Analysing community needs and skills for enhancing disaster resilience in the built environment

Abstract

Purpose – A better cooperation among all the stakeholders working towards enhancing the disaster resilience of societies can only be achieved if the expectations or the needs of each stakeholder are understood. This study attempts to outline the needs of communities affected by disasters for the purpose of aligning the needs and skill requirements with the abilities of built environment professionals serving these communities. Therefore, the study aims to identify and describe community needs and skill requirements for enhancing disaster resilience.

Design/methodology/approach – The study adopted literature review and semi-structured interviews. The semi-structured interviews were conducted with key members of some communities affected by disasters as well as some of the professionals that participated in the restoration/reconstruction of those communities. Data obtained were analysed using Nvivo 10.

Findings – The study revealed the current and emerging needs and skills of communities related to the built environment professionals towards enhancing disaster resilience. Thus, twenty nine classifications of skill and needs were derived and classified under five major disaster resilience dimensions to include social, economic, technological, environmental and institutional.

Research limitations/implications-This study focuses only of the needs and skills of the 'community', which is the major stakeholder that are basically the receiver of all what other stakeholders in disaster resilience have to offer.

Practical implications – This study would be beneficial to the built environment professionals involved in disaster resilience to be aware of the specific needs and skills of the communities affected by disasters for the purpose of developing their competences.

Originality/value – The study findings would be useful for both the built environment professionals and higher education institutions (HEIs). Since it is important for professionals to update and upgrade their knowledge towards enhancing their capabilities and meeting the expectations of stakeholders towards enhancing societal resilience to disasters across all domains of resilience.

Keywords: building resilience, built environment, communities, competencies, disaster resilience

Paper type Research paper

1 Introduction

The need for all stakeholders' contribution towards building disaster resilience was clearly emphasised by the Hyogo framework for action 2005 – 2015 (UNISDR, 2005) as well as many other authors. The community is one of the important stakeholders under the theme of disaster resilience; other stakeholders are local and national government, NGOs and international agencies, academia and research organisations, and the private sector. It should be noted that in all activities that require the participation of several parties, expectations and desires of each party usually vary but needs to be converged. Bosher *et al*. (2007a) attempted

to align Disaster Risk Management (DRM) activities with design-construction-operation process (DCOP) and the expected inputs from key stakeholders for each stage of the DRM and the DCOP. The study provided a visual representation of the link between stakeholders, DRM activities and DCOP. It therefore helps one to visualize how DRM activities can be built into the construction process as well as how the design, construction, operation process can be used to enhance the political, economic, social, technological, environmental and institutional resilience of a community. Similarly, a number of authors have identified the need for professionals involved in the development of the built environment to adopt and actively engage in the implementation of all strategies relating to disaster risk reduction (DRR) for resilience (Benson and Twigg, 2007, Bosher *et al*., 2007b).

Having established the fact that a number of stakeholders are relevant to the disaster resilience theme, this study focuses on the community group alone. Issues relating to other stakeholder groups will be reported in other publications. According to Twigg (2009), 'in conventional emergency management, communities are viewed in spatial terms: groups of people living in the same area or close to the same risks'. The habitants of any community execute their day to day activities by simply interacting with each other and both the natural and the built environment. The natural and the built environment should therefore be prepared to satisfactorily manage stressors. At times, communities lead the development process of the built environment at the pre-or post-disaster, this is called community driven development. Community-driven development (CDD) as it is referred to are programs that emphasize the engagement of beneficiaries in the design and management of development projects, this is done by giving communities direct control over major project decisions (Fearon *et al.*, 2008). Even when the community is not leading the development process, it still has a direct link with the development process (i.e. the property cycle) via the identification of property needs of the community, planning, provision of full or part funding, and provision of technical and non-technical expertise during preparation, design, construction, use, and reconstruction among others. A number of authors have described what should be in communities to make it resilient (Twigg, 2009); some others have described probable indicators of resilience of communities, researches and definite submissions on how to achieve these indicators are limited, none has actually observed things through the eyes of respective stakeholder groups and with adequate focus on a specific area of practice – built environment.

This study intends to fill the identified gap by identifying the specific expectations of the community stakeholder group that should be aligned and embedded with the activities and services of built environment professionals. The understanding of these needs and its entrenchment in the capabilities of construction professionals will enhance professionals' performance while serving communities in disaster situations. This will increase the satisfaction of members of disaster affected communities and as well assist in enhancing disaster resilience. This study will also help in reducing the impact of future disasters on communities if some of the needs relevant to new constructions are met.

2 Disaster resilience

Resilience has been described as an overloaded concept by many authors; this is because its meaning depends to an extent on the discipline in which it is being considered. Holling (1973) used the word resilience to describe a ''measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables". Resilience was defined as ''the capacity to cope with

unanticipated dangers after they have become manifest, learning to bounce back'' by Wildavsky (1991). Several authors have presented series of definitions and descriptions afterwards, the existence of varieties of definitions prompted the position of Twigg (2009), the study decided to settle for broad definitions and easily understood characteristics after describing the existence of large number of definitions as confusing. Manyena (2009) described disaster resilience as the ability to 'bounce forward' on following a disaster, but the definition left another ambiguity as the real meaning of bouncing forward needs to be explained further, it is currently being perceived by different stakeholders to mean different things. The confusing nature of the several definitions was also mentioned by Sapountzaki (2007). Alexander (2013) acknowledged the multidisciplinary nature of the term resilience and this has been supported by a number of researchers. The multidisciplinary nature of the term definitely has a role to play in the seeming confusion in its definition. However, UNISDR (2009) defined disaster resilience as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions. The UNISDR (2009) definition is being adopted in this study because it is perhaps among the most popular and most acceptable definitions.

The term 'Resilience' like a number of other principles and concepts can be described by some different characteristics. As a result, Authors have established the existence of several dimensions to resilience and some went ahead to establish indicators or probable measures with for the different dimensions. Burton (2012) attempted to develop a set of indicators for community resilience, as a result, some domains or dimensions of resilience were identified, these set of domains called variable are social, economic, institutional, infrastructure, community capital, and environmental resilience. Similarly, Cutter *et al.* (2008) in a study that aimed to develop a place based disaster resilience model identified six dimensions of resilience under which the study developed candidate variables (indicators), the dimensions used by Cutter *et al*. (2008) ecological, social, economic, institutional, infrastructure, and community competence. In a similar manner, Seneviratne *et al*. (2010) while discussing knowledge factors grouped the knowledge factors under technological, social, environmental, legal, economic, functional, institutional, political factors. Some other authors have other classifications. It is evident from the work of the authors above among others that a theme of issues exists within the context of disaster resilience. A careful consideration of the decisions of the above mentioned author among others with respect to dimensions of resilience resulted in the adoption of five dimensions or domains of resilience in this study, the dimensions used are economic, environmental, institutional, social, technological dimensions. The choice dimensions practically cover all the issues covered by the chosen dimensions of all other authors.

2.1 Community as a stakeholder group

According to Twigg (2009), 'in conventional emergency management, communities are viewed in spatial terms: groups of people living in the same area or close to the same risks'. Although, this definition is silent on other probable dimensions of 'community' i.e. values, common interests, activities, structures, social, occupational, religious, or other characteristics, it is indeed very appropriate for the disaster resilience theme. Disaster resilience is significantly increased by active planning and preparation for protecting human and properties. People living in the same area or close to the same risks should therefore know and be involved in local community disaster management arrangements as it is all about them. The community should simply lend her 'voices and choices' to the development

of human, organizational and management capacity to solve disaster related issues as they arise (Sastry, 2001, p. 2 cited in Hossain, 2013). With respect to the property cycle, the need for the involvement of the community cannot be overemphasised, but the modes of involvement and the expectations of the community in this regard should be known.

2.2 Built Environment professionals and property cycle

Built environment professionals have different responsibilities at different stages of property development. Several issues and duties are also associated with different stages in the development process. Careful consideration of requirements for each stage is definitely required to achieve a satisfactory delivery. With respect to disaster resilience and disaster management, Bosher *et al*. (2007b) attempted to align contributions from professionals and stakeholder groups at the design-construction-operation process (DCOP) with the phases of disaster management. Similarly, Thurairajah *et al*. (2011) mapped main built environment professionals' role in disaster management. It is obvious that the built environment professionals have a significant role to play in achieving disaster resilience and since respective professionals' duties are with respect to stage of the construction process, efforts at enhancing their performance are better viewed with respect to the phases of construction process. In this study, five-stage cycle was adopted; the stages are preparation, design, pre-construction, construction, and use stages.

3 Research methodology

A total of fifteen Semi-structured interviews were conducted with respondents from the "community" stakeholder group across different countries and continents. The respondents identified and interviewed were individuals that have either experienced disaster events as a member of an affected community or individuals that were deeply involved in the reconstruction and recovery of disaster affected communities. This is because issues relating to disasters are better discussed with people with relevant experience. This is consistent with ``judgement sampling'' (Sekaran, 1992). The focus of the interview was on the needs of communities, and the skills required from construction industry professionals serving these communities. Accordingly, the interviews were more of a discourse structured around the stages of disaster management cycle. It is believed that it will be easier for respondents, especially the ones from the community stakeholder group, to describe their disaster experience and associated issues for interviewers to sieve the relevant parts. The semi-structured questions provided a good check and guide for the discussion. The data gathered from respective interviews were subsequently analysed using thematic coding (Flick, 1998). The themes that emerged from the interviews conducted were collated. Similar themes were merged after combining all related themes. The themes were presented under two main headings i.e. Needs and Skills. The items identified as "needs" are desires and expectations of respondents, some of the needs were said to be made available to their communities during their disaster experience. Some of the needs are also part of what the communities were expecting but were not provided for them. All the needs were categorised into five dimensions of resilience (Social, Economic, Institutional, Environmental, Technological) and each of the dimensions of resilience is sub-headed with the five stages of property lifecycle i.e. Preparation, Design, Pre-construction, Construction and Use stage (see Figure I).

>>>>>>>>>Insert Figure I<<<<<<<<<

4 Data Analysis and Results

The interview generated a long list of needs and skills with respect to the property lifecycle stages under the respective dimensions of resilience. The summary of identified set of needs and skills are presented as follows:

4.1 Analysis results for market needs and skills

The resulting list of "market skills and needs" is discussed under dimensions of resilience with the highlight of related property lifecycle stages indicated in accompanying Tables I-V. Since there were stages in the entire process of this study, labels (needs and skills) derived from interview transcripts were directly classified under property lifecycle and dimensions of resilience; all related needs and skills were then classified into broader groups in a defined order. In this section, the respondents' submissions with respect to market needs and skills were explored and the classifications derived after merging needs and skills like-for-like are presented in tables. The stages of property lifecycle are represented in the tables as indicated thus: Preparation Stage – PS, Design Stage – DS, Pre-Construction Stage – PCS, Construction Stage – CS, Use Stage – US.

4.1.1 Market needs and skills for enhancing economic resilience

All related needs and skills derived as requirements for enhancing economic resilience were merged as described in an earlier section of this paper. This resulted in eighteen classifications presented in Table I. Each of the classifications listed have sub items. For instance, budgeting and financial planning is a name given to the combination of the demand for financing (flood) adaptation strategies, fund sourcing and financial management skills, financial help, budgeting and financial planning, funding or financing to address disaster resilience, as extracted from the interview transcripts. Also, item 9, business planning is the name given to a combination of labels that emerged from the interview transcripts, the labels are business continuity strategies, business protection, and business plans. Also, Asset/Resource management that appears in the table is a result of the combination of labels like damage assessment, damage assessment and claim management, use of local skills and resources, needs assessment and prioritisation of resources, resource management, needs assessment and prioritisation of resources among others. It should be noted that each of the classifications have similar list of sub-items which were all seen by interviewees as requirements for enhancing economic resilience at different stages of property lifecycle as indicated in the table. It is appropriate to mention that the procedure that led to the identification of the stage of property lifecycle to which a classification heading suits most has been explained in Figure I. The 'x' in the table indicates the property stage to which the skill and needs that made up the classification are mostly relevant. Appearance of 'x' in more than one of the stages of the property cycle for a single classification implies that the skill needs are important to more than one stage in the property lifecycle. The non-assignment of a classification to some property stages does not imply outright irrelevance of that classification (needs and skills) at that stage but not as important as the other stages to which it has been assigned, refer to Figure I for details of data analysis process. The needs and skills identified as well as the eventual classifications are to be viewed from the context of disasters, disaster resilience and disaster management.

>>>>>>>>>Insert Table I<<<<<<<<<

4.1.2 Market needs and skills for enhancing environmental resilience

Nine classifications were derived from the interview as needs and skills required for enhancing environmental resilience (see Table II). It should be noted that the classifications are not arranged in order of importance. Similar to earlier discussions, building regulation & planning is a combination of similar themes that emerged from the interviews, among these themes are: knowledge on land-use planning, resilience planning, designing and construction. The classification Environmental assessment is a combination of themes: awareness of potential disaster threats, knowledge of potential hazards, risk and exposure, knowledge on weather and environmental changes, local topography, dealing with listed and old properties, weather changes monitoring, knowledge and experience of environmental or environment management among others. Continuing professional development as a classification emerged from the combination of education and training, education on disaster resilience, sustainability and disaster resilience modules in schools. Other classifications emerged from specific themes also but the focus of this paper is currently limited to main classifications with respective dimensions of resilience and the property lifecycle stages to which they are related.

>>>>>>>>>Insert Table II<<<<<<<<<<

4.1.3 Market needs and skills for enhancing institutional resilience

Classifications under each dimension of resilience were well refined to prevent the allocation of different names to the same set of themes. Institutional resilience refers to timely return of institutions to satisfactory functionality in terms of the delivery of institution based services to citizens after a catastrophe. It covers issues relating to administration, legal, political and professional services. Interviewees made submissions based on real experience of disaster situations as well as technical experiences with illustrations on some occasions. Eventually, the themes that emerged from the interview resulted in twenty five (25) classifications presented in Table III. Consultancy services as a classification resulted from the request of respondents for access to independent professionals, construction professional help, need for someone to oversee reconstruction. Respondents decried the inability of many residents to have access to professionals that can give valid and non-profit based advice at the different stages of construction and reconstruction. Stakeholder management as a classification resulted from the combination of themes from interviews such as clarity on roles and responsibilities of different parties, multi-stakeholder engagement among others while management of dispute resolution as a classification emerged from the combination of knowledge of dispute resolution i.e. grievance management procedures and similar themes. Legal/Regulatory compliance is a combination of policy and legal framework addressing built environment resilience, knowledge of prevailing laws, need for them, implementation and enforcement of relevant laws, need for the flexibility of laws and policies among others. It is clear that some of the classifications listed in this category also appeared under previous dimensions of resilience, this implies that the skills and needs have influence across the other dimensions of resilience and across the society as a whole although they have more significance in specific contexts.

>>>>>>>>>Insert Table III<<<<<<<<<<

4.1.4 Market needs and skills for enhancing social resilience

The interview analysis resulted in a long list as earlier mentioned; this resulted in twenty five (25) classifications as needs and skills requirement for enhancing social resilience (see Table IV). Social resilience refers to the ability to start, nurture and maintain positive relationships even in the face of threats or unpleasant eventualities or mishaps (Cacioppo *et al*., 2011). Team working is a product of the combination of themes such as effective involvement of community groups, relationship with other agencies and communities, maintaining or re-establishing community relationships, team working, social cohesion, working with the community, community participation and mobilisation, collaborative working, empowering community among others while cross cultural awareness resulted from the merging of themes such as use of local skills and local knowledge, language (familiarity with local language) and communication skills, understanding of differences in cultures, attitudes, motivation among others. Communication & negotiation/Information systems as a classification resulted from the merging of communication effectiveness, effective communication links, understanding of information and communication technology and other scientific advances and other similar themes. Quality leadership & people management emerged from the combination of themes such as understanding the community needs, people management and leadership skills, people management and communication, understanding emotional and psychological conditions of disaster victims, knowledge of how to help people, decision making skills among others. All other classifications listed were formed in similar ways and they all have influence on relationships, people cohesion and social resilience at the different stages of property development.

>>>>>>>>>Insert Table IV<<<<<<<<<<

4.1.5 Market needs and skills enhancing technological resilience

The needs and skills identified under technological resilience resulted in thirteen (13) classifications as shown in Table V. It is believed that the satisfaction of the items listed will enhance technological resilience. Some of the items listed have been explained in an earlier section of this paper e.g. consultancy service, building regulation and planning, environmental assessment and some others. Governance is a classification that resulted from political structure, initiative from government authorities and similar themes, work progress and quality management emerged from the combination of provision of resilient infrastructure facilities, knowledge of how to build existing properties back better, sustainable drainage system, resilient buildings and infrastructure, and similar themes. Construction technology and environmental services as a classification emerged from the combination of knowledge and experience of construction, knowledge and experience of construction technology, resilient infrastructure and resilient building construction methods and materials.

>>>>>>>>>Insert Table V<<<<<<<<<<

5 Discussions

Several skill and needs that can enhance societal resilience were derived from the interviews and presented above. As mentioned in the earlier part of this paper, this is part of a bigger research that is concerned with the identification of labour market/industry needs and skills. Jo da Silva *et al*. (2010) described post-disaster reconstruction or recovery as a complex process that requires multi-sectoral involvement, range of skills, and consumes very significant resources. The study divided key considerations in post-disaster reconstruction in to three key sections; the sections are planning, design and construction. It described planning as a stage when decisions relating to whether and how the process of reconstruction will proceed. It is important to state that although Jo da Silva *et al*. (2010) focused on post-disaster reconstruction and its interest was not on the needs and expectations of any stakeholder group in the disaster resilience theme, the submissions of the study has been corroborated by this research. This is evident in the number of times that issues relating to community participation and mobilisation, effective use of community groups, user involvement in design process, use of local skills and local knowledge, empowering and engaging communities, multi-stakeholder management was mentioned and emphasized. Similarly, the need for enhancement of local council capacities, understanding of political structure, senior level management availability and similar issues were also prominent especially under social and institutional resilience. Multi-stakeholder engagement practically implies the deployment of a range of skills and consequentially the consumption of huge resources. Due to space constraints, there were no elaborate discussions on the just mentioned items in this paper; some of the items were briefly discussed but were all merged accordingly with related ones to form the classifications listed in the Tables VI. Thus, the final set of classifications derived from labour market needs with respect to resilience dimensions across property life stages was filtered to generate a total list of 29 classifications. The 29 classifications derived with their respective related resilience dimensions and property life stages are presented in Table VI. The classifications were achieved after matching related needs and skills like-for-like with reference to literature where necessary.

>>>>>>>>>Insert Table VI<<<<<<<<<

6 Conclusions

The resilience of societies remains the ultimate target of all disaster resilience researches. This study has contributed in a peculiar way as it concentrated on an area of practice and viewed resilience through the eye of a key stakeholder group. The resilience of communities has a strong link with the resilience of other stakeholders groups since they all belong to one community or the other "geographically", it is just that their lines of practice define them better than their geographic positioning. Hence, the real operators and administrators of the community are in a better position to speak for the community. This study has identified the needs that can enhance societal resilience at different stages of property cycle, it is expected that the satisfaction of these needs will enhance the performance of built environment professionals and enhance societal resilience to disasters across all domains of resilience. The findings of the study will help in enhancing the services of construction professionals since the specific needs of those they serve in disaster situations have been largely revealed. It will also help in streamlining the practice of construction industry professionals with the attributes and indicators of disaster resilient communities as described by Cutter *et al*. (2008), Twigg (2009) and (Burton, 2012) among other authors. This study and similar ones conducted with

other stakeholder groups as mentioned in the research method section will be synchronised with existing international policy documents and moulded into modules for a professional doctorate programme.

References

Alexander, D. E. (2013), "Resilience and disaster risk reduction: an etymological journey", *Natural Hazards and Earth System Sciences",* Vol. 13, pp. 2707-2716.

Benson, C. & Twigg, J. (2007), "Tools for mainstreaming disaster risk reduction: Guidance notes for development organisations", Geneva: International Federation of the Red Cross and Red Crescent Societies/The ProVention Consortium.

Bosher, L., Dainty, A., Carrillo, P., Glass And, J. & Price, A. (2007a), "Integrating disaster risk management into construction: a UK perspective", *Building Research & Information,* Vol. 35 No.2, pp. 163-177.

Bosher, L., Dainty, A., Carrillo, P. & Glass, J. (2007b), "Built-in resilience to disasters: a pre-emptive approach", *Engineering, Construction and Architectural Management,* Vol. 14 No.5, pp. 434-446.

Burton, G. C. (2012), "The development of metrics for community resilience to natural disasters*",* PhD thesis, University of South Carolina, United States.

Cacioppo, J. T., Reis, H. T. & Zautra, A. J. (2011), "The value of social fitness with an application to the military", *American Psychologist,* Vol. 66 No.1, pp.43 - 51.

Cutter, S. L., Barnes, L., Berry, M., Burton, C., Evans, E., Tate, E. & Webb, J. (2008), "A place-based model for understanding community resilience to natural disasters", *Global Environmental Change,* Vol.18, pp.598-606.

Fearon, J., Humphreys, M. & Weinstein, J. (2008), "Community-driven reconstruction in lofa county: impact assessment", available at: http://www.alnap.org/resource/8192 (Accessed 28 April 2015).

Flick, U. (1998), *An Introduction to Qualitative Research.* Sage Publications: London.

Holling, C. S. (1973) "Resilience and stability of ecological systems", *Annual Review of Ecology and Systematics,* Vol. 4, pp. 1-23.

Hossain, M. A. (2013), "Community participation in disaster management: role of social work to enhance participation", *Antrocom Online Journal of Anthropology,* Vol. 9 No. 1, pp. 159 - 171.

Jo da Silva, Lubkowski, Z., Batchelor, V. & Kabir, R. (2010), *Lessons from Aceh: Key Considerations in Post-Disaster Reconstruction*. Practical Action Publishing: United Kingdom.

Manyena, S. B. (2009), "Disaster resilience in development and humanitarian interventions*",* PhD thesis*,* Northumbria University, UK.

Sapountzaki, K. (2007), "Social resilience to environmental risks", *Management of Environmental Quality: An International Journal,* Vol. 18 No.3, pp.274-297.

Sekaran, U. (1992), *Research Methods for Business*. John Wiley & Sons: New York.

Seneviratne, K., Baldry, D. & Pathirage, C. (2010), "Disaster knowledge factors in managing disasters successfully", *International Journal of Strategic Property Management,* Vol. 14 No. 4, pp. 376-390.

Thurairajah, N., Palliyaguru, R. & Williams, A. (2010), "Incorporate disaster management perspective into built environment undergraduate curriculum", available at: http://www.orbee.org/images/stories/paper_building%20resilience%20conference%202011.pdf (Accessed 28 April 2015).

Twigg, J. (2009), "*Characteristics of a Disaster-resilient Community (Version 2)*. Department for International Development: UK.

UNISDR (2005), "Hyogo framework for action 2005-2015: building the resilience of nations and communities to disasters, available at: http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf (Accessed 28 April 2015).

UNISDR (2009), "UNISDR terminology on disaster risk reduction", available at: http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf (Accessed 28 April 2015).

Wildavsky, A. (1991), "*Searching for Safety.* Transaction Publishers: New Brunswick.

List of Tables

Table I: Classification of needs and skills for enhancing economic resilience

No.	Classifications	Resilience Dimension	Property lifecycle stages				
		Economic Resilience (ER)	*PS*	*DS*	*PCS*	*CS*	*US*
1	Budgeting & financial planning	x	x	x	x	x	x
2	Quantification & costing of construction works	x	x	x	x	x	
3	Supply chain management	x	x	x	x	x	
4	Consultancy services	x	x	x	x	x	x
5	Procurement & contract administration/practice	x			x		
6	Health & safety	x					x
7	Work progress & quality management	x	x	x		x	x
8	Team working	x	x		x	x	x
9	Business planning	x	x	x	x	x	x
10	Environmental assessment	x	x	x			x
11	Management of the built environment	x	x	x		x	
12	Insurance	x	x	x	x	x	x
13	Communication & negotiation/Information systems	x	x				
14	Project audit & reporting	x	x		x	x	
15	Project management	x	x	x	x	x	x
16	Asset/Resource management	x	x	x	x	x	x
17	Disaster management	x		x			
18	Risk management	x		x			x

Table II: Classification of needs and skills for enhancing environmental resilience

No.	Classifications	Resilience Dimension Environmental Resilience (EvR)	Property lifecycle stages *PS*	*DS*	*PCS*	*CS*	*US*
1	Building regulation & planning	x	x	x		x	
2	Health & safety	x	x				x
3	Work progress & quality management	x	x	x	x	x	x
4	Governance	x	x	x	x	x	x
5	Environmental assessment	x	x	x	x	x	x
6	Management of the built environment	x	x	x		x	x
7	Disaster management	x	x				
8	Continuing professional development	x	x	x	x	x	x
9	Quality leadership and people management	x		x			

Table III: Classification of needs and skills for enhancing institutional resilience

No.	Classifications	Resilience Dimension Institutional Resilience (IR)	Property lifecycle stages *PS*	*DS*	*PCS*	*CS*	*US*
1	Supply chain management	x			x		
2	Consultancy services	x	x	x	x	x	x
3	Procurement & contract administration/practice	x			x		
4	Building regulation & planning	x	x	x	x	x	x
5	Legal/Regulatory compliance	x	x	x	x	x	x
6	Health & safety	x	x				
7	Work progress & quality management	x	x	x		x	x
8	Quality leadership & people management	x	x	x	x	x	x
9	Team working	x	x	x	x	x	x
10	Governance	x	x	x	x	x	x
11	Stakeholder management	x	x	x	x	x	x
12	Business planning	x	x	x		x	x
13	Environmental assessment	x	x	x		x	x
14	Management of the built environment	x	x	x		x	x
15	Insurance	x	x		x		x
16	Time management	x	x	x	x	x	
17	Communication & negotiation/Information systems	x	x	x	x	x	x
18	Project audit & reporting	x	x				
19	Management & dispute resolution procedures	x	x	x	x	x	x
20	Cross cultural awareness in global resilience	x	x	x	x	x	x
21	Project management	x	x	x	x	x	x
22	Asset/Resource management	x				x	x
23	Risk management	x					x
24	Continuing professional development	x					x
25	Emergency management	x		x			

Table IV: Classification of needs and skills for enhancing social resilience

No.	Classifications	Resilience Dimension Social Resilience	Property lifecycle stages PS	DS	PCS	CS	US
1	Supply chain management	x	x	x	x	x	x
2	Consultancy services	x	x	x		x	x
3	Procurement & contract administration/practice	x	x		x		
4	Building regulation & planning	x	x	x		x	
5	Health & safety	x	x	x	x	x	x
6	Work progress & quality management	x	x	x		x	x
7	Quality leadership & people management	x	x	x	x	x	x
8	Team working	x	x	x	x	x	x
9	Governance	x	x	x	x	x	x
10	Stakeholder management	x			x		
11	Business planning	x	x		x	x	
12	Environmental assessment	x	x	x	x	x	x
13	Management of the built environment	x	x	x		x	x
14	Insurance	x	x				
15	Time management	x	x	x	x	x	
16	Communication & negotiation/Information systems	x	x	x	x	x	x
17	Cross cultural awareness in global resilience	x	x	x	x	x	x
18	Project management	x	x	x	x	x	x
19	Asset/Resource management	x	x	x	x	x	x
20	Disaster management	x		x			
21	Continuing professional development	x					x
22	Emergency management	x	x	x		x	x

Table V: Classification of needs and skills for enhancing technological resilience

No.	Classifications	Resilience Dimension Technological Resilience (TR)	Property lifecycle stages PS	DS	PCS	CS	US
1	Supply chain management	x	x	x	x	x	
2	Consultancy services	x	x	x	x	x	x
3	Building regulation & planning	x	x	x	x	x	x
4	Health & safety	x	x				x
5	Work progress & quality management	x	x	x	x	x	x
6	Governance	x	x	x	x	x	
7	Environmental assessment	x	x	x	x	x	x
8	Management of the built environment	x	x	x		x	x
9	Communication & negotiation/Information systems	x	x	x	x	x	x
10	Asset/Resource management	x		x	x	x	
11	Risk management	x	x	x			x
12	Continuing professional development	x					x
13	Construction technology & environmental services	x	x	x	x	x	x

Table VI: Final set of Classifications

No.	Classifications	Resilience dimensions					Property lifecycle stages				
		ER	EvR	IR	SR	TR	PS	DS	PCS	CS	US
1	Budgeting & financial planning	x					x	x	x	x	x
2	Quantification & costing of construction works	x					x	x	x	x	
3	Supply chain management	x		x	x	x	x	x	x	x	x
4	Consultancy services	x		x	x	x	x	x	x	x	x
5	Procurement & contract administration/practice	x		x	x		x		x		
6	Building regulation & planning		x	x	x	x	x	x	x	x	x
7	Legal/Regulatory compliance			x			x	x	x	x	x
8	Health & safety	x	x	x	x	x	x	x	x	x	x
9	Work progress & quality management	x	x	x	x	x	x	x	x	x	x
10	Quality leadership & people management			x	x		x	x	x	x	x
11	Team working	x		x	x		x	x	x	x	x
12	Governance		x	x	x	x	x	x	x	x	x
13	Stakeholder management			x	x		x	x	x	x	x
14	Business planning	x		x	x		x	x	x	x	x
15	Environmental assessment	x	x	x	x	x	x	x	x	x	x
16	Management of the built environment	x	x	x	x	x	x	x		x	x
17	Insurance	x		x	x		x	x	x	x	x
18	Time management			x	x		x	x	x	x	
19	Communication & negotiation/Information systems	x		x	x	x	x	x	x	x	x
20	Project audit & reporting	x		x			x		x	x	
21	Management & dispute resolution procedures			x			x	x	x	x	x
22	Cross cultural awareness in global resilience			x	x		x	x	x	x	x
23	Project management	x		x	x		x	x	x	x	x
24	Asset/Resource management	x		x	x	x	x	x	x	x	
25	Disaster management	x	x		x		x	x			
26	Risk management	x		x		x	x	x			x
27	Continuing professional development		x	x	x	x	x	x	x	x	x
28	Emergency management			x	x		x	x		x	x
29	Construction technology & environmental services					x	x	x	x	x	x

Key:
Preparation Stage – PS, Design Stage – DS, Pre-Construction Stage – PCS, Construction Stage – CS, Use Stage – US and Economic Resilience – ER, Environmental Resilience – EvR, Institutional Resilience – IR, Social Resilience – SR, Technological Resilience – TR.

List of Figures

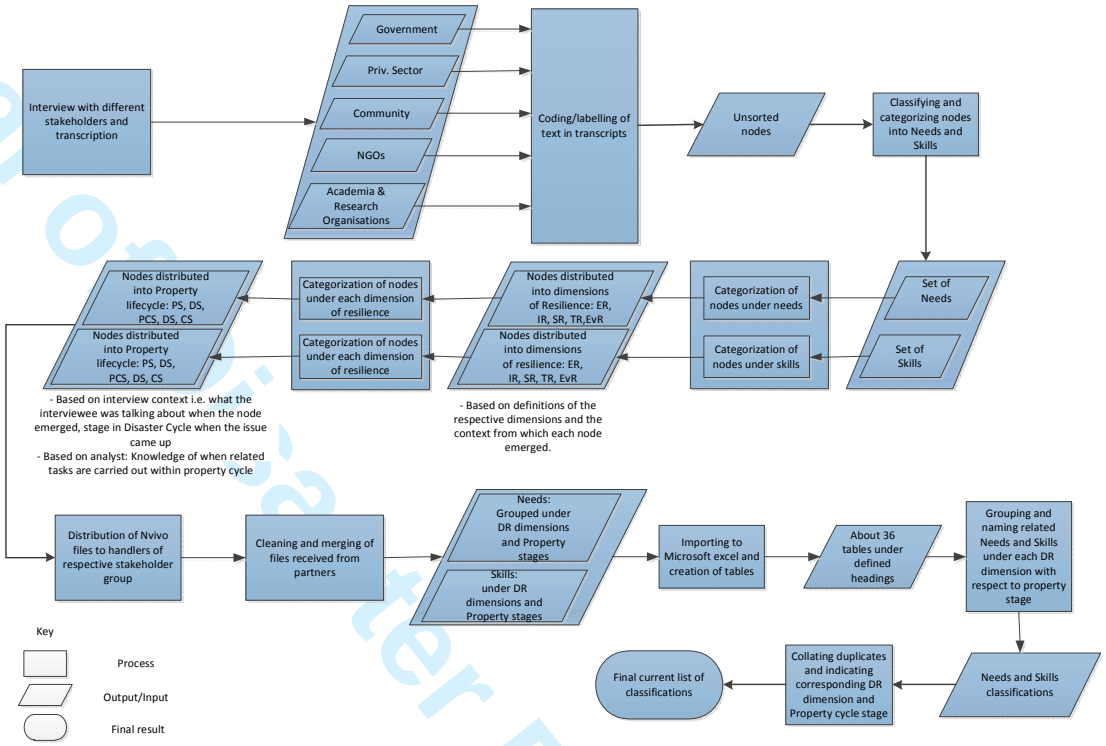

Figure I: Summary of data collection and analysis process