



University of HUDDERSFIELD

University of Huddersfield Repository

Ingirige, Bingunath

Theorizing construction industry practice within a disaster risk reduction setting: is it a panacea or an illusion?

Original Citation

Ingirige, Bingunath (2016) Theorizing construction industry practice within a disaster risk reduction setting: is it a panacea or an illusion? *Construction Management and Economics*, 34 (7/8). pp. 592-607. ISSN 0144-6193

This version is available at <http://eprints.hud.ac.uk/28980/>

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items on this site are retained by the individual author and/or other copyright owners. Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

- The authors, title and full bibliographic details is credited in any copy;
- A hyperlink and/or URL is included for the original metadata page; and
- The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

<http://eprints.hud.ac.uk/>



Theorizing construction industry practice within a disaster risk reduction setting: is it a panacea or an illusion?

Bingunath Ingirige

To cite this article: Bingunath Ingirige (2016) Theorizing construction industry practice within a disaster risk reduction setting: is it a panacea or an illusion?, *Construction Management and Economics*, 34:7-8, 592-607, DOI: [10.1080/01446193.2016.1200735](https://doi.org/10.1080/01446193.2016.1200735)

To link to this article: <http://dx.doi.org/10.1080/01446193.2016.1200735>



© 2016 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



Published online: 05 Jul 2016.



Submit your article to this journal [↗](#)



Article views: 62



View related articles [↗](#)



View Crossmark data [↗](#)

Theorizing construction industry practice within a disaster risk reduction setting: is it a panacea or an illusion?

BINGUNATH INGIRIGE**

Centre for Disaster Resilience, School of the Built Environment, University of Salford, Manchester, UK

Received 12 July 2015; accepted 7 June 2016

Construction industry practice is strongly influenced by the culture surrounding its operations and, with the prevailing emphasis on achieving efficiency, there is a strong focus on outcome metrics such as profitability and employee productivity. With the recent increases in natural hazard events worldwide, and the likelihood that this will worsen still further with anticipated climate changes, the industry is increasingly contributing to building resilience within disaster-affected communities. Existing industry expertise, its educational approaches and the related theoretical frameworks, however, all require adjustment if these changing needs are to be fully addressed. Most importantly, an agenda shift is required from the philosophical side and a more pragmatic approach is needed if community resilience goals and objectives are to be met, rather than the narrower focus of the current metrics-driven management system. A synthesis of the current literature is therefore presented, along with relevant case histories illustrating how such an agenda shift within a disaster management context may influence the development of appropriate theory, as well as impacting upon grass-roots educational requirements. The research concludes by discussing how the ‘mainstreaming’ of disaster management within construction industry practice could drive forward developments in theorizing expertise and educational provisions across the constituent disciplines.

Keywords: Construction education, construction industry, construction industry practice, disaster resilience, theorizing.

Introduction

Construction industry (hereafter CI) practice is strongly influenced by the culture surrounding its operations. Some of the common problems faced by the industry include its fragmented nature, the complex coordination and communication structure, lack of permanence in its workforce and skill shortages. The industry does, however, contribute quite significantly to the overall economy of a country in terms of output. The overarching philosophy within CI practice has, therefore, been to improve performance at firm and project levels, in order to achieve overall improvements across the industry and the wider economy. Some of the reports published in the UK by government task forces, notably Latham (1994) and Egan (1998) identified the synergy of the many smaller improvements as a significant opportunity. A very strong metrics manage-

ment system in evaluating outcomes (both at firm and project level) has become paramount in construction management, with a focus on timely completion, meeting of budgets and fulfilment of quality standards. From a philosophical point of view, this is indicative of a normative emphasis (Fuller, 1988) with management of key performance indicators (KPIs), exception reporting, further short-term targets and profitability being the key outcome goals or norms. This is consistent with the rationalist paradigm, adopted by the construction management research community as well, according to Dainty (2008). It could be argued, however, that relying on too many quantitative measures does not help in understanding the big picture. For example, the CI plays a leading role in the rebuilding phase following natural hazards; indeed, it is linked quite positively to the entire disaster management (hereafter DM) cycle (see Figure 1), from the point

*E-mail: B.Ingirige@hud.ac.uk

**Present address: Global Disaster Resilience Centre (GDRC), School of Art Design & Architecture, Huddersfield, University of Huddersfield, UK.

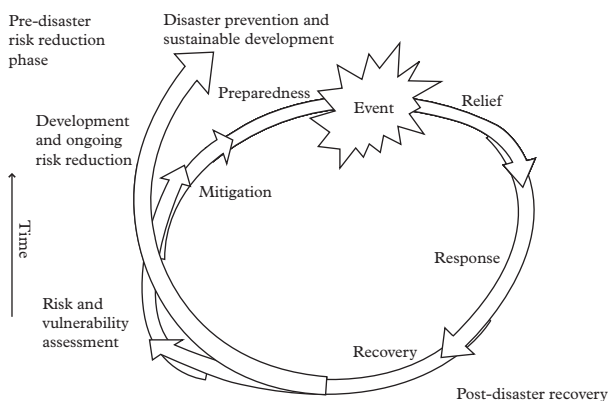


Figure 1 The disaster risk management and response spiral (adapted from O'Brien *et al.*, 2010 and Max Lock Centre, 2009)

of preparedness to recovery and reconstruction. Figure 1 is an adaptation of the Royal Institution of Chartered Surveyors (RICS, 2009) spiral model and O'Brien *et al.* (2010)'s four-stage model for DM.

DM involves plans, structures and arrangements established to engage the normal endeavours of governments, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs Moe and Pathranakul (2006). The intangible outcomes, in terms of community preparedness and vulnerability reduction achieved, which are part and parcel of DM are more socially constructed, far outweigh the normative targets that may be applied purely in a CI context. Therefore, when CI operates within a DM context, its scope is likely to extend towards satisfaction of community needs; hence, terms such as 'community preparedness' and 'vulnerability reduction' become the key in determining CI's performance. According to Yodmani (2001), vulnerability reduction aims to increase a community's capacities, their resources and coping strategies so that they are better prepared in facing a disaster. Communities are better prepared when the root causes of their vulnerability are either removed or their impact reduced. At a community level, social construction methods are used to create community preparedness plans so that community goals and expectations and actions are well represented (Lucini, 2014). With changing climate and extreme weather events becoming more widespread (Stern, 2007), such social construction measures are likely to become of increasing importance but, thus far, such community benefits seem to be taken for granted within construction. Although socially constructed viewpoints and benefits have been noted in some of the construction management literature, the theorizing of this does not seem to be linked to what the construction

practice dictates. Hence, a more pragmatic approach (Denscomb, 2008) is needed to theorize expertise in CI practice with a DM setting.

The aim of this paper was to consider whether there are particular kinds of expertise that integrate the social element of construction practice within the disaster recovery life cycle and what sort of expertise is needed to meet the demands of key stakeholders in disaster response and recovery. It further discusses how construction education might develop this such that the performance improvement within construction is steered towards a naturally progression incorporating social accountability pathways, rather than a purely metrics-oriented management system. This could permit the involvement of the CI within DM to be assessed as being a panacea or an illusion.

Construction industry practice and the desired agenda shift in theorizing

During the time period 1994–2000, three high profile government reports (Latham, 1994; Egan, 1998 and Department of the Environment, Transport and the Regions, 2000) were published, each of which stressed the importance of improving efficiency within the CI, particularly cost-effectiveness in resource utilization. More recently, the same agenda of cost savings has been pursued, but with a renewed focus on the use of modern technologies and management processes (such as supply chain management and framework agreements) to improve efficiency in the industry. With the new 'Construction 2025' strategy (McMeeken, 2013), this emphasis has been further reinforced, with a call for a 33% reduction in the whole life costs of built assets by 2025.

Whilst pursuing an efficiency agenda is important, understanding that the CI has a wider remit beyond a purely commercial focus should form an important and powerful consideration for theorizing expertise. In the longer term, this view may not only sustain the industry but also increase the number of new participants. Myers (2003) postulates an agenda shift, so that the CI contributes more towards sustainable development, including consideration of community goals. This would result in a more balanced portfolio of goals consisting of social and environmental targets, and moving away from the existing sole consideration of pursuing an agenda of efficiency improvements. With changing climate, and increases in both natural and anthropogenic hazard events in many parts of the world (Intergovernmental Panel on Climate Change, 2014), CI practice has been brought further to the fore. The greater involvement of the CI and its practitioners in the area of DM (Bosher and Dainty, 2011) provides an opportunity not just to

maximize revenue, profitability and the commercial goals, but also to contribute towards the betterment of community, environmental and other social outcomes. In the longer term, this might confer an advantage upon both the industry and its participants, in terms of contributing to both vulnerability reduction and improving coping capacity and resilience of communities. According to O'Brien *et al.* (2010), often the extensive media coverage on the disaster event focuses upon the involvement of the CI to a certain extent. But when considering the broader aims of DM, which is to reduce vulnerability and improving coping and resilience to disasters, the media coverage presents a narrow view of the CI involvement. This involvement rarely portrays the host of services that the CI can play within the DM context, however: for example, Scott (2010) identifies DM as a 'growth market', highlighting some of the opportunities that it might create for businesses. Such contexts, according to Boshier *et al.* (2007) and Boshier and Dainty (2011), provide opportunities for the CI to have more of a deeper engagement to contribute towards the rest of the phases of the DM cycle. This necessitates the theorizing of expertise to integrate DM and construction: for instance, construction practitioners are increasingly engaged in the area of building resilience and 'building back better' (Chang *et al.*, 2011) after a natural hazard event (which, according to Lyons (2009), is one of the ways in which resilience can be enhanced). Although, from a research point of view, the practical value of such a role makes sense, and the value has been demonstrated from a theoretical point of view, there is very little theory that drives this process from the construction side, hence developing expertise in such a direction has not been recognized as of any significant value. It can be argued that the CI practice community is to a certain extent distracted by the efficiency drive, hence the difficulty of maintaining a more balanced outlook. From an education and training point of view, it is proving challenging to address this problem, as the CI-DM nexus is difficult to develop. Figure 2 shows how the desired expertise can be created holistically, with a proper integration between DM and CI practice incorporating the integrated theorizing approach as proposed within this paper.

According to Figure 2, the desired expertise (the CI expertise that is appropriate when the full extent of the DM is considered) that assists in theorizing construction practice within a DM context is 'pulled' through in a systematic way by addressing competencies at a grass-roots level (which is the entry or the starting level for skills and competencies), which will then potentially develop the DM-embedded CI practice and ultimately lead to the theorizing as required within a DM setting. According to Ericsson and Smith (1991), the goal of expertise research is to:

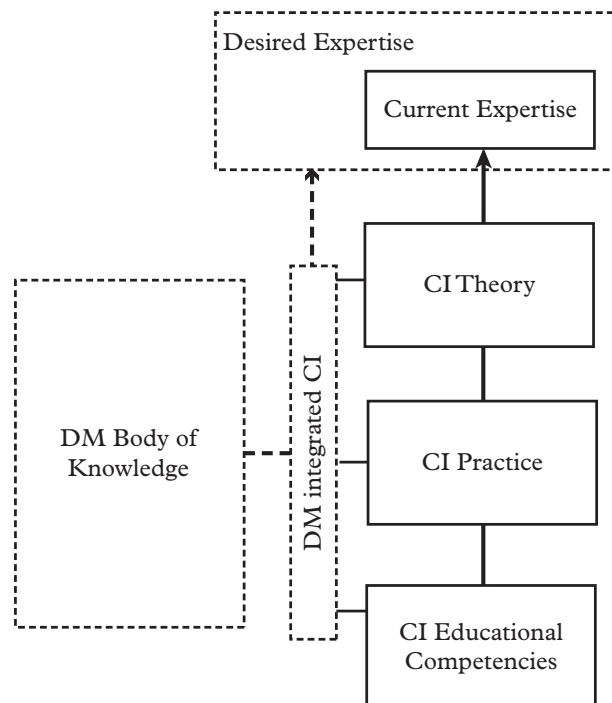


Figure 2 Holistic expertise development model

understand and account for what distinguishes outstanding individuals in a domain from less outstanding individuals in that domain, as well as from people in general. (p. 2)

A further characteristic of expertise is that it has, in the past, been equated with years of experience (Collins and Evans, 2002), such that a person with extensive experience was automatically regarded as an expert. Arguably, expertise may be seen as the culmination of knowledge and experience, which can then be developed within the desired setting or context. Heidegger (1997), in discussing expertise-in-context identified the value of practical knowledge in that the expertise becomes natural and action within a given context becomes instantaneous. Expertise is, thus, developed over time: for example, Dreyfus and Dreyfus (1986) present a 5-stage model to depict 'expertise' as a very high-level position in terms of skill acquisition, compared to the grass-roots scale, represented by entry-level Stage 1. Hoffman *et al.*, (2013), however, identified expertise as amenable to accelerated skills acquisition: although expertise is usually accumulated over time, the process of acquiring high proficiency can be foreshortened by specific training techniques. As more frequent and extreme disasters arise, there is a necessity to accelerate the integration of DM within CI, in order to advance from the present 'Stage 1 level' and this can be achieved by mainstreaming of DM

within CI. Applying and adapting the UN 'gender mainstreaming' definition (United Nations, 2002), the term could be best described as the integration of DM in CI in a process that includes the development of a methodology, tools and information materials to fulfil appropriate integration within the study's context.

Positioning and conceptualizing expertise-in-context within a philosophical base

Expertise in the construction industry comprises a whole host of skills, consisting of managerial (decision-making, financial and commercial), technical (adopting a variety of technologies, contracts, designs) and social aspects (teamwork, trust, culture). Addis (2010) argues that the reality, and the way the general public perceives what these construction activities actually represent, seems to be widely different. Effectively, the industry was needlessly 'selling itself short' as CI professionals tend to describe their expertise more simplistically than warranted. Reed (1995) identified a similar phenomenon amongst adult care nursing practitioners, as they often downplayed their role as experts (for example, they described their role as boring – 'You might feel that you have come to a really boring place. We don't do much here' (p. 339). According to Hackley (1999) and Boyd and Addis (2011), there is a strong tacit element embedded within expertise and this can be seen in the construction industry too. The skills represented within the CI industry are not only spread across a wider domain, as identified earlier, but also very difficult to articulate in terms of specific requirements (Polanyi, 1962). People who possess these skills tend to attribute less and less value to them when they acquire additional skills and proficiencies. Reed (1995) found that it takes considerable time to develop 'quick assessments and judgement skills' (which is the level of expertise needed to react instantaneously to a situation) for the nurses, but this is often taken for granted by the nurses themselves, along similar lines to construction professionals. Kuhn (1996) explains this phenomenon as similar to the way in which scientific progress takes place when a set of paradigmatic assumptions ceases to be implicit. But, quite in contrast to scientific progression, the expertise in CI remains implicit and it is challenging for the developing expert to acquire the appropriate skills.

The CI's long-standing drive to improve profitability, via cost-effectiveness in resource utilization, adds to the public representation of the CI industry as overly commercially driven, overlooking the important realities such as the strong social outcomes that now need to be further developed within the CI skill set to suit the DM context. Figure 2 conceptualizes both the current CI expertise and how it should, more desirably, be

situated. Labuschagne and Brent (2005) argue that this target-based focus is mainly caused by the extremely 'time pressed agenda' which is typical of any construction project. Adhering to a commercially driven target-orientated approach in CI, where commercial targets or KPIs predominate, also fails to bring about innovations (Styhre, 2010). According to Hoffman *et al.* (1995), experts, as one would expect, are very adept at their usual or familiar tasks; thus, the knowledge and experience within the CI tend to be guided and contextualized within the current target-driven system. The underlying system of education and training is, therefore, similarly designed and driven currently, as indicated by the continuous line in Figure 2. This becomes the primary goal, currently supported as a 'collective norm' by the majority of construction professionals (Lapinski and Rimal, 2005) despite the wide variety of education and training applicable to their constituent disciplines.

Increasing opportunities for CI professionals to work in non-commercial environments, subjected to natural hazards and contexts where there is a humanitarian catastrophe embedded within the CI, modifies the environment where the application of a target-orientated focus might cause tensions. McCann *et al.* (2015) studied UK's National Health Service (NHS) performance improvement schemes and argued that the excessive adoption and rigid application of target-based systems can actually foster dramatic organizational failures. They argue that, whilst such numerical target-based systems might be very effective in, say, automobile manufacture or back-office processing, these industries involve work typically performed on 'inanimate objects or digital information'. In the construction industry, not only project success but also very strong people-orientated approaches such as teamwork and trust are important social outcomes to be achieved, and numerical targets might not work: indeed, they might cause total failure. From a philosophical point of view, McCann *et al.* (2015) argue that it needs an interpretivist approach that takes into account several 'pragmatic improvisations' (Maynard-Moody and Musheno, 2003, p. 165) on underlying social outcomes, so that the reality and the practicalities can be better aligned with the performance management system. Given that the CI's involvement in DM is growing in many countries, it is more often the case that the sector as a whole has new stakeholders, such as humanitarian relief organizations, community-based organizations and several non-governmental organizations. These require not only construction services, but also to work in a more integrated fashion as part of a core team in disaster recovery, reconstruction and rehabilitation activities; hence, a more pragmatic way forward is needed. The CI should, therefore, be

more sympathetic towards betterment of communities or creating better social outcomes. This is the desired CI expertise as indicated by the 'dotted' lines and boxes in Figure 2. The necessity to consider the potentially valuable strong social element within CI and to differentiate from an 'inanimate' setting appropriate to a factory-based quality improvement system, thinking in similar lines of McCann *et al.* (2015), helps in further reinforcing the phenomenological philosophical position for integrating DM within CI. The strong context-dependent nature of a phenomenological position (Benner, 1984) also supports this view, as it will help from transcending the CI expertise within a DM context in a pragmatic way (Denscombe, 2010).

Construction industry practice and its link to disaster management

Haigh *et al.* (2009) argue that CI practice has a role in every aspect of the DM cycle. Looking at the construction process from the point of view of a life cycle allows its activities, from inception to eventual demolition, to be viewed in a systematic way. By deconstructing CI practice, it is also possible to see its existing and potential future contribution to the DM process (considering the established mature practices within a DM context), so that the said overall contribution can be carefully examined. Blanchard and Fabrycky (1998), for instance, present the life cycle of asset systems, encompassing a broader view of CI practice, with its components of conceptual design; preliminary design; detail design and development; construction; utilization; and finally retirement and disposal. The DM cycle can be viewed as consisting of mitigation, preparedness, response and recovery phases (O'Brien *et al.*, 2010); alternatively, as discussed by Hystad and Keller (2008), it can be seen as three phases: pre-disaster (prevention/mitigation), disaster and post-disaster (response/recovery). Prevention, according to Sena and Michae (2006), involves hazard identification (in which the actual threats facing a community are identified) and vulnerability assessments (in which an evaluation of community risk and capacity is conducted). Recovery according to the some of the UK government guidance (Cabinet Office, 2013) is defined as the process of rebuilding, restoring and rehabilitating the community following an emergency; although distinct from the response phase, recovery should be an integral part of the response from the very beginning, as actions taken at that point in the cycle can influence the longer term outcomes for a community.

Haigh *et al.* (2009) recommend that CI practice should explore ways in which it could contribute towards improved resilience, such as the adoption of a more expansive view of the construction life cycle to

encompass the need to anticipate, assess, prevent, prepare, respond to and recover from disruptive challenges. This requires a framework that integrates the construction life cycle with the DM life cycle. The ultimate goal of disaster risk management is to break the disaster life cycle (Frumkin, 2010): CI practice can, arguably, take up this challenge by becoming involved in all of the phases of the DM cycle. Max Lock Centre's (2009) proposal of a spiral model (as shown in Figure 1) attempts to demonstrate that a particular cycle can be broken and elevated to a recovery situation that will enable a community to face up to future disasters with more confidence. Taking up this challenge can also serve as an opportunity for CI practice to alter the focus from the current outcomes metrics to a more socially constructed community outcome, in order to anticipate, assess and prevent disasters. However, from a theoretical side, there appears to be inadequacy in existing expertise: some of the standard norms and processes developed within CI practice seem unlikely to cater to the unique demands of the DM context. For instance, Crawford *et al.* (2013) studied the Queensland flooding in 2011 and argued that the currently accepted construction project management techniques are inappropriate for meeting the demands of key stakeholders in disaster response and recovery. The misalignment of the existing standard CI practice with the desired level is often highlighted when proactive resourcing strategies and planning measures are not taken up during post-disaster scenarios (Mitchell, 2004). However, limited good practice and individual achievements have been noted from time to time during reconstruction efforts after disasters and those responsible tend to be recognized as role models (Crawford *et al.*, 2013). It can be argued that such unique achievements are noteworthy precisely because there is an absence of pre-determined processes available to which the experts can refer. This is indicative of the gap within the current level of expertise (due to the shortfall of knowledge and experience of CI participants in DM) as well as the lack of institutionalization (Bartlett *et al.*, 2007) of this expertise (as this tends to be pragmatically addressed within the appropriate education system).

Mapping the disaster management life cycle with the appropriate levels of education in the construction industry

According to Boshier *et al.* (2007), disaster risk management should be mainstreamed into the construction decision-making process, as the industry is a key component of an economy. Whilst it appears that there are a multitude of different ways by which this mainstreaming could be undertaken, the consideration of

its flow of activities in the form of a cycle, with the intention of determining the 'pull and the push' forces for theorizing, as highlighted earlier, provides a progressive way forward for further analysis. As it is stated by Boshier and Dainty (2011) that the construction industry is 'poorly positioned for embracing the tenets of disaster risk reduction', analysing how DM can be mainstreamed within the components of a cycle might prove to be a very detailed and a coordinated way to tackle the issue of effective DM in CI education, given that scholars such as Ofori (2008) advocate that curricula in the built environment need redesigning to achieve this mainstreaming effectively. Several academics have argued the importance of developing DM education within CI: for example, Boshier *et al.* (2015) advocate that institutes providing civil engineering education should educate their students on the roles of disaster risk reduction within the civil engineering curriculum; Wedawatta *et al.* (2012) address the importance of educating the surveying professions in the same area. Several studies have been undertaken that addresses resilient designs and resilient architecture (see Flowers, 2014). Lamond *et al.* (2010) called for knowledge enhancement in the behaviour of property prices after disasters such as flooding. The four stages of the DM cycle based on a spiral model (see Figure 1) are considered in the process of investigating the key educational competencies for DM expertise development in construction.

A majority of the work where the CI is (currently) involved in DM is in the latter stages of the cycle: the response and recovery stages where reconstruction is required, of which the immediate aftermath of the disaster is the key phase. After the initial rescue of survivors, the response phase is concerned with the distribution of basic supplies (including water, food, clothing, shelter and medical care) to prevent further loss of life, and it typically occupies the first few hours or days after the disaster impact. The recovery phase then commences, during the weeks and months following the disaster, and this begins the process of restoring normality to the locality, which include the first steps of reconstruction. Finally comes mitigation, which is a much longer term activity; once this stage is reached, then there is time for reflection and rethinking. This sequence, where recovery is followed by mitigation, does not always happen in practice, but for the purposes of setting out our educational mapping, we consider this as taking place in an ideal world. However, the most important final stage is where the community preparedness and improvements in disaster planning occurs: for example, a significant number of tsunami warning towers were built after the 2004 South Asian tsunami caused much devastation (Saengpassa and Samsamak, 2012).

The response and recovery phases after a disaster can offer many challenges, which are determined by the specific type of disaster, the location in which the disaster happens and the specific context. As experienced during the 2015 earthquake in Nepal (Burke *et al.*, 2015), the authorities responsible for recovery efforts were 'guesstimating' both the human catastrophe as well as the economic catastrophe. As argued by Crawford *et al.* (2013), it is often the case that what is known as 'traditional' project management practices and processes in the CI are too much time-consuming and inflexible for use under circumstances of high uncertainty and complexity which may pertain in the case of disasters. The need to deploy rapid response within a context of a complex multi-stakeholder environment is often a constraint as the situation demands more flexibility, typically having to start the process without much knowledge on specific requirements and outcomes. Koskela and Howell (2002) argue that the underlying theory of project management is obsolete, considering the application of production theories to project management. Their argument stems from the unrealistic assumptions that are often made in traditional project management in construction, when compared with what is usually found in practice. Koskela and Howell (2002) present an argument relating to a typical construction project, as follows:

... customers or clients ... do not necessarily know their requirements at the beginning. Typically, customer requirements are poorly investigated at the outset, and the process of requirement clarification and change leads disruption in the progress of the construction project. (p. 11)

This argument is all the more pertinent in the context of a reconstruction project after a disaster: it is not appropriate for the progress of the work to be controlled based on a 'performance baseline'. The confusion and the chaos that prevails during the immediate aftermath of a disaster requires a more flexible approach according to Crawford *et al.* (2013) who advocate 'participatory project management'. Such participatory methods enable stakeholders within a disaster setting to share a common vision of the project as the team works towards successful outcomes, which are derived out of participatory mechanisms of teamwork and engagement. Development of *participatory skills, knowledge and understanding* is, therefore, the first tenet of education that needs to progress towards a new understanding of expertise and is also important in theorizing.

Once the immediate aftermath has been dealt with, the DM cycle moves to the recovery phase where reconstruction predominates, to which the CI

contributes significantly. Quarantelli (1995) for instance, defines four typical stages of reconstruction plans specific to the housing sector, comprising immediate relief, immediate shelter, temporary housing and permanent housing. What is important in this process is the timing of each of the stages, but Johnson *et al.* (2006), who used this framework in the contexts of post-earthquake housing construction in both Western Turkey and Columbia, found that the process did not work according to the specified method. Instead, the authorities were forced to employ several ad hoc measures. As Johnson *et al.* (2006) argue, post-disaster reconstruction is a process that is both comprehensive and involves cross-disciplinary contributions of a wide variety of stakeholders. Although the degree of resilience of the community affected should increase with longer term cost-effective solutions (Godschalk *et al.*, 2009), the speed of providing these usually reduces when moving from the immediate relief to permanent housing due to problems typically associated with availability of funding, social problems, economic problems and technological problems (Johnston *et al.*, 2006; Ingirige *et al.*, 2008). The degree of funding allocated to each of the stages or solutions should be appropriately managed, as mismanagement of any of the stages of housing provision will result in the community not being settled in permanent housing for a longer period. CI expertise, therefore, has an opportunity to fill an existing vacuum in the area of *managing finance in collaboration with governmental and non-governmental actors and key community stakeholders*. This area contributes significantly to development of the desired level of expertise; hence, at an educational level, this area needs considerable development within the CI.

Koskela and Howell (2002) note that, quite often in the CI, some of the alternative methods developed from practical observations and needs have not had a theoretical explanation, which has slowed down their diffusion. Although this was a general comment made in relation to many construction settings, it has particular relevance when theorizing within the construction practice during recovery and reconstruction stages after a disaster. The lack of an underpinning theory has rendered education and training more difficult and has hampered effective professionalization of the CI's role in DM. Most importantly, according to Crawford *et al.* (2013) on most occasions, CI practice tends to maintain its status quo, irrespective of the context, and consequently lacks the flexibility required to cater to an unfolding disaster situation. This view is consistent with Davidson's (2010) observation that lack of adequate organization may be a key reason why reconstruction fails, as it is bound to involve complex processes of planning, procurement and building that requires decision-making appropriate to a gradually

unfolding situation. Lizarralde (2010) also states that the emergency focus of the initial phase should eventually progress to a sustainability phase (referring to effective recovery and reconstruction on a continuous basis without jeopardizing any of the existing resources that might inhibit any future potential for the communities to meet their needs), with a much longer term orientation, yet this progression seems to be a big step for the CI to manage. To achieve this, it will be necessary to build up some *practical case scenarios and flexible management systems* from an educational point of view. Joseph *et al.* (2014) show the importance of cost-benefit analysis as a measure of justifying measures of adaptation at property level against flood risk. Joseph *et al.* (2014)'s work also contributes to the argument of making available more practical case scenarios to enable further CI contributions to preparedness to integrate DM within CI practices so that, as argued by Lizarralde (2010), the process eventually progresses towards a sustainability phase.

In taking the step towards sustainability, as Lizarralde (2010) points out, the initial mitigation and disaster preparedness phase is propelled to importance. The phase incorporates a range of activities, reflecting the degree to which a community is in a state of readiness immediately before the disaster strike. It covers short-term emergency planning (that includes insurance), hazard warning (e.g. early warning systems), evacuation procedures (documentation and preparation of manuals and guidance) and the stockpiling (Coffrin *et al.*, 2011) of appropriate supplies to meet resource shortages. The phase should also address effective planning of supply chain logistics and just-in-time inventory control systems (Richey, 2009). Although at present the CI is less involved during the preparedness phase of a disaster, experts such as urban planners, together with representatives of strategic bodies (such as professional organizations and government departments), already play major roles in strategizing within the preparedness phase. This can help to minimize any unplanned shocks likely to occur during the disaster and post-disaster phases: for example, in the aftermath of the South Asian tsunami, the CI in many countries experienced severe skilled shortages and capacity gaps (Ingirige *et al.*, 2008; Le Masurier *et al.*, 2006). The wage bill for both skilled and unskilled workers increased markedly, as did the salaries commanded by professionals, due to the involvement of foreign contractors, consultants, expatriate workers and funding agencies in the construction market. In Sri Lanka, the very high upward trend in price levels of labour, materials and other resources due to shortages and high demand experienced during a short span of time had a negative effect on the industry during recovery and reconstruction stage after the

tsunami (Chang *et al.*, 2010). In the UK, there was a similar experience as a lot of property owners found there to be a dearth of builders after the Cumbrian flooding in 2006 (Felsted, 2007). From an educational point of view, therefore, there should be adequate skills to understand and study the *economics of a disaster situation* and gain an awareness of what preparedness and planning are needed.

In contrast to normal construction projects, post-disaster reconstruction is likely to suffer project deficiencies in relation to the availability of resources (Chang *et al.*, 2011), which the pre-disaster planning and preparedness stage needs to take into account. The field observations by Russell (2005) and Zuo *et al.* (2008) provided examples of rework or disruption of reconstruction projects, as a result of failure to procure resources required for projects post-disaster. Generally the supply chain in the CI that deals with reconstruction is quite extensive and may sometimes span across several geographic boundaries. Although it is impossible for managers to eliminate all the risks in the supply chain, the challenge now is how to make them sufficiently resilient so that they too can bounce back, and potentially thrive, from catastrophes and disruptive events (Abidin and Ingirige, 2015; Natarajarathinam *et al.*, 2009). Lack of an effective supply chain often results in cost/time overruns, poor quality of work, technical defects and lack of durable and long-lasting construction (Olawale and Sun, 2010; Abdul-Rahman *et al.*, 2008). To address these problems, building resilience towards disruptive events requires key players in the supply chain to focus not on their self-interest alone, but also take into consideration the interest of others. Thus, instead of a silo approach, all parts of the supply chain need to work together to build resilience to disruptive events and improve project performance. Knowledge of the *operation of the wider supply chain* is necessary as another tenet of education, to uplift the status quo of construction to be mainstreamed within a DM context.

New approaches and insights will contribute to the pragmatism (Denscombe, 2010) of energizing the desired theory and practice. If this were to be taken forward from a grass-roots educational level within CI, the following knowledge and skills are arguably important:

- (1) Development of participatory skills, considering the unique make-up of the stakeholder group that undertakes construction within a DM context. The skills demanded tend to be unique, as the scope of stakeholder interaction extends beyond the normal stakeholder group in construction.
- (2) Managing finance with a longer term view, considering vulnerability reduction and resilience

building as the primary consideration for better community benefits within a DM context. This also involves a shift towards becoming social outcomes orientated and able to employ pragmatism in working within the political climate that emerges in a developing disaster situation.

- (3) Enhancement of preparedness phase expertise, integrating planning measures and improved early warning systems within a comprehensive disaster preparedness plan.
- (4) Education on parameters to justify the economics of a disaster and the disaster preparedness phase.
- (5) Knowledge on key criteria for success of effective supply chains in DM.

The above knowledge and skills meriting the development of education to mainstream DM within construction can be considered as falling into two subgroups: the first two can be studied at micro level, utilizing documented cases; the last three areas within an educational strategy are more long-term orientated and hence taken forward at a longer term policy-making level and will be discussed as part of the synthesis of the case study discussion. Two documented case histories, in which there was involvement of the CI in the recovery efforts, will now be examined, to study the link between the CI-DM nexus and also to investigate how the developments could be linked to improved education at the grass-roots level. The original research questions are further refined as follows:

- (i) What sort of expertise is needed to meet the demands of key stakeholders in disaster response and recovery?
- (ii) How might construction education develop this expertise, grounded within the chosen philosophical position?

Analysis of documented cases method

'Documented cases' is a form of secondary research using case studies conducted and reported in the past. Bieniawski (1978) used documented cases as histories to address a new set of research questions based on a common thread suitable for a new context. The strong context-dependent nature underlined by the analysis of documented cases justifies grounding of this research under the chosen philosophical position of phenomenology. Further, the documented cases approach provides a pragmatic way forward to reflecting on two types of disasters that have already taken place where access to both contexts was provided to the author of this study, hence enabling a process of reflection based on new research questions.

Although the documented cases come from two diverse contexts, the main common thread in both scenarios is the protracted reconstruction effort, which is the focus of this research, which merits the choice of the two documented cases. The discussion of documented cases add value to this research, as the salient points can be drawn out of very specific locally held knowledge that can have wider benefits to a much larger population.

When, as is often the case, data on CI involvement in DM are scarce, the analysis of documented cases provides a refreshing way to address the research questions raised in this study. Documented cases also provide the basis of modifying and populating the original CI expertise development model (Figure 2) proposed earlier. The first case looks at property-level flood protection in the UK, whilst the second discusses an international case of housing reconstruction after a major disaster. The latter caused much destruction and devastation including more than 30 000 deaths in Sri Lanka, whereas the former created disruption and damage to livelihoods of people.

- (1) The case of small businesses recovering after the 2009 flood event in Cockermouth in Cumbria: an opportunity missed by the Construction Industry

The UK has in recent times experienced several severe flood events in places such as Somerset levels (McEwen *et al.*, 2014), Cumbria (Environment Agency, 2009) and Hull (Crichton, 2007). At an individual property level, there is renewed focus for protection against flooding, as argued by Hopkins and Warburton (2014) and Wedawatta *et al.* (2014). Whilst the recovery process in all such events has several layers of institutions involved, at the small business level the process seems to be driven mainly by the insurance industry. The entire recovery and reconstruction effort involves several participants in construction, but they are largely recruited, deployed and in certain circumstances led by insurance industry professionals. Several small businesses affected by the flooding of 2009 in Cockermouth reported that the organization of the recovery activity seemed to be uncoordinated, activities fragmented and often lacked a coherent strategy and direction (Joseph *et al.*, 2011; Wedawatta *et al.*, 2014), extending over a long time period. Wedawatta *et al.* (2014) discussed the case of small-and-medium-sized enterprises (SMEs) and the interactions between DM and CI experts in their recovery efforts after the 2009 flood event in Cockermouth in Cumbria. The resilience measures adopted by the SMEs have been brought together as a single case synthesis of SME resilience and recovery efforts within the context of the flood event. In all, 4 SME business owners and

2 professionals who advised SMEs on flood mitigation were interviewed, providing the basis for some of the synthesis made of their recovery and reconstruction efforts in 2009.

In all of the SMEs highlighted in Table 1, the recovery efforts did not require any structural adjustments to properties and the work involved was mainly focused upon interiors (including addressing some of the cosmetic damages to gas and electrical services) and rectifications of minor damages. One of the professionals interviewed stated that:

Most people think that flooding causes structural problems of buildings and a lot of structural work needs doing, which is a wrong notion

The above comment represents a typical observation by members of the public in that there is widespread belief that a flood causes structural instability of properties. This may be true for a minority of properties, but in most of the cases, the damage is to the finishes of the property, which are really cosmetic. At a macro level, the entire reconstruction effort was carried out on the basis of 'like for like' reinstatement, based on the insurance principle of 'non-betterment', which precludes adequate levels of adaptation. Whilst the businesses were quite keen to restart their activities as soon as possible, it required strong leadership and commitment to put in place a longer term solution. The small businesses were focused on quick recovery timescales, which does not necessarily incorporate longer term resilient reinstatement measures. It seems, from a government policy perspective, that several steps can be taken to promote long-term resilience against future flood events as the main driver in the recovery phases. This would allow appropriate holistic technical considerations to be taken into account, rather than short-term measures alone.

The Cockermouth case shows that the construction participants who were involved in refurbishment and reinstatement of properties did not adequately engage with the property owners/occupiers during the reconstruction process. Although the DM context opened up several opportunities for the construction participants to have more of a deeper engagement with the businesses affected by flooding, such engagement was not considered either a priority or an opportunity. As the recovery and reconstruction during the aftermath of the flood was predominantly driven by the insurance industry (Wedawatta *et al.*, 2014), this to a certain extent prevented appropriate input by the CI and that contributed towards an inefficient process. This resonates well with Davidson's (2010) argument that the DM process always fails due to poor organization and lack of coordination skills. The lack of deep

Table 1 Highlights of experiences of the flood-affected businesses (adapted from Wedawatta *et al.*, 2014)

Case No.	Type	Extent of work done in reconstruction of flood-damaged properties	Involvement of CI	Experiences of affected property owners
Case 1	Public house and restaurant	Reinstatement of floors and retrofitting of power sockets and interior works	All reconstruction work done by a small redecoration company	The claims procedure and the reconstruction process initiated by the insurance company
Case 2	Newsagent shop	Mainly interiors	Several building trades worked independently. The property owner was faced with coordinating the project	The process was initiated by the insurance company and the loss adjustor. Then, the whole process of managing the separate tradesmen fell on the property owner
Case 3	Hardware shop	Mainly interiors	Single contractor employed for refurbishment of premises	Difficulties faced in selecting the contractor as several small construction firms started advertising by dropping leaflets in the premises. Contractor was recommended by the drying firm
Case 4	Lighting and electrical shop	Mainly interiors	A lot of professionals from both construction and insurance industry involved in putting the project together	Suddenly required to engage and negotiate with professionals that they had no experience or knowledge of (architects, surveyors and loss adjusters).

engagement of CI shows that the first tenet of CI education within a DM context, namely *participatory skills*, was not appropriately developed. If DM is to be considered as a market (Scott, 2010), such key expertise is essential to the development of objectives and goals in the area.

(2) The case of housing reconstruction in Sri Lanka after the 2004 South Asian Tsunami

Sri Lanka was badly affected by the South Asian tsunami that occurred in December 2004: it destroyed about two-thirds of the Sri Lankan coastline and affected more than 1 000 000 people. It not only affected the lives of the community, but also had a devastating effect on their housing and livelihoods. The overall loss of 100 000 or more houses proved to be a major challenge to the emergency response teams and disaster planners. According to Manatunga (2005), Sri Lanka's natural rate of house building at the time was as low as 4000–5000 units per annum; therefore, the loss of 100 000 houses in 4 h overwhelmed the capacities and capabilities of the various authorities responsible for housing construction and private housing developers alike. The enduring reconstruction process after a disaster, therefore, provides a useful focus for exploring the process of expertise development in CI within a DM context.

Sri Lanka faced several challenges in its post-tsunami reconstruction, and this resulted in a focus upon

short-term rather than long-lasting solutions (Ingirige *et al.*, 2008). Often, post-disaster, permanent reconstruction is inefficiently managed, uncoordinated and takes time to initiate (Lloyd-Jones, 2006). Under extreme conditions, both long-term performance and the satisfaction and requirements of the intended occupants are issues that are often overlooked by policy-makers, practitioners, funding bodies and the occupants themselves.

The reconstruction efforts in Sri Lanka were carried out utilizing two methods: the donor-assisted programme (DAP) and the owner-driven mechanisms (Lyons, 2009) (whilst Chang *et al.* (2011) cover a third method known as 'contractor driven', this being embedded in this paper under the umbrella of DAP). The owner-driven mechanism included technical support and funding and organization of self-help schemes. All affected households that were able to demonstrate ownership to land were entitled to a grant from the State. In addition, several NGOs provided additional payments, or provided labour, materials and general technical assistance to support families rebuilding their own homes. This strategy was also termed 'assisted self-help' by Johnson *et al.* (2006).

The DAP was mainly targeted at people living within the buffer zones attached to the coastal areas affected by the tsunami, who had to be relocated. Under this strategy, the affected families were entitled to a house built by a donor agency, on land allocated

by the State, in accordance with Sri Lankan government standards. The donor provided each new settlement with an internal common infrastructure, whilst the Sri Lankan government provides the services up to the relocation site.

Figure 3 (Ingirige *et al.*, 2008) compares the user satisfaction in the two schemes adopted during post-tsunami housing reconstruction in Sri Lanka. The survey was conducted in the Galle district in Sri Lanka, where the effect of the tsunami was significantly higher. The questionnaire was administered within the Galle district amongst 226 victims of the 2004 tsunami. The sample represented a good cross-section of the different types of permanent and temporary housing provisions. The survey sample was divided into DAP housing and owner-driven housing.

The comparison of respondent satisfaction of the two housing strategies in Figure 3 shows that the occupants of DAP housing were significantly more satisfied than occupants of owner-driven houses, in the areas of aesthetics of the building, quality, durability and the functionality. However, the survey results also show that owner-driven house occupants were generally more satisfied than their DAP counterparts, with respect to availability of space, ability to influence design changes and affording flexibility to perform future expansion to the house. The main cause for this comparatively lesser satisfaction was that it fell short of meeting the communities' subtle demands related to dynamics of life, particularly in terms of understanding how their livelihoods were connected to the types and location of housing. In simple terms, lower satisfaction level tended to be

an indication of lower community participation through which the 'softer' needs of the people did not seem to have been addressed. In owner-driven housing, owners had the opportunity of identifying their needs and engaged in various community participatory schemes, allowing them to indicate their preferences in relation to parameters such as space, design changes and flexibility for future expansion. Thus, Figure 3 provides insights into the effects of the lower levels of community engagement in DAP properties compared to owner-driven methods. For example, the South Asia Disaster Report (Duryog Nivaran, 2006, p. 38) states that:

coastal women in Sri Lanka traditionally engaged in ... home based activities such as processing coir from coconut husks ... and other craft based work.

Some of these houses were not appropriate to meet the needs arising from the activities of these women: as highlighted by Ofori (2004), houses and livelihoods have a strong interconnection; hence, the poor satisfaction score related to space, current design and future flexibility of the DAP houses. The excessive dissatisfaction of the DAP scheme can be directly attributed to the poor ability of the contractors to engage with the community effectively. Hence, the post-tsunami DM context also shows the poorly developed *participatory skills*, which is the first tenet of CI education within a DM context. The community consultation is not only on user needs but those needs should also be translated into the use of appropriate materials and construction methods, considering that the post-disaster context is a new 'market' (Scott, 2010). CI expertise within the DM context presents some unique avenues for development as regards vulnerability reduction and resilience building. Overall within a context of reconstruction after a disaster, Lloyd-Jones (2006) states that the skills developments should progress through the areas of sourcing construction materials and equipment, procurement and project management, aiding logistical planning and finance over a longer term duration. Zuo *et al.* (2008) also identify that construction contractors have the unique opportunity of creating a boost to resource availability with better planning and preparedness. The post-disaster context also indicates the poorly developed skills in *managing finance with a longer term view, considering vulnerability reduction and resilience building as the primary consideration for better community benefits within a DM context*, which is the second tenet identified above. In other words, reconstruction processes should be considered as a redevelopment opportunity, with environment protection a priority on the sustainability agenda.

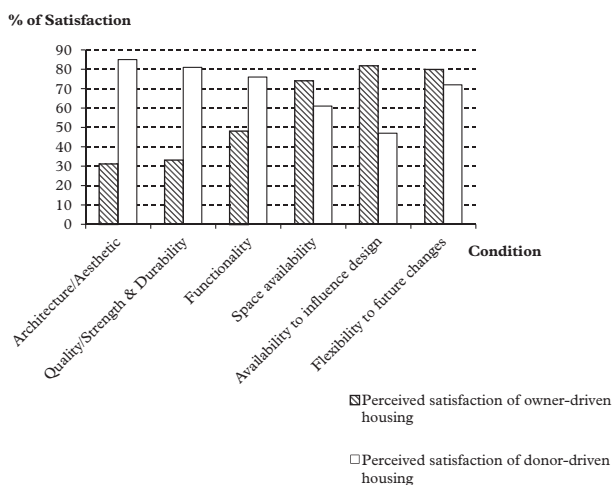


Figure 3 Comparison of the level of satisfaction of owner and DAP housing (Galle District, Sri Lanka) – after Ingirige *et al.*, 2008)

Synthesis and the modified expertise development model: a panacea or an illusion?

The two documented cases highlight the first two CI knowledge and skills (1 and 2) that need to be developed for effective DM integration, as currently the industry often fails to fully engage with communities during recovery and reconstruction efforts. Developing such knowledge and skills would improve understanding of each community’s unique needs which, in conjunction with a CI background, could potentially translate into successful recovery and reconstruction. It was reported that the lower the level of involvement of the CI during the needs assessment stage after a disaster, the less satisfied the community was. The level of involvement of the CI in other phases of a disaster is even more minimal, not being observed in either of the documented cases.

The other knowledge and skills (3, 4 and 5) argued and synthesized from the literature are relevant to broader community or government level development and belong to the preparedness and planning phases. It is also anticipated that a firm grounding of such core planning and preparedness knowledge and skills will further influence more positive development of the same at a micro level (knowledge and skills 1 and 2). Knowledge and skills 3, 4 and 5 will enable the CI experts to gain an understanding of the ‘big picture’ when it comes to reconstruction efforts, as the projects tend to be led by people outside the industry. In the case of flood recovery in the UK, the projects were scattered around the country in fragmented fashion and they were being led by the insurance industry and loss adjustors (Wedawatta *et al.*, 2014). In the case of post-tsunami reconstruction, the projects were being led by public organizations and non-governmental organizations, who did not necessarily possess construction skills. This gap defies all CI efforts to develop grass-roots skills in order to enhance expertise; it cannot, however, be closed just by a process of skills or competency development of DM within the CI. It needs a renewed emphasis on participatory community engagement by the CI, which changes the prevailing culture of achieving an efficiency drive based on a normative scale of performance. Education developments alone, therefore, cannot close this gap.

The availability of more documented cases which cover all phases of the DM cycle will give the CI the added impetus to be able to prepare their response in a more coordinated and a cohesive way. The phenomenological position with all its characteristics could be better fulfilled by extending the current target-driven normative focus to a more social outcomes-based strategy. The conceptual model in Figure 2 can be taken

forward as an explanatory theoretical model in Figure 4. This will provide the context and the basis for the desired expertise to emerge, in order to cater for better integration of the CI within DM.

Figure 4 is a theoretical model that shows the ‘pull’ forces that demand DM mainstreaming within CI education and its interconnected elements, based on a phenomenological philosophical position that is context dependent. The continued context-dependent nature is brought about by the need for more cases to be collected to enrich the case bank. The original conceptual model (Figure 2) is modified in the light of the synthesis discussion, where it emerged that the mainstreaming of DM within CI should commence from an educational level but also move into a theoretical and practical level, thereby building up the desired capability of the CI to seek more opportunities and exploitations within DM. The desired expertise (the word ‘desired’ here referring to the satisfaction of stakeholder interests in DM) is the culmination of the capability enhancement at a micro level (knowledge and skills 1 and 2), preparedness planning (knowledge and skill 3), grass-roots education that considers economics of DM (knowledge and skill 4) and theoretical and practical awareness to better understand community needs and unique contexts (knowledge and skill 5) in a way that integrates DM within the CI. It is important that the desired expertise is developed in such a way that DM is contextualized within CI in practice, thus enhancing theorizing in terms of a better CI–DM nexus. It is important to consider construction at times of disasters

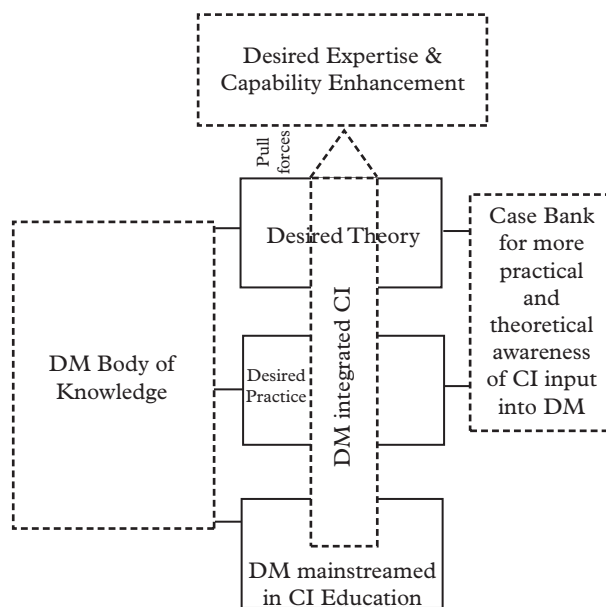


Figure 4 Modified expertise development model

as forming unique contexts of complexity, resource limitations and connected humanitarian and social issues, requiring continuous needs assessments and engagement of communities.

Bosher *et al.* (2015) question the extent to which prominent hazards such as floods and coastal storms are being considered in civil engineering education. Similarly, Wedawatta *et al.* (2012) identified gaps in competencies of chartered surveyors in undertaking flood risk management advice. The design professions are also calling for the incorporation of resilient design as a means of building in both resilience and sustainability from the outset; hence, such competencies should be taught in design courses (Flowers, 2014). There seem to be gaps in grass-roots education in the CI when trying to meet DM context needs and these appear as gaps in the CI professions as well. It is, therefore, obvious that construction professions should seek a wider role in reconstruction efforts, so that such educational gaps at grass-roots level are resolved. Figure 4 shows this connection through the links to the 'DM body of knowledge' box and the populating of the 'case bank' for more CI in DM box: these linkages will step up the grass-roots DM mainstreamed within CI education. Governments should also be made aware of both the theoretical benefits (the overall economic and the social improvements likely to be achieved) and the practical benefits of construction involvement in the process (so that the involvement is more widespread and covers the full life cycle of the DM spiral, as illustrated in Figure 1). CI leadership should be brought to the fore, enabling deeper engagement of construction professionals with communities and removing or reducing some of the existing barriers; this will then determine the position of the CI in DM as a panacea, rather than an illusion.

Conclusion

The research suggests that a 'unified DM focus' needs establishing within the CI and this could be the guiding principle for theorizing in the context of DM in the CI. This will, in the longer term, counteract the 'time pressed agenda' within construction and will make the industry better prepared for DM. A strategy that involves both a bottom-up and a top-down approach is suggested to achieve this change. The bottom-up approach is suggested to enhance capacity building within construction education (in Figure 4 this is the starting point, shown as 'DM mainstreamed within CI education'). Reports suggesting this mainstreaming have already been published by two of the relevant institutions: the ICE (Bosher *et al.* 2015) and the Royal Institution of Chartered Surveyors (RICS;

Lloyd-Jones, 2006; Wedawatta *et al.*, 2012; Max Lock Centre, 2009). Studies have also emerged in architecture as well as the property industries, in areas of resilient designs and property price behaviours after flooding and weather extremes. However, the process also needs a top-down approach, with the understanding that the process cannot be 'self-propelled' as several industry, cultural and political barriers exist, all of which need careful management at government and policy-maker level. In the UK, for example, during the immediate aftermath of a natural hazard event such as flooding, the insurance industry tends to undertake leadership of the recovery process and this affects the ability of CI participants to manage the process effectively. Educating the insurance industry on CI skills is not recommended, due to the rigorous study processes in CI education and professional membership, but instead, CI leadership should be developed within DM that leads to more resilience and long-lasting solutions. Further, within the international context, a wide variety of organizations (including governmental, non-governmental and community-based volunteers) tend to take leadership of recovery processes, which do seem to undermine CI efforts. Both the insurance industry and non-governmental actors tend to be very short-term orientated, in that their primary consideration tends to be returning people to usual locales as soon as possible, without consideration of the 'big picture' and the longer term sustainability of communities. Good practice, via better awareness of successful community resilience measures and practical schemes, might create improved awareness and sustainability. On the other hand, some disasters may create positive impacts on the industry as discussed earlier under the case of the 2004 Tsunami in Sri Lanka resulting in a certain extent of emergence of better working conditions and pay structures for local construction workers and establishment of smaller construction companies, increasing the net construction output in Sri Lanka.

This proposal, guided by a phenomenological philosophical position, has contributed to theorizing by identifying a methodology through a theoretical model to develop the desired expertise for mainstreaming DM within CI. Whilst the previous literature has addressed mainstreaming DM in CI, this research adds to the body of knowledge by presenting a modified expertise development model that identifies grass-roots knowledge and skills as specific tenets of DM education in CI. From a practice point of view, practitioners in the CI industry can identify the range of educational requirements and improve their preparedness to undertake and deliver a more wide ranging set of DM mainstreamed CI products and services. Given the fact that DM as a market is further expanding worldwide, it was identified that governments, policy-makers and

agencies have a shared role in cascading some of the requirements as good practice amongst industry stakeholders via good practice cases to increase the uptake of DM within CI.

In addition, for CI professionals and companies with hard-wired systems embedded in their knowledge bases, the research provides a refreshing conceptual basis to rethink on the basis of mainstreaming of DM within the CI. For the CI to be exploited as a 'panacea' for this mainstreaming, it is important that the appropriate DM in CI expertise is embedded in both theory and practice for longer term sustainability of the industry.

Disclosure statement

No potential conflict of interest was reported by the author.

References

- Abdul-Rahman, H., Yahya, I.A., Berawi, M.A. and Wah, L.W. (2008) Conceptual delay mitigation model using a project learning approach in practice. *Construction Management and Economics*, **26**, 15–27.
- Abidin, N.A.Z. and Ingirige, B. (2015) Building resilience of construction supply chain to disruptions: development of a conceptual framework, *Proceedings of the 12th International Postgraduate Research Conference*, 10th–12th June, pp. 518–36.
- Addis, M. (2010) The thinking man's industry. *Construction manager magazine*, 11th November. CIOB publication.
- Bartlett, J., Tywoniak, S. and Hatcher, C. (2007) Public relations professional practice and the institutionalisation of CSR. *Journal of Communication Management*, **11**(4), 281–99.
- Benner, P. (1984) *From Novice to Expert: Excellence and Power in Clinical Nursing Practice*, Addison-Wesley Publishing Company, Menlo Park, CA.
- Bieniawski, Z.T. (1978) Determining rock mass deformability: experience from case histories. *International Journal of Rock Mechanics and Material Science*, **15**, 237–47.
- Blanchard, B.S. and Fabrycky, W.J. (1998) *Systems Engineering and Analysis*, 5th edn, Prentice-Hall, Upper Saddle River, NJ.
- Bosher, L. and Dainty, A. (2011) Disaster risk reduction and 'built-in' resilience: towards overarching principles for construction practice. *Disasters*, **35**, 1–18.
- Bosher, L., Dainty, A., Carrillo, P., Glass, J. and Price, A. (2007) Integrating disaster risk management into construction: a UK perspective. *Building Research & Information*, **5**(2), 163–77.
- Bosher, L., Johnson, C. and Von Meding, J. (2015) Reducing disaster risk in cities: moving towards a new set of skills. *Proceedings of the Institution of Civil Engineers: Civil Engineering*, **168**(3), 99.
- Boyd, D. and Addis, M. (2011) Moving from Knowledge Management to Expertise Management: A Problem of Contexts – Centre for Environment and Society Research Working Paper series no. 3, Birmingham City University, Birmingham, AL.
- Burke, J., McCurry, J. and Jones, S. (2015) Nepal earthquake: authorities struggle to cope despite international aid efforts, *The Guardian*. Available at <http://goo.gl/pG18Wz> (accessed on 11 July 2015)
- Cabinet Office (2013). Emergency response and recovery – non statutory guidance accompanying the civil contingencies Act 2004, in Civil Contingencies Secretariat (ed.) 28/10/2013 ed. London: H M Government. Available from <http://goo.gl/crs5l3> (accessed on 23 February 2016)
- Chang, Y., Wilkinson, S., Potangaroa, R. and Seville, E. (2010) Resourcing challenges for post-disaster housing reconstruction: a comparative analysis. *Building Research & Information*, **38**(3), 247–64.
- Chang, Y., Wilkinson, S., Potangaroa, R. and Seville, E. (2011) Identifying factors affecting resource availability for post-disaster reconstruction: a case study in China. *Construction Management and Economics*, **29**(1), 37–48.
- Coffrin, C., Van Hentenryck, P. and Bent, R. (2011) Strategic stockpiling of power system supplies for disaster recovery. *IEEE*, **1**(8), 24–9.
- Collins, H.M. and Evans, R. (2002) The third wave of science studies: studies of expertise and experience'. *Social Studies of Science*, **32**(2), 235–96.
- Crawford, L., Langston, C. and Bajracharya, B. (2013) Participatory project management for improved disaster resilience. *International Journal of Disaster Resilience in the Built Environment*, **4**(3), 317–33.
- Crichton, D. (2007). The Hull Floods of June 2007 – some insurance industry implications. *Alert (Newsletter of Benfield UCL HRC)* [Online], 22.
- Dainty, A. (2008) Methodological pluralism in construction management research, in Knight, A. and Ruddock, L. (eds.) *Advanced Research Methods in the Built Environment*, Wiley-Blackwell, Chichester, pp. 1–13.
- Davidson, C.H. (2010) Multi-actor arrangements and project management, in Lizarralde, G., Johnson, C. and Davidson, C.H. (eds.) *Rebuilding after Disasters: From Emergency to Sustainability*, Spon Press, New York, pp. 88–109.
- Denscombe, M. (2010) *The Good Research Guide for Small-scale Social Research Projects*, McGraw-Hill, Maidenhead.
- Department of the Environment, Transport and the Regions (DETR). (2000) *Performance Indicators Show Improvement*, Construction Monitor, 4 May.
- Dreyfus, H. and Dreyfus, S. (1986) *Mind over Machine*, Free Press, New York.
- Duryog Nivaran, (2006). South Asia Disaster Report: 2005 – Tackling Tides and Tremors. Joint publishers: Practical Action, South Asia Programme and Rural Development Policy Institute, Pakistan. Available from <http://www.duryognivaran.org/> (accessed on 5 January 2008)
- Egan, J. (1998) *Rethinking Construction*, Department of the Environment, Transport and the Regions, London.
- Environment Agency (2009) *Cumbria 2009 Floods – Lessons Identified Report*, Environment Agency, Bristol.

- Ericsson, K.A. and Smith, J. (1991) *Toward a General Theory of Expertise*, Cambridge University Press, Cambridge.
- Felsted (2007) Dearth of builders for flood repairs, *Financial Times*, 17 July 2007. Available at <http://goo.gl/3OYII4> (accessed on 11 July 2015)
- Flowers, B. (2014) *Architecture in the age of uncertainty*, Ashgate Publishers, Surrey, UK.
- Frumkin, H. (2010) *Environmental health: from global to local*, 2nd edn, Wiley, New York.
- Fuller, S. (1988) *Social Epistemology*, Indiana University Press, Bloomington.
- Godschalk, D.R., Rose, A., Mittler, E., Porter, K. and West, C.T. (2009) Estimating the value of foresight: aggregate analysis of natural hazard mitigation benefits and costs. *Journal of Environmental Planning and Management*, 52(6), 739–56.
- Hackley, C. (1999) Tacit knowledge and the epistemology of expertise in strategic marketing management. *European Journal of Marketing*, 33(7/8), 720–36.
- Haigh, R., Amaratunga, D., Keraminiyage, K. and Pathirage, C. (2009) Disaster mitigation through collaborative knowledge-sharing practices, in Smyth, H. and Pryke, S. (eds.), *Collaborative Relationships in Construction: Developing Frameworks and Networks*, Wiley-Blackwell, New Jersey, NJ, pp. 163–78.
- Hartwell-Naguib, S. and Roberts, N. (2014) *Winter Floods 2013/14 Standard Note: SN/SC/06809*, House of Commons Library, London.
- Heidegger, M. (1997) Plato's Sophist. Indiana University Press, Indiana, IN.
- Hoffman, R.R., Shadbolt, N., Burton, A.M. and Klein, G.A. (1995) Eliciting knowledge from experts: a methodological analysis. *Organizational Behavior and Human Decision Processes*, 62, 129–58.
- Hoffman, R.R., Ward, P., Feltovich, P.J., DiBello, L., Fiore, S.M. and Andrews, D.H. (2013) *Accelerated Expertise: Training for High Proficiency in a Complex World (Expertise: Research and Applications Series)* Psychology Press, New York.
- Hopkins, J. and Warburton, J. (2014) Local perception of infrequent, extreme upland flash flooding: prisoners of experience? *Disasters*, 39(3), 546–69.
- Hystad, P.W. and Keller, P.C. (2008) Towards a destination tourism disaster management framework: Long-term lessons from a forest fire disaster. *Tourism Management*, 29, 151–62.
- Ingirige, B., Haigh, R., Malalgoda, C. and Palliyaguru, R.S. (2008) Exploring potential knowledge flows related to post tsunami housing (re-)construction in Sri Lanka. *Journal of Construction in Developing Countries*, Special Issue on knowledge flows for balanced development, 13(2), 21–42.
- Intergovernmental Panel on Climate Change (2014) *Climate change 2014: Synthesis report*. Contribution of working groups I, II and III to The Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Core Writing Team, Pachauri, R.K. and Meyer, L.A. (eds.) IPCC, Geneva, Switzerland.
- Jayasuriya, S. and McCawley, P. (2008) Reconstruction after a major disaster: lessons from the post-tsunami experience in Indonesia, Sri Lanka, and Thailand. Working Paper No. 125, ADB Institute, Tokyo.
- Johnson, C., Lizarralde, G. and Davidson, C.H. (2006) A systems view of temporary housing projects in post-disaster reconstruction. *Construction Management and Economics*, 24, 367–78.
- Joseph, R., Proverbs, D., Lamond, J. and Wassell, P. (2011) An analysis of the costs of resilient reinstatement of flood affected properties. *Structural Survey*, 29(4), 279–93.
- Joseph, R., Proverbs, D., Lamond, J. and Wassell, P. (2014) Application of the concept of cost benefits analysis (CBA) to property level flood risk adaptation measures. *Structural Survey*, 32(2), 102–22.
- Koskela, L. and Howell, G. (2002) The underlying theory of project management is obsolete. *Proceedings of the PMI Research Conference*, 2002, 293–302.
- Kuhn, T.S. (1996) *The Structure of Scientific Revolutions*, 3rd edn, University of Chicago Press, Chicago.
- Labuschagne, C. and Brent, A.C. (2005) Sustainable project life cycle management: the need to integrate life cycles in the manufacturing sector. *International Journal of Project Management*, 23(2), 159–68.
- Lamond, J., Proverbs, D. and Hammond, F. (2010) The impact of flooding on the price of residential property: a transactional analysis for the UK. *Housing Studies*, 25(3), 335–56.
- Lapinski, M.K. and Rimal, R.N. (2005) An explication of social norms. *Communication Theory*, 15(2), 127–47.
- Latham, M. (1994) *Constructing the Team*, HMSO, London.
- Le Masurier, J., Rotimi, J.O.B. and Wilkinson, S. (2006) A comparison between routine construction and post-disaster reconstruction with case studies from New Zealand, in Boyd, D. (ed.) *Procs 22nd Annual ARCOM Conference*, 4–6 September 2006, Association of Researchers in Construction Management, Birmingham, pp. 523–30.
- Lizarralde, G. (2010) From complexity to strategic planning for sustainable construction, in Lizarralde, G., Johnson, C. and Davidson, C. (eds.) *Rebuilding after Disasters: From Emergency to Sustainability*, Spon Press, New York, pp. 248–54.
- Lloyd-Jones, T. (2006) Mind the gap! Post-disaster reconstruction and the transition from humanitarian relief. Royal Institute of Chartered Surveyors, London. Available at <http://www.maxlockcentre.org> (accessed on 5 April 2016)
- Lucini, B. (2014) *Disaster Resilience from a Sociological Perspective: Exploring Three Italian Earthquakes as Modes for Disaster Resilience Planning*, Springer, Cham, Switzerland.
- Lyons, M. (2009) Building back better: the large-scale impact of small-scale approaches to reconstruction. *World Development*, 37(2), 385–98.
- Manatunga, R. (2005) Tsunami housing reconstruction: a major challenge, *Daily News*, 11 October 2005. Available at <http://bit.ly/1Q6R5D2> (accessed 30 June 2015)
- Maynard-Moody, S. and Musheno, M. (2003) *Cops, Teachers, Counselors: Stories from the Front Lines of Public Service*, University of Michigan Press, Ann Arbor.
- Royal Institution of Chartered Surveyors (RICS). (2009) *The built environment professions in disaster risk reduction and response, a guide for humanitarian agencies*. Lloyd-Jones, T. (ed). RICS London, UK.

- McCann, L., Granter, E., Hassard, J. and Hyde, P. (2015) 'You can't do both – something will give': limitations of the targets culture in managing UK healthcare workforces. *Human Resource Management*, 54(5), 773–91.
- McEwen, L., Jones, O. and Robertson, I. (2014) A glorious time? Some reflections on flooding in the Somerset levels. *The Geographical Journal*, 180(4), 326–37.
- McMeeken, R. (2013), Construction 2025 strategy: 33% the deepest cut?, *RICS Modus*, December 2013 – January (14), 31–3.
- Mitchell, J.K. (2004) Re-conceiving recovery, in Norman, S. (ed.) *New Zealand Recovery Symposium Proceedings*, July 12–13, Ministry of Civil Defence and Emergency Management, Wellington, New Zealand, pp. 47–68.
- Moe, T.L. and Pathranarakul, P. (2006) An integrated approach to natural disaster management. *Disaster Prevention and Management*, 15(3), 396–413.
- Myers, D. (2003) The future of construction economics as an academic discipline. *Construction Management and Economics*, 21(2), 103–6.
- Natarajarathinam, M., Capar, I. and Narayanan, A. (2009) Managing supply chains in times of crisis: a review of literature and insights. *International Journal of Physical Distribution & Logistics Management*, 39(7), 535–73.
- O'Brien, G., O'Keefe, P., Gadema, Z. and Swords, J. (2010) Approaching disaster management through social learning. *Disaster Prevention and Management*, 19(4), 498–508.
- Ofori, G. (2004) Construction Industry Development for Disaster Prevention and Response [online]. National University of Singapore. Available at <http://bit.ly/1SzEom1> (accessed 27 February 2006)
- Ofori, G. (2008) Construction in developing nations: towards increased resilience to disasters, in Boshier, L.S. (ed.) *Hazards and the Built Environment: Attaining Built-in Resilience*, Taylor and Francis, London, pp. 39–60.
- Olawale, Y. and Sun, M. (2010) Cost and time control of construction projects: inhibiting factors and mitigating measures in practice. *Construction Management and Economics*, 28(5), 509–26.
- Polanyi, M. (1962) *Personal knowledge. Towards a post-critical philosophy*, Chicago University Press, Chicago & London.
- Quarantelli, E.L. (1995) Patterns of shelter and housing in US disasters. *Disaster Prevention and Management*, 4(3), 43–53.
- Reed, P.G. (1995) A treatise on nursing knowledge development for the 21st century: beyond postmodernism. *Advances in Nursing Science*, 17(3), 70–84.
- Richey, R.G. (2009) The supply chain crisis and disaster pyramid. *International Journal of Physical Distribution & Logistics Management*, 39(7), 619–28.
- Russell, T.E. (2005) *The humanitarian relief supply chain: analysis of the 2004 South East Asia earthquake and Tsunami*, Massachusetts Institute of Technology, Engineering Systems Division.
- Saengpassa, C. and Samsamak, P. (2012) Tsunami warning system finally ready, after 8 years, The Nation. Available at <http://goo.gl/EiypTx> (accessed 11 July 2015)
- Scott, M. (2010) Disaster management is a growth market, *Financial Times*. Available at <http://goo.gl/nH1ynQ> (accessed 11 July 2015)
- Sena, L. and Michae, K. (2006) *Disaster prevention and preparedness*, USAID publication, EPHTI.
- Stern, N. (2007) *The Economics of Climate Change: The Stern Review*, Cambridge University Press, New York.
- Styhre, A. (2010) Disciplining professional vision in architectural work practices: of seeing and seeing beyond the visual. *The Learning Organization*, 17(5), 437–54.
- United Nations. (2002) Gender mainstreaming: an overview, United Nations, New York, 2002. Available at <http://bit.ly/1pY3p0a> (accessed on 7 May 2015)
- Wedawatta, G., Ingirige, B. and Proverbs, D. (2012), Impact of flooding on SMEs and their relevance to Chartered Surveyors, RICS research paper, RICS, London: UK Available at <http://goo.gl/9ix8K8> (accessed on 3 April 2015)
- Wedawatta, G., Ingirige, B. and Proverbs, D. (2014) Small businesses and flood impacts: the case of the 2009 flood event in Cockermonth. *Journal of Flood Risk Management*, 7(1), 42–53.
- Yodmani, S. (2001) Disaster risk management and vulnerability reduction: protecting the poor, *Paper presented at the Asian and Pacific Forum on Poverty*, 5–9 February 2001, Manila, Philippines.
- Zuo, K., Potangaroa, R. and Wilkinson, S. (2008) Supply chain analysis and the sustainability of post disaster construction: the boxing day tsunami reconstruction experience in Aceh, Indonesia, in *International Workshop on Post-Earthquake Reconstruction and Safe Buildings*, Sichuan University & Sichuan Post disaster Reconstruction Support and Research Centre, Chengdu, Sichuan, China.