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Minimising flood risk accumulation through effective private and public sector engagement

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Executive summary

Flooding is a global problem affecting both developing and developed countries. Academics and practitioners in climate science frequently argue that changing climatic conditions are likely to worsen the length and severity of these flood events, which will have catastrophic consequences to economies and social lives of communities world over. Whilst the overall consequences affecting many regions have been established, effective and efficient strategies to cope with the effects of flooding and building up resilience strategies have not properly evolved. This paper examines this issue by exploring effective strategies undertaken in partnerships between private and public stakeholders.

The paper details two case studies conducted in a developed and a developing country to investigate what global strategies for coping and resilience to flooding have worked in practice. The two case studies: Cockermouth in Cumbria, UK and Patuakhali in Bangladesh provide interesting insights on how some of the strategies work within the chosen developed and developing country contexts. The case study findings are mapped against UNISDR's ten-point checklist under the "Making Cities Resilient Campaign". In conclusion the paper examines how these findings can be incorporated within city development plans to develop stakeholder capacity and capability and eventually build up resilient cities.

1. Introduction

Recent years have seen a large number of catastrophic flood events. It is a global problem as demonstrated by several recent examples both in developed and developing countries. In developing countries such as Pakistan, some of the extreme flood events in 2010 and 2011 have caused catastrophic consequences. In India for instance, heavy rain and tropical cyclones continues to cause heavy flooding due to overflowing of rivers. Developed countries such as the USA, and several places in Europe have also experienced extreme flood scenarios due to hurricanes, gale force winds, over flowing of rivers and heavy rainfall. Climate change is expected to induce further changes in the frequency and severity of these events (Evans *et al*, 2004). As a result, the overall vulnerability (of people, infrastructure, environment and the economy) has increased as they have been exposed to new risk situations. The global flood events can cause two major threats to a society. Firstly, the environment and the society is characterised by densely populated urban areas (Lall and Deichmann, 2011). Therefore flooding in general can cause major effects to communities resulting in collateral damage, loss of lives, economic damage and failures in connected infrastructure. Secondly, the developments in infrastructure facilities such as rail and other transport networks, gas and other energy supplies have interlinked across several geographic regions, economies and sectors. Given this complex environment, such climate change induced major flood events therefore can potentially cause damage to many interconnected regions, economics and sectors, From the context

of UK this was evident after the flooding of 2007, where the total damage caused by flooding came up to the value of approximately £3 billion (Pitt, 2008).

As the length and severity of disaster recovery is highly correlated to the loss of returns from livelihood activities, extreme flood events can cause catastrophic consequences to the economy and social life. The overall consequences affecting many regions have been well established. However, strategies to cope with the effects of these events have not properly evolved. Furthermore, implementing approaches to improving the resilience of societies against extreme flood events that require the participation of both public sector (national government, local government and regulatory bodies) and private sector (individual households, businesses and voluntary bodies) have not been well established.

This paper details how the impact of flood risk can be minimised by adopting a capacity building approach through a partnership between public bodies and private sector establishments by adopting two broad case studies covering both developed and developing countries. Depending on the context the private / public domains will have variations in their own definitions. This will be the main thrust of the paper and this will be looked at in terms of how the various initiatives undertaken by the Centre for Disaster Resilience (CDR), the University of Salford in the UK will address this gap in knowledge. The case study discussion culminates in the development of practical capacity building measures that are appropriate within developed and developing country contexts. This synthesis supports and contributes to the next phase of the paper where a set of generic capacity building measures within the Sri Lankan context is discussed. The main aim of the paper is to relate the generic capacity building initiatives and the two case study findings to the UNISDR's 10 point checklist under the "Making Cities Resilient" initiative to energise some of its outcomes and key goals.

The paper first discusses disasters and their impacts and contextualises the growing problem of flooding and its effects globally.

2. Impacts of Disasters and contextualization of flooding

Disasters in general are on the increase. A global disaster database maintained by Centre for Research on Epidemiology of Disasters in Brussels, records that from 2000 to 2010, more than 600 disasters occurred annually, out of which more than 350 were natural disasters that impacted heavily on humans and economies. In 2010 alone, it is recorded that about 296,800 people were killed, 207 million people were affected and US$ 109 billion of damages was caused (CRED, 2011). The report shows that death toll and economic costs in 2010 was more than the annual average recorded from 2000 to 2009 (CRED, 2011). Figure 1 shows some of the highlights of natural disasters for the period from 1900 to 2010.

Accordingly, number of natural disasters and people affected increased while number of deaths decreased from 1900 to 2010. Increased frequency of natural disasters is linked to climatic change as scientists predict global warming to cause more extreme weather patterns with stronger and increasingly violent disasters (Helmer and Hihorst, 2006; Barnett and Adger, 2007; Nordas and Gleditsch, 2007; Salehyan, 2008). Disaster data published by CRED in year 2009 show that

hydrological and meteorological disasters occurred in a higher frequency when compared with other types of disasters from 2000 to 2008 (Vos *et al*, 2010). Annual Disaster Statistics Review published in year 2010 show that hydrological and meteorological disasters accounted for 79% of total disasters in year 2010 (Guha-Sapir *et al*, 2011). According to Bouwer *et al* (2007), costs of weather-related disasters increased from US$ 8.9 billion to US$ 45.1 billion from 1997 to 2007.

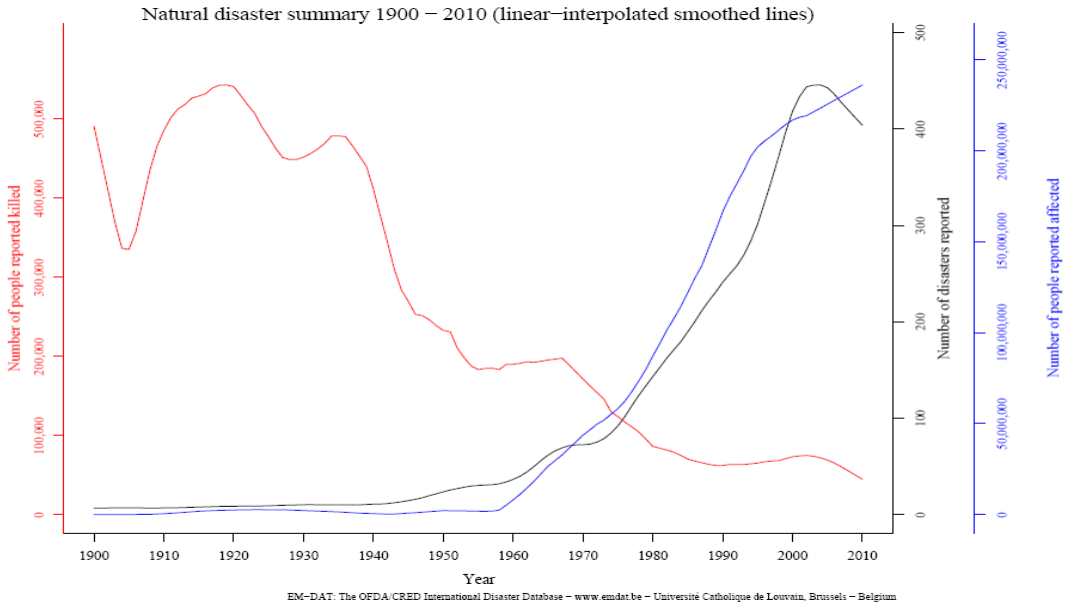

Figure 1: Natural disasters summary (1900-2010) (Source: EM-DAT: The CRED International Disaster Database, 2011)

Statistics reveal that number of disasters is not co-related with number of people affected. As illustrated at Figure 1, although more disasters occurred in 2005 (numbering 432), reported number of affected humans are higher in 2008 where number of disasters was less (numbering 354). In 2008, cyclone Nargis in Myanmar and earthquake in Sichuan, China accounted for 95.9% of deaths, 57.4% of people affected and 61.5% of economic damages reported in 2008 (Rodriguez *et al*, 2008; Guha-Sapir *et al*, 2011). Though the number of disasters in year 2010 remained at equal level with the annual average for the period from 2000 to 2009, number of affected people and amount of economic damages were comparatively higher than the corresponding average due to Haiti earthquake and Russian heat waves (Guha-Sapir *et al*, 2011).

It appears that some countries repeatedly suffer from disasters. Indonesia suffered more than 165,000 deaths and economic cost of US$ 5.0 billion during 2000 and 2006, apart from Indian Ocean tsunami in 2004 that caused unprecedented number of deaths and damages. About 28.9 million people were affected in 1994 and 2003 in Thailand, where people were subjected to more suffering due to floods in 2011. Chang *et al*, (2007) argue that occurrence of certain types of disasters is tied to specific geographical area. Kovacs and Spens (2009) provide examples of Iceland, Japan and New Zealand as countries prone to earthquakes, African continent affected by slow-onset disasters such as armed conflicts and Asia Pacific region frequently hit by serious earthquakes, seasonal storms and floods. In

general, Asia was the most affected continent accounting for over 80% of natural disasters reported from 2000 to 2009 with the highest disaster-related deaths and economic damages (Guha-Sapir *et al*, 2011). In 2010, American continent reported the most number of disasters, victims and highest costs of damages (Guha-Sapir *et al*, 2011).

Statistics reveal that most disaster-related deaths were reported from poor countries and communities (Rodriguez *et al*, 2008; Guha-Sapir *et al*, 2011). Jayaraman *et al,* (1997) state that effects of disasters is aggravated by poverty, tropical climate and unstable landforms, high population density, illiteracy and lack of infrastructure development. The Department for International Development (DFID) in Great Britain, through its report titled "*Disaster risk reduction: a development concern*" highlight a link between disasters and poverty showing how increasing numbers and seriousness of disasters disproportionately affect poor countries and communities (DFID, 2005). Oxfam (2005) says the Indian Ocean tsunami in 2004 mainly affected the poorest people in each of the three worst hit countries. In Sri Lanka nearly one-third of the population in affected areas were below the poverty line.

Ofori (2004) who has studied disaster impacts from the point of view of the built environment states that economic damages of disasters has been increasing through past decades. Out of the 100 most expensive natural disasters of 20th century, 65 occurred in 1990s, 25 in 1980s and 10 in 1970s (Du Plessis, 2001, cited Ofori, 2004). Year 2005 reported the highest ever estimated economic damages of approximately US $ 220 billion (CRED, 2011). Alexander (2006) suggest that costs of disasters shall include damages to international reputation of a disaster-prone nation, affecting inward investment, creating negative multiplier effects on jobs and wages throughout the economy and it affects productivity, growth and economic performance over the long term. Ofori (2002) says that losses due to natural disasters are 20 times greater (as a percentage of GDP) in developing countries than in developed nations, according to World Bank estimates. Thus, Ofori (2002) claims that recovery from disasters of an individual in a developing country can be more severe and take longer time than in a developed country. Kovacs and Spens (2009) state that impact of a disaster depends on geography, demography and socio-economic status, and is unfortunately expected to get worse in future due to effects of climate change.

Annual Disaster Statistical Review for 2008 reveals that impacts on societies in terms of number of affected people and economic damages is more stable due to human adaptation and implementation of mitigatory measures. It is argued that it may change with the increase of global population over time (Rodriguez *et al*, 2008). A high level of exposure and a low level of capacity to cope is a greater factor of risk than the natural hazard itself (Cannon, 1994; Hewitt, 1997). In 2010, an earthquake in Haiti caused more deaths than another earthquake in Chile which was stronger due to Haiti's unplanned urban and eco systems (Red Cross, 2010).

Haigh and Amaratunga (2010) state that, though origin and causes of disasters vary consequences to human society are similar with extensive loss of lives, economic losses, hindering development goals and destruction of built and natural environment.

The above section shows the magnitude of disasters and their impact. The section identified the generic impacts that any disaster can cause to communities worldwide. The next section attempts to identify some of the common flood catastrophes and the extent to which tackling them through a multi-stakeholder involvement will be beneficial.

3. Flood catastrophe and multiple stakeholder involvement

The stern review (2007) looked into the climate change in detail and how it impact the economy of a country, thereby further reinforcing the flood damage – economic consequence link. As introduced in this paper, the economic damage caused by flooding has been felt world over and has come into the spotlight of policy makers in both developed and developing countries. This section starts off by dealing with the different types of flood catastrophes facing UK, Europe and the rest of the world and their growing increase due to the changing climatic conditions.

Flood catastrophes affecting the regions under consideration

Flash flooding

Climate change impacts have increased the frequency of flash flooding in many parts of the world. As the name implies, flash flooding could cause severe devastating effects over a very short period of time. Due to the very low level of warning and the lack of adopting any quick resistance measures, it is highly likely to cause major collateral damage to infrastructure and businesses. The significance of flash flooding in the UK has been identified in the Pitt review (2008) and it has recommended measures to map the trends of urban flash flooding to improve the predictive capability. In Bangladesh for instance flash flooding is caused on many occasions due to frequent cyclones. Compton *et al* (2008) who studied this area proposed a “catastrophe model” to manage the risk of urban flash flooding in Vienna.

Pluvial flooding

Flooding due to heavy rainfall is classified as pluvial flooding. The devastation due to pluvial flooding is caused when the amount of surface water that is created overwhelms the capacity of the drainage system. According to the Pitt Review, 50% of the 2007 floods in UK occurred away from Environment Agency floodplains, with 60-70% caused by pluvial flooding. According to Houston *et al* (2011), the majority of the areas liable to pluvial flooding coincidentally are located in socially deprived areas in the UK. This is likely to cause major economic consequences to the population living in those areas. Pluvial flood risk can be heavily mitigated in new developments through a combination of avoiding the

highest risk locations, investment in drainage systems, flood proof building design and innovative surface water management schemes.

Coastal flooding and tsunamis

Threats of coastal flooding and tsunamis can cause major economic damage due to direct and indirect effects. For instance, the recent tsunami in Japan has had a major impact on the Japanese car manufacturing industry. Several parts of Europe and South and South East Asia are particularly vulnerable to the effect of rising sea levels, coastal flooding and tsunamis. These exceptional coastal storm impacts caused by tropical and extra-tropical weather systems result in broader societal losses and affect at the same time developed and developing nations.

Fluvial flooding

This is a very common source of flooding when water levels in rivers rise and overtop their banks. Typically, river floods are defined hydrologically in terms of a river's water level or discharge. According to Wilby *et al* (2008) the potential impact of climate change on fluvial flooding is receiving considerable scientific and political interest thanks to evidence from climate model projections and a widely held belief that flood risk may be increasing at European levels.

Multi-stakeholder strategies and introduction to Centre for Disaster Resilience (CDR) initiatives

Due to the devastation caused by flooding in various forms, the recent flood management schemes tend to take the view that a multi stakeholder strategy should be adopted to both the preparation and recovery stages of a major flood event or events. Effective survival and recovery from disasters depends not just on the physical impacts of the event but also on how the societal environment supports the complex and protracted processes of recovery (Gordon 2004). However, findings of research projects show that there are major concerns that such partnership working seems yet untested to its full potential.

CDR initiatives span several contexts. One of its main initiatives undertaken in the UK is in the area of small townships affected by flooding. Under this initiative this paper covers the work undertaken in the small market township of Cockermouth in Cumbria. Cockermouth was affected by severe flooding in November 2009. Several residential and business properties were destroyed due to flooding. Within the Cumbrian region, Cockermouth was the worst affected area where flood depths in excess of 1.5m have been reported (Environment Agency, 2009b). Although Cockermouth has been flooded previously; for instance, in December 2003 and January 2005, the scale and impact of 2009 flooding was seen as unprecedented. The study of the 2009 flood event in Cockermouth would provide a useful case study of how major flood events affect SMEs in a rural market town and their subsequent experiences of the repair and recovery process.

The other main initiative of CDR is from a developing country. Bangladesh is exposed to a range of natural hazards, flooding and cyclones have posed the greatest risk when taken as a whole at the country level (MoFDM, 2010; World Bank, 2011), and especially on coastal communities. Flooding affects Bangladesh

almost every year (Gupta and Muralikrishna, 2010) and is the most recurring type of disaster affecting the country (World Bank, 2011).

In broad terms, the above CDR initiatives enable policy makers to learn possible lessons to improve flood resilience of the communities at risk of flooding. These initiatives broadly discuss the current emphasis of multi stakeholder strategies. Apart from the individual householders and the policy-making community, a major stakeholder group that needs to be recognised within a multi stakeholder strategy is the business community.

The growing need to concentrate on small businesses and to the extent to which they contribute towards the prosperity of a city, township or region and the need to enhance their resilience to catastrophic flood events is gaining recognition. Therefore in developed nations some of the multi stakeholder approaches to flood mitigation take into account the needs and views of business networks such as chambers of trade and commerce and local business leaders. Quite in contrast, in developing countries (Bangladesh and Sri Lanka) the role played by the private sector businesses seem to be lower, which is indicative of some of the practical realities connected with joined up strategies in similar contexts.

4. Flood Impacts on small businesses

Flooding can have a critical impact on a business if affected either directly or indirectly (Ingirige and Wedawatta, 2011). Damaged or lost stock, damage to building / premises, damaged or lost building equipment, inability to conduct business, and inconvenience to staff were the main short term impacts experienced by small businesses in Yorkshire affected by 2007 summer floods (EKOS Consulting (UK) Ltd, 2008). Long-term impacts included disrupted cash flow and lost income, staff anxiety from flooding to business, and higher insurance premiums as some of the long term impacts. In a survey of businesses affected by flooding in the event of 2009 Cumbria floods (BMG Research, 2011), businesses were requested to estimate the costs that have been incurred as a result of damage or loss caused by the storms and flooding, during the event (November 2009) up to August 2010. The mean costs incurred per business were found to be about £35,000, as per the estimates by a sample of 324 businesses. Whilst there may be significant variations in costs incurred by larger businesses and SMEs, the figure suggests how costly flooding can be to a business. Although direct impacts are often highlighted, indirect impacts of flooding can also create negative consequences on businesses. Woodman (2008) identified staff unavailable for work -53%, premises flooded (offices, shops etc) – 38%, and suppliers disrupted – 27% as the main impacts of flooding experienced by a sample of 255 businesses affected by 2007 flooding, suggesting that the impacts of flooding extend well beyond the direct impacts.

Above facts suggest adaptation to the risk of flooding as important for businesses; particularly for SMEs, which are said to be highly vulnerable to disruptions compared to larger businesses, if such negative impacts are to be managed (Wedawatta and Ingirige, 2012). Whilst many of the studies addressing adaptation has focused on long term climate change, the importance of adapting to short term climate stimuli such as flooding is also recognised. For instance, one of the

principals of the adaptation policy framework developed by Spanger-Siegfried *et al* (2004: pp10) is that "adaptation to short-term climate variability and extreme events serves as a starting point for reducing vulnerability to longer-term climate change". In this respect, adaptation to flooding is important not only as a response to current risk of flooding, but also as a starting point to long term adaptation to changing climatic conditions. Further, given that climate change mitigation is likely to come before adaptation to many (Morton *et al*, 2011), flood risk adaptation can be used to highlight the need for adaptation rather than mitigation alone.

5. Creating flood resilience

Conceptual understanding of resilience

Disaster resilience is one of the catchphrases to have recently entered the disaster discourse, but its entrance could be seen as a birth of a new culture of dealing with disasters. The outcomes of the 2005 World Conference on Disaster Reduction (WCDR) confirmed that the concept had been gradually finding more space in both theory and practice in a wide range of disaster risk reduction discourse and some interventions. The concept of resilience is now widely adopted across academic and policy debates as a way of reducing society's vulnerability to threats posed by natural and human induced hazards (Haigh and Amaratunga, 2010). Terms such as "sustainable and resilient communities", "resilient livelihoods" and "building community resilience" have become common terms in journal articles and programme documents. Yet the definition of resilience remains a contested one. Because of the multidisciplinary nature of the concept, several definitions have been coined, especially from geography, sociology, engineering, health, environmental studies and disaster fields. However, most of the definitions view resilience as both a process and outcome.

The term resilience was introduced into the English language in the early 17th Century from the Latin verb *resilire*, meaning to rebound or recoil.However, there is little evidence of its use until Thomas Tredgold introduced the term in the early 18th Century to describe a property of timber, and to explain why some types of wood were able to accommodate sudden and severe loads without breaking. In 1973, Holling presented the word resilience into the ecological literature as a way of helping to understand the non-linear dynamics observed in ecosystems. Ecological resilience was defined as the amount of disturbance that an ecosystem could withstand without changing self-organised processes and structures. Haigh and Amaratunga (2011).

In subsequent decades, the term resilience has evolved from the disciplines of materials science, the ecology and environmental studies to become a concept used by policy makers, practitioners and academics. During this period, there have been a range of interpretations as to its meaning. The Resilience Alliance (www.resalliance.org) defines resilience as "an integrated system of people and nature" with at least three traits (Berkes *et al*, 2002):

- the ability to continue to function under conditions of uncertainty and increasing stress, to absorb minor and major disturbances, and to still retain essential key attributes and functions;

- the ability to self-organise (adapt) when disturbed and external conditions change; and
- the ability to adapt in ways that increase the extent and range of opportunities for future development and resilience.

Resilience can be viewed as “the intrinsic capacity of a system, community or society predisposed to a shock or stress to ‘bounce forward’ and adapt in order to survive by changing its non-essential attributes and rebuilding itself (Manyena *et al*, 2011). Resilience can also be defined as the “ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions” (UNISDR, 2007).

Resilience is evidently complex and open to a variety of interpretations but how can it be applied to the built environment? The relationship between disaster risk, resilience and the built environment suggests that a resilient built environment will occur when we *design, develop and manage context sensitive buildings, spaces and places that have the capacity to resist or change in order to reduce hazard vulnerability, and enable society to continue functioning, economically and socially, when subjected to a hazard event*. It is possible to elaborate on this definition by exploring specific characteristics of resilience and how they may be present in the built environment (Haigh and Amaratunga, 2011)

Firstly, resilience is seen as the ability to accommodate abnormal or periodic threats and disruptive events, be they terrorist actions, the results of climatic change, earthquakes and floods, or an industrial accident. Identifying, assessing and communicating the risk from such threats and events are therefore vital components. Individuals, communities, organisations and, indeed, nations that are prepared and ready for an abnormal event, tend to be more resilient. Consequently, those responsible for the planning, design and management of the built environment need to understand the diverse hazard threats to buildings, spaces and places and the performance of the same if a disruptive event materializes (Haigh and Amaratunga, 2011).

The next characteristic is the ability to absorb or withstand the disturbance while still retaining essentially the same function. This may mean returning to the state or condition that existed before the disturbance occurred, or returning to an improved state or condition. This absorption might be realized through the specification and use of hazard resistant methods, materials and technologies. It might also result from the construction of protective infrastructure, or the protection of critical infrastructure. Such measures may resist the threat, or at least reduce the losses experienced (Haigh and Amaratunga, 2011).

From this discussion of its characteristics, it is evident that the concept of resilience provides a useful framework of analysis and understanding on how we can plan, design and maintain a built environment that copes in a changing world, facing many uncertainties and challenges. Sometimes change is gradual and things move forward in continuous and predictable ways; but sometimes change is

sudden, disorganising and turbulent. Resilience provides better understanding on how society should respond to disruptive events and accommodate change, as highlighted by Haigh and Amaratunga (2011).

Resilient communities

Resilient communities take deliberate action to reduce risk from hazards with the goal of avoiding disaster and accelerating recovery in the event of a disaster. They adapt to changes through experience and applying lessons learned. These characteristics are illustrated in Figure 2.

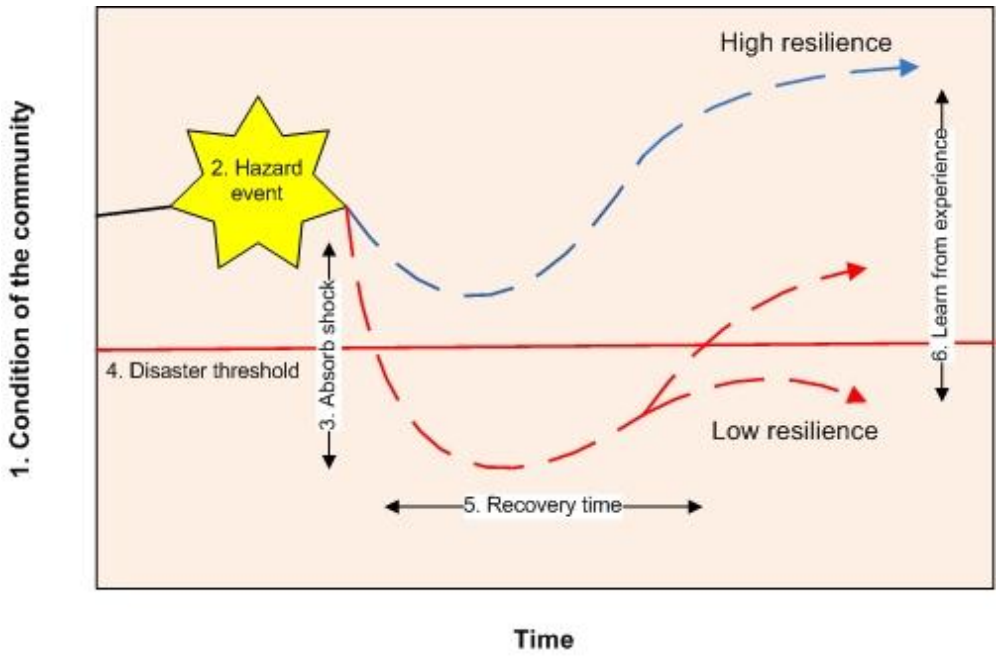

Figure 2: Role of resilience in determining community response to a hazard event (Haigh, 2010)

An explanation of Figure 1 is provided below, corresponding to the numbered points on the diagram (Haigh, 2010):

- The y-axis represents the condition or state of the community's economy, society, and environment.
- Hazard events can be either episodic, such as cyclones and tsunamis, or more chronic, such as erosion or sea level rise.
- Resilient communities are able to absorb or avoid impacts of hazard events. Enhancing resilience decreases the magnitude of impacts of hazard events on the community.
- A community crosses the threshold between a hazard event and a disaster when it cannot function without considerable outside assistance.
- Resilient communities are able to recover from hazard events quickly. Enhancing resilience accelerates recovery time.
- Resilient communities are able to adapt to changing conditions. Enhancing resilience builds the capacity of communities to learn from experience.

Flood resilience

Indeed, the increasing irregularity and severity of extreme weather events being experienced due to global warming mean that disaster risk reduction and the enhancement of disaster resilience have become important priorities for businesses of varied types and sizes, for city politicians and planners. Similarly, also, the nature of social relations and socio-political capabilities are the keys to disaster resilience in a city or region. As Haigh and Amaratunga (2011) write: “As society becomes more complex, resilient communities tend to be those which are well coordinated and share values and beliefs. This sense of interconnectedness can be undermined by self-interest and personal gain, resulting in vulnerable societies that are less able and willing to plan for, and react to, disruptive events.

Dawson *et al* (2011) asserted the ability of reducing the risk of flooding by implementing a portfolio of structural as well non-structural flood resilience measures, and claimed that “society is capable of adapting and significantly reducing flood risk using currently available measures” (pp644), suggesting the importance and feasibility of flood resilience. Community-level flood protection schemes can be considered as the first line of defence against flooding, and is largely a preventive response. Examples for community-level flood protection schemes include storage basins, raised river embankments, coastal defences (Bichard and Kazmierczak, 2010), maintained river channels, floodwalls and barriers (Environment Agency, 2009a). Given that it is being practically difficult to protect every property at risk of flooding through community level strategic flood protection schemes (Environment Agency, 2009a), adapting properties to the risk of flooding; i.e. implementing property-level flood resilience measures, is considered an effective means of managing the flood risk to existing buildings. It was discussed previously that despite the presence of community-level flood protection measures, there is the risk that properties will still be left at risk of flooding. Therefore as indicated at a community level, two broad resilience measures are applicable. Community-level flood protection mechanisms are widely available in the UK. However, their usage and value has been undermined due to significant localised flood events in the recent times. Therefore despite Government funding and measures for community-level flood protection schemes, for SMEs’ individual property-level and business continuity measures could enhance their sustainability and business continuity. These issues are relevant and of value in both developed and developing countries.

6. Aims of the study

Based on the above discussion the following aims are set out.

- Identify variations in current flood resilience measures taken at a community level in developed and developing countries
- Examine how private and public sector engagement work in practice
- What types of capacity building measures work in practice
- Recommend how a global level strategy could be evolved in this area

7. Methodology adopted in the study

The paper adopts a multiple case study approach by conducting two case studies to study the impact of flooding on the business sector and the third case study will be utilised to investigate the capacity building and empowerment approaches undertaken in the third case study city.

First the methods adopted in the UK based study is stated as follows. A desk-based literature review was first conducted to assess the existing knowledge on the issues. Primary data were collected from SMEs as well as surveyors involved in providing flood advice to them. Information from SMEs was collected via a questionnaire survey as well as interviews with small business owners. Further, information from flood advisors was collected by conducting face-to-face interviews. Based on this understanding and given the research objectives, a template for the questionnaire survey was developed. Findings of the questionnaire survey informed compilation of the guidelines for detailed investigation of the case study SMEs. The literature review, survey analysis and initial case study analysis informed the interview guidelines for flood advice experts.

Within the second case study conducted in Bangladesh, community consultation was conducted via focus group interviews with local community leaders and policy makers, in order to answer the research questions raised. Focus group method is a form of group interview, where several participants are questioned on a tightly defined topic (Bryman, 2008). The emphasis of focus group discussions is on the joint construction of meaning, derived from the interaction within the group (Bryman, 2008). Focus group interviewing was selected for the purpose of this research, as it provided the opportunity to identify collective viewpoints of community leaders involved. Further, it was thought that this method would eliminate cultural barriers such as interviewing women on an individual basis (Kulatunga, 2010) and foster participation.

Conducting of the two case studies provides the necessary basis for the current practical resilience measures adopted at a community level and how the community engagement schemes between private and public sector multi stakeholders to help building up of community resilience. The case studies also contribute to how capacity building can enhance the effectiveness of the current engagement schemes.

8. Findings

Case study 1: Cockermouth in Cumbria, UK (CS1)

Cockermouth was affected by severe flooding in November 2009. About 700 residential properties and 225 businesses were directly affected (Cumbria County Council, 2010; Tickner, 2011). Cockermouth was the worst affected area in Cumbria, where flood depths in excess of 1.5m have been reported (Environment Agency, 2009b). Although Cockermouth has been flooded previously; for instance, in December 2003 and January 2005, the scale and impact of 2009 flooding was seen as unprecedented. The study of the 2009 flood event in Cockermouth would

provide a useful case study to show how the township recovered with a successful partnership between the Allerdale Borough council and the small businesses in the area close collaboration with the local chambers of trade. Further, as the risk of flooding in many areas is expected to increase in the future, placing more properties at risk, this knowledge will be vital for similar market townships in the UK and internationally.

The Cockermouth flood event in 2009 has emphasised the devastating impacts of flooding on small businesses. Their reinstatement and recovery experiences suggest the common problems faced by such small businesses. Level of resilient reinstatement undertaken by SMEs shows the need for enhancing their awareness on this aspect.

The initial survey was conducted in association with the Allerdale Borough Council as a combination of web-based and postal survey, allowing the respondents to select their preferable response method. Survey respondents were mostly the senior management of the businesses, including managing directors, owners, sole proprietors, partners, and directors, who are responsible for decision making in their businesses. In total, 190 questionnaires were distributed (see Wedawatta *et al*, 2012 for more details). Upon this, 48 completed questionnaires were received, amounting to a response rate of 25%. A range of industry sectors were represented in the survey, whilst retail and wholesale (25%) and pubs, restaurants and hotels (23%) were dominant (the full classification appears in Figure 3). A significant majority of the businesses were micro (0-9 employees) businesses (75%), whilst 21% were small (10 – 49 employees) and 4% were medium (50 – 249 employees).

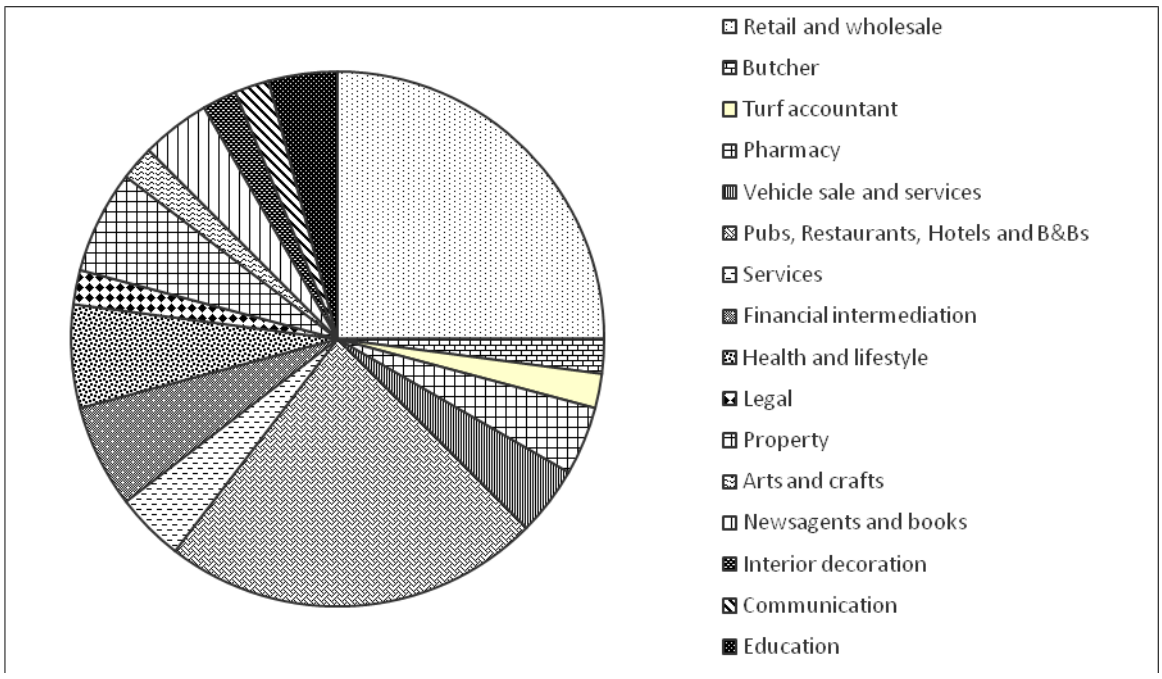

Figure 3 – Types of the businesses represented in the survey (source: Wedawatta *et al*, 2012)

The main success of the recovery programme after the flood event was the close coordination between the Borough Council and the businesses. During the immediate aftermath of the flood event, the businesses moved into a temporary premise assisted by several organisations in the area. This process limited the disruption experienced by the individual businesses.

The survey results suggested that moving to temporary business premises is likely to minimise decrease in sales, travel difficulties for customers, and delays in providing supplies to customers as a combined effect. This combined effect is likely to contribute towards retaining the customer base and maintaining business continuity. However, it can be noted that although premises were flooded in 82% of the businesses, only 34%, n=15, (47% of the businesses whose premises were flooded) have moved to temporary business premises. Except in one case, in all the cases where the business has moved to temporary business premises have said that they were “very much affected” by the issue “premises flooded”. In total, out of the 225 flooded businesses in Cockermouth town centre, 34 businesses have continued their business in temporary premises by January 2010; nearly 2 months after the flood event (Tickner, 2011). Overall, the level of satisfaction expressed by the businesses in temporary relocation suggests that this could be a very good initiative to implement in similar situations in the future (Wedawatta *et al*, 2012). All the businesses that have moved to temporary premises have moved back to their original business premises within 12 months, whilst more than half have taken about 4-6 months for this. Effectively, the businesses would have been out of business for this period, if they had not moved to a temporary premise. The main emphasis and the contribution made by this research is to bridge this gap by enhancing the current understanding of SMEs on preparedness for flooding by considering both the direct and the latent impacts of flooding. Accordingly, guidance available for small businesses regarding flood protection should also highlight the multifaceted nature of flood impacts, their inter-connections and benefits of flood protection. Further, major flood events such as the Cockermouth flood event provide an opportunity to integrate flood resistant and resilient measures to existing properties, especially to those flooded and extensively damaged. However, findings of the survey suggest that this opportunity had not been grasped by many SMEs. As SMEs often turn to their insurance companies and loss adjusters for assistance during the aftermath, their role in promoting resilient reinstatement and property-level protection seems vital. This vital knowledge provides the much-needed support for capacity building in terms of those professionals who would be called upon to provide advise.

Case study 2: Patuakhali, Bangladesh (CS2)

Geographical location and land characteristics make Bangladesh one of the most hazard-prone countries in the world (World Bank, 2011), and hence the country is often considered as a natural disaster hotspot in the world. The country is vulnerable to and is frequently affected by a multitude of natural hazards including cyclones, floods, droughts, riverbank erosion, earthquakes, water logging, and salinity. Impacts of these events are often severe; frequently resulting in loss of life, damages to infrastructure and assets, and livelihoods; especially of deprived communities (MoEF, 2009). For an example, Bangladesh was ranked as the

country that suffered the highest number of human casualties in the Asia-pacific region due to natural disasters during the period between 1980 and 2009 (Bhatia *et al.*, 2010).

Whilst the country is exposed to a range of natural hazards, flooding and cyclones have posed the greatest risk when taken as a whole at the country level (MoFDM, 2010; World Bank, 2011), and especially on coastal communities. Flooding affects Bangladesh almost every year (Gupta and Muralikrishna, 2010) and is the most recurring type of disaster affecting the country (World Bank, 2011). Total land area that gets flooded is significant, ranging between 30% - 50% of the country on average (World Bank, 2011). Bangladesh government estimates that whilst the regular river floods affect 20% of the country annually, this could increase as much as 68% in extreme years (MoFDM, 2010). These figures are not an over estimation, as flood events in years 1987, 1988, and 1998, have inundated over 60% of the country (IPCC, 2012). Risk of cyclones, accompanied by storm surges is also significant. On an average Bangladesh is affected by over 16 major cyclones in a decade (Gupta and Muralikrishna, 2010). Over 50% percent of the cyclones that have claimed more than 5000 lives have been reported in Bangladesh (Government of Bangladesh, 2008), providing an account of the country's vulnerability to cyclones.

The study area for this case study, Patuakhali is a Southwestern region in Bangladesh, facing the Bay of Bengal and consisting of a number of rivers connected to the Indian Ocean. The constituent districts of Patuakhali region for this study are considered as Patuakhali and Borguna. The area is highly vulnerable to a range of natural disasters; most importantly cyclones and storm surges, flooding, and also river erosion. The study area was one of the hardest hit by the 2007 super cyclone Sidr (Government of Bangladesh, 2008; MoFDM, 2010). Further, one of the study areas (Mirzaganj) of the research by Concern Universal Bangladesh mentioned above is within the region, which concluded that the local residents as capable of offering invaluable knowledge on structural risk reduction measures. The area was selected for the study due to its significant vulnerability to the two most devastating disasters affecting Bangladesh; that of cyclones and flooding, previous experience of such events, and the ability of local communities to provide useful insights in to structural risk reduction measures were studied under this research.

Following sections discuss the findings of focus group interviews, primarily addressing participant views on existing disaster risk reduction infrastructure, their deficiencies and community requirements. As the communities interviewed have been affected by cyclones and flooding previously, they were able to provide a detailed account of virtues and shortcomings of existing measures as well as community requirements. Local community leaders identified a number of issues with regard to cyclone shelters. One of the main concerns regarding cyclone shelter is there inadequacy to cater during a disaster. Lack of cyclone shelter numbers has been identified in previous studies as well (Hossain *et al*, 2008; Karim and Mimura, 2008). The government estimated that about 2000 new shelters are required to be built in coastal areas, in addition to nearly 3000 that are already available (MoFDM, 2010).

Location of shelters and transport infrastructure to and from the shelters also warrant attention. Community leader interviews revealed that poor road network leading to shelters as a major factor that hinders speedy access in an emergency situation. Alam and Collins (2010) singled out lack of a proper transport infrastructure as an important factor that makes coastal communities in Bangladesh vulnerable to cyclone disasters. Transport infrastructure being in a poor state and lack of cyclone shelters result in people having to move to distant and difficult to reach shelters, making them vulnerable in cyclone situations (Alam and Collins, 2010). Moreover, poor road network was quoted as a reason for remote communities not receiving disaster warnings in time. For example, in FC3 it was mentioned that they only receive early warnings at the last minute, when the level of warning is very high. It was mentioned that timely warnings are not received, especially lower level warnings, due to it being difficult for local authorities to access their village. According to community leaders, this gives them very little time to take action, when the warnings are received belatedly. Lack of transport infrastructure then add to their difficulties, making it difficult for them to move quickly to a nearby cyclone shelter. It was noted in policy maker focus group that little attention is paid towards access routes to shelters and their vulnerability. For instance, the main road connecting the shelter and a village might get flooded before the village, thus making it riskier for people to access the shelter. Therefore, the need for conducting a proper risk assessment of the locality; location of the cyclone shelter and road network connecting communities to the shelter, was highlighted.

Community leaders were particularly concerned about the maintenance of cyclone shelters. It was pointed out that due to lack of maintenance, in some instances the shelters were not in a fit state condition to be occupied by the evacuated residents. The government proposed to facilitate maintenance of shelters by appointing a cyclone center management committee for each shelter, comprising of a member of local disaster management committee, locally elected representative, head master of local primary school, Imam of local mosque (leader of the local mosque), NGO and women representatives (MoFDM, 2010). Focus group discussion with policy makers revealed that in some instances such committees are successfully maintaining local cyclone shelters. Therefore, it seems that issues surrounding lack of maintenance can be reduced to a minimum by implementing the government proposal of devolving the responsibility of maintenance to a local committee.

The need for assessing future scenarios, under changing climatic conditions, was highlighted in discussions with policy makers. As cyclone shelters are permanent structures built to last many years in to the future, it is important that future conditions are also considered in their design and location. For an example, Karim and Mimura (2008) highlighted the need for considering future flood depths when estimating appropriate cyclone shelter height. It was estimated that surge flood depths may increase significantly due to climate change, especially in coastal areas, leaving first floor of many existing cyclone shelters inundated, and making the first floor unusable in the event of a cyclone (Karim and Mimura, 2008). Policy

maker interview did not reveal occasions where future scenarios have been considered in designing and building cyclone shelters.

The study highlights the drawbacks of existing measures and more importantly how they can be improved. It also has to be noted that many initiatives, including structural measures as well as other measures, were found to be in place to reduce disaster vulnerability in the region. Initiatives where community concerns are addressed or are planned to address were mentioned in discussions with the local policy makers. Where new initiatives are required, these were acknowledged by the local policy makers. As an example for the former, the issue of multi-purpose cyclone shelters can be cited. It was mentioned that cyclone shelters nowadays are made as multipurpose shelters that can be used for community, educational or economic purposes during non-disaster periods. The government also recognises the need for building multi-purpose cyclone shelters and converting the existing shelters (MoFDM, 2010). In this regard, the Government's Disaster Management Bureau (DMB) has proposed to promote multipurpose use of shelters by allowing local NGOs, civil society groups and community access the shelters for public functions like marriage ceremonies, meetings, training sessions and other social functions under the supervision of local shelter management committee (MoFDM, 2010). Yet, the fact that local community leaders specifically mentioning the need for multi-purpose shelters suggest that these proposals are yet to be fully realised and in some instances local residents are yet to visibly benefit from shelters during normal periods.

Cross case discussion

The two CDR case studies highlight some of the multi-stakeholder public – private initiatives for recovery and resilience of communities at risk of flood catastrophes within two completely different contexts. Within CS1 the main emphasis was on how the local council in the Cockermouth area in Cumbria initiated joined up strategies with the business community to recover during the immediate aftermath of a flood and devised strategies to gradually recover during an intensive 12-month period. The temporary shelters in this instance were put up in a way to align with the business needs of the community. The rapid temporary relocation and recovery allowed the business owners and the council to achieve two benefits. The business disruption was significantly minimised as they operated from the temporary relocated area hence loss of customers was minimised. The second benefit was that whilst the businesses were relocated, it allowed the reconstruction activity to take place in full flow. With the initiative of the council a majority of the business owners affected by the flooding, received funding to reconstruct or refurbish their shop fronts. The new look created by these shop fronts brought back the vibrancy of the township fairly rapidly. Even those shop owners who attended to some of the structural defects of their properties benefited from the shop front scheme as they were able to contribute towards the vibrancy of the city that attracted customers to the township.

In CS2, the main emphasis was on community householder recovery in a major flood situation, hence effective early warning systems of cyclones, the management of the complex logistics with regard to temporary shelters were identified by the community as important in the context of Pataukhali. The

community engagement strategy worked towards making the evacuation process more efficient and effective both in the short and the long term. Within the short term the main problem is to have better early warning systems and effective location of the shelters and to manage the transportation of the flood victims. In the long term the multi-stakeholder engagement concentrated on how to optimise the use of shelters. Interesting multi uses were identified for these shelters so that they are not only used during emergencies but their space is optimised throughout the year. This knowledge would benefit their design.

In both case studies the common thread was the basis and the rationale of the multi-stakeholder engagement strategy. In CS1 the local council worked with community funding agencies, emergency planners, the chambers of trade in the area, the environment agency and the whole small business community in the recovery process. In CS2 the immediate recovery was mainly a public activity, however the focus group interviews showed the degree of community consultation with regard to location of shelters and the multiple use of the facilities. It is also usual to see the involvement of several Non Governmental Organisations who provide various practical measures in the recovery process as well as funding various community schemes to flood affected communities.

The above findings are taken forward further within the context of capacity building in the next section.

9. Capacity building for flood resilience

In 1990s, concept of capacity building became an essential component in development theory and practice. Organisations with different perspectives, varying from the World Bank to governments and international donor agencies to local civil societies have appropriated the concept (Pieterse and Donk, 2002). Specifically in developing countries it has been identified as a key concept in achieving sustainability (UNEP 2005, Hartwig *et al*, 2008). Although, there is no agreement as to what is meant by sustainability (Shediac-Rizkallah and Bone, 1998) it has been interpreted as ensuring adoption and maintenance of communities and local organizations to cope future challenges while achieving set objectives (Schwartz *et al*, 1993). Eade (1997) stated that capacity building is a vague concept both in its conceptualisation and in implementation. LaFond *et al* (2002) stated it as an indefinable concept, which can be defined as either process or outcome, dynamic and multidimensional. Goodman *et al* (1998) described capacity as *ability to carry out the stated objectives* whereas capacity building was defined as process or activity that improves the ability (LaFond *et al*, 2002). LaFond *et al*, (2002) further argued that capacity building can be seen in two extremes. In one extreme resides the increase of knowledge and development of skills of individuals through training programs whereas the other, in a broader context integrates wide range of systems such as policy making, management and finance.

UNDP (1997) defines capacity building as a *process by which individual, organizations, institutions and societies develop abilities to perform functions,*

solve problems and set and achieve objectives. Further, various scholars argued that it is not solemnly based on ability but also on one's managerial, physical, human, financial and social assets (Green and Haines 2002; Mathie and Cunningham, 2003, Lowe and Schilderman, 2001). Franks (1999) defines capacity building as the *ability of the individual or group to actually perform the responsibilities depending on the resources available to perform*. UNDP (2008) redefined capacity building in much broader terms as *the creation of an enabling environment with appropriate policy and legal frameworks, institutional development, including community participation, human resources development and strengthening of managerial systems.* It further recognizes capacity building as a *long-term, continuing process, in which all stakeholders need to be participated (Ministries, local authorities, non-governmental organizations, professional associations, academics and others)*. However, Morgan (1998, p6) argued capacity building as a *risky, murky, messy business, with unpredictable and unquantifiable outcomes, uncertain methodologies, contested objectives, many unintended consequences, little credit to its champions and long time lags*.

Importance of capacity building

Research on capacity building is significantly affected by theories relating to organizational change, skakeholder types, knowledge transfer, social action, systems theory, behavioral science, public administration and community engagement and management. psychology (Hentry *et al* 2004), specifically related to human health, ecological systems and socio-economics sectors in developing countries in recent past (UNEP, 2005, Hartwig *et ,al*, 2008). This is mainly due to lack of financial, institutional and technological capacities and access to knowledge to deal with risks and benefits (Ayele and Wield, 2005). Boyd and Juhola, (2009) indicate that capacity building provides an opportunity to understand strengths, weaknesses, threats and opportunities towards a resilient future through identification of broader issues around sustainable development of a particular program, project or process, including their unique cultural, social, and ecological characteristics.

Though capacity building has become popular in recent decades, it was in existence since 1950s. In 1974 it was termed as a "***capacitation***", an effort to measure and promote relief and development programmes by donors (Wolfe, 1996). In 1980's it was termed as "***capabilities approach***" which provides opportunities to improve people's quality of life through access to wide range of capabilities (Sen, 1981). In early, 1990's, capacity building has been termed to focus on issues related to management and administration at governance levels (McGuire *et al*, 1994; Grindle and Hilderbrand, 1995). McGuire *et al* (1994) stated that with the shift of economic growth from national governments to local governments, where demands were placed by communities for new jobs, higher personal incomes and new infrastructure, development capacity at local levels is a prime determinant of economic and government performance. Blunt, (2003) claimed that it enhanced accountability and transparency of various systems which eventually enhance the confidence of public towards governance. More literature revealed capacity building in broader terms of service delivery on organizations and health systems in developing countries (LaFond *et al* 2002; Hartwig *et al*,

2008). In addition, capacity building has become dominant in disaster management, policy and practice in recent decades with increasing impacts of climate change (UNISDR, 2005; Boyd and Juhola, 2009). Specifically, building of local capacities in human skills, technology, data, models and methods to face future disasters in developing countries. Accordingly, literature established that early efforts of capacity building mainly focused on achieving basic institutional activities and improving ability of organizations to handle effectively donor funded projects. However, recent examples bear evidence of broadening scope of capacity building, such as development of policies in various contexts.

In terms of the CS1 and CS2, the following capacity building measures were noted. In CS1, during the immediate aftermath, the emergency planners play a major role in the recovery process. The involvement of the council and the chambers of trade, enabled the emergency planners to conceptualise and link the recovery effort to the business needs. Further capacity building could be enhanced by developing the skills and capabilities of the advisors such as chartered surveyors, loss adjustors and insurance workers on appropriate flood recovery and reconstruction schemes. During the aftermath of the recovery effort the capacity building measures should concentrate on both business recovery as well as effective property reinstatement so that resilience is built up in two fronts. The latter is important in CS2 as well where the community housing and the shelters should consider flood resistance and resilience design to face future flood events. In CS2 this area could be enhanced by improving the capacities and capabilities of the professionals that assist the local government and the community leaders in the case study site.

10. Outcomes in relation to the research findings and the extent to which they link to the UNISDR resilient cities 10 point checklist

UNISDR campaign on "making cities resilient: my city is getting ready"

Due to the emerging need for improving resilience of cities the United Nations International Strategy for Disaster Reduction (UNISDR) launched a new campaign in May 2010 to "Making Cities Resilient – My City is Getting Ready". The vision of this campaign is to achieve resilient and sustainable urban communities and to insist local governments to act effectively in order to reduce the risk of disasters to cities. (Details of this campaign can be found at http://www.unisdr.org/campaign/resilientcities/). This campaign has developed 'ten essentials' for local governments to make their cities more disaster resilient and they are listed below (UNISDR, 2012).

- Essential 1: Institutional and Administrative Framework
- Essential 2: Financing and Resources
- Essential 3: Multi-hazard Risk Assessment- Know your Risk
- Essential 4: Infrastructure Protection, Upgrading and Resilience
- Essential 5: Protect Vital Facilities: Education and Health
- Essential 6: Building Regulations and Land Use Planning
- Essential 7: Training, Education and Public Awareness
- Essential 8: Environmental Protection and Strengthening of Ecosystems

- Essential 9: Effective Preparedness, Early Warning and Response
- Essential 10: Recovery and Rebuilding Communities

Efforts have been taken in this section to explore the links between the findings reported in this paper with the essential criteria as listed above.

Capacity development specifically seeks to address Essential 1, which is related to strengthening the institutional and administrative framework. In making cities resilient to disasters, a holistic approach is required with the participation of all stakeholders such as local government decision makers, city officials and departments, academia, business and citizens groups (UNISDR, 2012). As such, a well structured institutional and administrative framework is a pre-requisite for a sound city's resilience initiatives. In achieving this, it is important to establish or strengthen the city-level institutional and coordination capacity; establish a legislative framework for resilience and disaster risk reduction; coordinate all emergency services within the city; and create alliances and networks beyond the city (UNISDR, 2012). All these require an empowered local government to take up the lead in its city's disaster resilience activities. Therefore this research seeks to address Essential 1 through empowering local governments. In doing so, both the CS1 and CS2 shows the achievement of the following findings, which are then mapped against the UNISDR's 10 point checklist.

Finding 1: ***The core group of the community is considered as the centre of the recovery effort after a flood disaster***. In case of CS1 the business needs were at the forefront of the recovery effort and in CS2 the community householder needs were the primary focus. The critical infrastructure, schools and other community facilities were all centred on the core community group.

Finding 2: ***The mix of the multi-stakeholder group for recovery, reconstruction and resilience efforts after a flood catastrophe should be based on the overarching needs of the specific community group.*** For instance CS1 the local chambers of trade played a major role on behalf of the small businesses and in CS2 the community householder leaders were consulted by the institutions in the multi-stakeholder group, Also some of the foreign NGOs also played a major role in the consultation process.

Finding 3: ***The elements of the funding scheme for recovery after a catastrophic flood event should be effectively and efficiently prioritised based on the specific context.*** In CS1 the main element of the funding was to very quickly relocate the businesses to a new premise and to invest in creating a vibrant township in a way to minimise the loss of customers. In CS2 the funding was mainly to maximise the number of shelters, optimise their use and enhance the capability and capacities of the early warning systems.

Finding 4: ***The initiatives gleaned out from the study emphasised the importance of having a good balance between short term and longer-term measures.*** For instance in CS1 whilst the short term recovery and rehabilitation took place, there was emphasis placed on appropriate property level reinstatement schemes and business continuity measures to enhance longer term resilience against future flood events. In CS2 the multi-stakeholder engagement not only

focused on short-term evacuation but also how in the longer term some of the shelters can have multiple uses.

Finding 5: ***Exploration of the concept of resilience both at strategic and an operational level and identifying players at different levels in the multi–stakeholder teams in employing joined up strategies.*** For instance in CS1 there was consideration of a community flood protection scheme as a first line of defence against major recurring flood events and property level schemes employed at individual property level. CS2 in particular looked at holistic schemes to achieve effective and efficient outcomes within the context of constrained funding schemes available to the multi-stakeholder teams.

The above five findings are mapped against the UNISDR's 10 point checklist as follows in Table 1:

Table 1: Mapping of case study findings against the UNISDR's 10 point checklist

UNISDR Resilient cities 10 point checklist	Finding 1	Finding 2	Finding 3	Finding 4	Finding 5
1 Put in place organization and coordination to understand and reduce disaster risk, based on participation of citizen groups and civil society. Build local alliances. Ensure that all departments understand their role to disaster risk reduction and preparedness.	X	X	X	X	X
2 Assign a budget for disaster risk reduction and provide incentives for homeowners, low-income families, communities, businesses and public sector to invest in reducing the risks they face.	X	X	X	X	X
3 Maintain up-to-date data on hazards and vulnerabilities, prepare risk assessments and use these as the basis for urban development plans and decisions. Ensure that this information and the plans for your city's resilience are readily available to the public and fully discussed with them.			X	X	X
4 Invest in and maintain critical infrastructure that reduces risk, such as flood drainage, adjusted where needed to cope with climate change.	X		X	X	X
5 Assess the safety of all schools and health facilities and upgrade these as necessary.	X	X		X	X
6Apply and enforce realistic, risk compliant building regulations and land use planning principles. Identify safe land for low-income citizens and develop upgrading of informal settlements, wherever feasible				X	X
7 Ensure education programmes and training on disaster risk reduction are in place in schools and local communities	X		X		X

UNISDR Resilient cities 10 point checklist	Finding 1	Finding 2	Finding 3	Finding 4	Finding 5
8 Protect ecosystems and natural buffers to mitigate floods, storm surges and other hazards to which your city may be vulnerable. Adapt to climate change by building on good risk reduction practices.			✕		X
9 Install early warning systems and emergency management capacities in your city and hold regular public preparedness drills.			X	X	X
10 After any disaster, ensure that the needs of the survivors are placed at the centre of reconstruction with support for them and their community organizations to design and help implement responses, including rebuilding homes and livelihoods.	X	X		X	X

As demonstrated in Table 1, above the cross case findings could be mapped against the 10 point checklist under the making cities resilient campaign. To ensure that these are considered strategically within urban development planning, the next section provides how flood resilience can be incorporated in city development plans.

11. Discussion on how to incorporate flood resilience within city development plans

Entry points for Disaster Risk Reduction (DRR) integration

Broad DRR strategies (which incorporates flood resilience) can be categorised in various ways. Integration of DRR philosophies into infrastructure reconstruction projects within urban settings for example can be done at different levels. Starting from the policy and planning strategies, they are extended to physical/technical strategies, emergency preparedness strategies, natural protection strategies and knowledge management strategies. In this context, this section covers the way in which DRR strategies can be integrated into city development plans to reduce v0ulnerability of the communities.

Impact of disasters on urban development

Disasters sometimes put development gains at risk (UNDP, 2004): disasters on their own can set back development. For instance, meeting risk reduction goals are extremely challenging for many communities and countries due to losses from disasters triggered by natural hazards. Such disaster losses may set back social investments aiming to or originally planned for development and service provision, ameliorate poverty and hunger, provide access to education, health services, safe housing, drinking water and sanitation, or to protect the environment as well as economic investments that provide employment and income mainly due to funding redirected to rehabilitation and reconstruction requirements (Bendimerad, 2003; UNDP, 2004). Thus, disasters delay development programmes by reducing available assets and interrupting planning (Bendimerad, 2003). Disasters also

decrease the economic potential of society by exacerbating poverty, disrupting small business and industry activities, and disabling lifelines vital for economic activity and service delivery.

Integration of disaster risk reduction into city development plans

As far as the concept of disaster risk reduction is concerned, it can be more easily promoted after a disaster than before due to many reasons such as new awareness of risk after a disaster that leads to broad consensus, revealing of fault lines in development policies etc. Disasters are opportunities to realise particular areas of vulnerability, such as general level of underdevelopment (Stephenson and DuFrane, 2005). Reconstruction can therefore be used as development opportunity and also as a tool to help reduce these various disaster risks through the particular attention to various vulnerabilities (Shaw, 2006). It can be done through building up infrastructures such as dams which particularly aimed at disaster risk reduction. On the other hand, the concept of disaster risk reduction can be integrated into other common, day-to-day infrastructures such as road systems during their reconstruction process.

There is a wide range of disaster risk reduction strategies which are classified in different ways. As elaborated previously, the concept of disaster risk reduction is not only physical and technical measures but also a wider array of measures involved solving much complex political, social, economic, environmental challenges (Hamilton, 2005). It was further realised that application of this concept into infrastructure reconstruction projects can be done at different levels within the context of infrastructure reconstruction. Accordingly, below is an integrated model details the strategies and their classifications; possible levels/areas to link infrastructure reconstruction with disaster risk reduction are at the national level, intermediate-organisational level, construction consultant/contract organisational level, project level and individual level.

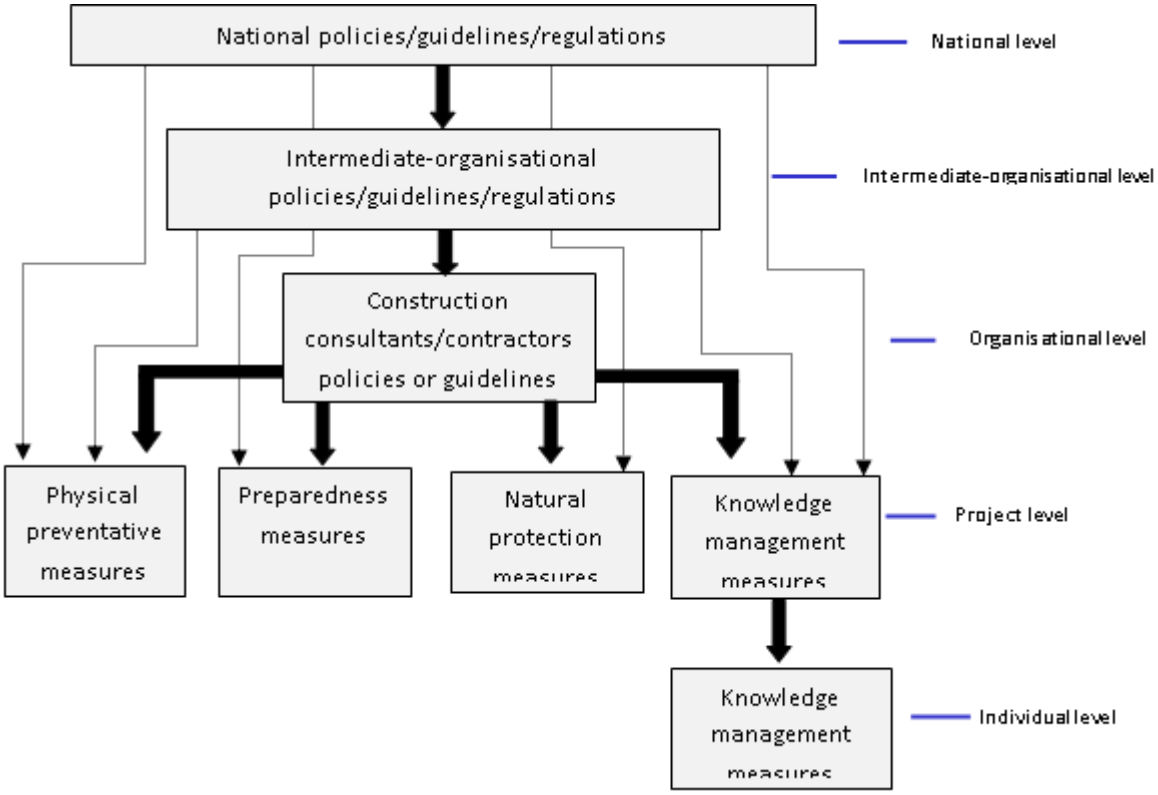

Figure 4 : Modelled classification of disaster risk reduction strategies

According to the above Figure 4, project level disaster risk reduction strategies have been identified as physical/technical measures, emergency preparedness measures, natural protection measures and knowledge management measures.

12. Discussion and Conclusion

In broad terms Cockermouth case study showed how flood resilience could be cotextualised within a small market township in the UK, thus highlighting the importance of how a micro scale experience can contribute to similar townships in the UK and other countries. Energised by the mapping of the UNISDR's 10 point checklist, this paper also showed a small township could achieve its resilience to disasters. In CS2, the paper showed how Patuakhali as a city in Bangladesh can contribute how short and long term measures of flood resilience are incorporated with city development plans. Both case studies demonstrated different multi-stakeholder public-private initiatives.

The Cockermouth flood event in 2009 covered in CS1 has emphasised the devastating impacts of flooding on small businesses. Their reinstatement and recovery experiences suggest some of the positive and negative experiences that at a policy making level can be taken forward. Their positive experience consist of parallel relocation and recovery process led by the local council and the chambers of trade to minimize the disruption to their business operations. The small businesses in Cockermouth also identified lack of skills and knowledge in terms of conducting appropriate resilient reinstatement work, thereby highlighting capacity

building measures to improve their skills and capabilities. The relevant city development plans looking at future flood risk in cities should incorporate some of these views to improve the capacity and capabilities at local levels. The Cockermouth flood event in 2009 has emphasised the devastating impacts of flooding on small businesses. Their reinstatement and recovery experiences suggest the common problems faced by such small businesses. Level of resilient reinstatement undertaken by SMEs shows the need for enhancing their awareness on this aspect.

In CS2 case study, the paper focused on Patuakhali in Bangladesh as an area at risk of a range of natural hazards. Following devastating impacts of such disaster events, disaster risk reduction initiatives in the country have evolved and developed over the years. This paper specifically looked at disaster risk reduction infrastructure in Patuakhali, Bangladesh. Although comprehensive disaster risk reduction initiatives should not be limited to infrastructure alone, and should encompass a broad range of measures as appropriate; representing physical science, engineering, structural, and organisational schools, infrastructure facilities play a significant role in reducing the vulnerability of at-risk communities. This is especially critical in a developing country like Bangladesh; where the ability of communities to implement measures of their own is limited. Whilst the risk reduction strategies in Bangladesh have improved over the years, gaps seem to still exist in providing protection infrastructure to local communities.

Note:

Authors of this report, ***Dr Bingu Ingirige and Professor Dilanthi Amaratunga*** *are from Centre for Disaster Resilience (CDR) at the University of Salford, UK. CDR promotes research and scholarly activity that examines the role of building and construction to anticipate and respond to disasters that damage or destroy the built environment. The Centre has strong links to extensive international networks such as CIB, a world-wide network of over 5000 construction experts, and international organisations such as UN-HABITAT. Salford is thus well placed to lead the transfer of knowledge from project outcomes to the UNISDR and broader international community. Its previous research and industry engagement work in disaster management, disaster risk reduction, developmental activities, alternative dispute resolution, post-conflict reconstruction, gender empowerment, and general construction, will provide the campaign with a strong theoretical and practical knowledgebase. Further details about the Centre and its work are documented at www.disaster-resilience.salford.ac.uk.*

CDR is an academic partner of the Making Cities Resilient campaign and Professor Dilanthi Amaratunga is an Advisory Panel member of the UNISDR Making Cities Resilient campaign. Accordingly, CDR contributes as a main global partner in the campaign, representing academic, technical and expert institutions, and also contributes toward the overall goal - empower local governments with stronger national policies to invest in risk reduction at local level, as part of urban and regional development plans by working with them closely. Below sections illustrate a short biography of the authors:

Dr Bingunath Ingirige

Dr. Bingu Ingirige is a Senior Lecturer at the School of the Built Environment, University of Salford, UK and a member of the Research Centre for Disaster Resilience (CDR) at the University of Salford. His main research interests are in the area of flood adaptation and community resilience against flooding and other weather extremes. He has been the co-investigator of the EPSRC (one of the UK Government's research councils) funded Community Resilience to Extreme Weather (CREW) project, where he led a work package on SME adaptation and coping measures against extreme weather events. As part of the CREW project, his research team conducted surveys, interviews and case studies with small businesses in London on measures of property level protection and business continuity. He was also the principal investigator for the RICS Education trust funded "Developing Flood Expert Knowledge in Chartered Surveyors" (DEFENCES), where he focused on the small market township of Cockermouth in Cumbria in their recovery after the 2009 catastrophic flood event. Dr. Ingirige lectures in the area of construction and project Management at both Undergraduate and postgraduate levels at School of the Built Environment (SOBE), University of Salford. He is a member of the Royal Institution of Chartered Surveyors (MRICS). He is also a Fellow of the Higher Education Academy of UK. He is an active researcher and has published in the areas of knowledge management, project collaboration, Intranets / extranets, SME capacity building, knowledge transfer, post disaster reconstruction and rehabilitation, community

development, disaster management, resilience and adaptive capacities of SMEs. He currently supervises several PhD students in the above areas of research and he serves in the Editorial Board of the International Journal of Disaster Resilience in the Built Environment (IJDRBE) and a regular reviewer of the Journal of Construction Management and Economics, Construction Innovation, International journal of disaster resilience in the built environment and the ITCON journal. Dr. Bingu Ingirige's contact details are: (Email: M.J.B.Ingirige@salford.ac.uk; Web: Http://www.bingu-ingirige.net)

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She has presented widely at international conferences, has led international disaster management workshops and seminars and is working actively with the United Nations. She is an Advisory Panel Member of United Nations International Strategy for Disaster Reduction Campaign on Resilient Cities 2010 - 2015. She has supervised and supported a wide range of Post Graduate Research students. To date she has produced over two hundred publications, refereed papers and reports, and has made a large number of presentations in around 25 countries. Dilanthi is also a Member of the Royal Institution of Chartered Surveyors (RICS) and works actively with UNHABITAT, UNISDR and UNDP. For further details of her profile, please visit: www.dilanthiamaratunga.net.

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