A Decision Support System for Affordable and Sustainable Housing Design and Delivery in Least Developed Countries (LDCs)

John Bruen, John P. Spillane and Su Taylor

Introduction

The right to adequate housing is central within the global legal system and has been recognised from as far back as 1948 in the Universal Declaration of Human Rights to current day recognition as a human right within the United Nations Universal Declaration of Human Rights. The adequacy of housing should not be merely interpreted as just shelter or having a 'roof over one's head'. Housing is a multidimensional and complex area involving many stakeholders from a wide variety of backgrounds. The adequacy of housing needs to reflect this complexity and should be measured against factors such as security of tenure, materials, availability of services, affordability, habitability, cultural adequacy and its contribution to society and sustainable communities so as to ascertain its true value (IASC, 2011).

The need for a sustainable approach to housing has been recognised globally and outlined in a number of globally recognised documents. These strategy and goal documents provide guidance and have promoted and reinforced new approaches to housing provision in LDCs. They include the Global Strategy for Settlement and Shelter and Agenda 21. The need for sustainable approaches to all aspects of development is further recognised in the United Nations Sustainable Development Goals, or SDGs as they are also referred to. Also known as the Global Goals, they are a universal call to end poverty and protect the planet for the enjoyment of all people.

J. Bruen (✉) · S. Taylor
School of Natural and Builit Environment, Queen's University, Belfast, UK
e-mail: john@bruenarchitects.com

J. P. Spillane
University of Limerick, Limerick, Ireland

L. Scott et al. (eds.), *Sustainable Ecological Engineering Design*,
https://doi.org/10.1007/978-3-030-44381-8_9

They consist of 17 interconnected global goals covering a wide range of global issues such as poverty, climate, global inequality and other priorities. Sustainable Goal 11 "Sustainable Cities and Communities" makes specific reference to the built environment, housing, disasters and the importance of preserving culture and identity:

> *By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums*
>
> *Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials*
>
> *Strengthen efforts to protect and safeguard the world's cultural and natural heritage*

The SDGs recognise important aspects of sustainable development that are often overlooked in the implementation of housing, for example, culture, natural heritage, use of natural materials and building resilient buildings. However, the SDGs only provide a broad overview of the objectives, targets and goals to be achieved on a macro scale and not a specific approach to achieve them in the specific context of housing provision in individual LDCs to which this study relates. People and how they live are central to global sustainable development and the achievement of the global SDGs. The current and future demands for adequate housing play a central role in achieving the SDGs and fulfilling recognised human rights. However, a number of aspects affect achieving these noble goals and despite its central place in international law over 1 billion of the world's population are not adequately housed (UN-Habitat, 2009).

The aim of this research is to examine the current decision-making process of leading international organisations in the design and delivery of sustainable post-disaster housing in LDCs, and through a case study approach, develop a DSS for use in the development of better sustainable design practices in house construction in LDCs. To achieve this aim, the following objectives will be met:

1. Identify and explore the current challenges/barriers to the design and delivery of sustainable post-disaster housing in LDCs.
2. Identify current approaches to housing delivery in LDCs and post-disaster contexts.
3. Identify the drivers that contribute to sustainable and affordable housing in LDCs and post-disaster contexts.
4. Develop a DSS that will be freely available to NGOs, communities and other relevant stakeholders operating in the field of housing design and delivery in LDCs and post-disaster contexts. The overall objective is that the free dissemination of the decision support system will ultimately aid in enhancing the quality of design and delivery of sustainable post-disaster housing and the communities it serves that are affected by homelessness and poverty.

Literature: Housing Shortages in LDCs

There are various themes and concepts involved in the complex area of housing provision in LDC contexts in order to obtain an overall view of the various aspects for consideration and to inform the research study. The literature explored various aspects to include causes of housing shortage, current approaches to housing in LDCs, current challenges and barriers faced in the provision of housing and also the drivers that can aid effective design and delivery of housing in LDCs.

Population Growth

A number of main factors contribute to the global housing shortage and associated poverty. Population growth is a main contributor to the global housing shortage (UN-Habitat, 2009). World population growth has increased at an unprecedented rate in recent times and is predicted to continue to grow in the foreseeable future (UN, 2017). Global population has grown to almost 7.6 million as of mid-2017 and is projected to continue growing to 9.8 billion by 2050. LDCs are set to contribute disproportionally to the overall global population growth. Population growth in these counties is predicted to nearly double between 2017 and 2050 (UN, 2017). With this upward trajectory in global population growth comes the unavoidable rise in demand of basic human needs such as water, food and shelter.

Disasters

Disasters are a somewhat unknown quantity in terms of when and where they will occur. Historically disasters were considered “acts of god” and nothing could be done to prevent their occurrence (Voogd, 2004). In more recent times disasters were considered “acts of nature”, and more recently they are considered an “act of society” (Malalgoda, Amaratunga, & Haigh, 2014). They can be both natural, such as an earthquake and tsunami, and man-made, such as conflict and biological disasters. What is known is that the frequency and destruction caused by disasters increases and LDCs are worst affected. Many LDCs are innately more vulnerable to natural disasters and have experienced disproportionate levels of devastation as a result of disasters, both in the human life, cost and the resulting large numbers of internally displaced populations (Schilderman, 2004). This vulnerability is often caused by common issues which are experienced in many LDCs including lack of preventative actions plans and preparedness, development in areas susceptible to natural disasters, unsettled governments, poor construction standards and techniques, insufficient resources and knowledge in post-disaster recovery and the reconstruction cost relative to GDP in these regions (Toya & Skidmore, 2007). The scale of

displacement of populations resulting from disasters is growing. In 2015, natural disasters displaced an estimated 19.2 million people worldwide (IDMC, 2016).

The built environment and construction sector accounts for a significant part of a country's physical assets and economic development contribution. As such, the built environment is a major part of society and it is important to develop appropriate built environments that provide resilience and the ability to adapt to the threats of disasters (Bosher, 2008). However, regardless of preparation the built environment is vulnerable to the effects of disasters and as such disasters have the potential to have a devastating impact on a country and can create significant impacts on social and economic activities (Malalgoda & Amaratunga, 2015).

Disaster Management Cycle

Many organisations involved in works relating to disaster utilise a disaster management approach referred to as the disaster management cycle. White et al. (2004) describes the disaster management cycle as a set of sequential stages that occur during the unfolding of a disaster at which interventions can be undertaken to help lessen or mitigate against the impact of that disaster. This includes not just reactive measures during or after the event but also preventive measures prior to the event. Traditionally there are four stages to the disaster management cycle, namely, (1) preparation, (2) mitigation, (3) response and (4) recovery, which occur at three different periods during the cycle. The three periods include before the event (pre-disaster), impact (disaster) and after the event (post-disaster).

Post-disaster Reconstruction

Post-disaster reconstruction forms only one element of the overall recovery process but a very important one. Sevin and Little (1998) outline that although construction by itself will not eradicate all the impacts of disasters, the construction community and construction has an important role to play in finding and providing appropriate solutions to the continuous threat of disaster. There is also recognition that the construction industry can play a wider role as it assesses, prepares, prevents, responds and recovers from disasters. Post-disaster reconstruction covers many different aspects of the built environment depending on the context and disaster that preceded it. Housing projects often come as first priority in many post-disaster contexts. In LDCs much of the population would have no home insurance as in developed countries and it falls on the government and the international community to endeavour to provide housing for the homeless as a result of the disaster (Hidayat & Egbu, 2010). The process of reconstruction requires considerable medium- and long-term strategic consideration in order to capitalise on an opportunity to improve on the built environment that preceded it.

Sustainable Construction in LDCs

The majority of the world's population currently live in LDCs and future population growth projections anticipate that the majority of growth will also be in LDCs. The need for long-term sustainable approaches in the delivery of construction projects to meet these demands from the construction industry is clear (Du Plessis, 2002). Reffat (2004) states that the concept of sustainability has only recently been introduced into LDCs construction industries and that sustainability and sustainable construction are not yet an essential part of the decision-making process. Banishashemi, Hosseini, Golizadeh, and Sankaran (2017) argue that LDCs put economic development above sustainable requirements with construction demand overshadowing environmental concerns. The demands of sustainable construction in LDCs can differ greatly from that of developed countries. Du Plessis (2002) states that the construction approaches from developed countries, which are highly reliant on technical solutions, adapted by LDCs are inappropriate and must be expanded to address the social and economic pillars of sustainability. Perceived higher costs and underlying socio-cultural factors also contribute to the lower levels of social acceptability of sustainable construction in the main stream affordable housing market (Sibley, Hes, & Martin, 2008). Othman and Ahmed (2013) note that a wide range of challenges exist that affect delivery of sustainable construction projects in LDCs outlining five main headings under which they fall which include human development, technical, managerial, political and the triple bottom line of sustainability (environmental, social and economic).

Decision-Making

Human performance in decision-making has been the topic of research from a number of different perspectives. From a psychological perspective, it is necessary to examine individual decisions in the context of a set of needs, preferences an individual has and values they seek. From a cognitive perspective, the decision-making process must be regarded as a continuous process integrated in the interaction with the environment. From a normative perspective, the analysis of individual decisions is concerned with the logic of decision-making and rationality and the invariant choice it leads to (Kahneman & Tversky, 2000). Different professions refer to decision-making differently, i.e. architecture may refer to decision-making as design. All architects and engineers as designers and project managers, make many decisions on a daily basis in relation to their work. The process of designing reconstruction projects, infrastructure, public space, etc. involves many decisions to be taken on many different levels. On a very simple level a typical design process involves three main stages (Cuff, 1991):

1. Initial concept stage.
2. Design development (problem solving stage).

3. Working drawing/implementation phase.

As every project is unique, these three basic main stages may vary from project to project. However, regardless of what stage a project is at or what context it is located in, design decisions, like all decisions, are based on some rationale or logic as well as being conducted in the context of that particular project (Holm, 2006). Logical decision-making is an important part of all science-based professions within which architects and engineers are deemed to exist, where specialists apply their knowledge in a given area to making informed decisions. Professional decision-making is often seen as being the skilful application of technical knowledge within ethical limitations (Holm, 2006).

Affordability and Sustainability

Affordable housing is an essential concept to LDCs as governments in these countries cannot afford to provide all the required housing Menshawy, Shafik, and Khedr (2016). Affordability and affordable housing is a difficult term to define as it can have different meaning to different people and vary widely from country to country or region to region. In many LDCs, affordability in mainstream housing markets is associated with economic sustainability often with little emphasis on environmental social sustainability (Randolph, Kam, & Graham, 2008). Stone (2006) states that the term "affordable housing" is an unjustified term and that affordability is not a characteristic of housing but rather it is a relationship between housing and people arguing that for some people all housing is affordable regardless of price and for others it is not affordable unless it is free. Stone further argues that "affordable" housing can have meaning and use but only if three essential questions are answered:

1. Affordable to who?
2. On what standard of affordability?
3. For how long?

Incomes in LDCs are lower and as such housing can represent a much higher proportion of a family's income. Other aspects relative to LDCs such as immense population growth with demand out stripping supply, lack of materials, skills and design/construction knowledge, higher levels of natural disasters and fewer utilities often serve to raise the cost of housing relative to the incomes in many contexts. Hayles (2006) states that affordability and sustainability are intrinsically linked, and to be affordable, a house must embrace sustainability principles and be designed and constructed to last. Hayles further states that sustainable affordable housing must meet several goals and be designed so that value to the consumer outweighs its financial cost. In many developed countries this can be largely related to the energy efficiency of the dwelling and the running and maintenance cost over its lifetime. Johnson (2006) further argues that decent affordable housing contributes to the economic, environmental and social health—the sustainability—of communities. McIntosh

(2013) develops this view arguing that any new house, regardless of context, must be within the confines of what is affordable, resilient to future extreme weather events, be culturally appropriate and strengthen community structures.

Research Methodology and Method

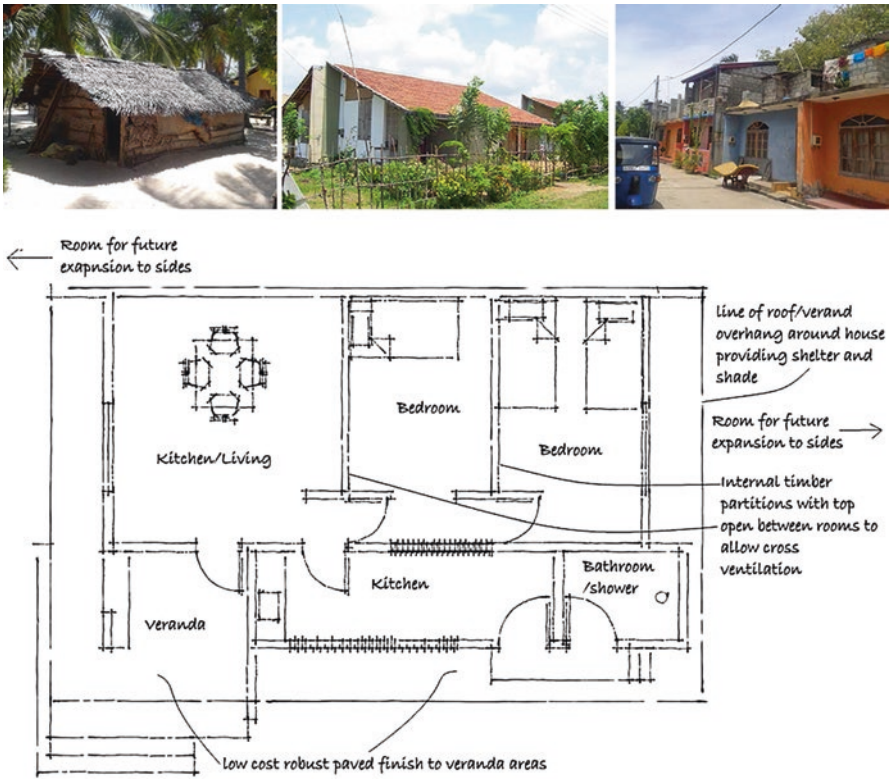
The research bridges the domains of architecture and project and design management, in particular the aspect of decision support. A literature review in the relevant areas provided background knowledge of the issues and challenges in this research area and informed the overall identification of gaps in knowledge and the research methodology. A qualitative approach to the research was employed as an appropriate method to ascertain the experiences, attitudes and processes of the various international organisations operating in post-disaster contexts. A multiple qualitative case study approach consisting of 12 individual case studies was undertaken with 9 selected international organisations operating in the area of housing provision in LDCs and post-disaster contexts on a worldwide basis. For environmental and intensity of data collection reasons Sri Lanka was chosen as a country for 10 of the 12 case studies. Sri Lanka was subject to a number recent disasters, e.g. tsunami and recently the ended 30 year civil conflict, and was in the process of rebuilding many parts of the country as a result.

Multiple sources of evidence were utilised, e.g. literature review, 15 semi-structured interviews, documentation and observation of the physical artefact (constructed houses in their context) to collect case study data from the field. Selected approaches were utilised to analyse the data including cognitive mapping, data reduction, logic diagrams and thematic analysis to ascertain the key themes that informed the organisations decision-making and to identify the process followed in undertaking projects in LDC and post-disaster contexts (Figs. 1–4).

Research Results

Research Aim 1 Identify and explore the current challenges/barriers to the design and delivery of sustainable post-disaster housing in LDCs.

The literature identified an extensive list of barriers to the design and delivery of affordable and sustainable housing in LDCs. Many of these barriers were also identified in the field research which further verifies their existence as legitimate barriers in a real-world context and further adds to and confirms the existing knowledge on this topic. On review of the identified barriers, they can be summarised into a number of broad categories some of which relate to the organisations or designers themselves and other wider societal factors which include:



Figs. 1–4 Examples of field research data collection

- Lack of understanding of the true concept of sustainable design and its holistic application in the design and delivery of sustainable housing in LDCs.
- Sustainable design not prioritised in LDCs and post-disaster contexts.
- Governmental and institutional rules and parameters, e.g. design constraints, procurement routes and inappropriate regulations.
- Psychological and sociological issues in relation to sustainable design and its potential output, e.g. materials and approaches that deviate from what is deemed the norm.
- Lack of guidance and guidelines for relevant stakeholders operating in the area.
- Lack of research into this area.
- Poor management in relation to the design and delivery of sustainable housing in terms of both design and project management.

Research Aim 2 Identify current approaches to housing delivery in LDCs and post-disaster contexts.

Top-down strategies from governments and NGOs were identified as a common approach to housing in LDCs and post-disaster contexts. These approaches resulted

in little or no consultation or participation with the beneficiaries and were often detrimental to the long-term sustainable performance of the houses and communities. Standardised house design with the use of inappropriate materials and technologies with little reflection of the local culture were identified as common approaches to housing provision. More recent times have seen the greater use of bottom-up macro level self-help approaches. Barriers to the effective implementation of a participation process were identified from the literature. It was observed in both the literature and case studies that in order for participation to be meaningful, the project beneficiaries must be involved from the outset and have genuine control over decision-making. The case studies demonstrate that effective use of a participatory design and delivery process utilising a holistic approach to sustainability can result in appropriate and affordable long-term homes.

Research Aim 3 Identify the drivers that contribute to sustainable and affordable housing in LDCs and post-disaster contexts.

Three main design drivers were identified from the research that contributed to the implementation of sustainable and affordable housing LDCs and post-disaster contexts.

1. Appropriate design and material selection.

   The use of appropriate design and materials were identified as key drivers in the efforts to deliver sustainable and affordable housing LDCs and post-disaster contexts. Localised skills, materials and techniques offered the potential to both deliver appropriate housing and adequately address a holistic approach to sustainability as a result of the spin off effects of this approach. The use of local and traditional materials can generate employment in the community, in the supply of materials and manufacture of building products as well the utilisation and improvement if required, of local knowledge in terms of construction techniques. Practical aspects such as maintenance, future community expansion and employment within the community can all benefit from this approach. Housing typologies should contextually and culturally appropriate of the communities they serve. Case studies highlighted the obstacles to implementing this approach in practice which were predominantly external factors outside of their control, e.g. government or building standards, donors requirements for a particular material or housing typology.
2. Appropriate innovative technology and knowledge transfer specific to developing world contexts.

   Appropriate technology use in conjunction with appropriate design and materials informed by the local conditions and culture can result in long-term sustainable and affordable housing. Western technology imported to a LDC context does not necessarily result in a seamless assimilation into that context. Care should be taken to ensure that the transfer of knowledge and technology by whatever means is firstly well considered on different levels and assessed as to its appropriateness to the context. Achieving this can often require in-depth research

into the housing beneficiaries cultural beliefs and the wider cultural context prior to commencing any design work. The research highlighted that this approach was undertaken by a number of organisations and was central to their informed approach with positive outcomes. Small improvements to existing approaches and technology resulted in long-term positive outcomes in a number of instances. However, aspects such as time, cost and acceptance by the community were highlighted as a main obstacle to implementing this approach.

3. Design decision-making assistance tools.

   The literature outlined that limited knowledge and information coupled with the complex relationship between a building and its environment are often the cause of ill informed decisions on long-term sustainable and affordable design and delivery of housing in LDC and post-disaster contexts. Frameworks and structured systematic approaches that enable complex decisions with many competing variables to be made manageable are identified as effective methods to address this. It was highlighted that decision support tools to date were focused on developed country contexts and none were specifically designed for sustainable and affordable housing in LDC or post-disaster contexts. The case study research further confirms this finding. Despite many years' experience on a global basis, none of the organisations had a specific decision support system or framework formulated to aid in the design and delivery process, instead relying on tacit knowledge within the organisation and lessons learned from previous projects.

Research Aim 4 Develop a decision support system that will be freely available to NGOs, communities and other relevant stakeholders operating in the field of housing delivery in LDCs and post-disaster contexts.

A gap was identified for a tool that enabled and assisted architects, project managers and another stakeholders operating in this complex area with their decision-making process from inception to completion. Detailed analysis was undertaken of the case study organisation's approaches to the design and delivery of housing in LDC and post-disaster contexts. Semi-structured interviews with key design decision-makers from each organisation were analysed utilising a combination of cognitive mapping and thematic data reduction to ascertain key themes across all organisations in relation to their decision-making and approaches on projects. Further analysis of logic diagrams constructed for each organisations approach highlighted key stages and aspects considered by the organisation at each stage which enabled a further in-depth understanding of each organisation's overall approach in a graphical format. Analysis of the logic diagrams for each organisation identified key stages common to all organisation as well as additional stages undertaken by some. Combining all research findings a user-friendly decision support system was designed utilising Microsoft Excel as a platform (Fig. 5).

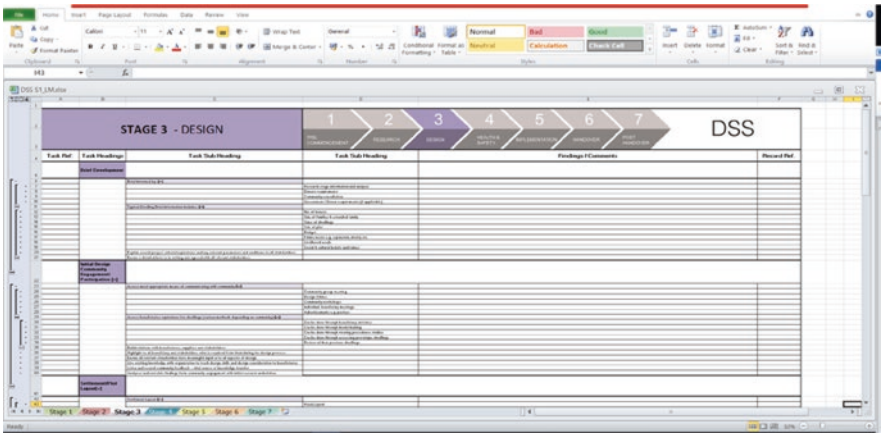


Fig. 5 Screen print of Decision Support System developed from the research

Discussion and Conclusion

The finding and output of this research contribute to both architectural and design management theory and practice. On review of the literature, it was evident that there was a lack of documented knowledge in relation to the decision-making process and management for the design and delivery of sustainable housing in LDC and post-disaster contexts. While the literature has recognised barriers and drivers that organisations face in the design of housing and delivery, the majority of the literature fails to address the processes and stages a typical organisation go through in terms of the design and delivery of housing and the variables that impact their decisions. Through detailed analysis of case study data from a real-world context and the contribution from leading international organisations, the study provides pivotal new information on the various aspects and stages involved in the overall complex process. The study's findings on key themes that influence design decision-makers both confirm findings from the literature review and provide additional findings. This combined with the development of a decision support system for use in a real-life context provide a fresh perspective on the overall process and key aspects in decision-making and contribute to the body of knowledge in this area.

Unfortunately many NGOs, INGOs and other organisations often utilise ad hoc and inappropriate or outdated approaches to housing design and delivery in post-disaster contexts that lack meaningful design considerations and engagement with the wider factors that affect the communities they are serving. This is often as a result of organisations not having the requisite expertise or being forced into a role that they are not competent to undertake. This study aims to address these short comings through the detailed analysis of approaches of leading international housing organisations and the development of a decision support system that can be easily disseminated to assist many different stakeholders involved in the field and ultimately benefit the communities served in the long term. Regardless of each

organisation's approach, the participating organisations had a high degree of tacit knowledge based on many years' experience working in many LDCs and post-disaster contexts worldwide.

The study is unique in nature in that it gained access to, documented and analysed this knowledge from leading international organisations and identified common themes and approaches for best practice from real-world field research. Each organisation brought something unique to the study and the final proposed decision support system is based on their individual experiences. This was further reflected in the fact that each participating organisation was happy to participate in the study as they recognised that their own methods and approaches, while successful for their organisation, were not guaranteed to be correct or best practice. The organisations were keen to learn from other leading organisations and disseminate their own knowledge in this area with the overall aim of contributing to academic knowledge with data from the field and to assist other organisations and ultimately the communities served.

References

Banishashemi, S., Hosseini, M. R., Golizadeh, H., & Sankaran, S. (2017). Critical success factors (CFFs) for integration of sustainability into construction project management practices in developing countries. *International Journal of Project Management, 35*, 1103–1119.

Bosher, L. (2008). The need for built in resilience. In L. Bosher (Ed.), *Hazards and the built environment—Attaining built-in resilience* (pp. 3–19). Oxon: Routledge.

Cuff, D. (1991). *Architecture: The story of practice*. Cambridge, MA: MIT Press.

Du Plessis, C. (2002). *Agenda 21 for sustainable construction in developing countries: A discussion document*. Pretoria: CSIR Building and Construction Technology.

Hayles, C. S. (2006). An examination of the relationship between sustainability and affordability in residential housing markets. In *12th Pacific Rim Real Estate Conference, Auckland, New Zealand, January 22–25, 2006*.

Hidayat, B., & Egbu, C. (2010). A literature review of the role of project management in post-disaster reconstruction. In C. Egbu (Ed.), *Proceedings of the 26th Annual ARCOM Conference, September 6–8, 2010* (pp. 1269–1278). Association of Researchers in Construction Management: Leeds.

Holm, I. (2006). *Ideas and beliefs in architecture and industrial design*. Doctoral Thesis, Oslo Scholl of Architecture and Design.

IDMC. (2016). *Global report on internal displacement*. Retrieved August 20, 2017 from http://www.internal-displacement.org/assets/publications/2016/2016-global-report-internal-displacement-IDMC.pdf

Inter-Agency Standing Committee. (2011). *IASC operational guidelines on the protection of persons in situations of natural disasters*. The Brookings—Bern Project on Internal Displacement.

Johnson, M. (2006). Decision models for affordable housing and sustainable community development. *Journal of the American Planning Association: The Future(s) of Housing*. Retrieved December 29, 2018 from https://www.researchgate.net/publication/228797899_Decision_Models_for_Affordable_Housing_and_Sustainable_Community_Development

Kahneman, D., & Tversky, A. (2000). *Choice, values, frames*. Cambridge: Cambridge University Press.

Malalgoda, C., & Amaratunga, D. (2015). A disaster resilient built environment in urban cities: The need to empower local governments. *International Journal of Disaster Resilience in the Built Environment, 6*(1), 102–116.

Malalgoda, C., Amaratunga, D., & Haigh, R. (2014). Challenges in creating a disaster resilient built environment. *Procedia Economics and Finance, 18*, 736–744.

McIntosh, J. (2013). The implications of post disaster recovery on affordable housing. In *Approaches to disaster management—Examining the implications of hazards, emergencies and disasters*. ISBN: 978-953-51-1093-4. Retrieved December 29, 2018 from https://www.intechopen.com/books/approaches-to-disaster-management-examining-the-implications-of-hazards-emergencies-and-disasters

Menshawy, A. E., Shafik, S., & Khedr, F. (2016). Affordable housing as a method for informal settlements sustainable upgrading. *Procedia—Social and Behavioural Sciences, 223*, 126–133.

Othman, E., & Ahmed, A. (2013). Challenges of mega construction projects in developing countries. *Organization, Technology and Management in Construction, An International Journal, 5*(1). Retrieved December 28, 2018 from https://www.researchgate.net/publication/243457533_Challenges_of_mega_construction_projects_in_developing_countries

Randolph, B., Kam, M., & Graham, P. (2008). Who can afford sustainable housing. In A. Nelson (Ed.), *Steering sustainability in an urbanizing world*. Aldershot: Ashgate.

Reffat, R. (2004). Sustainable construction in developing countries. In *Proceedings of First Architectural International Conference*. Giza: Cairo University.

Schilderman, T. (2004). Adapting traditional shelter for disaster mitigation and reconstruction: Experiences with community-based approaches. *Building Research & Information, 32*(5), 414–426.

Sevin, E., & Little, R. (1998). Mitigating terrorist hazards. *The Bridge, 28*(3), 156–172.

Sibley, J., Hes, D., & Martin, F. (2008). A triple helix approach: An inter-disciplinary approach to research into sustainability in outer suburban housing estates. In *Proceedings of Methodologies in Housing Research Conference, Stockholm, September 2008*.

Stone, M. E. (2006). What is housing affordability? The case for the residual income approach. *Housing Policy Debate, 17*(1), 151–184. Retrieved October 1, 2017 from www.works.bepress.com/michael_stone/5/

Toya, H., & Skidmore, M. (2007). Economic development and the impacts of natural disasters. *Economics Letters, 94*, 20–25.

United Nations, Department of Economic and Social Affairs, Population Division. (2017). *World population prospects: The 2017 revision, key findings and advance tables*. Working Paper No. ESA/P/WP/248.

United Nations Human Settlements Programme (UN-HABITAT). (2009). *Planning sustainable cities: global report on human settlements 2009*. London: Earthscan.

Voogd, H. (2004). Disaster prevention in urban environments. *European Journal of Spatial Development, 12*, 1–14.

White, P., Pelling, M., Sen, K., Seddon, D., Russel, S., & Few, R. (2004). *Disaster risk reduction: A development concern. A scoping study on the links between disaster risk reduction, poverty and development*. Oversears Development Group, University or East Anglia. Retrieved October 2, 2017 from www.preventionweb.net/files/1070_drrscopingstudy.pdf