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Integrated community emergency management and awareness system: A knowledge management system for disaster support

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ABSTRACT

The initial start of this paper deals with reviewing the literature on Emergency Management Information Systems (EMIS) and integrating it into a Knowledge Management System (KMS) structures. This leads to the ability to take information seeking tasks in Emergency Management and translate it to a path in Knowledge Management Structure. This was used to develop an ability to compare current time requirements for information via current data-bases and phones with the performance of an integrated Knowledge Management System in 128 emergency managers of the Government of Malaysia via multi-method strategy including survey, interviews and simulation tests. This led to the recognition of the potential of such a system for the country and the initial parameters of a prototype of the first implemented system design. The resulting integrated Community Emergency Management and Awareness Systems (iCEMAS) is a prototype KMS that was developed and tested. This paper seeks to emphasize that a KMS for emergency management must incorporate features that enable role changes and allow people to access changes based on the situational requirement. The paper provides a highly concise overview and results that supplements our systematic review of KMS in Emergency Management in 2013.

1. Introduction

Over the last two decades (1995–2015), disaster losses remain substantial because of increasing frequency of disasters, especially in developing countries. The Global Assessment Report 2015 on Disaster Risk Reduction by the United Nations reports that an average annual loss from disaster such as tsunami, river flooding, cyclone and earthquakes is estimated at USD314 billion for built environment (GAR, 2015). This amount must be set aside by all countries to prepare for future disasters. The occurrence of weather-related disasters has increased by 14% in the last decade, thereby making the number of disasters as 335 per year. Although the number of affected people has decreased from 245 million people in 1995–2004 to 165 million in 2005–2014, the number of deaths has increased from an average of 24,000 per year in 1995–2004 to 36,000 per year in 2005–2014 (CRED, 2015). This shows the increasing trends in vulnerability of the community at risk and the need for an improved resiliency level.

The various initiatives that are being implemented throughout the world indicate the heightened awareness on improving resiliency level. One such initiative by the United Nations is Making Cities Resilient: "My City is Getting Ready" (CRED, 2015). In August 2015, the campaign had 2550 cities as members. The campaign tools, namely the Local Hyogo Framework for Action Monitor, the "10 essentials" and the disaster resilience scorecard, have provided municipalities with the means for a better understanding and managing disaster risk (CRED, 2015). A total population of 700 million people is committed in this campaign. They consist of residents of all cities and local governments. Fifty-four role model cities play essential roles in increasing knowledge sharing among city officials to make cities more resilient (CRED, 2015). However, many developing countries, including Malaysia, continue to struggle in alleviating the resiliency level.

The need for a more resilient community is also felt in Malaysia. Our preliminary interviews with the National Security Council of Malaysia (NSC), the main agency that manages emergency revealed that the country is facing three main challenges. These challenges include (1) poor communication, coordination and collaboration (3Cs) between the council members and its affiliate agencies (2) lack of proper data/information management and (3) limited knowledge sharing and dissemination within the organization (Dorasamy and Raman, 2011). Disaster-prone areas are totally dependent on the government agencies' support.

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Despite extensive programs and initiatives by the government, vulnerable communities are still far from self-awareness on disaster resilience (Dorasamy and Raman, 2011). This naturally results in low resilience level among citizens.

The existence of various stakeholders in emergency management presents a complex set of skills and experiences that create a complex and dynamic environment (Jennex, 2008, 2012). The emergency management stakeholders in Malaysia include government agencies for health, agriculture, civil, environment and chemical; rescue teams, which involve police, fire and rescue department, army, volunteers, public service department, hospitals and Special Malaysia Disaster Assistance and Rescue Team (SMART); recovery teams, which involve road works, local recovery rescue team, energy and electricity board, telecommunication, irrigation and meteorology department; welfare teams, which include welfare department, non-government organizations (NGO), and health department; international teams involving the United Nations, experts in medical, psychology, disaster, technology, volunteers, and scientific researchers; NGOs such as the Red Cross and religious-based associations; vulnerable communities, special interest groups, and victims; and medias team and policy makers. This complexity leads to difficulty in making life-saving decisions. Knowledge from past experiences is not systematically collected and readily available for future retrieval.

Interest in knowledge management (KM) and knowledge management systems (KMS) for emergency management (EM) has increased because of the alarming occurrences of disasters worldwide, the existence of complex structure of stakeholders in the disaster domain, and the low resiliency level among citizens. The use of KM and KMS functions for EM is supported and recommended by existing literature. KMS could play an important role in improving the speed and quality of response actions (Murphy and Jennex, 2006; Raman et al., 2006). Future emergency management information systems (EMIS) should incorporate KM considerations because KMS has the ability to handle both explicit and tacit knowledge (Borkulo et al., 2005). The present study postulate that this is a KM problem and that an effective KMS is necessary. Hence, a well-designed KMS could support the national EM generally and community resiliency specifically. KMS can be used to capture and reuse EM knowledge by applying knowledge from past experiences to support decision-making in EM (Jennex, 2005, 2008). Effective decision-making can lead to organizational efficiency and effectiveness.

Evidently, information systems (IS) can ease prominent EM issues. The EM issues include the lack of integrated systems for 3Cs (Catarci et al., 2011; Cao & Zhou, 2008), as well as lack of free flow of information across various stakeholders (Dorasamy et al., 2014; McEntire, 2012; Turoff et al., 2011). Scholars have affirmed that IS could provide real-time accessibility, visibility and availability of information and knowledge (Turoff, 2012; Bui and Sebastian, 2011; Seneviratne et al., 2010). As a result, increase in both individual and organizational responses to turbulence and discontinuities will ensure high resiliency (Bhamra et al., 2011).

One common trend in IS literature involves emergency management information systems. System designers seem to have placed greater emphasis on system functions and features that are model-based or based on technical requirements rather than situational (Shen et al., 2012; French et al., 2009; Borkulo et al., 2005; French and Niculae, 2004; Turoff et al., 2004). Disaster management demands the communication of life-saving information or knowledge, coordination among different and possibly unknown roles and actors as well as collaboration between different groups through socialization (Plotnick and Turoff, 2011; Samarajiva, 2005; Turoff et al., 2004; Turoff et al., 2011). These demands are uncertain because disasters are unique, complex, unpredictable, and dynamic by nature (Ashish et al., 2008; Raman et al., 2006). Thus, developing an EMIS based on data analysis and models alone may not fit complex situations such as disasters (French and Niculae, 2004).

Given that, disaster situations are often unique and demand greater coordination in multi-party context, time constraint decision-making, and changes in roles and responsibilities, this paper proposes that success of an IS for emergency requires additional situational qualities. Situational qualities includes environmental complexity, rigidity in responding to threat, dynamic response, situational awareness, changes in roles and responsibilities, cognitive absorption, as well as agility and discipline. Situational qualities will provide vital design considerations for effective emergency management information systems in terms of lesser time taken for emergency decision-making.

The proposed prototype was named iCEMAS (Integrated Community Emergency Management and Awareness System) with two main sub components, namely MySedia (a portal for community) and CEMAS (the dashboard containing database functions, communication tools and disaster knowledge bank) and implemented in the NSC. The system was simulated, tested and evaluated to ascertain its effectiveness to support EM in the NSC toward improving the overall resiliency level in the nation. The kernel theory used for this research is the KMS Success Model by Jennex and Olfman (2006). The model is an extension of the IS success model of Delone and McLean (2003). This research attempts to solve the puzzle of designing a KMS for EM, thereby ensuring that IS could effectively support unique and complex situations, thus improve disaster resilience.

Against this backdrop, the present paper has the following objectives:

(1) To develop a model that explains and guides an effective design considerations for KMS success to support EM;
(2) To develop and implement a web-based KMS prototype to address the 3Cs, information visibility, as well as information/knowledge sharing and dissemination challenges that face the NSC and community in relation to its EM efforts toward improving disaster resilience.

These objectives required the researchers' direct participation and involvement with NSC.[1] Therefore, an action research method was used as the underlying methodology to conduct the study. Specifically, canonical action research (CAR) was chosen and was used to guide the research. By linking situational qualities to the net benefit of a well-designed KMS for EM, this work is expected to contribute to research on applied-KMS[2] for EM and disaster resilience. This work responds to the call to move beyond technocentric systems and include construct related to socio-technical components (French & Niculae, 2004). The importance of time saving by using EMIS during time-constrained situations is underscored in prior research. By developing a system with strong underlying theories that guide the design consideration which in turn can lead to greater time saving for emergency managers, it is expected to contribute to the understanding of interventions to foster KMS success in general and KMS for EM in particular. In 2013, a state of the art review of KMS in EM was presented and this paper provides a concise overview with some details of new review material on knowledge systems (Dorasamy et al., 2013). Finally, this work will contribute to our understanding on how a well-designed system that incorporates situational quality in KMS for EM will result in improved disaster resiliency of community and emergency managers, especially in developing countries that are constantly facing challenges from disaster occurrences, as well as time saving during critical decision-making.

[1] National Security Council is the main agency that manages all the activities related to emergency management.
[2] Applied KMS refers to actual system that was built and applied in the real situation to solve the problem studied.