Competence-based system development for post-disaster project management

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Abstract

Purpose – One of the key elements contributing to successful post-disaster project teams is individual competence. Each project participant brings his or her own knowledge, experience and ideas to the collective. The kind of chaotic and fragmented environment that is common in post-disaster scenarios presents specific barriers to the success of projects, which can be mitigated by ensuring that staff members possess competencies appropriate for their deployment to particular contexts. The paper aims to discuss these issues.

Design/methodology/approach – The study utilizes a mixed-methods approach, incorporating unstructured interviews to extract key factors of competence, project barriers and strategy, and a subsequent questionnaire survey, designed to quantify the various elements. Interviews were undertaken and analysed using a cognitive mapping procedure, while survey data were processed using SPSS. The data were then utilized in the development of a software prototype using Design Science Research methodology, capable of modelling the deployment of staff under various disaster scenarios.

Findings – Analysis of the survey and cognitive mapping data, in conjunction with relevant established frameworks, has allowed the classification of relevant competency elements. These elements have subsequently been measured and modelled into the competency-based tool and developed into a working prototype.

Originality/value – The developed system offers novel disaster competency assessment criteria. The system contains a variety of real-life scenarios derived from extensive data collection. These multi-hazard scenarios are embedded with knowledge and competency valuation criteria that can facilitate actors to assess their team's knowledge based on selective scenarios. In disaster response, time is a critical element, and this tool assists decision makers. It can enable disaster response actors to evaluate and assemble the appropriate personnel to deploy into disaster areas and into specific types of disaster environment.

Keywords Human resource management, Project management, Competency, NGO, Post-disaster reconstruction

Paper type Research paper

Introduction

Post-disaster recovery interventions are highly complex and frequently involve factors outside the control and competence of most actors in the humanitarian sector (Telford *et al.*, 2006). Non-governmental organizations (NGOs) form an increasingly important

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element of this sector. Recent disasters have seen the growing number of NGOs, changes in their functions and intensification of their networks (Kent, 2014; Guo and Kapucu, 2015). Since the Asian Tsunami of 2004, we have witnessed increasing international deployment of resources in post-disaster reconstruction (PDR). Recent examples of international mobilization in this area include responses to the Haiti Earthquake (2010), the Great Japan Earthquake and Tsunami (2011), Typhoon Haiyan (2013) and the Napal Earthquake (2015).

This presence of NGOs in the context of post-disaster recovery has been promoted by international key agencies such as the World Bank. NGOs are promoted based on the promise that they are more innovative and flexible than national or international entities, are able to facilitate participation and empowerment and to reach different social groups by forging informal linkages with people and other actors (Edwards and Hulme, 1996). In practice, however, the literature shows that NGOs frequently fail to live up to these expectations, in particular, in terms of the quality of interventions, transparency and accountability (Fisher, 1997; Hilhorst, 2002). In order to address these issues, a wide variety of actions have been suggested or undertaken by different international entities; this includes suggestions for professionalization of the humanitarian sector (Walker and Russ, 2010), proliferation of the humanitarian standards and guidelines, like the Sphere standards (Parker *et al.*, 2014), and initiatives like the Humanitarian Accountability Partnership (Everett and Friesen, 2010). In addition to external initiatives, there is a considerable scope for the internal improvement of the quality of NGOs' interventions.

Aimed at improving NGOs' PDR projects and extending the capabilities of NGOs in the face of challenges of undertaking such projects, a prototype has been developed which can assist such organizations in developing and deploying their human resources with appropriate competencies in planning and implementing reconstruction projects. The development of the prototype seeks to increase the opportunities of NGOs to leverage their competencies to address specific barriers that they face during reconstruction projects. This paper introduces this prototype, explains its theoretical underpinning and outlines its development process.

The prototype is developed within the competency modelling framework, which links barriers to planning and operating in PDR projects, with organizational and operational competencies of NGOs and their reconstruction project outcomes. The theoretical underpinning of this prototype is mainly drawn from the literature on dynamic capabilities and competency modelling. The next section explores how this body of knowledge informs the development of the prototype. Following this, the two major components of the prototype will be explained: the barriers that NGOs face in PDR and the competencies that they need to develop and deploy to overcome these barriers. The final sections introduce the prototype and outline its applications as well as its limitations.

Dynamic capabilities

The dynamic capabilities approach is mainly promoted in the context of rapid external changes. As a result, it can provide a meaningful and applicable framework for understanding how NGOs can leverage their organizational competencies to effectively operate in unstable and constantly changing post-disaster conditions. According to Hafeez *et al.* (2002), within a dynamic capabilities framework, an NGO can be conceptualized as an organization "formed by processes, routines and resources including tangible and intangible assets and capabilities". An organizational capability

can be defined as "a high-level routine (or collection of routines)" that can confer upon the organization's management a set of decisions for producing significant outputs (Winter, 2003). Being viable and effective, as an implementing agency in the dynamic context of PDR, requires deploying and exploiting capabilities and "continual reshaping of the portfolio of assets". Developing and acquiring competencies and capabilities necessitate internal and external cooperation (Hafeez *et al.*, 2002).

Dynamic capabilities differ from the capability of making ad-hoc changes in response to external forces, as are often observed in the context of post-disaster interventions. According to Winter (2003), unlike capability to perform ad-hoc responses, dynamic capabilities often result in changes that are deliberate and innovative. Innovation implies that such changes are not completely patterned or coded. However, they do "rise from a patterned and practice performance", which require the long-term involvement of specialized resources (Winter, 2003, p. 993). This poses a major challenge for NGOs when we consider that human resources in the humanitarian sector are highly fluid (Hayles, 2010). A dynamic capabilities approach to project activities will deploy and exploit resources, renewing capabilities and developing competencies.

(Sanghi, 2007) argues that a "competence" refers to a skill and standard of performance while a "competency" refers to the attitudes and behaviours by which this performance is achieved. Miller *et al.* (2001) and Boyatzis (1982) maintain that using the word "competencies" covers both skills and behaviours in modern use. Often, competency or competencies are key factors in identifying, defining and measuring individual differences in ability to achieve outstanding job performance. Armstrong (1999) describes a competency as "a person-based concept which refers to the dimensions of behaviour lying behind competent performance", while Mentkowski *et al.* (2000) talks of "complex interactive clusters" that are based around a comparative integrated knowledge of "concepts and procedures; skills and abilities; behaviours and strategies" and "attitudes, beliefs and values".

Competency modelling

Competency modelling is increasingly being used by governmental and NGOs to enable transformation, improve performance and refine human resource management (Draganidis and Mentzas, 2006). Competency modelling is concerned with the desired characteristics, or competencies, that are expected "to predict behaviour across a wide variety of tasks and settings" (Goldstein and Ford, 2002). Adopting competency models is often prompted by the desire for organizational change and development (Campion *et al.*, 2011) and, therefore, can drive high performance in the activities of NGOs in PDR.

The strength of competency modelling lies in its ability to link individual with organizational development and performance (Stevens, 2013). Competency modelling focuses on those competencies that "contribute to high performance aligned with an organization's strategy" (Stevens, 2013). These are competencies that are instrumental to meet objectives and to deliver strategies of organizations. In competency modelling, these competencies are identified, described and grouped in a way that highlights their links to different objectives. This implies that in competency modelling identification of competencies is a deductive process (Campion *et al.*, 2011), in the sense that it starts from the objectives and strategies and then defines the desirable competencies for achieving those objectives.

Competency modelling can play a role in improving the performance of NGOs active in PDR, by assisting them to identify competencies required for developing and

operationalizing strategies and meeting the organization's objectives; in the process refining their human resource management in line with said strategies and objectives. In addition it creates opportunities to highlight existing gaps in competencies and resources, and more importantly to foster their dynamic capabilities. The modelling of specific disaster scenarios would also open up possibilities to project to a certain degree the suitability of staff to deploy into the field in certain circumstances. In the following sections we explain the process of development of a competency model tailored for NGOs active in PDR.

Development of the competency model for NGOs operating in PDR

As previously noted, the development of competency models is a deductive process, which starts with defining organizational goals and strategies. NGOs active in PDR have their own distinctive goals and agendas; an obvious example is faith-based NGOs that often assert value-laden objectives in addition to their project specific goals (Labadie, 2008). Broader agendas, like "building back better", have also proved to be problematic due to their vagueness (Lyons, 2009). Furthermore, the problem of who defines the goals of post-disaster projects and what indeed are the indicators of successful reconstruction, are valid and critical questions. Often PDR projects are entirely donor driven, with implementing agencies restricted in terms of resource allocation, success metrics and project objective definition (Weiss, 1999; Bebbington, 2005; Karunasena and Rameezdeen, 2010). This presents an ethical challenge both for professionals engaged in such project, and for the organizations that implement them.

Given the myriad issues that arise in PDR projects involving in particular International NGOs; agenda-driven NGO operations, donor restrictions and motivations, lack of transparency and accountability, proliferation of the "aid business", undermining of local markets, creating dependency on aid, etc.; some question the underlying legitimacy of NGOs, particularly as part of the so-called "aid business" (Baur and Palazzo, 2011). We view NGO engagement as entirely necessary to fill a gap left by lack of government capacity to respond to community needs with impartiality and without agenda. We appreciate, however, that much could be done to improve quality, transparency and long-term community impacts, and we hope that this research contributes towards this end.

We draw on project management literature and look at reconstruction undertakings as projects. From this perspective, a project is defined as a time-limited and unique endeavour undertaken to create a unique product or services. In PDR, project success relates to the internal and external factors such as political, economic, social, technological, client-related factors (Jugdev and Müller, 2005). This competence-based process modelling tool, therefore, is primarily concerned with identifying these internal and external obstacles to the planning and delivery of reconstruction projects and identifying the competencies instrumental in overcoming these obstacles. The research has the potential to reduce risk for organizations in post-disaster project implementation by enabling the appropriate staff to be deployed to the field. This study classifies competencies required in PDR, as represented and articulated in Von Meding *et al.* (2014).

Methodology

Various studies have already identified best practice in developing competency modelling (e.g. Campion *et al.*, 2011; Sanghi, 2007; Draganidis and Mentzas, 2006).

This study expands the concept to the field of PDR (Von Meding *et al.*, 2009). In developing this prototype, and in addition to these general best practices, we draw on fieldwork data collection in two different settings. The research focuses on four organizations active in PDR after the 2004 Asian Tsunami in Sri Lanka and the 2007 Cyclone Sidr in Bangladesh. These four organizations were selected as they were active in reconstruction activities aftermath of both disasters and displayed signs of emergent best practice. These organizations are also internationally known as active role players in disaster recovery interventions. Due to their extensive experiences in PDR activities in different settings, these organizations can be seen as "critical cases" with strategic importance in relation to the issue under-investigation (Flyvbjerg, 2006).

Data collection

In order to understand the perceived obstacles to and competencies desired for reconstruction, 24 unstructured interviews were conducted with professionals in these organizations who were involved with managing reconstruction projects following the Asian Tsunami and Cyclone Sidr. Interviews aimed at exploring the interviewee's perceived obstacles to the successful reconstruction, strategies for addressing these obstacles and the critical competencies that enable the organization to overcome these obstacles and meet the objectives of reconstruction projects. The collected data were analysed through cognitive mapping and content analysis (Von Meding *et al.*, 2014). At the next step, the findings provided the foundation for the design of a paper-based questionnaire. This questionnaire was used as a follow up with the same interviewee experts, with the view to validate the findings of the content analysis. The findings were corroborated with the existing literature to finalize the prototype. The next sections report how the findings of the data analysis fed into the system development process. This research adopted Design Science Research (DSR) methodology for competency evaluation tool development. Detail about DSR is included in the system development process section.

Data analysis

The data from the 24 interviews with NGO staff with experience managing PDR projects helped to identify themes around project barriers. The barriers were linked to the competency areas (Von Meding *et al.*, 2014) and strategies necessary to address each barrier.

Mapping barriers in PDR

According to Lewis (2001), NGOs are not closed systems and cannot be viewed in isolation from the context within which they are operating. Being part of "open systems", NGOs' success in reconstruction activities is highly dependent on the events occurring and resources available in their environment. Therefore, the barriers to successful reconstruction have two dimensions; the first one lies within the NGO's internal resources, competencies, organization and management. The second dimension is defined across the organizational boundaries of the NGOs and in the interface with other stakeholders.

The first major group of stakeholders in PDR is the communities that will benefit or will be impacted by the reconstruction project. In this interface, the major challenge is legitimacy, which on one hand relates to the process of intervention, i.e. participation, transparency and accountability, and on the other relates to effectiveness of the

intervention and its impacts on community empowerment. Research shows that NGOs often lack the knowledge of how to design and operationalize a participatory approach within project-by-project interventions (Davidson *et al.*, 2007; Dercon and Kusumawijaya, 2007). Not only does this affect community ownership of reconstruction projects, it also results in inappropriate project design and outcomes; due to a lack of understanding of the needs, priorities and capabilities of different community-based actors (Perry, 2007; Mulligan *et al.*, 2012). When appropriately deployed, community involvement can provide non-local NOGs with a better understanding of context-specific vulnerabilities, socio-cultural issues, business climate (e.g. local material chain market), environmental condition and land rights issues, all of which are key to a high-quality reconstruction project (Chang *et al.*, 2011; Hayles, 2010).

Designing and operationalizing community involvement also requires the knowledge of how to identify and advocate for marginalized groups; based on gender, age, race and those with disability or non-landowners (Priestley and Hemingway, 2007). Furthermore, ethical challenges often arise. For instance, who is the community: is it only the affected households, host communities or those who migrated into affected areas to seek relief? (Kennedy *et al.*, 2008). Other ethical challenges include assistance distribution arrangements, targeting beneficiaries, identification of recipients, compensatory arrangements and establishing appropriate redress mechanisms. The involvement of communities in all stages of the project requires constant, consistent and clear communication to build trust and demonstrate commitment. A sound background knowledge of social dynamics and awareness of risks is often associated with participatory processes (Lawther, 2009).

A second group of stakeholders is the humanitarian sector, i.e. other NGOs operating in similar spatial context as well as the major key actors at a higher level like the World Bank and the UN system. The major challenges in this interface are coordination as well as survival in the context of the hierarchy and competition of "the aid business". Numerous studies highlight the issues of lack of capacity and willingness of some NGOs to coordinate their efforts and exchange information, staff and goods with other actors (Moore *et al.*, 2003). Additionally, existing literature shows the precarious condition of smaller NGOs in maintaining their human resources, which tend to be hired away by major international entities (Moore *et al.*, 2003). Research in Aceh and Sri Lanka after the 2004 tsunami shows that poor coordination between NGOs affected the basic quality of reconstruction, with consequences such as the absence of basic services in new housing projects (Steinberg, 2007; Mulligan *et al.*, 2012). Furthermore, studies highlighted the problem of competition between NGOs for material procurement, logistics, information, location and human resources (Hilhorst and Jansen, 2010; Chang *et al.*, 2011; Perry, 2007). International Federation of Red Cross, Red Crescent Societies and Centre for Research on the Epidemiology of Disasters (2005), for instance, report that certain agencies kept information to ensure their "niche" in disaster recovery. In such a climate, NGOs need to build their ability (and willingness) to communicate and build reciprocal formal and informal relationships at different levels of sector hierarchy active in disaster-affected areas.

The third group of stakeholders in PDR is donors. A major challenge for NGOs is overcoming "donor fatigue" (Özerdem, 2006), which affects the availability of resources for reconstruction projects. Another major problem with donors – and some international key agencies – is their separate budget lines for different "sectors" (like housing, livelihood, infrastructure) and sectionalizing of their funds. This is found to be widely detrimental, particularly in interdisciplinary projects (Hayles, 2010).

Furthermore, research has underlined the problem of donor pressure to spend quickly (Perry, 2007), in projects where success is measured by traditional project management metrics (time/cost/quality) rather than by the broadly accepted best practice of an outcome/impact-based approach to measuring success. There is certainly a case to be made for "educating" donors about the bigger picture in disaster recovery interventions, particularly for multidisciplinary projects that require a long-term commitment, a participatory approach and the building of trust in the local context.

The fourth major stakeholder in PDR is local authorities. This is particularly relevant in those contexts where international donors prefer to divert financial resources to NGOs instead of national or local authorities, creating competition rather that collaboration (Paul, 2003). Even in the absence of such competition, NGOs often face major challenges in working with local governments, which might be bureaucratic or inefficient (Lewis, 2001), corrupt or with unacceptable ideological/political agendas. This sometimes poses a major conflict between the identity and legitimacy of the NGO and the necessity of collaborating with local authorities (which is unavoidable in providing services like water and electricity). Nevertheless, a good understanding of policies, related departments (and their internal changes) and links with those government agencies that work in similar spatial or professional area is critical for successful reconstruction.

In the humanitarian sector NGOs also face a number of sector-specific challenges in their internal operations. One example is the fluid employment patterns (moving between organizations and localities) in this sector (Hayles, 2010), which makes the internal knowledge transfer within the NGO from project to project a major challenge (Hasnain and Jasimuddin, 2012). Another challenge is fragmentation within trans-disciplinary teams, which poses a threat to internal coordination. This has been recently exacerbated with sectionalisation of the humanitarian interventions at the international scale (e.g. the cluster approach) (Tierney, 2012; Krause, 2014).

A range of barriers was brought forward from literature as a starting point for the project fieldwork. We compared the findings elicited from the content analysis (Elo and Kyngäs, 2008; Guthrie *et al.*, 2004) of our interviews with the challenges identified in the literature, then categorized these challenges into seven areas of barriers; economic, political, ethical, community, social, environmental, professional and organizational. "An explanation of these seven categories, and full detail of the data analysis involved can be found in the authors' previously published work" (Von Meding *et al.*, 2009, 2011, 2014). This list is not exhaustive and can be expanded to accommodate more complex conditions with a combination of multiple criteria measurement code that have been embedded in the system prototype. The system prototype is designed to build scenarios based on one or a combination of these barriers. Facing with these scenarios, an organization needs to adopt particular strategies (involving the deployment of select staff) to ensure the completion of its reconstruction task and the achievement of the project objectives.

System development process

In this project, DSR methodology (Baskerville *et al.*, 2007; Hevner *et al.*, 2004) has been adopted during the system development process. This DSR is in line with approach used in information system research (Wynn *et al.*, 2013). In this research an IT-based tool has been developed to facilitate NGO's organization to evaluate current human resources (operational personal) based on their competencies to fit the incoming disaster project's requirements and characteristics, which also require operational

personal that has specific skill set. The competencies model mentioned is the derived outcome from previous phase of the research. Successful empirical research (Geerts, 2011; Gregor and Hevner, 2013; Kanjanabootra *et al.*, 2013; Wang *et al.*, 2011) that has adopted DSR has demonstrated that systematic system development procedure that the DSR provided is a rigorous and viable method. DSR methodology has guidelines for system development and (Hevner and Chatterjee, 2010; Hevner *et al.*, 2004; Baskerville *et al.*, 2007) were adopted in this study (Table I).

A scenario approach has been adopted during the system development process. Scenario planning has been viewed as tool that can help organizations strategically

Guidelines and description	Research activity adopted
1. Design as an artefact Design science research must produce a viable artefact. This could be in a form of construct, a model, a method or an instantiation	This research started with the development of a resource management competencies model. Then the model has been developed into an IT-based tool to facilitate and NGO's organization to manage their human resource to suite specific disaster response project
2. Problem relevance The objective of design science research is to develop technology-based solutions to important and relevant business problems	In this research a developed IT-based tool is innovative and purposeful in the domain of disaster management to complement and addressed in the context of selecting human resource to suit specific requirements of specific disaster events
3. Design evaluation The utility, quality and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods	The system requirements have been gathered from domain experts via interviews and quantitative data collection with (details described in previous section). The developed system also will be evaluated in iterative manner with domain expert (next phase)
4. Research contributions Effective design science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations and/or design methodologies	Through the adoption of software development fundamental the method such as Use-Case analysis which analysed the interaction between users and the developed system and unified modelling language (UML) which analysed the relation of system elements are addressing the effective of the system design
5. Research rigour Design science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact	Due to the adoption of well-established design fundamentals the system development process is rigorously addressing the application of system
6. Design as a search process The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment	The next stage of the research is the system usage evaluation with domain expert users which will close the iteration circle of the DSR
7. Communication of research Design science research must be presented effectively to both technology-oriented and management-oriented audiences	The system development aims to bridge the gap of IT and disaster management communities. First part of this communication of this process already has been done during the requirements gathering from domain experts. The second part will be carried out through system evaluation process with expert users (next stage)

Table I.
Design science research guidelines and research activities

plan their operational (Wright *et al.*, 2013) and can help organizations understand multiple casual underlying processes that might happen in the future so they can be ready for any unfolding events (Mackay and Tambeau, 2013). The scenario used by the NGOs during their operations when disaster events occur is used to structure the competency modelling system.

The purpose of this system is to capture relevant lessons learnt from past disaster events that impacted on the effectiveness of post-disaster reconstruction projects. With this information, NGOs can then utilize these scenarios to assess and evaluate available personnel in their organization based on appropriate competencies for deployment in future projects. The developed system adopted a unified modelling language (Zubcoff and Trujillo, 2007) approach to model the system elements and store them in the system where they can be used to create desired disaster scenarios. The different types of disaster have different scenarios. These are modelled in "scenarios" class (A). The NGO then internally selects available agents to suit the type of disaster and factors and barriers that are associated with that disaster. These agents need to have appropriate decision-making skills and knowledge for a given scenario. These decision-making skills are modelled in the "decision maker" class (B). Decision-maker characteristics are defined by competency area (C) and are measured by the specific type of skills (D) of the agent. The NGO also has to select possible barriers from the "barrier category" class (E). This "barrier category" contains a number of classified "barriers" (F). The system also contains "strategy" (G) which contains a required ability that suits the "competency area". The system structure and its' elements are depicted in Figure 1.

Once all of the relevant elements have been modelled, the next step is to determine an interaction between the developed system and users. The common technique used is to draw a "Use-Case" diagram which will identify the requirements of the system that relate to users and processes (Alhir, 1998). The simple Use-Case annotation includes human stick symbols, representing system actors; an oval shape with action words in it that represents activities associated with the design system. In the Use-Case diagram the whole modelled system has been collapsed and represented as one unit, which is a "Competency Modelling Tool". The developed system has been designed in a way that managerial level of NGOs, represented by a "Model Designer", can access the "Edit Model" and "Create Model". The "Create Model" task allows users to create new specific disaster events while "Edit Model" allows users to determine specific barriers and the situations that reflect what might happen in the disaster event. In real life each

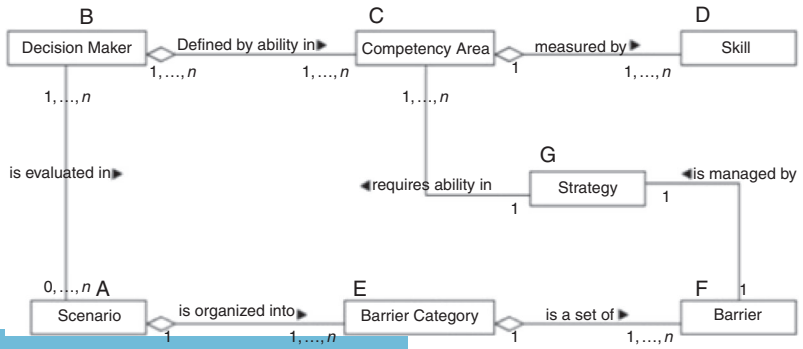

Figure 1.
System elements and relationships between elements

disaster event has a dynamic nature and each has specific characteristics. Even the same type of disaster happening in the same area on a different occasion often creates different outcomes. This scenario-modelling tool enables user to strategically plan their operation to respond to real disaster events. The next key actor involved with the system is the NGO human resources department, represented by "Data Entry (HR staff)". This actor carries out administrative tasks within the organization involving decision-maker detailed information. The last actor is "Model User" who can manipulate and simulate the competency modelling tool. The overall Use-Case diagram of the competency modelling tool is shown in Figure 2.

The competency modelling tool's typical operation includes various users and associated operations; the process briefly involves:

(1) start the process;

(2) create scenarios that relate to the occurring disaster event;

(3) determine relevant barriers from multiple scenario categories;

(4) select the decision maker from the available agents; and

(5) evaluate the selected decision makers against determined competencies.

If the selected decision-maker models well in the given scenario, he/she may be appropriate for deployment and should be strongly considered. If not, the model user could run other profiles against the scenario in the hope of locating a more suitable staff member for deployment. This process is shown in Figure 3.

Once all system elements, users and system interactions have been modelled, we developed programme coding and designed a graphics user interface using JavaScript. One of the advantages of using JavaScript language for programme coding is that it has a high compatibility. Therefore, the system can be operated in various HTML browsers. The following are some examples of system screen shots associated with the system operational steps. Figure 4 depicts a beta version of the software where the model designer starts the project by selecting login from available options which include USER interface and an ADMIN interface. The USER is able to add decision

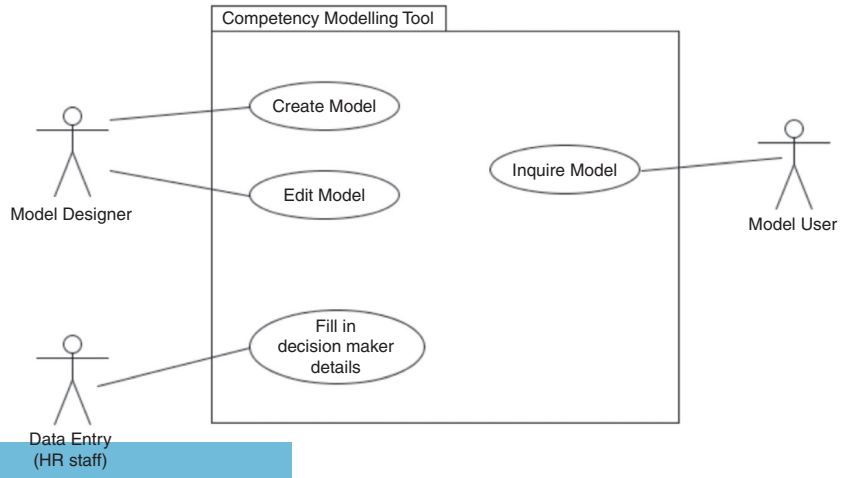

Figure 2.
Competency modelling system Use-Case diagram

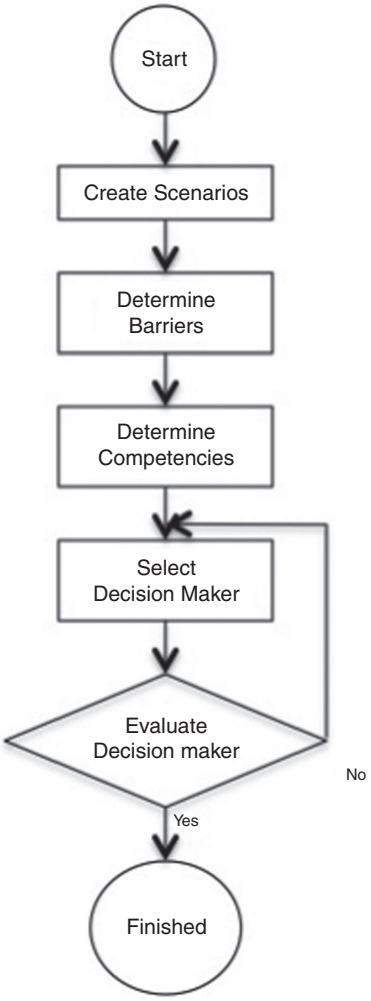

Figure 3.
Typical competency modelling system operations

makers and evaluate them, as well as create scenarios based on a list of variables. In the ADMIN area, the variables for decision makers and details can be edited in detail.

Figure 5 depicts the "Scenario Builder" (USER interface) during the "Create scenario" step where variables can be selected via a searchable list to develop customized scenarios. These scenarios are linked via the back-end data to the competence areas of decision makers. At the same time, individual decision makers can also be added and deleted in the "Decision-Maker Evaluator". Once the individual has been scored on individual measures of each competency area, the area turns green. When all scores are completed, the user can "run simulation" during the evaluate decision-maker step.

Figure 6 depicts the step where competency areas can be determined from the available list. The system also allows the model designer to add relevant competencies and skill relate to each competency area. The importance of each competency/skills can

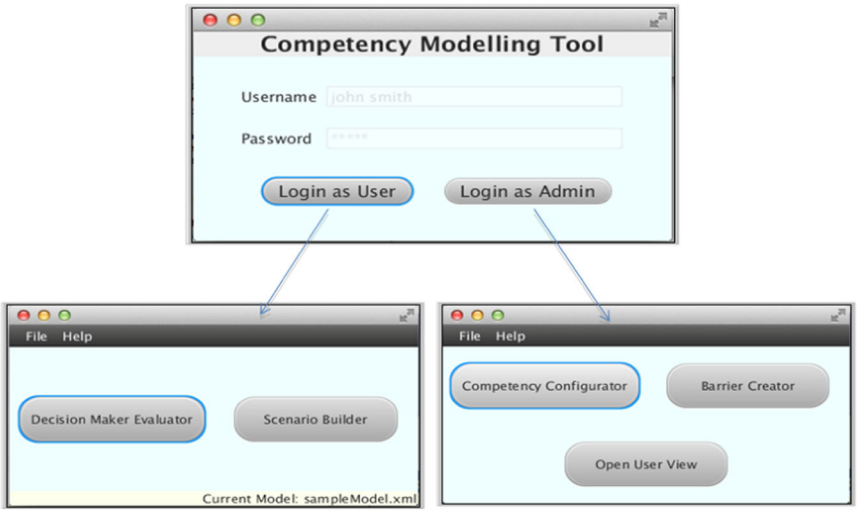

Figure 4.
Starting step of competency modelling tool

also be weighted on a scale of 1-100 (with 100 being the most important). This interface allows the model designer to have complete control over both the decision-maker and scenario variables.

After the scenarios, barriers category and all variables have been configured, the model user can begin to evaluate staff in their organization based on individual suitability in the simulated disaster scenario. During the "evaluate decision maker" step, the model user can evaluate the selected decision maker against all of the determined skills and competencies. The system has been designed so that the model user will click each competency area then evaluate the selected personals by giving them a score from 1 to 10 on each variable. Once every competency has been evaluated the indicator next to that competency area will turn green. Figure 7 depicts an individual decision-maker evaluation mode.

Following the creation of staff profiles and individual evaluation, the model user can simulate the competency model based on any scenario that has been created. Personal competency is then simulated and a report is generated as shown in Figure 8. This simulation report gives overall picture of personal competency, which can facilitate the organization in the process of selecting human resource personal to match specific type of disaster events. Future development of the tool will include the ability to generate more detailed reporting data.

This simulation tool has clear benefits for organizations involved in PDR. The principles of the model could also be applied to many other project-based activities. The data underpinning the software is drawn from a scope-limited field study focused on understanding competencies and barriers in PDR projects. As such, further iterations of the software may require further data collection as it becomes more refined. The potential to deliver this organizational tool that enhances the analytical capacity necessary to make appropriate deployment decisions is of critical importance in the high-stakes arena of disaster management.

Beyond the prototype

At this stage a competency modelling tool prototype has been developed. The next step is to evaluate and test the prototype system in the field, as recommended in the DSR guidelines.

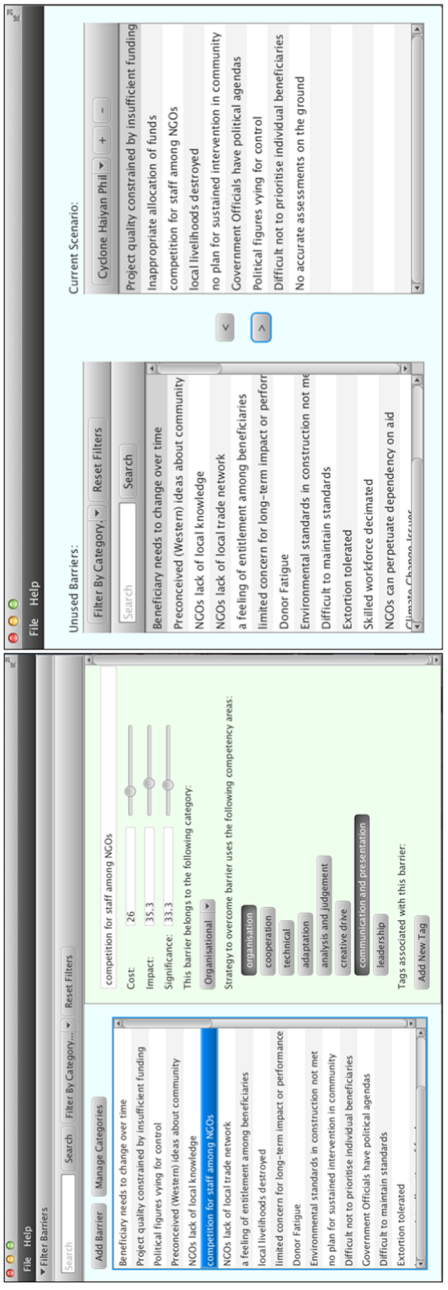

Figure 5.
Scenarios editing mode

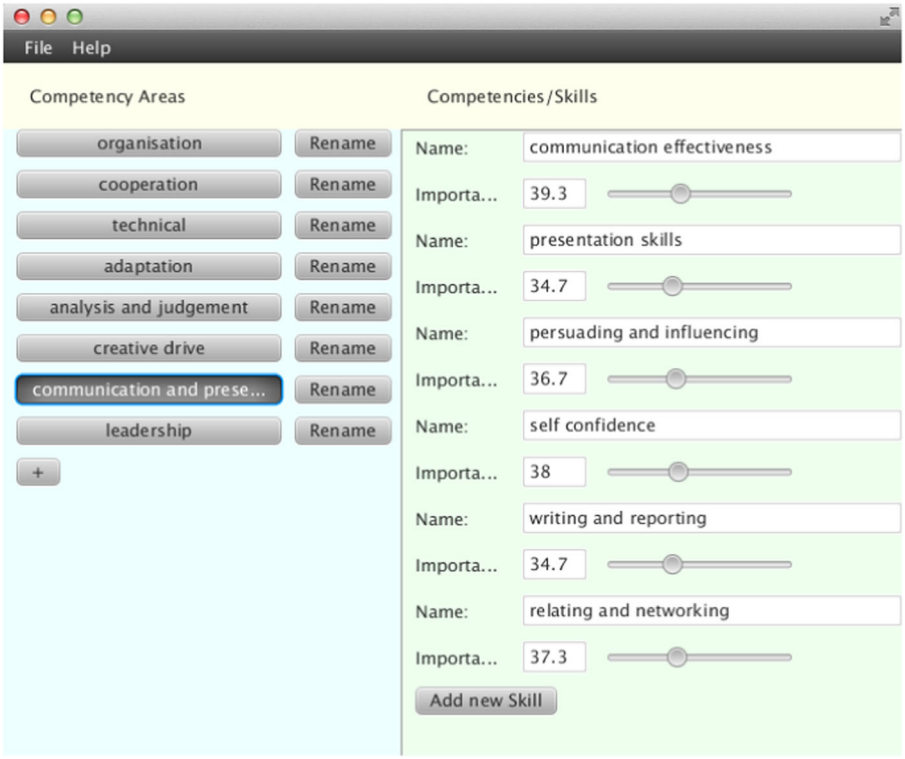

Figure 6.
Competency area and variable editing mode

Figure 7.
Individual (human resource personal) evaluation mode

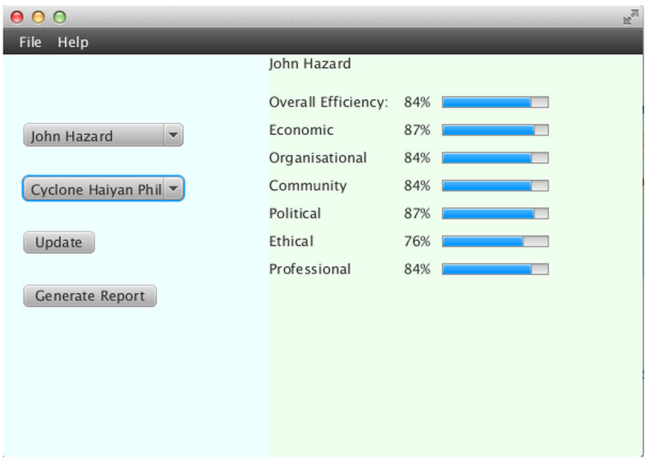

Figure 8.
Example results of simulation of John Hazard in Cyclone Haiyan scenario

This testing will be with relevant disaster response professionals. There are various areas that need to be evaluated. The research has adopted a system evaluation framework from Kanjanabootra *et al.* (2013). The evaluation criteria include functionality, quality, efficacy, performance, reliability, consistency, effectiveness and accuracy. The system evaluation procedure includes activities such as system demonstration to potential users, users trial and evaluation interviews. The system developed through DSR has to be iteratively evaluated by the system users. In this research the system users include a range of organizations involved in PDR projects. Research activities to date have allowed the researchers to develop the beta version currently being used in trials with selected agencies. Moving forward, the prototype will be tested with a wider group of implementing agencies for validity and usability. This next stage of development will allow the team to both refine the tool and create a database of sample scenarios for the model backend.

However, this prototype was developed only using data collected from 24 disaster response professionals who were involved in two disaster reconstruction projects, the Asian Tsunami event of 2004 and the Cyclone Sidr event of 2007 (Von Meding *et al.*, 2014). Most disaster events are unpredictable, never produce unique impacts and have specifically individual features (Cavallo and Ireland, 2014; Schultz *et al.*, 2012; Shafiq and Ahsan, 2013). This prototype competency modelling tool for HR resources allocation in disaster scenarios, developed using DSR methodology, however, is designed to be flexible with its inherent procedures able to be adapted to suit the unique characteristics of a specific disaster event. The model then is transferable and events able to duplicable into future. Like all system prototypes, there is one limitation initially, that it is based on just these two events, which can be overcome as the system is used frequently. Some adjustments then will be required in each future scenario.

Conclusion

Post-disaster actors consistently wrestle with the dilemma of deploying appropriate professional staff into disaster scenarios. The post-disaster context is invariably complex, and the competence profile required in order to address the barriers that arise rarely repeats. When project decisions are made by staff deployed under a "resource stretching"

strategy, this can lead to mismanagement, underperformance and reduction in both project success and stakeholder outcomes.

This research project has gathered data on the competencies of post-disaster project managers, the barriers faced in PDR projects and the strategies that lead to success. This data have been utilized to design a prototype tool for the use of actors operating in this challenging context, in order to assist in deploying individuals with a competence profile likely to fit the unfolding disaster scenario. DSR methodology has been utilized to develop the system underpinning the tool, which incorporates a "front-end" USER interface and a "back-end" ADMIN interface.

This tool is currently in development and testing with end-users. It has the potential to assist post-disaster actors in appropriately matching staff to projects, using a mechanism that models competency profile against disaster scenarios. In time, this can become an essential support tool for decision makers.

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