Contact

Principal Investigator
Professor Dilanthi Amaratunga

Global Disaster Resilience Centre
QSBG/22 Queens Street Building
School of Art, Design and Architecture
University of Huddersfield
Queensgate, Huddersfield
HD1 3DH, UK

T: +44 (0) 845 155 6666

E: d.amaratunga@hud.ac.uk

Mainstreaming disaster resilience in the construction process:
Professional education for a disaster resilient built environment

A report of the CADRE project: Collaborative Action towards Disaster Resilience Education

About CADRE

Among many communities in the EU and beyond, disasters pose significant concerns and challenges. The importance of tackling disaster risk is highlighted in all three of the major global agreements that were finalised in 2015: Sendai Framework for Disaster Risk Reduction 2015 - 2030, Climate Change (COP21), and the Sustainable Development Goals.

The Sendai Framework, endorsed by 187 UN states in 2015, recognises that disaster risk reduction practices need to be multi-hazard and multisectoral, inclusive and accessible in order to be efficient and effective.

The construction industry and associated built environment professions are a vital component of this capacity. The scale, size and impact of the built environment cannot be ignored. It generates about 9% of gross domestic product (GDP) in the European Union and provides 18 million direct jobs. As a major consumer of services and intermediate products such as raw materials, chemicals or electrical equipment, construction impacts many other economic sectors.

The vital role of the built environment in serving human endeavours means that when elements of it are damaged or destroyed, the ability of society to function – economically and socially – is severely disrupted. Those responsible for the built environment have a vital role to play in developing societal resilience to disasters.

An EU funded project entitled CADRE (Collaborative Action towards Disaster Resilience Education), which was launched in 2013, set out to identify mechanisms to mainstream disaster resilience in the construction process.

This report examines the past and present impact of disasters and current trends that are driving disaster risk. It considers the vital role of built environment professionals in contributing to the aims of the Sendai Framework for Disaster Risk Reduction 2015-30. In supporting this goal, the report documents some of the key knowledge gaps that must be addressed by education programmes for construction professionals, and sets out a series of recommendations to make this happen.

ISBN 978-1-86218-145-8
9 781862 181458

University of Huddersfield
Inspiring tomorrow's professionals

Lifelong Learning Programme

cadre

Suggested citation

Amaratunga, D., Haigh, R., Malalgoda, C. and Keraminiyage, K. (eds.) (2017) Mainstreaming disaster resilience in the construction process: Professional education for a resilient built environment. A report of the CADRE project: Collaborative Action towards Disaster Resilience Education. Available from: www.disaster-resilience.net/cadre.

ISBN 978-1-86218-145-8

Copyright

Editors

Professor Dilanthi Amaratunga, University of Huddersfield, United Kingdom
Professor Richard Haigh, University of Huddersfield, United Kingdom
Dr Kaushal Kermainiyage, University of Huddersfield, United Kingdom
Dr Chamindi Malalgoda, University of Huddersfield, United Kingdom

Editorial Board

This report is based on input from the partners of the CADRE project, supported under the EU Lifelong Learning programme. CADRE aims to identify mechanisms to mainstream disaster resilience in the construction process, including an innovative professional doctorate programme that addresses the requirements for lifelong learning and actively promotes collaboration between higher education, industry and the community.

About the CADRE project

There are wide-ranging origins and causes to the many disasters that have affected communities across Europe and globally with ever-greater frequency. If construction researchers and practitioners are to be able to contribute to reduce risk through resilient buildings, spaces and places, it is important that capacity is developed for modern design, planning, construction and maintenance that are inclusive, inter-disciplinary, and integrative.

In order to address this challenge, the CADRE project was initiated to mainstream disaster resilience in the construction process through development of an innovative professional doctorate programme that addresses the requirements for lifelong learning and actively promotes collaboration between European HEIs, industry and the community. This novel programme will address the career needs, and upgrade the knowledge and skills, of practising professionals working to make communities more resilient to disasters, and particularly those in, or who aspire to, senior positions within their profession.

Partners:
University of Huddersfield, UK (Lead Institution)
Vilnius Gediminas Technical University, Lithuania
Tallinn University of Technology, Estonia
Northumbria University, UK
United Nations International Strategy for Disaster Reduction, Switzerland
University of Moratuwa, Sri Lanka
Federation of Sri Lankan Local Government Authorities, Sri Lanka

About the EU Lifelong Learning programme

As the flagship European Funding programme in the field of education and training, the Lifelong Learning Programme (LLP) enables individuals at all stages of their lives to pursue stimulating learning opportunities across Europe. It is an umbrella programme integrating various educational and training initiatives. LLP is divided in four sectorial sub programmes and four so called ‘transversal’ programmes.

This report has been produced with the financial assistance of the European Union. The contents are the sole responsibility of the project consortium and can under no circumstances be regarded as reflecting the position of the European Union.

Contents

Executive summary

Introduction

The past decade has seen a concentration of disaster events causing major social, economic and financial impacts. In order to tackle these increasing losses, the Sendai framework for disaster risk reduction 2015–2030, endorsed by 187 UN states in 2015, promotes disaster risk reduction practices that are multi-hazard and multisectoral, inclusive and accessible in order to be efficient and effective. The framework also identifies: "a need for the private sector to work more closely with other stakeholders and to create opportunities for collaboration, and for businesses to integrate disaster risk into their management practices"; and, "a need to promote the incorporation of disaster risk knowledge, including disaster prevention, mitigation, preparedness, response, recovery and rehabilitation, in formal and professional education and training".

This report is an account of a study to identify gaps in the knowledgebase of construction professionals that are undermining their ability to contribute to the development of a more disaster resilient society, and preventing the mainstreaming of disaster resilience within the construction process. This study is part of an EU funded research project that is seeking to develop innovative and timely professional education that will update the knowledge and skills of construction professionals in the industry, and enable them to contribute more effectively to disaster resilience building efforts.

The CADRE research team conducted a detailed study to capture labour market requirements for disaster resilience, and its interface with the construction industry and its professionals. The initial investigation aimed at capturing current and emerging skills for built environment professionals that could contribute to enhancing societal resilience to disasters across the property cycle (strategic definition, preparation and brief, concept design, developed design, technical design, construction, handover and closeout, and in use), the needs of key stakeholders (local and national government, the community, NGOs, INGOs and other international agencies, academia and research organisations, and the private sector) involved in disaster resilience, and management and across five dimensions of resilience (social, economic, institutional, environmental, technological). This analytical framework was developed through an extensive consultation process with project partners. It was refined with the emerging literature findings and with the opinion of stakeholders who were interviewed to capture the labour market demands in construction industry to increase societal resilience to disasters.

Global policy convergence

2015 saw the convergence of three global policy frameworks: the Sendai Framework for Disaster Risk Reduction 2015 - 30 (March 2015), the Sustainable Development Goals (September 2015; SDGs) and the Climate Change Agreement (December 2015: COP21). This represents an opportunity to emphasise cross-cutting themes, including the importance of research and education across the different global policy agendas in disaster risk reduction, sustainable development and climate-change mitigation and adaptation, and in doing so, to support evidence-based decision-making.

The new Sendai framework for disaster risk reduction includes a strong call for the research and education communities to support the understanding of disaster risk and promote risk-informed decisions and risk sensitive planning from the local to the global levels. It also calls for the coordination of existing networks and scientific research institutions at all levels and all regions. The goal is to strengthen the evidence-base in support of the implementation of the new framework.

The economic scale, size and impact of the built environment are significant. It is one of the largest sectors of the economy, comprises many businesses, and is a major employer. As a major consumer of services and intermediate products such as raw materials, chemicals or electrical equipment, construction impacts many other economic sectors.

In recognition of the built environment's importance to a society, there have been growing calls for greater engagement of the construction industry in disaster resilience building efforts. Many studies have indicated a need for greater integration of disaster resilience concepts into the education of construction professionals.

The changing role of the construction sector

Unprecedented urbanisation, changing demographics and changes to our climate are some of the trends that are driving disaster risk and reshaping the world in which we live and work.

In order to address the complex challenges associated with resilience building, the role of the built environment professional will need to change. This signals the importance of a rethink around the types of knowledge that will be needed across the construction and property sector so that it can contribute towards the aims of the Sendai Framework for Disaster Risk Reduction 2015 - 30 and other global agreements on sustainability, climate and development.

The CADRE study identified thirteen key knowledge gaps among construction professionals. These were identified from a detailed study to capture labour market requirements for disaster resilience, and its interface with the construction industry and its professionals.

1. Governance, legal frameworks and compliance
2. Sustainability and resilience
3. Business continuity management
4. Ethics and human rights
5. Disaster response
6. Innovative financing mechanisms
7. Contracts and procurement
8. Resilience technologies, engineering and infrastructure
9. Multi-stakeholder approach, inclusion and empowerment
10. Knowledge management
11. Social and cultural awareness
12. Post disaster project management
13. Multi-hazard risk assessment

The higher education sector will need to play a significant role in addressing these knowledge gaps This includes the design and delivery of educational programmes, and the development and dissemination of new knowledge.

Recommendations

The CADRE study identifies a series of recommendations to key actors in the built environment on how to more effectively mainstream disaster resilience in the construction process.

1. Education

Multi stakeholder approach

Built environment researchers and educators must interact and collaborate with policy-makers and practice based actors at the local, national, regional and global levels. Collectively they must work to identify and address problems and knowledge gaps from the field.

Multi hazard approach

An all-hazard, problem-focused approach should be used in built environment research and education to address the complexity of disaster risk. This will require collaboration and communication across the scientific disciplines.

Address problems from the field

Built environment educators and researchers must recognise the importance of public engagement before, during and after research.

Develop OERs that are freely accessible

Higher education should be supported to develop open educational resources that are freely accessible and openly licensed, for use in teaching, learning, and assessing as well as for research purposes linked to building resilience.

Flexible and customisable educational programmes

There is an expanding field of disaster management, but simultaneously, a lack of young professionals in the built environment with appropriate skills and knowledge to support the building of resilience within relevant stakeholders. There is a need to maintain and expand the network of key persons, including change agents and facilitators.

2. Policy

Development of Sendai "Words into Action"

The prime focus must be that the policy-science gap is closed. Through the UN Words into Action process, one or more implementation guides should be developed on construction policy and practice.

3. Practice

Recognise disaster resilience through accreditation

It is vital that construction and property professional bodies continuously update the accreditation or services needed to identify and verify expertise in weak or emerging new areas of practice highlighted as knowledge gaps in this report. Without this recognition, it is unlikely that construction professionals will value education and training in related skills.

Disaster resilience in professional & ethical standards

Construction and property professional bodies must ensure ethical behaviours are practised across the sectors they represent. This should address all elements of the UN Global Compact, including human rights, labour and the environment, as well as corruption-related issues.

Regulatory frameworks following large scale disasters

Whilst routine and sometimes existing construction processes have often proved adequate for smaller scale disasters, the greater degree of coordination required for programmes of reconstruction following a larger disaster must be addressed through formal regulatory frameworks.

6.4 Cross cutting

Link research, education and practice

There remains a need for construction and property groups in higher education, through researchers and educators, to provide and communicate actionable knowledge with explicit links to inform effective, evidence-based decision-making. As well as creating new knowledge, higher education has a vital to play in capacity development and in doing so, providing a means by which effective knowledge transfer can take place.

Common language

Educators and the research community must take time and effort to understand the audience they are seeking to inform. Scientific results are often subject to misunderstanding due to poor comprehension of numbers and statistics, as well as conflicting languages and terminology. Adding meta-information that explains concepts such as the quality of the evidence may help eliminate frustration and trigger reflection.

6.5 Research

Understand the audience

Greater priority should be put on sharing and disseminating scientific information. The research community must make more effort to translate traditional outputs into practical methods that can readily be integrated into policies, regulations and implementation plans towards building resilience.

Translate traditional outputs into practical methods

Knowledge integration provides a starting point for building and operationalising resilience through the co-design of policies and interventions by scientists, practitioners, policy makers and communities themselves. Standardised definitions are essential to the operationalization of concepts such as resilience for research, monitoring and implementation purposes.

Collaboration across disciplines

There are already a number of regional initiatives that promote collaboration among higher education towards building resilience. These networks should be supported and encouraged to grow. This global network should collaborate with existing bodies such as the UN ISDR Scientific and Technical Advisory Group to ensure that the role of higher education is understood and can be exploited towards achieving the objectives of the Sendai Framework.

Coordination mechanisms for science

Funding bodies for science should coordinate their efforts to ensure that resource are being deployed effectively and efficiently, and to promote collaboration across disciplines, as well as regionally and internationally. This will help to avoid duplication of effort and integrate funding.

An aggregator of knowledge

The volume of built environment research activity and associated outputs has rapidly increased over recent decades, none more so than relating to disaster risk reduction and resilience building. While expanding the knowledgebase may be considered positive in one sense, it has made the field increasingly difficult to navigate. Methods and tools for aggregating knowledge must be developed to facilitate access to science, technology and innovation outputs that help inform policy-making and practice, and also ensure that educational programmes and researchers have access to and can build upon the state of the art.

1. Introduction

In recent years, the European higher education community has played an increasingly important role in moving disaster science from a responsive, primarily technical discipline, to a broad, multi-disciplinary movement that seeks to build societal resilience to disaster. This movement coincides with the increasing global emphasis on the need to tackle the inter-related challenges of disaster risk reduction, sustainable development and climate change.

1.1 Background

The past decade has seen a concentration of disaster events causing major social, economic and financial impacts. Seven of the ten most costly disasters since 1980 have occurred in the last decade (Munich Re, 2015). This increasing trend of disaster losses is due in part to the unprecedented rate of urban growth, increasing dependence on complex infrastructure and changes in climate that are increasing exposure to anthropogenic and natural hazards (IPCC, 2014).

In order to tackle these increasing losses, the Sendai framework for disaster risk reduction 2015–2030 (UNISDR, 2015), endorsed by 187 UN states in 2015, promotes disaster risk reduction practices that are multi-hazard and multisectoral, inclusive and accessible in order to be efficient and effective. The framework also identifies: "a need for the private sector to work more closely with other stakeholders and to create opportunities for collaboration, and for businesses to integrate disaster risk into their management practices"; and, "a need to promote the incorporation of disaster risk knowledge, including disaster prevention, mitigation, preparedness, response, recovery and rehabilitation, in formal and professional education and training".

As a process, building disaster resilience involves supporting the capacity of individuals, communities and states to adapt through assets and resources relevant to their context (Manyena, 2006). There has been growing recognition that the construction industry and associated built environment professions are a vital component of this capacity, which needs to be deployed before and after a hazard visits a community. Effective mitigation and preparedness can greatly reduce the threat posed by hazards of all types. The post-disaster response can impact the loss of life, while timely reconstruction can minimise the broader economic and social damage that may otherwise result.

1.2 CADRE project

This report is an account of a study to identify gaps in the knowledgebase of construction professionals that are undermining their ability to contribute to the development of a more disaster resilient society, and preventing the mainstreaming of disaster resilience within the construction process. This study is part of an EU funded research project that is seeking to develop innovative and timely professional education that will update the knowledge and skills of construction professionals in the industry, and enable them to contribute more effectively to disaster resilience building efforts.

1.3 Role of the construction sector in disaster resilience building

The economic scale, size and impact of the built environment are significant. In the UK, construction is one of the largest sectors of the economy. It contributes almost £90 billion to the UK economy (or 6.7%) in value added, comprises over 280,000 businesses covering some 2.93 million jobs, which is equivalent to about 10% of total UK employment (Department for Business Innovation & Skills, 2013). It generates about 9% of gross domestic product (GDP) in the European Union and provides 18 million direct jobs. The European Union's internal market offers international partners access to more than 500 million people and approximately EUR 13 trillion in GDP (Internal Market, Industry, Entrepreneurship and SMEs Directorate, 2016). As a major consumer of services and intermediate products such as raw materials, chemicals or electrical equipment, construction impacts many other economic sectors.

In recognition of the built environment's importance to a society, there have been growing calls for greater engagement of the construction industry in disaster resilience building efforts. Hecker et al. (2000), Prieto (2002), Godschalk (2003), Liso et al. (2003), Lorch (2005), Aldunate et al. (2006), Haigh et al. (2006), Rees (2009), Haigh and Amaratunga (2010) and Bosher and Dainty (2011) have all indicated a need for greater integration of disaster resilience concepts into the education of construction professionals.

Supporting this view, the Royal Institute of Chartered Surveyors (RICS), called in 2015 for, "a massive rethink around how we build up skills across our sector to meet the challenges we're facing and how we ensure economic viability for land and real estate firms while delivering on social needs and managing finite resources." Similarly, the Institution of Civil Engineers (ICE) have identified a need to make their members aware of their responsibility to help create a sustainable future, as well as providing opportunities to develop their knowledge on the subject, including sustainability as a system and the civil engineers' role in reducing climate change and adapting to its effects. In recent years, several professional bodies in the construction industry have run Continuing Professional Development (CDP) events focused on disaster risk reduction and resilience. For example, the Royal Institute of British Architects (RIBA) recently ran a 'Disaster Day' workshop aimed at developing preparedness and built in resilience approaches for the cities located in disaster prone areas (RIBA, 2016). The potential scope of this contribution to resilience building efforts would appear to be considerable. Witt et al (2014) mapped, "the many and varied disaster resilience roles of construction professionals identified in the literature", to the disaster management cycle. They noted that each of the roles identified also reflected a corresponding need for construction education and research inputs.

1.4 Research methodology

The consequences outlined above serve to underline and support the growing recognition that those responsible for the built environment have a vital role to play in developing societal resilience to disasters. It has also revealed the perceived challenges to deal with in developing a more resilient built environment. There is a dire need for construction industry and its professionals to adopt disaster resilience concepts and practices incorporating the multi-dimensional nature of the problem.

To this effect, the CADRE research team conducted a detailed study to capture labour market requirements for disaster resilience, and its interface with the construction industry and its professionals. The initial investigation aimed at capturing current and emerging skills for built environment professionals that could contribute to enhancing societal resilience to disasters across the property cycle (strategic definition, preparation and brief, concept design, developed design, technical design, construction, handover and closeout, and in use), the needs of key stakeholders (local and national government, the community, NGOs, INGOs and other international agencies, academia and research organisations, and the private sector) involved in disaster resilience, and management and across five dimensions of resilience (social, economic, institutional, environmental, technological). This analytical framework was developed through an extensive consultation process with project partners. It was refined with the emerging literature findings and with the opinion of stakeholders who were interviewed to capture the labour market demands in construction industry to increase societal resilience to disasters.

There is growing recognition that those responsible for the built environment have a vital role to play in developing societal resilience to disasters. If construction researchers and practitioners are to be able to contribute to reduce risk through resilient buildings, spaces and places, it is important that capacity is developed for modern design, planning, construction and maintenance that are inclusive, inter-disciplinary, and integrative. This provided the basis for the identification of this multi dimensional framework combining construction life cycle, key stakeholders and the elements of resilience. This further supports the view that resilience needs to be created and embedded through the products and processes of the built environment. The importance of a community's built environment – the processes and physical products of human creation that enable society to function economically and socially – was examined in the context of broader societal resilience.

The study also considered the relative importance of the end product and the process used to create it. To what extent should those responsible for the planning, design and management of the built environment focus upon the elements of resilience? The starting point is that as society becomes more complex, resilient communities tend to be those which are well coordinated and share common values and beliefs and a sense of interconnectedness.

Further details about the detailed research methodology are provided in Annex B.

1.5 How this report is organised

Section 2 defines the concepts underpinning the CADRE study, including disaster resilience, the built environment, capacity building and how higher education can contribute to the Sendai Framework for Disaster Risk Reduction 2015 - 30.

Section 3 presents the thirteen key knowledge gaps in construction and property that emerged from a detailed study undertaken with key stakeholders of the construction industry.

Section 4 considers some of the ways in which higher education can contribute to capacity building and help address these knowledge gaps.

Section 5 presents an innovative professional doctorate framework (DProf), which allows a wide range of professionals associated with different built environment sectors in disaster resilience and management to negotiate programmes that are applicable to their own circumstances.

Section 6 provides a series of recommendations to key actors in the built environment on how to more effectively mainstream disaster resilience in the construction process.

Annex A recognises the contributions of experts at several stakeholder workshops. These inputs helped to guide development and validation of the project findings.

Annex B provides a more detailed description of the research methodology for this study.

References

Aldunate, R., Ochoa, S., Peña-Mora, F., Nussbaum, M. (2006) Robust Mobile Ad Hoc Space for Collaboration to Support Disaster Relief Efforts Involving Critical Physical Infrastructure. ASCE Journal of Computing in Civil Engineering, January/February 2006, 13-20.

Bosher, L., Dainty, A. (2011) Disaster risk reduction and 'built-in' resilience: towards overarching principles for construction practice. Disasters, 35(1): 1–18.

Department for Business Innovation & Skills (2013) UK Construction: An economic analysis of the sector, July 2013.

Godschalk, G. (2003) Urban Hazard Mitigation: Creating Resilient Cities. ASCE Natural Hazards Review, August 2003, 136-143.

Haigh, R., Amaratunga, D. (2010) An integrative review of the built environment discipline's role in the development of society's resilience to disasters. International Journal of Disaster Resilience in the Built Environment, 1(1), 11-24.

Haigh, R., Amaratunga, D., K. Kerimanginaye, K. (2006) An Exploration of the Construction Industry's Role in Disaster Preparedness, Response and Recovery. The construction and building research conference of the Royal Institution of Chartered Surveyors University College London, 7-8 September 2006. London, United Kingdom.

Hecker, E., Irwin, W., Cottrell, D., Bruzewicz, A. (2000) Strategies for improving response and recovery in the future. ASCE Natural Hazards Review, August 2000, 161-170.

Internal Market, Industry, Entrepreneurship and SMEs Directorate (2016) The European construction sector: a global partner, European Union.

IPCC (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.

Liso, K., Aadahl, G., Eriksen, S., Alfsen, K. (2003) Preparing for climate change impacts in Norway's built environment. Building Research & Information, 31(3-4), 200-209.

Lorch, R. (2005) What lessons must be learned from the tsunami? Building Research & Information, 33(3), 209-211.

Manyena, S. B. (2006) The concept of resilience revisited. Disasters, 30(4), 433-450. DOI: http://dx.doi.org/10.1111/j.0361-3666.2006.00331.x.

Munich Re (2015) Loss Events Worldwide 2014: 10 Costliest Events, Annual Statistics, Geo Risk Research, NatCatSERVICE.

Prieto, R. (2002) The 3Rs: Lessons learned from September 11th. Address to the Royal Academy of Engineering, 28th October 2002.

Rees, W. (2009) The ecological crisis and self-delusion: implications for the building sector. Building Research & Information, 37(3), 300-311.

RICS (2015) Our changing world: let's be ready, RICS.

RIBA, (2016) DISASTER DAY - Creative design workshop for adults. Available: https://www.architecture.com/WhatsOn/March2016/DisasterDay.aspx.

United Nations International Strategy for Disaster Reduction (2015) Sendai framework for disaster risk reduction 2015–2030. Geneva: UNISDR.

Witt, E., Sharma, K. and Lill, I. (2014) Mapping construction industry roles to the disaster management cycle, In the Proceedings of the 4th International Conference on Building Resilience, Building Resilience 2014, 8-10 September 2014, Salford Quays, United Kingdom, Procedia Economics and Finance 18 (2014) 103 – 110.

2. Contributing to the Sendai Framework 2015 - 30

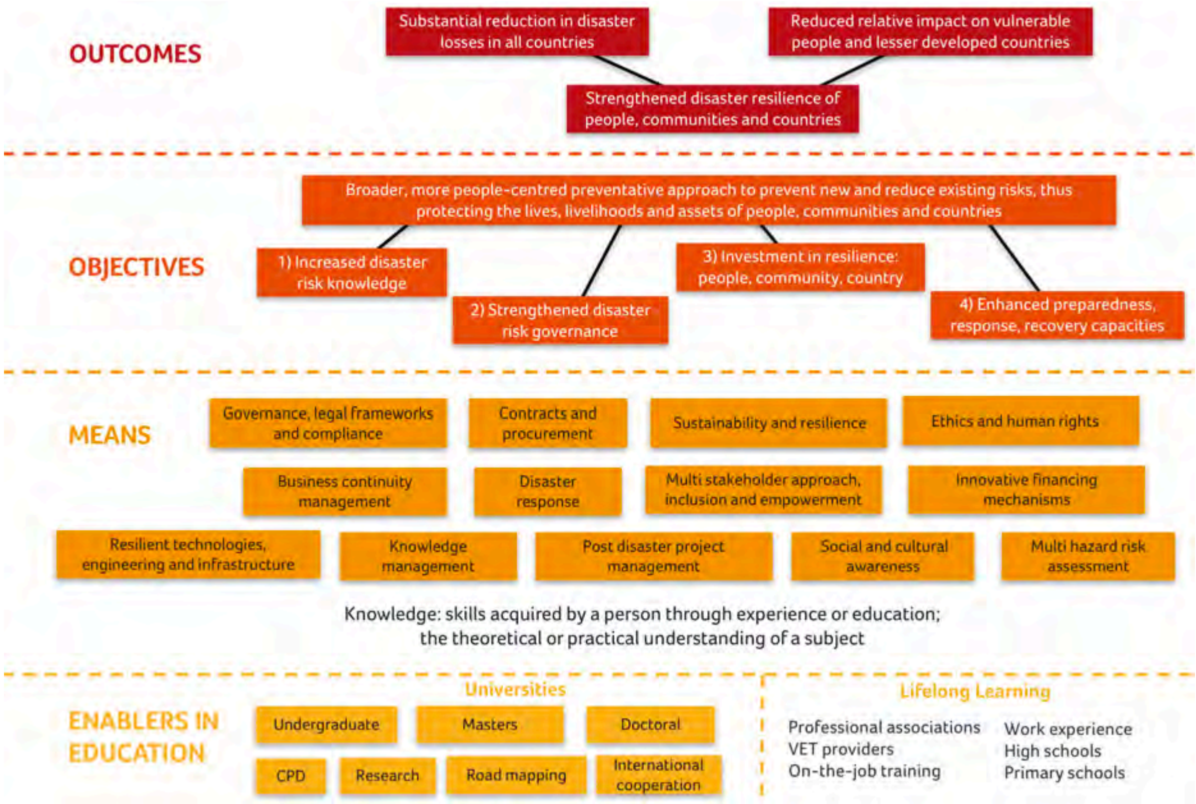

Figure 1: How can built environment professionals contribute to the aims of the Sendai Framework for Disaster Risk Reduction?

2.1 Global policy convergence

2015 saw the convergence of three global policy frameworks: the Sendai Framework for Disaster Risk Reduction 2015 - 30 (March 2015), the Sustainable Development Goals (September 2015; SDGs) and the Climate Change Agreement (December 2015: COP21). This represents an opportunity to emphasise cross-cutting themes, including the importance of research and education across the different global policy agendas in disaster risk reduction, sustainable development and climate-change mitigation and adaptation, and in doing so, to support evidence-based decision-making.

The new Sendai framework for disaster risk reduction includes a strong call for the research and education communities to support the understanding of disaster risk and promote risk-informed decisions and risk sensitive planning from the local to the global levels (see figure 1). It also calls for the coordination of existing networks and scientific research institutions at all levels and all regions. The goal is to strengthen the evidence-base in support of the implementation of the new framework.

Researchers and educators must work with policy-makers and practitioners to co-design and co-produce research that can be used effectively. Higher education must also play a vital role in translating that research into action through its educational programmes.

2.2 Sendai Framework for Disaster Risk Reduction 2015 - 30

The Sendai Framework for Disaster Risk Reduction (2015-2030) is an international document which was adopted by UN member states between 14th and 18th of March 2015 at the World Conference on Disaster Risk Reduction held in Sendai, Japan and endorsed by the UN General Assembly in June 2015. It is the successor agreement to the Hyogo Framework for Action (2005–2015), which had been the most encompassing international accord to date on disaster risk reduction.

The Sendai document emerged from three years' of talks, assisted by the United Nations International Strategy for Disaster Reduction, during which UN member states, NGOs, and other stakeholders made calls for an improved version of the existing Hyogo Framework, with a set of common standards, a comprehensive framework with achievable targets, and a legally-based instrument for disaster risk reduction. Member states also emphasized the need to tackle disaster risk reduction and climate change adaption when setting the Sustainable Development Goals, particularly in light of an insufficient focus on risk reduction and resilience in the original Millennium Development Goals.

Priorities for action

The Sendai Framework sets four specific priorities for action:

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response, and to “Build Back Better” in recovery, rehabilitation and reconstruction

Global targets

To support the assessment of global progress in achieving the outcome and goal of the Sendai Framework, seven global targets have been agreed:

1. Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality between 2020-2030;
2. Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 between 2020-2030 compared to 2005-2015;
3. Reduce direct disaster economic loss in relation to global gross domestic product by 2030;
4. Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030;
5. Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020;
6. Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the framework by 2030;
7. Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

2.3 Disaster resilience

The risks and vulnerabilities exposed by natural hazards and disasters are on the rise globally, and the impacts are severe and widespread: extensive loss of life, particularly among vulnerable members of a community; economic losses, hindering development goals; destruction of the built and natural environment, further increasing vulnerability; and, widespread disruption to local institutions and livelihoods, disempowering the local community. Rising population and infrastructures, particularly in urban areas, has significantly increased disaster risk, amplified the degree of uncertainty, challenged emergency arrangements and raised issues regarding their appropriateness.

What is becoming equally apparent, however, is the importance of resilience - not only in the structures that humans design and build, but in the way society perceives, copes with, and reshapes lives after the worst has happened: to use change to better cope with the unknown. In ancient times, cities like Pompeii were simply abandoned after disaster struck - a move that today seems unthinkable. But learning to bounce back is an emergent behaviour that must be both improvised and adaptive, and our creativity is vital.

Disasters strike most often in poor countries. The losses of life and destruction of the economy, as a percentage of overall growth, are far greater in these more vulnerable regions. It is also true that the three main categories of “natural” disasters - floods, earthquakes and tropical cyclones, which account for 90 per cent of the world’s direct losses - tend to revisit the same geographic zones. As if to complete the vicious natural cycle, these disasters in turn limit the ability of those communities to emerge from the mire of poverty. In 2011 the Eastern Horn of Africa saw the worst regional drought in 60 years, with the lives and future of more than 12.4 million people in Somalia, Ethiopia, Kenya and Djibouti at serious risk. However, the disaster is not only the result of failed rains, but also underlying chronic problems that have increased vulnerability, such as limited water supplies, increased populations, migration patterns and environmental degradation.

But wealthier, well-developed communities are far from immune. In 2005, in New Orleans, it was not Hurricane Katrina that devastated the community, but flooding, caused by the faulty design specifications and substandard construction and maintenance of the levees. The city, federal government later acknowledged, had been badly prepared. Similarly, much of Europe has suffered significant losses. During 2000 - 2008, Europe accounted for 10.62% of lives lost globally due to natural disasters. Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated. Even countries that had previously not been considered at high risk are now needing to re-evaluate and strengthen their disaster prevention strategies and capacities. Earthquakes in Italy and Greece, and extreme floods in the UK, the Czech Republic, France, Germany, and Poland, are recent examples. Floods and storms explain part of the economic losses, as weather related disasters have devastating effects on infrastructures, which have on average, a higher value in Europe than in Asia or Africa. Significantly, the upward trend is expected to continue, as climatic changes are expected to bring more frequent and severe hazards to Europe in the future.

Despite ‘resilience’ having been widely adopted in research, policy and practice to describe the way in which they would like to reduce our society’s susceptibility to the threat posed by such hazards, there is little consensus regarding what resilience is, what it means to society, and perhaps most importantly, how societies might achieve greater resilience in the face of increasing threats from natural and human induced hazards. If the concept of resilience is to be a useful framework of analysis for how society can cope with the threat of natural hazards, it is necessary to understand attributes that enable physical, socio-cultural, politico-economic and natural systems to adapt, by resistance or changing in order to reach and maintain an acceptable level of functioning.

2.4 Built environment

The environments with which people interact most directly are often products of human initiated processes. In the 1980s the term built environment emerged as a way of collectively describing these products and processes of human creation. The built environment is traditionally associated with the fields of architecture, building science and building engineering, construction, landscape, surveying, urbanism. In Higher Education, Griffiths (2003) describes, 'a range of practice-oriented subjects concerned with the design, development and management of buildings, spaces and places'.

The importance of the built environment to the society it serves is best demonstrated by its characteristics, of which Bartuska (2007) identifies four that are inter-related. First, it is extensive and provides the context for all human endeavours. More specifically, it is everything humanly created, modified, or constructed, humanly made, arranged, or maintained. Second, it is the creation of human minds and the result of human purposes; it is intended to serve human needs, wants, and values. Third, much of it is created to help us deal with, and to protect us from, the overall environment, to mediate or change this environment for our comfort and well-being. Last, is that every component of the built environment is defined and shaped by context; each and all of the individual elements contribute either positively or negatively to the overall quality of environments.

Several important consequences for disaster risk can be identified from these characteristics (Haigh and Amaratunga, 2010; Amaratunga and Haigh, 2011). The vital role of the built environment in serving human endeavours means that when elements of it are damaged or destroyed, the ability of society to function – economically and socially – is severely disrupted. Disasters have the ability to severely interrupt economic growth and hinder a person's ability to emerge from poverty. The protective characteristics of the built environment offer an important means by which humanity can reduce the risk posed by hazards, thereby preventing a disaster. Conversely, post-disaster, the loss of critical buildings and infrastructure can greatly increase a community's vulnerability to hazards in the future. Finally, the individual and local nature of the built environment, shaped by context, restricts our ability to apply generic solutions.

The consequences outlined above serve to underline and support the growing recognition that we must develop the capacity of those responsible for the built environment so that they can play a greater role in disaster resilience building efforts.

2.5 Capacity development

The concept of capacity building or capacity development appeared in the late 1980s and became deeply entrenched within the development agenda in the 1990s. Rather than representing a new idea, it reflected growing criticism of many development assistance programmes. In contrast to this extraneous approach, it emphasised the need to build development on indigenous resources, ownership and leadership and by bringing human resources development to the fore.

The concept of capacity development was therefore a move away from 'aid' or 'assistance' towards a 'help yourself' approach that was designed to prevent a dependency on aid emerging.

Capacity development is based on learning and acquisition of skills and resources among individuals and organisations. While this process may rely on some imported resources, external capacity is seen as a knowledge-sharing device, which allows the strengthening and developing of the local capacity. As such, it relates closely to some definitions of resilience, which stress the objective is to build resilience by maximising the capacity to adapt to complex situations, and whereby resilience describes an active process of self-righting, learned resourcefulness and growth.

Capacity development is committed to sustainable development, to a long rather than short term perspective, and attempts to overcome the shortcomings of traditional donor- led projects that have been prevalent in many pre- and post-disaster projects and — typically criticised for being too short-term rather than sustainable, and not always addressing the needs of the recipients. Development within a capacity building context allows communities and countries to identify their own needs, and design and implement the best resilience building strategy within the local context. As a process, it builds on monitoring and evaluation in order to identify existing capacities, deficiencies and the progress and achievements of development towards resilience.

According to capacity development principles ownership of disaster risk reduction and reconstruction projects is transferred from the donor to the recipient community. For this reason, capacity development is not necessarily linked to development aid but can also describe a community or country's effort to meet their resilience building goals regardless of external assistance.

In section 3 of this report, thirteen key knowledge gaps are defined and described. These represent the skills that must developed among built environment professionals so that they are better able to support disaster resilience building efforts within communities. The study used to identify these gaps is described in Annex B.

2.6 Enablers in built environment education

At the individual level, capacity building refers to the acquisition of skills, through formal education or other forms of learning. Although skills and knowledge among built environment professionals can be acquired in various settings, formal education systems play a paramount role in this connection.

At the organisational level, capacity building focuses on infrastructure and institution building, the availability of resources and the efficiency of processes and management to achieve effective and quality results within existing infrastructures. In education, this level signifies the improvement of domestic educational institutions, e.g. universities, through additional resources and a better use of those already available.

At the sector/network level, capacity building seeks to enhance the consistency of sector policies and promote a better co-ordination between organisations. In education, capacity building could for example aim at improving links between vocational and academic educational institutions, between research-intensive and teaching-only institutions or to improve the co-ordination of institutions across different academic fields.

In general, the higher education sector plays a significant role in any capacity development strategy. The ultimate goal of a capacity development strategy is to achieve progress and development. Higher education has a unique privilege as a built-in feature of any capacity development strategy. Whatever the sector, including those engaged with disaster risk reduction and reconstruction, capacity building relies on the strengthening of individual capacity through training and learning, in order to raise the domestic or regional stock of human capital in a specific field. This can be done by setting up specific educational programmes in the formal education system or by other forms of learning. Although some of the necessary skills would typically be acquired on-the-job or through learning-by-doing, countries characterised by less efficient organisations of work or by obsolete technologies might need to rely more on formal vocational education and training. What level of education (primary, secondary or tertiary) is required to achieve this goal depends on the kind of competence to be built. Post-secondary education, including degree-granting tertiary education is vital for developing capacity in building resilience to disasters due to the complexity of the associated challenges.

References

Amaratunga, D. and Haigh, R. eds. (2011) Post-Disaster Reconstruction of the Built Environment: Rebuilding for Resilience, John Wiley & Sons.

Bartuska, T. (2007) The Built Environment: Definition and Scope, in Bartuska T., and Young, G. (Eds) The Built Environment: A Creative Inquiry into Design and Planning, Crisp Publications.

Griffiths, R. (2004) Knowledge production and the research-teaching nexus: the case of the built environment disciplines. Studies in Higher Education, 29(6), 709-726.

Haigh, R. and Amaratunga, D. (2010) An integrative review of the built environment discipline's role in the development of society's resilience to disasters. International Journal of Disaster Resilience in the Built Environment, 1(1), 11-24.

3. The changing role of the built environment professions - emerging knowledge gaps

Unprecedented urbanisation, changing demographics and changes to our climate are some of the trends that are driving disaster risk and reshaping the world in which we live and work.

In order to address the complex challenges associated with resilience building, the role of the built environment professional will need to change. This signals the importance of a rethink around the types of knowledge that will be needed across the construction and property sector so that it can contribute towards the aims of the Sendai Framework for Disaster Risk Reduction 2015 - 30 and other global agreements on sustainability, climate and development.

This section summarises thirteen key knowledge gaps among construction professionals. These were identified from a detailed study to capture labour market requirements for disaster resilience, and its interface with the construction industry and its professionals. The initial investigation aimed at capturing current and emerging skills for built environment professionals that could contribute to enhancing societal resilience to disasters across the property cycle (strategic definition, preparation and brief, concept design, developed design, technical design, construction, handover and closeout, and in use), the needs of key stakeholders (local and national government, the community, NGOs, INGOs and other international agencies, academia and research organisations, and the private sector) involved in disaster resilience and management and across five dimensions of resilience (social, economic, institutional, environmental, technological). This framework was developed through an extensive consultation process with project partners, and was refined with the emerging literature findings and with the opinion of stakeholders who were interviewed to capture the labour market demands in construction industry to increase societal resilience to disasters. A detailed description of this study can be found in Annex B.

The thirteen knowledge gaps are:

1. Governance, legal frameworks and compliance
   Building codes, regulations and planning
   Urban planning and land-use
   Health & safety
   Principles of accountability and transparency
   Inclusive economic planning
   Changing practice and policies

2. Sustainability and resilience
   Environmental impact assessment and management
   Sustainable design principles
   Waste production and pollution of land water and air
   Sustainable retrofitting
   Debris management

3. Business continuity management
   Managing and recovering from the impacts of a business disruption event
   Ensure continuity of critical services
   Stabilise the effects of a disruptive event
   Capitalise on opportunities

4. Ethics and human rights
   Reflecting social demographics
   Social responsibility

5. Disaster response
   Emergency and temporary shelters
   Evacuation
   Damage assessment
   Temporary services

6. Innovative financing mechanisms
   Budgeting and estimating
   Investment appraisals and cost benefit analysis
   Economic loss of disasters
   Affordable and cost effective design and usage
   Claims and insurance
   Public-private partnership (PPP)

7. Contracts and procurement
   Supply chain management
   Dispute resolution
   Community wide engagement

8. Resilience technologies, engineering and infrastructure
   Capacity and adequacy of critical infrastructure
   Strengthen / retrofit the vulnerable infrastructure
   Infrastructure interdependencies
   Clean and environmentally sound technologies and processes
   Automation & standardisation
   Project complexity
   Climate change adaptation technologies

9. Multi-stakeholder approach, inclusion and empowerment
   Team working – collaboration and cross professional working
   Soft skills of communication
   Community empowerment
   Leadership and people management
   Disaster awareness
   Alliances and partnerships
   Interdisciplinary working
   Change management

10. Knowledge management
    Performance metrics
    Big data analytical skills
    Standardisation and integration of data
    Data and information management
    Communication

11. Social and cultural awareness
    Cultural intelligence
    Indigenous knowledge

12. Post disaster project management
    Time management
    Human resource management
    Leadership and people management
    Process and quality management
    Materials and resource management

13. Multi-hazard risk assessment
    Vulnerability, risk and exposure mapping
    Understanding disaster risk

1. Governance, legal frameworks and compliance

Sub-themes: Building codes; regulations and planning; Urban planning and land-use; Health & safety; Principles of accountability and transparency; Inclusive economic planning; Changing practice and policies

Adoption and promotion of robust and sound policies, legislation, coordination mechanisms and regulatory frameworks, and the creation of an enabling environment that is characterised by appropriate decision making processes

Effective governance is a key element of a successful disaster risk reduction initiative. According to WMO (2010) good governance includes "adoption and promotion of robust and sound policies, legislation, coordination mechanisms and regulatory frameworks, and the creation of an enabling environment that is characterised by appropriate decision making processes to allow effective participation of stakeholders, complemented by the appropriate allocation of resources". Furthermore, good governance systems will include, respect for human rights, political openness, tolerance and administrative and bureaucratic capacity and efficiency (Work, 2002).

Disaster risk governance refers to "the way in which the authorities, public servants, media, private sector, and civil society coordinate in communities, and on regional and national levels in order to manage and reduce disaster risks" (UNDP, 2012). Accountability, participation, predictability and transparency are key features of a governance structure that encourages development and supports risk reduction (Ahrens and Rudolph, 2006).

Disaster risk management requires a multi stakeholder approach and therefore there is a need for well defined legal mandates and plans. Legislation is a key for disaster risk management and therefore it is important that laws are made to make risk reduction a national and local priority. This needs to be supplemented by various regulations to encourage and incentivise compliance. Due to its importance, the priority 2 of the Sendai Framework is specifically focused on strengthening disaster risk governance to manage disaster risk (UNISDR, 2015).

The Sendai Framework highlights the importance of compliance with the existing safety-enhancing provisions of sectoral laws and regulations, including those addressing land use and urban planning, building codes, environmental and resource management, and health and safety standards. As such, it is important to develop and enforce resilient building codes, disaster resilient planning, construction and maintenance guidelines, hazard and risk maps, set back zones and urban development plans. All these need to incorporate disaster resilient provisions and it is important that they are enforced by law and compliance with regulations needs to be monitored in all development activities.

If people and assets are to be protected, concepts of disaster resilience must be integrated, or "mainstreamed" into planning and infrastructure, and other social development strategies. Mainstreaming is a governance process that helps ensure that development is protected from the impacts of disasters, and that new development activies does not increase existing and future levels of natural hazard risk. This also emphaises the responsibility of a transparent construction process (Haigh et al, 2016).

References

Ahrens, J. and Rudolph, P.M., (2006) The importance of governance in risk reduction and disaster management. Journal of Contingencies and Crisis Management, Vol. 14 No. 4, pp. 207-220.

Haigh, R., Amaratunga, D & Hettige, S. (2016) Briefing paper on "Ensuring Accountability in Disaster Risk Management and Reconstruction" organized as a part of a global, regional and national partnership by SPARC, University of Colombo-Sri Lanka and Global Disaster Resilience Centre (GDRC), University of Huddersfield-UK, and Essex Accounting Centre, UK.

UNDP (2012) Issue brief: disaster risk governance, New York <http://www.preventionweb.net/files/29974_20121311issuebriefdisasterriskreduc.pdf> [Accessed 22 October 2015].

UN-ISDR (2015) Sendai framework for disaster risk reduction 2015-2030. [online] Available at: <http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf > [Accessed 22 October 2015].

WMO (2010) A framework for disaster risk management derived from HFA. [online] World Metrological Organisation. Available at: <http://www.wmo.int/pages/prog/drr/DrmFramework _en.htm>.

Work, R. (2002) Overview of decentralisation worldwide: a stepping stone to improved governance and human development, Proceedings of 2nd International Conference on Decentralisation – Federalism: the future of decentralising states?. Manila, Philippines, 25-27 July 2002.

2. Sustainability and resilience

Sub-themes: Environmental impact assessment and management; Sustainable design principles; Waste production and pollution of land water and air; Sustainable retrofitting; Debris management

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs

Ten years after the adoption of the Hyogo Framework for Action, disasters continue to undermine efforts to achieve sustainable development, a point highlighted by the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015), while effective disaster risk management contributes to sustainable development. A guiding principle of the Sendai Framework is, 'the development, strengthening and implementation of relevant policies, plans, practices and mechanisms need to aim at coherence, as appropriate, across sustainable development and growth, food security, health and safety, climate change and variability, environmental management and disaster risk reduction agendas'.

Sustainable development is, "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland G et al, 1987). Sustainability is observed in the good practices of Environmental Impact Assessment and other environmental auditing methodologies to, "evaluate likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse" (Convention on Biological Diversity, 2006). Such assessments throughout the construction process would evaluate waste production and debris management and disposal methods in relation to potential contaminant pathways (land, water and air). Disasters in terms of physical damage create enormous amounts of demolition waste through the destruction of buildings and infrastructure, and this is considered to be a grave consequence of disaster. Karunasena et al, (2016) revealed that the lack of a sound legal framework, finance and technology constraints, community unawareness, lack of human resources and physical assets and inadequate capacities of responsible authorities all emerge as key challenges of post disaster construction and demolition waste management.

Resilient design promotes sustainable design principles within the contruction process. It is the intentional design of buildings, landscapes, communities, and regions in order to respond to natural and manmade disasters and disturbances—as well as long-term changes resulting from climate change—including sea level rise, increased frequency of heat waves, and regional drought (Resilience Design Institute, 2016). In general, resilient building design principles are focused towards promoting construction of energy efficient buildings and infrastructure by using durable, long lasting materials to aid buildings in being more adaptable to extreme weather events. there is a need, at each stage of the construction cycle, simultaneously assuring and providing (when possible) innovative improvements, to fulfill minimal environmental impacts (short to long term) and absorptive capacity to disaster impacts.

References

Anderson, M.B. (1995) Vulnerability to disaster and sustainable development: A general framework for assessing vulnerability. In: Munasinghe, M. and Clarke, C. (ed.) Disaster Prevention for Sustainable Development: Economic and Policy Issues, Washington: D.C.: International Decade for Natural Disaster Reduction (IDNDR), pp. 41-59.

Brundtland G et al (1987) Our Common Future: Report of the 1987 World Commission on Environment and Development, Oxford, Oxford University Press.

Convention on Biological Diversity (2006) Global Biodiversity Outlook 2 Secretariat of the Convention on Biological Diversity, Montreal.

Karunasena, G & Amaratunga, D. (2015) Capacity gaps in post disaster construction & demolition waste management, Engineering, Construction and Architectural Management journal, Vol. 22 Iss: 4, pp.446 - 466.

Resilience Design Institute (2016) Defining Resilent Design [online] Available at:http://www.resilientdesign.org/what-is-resilient-design/ [Accessed Janaury 2016].

UN-ISDR (2015) Sendai framework for disaster risk reduction 2015-2030. [online] Available at: <http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf > [Accessed 22 October 2015].

3. Business continuity management

Sub-themes: Managing and recovering from the impacts of a business disruption event; Ensure continuity of critical services; Stabilise the effects of a disruptive event; Capitalise on opportunities

Processes and procedures an organisation must put in place to ensure that mission-critical functions can continue during and after a disaster

Super typhoon Haiyan/Yolanda hit Central Philippines in November 2013 killing 6,300 people, affecting more than 11 million others and causing US$ 10 Billion in estimated losses. "Adopting business continuity plans is not a question of choice but a double imperative as disaster risks are on the increase and seriously threaten business assets and profits", Margareta Wahlström, the UN Secretary-General's Special Representative for Disaster Risk Reduction commented (UNISDR, 2014). Taking the recovery lessons, there are calls for protocols on the promotion of business continuity planning in the management of supply chains, cooperation between private companies and the Government, and the promotion of resilience in critical infrastructure.

Business Continuity Management (BCM) is about identifying those parts of your organisation that you can't afford to lose – such as information, stock, premises, staff – and planning how to maintain these, if an incident occurs. BCM describes the processes and procedures an organisation must put in place to ensure that mission-critical functions can continue during and after a disaster. BCM is also the way an organisation can prepare for and aid in disaster recovery.

Business continuity and disaster recovery are closely related practices that describe an organisation's preparation for unforeseen risks to continued operations. It is an arrangement agreed upon in advance by management and key personnel of the steps that will be taken to help the organisation recover should any type of disaster occur. The trend of combining business continuity and disaster recovery into a single term has resulted from a growing recognition that both business executives and technology executives need to be collaborating closely instead of developing plans in isolation. Elliot et al (2002) discuss that the evolution of BCM has progressed from a focused technical bias to a broader strategic organisational requirement. But, the ultimate goal is to help expedite the recovery of an organisation's critical functions and manpower following these types of disasters. This sort of advanced planning can help an organization minimize the amount of loss and downtime it will sustain while simultaneously creating its best and fastest chance to recover after a disaster.

The need to protect critical infrastructure systems stems from the consequences of a major disruption to society is greater than ever. Their vulnerability is exacerbated by their inherent design complexity and heterogeneity, their interdependency with other critical infrastructure systems, their spatial diversity and an ageing physical component. A science-to-policy approach is necessary to capitalise on the knowledge generated through research and inform policy and strategy decisions regarding BCM. There are several BCM planning methodologies available. Pitt & Goyal (2004) identify that most of these models have the following phases: project initiation; risk assessment/business impact analysis; design and the development of the BCM; creation of the BCM; testing and exercising: and maintenance and sustainability. This will also be linked to consider the following questions: What are your organisation's key products and services?; What are the critical activities and resources required to deliver these?; What are the risks to these critical activities?; and, How will you maintain these critical activities in the event of an incident (loss of access to premises, loss of utilities etc)? Business operations can be significantly affected almost instantly after the impact or they can also be impacted due to a slow recovery cycle of a disaster. It is recognised by policy makers, business leaders and researchers that the process of recovery can be complex, involving several stakeholders. Therefore a focus on effective business continuity planning and awareness of simple tools of recovery and preparedness are important.

References

Elliot, D., Swartz, E. & Herbane, B. (2002) Business continuity management, Routlege, London.

Pitt, M. & Goyal, S. (2004) Business Continuity Planning as a Facilities Management Tool, Facilities. Vol 22. No 3 / 4, pp 87-99.

United Nations Office for Disaster Risk Reduction - Regional Office for Asia and Pacific (UNISDR AP) (2014), Disasters and business continuity in the Philippines, available at (online): https://www.unisdr.org/archive/40331.

4. Ethics and human rights

Sub-themes: Reflecting social demographics; Social responsibility

A human rights-based approach, promoting and protecting all human rights, including the right to development

Ethical principles relate not just to direct local victims, but also to all parties involved in disaster planning, response, and reconstruction, at any time and in any place. An emergency implies rapidity of intervention no matter the origin of the disaster. Human rights cannot be ignored under the deceptive pretext of exceptional circumstances. Prevention aims at risk reduction before a disaster and is adapted to various types of disaster. It implies the usual respect of human rights. The context of the two situations is radically different and so the ethical principles applicable require an assessment adapted to the circumstances.

Within the built environment professions, there can be a confusing proliferation of different pronouncements on ethics. The engineers, architects, surveyors, lawyers and construction managers directing and implementing each stage of the construction process have their own ethical codes. Those working in disaster risk reduction have a social responsibility and should be aware of a human rights-based approach and the legal protection of human rights, including advocacy tools and ways of disaster victims to obtain compensation for disaster losses. The core of professionalism has been described (Greenhalgh, 1997) as 'the possession and autonomous control of a body of specialised knowledge, which when combined with honorific status, confers power upon its holders'. The exercise of this control by the respective professional bodies is often manifested in the promotion and enforcement of global professional and ethical standards.

Disasters affect most severely the vulnerable sector of the population. This is because those that are often subject to discrimination and lack opportunities in a given society will experience similar patterns of exclusion in the event of a natural disaster (Bizzarri, 2009). Furthermore, because of their pre-existent exclusion, it is likely that these individuals already occupy risky areas and live in precarious housing. Groups that are likely to experience the negative impact of natural hazards more severely are women, children, people with disabilities, the elderly, indigenous communities, and minorities (Wisner, 1992). The social demographics of the context needs to be carefully considered.

Human rights are rights inherent to all human beings. All human beings, regardless of nationality, place of residence, sex, national or ethnic origin, color, religion, language, or any other status are endowed with dignity, which is protected through the idea of human rights. As proclaimed by the UN General Assembly in the Universal Declaration of Human Rights adopted on 10 December 1948, this is a common standard of achievement for all peoples and all nations.

The application of the human rights standards can strengthen disaster risk management. The promotion and protection of all human rights, civil and political rights, economic, social and cultural rights, elimination of racial discrimination and discrimination against women, children and persons with disabilities' rights, have a direct bearing on participation, equality, capabilities, vulnerabilities, resilience, possibility of taking risk-informed decision, accountability, and thus on the causes of risk, and disaster risk reduction.

Rights advocates had lobbied for the Sendai Framework for Disaster Risk Reduction to take a strong approach to human rights, which are often violated in disasters. The final text says that managing the risk of disasters is aimed at protecting persons and their property, health, livelihoods and productive assets, as well as cultural and environmental assets, "while promoting and protecting all human rights, including the right to development" (UNISDR, 2015).

References

Bizzarri, M. (2009) 'Protection of Vulnerable Groups in Natural and Man-Made Disasters', in A. de Guttry, M. Gestri and G. Venturini (eds.), International Disaster Response Law 381 (2012), at 386–389; N. Zack, Ethics for Disaster (2009), at 108.

Greenhalgh, B. (1997) Practice Management for Land, Construction and Property Professionals, Chapman and Hall , New York.

UNISDR (United Nations International Strategy for Disaster Reduction) (2015) Sendai framework for disaster risk reduction 2015–2030. http://www.wcdrr.org/preparatory/post2015.

Wisner, B. (1992) 'Marginality and vulnerability: Why the homeless of Tokyo don't "count" in disaster preparations', 18 Applied Geography 25 (1998), at 26; G. Wilches-Chaux, 'The Global Vulnerability' in Y. Aysan and I. Davis (eds.), Disasters and the Small Dwelling: Perspectives for the un idndr 30.

5. Disaster response

Sub-themes: Emergency and temporary shelters; Evacuation; Damage assessment; Temporary services

Rescue from immediate danger and stabilization of the physical and emotional condition of survivors

Disaster response is a broad concept and is usually recognised as the second phase of the disaster management cycle. An effective disaster response strategy not only helps in maximising the number of survivals after a disaster, but it also helps disaster prone communities to improve their resilience by being prepared. Disaster response usually entails activities such as warning and evacuation, search and rescue, immediate and continuing assistance, damage assessment and the immediate restoration of infrastructure. Providing emergency and temporary shelters is a part of disaster response, and coupled with technological innovations such as new light weight construction materials, rapid construction techniques and strategies such as offsite manufacturing, the efficiency of the this provision can be improved.

The primary aims of disaster response are rescue from immediate danger and stabilization of the physical and emotional condition of survivors (IFRCRCS, 2016). Disaster affected groups may sometimes live in temporary shelters for months and in some cases years. This also includes the provison of temporary housing, as a crucial step of the permanent housing development provison. Temporary shelters are an essential element during the aftermath of large scale disasters, which also receives its fair share of criticism, mainly for being unsustainable and being culturally inadequate (Felix et al, 2013). As such, it is an integral part of the disaster response actions to ensure such groups are provided with essential temporary services. These services include sanitation facilities, electricity, water and other utilities. Depending on the size, nature and the expected duration of operation, the complexities and issues related to the provision of these services will differ, creating yet another challenge in disaster response.

The effectiveness of any disaster response attempt will depend on the disaster response capacity of the disaster affected community, and the local and national governments.

The UNISDR (2015) Sendi framework for disaster risk reduction recognises the importance of improving the aspects of disaster response in order to achieve its global targets. Under priority 4 of the Sendai framework, it is noted that countries at the local and national level should focus on: "...training the existing workforce and voluntary workers in disaster response and strengthen technical and logistical capacities to ensure better response in emergencies".

References

Felix, D., Branco, J. & Feio, A. (2013) Temporary Housing after disasers: A state of the art survey. Habitat International 40:136-141.

IFRCRCS (International federation of Red Cross and red Cross Societies) (2016) Responding to Disasters. http://www.ifrc.org/en/what-we-do/disaster-management/responding/.

UNISDR (United Nations International Strategy for Disaster Reduction) (2015) Sendai framework for disaster risk reduction 2015–2030. http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf.

6. Innovative financing mechanisms

Sub-themes: Budgeting and estimating; Investment appraisals and cost benefit analysis; Economic loss of disasters; Affordable and cost effective design and usage; Claims and insurance; Public-private partnership (PPP)

Raise awareness for the economic rationality of disaster risk management, and the design of risk sensitive investment mechanisms and risk financing mechanisms

For the first time in history the world has experienced three consecutive years where annual economic losses have exceeded $100 billion due to an enormous increase in exposure of industrial assets and private property to extreme disaster events: "A review of economic losses caused by major disaster events since 1980 shows that since the mid-90s there has been a rise in economic losses and this has turned into an upward trend as confirmed by the losses from last year when, despite no mega-disaster such as a major urban earthquake, economic losses are conservatively estimated in the region of $138 billion." (UNISDR, 2013). To raise awareness for the economic rationality of disaster risk management, to reach a better understanding of the potential of applying cost-benefit- analysis and to lay the basis for partnerships to improve the methodology and its application has never been important before.

To reduce the impacts of disaster, governments need to invest in DRR. Yet in many developing countries, few preventive measures have been taken by private sector on natural hazards and to adapt to climate change (e.g. setting incentives for climate change adaption construction measures, appropriate management methods, insurance policies, financing mechanisms) (Ingirige et al, 2015). The reason for this includes a lack of institutional mechanism, awareness and information of the risk of damage, little knowledge of the options for adaptation, limited financial resources to implement technical preventive and non-technical adaptive measures, and a lack of advisory and support services from the government. (AMCDRR, 2012).

Public-private partnerships (PPP) are increasingly considered as a viable solution: a contractual partnership between the public and private sector agencies, which is usually targeted towards financing, designing, implementing, and operating infrastructure facilities and services that were traditionally provided by the public sector (Asian Development Bank, 2006). An important benefit of PPP is that the initiative gives value for money to justify collections by government from the taxpayers. This can manifest in the following aspects: better coordination and greater synergy between the phases of design, construction and operation; allows for an innovative design, the application of re- engineering principles and efficient management techniques; it places emphasis on quality of service offered to user; aimed at minimizing total project cost throughout the project life cycle (capital investment + maintenance + operators); and promotes efficient use of capital investment (Singh, 2012).

The World Economic Forum (2010) proposed a new model of PPP (3P) to improve reconstruction practices and overall disaster management performance (Ingirige et al, 2015). In this model, the private sector shifts from any previous 'donor' role to a more active mode of sharing expertise and specialist knowledge and skills. From another angle, the private parties also strengthen relationships and reputations with government and the public, develop their personnel and open up more business opportunities. In disaster management, some reconstruction and rehabilitation projects may may be seen to benefit from both public and private sector inputs in the rebuilding or even in the new development and sustenance of certain types of physical and social infrastructure, for example in utilities such as power, water and communication infrastructure and in health, education and social services (Ingirige et al, 2015). The key questions that governments must tackle would be, "how much money should be allocated to DRR in total?" and "how to decide the most efficient and effective allocation of money between risk reduction and risk financing?". Subsequently, more specific issues need to be examined: the design of risk sensitive investment mechanisms and risk financing mechanisms (i.e. appropriate combination of contingency funds, insurance and other tools). Both macro-economic modelling and cost benefit analysis supports these analysis.

References

AMCDRR (2012) Yogyakarta Declaration on Disaster Risk Reduction in Asia and the Pacific 2012. 5th Asian Ministerial Conference on Disaster Risk Reduction. Yogyakarta, Republic of Indonesia, 22-25 October 2012. Available at : http://www.preventionweb.net/english/professional/policies/v.php?id=29332 [Accessed on 14 April 2016].

Asian Development Bank (2006) Public-Private Partnership Handbook. Available at: http://www.apec.org.au/docs/ADB%20Public%20Private%20Partnership%20Handbook.pdf. [Accessed on 14 April 2016].

Ingirige, B., Amaratunga, D., Kumaraswamy, M., Liyanage, C., Perwaiz, A., Towashiraporn, P. & Wedawatte, G. (2015) Private Investment and Disaster Risk Management, GAR 2015 Background paper.

Singh K. (2012) Public-Private Partnership: advantages and disadvantages. Project Vendor: A Construction & Engineering Magazine for Projects. Available at: http://www.projectvendor.com/ArticleDetailsByCategory.aspx?aid=795. [Accessed on18 October 2016]

United Nations Office for Disaster Risk Reduction (UNISDR) (2013) http://www.unisdr.org/archive/31685

UNISDR (2015) Economic Aspects of DRR, Issue Brief.

7. Contracts and procurement

Sub-themes: Supply chain management; Dispute resolution; Community wide engagement

Securing goods, services and works that best meet the needs of users

In its simplest form, procurement is concerned with securing goods, services and works that best meet the needs of users. This process may starts with the identification of needs and goes through to the end of a service or the end of the useful life of an asset and its disposal (GOSS, 2015).

Due to its highly complex and uncertain nature, appropriate and timely procurement of goods and services is vital within a post disaster context, particularly at the stage of immediate relief. Falasca & Zobel (2011) claim that within disaster relief logistics, procurement accounts for 65 % of total expenditure. However, the ordinary procurement strategies adopted under normal circumstances may not be applicable within a disaster context, as such circumstances often demand flexible but efficient supply chains, which makes special demands on procurement operations. As Zobel (2010) notes, managing the supply chain arrangements appropriately is vital in effective managing disasters and frequently used in disaster relief efforts.

Contracts management is an integral part of a procurement strategy. It concerned with the continuous review and management of the contractual terms and / or service level agreement secured through the procurement process to ensure the outcomes agreed are actually delivered by suppliers or partners (GOSS, 2015). Moreover, well formulated contract encapsulated by a well designed procurement strategy often provide a sound mechanism for dispute resolution.

The term "Procurement Systems" has a specific definition within the construction sector. As McDermott and Jagger (1996) states that procurement system is the framework within which construction is brought about, acquired or obtained. This area is well researched and there are well established procurement strategies (both traditional and contemporary) within the construction sector. However, during a disaster reconstruction, it is unlikely that these normal procurement mechanisms will deliver the best outcome. Following a disaster, one of the requirements for reconstruction in the establishment of a comprehensive procurement framework for reconstruction. Without this, reconstruction and new development will be carried out on an ad-hoc basis with little regard for the needs of the society needing reconstruction (Masurier et al, 2006).

One of the key factors to consider is the development of a fast and efficient contractual framework, or procurement system, for rebuilding following a disaster event (Zuo, 2010). Disaster reconstruction management requires a different response to ordinary construction to ensure effective collaboration between various stakeholders such as suppliers, end users and the local / national governments. This is often energized by community wide engagement initiatives such as owner driven approach to post disaster housing reconstruction. The Senadi framework for disaster risk reduction also highlights the importance of this coordination and collaboration as one of the guiding principles to reduce the disaster risk globally. Hence this warrants a different approach to construction procurement.

References

Falasca, M. & Zobel, C. W. (2011) A two-stage procurement model for humanitarian relief supply chains. Journal of Humanitarian Logistics and Supply Chain Management, 1 (2), 151-169.

GOSS (Go shared services) (2015) Procurement and contract management strategy. http://www.cotswold.gov.uk/media/1320639/GOSS_procurement-and-contract-management-strategy_2015-v2-0.pdf

Masurier, J., Wilkinson, S. & Shestakova, Y. (2006) An analysis of the alliancing procurement method for reconstruction following an earthquake. In the Proceedings of the Conference on Earthquake Engineering April 18-22, 2006, San Francisco, California.

McDermott, P., and Jaggar, D. (1996) "A strategic exploration of procurement: Seven years of CIB working commission W92 procurement systems." Shaping Theory and Practice: Managing the Construction Enterprise, Proc., of CIB W65 Symp., D. A. Langford and A. Retik, eds., Univ. of Strathclyde, Glasgow.

Zobel, C (2010) Improving supply chain management for disaster relief http://www.magazine.pamplin.vt.edu/fall10/supplychain.html

Zuo, K. X. (2010) Procurement and contractual arrangements for post-disaster reconstruction. University of Auckland.

8. Resilience technologies, engineering and infrastructure

Sub-themes: Capacity and adequacy of critical infrastructure; Strengthen / retrofit vulnerable infrastructure; Infrastructure interdependencies; Clean and environmentally sound technologies and processes; Automation & standardisation; Project complexity; Climate change adaptation technologies

Reducing disaster damage to critical infrastructure and disruption of basic services

In today's modern era, technology is playing a vital role in reducing risk and enhancing policy-makers abilities to manage natural and man-made disasters. The basic dictionary definition of the term "technology" represents a capability given by the practical application of knowledge. Within this context, resilience technologies can be defined as processes, techniques, equipment or tools, which can be used to increase the disaster resilience of a system, community or society. Modern advancements and innovations in engineering facilitate the creation of resilience technologies. Clean and environmentally sound technologies and processes can help to minimise future disasters and climate change. In a similar vein, climate change adaptation technologies can play a major role in making communities adaptable and more resilient to the climate change.

Recognising its importance in improving societal resilience to disasters, experts have recently started to address the need for physical infrastructure systems (road networks, communication system, dams, flood retention systems) and also social infrastructure (schools, libraries, etc.) that are resilient to disasters. Capacity and adequacy of critical infrastructures has a significant bearing over the disaster resilience of a community. Kong et al (2013) identifed key port infrastructure elements affected by climate change, to understand the deterioration mechanisms relevant to these structural components, and forecast the rate of deterioration of structures over a period for which climate scientists could provide the necessary projections.

During a disaster event often this adequacy and capacity are reduced (due to damages to the infrastructure), hence strengthening such vulnerable infrastructure is important in order to enhance the resilience of disaster prone communities. For example, consequence assessment of disasters on road structures provides valuable information for decision makers to measure the potential risk on structures and to identify and implement appropriate strategies and programs to sustain the infrastructure (Gajanayake et al, 2016).

When developing new infrastructure, resilience technologies can be used to ensure its ability to withstand future disasters, and retrofitting can be used as a technique to strengthen existing vulnerable infrastructure. As Bruneau et al (2003) highlight, resilience of these infrastructures entails three interrelated dimensions: lower probabilities of failure; less-severe negative consequences when failures do occur; and faster recovery from failures. However, due to rapid advancements in user needs, the scale and frequency of disasters, and the complex nature of interdependencies between infrastructures, more research needs to be carried out to ensure the resilience of these infrastructures.

Owing to its significance, the UNISDR (2015) Sendi framework for disaster risk reduction seeks to: "Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030".

References

Bruneau, M., S.E. Chang, R.T. Eguchi, G.C. Lee, T.D. O'Rourke, A.M. Reinhorn, M. Shinozuka, K. Tierney, W.A. Wallace, and D. von Winterfeldt. 2003. A framework to quantitatively assess and enhance the seismic resilience of communities. Earthquake Spectra 19(4): 733–752.

Gajanayake, A.,Setunge, S.,Zhang, K.,Mohseni, H. (2016). Measuring social, environmental and economic impacts of road structure failure In: Proceedings of the 6th International Conference on Building Resilience, Auckland, New Zealand, 7-9 September 2016.

Kong, D, Setunge, S, Molyneaux, T, Zhang, G, Law, D. (2013). Structural resilience of core port infrastructure in a changing climate, Enhancing the resilience of seaports to a changing climate report series, National Climate Change Adaptation Research Facility, Gold Coast.

UNISDR (United Nations International Strategy for Disaster Reduction) (2015a) Sendai framework for disaster risk reduction 2015–2030. http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf.

9. Multi-stakeholder approach, inclusion and empowerment

Sub-themes: Team working – collaboration and cross professional working; Soft skills of communication; Community empowerment; Leadership and people management; Disaster awareness; Alliances and partnerships; Interdisciplinary working; Change management

Empowerment, inclusion and active participation of common stakeholders intending to search for solutions to a common problem

Most building and infrastructure reconstruction projects after a disaster will have a large number of stakeholders. This is because, as Bhatt (2003) notes, every disaster has to deal with two sets of stakeholders: one that is active in the area before the disaster (normal development); and, one that becomes prominent after the disaster (response actors), at which time actors usually interact, collide or connect, spending much of their resource managing interpersonal relationships. The reconstruction process gives birth to groups of stakeholders with differing degrees of power, legitimacy and proximity to any resultant projects (Siriwardena and Haigh, 2011).

Similarly, many actors in disaster risk reduction are calling for more innovative and integrated governance approaches in dealing with complex problems posed by disasters (Renn, 2008; IGRP, 2010). One such innovation for more flexible and participatory methods of governance is through multi-stakeholder approach such as the multi-stakeholder platform (MSP), defined by Steins and Edwards (1999, p. 244) as:

"Decision making bodies (voluntary or statutory) comprising different stakeholders who perceive the same re- source management problem, realise their interdependence for solving it, and come together to agree on action strategies for solving the problem."

The objective of an MSP is mainly to create a space for the empowerment, inclusion and active participation of common stakeholders intending to search for solutions to a common problem (Faysse, 2006). In a similar vein, the Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR, 2015) promotes a whole-community approach that requires full participation of persons with disabilities, women, children, older people and their representative organisations in preparedness activities and programs at all levels. This also ensures a rights-based approach that meets the equal access and functional needs of all individuals.

The United Nations International Strategy for Disaster Reduction (UNISDR) proposes the MSP as a mechanism that serves as an advocate for DRR towards coordination, analysis and advice on areas of priority needing concerted action (UNISDR, 2007). Recent global reviews on the progress in DRR, such as the Mid-Term Review of the HFA and the 2011 Global Assessment Report, stated that MSPs play important roles in integrating DRR into sustainable development policies and supporting less developed countries in implementing the HFA (UNISDR, 2011).

There are three key elements of MSPs: "multi", "stakeholder" and "platform" (Warner, 2006). "Multi" refers to the diversity of stakeholders. "Stakeholders" are individuals, groups or organisations that have stakes or interests, directly or indirectly, in the resources or problems at hand. "Platform" means "dialogues, fora, partnerships and learning alliances".

Such an approach requires a range of skills such as effective team working, collaboration and cross professional working, soft skills of communication, leadership and people management. An understanding of related approaches such as interdisciplinary working, community empowerment, disaster awareness, alliances and partnerships, and change management are also important.

References

Bhatt, M. (2003) Increasing Accountability through External Stakeholder Engagement:The Experience of the Disaster Mitigation Institute (DMI), One World Trust Workshop on "Increasing Accountability through External Stakeholder Engagement" 23-24 October 2003, London, UK.

Faysse, N. (2006) Troubles on the way: An analysis of the challenges faced by multi-stakeholder platforms, Natural Resources Forum, 30, 219–229, doi:10.1111/j.1477-8947.2006.00112.x, 2006.

IGRP (2010) Integrated Risk Governance Project, http://www.irg-project. org/.

Renn, O. (2008) Risk Governance: Coping with Uncertainty in a Complex World, Earthscan, London, UK.

Siriwardena, N. & Haigh, R. (2011) Stakeholder consultation in the reconstruction process. In: D. Amaratunga & R. Haigh (eds.). Post-Disaster Reconstruction of the Built Environment: Rebuilding for Resilience. Chichester: Wiley-Blackwell, pp. 117-132.

Steins, N. A. and Edwards, V. M. (1999) Platforms for collective action in multiple-use common-pool resources, Agriculture and Human Values, 16, 241–255, doi:10.1023/a:1007591401621.

UNISDR (2007) Guidelines: national platform for disaster risk reduction, United Nations, Geneva, http://www.unisdr.org/files/601engguidelinesnpdrr.pdf.

UNISDR (2011) Global Assessment Report on Disaster Risk Reduction: Revealing Risk, Redefining Development, United Nations, Geneva, http://www.preventionweb.net/english/hyogo/gar/ 2011/en/bgdocs/GAR-2011/GAR2011 Report FrontCover.pdf.

UNISDR (United Nations International Strategy for Disaster Reduction) (2015) Sendai framework for disaster risk reduction 2015–2030. http://www.wcdrr.org/preparatory/post2015.

Warner, J. F. (2006) More Sustainable Participation? Multi-Stakeholder Platforms for Integrated Catchment Management, International J. Water Resource Development, 22, 15–35, doi:10.1080/07900620500404992.

World Bank (2007) Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets, International Finance Corporation: The World Bank Group, Washington.

10. Knowledge management

Sub-themes: Performance metrics; Big data analytical skills; Standardisation and integration of data; Data and information management; Communication

Capturing, developing, sharing, and effectively using organisational knowledge based on the open exchange and dissemination of disaggregated data

Disaster risk reduction policy and practice require knowledge for informed decision making and coordinated action. Knowledge is created by accumulating and organising information with respect to breadth, depth, and amount. Facts, data, and information are necessary mediums for eliciting and constructing knowledge. According to Davenport and Prusak (1998, p. 5), knowledge is ''a fluid mix of framed experience, contextual information, values and expert insight that provides a framework for evaluating and incorporating new experiences and information''.

Weichselgartner and Obersteiner (2002) found that despite an immense expansion of risk-related knowledge systems – special research programs and institutes, specialised journals, advanced technology, increased financial resources, and so on – insufficient progress has been made in converting research findings into concrete applications in practical DRR management. This has raised questions about potential barriers in the science–policy–practice interface that hinder the effective use of existing knowledge.

As an example, Pathirage (2011) notes that the reconstruction of buildings and infastructure after a disaster, as a major driver for change and with the support of large investment, represents a significant opportunity for improved resilience. The techniques learned and the expertise developed could be applicable elsewhere in the country, within the region or across the world.

Knowledge management is the process of capturing, developing, sharing, and effectively using organisational knowledge. It refers to a multi-disciplinary approach to achieving organisational objectives by making the best use of knowledge. Studies suggest that there is very little reassessment and evaluation of collected and used data and information for disaster risk reduction. (López-Peláez and Pigeon 2011). This includes the processes of generating, acquiring, and sharing knowledge, as well as incorporating the newly acquired knowledge into future activities.

The Sendai framework for disaster risk reduction takes into account that informed decision making and coordinated action require reliable knowledge. The Sendai framework's implementation is guided by several principles, and Paragraph 19 directly refers to knowledge: ''Disaster risk reduction requires a multi-hazard approach and inclusive risk-informed decision-making based on the open exchange and dissemination of disaggregated data, including by sex, age and disability, as well as on the easily accessible, up-to-date, comprehensible, science-based, non-sensitive risk information, complemented by traditional knowledge'' (UNISDR 2015, p. 9).

The development of more effective knowledge management in risk reduction will require a range of technologies, approaches and skills including more effective data and information management, improved communication, big data analytical skills, better standardisation and integration of data, and more reliable performance metrics. In supporting disaster risk reduction, the management of large volumes of data is perhaps one of the biggest challenges to be addressed by computer science. The wide variety of data acquisition sources available in times of crisis and disaster creates a need for data integration, aggregation and visualisation. Such techniques assist disaster management officials to optimise the decision-making procedure, while pre disaster they can inform risk reduction measures. The quality of these decisions depends on the quality of the information available.

References

Davenport, T. (1994). "Saving IT's Soul: Human Centered Information Management". Harvard Business Review 72 (2): 119–131.

Davenport, T. and Prusak, L. (1998) Working knowledge. Boston: Harvard Business School Press.

López-Peláez, J. and Pigeon, P. (2011) Co-evolution between structural mitigation measures and urbanization in France and Colombia: A comparative analysis of disaster risk management policies based on disaster database. Habitat International 35(4): 573–581.

Mansourian, A., Rajabifard, A., Valadan Zoej, M. J., & Williamson, I. (2005) Using SDI and web-based system to facilitate disaster management. Computers & Geoscience, 32, 303- 315.

Pathirage, C. (2011) Knowledge Management Practices and Systems Integration. In: D. Amaratunga & R. Haigh (eds.). Post-Disaster Reconstruction of the Built Environment: Rebuilding for Resilience. Chichester: Wiley-Blackwell, pp. 117-132.

UNISDR (United Nations International Strategy for Disaster Reduction) (2015) Sendai framework for disaster risk reduction 2015–2030. http://www.wcdrr.org/preparatory/post2015.

Weichselgartner, J. and Obersteiner, M. (2002) Knowing sufficient and applying more: Challenges in hazards management. Global Environmental Change Part B: Environmental Hazards 4(2–3): 73–77.

11. Social and cultural awareness

Sub-themes: Cultural intelligence; Indigenous knowledge

Tailoring disaster risk management to the needs of users, including social and cultural requirements

Disasters have a significant impact on poor and developing countries. They have long term impacts on social and economic systems due to the destruction of infrastructure and displacement of populations. The vulnerabilities that already existed in the communities will determine the severity of impact from disasters (McDermott et al., 2014). Reconstruction is not merely reviving back to pre-disaster condition, but also addressing the existing vulnerabilities and empowering the communities to face future disasters. This is widely known as "build back better" (Jordan et al., 2015).

Social and cultural awareness is very important in disaster risk management. Responsiveness to culture allows us to better understand the community needs and promote a culture of prevention with a strong community involvement. According to Indart (2011), lack of social and cultural awareness will lead to disconnection, disillusionment, distress and dysfunction. Therefore it is very important that cultural matters are considered in all disaster risk management endeavours. In supporting this, Sendai framework highlights the importance of developing disaster risk management processes through participatory process and emphasises the importance of tailoring them to the needs of users, including social and cultural requirements (UNISDR, 2015).

Disasters resulting from natural hazards often strike in areas that are subject to other disasters of other types, such as conflict, which have exposed greater vulnerabilities. For example in Sri Lanka, prior to the end of the war but in the aftermath of the tsunami, Rajasingham-Senanayake (2005) describes a process of recovery with a broader approach of involving communities to build their capabilities to deal with post crisis situation. The conflict context is different from the intervention in non-conflict contexts. Haigh et al (2016) caution that if the reconstruction process is insensitive to social, political and cultural dimensions, the society may be drawn back to conflicts, sometimes after decades.

According to Hewitt (2009), "peoples' concerns and actions or inaction, and the extent and value of local knowledge, are linked to culture". Indigenous knowledge is another important aspect when it comes to risk reduction and resilience. According to Ireni-Saban (2012) local knowledge places a greater importance, including understanding communities at risk, including their practices, traditions, customs and beliefs. Understanding the indigenous knowledge, such as local skills and materials, and how it can be successfully used, will determine a community's success in coping with disasters over time (UNISDR, 2008) . However, according to Gaillard and Mercer (2012), there is a gap in integrating local and scientific knowledge because of the lack of trust between stakeholders operating at different levels. As a result, contributions of local communities are often disregarded, which leads to gaps between policy development at the national level and the practice at the local level.

References

Gaillard, J.C and Mercer, J. (2012), "From knowledge to action: Bridging gaps in disaster risk reduction", Progress in Human Geography 1-22.

Haigh, R., Hettige, S., Sakalasuriya, M., Vickneswaran, G. and Weerasena, N. (2016) Post-disaster housing reconstruction in conflict affected Sri Lanka. Disaster Prevention and Management, 25 (5).

Hewitt, K. (2009), Culture and Risk, Kathmandu: ICIMOD, available at http://www.preventionweb.net/files/11039_icimodculture1.pdf

Jordan, E., Javernick-Will, A., and Amadei, B. (2015) Post-disaster reconstruction: lessons from Nagapattinam district, India, Development in Practice, Vol. 25 No. 4, pp. 518-534.

Indart, M. (2011), Applying Cultural Awareness to Disaster Behavioural Health, available at http://www.samhsa.gov/sites/default/files/cultural-awareness-dbh-presentation.pdf

Ireni-Saban, L. (2012), "Challenging disaster administration: towards community-based disaster resilience." Administration & Society 45(6): 651-673.

McDermott, T. K. J., Barry, F. and Tol, R. S. J. (2014) Disasters and development: Natural disasters, credit constraints, and economic growth, Oxford Economic Papers, Vol. 66 No. 3, pp. 750-773.

Rajasingham-Senanayake, D. (2005) Sri Lanka and the violence of reconstruction. Development, Vol. 48 No. 3, pp. 111-120.

UNISDR (2008), Ingenious knowledge for disaster risk reduction: Good practices and lessons learned from Experience in the Asia Pacific Region, Bangkok, UNISDR.

UNISDR (2015), Sendai Framework for Disaster Risk Reduction 2015 – 2030, Geneva, Switzerland: UNISDR.

12. Post disaster project management

Sub-themes: Time management; Human resource management; Leadership and people management; Process and quality management; Materials and resource management

'Build back better' through integrating disaster risk reduction measures

Post disaster project management is a complex process, which requires careful planning, monitoring and coordination. It is not about restoring buildings and infrastructure as they were before (Lindell, 2010). Restoring communities back to its original condition will reproduce the previous hazards and vulnerabilities and therefore it is important to adopt the principles of 'build back better' and to rebuild as safely and sustainably as possible.

The Sendai framework re-emphasised the importance of 'build back better' through integrating DRR measures and this has been identified as a priority for action in the framework (UNISDR, 2015a). 'Speed' remains one of the key measures of success in any reconstruction project, which are subject to very compressed time frames (Norling, 2013). Reconstruction must begin as soon as possible and it is important that these operational mechanisms are established prior to disasters, including pre-assigning resources before the disaster (UNISDR, 2015b). To provide a timely restoration to the affected population, effective approaches in terms of design, technology, materials and construction methods need to be adopted (Thayaparan et al, 2015). Similarly, due to limitations of funding, low cost solutions are often encouraged with the use of local materials and labour. In addition, the involvement of multi national donor agencies makes the funding arrangements more complex and due to the involvement of many stakeholders, well-coordinated approaches are of paramount importance.

Community based, participatory approaches are highly regarded in providing locally acceptable solutions in post disaster scenarios (Ophiyandri et al, 2010). The Sendai framework highlights the importance of promoting gender-equitable and universally accessible approaches during the reconstruction phases (UNISDR, 2015a). All these make post disaster project management more complex than traditional project management and it is therefore important that these complex tasks are well planned and managed.

Post disaster projects often face many issues, some of which include delay, resourcing, community participation, poorly funded reconstruction, preliminary assessment, lack of coordination, corruption, build back better, policies, quality of works, land issues, cost overruns and a shortage of technical staff (Ismail et al., 2014). All these adversely affect the post disaster reconstruction efforts and better planning and management is needed to overcome these challenges. Out of these issues, resourcing is a key challenge for post disaster project management and successful resourcing depends on multi stakeholder collaboration, market flexibility, donor management and government intervention (Chang et al, 2010).

References

Chang, Y, Wilkinson, S, Potangaroa, R and Seville, E (2010) Resourcing challenges for post disaster housing reconstruction: a comparative analysis, Building research and information 38 (3): 247-264.

Ismail, D, Majid, TA, Roosli, R and Samah, NA (2014) Project Management Success for Post-disaster Reconstruction Projects: International NGOs Perspectives, Procedia Economics and Finance, 18: (120-127)

Lindell, MK (2010) Recovery and reconstruction after disaster, in Encyclopedia of natural hazards, Bobrowsky, PT (Ed). 812-824.

Norling, B (2013) Effective time management in post disaster reconstruction. Available at: < http://theyellowcompany.com.au/wp-content/uploads/2013/10/Effective-Time-Management-in-Post-Disaster-Reconstruction1.pdf> [Accessed 22 October 2015].

Ophiyandri, T, Amaratunga, RDG and Pathirage, CP (2010) Community based post disaster housing reconstruction: Indonesian perspective , in: CIB 2010, 10th - 13th May 2010, University of Salford.

Thayaparan, M., Siriwardena, M., Malalgoda, CI., Amaratunga, D., Lill, I. & Kaklauskas, A. (2015) Enhancing post-disaster reconstruction capacity through lifelong learning in higher education. Disaster Prevention and Management: An International Journal, 24, 338-354.

UN-ISDR, (2015a) Sendai framework for disaster risk reduction 2015-2030. [online] Available at: <http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf > [Accessed 22 October 2015].

UN-ISDR, (2015b) Making cities resilient – my city is getting ready. [online] Available at: < http://www.unisdr.org/campaign/resilientcities/home/index > [Accessed 22 October 2015].

13. Multi-hazard risk assessment

Sub-themes: Vulnerability, risk and exposure mapping; Understanding disaster risk

Understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment

Many world regions are subject to multiple natural hazards. In these areas, the impacts of one hazardous event on the built environment are often exacerbated by interaction with other hazards (Marzocchi et al., 2009).

Understanding disaster risk is one of four priority areas identified within the Sendai framework (UNISDR, 2015). The framework stresses that policies and practices for disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. It also promotes the conduct of comprehensive surveys on multi-hazard disaster risks.

Risk assessment is an essential task that is conducted initially to determine the degree of risk that communities face, and subsequently to identify the measures that are needed to reduce such risks through a variety of structural and non-structural measures. These are aimed at reducing exposure to such hazards, reducing vulnerability, increasing preparedness and increasing coping capacities.

For detailed quantitative assessment of risk it is necessary to quantify the main components of risk, which is a challenging task. Risk is expressed in the form:

Risk = Hazard x Vulnerability

It is possible to quantify risk in terms of loss because hazard is associated with the probability of occurrence of catastrophic events and vulnerability as proneness of society and its full structure to be affected by potential damage and losses. However with the introduction of capacity or preparedness it is difficult to adopt direct quantification methods. Deficiencies in preparedness represent the lack of measures and tasks which could reduce the loss of human lives and property during disaster.

A number of methods have been developed by researchers including quantitative and qualitative methods. For example, Mulyani highlighted the importance of a multi-hazard risk assessment framework in seismic mitigation process considering the massive consequences caused by earthquake associated hazards in the past events. However, there is no standard technique for such assessment of risk. Quantification based on both qualitative description (ranking methods) and quantification based on detailed analysis of respective parameters has been successfully adopted. Although studies relating to risk will be able to capture the significance of its components there are limitations in the assessment process.

It is emphasised that hazard, vulnerability and risk maps play a vital role in risk management. It is important to upgrade these maps regularly taking on board the beneficial aspects of risk management measures adopted.

References

Marzocchi, W., Mastellone, M., Di Ruocco, A., Novelli, P., Romeo, E., and Gasparini, P. (2009) Principles of Multi-Risk Assessment: In- teractions Amongst Natural and Man-Induced Risks, European Commission, Directorate-General for Research, Environment Directorate, Luxembourg, 72.

Mulyani, R. (2013) Extended Framework for Earthquake and Tsunami Risk Assessment: Padang City A Case Study, in Civil and Structural Engineering. The University of Sheffield: Sheffield, UK. p. 242.

UNISDR (United Nations International Strategy for Disaster Reduction) (2015) Sendai framework for disaster risk reduction 2015–2030. http://www.wcdrr.org/preparatory/post2015.

4. Enablers in built environment higher education

The higher education sector plays a significant role in any capacity development strategy. This section considers the enabling role of higher education in developing capacity among built environment professionals for disaster resilience building. This includes the design and delivery of educational programmes, and the development and dissemination of new knowledge.

4.1 Lifelong learning

Lifelong learning is the "ongoing, voluntary, and self-motivated" (Department of Education and Science, 2000) pursuit of knowledge for either personal or professional reasons. Therefore, it not only enhances social inclusion, active citizenship, and personal development, but also self-sustainability, as well as competitiveness and employability (Commission of the European Communities, 2006).

The term recognizes that learning is not confined to childhood or the classroom but takes place throughout life and in a range of situations. Allen Tough (1979), Canadian educator and researcher, asserts that almost 70% of learning projects are self-planned.

During the last fifty years, constant scientific and technological innovation and change has had profound effects on how learning is understood. Learning can no longer be divided into a place and time to acquire knowledge (school) and a place and time to apply the knowledge acquired (the workplace) (Fisher, 2000). Instead, learning can be seen as something that takes place on an ongoing basis from our daily interactions with others and with the world around us. It can take the form of formal learning or informal learning, or self-directed learning.

Higher education can contribute to disaster risk reduction and resilience building through its research, teaching and learning activities.

4.2 Undergraduate

A bachelor's degree program is an undergraduate program that usually takes three or four years to complete. A bachelor's degree is usually required for admittance into a graduate program.

Enrolling in a bachelor's degree program requires that students choose a major area of study. Many built environment professionals will have degrees in construction and/or management, quantity surveying, building surveying, real estate, property and valuation, or variations of these.

Due to its more specialised context, there is very little provision of undergraduate programmes for disaster risk reduction or resilience. The CADRE project also found very little evidence of modules or courses within current built enviornment degree programmes that focus on the key knowledge gaps identified in section 3.

4.3 Masters

Master's degree programs are graduate programs that let students specialise in an area of study. They typically take 1-2 years to complete. Along with an undergraduate degree, enrolling in a master's degree program usually requires a minimum degree classification and/or work experience in a related field.

A survey on education supply and demand (Amaratunga et al, 2015) found that despite considerable need for programmes to support the building of resilience, there is currently a lack of programmes that meet employer needs. It also found that the availability of programmes differed greatly across Europe, and that most programmes are recent developments, with very few having been in operation for over 5 years. This emphasises the immaturity of the discipline and the needs for further studies to better understand market needs.

4.4 Doctoral

Doctoral degree programs, also known as Ph.D. programs, are the most advanced type of degree program available. Admittance into a doctoral degree programmes may require individuals to hold a master's degree, although some programmes may accept candidates who only hold high classification bachelor's degrees. Additional requirements to be accepted into these programs may include submitting standardised test scores and sending in letters of recommendation.

Completing a Ph.D. program usually takes several years, and typically involves the completion of a dissertation and a major research project. Many disaster risk reduction and disaster resilience research centres in Universities actively promote doctoral studies in related areas, and also possess the supervisory capacity to support such programmes.

Due to the significant time required to obtain a doctoral degree and learning outcomes that are typically focused on a 'contribution to knowledge', many traditional doctoral programmes are not attractive to professionals working in practice. This has led to a growing interest in the provision of professional doctorates (DProf). These are discussed in Section 5.

4.5 Continuous professional development

Continuing professional development (CPD) is a commitment by members of professional associations and institutions to continually update their skills and knowledge in order to remain professionally competent.

Members of professional institutions linked to the construction industry must typically undertake and record a minimum number of CPD activity each calendar year.

The CADRE study found strong support for using CPDs as a means for embedding disaster risk reduction and resilience building in construction education due to the flexibility afforded and its ability to reach a large number of construction professionals. Professional institution support will be essential.

4.6 Research

Despite 'resilience' having been widely adopted in research, policy and practice to describe the way in which they would like to reduce our society's susceptibility to the threat posed by such hazards, there is little consensus regarding what resilience is, what it means to society, and perhaps most importantly, how societies might achieve greater resilience in the face of increasing threats from natural and human induced hazards. If the concept of resilience is to be a useful framework of analysis for how society can cope with the threat of natural hazards, it is necessary to understand attributes that enable physical, socio-cultural, politico-economic and natural systems to adapt, by resistance or changing in order to reach and maintain an acceptable level of functioning.

Higher education must play an important role in undertaking research that can be translated into action. Research studies document a trend of increasing disaster losses, but the translation of research findings into practical actions has proven difficult and remains a barrier that prevents the best use of science.

There remains a recognised need for higher education, through researchers and educators, to provide and communicate actionable knowledge with explicit links to inform effective, evidence-based decision-making. As well as creating new knowledge, higher education has a vital to play in capacity development and in doing so, providing a means by which effective knowledge transfer can take place.

4.8 International cooperation

Progress in risk reduction and resilience building is uneven across the world, with some high-risk, low-capacity countries falling behind. There is also uneven progress by hazard type and subregion.

From an EU perspective, cooperation within the EU and with non-EU countries enhances the quality of research, education and training in the EU and beyond by promoting knowledge exchange, peer-to-peer learning and comparison with education systems worldwide. It offers opportunities for staff and students to broaden their horizons. Many EU universities have a positive record of internationalisation; they have facilitated the development of international curricula and joint degrees, fostered international innovation projects, and supported the exchange of students, staff, and knowledge.

This type of international cooperation will be vital to address the complex challenges associated with tackling disaster risk, as well as in ensuring that less developed regions and countries are not left behind.

References

Amaratunga, D., Faber, M., Haigh, R., Indirli, M., Kaklauskas, A., Lill, I., Perdikou, S., Rochas, C., Sparf, J., Perera, S., Thayaparan, M., and Velazquez., J. (2015) ANDROID Report: Disaster Resilience Education and Research Roadmap for Europe 2030. Disaster Resilience Network. Available from: www.disaster-resilience.net.

Commission of the European Communities: "Adult learning: It is never too late to learn". COM (2006) 614 final. Brussels, 23.10.2006.

Department of Education and Science (2000) Learning for Life: Paper on Adult Education. Dublin: Stationery Office.

Fischer, Gerhard (2000) "Lifelong Learning - More than Training" in Journal of Interactive Learning Research, Volume 11 issue 3/4 pp 265–294.

Tough, A. (1979) The adult's learning projects: a fresh approach to theory and practice in adult learning, Ontario Institute for Studies in education.

5. Professional doctorate framework

5.1 What is a professional doctorate?

The UK Council for Graduate Education has defined a professional doctorate as 'a programme of advanced study which, whilst satisfying the university criteria for the award of a doctorate, is designed to meet the specific needs of a professional group external to the University, and which develops the capability of individuals to work within a professional context' (UKCGE, 2002). However, it was revealed that there is no agreement within and across countries on the core characteristics and standards of professional doctorates. As such professional doctorates may differ across institutions and subjects and even within subjects (Bourner et al., 2001). Various models of professional doctorates exist even within the UK, and these are usually summarised by the respective institution in their programme specification (The Quality Assurance Agency for Higher Education, 2011).

Professional doctorates have certain characteristics that distinguish them from traditional PhDs. Neumann (2005) emphasised that the major difference between a PhD and a professional doctorate is in the target population and the selection criteria of students. Professional doctorates target practicing professionals and aim to integrate professional and academic knowledge in the selected discipline. Professional doctorates usually include structured elements such as lectures, seminars, and workshops, helping the candidates to acquire skills relevant to their professional practice, in addition to producing original research (The Quality Assurance Agency for Higher Education, 2011). The UK model of professional doctorates usually consists of a taught component focusing on the field of study and on research training (Bourner et al., 2001). The taught component is usually structured based on credit rated modules.

"Professional practice, the development and/or application of expertise directly in the practice setting and practitioner research are central to professional doctorates" (McGraw-Hill Education, 2014). As such most professional doctorates expect the candidates to research on a topic that relates to their own working lives (Bourner et al., 2001). Candidates are expected to start their research with a problem in professional practice and to make an original contribution to knowledge of professional practice through research. In addition, these doctorates provide the opportunity to undertake research in the workplace and to select a topic that has a direct effect on improving the professional practice related to the host organisation. These are usually open to experienced professionals employed in any area of work, including emerging professions and disciplines. They are often undertaken in a part time mode of study while working at the host organisation. Successful completion normally leads to professional and/or organisational change (The Quality Assurance Agency for Higher Education, 2011). However, in some cases, candidates are registered as full time students while most of their time is spent working at an industrial or professional organisation (Bourner et al., 2001).

5.2 Applicability

Education and training for construction professionals are generally provided by HEIs, vocational education and training providers, built environment professional bodies, construction organisations, and training and development authorities (Thayaparan et al., 2015). Out of these, higher educational institutes are expected to play a key role in developing capacities of built environment professionals in contributing to disaster resilience (Witt et al., 2014; Thayaparan et al., 2015). Learning opportunities provided by HEIs can mainly be categorised as formal learning through organised programmes recognised by a qualification or part of a qualification (OECD, 2004). However, studies such as Siriwardena et al. (2013), highlight that providing disaster management education as a degree programme is ineffective due to the complexity and multi-disciplinary nature of the subject. The lack of industry involvement and the lack of research and development activities on disaster management by construction sector professionals is also a hindrance to effective disaster management education.

There is a need to continuously update the skills and knowledge of construction professionals in order to contribute effectively to disaster resilience (Thayaparan et al., 2015). Thus, in overcoming the challenges of existing approaches of disaster management education, lifelong-learning has been identified as the most appropriate approach to educate construction professionals in the context of disaster resilience and management (Thayaparan et al., 2015; Siriwardena et al., 2013).

In supporting the concept of lifelong learning, a professional doctorate on disaster management for construction professionals is required. The professional doctorate addresses challenges such as: the complexity and multi-disciplinary nature of the subject; the lack of industry involvement; and the lack of research and development activities on disaster management by built environment professionals.

5.3 DProf development process

Development of an appropriate DProf programme requires a substantial amount of effort to understand market needs and capture the labour market requirements.

The first phase of this study involved capturing the needs of 5 stakeholder groups, as well as current and emerging skills and knowledge gaps of built environment professionals.

The data collection and analysis framework of the study is a three dimensional framework consisting of built environment stakeholders, dimensions of resilience and stages of the property lifecycle (Annex B). The data collection and analysis framework was developed through an extensive consultation process with project partners and was refined throughout the first year of the project with the emerging literature findings and with the opinion of stakeholders who have been interviewed to capture labour market demands.

Data was collected via semi-structured interviews (see Annex B). The interviews generated a long list of needs and skills with respect to the property lifecycle stages under the respective dimensions of resilience. Finally, the identified needs and skills were combined 'like-for-like' to produce a broader level of knowledge gaps. In parallel, an extensive literature review and a policy analysis was conducted to capture the emerging needs in the disaster resilience in the built environment. The findings were then validated using focus group discussions that were conducted as part of 6 organised stakeholder workshops.

The key knowledge gaps identified are detailed in Section 3. These form the basis for the initial programme specification for the proposed DProf. Based on these a structured doctoral programme was developed in order to reflect how the construction sector and its professionals can contribute to achieving resilience in the case of increasing threats from natural and human induced hazards.

5.4 Key features of the DProf framework

The aim of this section is to highlight the key features of the DProf framework.

The broader title of the programme is defined as "Professional doctoral programme in disaster resilience in the built environment". It is important that the title reflects institutional and country specific regulations and other requirements. Various DProf models are available. In the UK and Australia, the award can be a professional doctorate in disaster resilience in the built environment. However, for countries like Estonia and Lithuania, where there are no 'professional doctorate' programmes available at any higher education institution, it would require legislative amendments before such programmes could be offered. Therefore, in such instances, the award can be named as "PhD in disaster resilience in the built environment".

The programme is offered in the context of disaster resilience in the built environment. To reflect the scope of the programme, some broader aims were developed, linking with the QAA doctoral degree characteristics. They are:

- Provide students with a critical understanding of developing approaches to systematic inquiry reflecting theoretical, and philosophical approaches to generation of new knowledge and its application within the professional context of disaster resilience in the built environment
- Provide students with the ability to create new knowledge through practice based research, contributing to the professional knowledge in disaster resilience in the built environment
- Appraise and synthesise a substantial body of knowledge at the forefront of disaster resilience in built environment practice and its application

Any adopting institution is required to check and refine these aims to reflect institutional and country specific regulations and other requirements. The next section highlights the key features of the DProf framework.

A generic framework: CADRE offers a generic DProf framework, which allows a wide range of professionals associated with different built environment sectors in disaster resilience and management to negotiate programmes that are applicable to their own circumstances. In other words, having a generic framework allows the prospective candidates to customise the programme to suit their own professional practice. Furthermore, CADRE being a multi-partner project, developing a generic framework provided the opportunity for different institutions to alter the programme to match their individual institutional and country specific demands, capabilities and regulatory frameworks.

Accordingly, the framework suggests various options for entry requirements, duration, course structure, assessment structure, themes, skills needs and training needs. Apart from the commonalities of the contents across the partner institutions, the specifications are customisable so as to be compatible with the individual institutional standards. It is expected that all construction professionals serving all of stakeholder groups attached to disaster resilience and management will benefit from the developed programme.

Address the knowledge gaps in disaster resilience in the built environment: The DProf framework was developed based on a systematic and extensive analysis of knowledge gaps in disaster resilience in the built environment. The findings were validated using focus group discussions that were conducted as part of organised stakeholder workshops. All these enabled developing a DProf framework that directly addresses the current and emerging knowledge gaps in disaster resilience in the built environment. As a result, the education and training delivered are more relevant to the demands of candidate's professional practices, which is vital for the labour market and for people's employability. The proposed programme will attract learners from the construction industry to develop solutions to their labour market demands through doctoral studies.

Integration of practice, community and university: Teaching disaster resilience and management requires, multi-sectoral and multi-stakeholder engagement and thus, designing and delivery of education programmes catering the built environment practitioners require collaboration between all disaster related stakeholders, BE practice and the university. In order to promote the collaboration, the proposed DProf framework encompasses a Practice, Community and University (PCU) framework to ensure continuous monitoring of market demands and to tailor the contents to meet the demands. Accordingly, appropriate mechanisms were built to integrate all disaster related stakeholders, BE practice and the university in order to ensure the success in the DProf programme development and delivery.

A taught and research components: The framework includes two main components: Taught and research. The taught component is essential – preferably at the beginning of the programme (year 1 and year 2). The taught component includes some generic modules on research methodology, critical professional reflection in disaster resilience in the built environment and literature review and synthesis. Based on the knowledge gaps identified, a pool of modules is developed as part of the DProf framework and is available in the CADRE Open Education Resource (OER) platform. In addition, the candidates are expected to start the research with a problem in professional practice and to make an original contribution to knowledge in professional practice through research. The proposed programme structure includes a taught and a research component with various assessment techniques.

Open educational resources (OER): The taught elements of the DProf framework draws on a variety of teaching and learning methods. Teaching takes the form of face-to-face or online units, with a combination of e-learning support and supervision. All course materials are available through the OER platform developed as part of the CADRE project, which is accessible to students across all regions. Part time/ distance learning programmes are usually supplemented by occasional intensive study days. The recorded sessions will also be available through the OER platform for students who are unable to attend.

Intermediate exit routes: Intermediate exit points can be defined based on partner's discretion and depending on the individual institutional standards and regulations. Available options include a PGCert at the end of the 1st year and MRes/ MProf at the end of 2nd year. The DProf is offered for practicing professionals and therefore having intermediate exit points provides flexibility for the candidates to exit from the programme at different points with an appropriate award.

Contribution to theory and practice: In terms of disaster resilience and management, more applied research is required in order to develop a construction industry with the necessary capacities to plan, design, build and operate resilient structures to increase societal resilience to disasters. The aim of a DProf programme is to integrate professional and academic knowledge in the selected discipline. Accordingly, it provides opportunities for the candidates to undertake research aimed at making a contribution to the knowledge of professional practice and involves applied rather than pure research. It requires candidates to undertake the research in the workplace and to select a topic that has a direct effect on improving the professional practice related to the host organisation. Successful completion normally leads to professional and/or organisational change. It therefore strengthens not only the academic knowledge and cooperation between the universities and industries, but also the concerns, capabilities and expectations of the relevant stakeholders related to disaster resilience and management. As such, professional doctorates are very much appropriate to construction sector in developing societal resilience to disasters. It makes a research-based contribution to practice within the context of upselling construction professionals with disaster resilience expertise.

Cross-institutional supervisory teams and working environments: The proposed DProf framework enables cross-institutional supervisory teams, as well as supervisors from the industry. Due to the multi-disciplinary nature of the subjects, having cross-institutional supervisory teams enhances the quality and relevance of the research and ultimately the contribution to practice. Unlike a traditional PhD, having supervisors from the industry where research is based can significantly add value to the research. In addition, DProfs allow students to be based at a relevant industry, which will lead to pan-stakeholder links, help to promote inter-disciplinary and inter-sectoral working among candidates, and address the problem of social and intellectual isolation that is common in doctoral study. The research phase of the programme is supervised by a panel of supervisors, usually comprising an academic member of staff and a practice-based specialist.

Career needs of practicing professionals: One of the main disadvantages of traditional doctorates is that it is not very attractive to the practicing professionals. As explained earlier, traditional doctorates more often contribute to theory of knowledge and as a result, is not much popular with the practicing professionals in the construction sector. As argued by Bourner et al. (2001) professional doctorates are attractive to those who aspire their own personal development and a commitment to furthering the cause of their profession.

The CADRE professional doctorate addresses the career needs and upgrades the knowledge and skills of practising professionals working to make communities more resilient to disasters, and particularly those in, or who aspire to, senior positions within their profession. The education and training delivered are more relevant to the world of work, which is vital for the labour market and for people's employability. It further broadens and deepens the employees' understanding of the disciplines in which they are studying, upgrades their skills, promotes inter-disciplinary working, and provides them with appropriate transferable skills. The CADRE DProf programmes will attract learners from the construction industry to develop solutions to their labour market demands through doctoral studies.

Flexible study modes: Another major barrier in traditional PhDs for construction practitioners is that often they are unable to study full-time, and employers are not willing to invest for full-time PhDs. In order to meet the needs of practising professionals and their employers, flexible study modes are offered in DProfs, with only part-time attendance necessary; the rest of the time the candidate is expected to spend in industry or a professional organisation. It is recommended to offer flexible study modes (such as part –time attendance or distance learning) allowing candidates to spend the rest of the time in industry or a professional organisation. Different models of DProf programmes are available, spanning from, full time to part time, and some institutions even offer distance learning and blended courses. When looking at existing DProfs, there is no commonly accepted mode of study. Some institutions offer full time and part time courses while others offer part time only courses. The study mode needs to be defined by the individual institutions according to the individual institutional standards and regulations. Typical modes are full time, part time, distance learning, and blended.

Lifelong learning and continuous professional development: The DProf is intended to be a form of in-service professional development. Construction professionals therefore benefit from the professional doctoral programme, which provides opportunities for learners to access lifelong learning in increasing societal resilience to disasters. In overcoming the challenges of existing approaches of disaster management education, lifelong-learning has been identified as the most appropriate approach to educate construction professionals in the context of disaster resilience and management (Thayaparan et al, 2015; Siriwardena et al., 2013). Developing an innovative professional doctorate addresses the requirements for lifelong learning and enhances not only academic knowledge, but also the concerns, capabilities and expectations of the relevant industries and communities. In turn, this creates the necessary intra industry, community and University feedback and feed-forward mechanisms to enable effective lifelong learning.

References

Bourner, T., Bowden, R. & Laing, S. (2001) Professional Doctorates in England. Studies in Higher Education, 26, 65-83.

Maxwell, T. (2003) From First to Second Generation Professional Doctorate. Studies in Higher Education,, 28, 279-291.

McGraw-Hill Education (2014) Appraising professional doctorates: what, who and why? [Online]. Available: http://www.mheducation.co.uk/openup/chapters/9780335227211.pdf [Accessed 15 June 2015].

Neumann, R. (2005) Doctoral Differences: Professional doctorates and PhDs compared. Journal of Higher Education Policy and Management, 27, 173-188.

OECD (2004) Lifelong learning. OECD Policy Brief [Online]. Available: http://www.oecd.org/dataoecd/17/11/29478789.pdf [Accessed 15 April 2015].

Siriwardena, M., Malalgoda, C., Thayaparan, M., Amaratunga, D. & Keraminiyage, K. (2013) Disaster resilient built environment: role of lifelong learning and the implications for higher education. International Journal of Strategic Property Management, 17, 174-187.

Thayaparan, M., Siriwardena, M., Malalgoda, C. I., Amaratunga, D., Lill, I. & Kaklauskas, A. (2015) Enhancing post-disaster reconstruction capacity through lifelong learning in higher education. Disaster Prevention and Management: An International Journal, 24, 338-354.

The Quality Assurance Agency for Higher Education (2011) Doctoral degree characteristics.

UKCGE (2002) Professional Doctorates UKCGE. Dudley, UK.

Witt, E., Bach, C., Lill, I., Palliyaguru, R., Perdikou, S. and Ozmen, F. (2014) Determining Demand for Disaster Resilience Education through Capacity Analysis of European Public Authorities. CIB International Conference 2014: W55/65/89/92/96/102/117 & TG72/74/81/83 Construction in a Changing World. Kandalama, Sri Lanka.

6. Recommendations

This report is an account of a study to identify gaps in the knowledgebase of construction professionals that are undermining their ability to contribute to the development of a more disaster resilient society, and preventing the mainstreaming of disaster resilience within the construction process.

Based on the findings of the CADRE study, this section sets out a series of recommendations to key actors in the built environment on how to more effectively mainstream disaster resilience in the construction process.

The recommendations are set out in five key themes:

- Education
- Policy
- Practice
- Cross-cutting
- Research

6.1 Education

Multi-stakeholder approach

Built environment researchers and educators must interact and collaborate with policy-makers and practice based actors at the local, national, regional and global levels. Collectively they must work to identify and address problems and knowledge gaps from the field.

Rather than being passive recipients of new knowledge, policy makers and practitioners should join with construction and property groups in higher education to form multi-stakeholder groups that work together from the outset to design and deliver new knowledge. The scientific results will be more relevant and actionable.

Multi hazard approach

An all-hazard, problem-focused approach should be used in built environment research and education to address the complexity of disaster risk. This will require collaboration and communication across the built environment and other scientific disciplines. Built environment departments can promote this approach by providing construction and property researchers and students with:

- Exposure to a variety of disciplinary work
- Exposure to interdisciplinary work
- Exposure to and experience with tools and methods from a variety of disciplines
- Exposure to and experience with interdisciplinary tools and methods
- Experience working with others in an interdisciplinary mode

Higher education programmes and research training must develop the skills to shift perspectives easily, and continually see things in new ways. Researchers and students must be comfortable with multiple languages and a variety of ontologies, epistemologies, methods, tools, and theoretical perspectives, and shift easily among them.

Built environment funders, publishers and editors in must not reinforce disciplinary silos, and should promote and encourage the development and publication of multi- and inter-disciplinary research. The scope of scientific panels and peer-reviewed journals should reflect the importance of problem-focused research, rather than be defined by traditional academic disciplines.

Review panels, editorial boards and scientific committees should reflect the diverse array of disciplines required to address major societal challenges such as building disaster resilience.

Address problems from the field by providing localised knowledge and solutions to the local context

Built environment educators and researchers must recognise the importance of public engagement before, during and after research, in particular with institutions and individuals as risk of disasters. This can serve a number of often overlapping purposes:

Informing: inspiring, informing and educating the public and making the work of higher education in building resilience more accessible.

Consulting: actively listening to the public's concerns and insights - institutions and individuals at risk of disasters should be invited to participate in research (surveys, vulnerability assessments and other activities) to collect local knowledge.

Collaborating: working in partnership with communities and the public to solve problems together, drawing on each other's expertise.

Localisation: a lot of disaster knowledge has been developed at an abstract level, or based on a specific context. Public engagement can help calibrate knowledge to a local context, extending the impact and reach of existing research.

Develop OERs that are freely accessible

The recent shift towards open access of research outputs and education is to be welcomed and should continue to be encouraged.

The high levels of disaster risk found in low-income countries make it an imperative that European research and education is made widely available. The European Union and other research funding bodies should require all funded scientific outputs to be made available as open access. This includes the use of green publishing routes where possible, or financially supporting gold publishing as necessary.

Higher education should be supported to develop open educational resources that are freely accessible and openly licensed, for use in teaching, learning, and assessing as well as for research purposes linked to building resilience.

Flexible and customisable educational programmes

There is an expanding field of disaster management, but simultaneously, a lack of young professionals in the built environment with appropriate skills and knowledge to support the building of resilience within relevant stakeholders. There is a need to maintain and expand the network of key persons, including change agents and facilitators.

There is currently a lack of programmes that meet employer needs. Higher education within Europe must develop flexible and customised programmes and curricular, whether a module in regular Masters or Undergraduate curriculum, or as dedicated postgraduate programmes such as Professional Doctorates.

Detailed market research is required to understand the need and interest in potential students, with clear linkages to future job markets.

This will help to ensure that educational programme address the problems from the field and can promote affordable solutions, as per local context, including the cultural calibration of technology.

Educational programmes should promote a multi-disciplinary approach and understanding, drawing upon a combination of different faculty. Built environment disciplines should be at the core of such programme offerings.

The problem-based nature of the field determines that programmes should offer an appropriate balance of theory and field experiences. Internship programmes for students in government, NGOs, UN agencies, private sectors, research institutions should be strongly promoted.

At the same time, the pace of scientific discoveries demands that programmes are research linked to ensure that what is being taught by higher education is consistent with the state of the art. Improving the link between research, education and action will require the transfer of research knowledge into teaching but also recognising that the research and teaching link as a two-way knowledge transfer process. In a 'knowledge society' all graduates have to be researchers. Not only are they engaged in production of knowledge; they must also be educated to cope with risks and uncertainties generated by the advance of science.

6.2 Policy

Development of Sendai Framework "Words into Action" Implementation Guide for Construction Policy and Practice

The Sendai Framework for Disaster Risk Reduction 2015-2030 aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.

It has been recognised that the success of this post-2015 framework hinges on creating and implementing policies that are built on the best available knowledge. Higher education has a vital role in supporting this move to a more disaster resilient society by 2030.

The prime focus must be that the policy-science gap is closed with research that can be translated to action. Research studies document a trend of increasing disaster losses, but the translation of research findings into practical actions has proven difficult and remains a barrier that prevents the best use of science.

Higher education has a key role in mainstreaming disaster resilience in the construction process. There remains a recognised need for higher education, through researchers and educators, to provide and communicate actionable knowledge with explicit links to inform effective, evidence-based decision-making. As well as creating new knowledge, higher education has a vital to play in capacity development and in doing so, providing a means by which effective knowledge transfer can take place.

Through the UN Words into Action process, one or more implementation guides should be developed on construction policy and practice. These guides can be used as practical guidance to support implementation, ensure engagement and ownership of action by all construction industry stakeholders. They should translate the global targets and four priorities into meaningful actions that can be adopted by the various actors in the construction industry, including professional bodies, industry regulators, clients, and construction and property companies.

6.3 Practice

Built environment professional bodies to recognise disaster resilience through accreditation

It is vital that construction and property professional bodies continuously update the accreditation or services needed to identify and verify expertise in weak or emerging new areas of practice highlighted as knowledge gaps in this report. Without this recognition, it is unlikely that construction professionals will value education and training in related skills.

Disaster resilience to be part of professional and ethical standards

The built environment sector has a poor public image internationally. In the 2011 Bribe Payers Index, real estate, utilities and construction languished at the bottom of the league table.

Construction and property professional bodies must ensure ethical behaviours are practised across the sectors they represent. This should address all elements of the UN Global Compact, including human rights, labour and the environment, as well as corruption-related issues.

Regulatory frameworks are required for reconstruction following large scale disasters

Resourcing is a key challenge for post disaster project management and successful resourcing depends on multi stakeholder collaboration, market flexibility, donor management and government intervention.

Whilst routine and sometimes existing construction processes have often proved adequate for smaller scale disasters, the greater degree of coordination required for programmes of reconstruction following a larger disaster must be addressed through formal regulatory frameworks.

6.4 Cross cutting

Link research, education and practice

The Sendai Framework for Disaster Risk Reduction 2015-2030 aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health, and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.

It has been recognised that the success of this post-2015 framework hinges on creating and implementing policies that are built on the best available knowledge. Built environment education and research has a vital role in supporting this move to a more disaster resilient society by 2030.

The prime focus must be that the policy-science gap is closed with research that can be translated to action. Research studies document a trend of increasing disaster losses, but the translation of research findings into practical actions has proven difficult and remains a barrier that prevents the best use of science.

There remains a need for construction and property groups in higher education, through researchers and educators, to provide and communicate actionable knowledge with explicit links to inform effective, evidence-based decision-making. As well as creating new knowledge, higher education has a vital to play in capacity development and in doing so, providing a means by which effective knowledge transfer can take place.

Common language

Educators and the research community must take time and effort to understand the audience they are seeking to inform.

Scientific results are often subject to misunderstanding due to poor comprehension of numbers and statistics, as well as conflicting languages and terminology. Correct comprehension depends not only on the skills and knowledge of the reader, but also on the way the information is presented. By assuming a weaker background knowledge (e.g. of scientific language) and low "statistical literacy", evidence summaries can add information to help readers better understand the strengths and limitations of the scientific evidence being summarised. Adding meta-information that explains concepts such as the quality of the evidence may help eliminate frustration and trigger reflection.

6.5 Research

Understand the audience and devise appropriate dissemination mechanisms for scientific knowledge

Greater priority should be put on sharing and disseminating scientific information. The research community must make more effort to translate traditional outputs into practical methods that can readily be integrated into policies, regulations and implementation plans towards building resilience.

National research assessment exercises, the European Union and national funding bodies, and higher education promotion policies, which often emphasise traditional academic outputs (e.g., peer reviewed journal articles), should appropriately incentivise and reward non-standard scientific outputs, such as research summaries and policy briefs.

Translate traditional outputs into practical methods that can readily be integrated into construction policies and regulations related to resilience building

Science provides an evidence base that can be relevant to and therefore draw together different areas of policy. Knowledge integration provides a starting point for building and operationalizing resilience through the co-design of policies and interventions by scientists, practitioners, policy makers and communities themselves. Standardised definitions are essential to the operationalization of concepts such as resilience for research, monitoring and implementation purposes. For example, in epidemiology, case ascertainment/definition is essential to accurately understanding the causal relationship between a disease exposure and its outcome.

Common understanding amongst all actors is essential for effective disaster risk reduction and management. Approaching towards 2015, the Joint Research Centre of the European Commission has been contributing to identifying the most common terms and definitions used in disaster risk reduction. This background information would provide a solid basis to continue updating the terminology and contribute to the implementation of the post-2015 framework on disaster risk reduction.

Collaboration across disciplines as well as regionally and internationally

There are already a number of regional initiatives that promote collaboration among higher education towards building resilience. These networks and events have helped to gather a wide and advanced set of competencies in the field of disaster resilience, sharing knowledge, discussing methodologies, disseminating good practices and producing and promoting innovation. These networks should be supported and encouraged to grow.

Given their different capacities, the EU must continue to strengthen its engagement with developing countries through international cooperation and global partnership for development, and continued international support, to strengthen their efforts to reduce disaster risk. In supporting this, the current regional networks should collaborate to form a global higher education network that can influence strategic agendas.

This global network should collaborate with existing bodies such as the UN ISDR Scientific and Technical Advisory Group to ensure that the role of higher education is understood and can be exploited towards achieving the objectives of the Sendai Framework.

Coordination mechanisms for science

Funding bodies for science should coordinate their efforts to ensure that resource are being deployed effectively and efficiently, and to promote collaboration across disciplines, as well as regionally and internationally. This will help to avoid duplication of effort and integrate funding.

Design and develop research degree programmes covering the knowledge gaps in disaster resilience.

An aggregator of knowledge to improve access and focus on quality

The volume of built environment research activity and associated outputs has rapidly increased over recent decades, none more so than relating to disaster risk reduction and resilience building. While expanding the knowledgebase may be considered positive in one sense, it has made the field increasingly difficult to navigate, whether it be for experienced researchers and educators, early career researchers and students, or other stakeholders, including policy makers. Identifying and accessing the most recent and high quality science is proving increasingly challenging despite the advance of technology.

Methods and tools for aggregating knowledge must be developed to facilitate access to science, technology and innovation outputs that help inform policy-making and practice, and also ensure that educational programmes and researchers have access to and can build upon the state of the art.

Annex A: Acknowledgements

The project team gratefully acknowledge the input of the eighty seven interview respondents that contributed to the study. In addition, the team wish to formally acknowledge the following people who attended and contributed at workshops held in Colombo, Sri Lanka (December 2015), Vilnius, Lithuania (April, 2016), Auckland, New Zealand (September 2016), London, UK (November 2016) and Tallinn, Estonia (November 2016).

Abdulquadri Bilau, Gilda Nigeria Ltd, Nigeria

Dr Agnė Kuzminskė, Vilnius Gediminas Technical University, Lithuania

Alan Muse, RICS, UK

Arūnė Binkytė, Vilnius Gediminas Technical University, Lithuania

Arvydas Bagdonavičius, The State Enterprise Centre of Registers, Lithuania

Dr Arvydas Survila, Mykolas Romeris University, Lithuania

Astrid Vachette, James Cook University, Australia

Dr Bridgette Sullivan-Taylor, The University of Auckland, New Zealand

Chandi De Alwis, Construction Industry Development Authority, Sri Lanka

Chathura Velivitiya, Help O Organisation, Sri Lanka

Condrad de Tissera, Construction Industry Development Authority, Sri Lanka

Dalia Bagdonavičienė, State Enterprise "Turto bankas", Lithuania

Dr Dalia Bardauskienė, Vilnius City Municipality, Lithuania

Danutė Pučkytė, Vilnius County Fire and Rescue Service Board, Lithuania

Dhammika Gunewardena, Construction Industry Development Authority, Sri Lanka

David Duffin, RICS, UK

Eneli Liisma, Tallinn University of Technology, Estonia

Erki Laimets, Estonian Association of Civil Engineers, Estonia

Erki Soekov, Esenter Systems, Estonia

Dr Gayani Karunasena, University of Moratuwa, Sri Lanka

Heiman Dianat, The University of Auckland, New Zealand

Dr Helen Giggins, University of Newcastle, Australia

Indu Weerasoori, UN Habitat, Sri Lanka

Jessica Hulme, Victoria University of Wellington, New Zealand

Dr Jurga Naimavičienė, Vilnius Gediminas Technical University, Lithuania

Justas Čerkauskas, Vilnius Gediminas Technical University, Lithuania

Kea Siidirätsep, Estonian Building Centre, Estonia

Kushani De Silva, International Union for Conservation of Nature

Dr Lina Pečiūrė, Vilnius Gediminas Technical University, Lithuania

Prof Makarand (Mark) Hastak, Purdue University, USA

Margarita Leonova, Novarc, Estonia

Dr Mindaugas Gikys, JSC "MF LT", Lithuania

Mohomed Nusry, Access Engineering Ltd. Sri Lanka

Moonika Mändla, Tallinn University of Technology, Estonia

Neringa Gudienė, Vilnius Gediminas Technical University, Lithuania

Dr Niluka Domingo, Massey University, New Zealand

Dr Nishara Fernando, University of Colombo, Sri Lanka

Dr Paulius Kazokaitis, JSC "Getweb", Lithuania

Prof Priyan Dias, University of Moratuwa, Sri Lanka

Prof Ranjith Dissanayake, University of Peradeniya, Sri Lanka

Prof Renaldas Gudauskas, Martynas Mažvydas National Library of Lithuania, Lithuania

Samite Barvika, Riga Technical University, Latvia

Prof Siri Hettige, University of Colombo, Sri Lanka

Prof Sujeeva Setunge, RMIT Univerity, Australia

Suranga Kahandawa, World Bank, Sri Lanka

Susith Arambepola, Asian Disaster Preparedness Centre, Thailand

Prof Suzanne Wilkinson, The University of Auckland, New Zealand

Tanel Tuisk, Certification Centre for Construction Materials, Estonia

Dr Thayaparan Gajendran, University of Newcastle, Australia

Tiina Nutter, Tallinn University of Technology, Estonia

Tony Lloyd-Jones, University of Westminster, UK

Victoria Cable, RICS, UK

Vijolė Arbas, Vilnius Gediminas Technical University, Lithuania

Viktorija Prilenska, Riga City Council, Latvia

Virajh Dias, Central Engineering Consultancy Bureau, Sri Lanka

Prof Virginia Murray, Public Health England, UK

Virgo Sulakatko, Ministry of Economic Affairs and Communications, Estonia

Annex B: Methodology

Analytical framework

Development of the professional doctoral programme involves a substantial level of research activities to study and analyse market needs, and capture the labour market requirements for disaster resilience and its interface with the construction industry and its professionals. The first phase of the CADRE study involved capturing the needs of 5 stakeholder groups associated with disaster resilience and management, as well as current and emerging skills and knowledge gaps for disaster resilience building.

The data collection and analytical framework of the study was developed through an extensive consultation process with project partners. It was refined throughout the first year of the project with the emerging literature findings and with the opinion of stakeholders who were interviewed to capture the labour market demands in construction industry.

The framework of the study is a three dimensional framework consisting of the following parameters.

Built environment stakeholders: National and local government organisations; Community; NGOs, INGOs and other international agencies; Academia and research organisations; and Private sector.

Dimensions of resilience: Economic Resilience; Environmental Resilience; Institutional Resilience; Social Resilience and Technological Resilience

Stages of property lifecycle: Strategic definition, Preparation and brief, Concept design, Developed design, Technical design, Construction, Handover and closeout, and In use.

Figure 2 shows a diagrammatic representation of the framework.

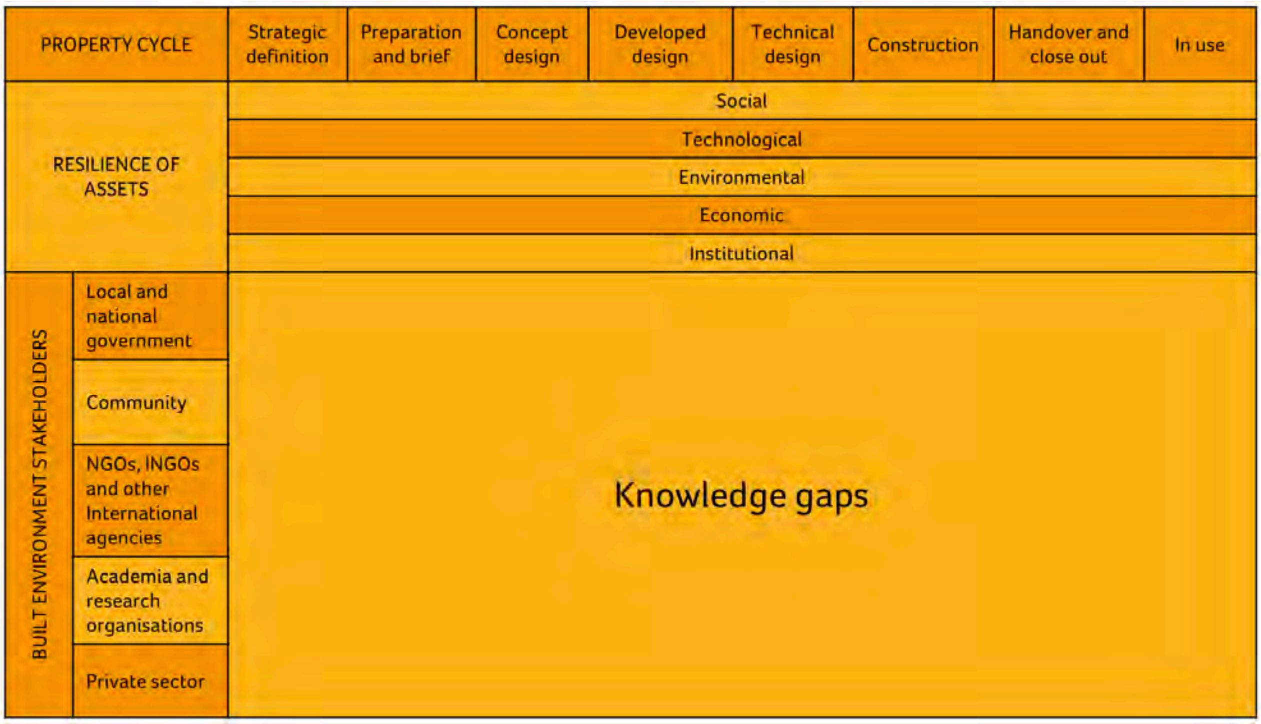

Figure 2: Analytical framework

Data collection and analysis

Semi-structured interviews were employed as the main technique for data collection. During the interviews, there was special interest and focus on the needs of 5 stakeholder groups: local and national governments; community; NGOs, INGOs and other international agencies; academia and research organisations; and the private sector.

Separate interview guidelines were prepared for each stakeholder to match their backgrounds and expertise. A study brief was sent to each interviewee prior to their interview. At the start of the interview the interviewer explained the research topic and the aims and objectives of the study. During the interview the interviewer asked questions based on the interview guidelines; however the process allowed the interviewee to elaborate on any issues that were relevant to the study.

This process allowed interviews to progress in a more proactive manner where the interviewer was able to capture the data, which were more relevant to the study. The interviews lasted for between 15-80 minutes. Most of the interviews were audio recorded using a digital voice recorder with the consent of the interviewees. All the interviews were then transcribed using MS word and this process allowed the researcher to use direct quotations from the interviewees when presenting the data. These steps helped to increase the reliability and validity of the research findings.

The interviews were conducted by CADRE project partners. Table 1 presents the number of interviews conducted for each stakeholder group. Semi-structured interviews were conducted with a total of 87 respondents across different countries and continents.

The data gathered from respective interviews were subsequently analysed by the CADRE project partners. The analysis was done using NVivo (version 10) data analysis software. The themes were presented under two main headings: needs and skills.

The interviews generated a long list of needs and skills with respect to the property lifecycle stages and under five dimensions of resilience. Finally, the identified needs and skills were combined 'like-for-like' to produce broader level of knowledge gaps. In parallel an extensive literature review and a desk review of key policies related to disaster resilience was carried out to reinforce the gaps yielded from the primary data. Policies considered for the study were: the Sustainable Development Goals; the Sendai framework for Disaster Risk Reduction (2015-2030); the Paris 2015 climate change agreement; and UNISDR's 10 Essentials for making cities resilient. The findings were then validated using focus group discussions that were conducted as part of six organised stakeholder workshops.

Table 1: Interviews conducted by stakeholder group

National and local government	HEIs and research organisations	Private sector	Community	NGOs/ INGOs	Total
20	21	19	15	12	87