoted as far as possible beyond the reconstruction area to other areas at risk from similar hazards, and that mitigation encompasses all the hazards likely to be encountered. The experiences of the disaster, and the reconstruction and the mitigation measures it engenders, should be shared and exported with relevant adaptations to people and institutions that need it most. Hence, effective knowledge sharing should reduce the risk of future disasters through well-informed mitigation and preparedness planning. Ensuring the availability and accessibility of accurate and reliable disaster risk information when required entails an efficient system for knowledge sharing. The ISLAND project could be considered as the initial step towards developing such an efficient system for sharing disaster related knowledge.

“The experiences of the disaster, and the reconstruction and the mitigation measures it engenders, should be shared and exported with relevant adaptations to people and institutions that need it most.

However, the UK Higher Education Disaster Relief Project Report (2007) highlighted a lack of mechanisms at national level in the UK to link the expertise, skills and knowledge which reside in UK HE with the practitioners in the humanitarian agencies. Nor is there a comprehensive overview of the expertise which exists and who is willing to offer expertise. Therefore, ISLAND could be extended to create mini-hubs of academic (and non-academic) expertise in order to act as the mechanism by which needs for expertise in a range of areas could be identified by the humanitarian agencies with a specific need. Further, case material relating to different phases and types of disasters could be collated and populated using the available infrastructure of ISLAND website. Moreover, the existing infrastructure of the ISLAND website could be evaluated and tested as the initial step before extending further towards different disaster types and phases.

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Appendix 1: Methodology

The research was carried out according to three Work Packages (WPs), as follows:

Work Package 1: Develop knowledgebase infrastructure

Aim: WP1 aimed at developing infrastructure for capturing, sharing and disseminating knowledge about disaster management in land, property and construction. Going beyond the scope of mere information management, it integrated knowledge extraction and dissemination techniques within this WP. The objective of this initiative is to ease and speed up the decision-making process within disaster management exercises. Specifically, mechanisms were developed to extract and disseminate explicit knowledge from materials gathered in WP2. This provided the necessary scalability for the knowledge dissemination exercise within the proposed project, be it internal to an organisation or accessible worldwide, as the database can be hosted centrally. A dynamic web portal was created as the front end of this database, providing the search and update facilities to the database, to ensure enhanced user friendliness and self expansion of the proposed knowledgebase.

Tasks:

Develop database structure: a relational database was created for the purpose of gathering and organising relevant data, and a modern database management system such as MySQL or MS SQL was deployed.

Develop dynamic web portal: a front-end portal was created to provide the search and update facilities to the database.

Evaluate portal: periodic evaluation of the portal will be used to refine it during the project. All users will be invited to complete surveys to inform development and evaluate its user friendliness and accessibility, as well as its value for information and knowledge dissemination.

Write sustainability plan for the portal: On conclusion of the project, the portal will remain operational indefinitely, permitting data upload and retrieval.

Deliverables from WP1 include: dynamic web portal and database.

Work Package 2: Populate knowledge base

Aim: WP2 aimed at populating the knowledge base with a range of land, property and construction mitigation strategies related to tsunamis. Accordingly case materials focusing on good practices and lessons learned from 2004 tsunami, particularly in the Sri Lankan post-tsunami context, were collated and analysed. The portal user interface developed in WP1 provided the capability to upload case study information to the back end database. In addition, professional bodies and relevant research groups were identified, and invited to contribute material to the knowledge base: disaster recovery strategies, their effectiveness, drawbacks and current good practices; the level of community involvement; details on the allocation of funding to recovery and reconstruction programmes in the region; details on short term relief and its benefits; plans for long term developments including the consultation process between the government and the local community, knowledge on planning and building settlements that respond to community needs while providing a more secure environment; and, information on reporting frameworks.

Tasks:

Collect case material on post-Tsunami response in Sri Lanka: Generic guidance, local experiences and good practices about post-tsunami programmes in Sri Lanka were gathered through a review of published materials, supplemented by interviews with researchers, and policy makers and implementers in Sri Lanka.

Identify and approach potential contributors: Relevant professional bodies, policy makers and implementers, and research groups were identified and invited to contribute materials to the knowledgebase.

Populate knowledge base: Collated material was uploaded to the knowledge base. Further, contributors will have the ability to upload materials independently using the front-end portal, which includes search and update facilities to the database.

Deliverables from WP2 include: populated knowledge base; analysis of case study material.

Appendix 1: Methodology

Work Package 3: Disseminate research and identify future research directions

Aim: WP3 aimed at disseminating the research outputs and identifying future research directions. The web portal forms the focal point for the dissemination strategy for the research. However, the project will also use and integrate with other appropriate dissemination mechanisms. A range of academic publications and international conferences on relevant themes were targeted as a means of promoting the portal and disseminating the case material to a wider audience.

Tasks:

Identify new research directions: The review of published material and interviews with researchers, and policy makers and implementers in Sri Lanka were used to identify gaps in the current knowledge base and to identify opportunities for further research.

Academic publications: The academic team was responsible for the dissemination of research findings through publication in academic journals and papers.

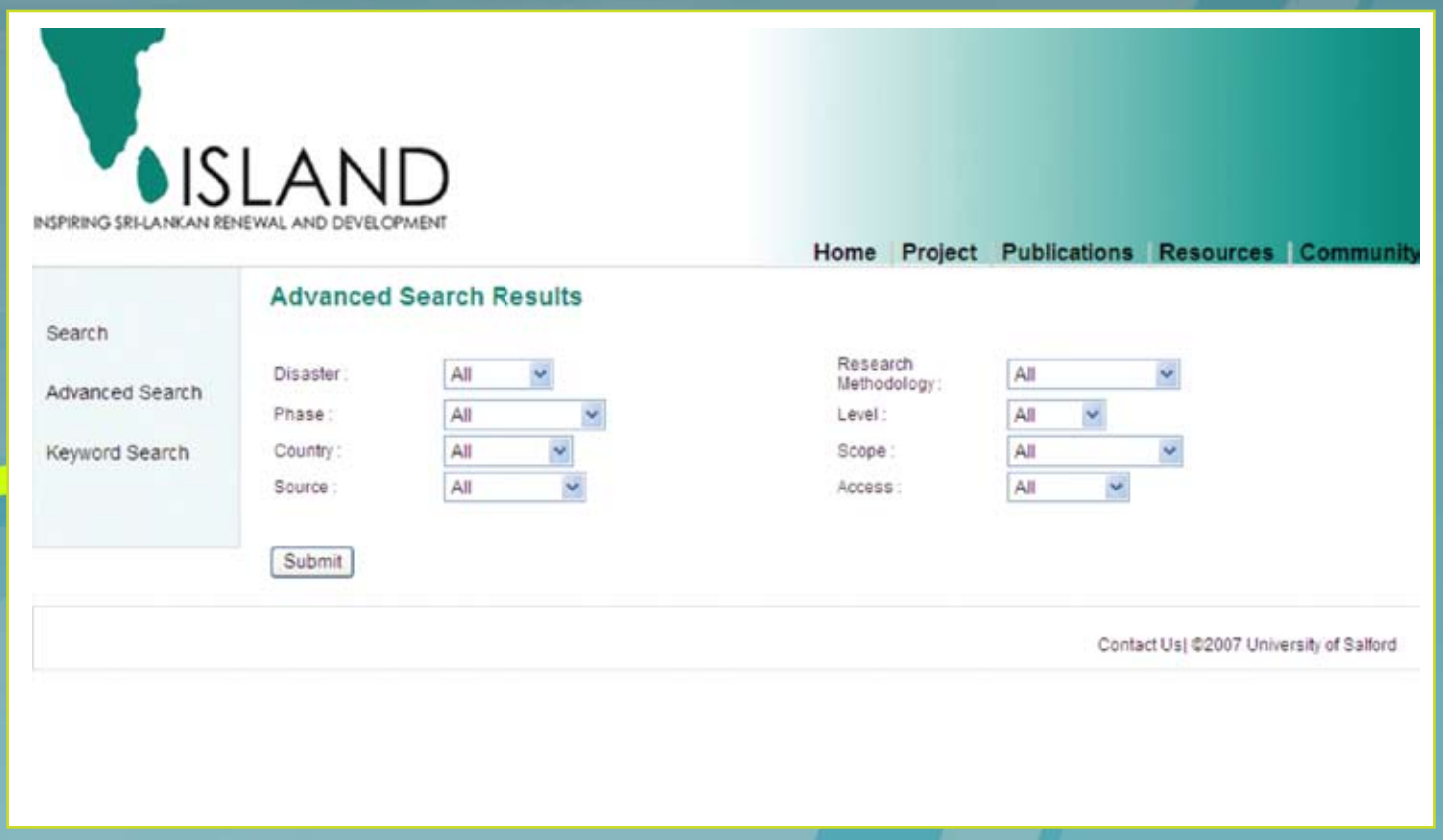
Final project report: the project's final report details the project's outputs and reports on the case material gathered and collated during the project. The report also presents an evaluation of the post-tsunami recovery and reconstruction portal (based on WP1), and identify future research directions.

Deliverables from WP3 include: Final project report; Academic journals and papers; Conference and other presentations; Report on new research directions.

Appendix 2: ISLAND website

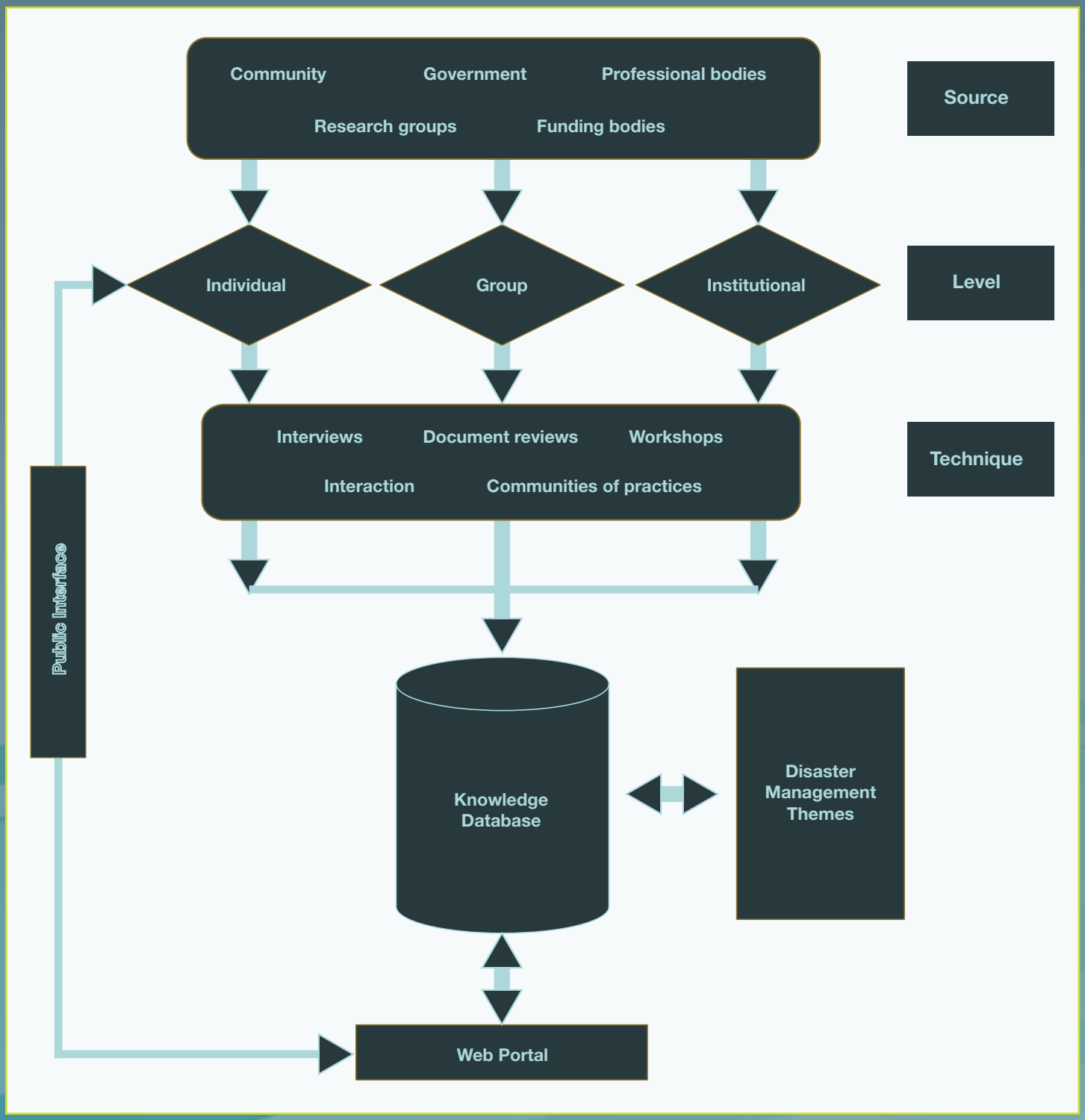
ISLAND Project Website- Methodology

ISLAND Project Website- Advanced Search



Appendix 3

Knowledge base infrastructure facilitating dissemination



Appendix 4: ISLAND project website: Article Description

ISLAND
INSPIRING SRI-LANKAN RENEWAL AND DEVELOPMENT

Title: Lessons Learned from Tsunami Damage in Sri Lanka

Authors: Dias, P., Dissanayake, R. and Chandratilake, R

Year: May 2006

Description
The 2004 tsunami is widely acknowledged as the largest, most devastating natural catastrophe in the history of Sri Lanka. Tsunami affected two-thirds of the coastline of Sri Lanka, and it also resulted in the destruction of nearly 100,000 houses and infrastructure like roads, bridges etc. Depending on the wave height, various types of structures were affected. Two common threads that run through the structural failures can be identified. The first is that structures have to be tied down in addition to being held up. When natural disasters such as tsunamis occur they have the effect of trying to lift up or push aside structures. Such actions can be resisted only by having a continuous chain of tying down from roof to foundation. Newly published national guidelines for reconstruction emphasise the importance of tying down structures against upward and lateral loads as well as the need to anticipate and reduce soil scour around foundations, especially of backfilled earth.

Authors of this paper report on how coastal buildings and infrastructure in Sri Lanka behaved under various tsunami wave heights by considering several case studies. Paper also explores the many lessons learned for reducing vulnerability to future events. Authors try to identify the factors that make structures more resistant against tsunami attack, in a qualitative manner, by considering structural forms that have performed either poorly or well.

Key Words: Disaster Engineering, Failures, Safety, Standards

Site Link

Appendix 5

Supporting literature analysis of knowledge management

The Work by Polanyi (1958), Nonaka and Takeuchi (1995), divided knowledge into tacit and explicit. Although knowledge could be classified into personal, shared and public; practical and theoretical; hard and soft; internal and external; foreground and background, the classification of tacit and explicit knowledge remains the most common. In all these discussions, knowledge is considered as an asset with an objectively definable commodity, which represents an important source of competitive advantage. 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). Since tacit knowledge is linked to the individual, it is very difficult, or even impossible, to articulate. Explicit knowledge, in contrast, is codifiable knowledge inherent in non-human storehouses including organisational manuals, documents and databases. However, it is difficult to find two entirely separated dichotomies of tacit and explicit knowledge: instead knowledge can fall within the spectrum of tacit knowledge to explicit knowledge. Several researchers (for example, Nonaka and Takeuchi, 1995; Stahle, 1999) consider that the success of an organisation is formed by the interaction between individuals and several types of knowledge. This provides the insight that knowledge is a social construct, developed, transmitted and maintained in social situations. Thereby, information becomes knowledge when it enters the system and when it is validated (collectively or individually) as a valid, relevant and useful piece of knowledge to implement in the system (Blumentritt and Johnston, 1999). These discussions on knowledge emphasise two perspectives as identified by Empson (2001): 'knowledge as an asset' and 'knowing as a process.' On the 'knowledge as an asset' perspective, knowledge is often viewed as an objectively definable commodity, which can be managed and controlled by certain mechanisms. With regard to 'knowing as a process', knowledge is seen as a social construct, developed, transmitted and maintained in social situations. When knowledge is seen as an 'asset', codification strategies, which especially disseminate explicit knowledge through person-to-document approaches, are considered. When knowledge is seen as a 'flow', personalised strategies, which especially disseminate tacit knowledge through person-to-person approaches, are considered.

Hence, KM definitions and tools further emphasise this dominant perspectives of knowledge. Accordingly, KM discussion has focused around two principal camps. These fall mainly into the IT perspective (Explicit knowledge) where authors focus on IT tools to deliver KM solutions i.e. codification strategies, or the Human Resource (Tacit knowledge) perspective that relies on the people aspect to provide KM solutions i.e. personalised strategies. Yet, any KM approach that is purely based on IT is bound to be less successful because people issues, which are not readily solved by IT systems, would need to be addressed. Thus, the process view critically considers the human element of knowledge sharing by adding the element of people experiences to the equation of knowledge (Kogut and Zander, 1992). The process perspective of knowledge emerges as more of a relevant view for managing knowledge within built environment and within the FM context due to its intrinsic nature.

With the realisation of the strategic importance of the people factor within the last decade, there has been an increasing interest in the tacit dimension of knowledge, which is perhaps hardest to manage as it cannot be formally communicated and is often embedded within human beings. As Herrgard (2000) suggests, tacit knowledge is obtained by internal individual processes like experience, reflection, internalisation or individual talents. Individuals are the primary repositories of tacit knowledge as, due to its transparent characteristics, it is difficult to communicate and therefore cannot be managed and taught in the same manner as explicit knowledge. While highlighting the importance of tacit knowledge, Tiwana (2000) defines it as know-how that is stored in people's heads which is personal, acquired mainly through education, training and experience. In a similar sense, Saint-Onge (1996) describes tacit knowledge as an individual's intuition, beliefs, assumptions and values, formed as a result of experience. It is from these beliefs and assumptions, which make up an individual mindset, that decisions are made and patterns of behaviour developed. Hence, the strategic importance of human knowledge can not be underestimated in this context.

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