The role of disaster knowledge management in improving housing reconstruction outcomes: with particular reference to Postearthquake reconstruction in Pakistan

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Abstract

Purpose – Rural building practices, especially in developing communities, are often plagued by inadequate local construction knowledge and a limited understanding of the best building practice guidelines. This has contributed significantly to compounding the effect of significant catastrophic events. The purpose of this paper is to examine the potential impact of disaster knowledge management (DKM) on improving housing resilience and makes particular reference to the 2005 earthquake in rural Pakistan.

Design/methodology/approach – Our research uses a comprehensive literature review that involves a qualitative approach to research aimed at understanding the 2005 earthquakes, their impacts, reconstruction challenges and DKM. Conventional published journals, articles, previous case studies and books were included. But importantly, to take in relevant local information, the review also took in published government reports, disaster mitigation policy documents, national and international NGOs publications, conference proceedings and news articles. More than 80 research papers and conference proceedings over 21 years, from 2001 to 2021, were analyzed in eight major online databases. These include Google Scholar, Science Direct, Research Gate, Scopus, Jstor, Springer, Emerald and Semantic Scholar.

Findings – The investigation identified that DKM has an important role to play in capacity building and technical knowledge transmission relating to seismic guidelines aimed at improving housing resilience. Consequently, a theoretical framework was developed, focused primarily on the post-2005 rural reconstruction mechanism and the identification of key challenges to disseminating seismic guidelines effectively in relation to rural construction practices.

Originality/value – This paper makes an original contribution by developing a DKM framework via the identification of key challenges that need to be addressed, in relation to rural construction practices, generally, but particularly in the Pakistan context.

Keywords Earthquake resistant construction, Disaster knowledge management (DKM), Owner driven reconstruction (ODR), 2005 Earthquake Pakistan, Rural construction mechanism, Mitigation measures, Nonengineered construction

Paper type Literature review

1. Introduction

The essential shift toward improving resilience in disaster management (DM) planning in countries like Pakistan relates to both minimizing losses from disasters and maximizing the capacity to proactively recover from the disaster situation (Rafi et al., 2016). The...
establishment of sustainable society goals challenges the capacity of countries everywhere to adapt and change (Bothara and Hiçyılmaz, 2008). DM capacity broadly refers to the systematic organization and management of significant roles and responsibilities in dealing with emergencies (Ahmed, 2013; Haseeb et al., 2011). Consequently, to build resilient and sustainable infrastructure, DM, at the national and regional levels, must incorporate effective mitigation measures (Pearce, 2003). Such measures are most effective when they involve a wide range of stakeholders, who co-develop response-to-hazard events and effects scenarios that improve realistic long-term plans for structuring local resilience (Sheppard et al., 2011). However, disaster mitigation policies are heavily biased toward the technical issues relating to resilient structures and construction. But the serious shortcoming identified by some researchers is that this tends to undervalue other essential elements significantly, in particular, the knowledge, skill and capacities of local people who would be directly involved in the associated construction practices (Rafi et al., 2016).

In the World Risk Index (2016), Pakistan has an exposure rating of 11.4% and a 61.3% vulnerability rating. The primary problem in Pakistan is the lack of coping capacity, with a deficiency rating of 86.26% to deal with negative consequences and a deficiency of 62.48% in adaptive capacity in relation to long-term strategies for necessary societal change (Wallemacq, 2018). Seismic disaster is the most life-threatening type of disaster event in Pakistan (Arifeen and Nyborg, 2021; Alcántara-Ayala, 2002), even when compared with the 2010 flood, which led to one-fifth of Pakistan being underwater (Amaratunga et al., 2009; Moe et al., 2007). The consequences of the 2005 earthquake were much more severe in terms of economic losses and a loss of life, which indicated low resilience and high exposure to earthquakes. It was the deadliest earthquake experienced in the country in modern history and occurred in northern parts of Pakistan and Azad Jammu and Kashmir, registering 7.6 mV on the Richter scale (Rossetto and Peiris, 2009; Sato et al., 2007). It made 2.8 million people homeless overall; 73,338 people were killed, and more than 70,000 were incapacitated (Bloom et al., 2005; Wallemacq, 2018; Group, 2014). The deaths were primarily in conventionally built houses located in rural areas. These houses typically lacked adequate engineering input and vetting by authorities and were often built without any planning consent (Rafi et al., 2016). The majority of the building stock in the affected areas was nonengineered structures.

In this paper, “non-engineered construction” refers to informal construction with little or no involvement by qualified architects’ or engineers’ input, as defined by Amaratunga et al. (2009). Such structures are often deficient, particularly in hazard-prone areas (Doberstein and Stager, 2013; Usamah et al., 2014; Ofori, 2002). Some of the key contributing factors to the devastating situation of the 2005 earthquake as defined by Birch (2021) and Bothara and Hiçyılmaz (2008) are as follows:

- building construction process,
- technological and socio-economic barriers to addressing the safety issues;
- lack of resources on construction;
- maintenance and quality control; and
- negligence and lack of knowledge in implementing earthquake seismic-resistant constructions.

Furthermore, lack of technical knowledge and poor training and institutional actions are often significant. This highlights the need to develop awareness and commitment to the implementation of policies and guides at all levels of development planning (Lee et al., 2021; Cimellaro et al., 2010). Overall, there is a consistent pattern to research outcomes that point
to the inadequacy of holistic transition mechanisms that involve all stakeholder groups. Actions are therefore needed to achieve long-term housing resilience starting from the first phase of response, as noted by Rose (2011) and Shaw (2015). Although the 2005 earthquake alerted the stakeholders and institutions to the high level of risk in Pakistan, the efficiency of planning and management-related activities has remained inadequate, according to Enam (2015). Inadequate disaster risk reduction (DRR) strategies and policy implementation contributed significantly to the catastrophic consequences of the 2005 earthquake. This fact has, in turn, directed the focus of the study presented here. The gap in the research literature suggests a need to explore the improvement of societal capacity in terms of seismic knowledge and appropriate response. The study investigates the level of preparedness, particularly in relation to structural capability, among all stakeholders.

1.1 Building resilience in postdisaster context

The term resilience is defined as “the fundamental capability of a system, community or society focus to adapt and continue by changing its nonessential attributes and transformation itself” (Masten, 2021; Dagenais et al., 2013). The four principles of resilience, according to Graham et al. (2006), are stated as four “R”s: robustness (strength or ability of system), rapidity (capacity to timely achieve targets), redundancy (potential of substitution) and resourcefulness (capacity to mobilize resources). Disaster resilience is most appropriate when directly linked with the sustainable utilization of resources and human–environment interaction.

The factors to be considered in forming an effective disaster resilience and sustainable society, as noted by Khan et al. (2013), can be summarized as follows:

- local knowledge and construction practice to develop long term disaster resilient housing;
- improving local awareness and supporting the local economy to enhance resilience;
- improving communication between the local building constructors and the appropriate professional expertise;
- application of planning codes and construction regulation; and
- enhancing local governance capabilities.

By enhancing the local capacity and capability in the disaster-affected population of rural areas, the understanding and application of local knowledge and construction practices should lead to improved long-term, resilient and sustainable construction practices. According to Bouhadad (2014) and Achour et al. (2011), code implementation can be achieved by law enforcement, but what is most effective is spreading awareness. Our aim is to support that important goal by spreading awareness of seismic construction guidelines on safe buildings practices via effective knowledge management systems.

1.2 Disaster management and mitigation

DRR is a concept achieved by carefully investigating and analyzing disaster causes then developing and implementing policies and strategies to reduce disaster risk (Naheed, 2021). Good DRR requires an integrated process of DM planning, coordinating and implementing measures effectively that deal with the impact on people (Marincioni, 2007). This includes actions on mitigation, preparedness, response and recovery (Chikoto-Schultz et al., 2019). Mitigation and preparedness refer to dealing proactively before any disaster occurs, whereas response and recovery deal reactively in the postdisaster phases. The DRR focus has typically been on a reactive approach (Achour et al., 2011; Van Niekerk, 2007). In this
context, DRR involves developing an integrated approach from the causing factors to the reduction of disaster impacts proactively (Alexander, 2013; Mercer, 2010; Thomalla et al., 2006).

In response to disaster impacts, many governments around the world have shifted or are in the process of shifting their DM policies to explicitly emphasize mitigation. In New Zealand, mitigation is one of the fundamental themes in New Zealand’s National Civil Defence Emergency Management Strategy. In Australia, the Disaster Mitigation Programme involves matching federal funds with state and local contributions. In the USA, mitigation is explicitly incorporated into DM through the Disaster Mitigation Act. One of the outcomes of this legislation is the hazard mitigation grant program that provides funds to state and local governments incorporating mitigation. In the UK, disaster mitigation and risk reduction are taken as the core elements of community resilience (Henstra and McBean, 2005).

However, Pakistan has one of the most deficient adaptive capacities in the world due to its failure to implement extensive disaster risk mitigation strategies effectively. According to World Risk Report (2016), Pakistan ranked 14th in the highest deficient countries in adaptive capacities. In contrast, Japan has a DM system that is ranked 17th highest in the world, the highest rank among developed countries. It has a coping capacity of 38% and an adaptive capacity of 29% for long-term measures (World Risk Report, 2016). Japan’s national government has addressed all phases of DM, with the clear articulation of responsibilities at national and local government levels. The positive measures in place in consideration of the Tokai earthquakes are summarized by Ikeuchi and Isago (2007) as follows:

- Implementation of an urgent upgrade of seismic resistance measures in buildings and infrastructure.
- Reinforcement of community capabilities against disasters.
- Establishment of a strong DM system in the case of a disaster warning.
- Establishment of a wide-area management system in disaster occurrence.

1.3 Use of knowledge in disaster management

Good DM requires an integrated process of planning, coordinating and implementing measures (Twigg, 2015). This includes actions on mitigation, preparedness, response and recovery (Gómez et al., 2016). Mitigation covers the measures undertaken to avoid or reduce the risk to lives, assets, socio-economic activities and resources from hazards. Awareness, preparedness, education, prediction and warning systems can all reduce the disruptive and catastrophic effects of a natural disaster on societies. As noted above, it has been shown that effective disaster knowledge management (DKM) strategies can help to reduce the negative impacts of disasters by using effective knowledge accumulation and dissemination (Khan and Shaw, 2015).

Broadly speaking, knowledge management is a systematic progression by which knowledge is accumulated, managed and used (Sajjad et al., 2021). Sen et al. (2021b) state that the use of knowledge strategies to influence policies and practices has been rapidly expanding; the associated process is commonly referred to as knowledge transfer (KT). KT is a complex process that involves both individual and organizational training. The aims behind it are to shift behaviors, improve decision-making, facilitate interactions between experts and potential users and understand the cumulative effects on factors, actors and the environment in which they work.
People in rural areas rely heavily on local knowledge to prepare for future events (Jon, 2019). Their knowledge is often limited to local experience and tradition. So, in some disadvantaged communities, deficiencies in local knowledge become a major hurdle in promoting and implementing sustainable, resilient construction practices. This is the core issue addressed in our work. Consequently, we take good practice seismic design guidelines as an instrumental tool and investigate how to establish effective KT mechanisms to implement that tool, given the particular circumstances in rural Pakistan. In doing this, we note the reality that in such areas, local people regularly take the lead in managing their environment when dealing with devastating events.

In the context of DKM, success factors can be defined as circumstances, facts or influences that are input into the knowledge of DM that can directly or indirectly affect the outcomes of DM. Some researchers have attempted to identify key knowledge factors for managing disasters successfully and to map them against the typical DM cycle. The factors generally identified are:

- technological;
- social;
- environmental;
- legal;
- economical;
- functional;
- institutional; and
- political.

The factors identified are common to all disasters types and can apply to all phases of mitigation, preparedness, response and recovery (Abubakar et al., 2019; Cvitanovic et al., 2015; Opdyke et al., 2018; Seneviratne, 2011). Based on key research papers published over the past 15 years reporting on evidence of knowledge application in disaster scenarios, we have produced an over-arching table summarizing the analysis of subfactors revealed in research findings (Table 1).

Examination of a selection of appropriate research publications enabled analysis of the role of DKM, and the main goal was to identify the most influential factors in improving disaster resilience. A study of research outputs in this area reveals that the majority of the papers relating to knowledge management note that the key issues are the dynamics of risk and environmental scenarios, dissemination, adaption and improving anticipation capacity. Addressing these issues is achieved most effectively through the implementation of appropriate DKM factors applied at the right time. This enhances the interaction between the disaster stakeholders and enables correlation with and integration of local knowledge. Our analysis of DKM summarized in Table 1 reveals the primary focus areas of communication, education, training, coordination, participation and technical skills and knowledge in the effective use of DKM.

2. The case of the 2005 earthquake

2.1 Overview

Of the earthquakes in the modern era, the earthquake of October 2005 was beyond doubt the most devastating (Basharat et al., 2016; Haris et al., 2019; Naeem et al., 2005; Rehmani et al., 2018). This deadly earthquake occurred on 8 October 2005 in northern parts of Pakistan and Azad Kashmir and measured 7.6 mV on the Richter scale (Basharat et al., 2021; Khan et al.,...
### Table 1.
Suggested critical factors in effective disaster management

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Table 1. Disaster knowledge management.
The focal depth of the earthquake was 10 km, and its epicenter was in the north of Muzaffarabad (Azad Kashmir), about 1,190 km north of Islamabad, Pakistan (ADB, 2015; Arshad and Athar, 2013). The region affected was Khyber Pakhtunkhwa (formerly known as Northern West Frontier Province), and the Northern Punjab region of Pakistan and Kashmir. It affected a 30,000 sq. km area that covered nine districts, 25 sub-districts and 4,000 villages (Husain, 2008). The destruction from the earthquake resulted in 2.8 million people being left homeless. A total of 73,338 people died (including 35,000 school children), and more than 70,000 were injured. More than 400,000 housing units were destroyed or severely damaged (ADB, 2015; Arshad and Athar, 2013). Significantly, 90% of the houses destroyed were in rural areas, and it is estimated that more than 95% of buildings were built without attention to seismic considerations (Mumtaz et al., 2008). The collapse of small nonengineered houses is estimated to be responsible for up to three-quarters of the earthquake’s fatalities (Khan, 2013). Alam et al. (2008) described nonengineered construction as informal construction that is undertaken with little or no involvement by qualified architects or engineers.

### 2.2 Building construction process

The construction processes in rural housing are largely informal, with engineers playing a minor or nonexistent role in the entire process of construction. Professional assistance is rarely taken, and if taken, it is only for the building permit process (Mumtaz et al., 2008). Some of the homeowners in rural areas are able to follow the empowering approach of owner-driven reconstruction (ODR) as described by Deshmukh et al. (2008) and Vahanvati and Beza (2017). Home-owners who have lost their houses are provided some combination of cash grants and technical assistance to build their houses. The term “owner” in ODR terminology actually refers more to the constructor than to the owner of the house. The owners of the houses may build their own houses by themselves, using family labor, using local labor or contractor or by using the combination of these options. ODR is similar to the “aided self-help approach” that is used extensively to provide housing assistance to the urban poor in Latin America (Barenstein and Iyengar, 2010).

The regulatory authority to regulate and enforce laws in Pakistan are at province, district, tehsil (county) and union council representing a cluster of villages (Husain, 2008). Analysis after the 2005 earthquake showed that the construction rarely met the expected standards (Maqsood and Schwarz, 2008).

### 2.3 Construction materials

The design and construction processes are mostly procured by the owners themselves by hiring locally skilled builders. The traditional builders provide assistance in overall construction activity without any formal training, and the owner typically relies on them for advice. Furthermore, the construction in these rural areas largely relies on the availability of construction materials. The owners or builders procure the materials themselves and are responsible for material inventory and quality construction (Mumtaz et al., 2008). The common construction materials for building construction before the 2005 earthquake were mud, steel, fired brick, concrete, stone and timber. Use was dictated largely by local availability, affordability, economic situation and local climatic condition (Bothara and Hicyilmaz, 2008). Stone has traditionally been the common material used in house construction due to its local availability and affordability (Mumtaz et al., 2008). However, confined concrete block masonry and reinforced concrete frame with concrete block or brick masonry have been more commonly adopted construction following the earthquake of 2005 (Bothara and Hicyilmaz, 2008). According to Maqsood and Schwarz (2011), despite the
vulnerability of mud houses, the construction of mud houses is still common in rural areas. But it is worth noting that timber frame construction is actually regarded as one of the most suitable responses for single-story residential housing in earthquake regions (Arshad and Athar, 2013).

2.4 Rural housing reconstruction program

The event in 2005 made it clear that the Government of Pakistan was not prepared in terms of the formulation of an adequate response program. Consequent to the disaster, the government was under great pressure both to deal with the current disaster quickly and also to develop better strategies for the future (Cheema, 2012). In response to the impact of the 2005 earthquake, the government created the National Disaster Management Authority (NDMA) under the National Disaster Management Commission in 2006. The NDMA formulated a National DRR Policy in 2013 and National Disaster Management Plan up to 2022. This included links to more area-focused actions involving the Provincial Disaster Management Authority and District Disaster Management Authority. The NDMA, in collaboration with international partners, established the Earthquake Rehabilitation and Reconstruction Agency (ERRA) in November 2005, giving it the task of designing and overseeing the response process at the federal level. The ERRA launched the rural housing reconstruction program (RHRP) at the cost of over US$1.5bn, with the technical assistance of US$0.21bn from the World Bank (Arshad and Athar, 2013).

The ERRA established two coordinating bodies, the Provincial Earthquake Reconstruction and Rehabilitation Authority in Pakistan and the State Earthquake Reconstruction and Rehabilitation Authority in Azad Kashmir, to guide the implementation of the district reconstruction plans.

As part of this, it was decided that postdisaster reconstruction should improve the community’s physical, social, environmental and economic conditions to create a new state of normality. Mitigation and preparedness were the basis of the government policy (Bacha, 2016). The following section summarizes the most important components of the reconstruction policy.

2.4.1 House-owner-driven reconstruction strategy. By adoption of the policy framework, ERRA aimed to sustain a local culture of construction among rural dwellers through a single point of contact mechanism referred to as “Owner Driver Reconstruction” (Deshmukh et al., 2008). The policy places a specific emphasis on house-ODR involving prior training, KT and education and communication campaigns.

2.4.2 Ensuring seismic safety. The policy incorporates seismic safety into building construction through the development of approved mechanisms for architectural and structural design standards, plus training curricula that meet internationally accepted requirements for low-cost earthquake-resistant housing (ERRA, 2006; Mumtaz et al., 2008). The development of design and implementation guides to support Owner Driver Reconstruction entailed conducting multistakeholder consultations with various NGOs, INGOs, donors such as World Bank, the United Nations and other national and international organizations such as the National Society of Earthquake Technology-Nepal. ERRA hired the government-controlled engineering firm, National Engineering Services of Pakistan, to formulate design solutions that responded not only to structural performance needs but also to cultural preferences, climate, terrain and safety features (Haseeb et al., 2011).

2.4.3 Enforcement. Because of the diverse socio-economic situations in rural areas, their limited access to materials, technology and information and the state’s seeming inability to enforce compliance with building codes, ERRA recognized that interventions in rural areas would differ from those in urban areas. They, therefore, developed a different strategy for
reconstruction that relied on easily accessible seismic guidelines supported by an awareness strategy. However, Cheema and Issa (2008) note that, nevertheless, ERRA regulations are poorly understood.

2.4.4 Capacity building activity. To increase capacity in postearthquake reconstruction, large-scale training was conducted among the “earthquake masons”, a term referring to people who became construction experts almost overnight (Haris et al., 2019); this group included builders and engineers. To improve the safety, knowledge dissemination and need for safe construction practices; several programs were carried out in the community, such as orientation programs, radio programs, print media, earthquake exhibitions, safety walks and debates on school and universities (Mumtaz et al., 2008; Onwuegbuzie and Frels, 2016).

3. Research methodology
The research aims outlined at the start of this paper necessitated an extensive study to establish the context for the study as adopted by Patel et al. (2020) and Ahmed and Charlesworth (2015). The research uses a comprehensive literature review (CLR) that chronicles the process of inquiry into the current status of specialized knowledge in terms of examination, organization, reflection and assessment of five major modalities; media, observation, documents, experts and secondary sources (Onwuegbuzie and Frels, 2016). The CLR method adopted involved a qualitative approach to understanding the 2005 earthquakes, impacts, reconstruction challenges and DKM. It required the establishment of the success factors to develop both the conceptual model and subsequent theoretical framework. These then direct the primary mixed-use research aimed at establishing the most appropriate future ways to implement seismic construction guidelines in rural areas of Pakistan.

The research analyzed addressed the challenges in the post-2005 earthquake RHRP. The study then focused on the understanding of DKM and associated factors needed for the successful elements of effective disaster recovery and preparedness. It also took in the importance of DKM in the international context. Additionally, the study looked at the application and existing challenges of DKM in the particularly earthquake-prone rural context. We interpreted a wide range of research evidence relevant to DKM and took in a particular focus on the study of post-2005 earthquake research.

The research incorporated keyword search; 2005 earthquake Pakistan, rural areas, nonengineered construction, rural construction mechanism, ODR, mitigation measures, DM and DKM. Conventional published journals, articles, literature on previous case studies of the 2005 earthquake and books were included. But importantly, to take in relevant local information, the material review also took in published government reports, disaster mitigation policy documents, national and international NGOs publications, conference proceedings and news articles relevant to the 2005 earthquake case and the application of DKM techniques. More than 80 research papers and conference proceedings in the past 21 years from 2001 to 2021, were analyzed in eight major online databases. These include Google Scholar, Science Direct, Research Gate, Scopus, Jstor, Springer, Emerald and Semantic Scholar.

After the data extraction process, category clustering was undertaken by analyzing the abstracts and filtering irrelevant papers based on full paper examinations. This analysis produced two major outcomes:

1. first, it identified the research gap in relation to DKM deficiencies related to the 2005 earthquake, thus delivering a means of developing a well-founded conceptual research framework (Figure 2).
Second, it consequently helped to direct the exploratory approach and framework via the identification of independent variables, dependent variables and controlled variables that have been identified and extracted from the extensive analysis undertaken.

The independent variables identified were: technological, social, economic, legal, environmental, functional and institutional. However, one of the independent variables, “political” is excluded from the emerging framework, as this is a meta-level aspect. Our work aims to find the most practical, structural and instrumental solutions that can fundamentally minimize significant vulnerabilities and increase resilience. The resulting theoretical framework gives the justification, direction and essential framework elements for a further study that is intended to lead to improving housing resilience in rural Pakistan through effective DKM (Figure 3). The flowchart to develop a conceptual model is illustrated in Figure 1 (Figures 1–3).

**Figure 1.** Flowchart showing theoretical framework development
4. Conclusion
To build a resilient and sustainable society in a disaster-prone region, resilient and sustainable practices are essential, but such practices challenge a government’s capacity and capability to adapt and change. Local knowledge and construction practice, in rural Pakistan in particular, has relied on too much as an effective means of achieving disaster resilience and sustainable construction. For Pakistan, the reconstruction after the 2005 earthquake revealed that in the rural context, there was a significant incapacity due to ineffective KT of reliable information and due to inconsistency in such communications.

The conclusion of our study is that the key problem facing Pakistan in relation to future DRR is the gap in DKM provision and that this gap requires well-formulated attention to ensure sustainable construction practices and resilient buildings. A framework has been developed with the aim of addressing the need identified. The critical success factors in developing the theoretical framework have been taken as the independent variables that contribute to success in DKM. Consequently, the evaluation of existing local knowledge is important – recognizing the fact that local people take the primary role in managing their environment and practices in dealing with devastating events of all types. In support of this, the appropriate delivery of reliable information and its effective application are critical success factors in assessing disaster response and preparedness.

Previous research on DKM in an international context also identifies a particular need for the effective use of disaster-based information in buildings best practices. This is needed to support a transition from vulnerability toward resilience. By developing the elements of the theoretical framework described above, the research evaluates the barriers and opportunities in improving seismic construction knowledge and in overcoming the

![Diagram of Conceptual model](image)

![Diagram of Elements of theoretical framework](image)
deficiencies of ineffective construction knowledge implementation. The research in this paper and its subsequent application are intended to contribute usefully to dealing with future disaster situations in the earthquake-prone regions of Pakistan. It is intended to do so by suggesting how resilience and sustainable societies can be achieved through the effective management of organizations, institutions, communities and native construction workers in DKM and the knowledge that these provide.

5. Next phase of research

The target output of our research is the development of a KT framework that would genuinely assist policymakers in disaster organizations and guide households and builders in relation to resilient and sustainable construction practices.

The next phase of the research work tests the deployment of seismic guidelines as an instrumental input tool for assessing the potential means of achieving increased knowledge capacity in rural construction practices. This stage applies a mixed-method research approach. The field survey is being conducted using a nonprobabilistic convenience sampling of 385 households, builders and contractors who have knowledge and experience in construction practices in rural areas. The survey result is complemented by expert interviews that use a nonprobabilistic purposive sampling from disaster organizations. The analysis will require the empirical triangulation of qualitative and quantitative data across descriptive content derived from a structured questionnaire and experts’ semi-structured interviews. This is intended to help determine the scope of the current DKM and thus, aid the development of an improved KT framework.

References


Further reading


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