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# Knowledge Management Systems and Disaster Management in Malaysia: An Action Research Approach

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**Abstract.** This paper examines the role of knowledge management systems (KMS) for disaster planning and response in the context of social work in Malaysia. The research is focused on the client — the Malaysian Association of Social Workers (MASW), where a web-based system to support disaster management was developed and implemented. The research objectives required the researchers' direct involvement with the MASW. Canonical Action Research (CAR) was used as the research methodology. The process and outcomes of this action research initiative is presented based on the five-stage CAR approach, consisting of (i) problem diagnosis, (ii) action planning, (iii) intervention, (iv) evaluation and (v) learning outcomes. The evaluation of the system is supported by quantitative analysis driven by survey instrumentation. Our findings suggests that successful utilisation of the system in the context of MASW's efforts and roles in disaster management in Malaysia, is contingent upon issues such as acceptance of KMS, and availability of resources to maintain the system. Other issues such as clear definition of the role of Information Technology (IT) for disaster management and willingness to share knowledge are also vital in this regard.

*Keywords*: Canonical action research; knowledge management; disaster management; Malaysia.

## 1. Introduction

Knowledge management (KM) is about capturing knowledge created in an organisation and making it available to those who need it to make decisions. Disaster management is about making decisions under stress and time pressure (Jennex, 2008). While it would seem natural to use KM to support crisis response decision making; a review of the literature pertaining to implementation of KM and KM systems (KMS) finds that the emphasis in KM research is focused on KM impacts on organisational performance and competitive enhancement (von Krogh, 1998; Hackbarth, 1998; Davenport and Prusak, 1998; Alavi and Leidner, 2001; Jennex and Olfman, 2005, 2006; Raman *et al.*, 2006). However, events such as the 9/11 terrorist attacks, the London subway bombings, the 2004 tsunami and hurricane Katrina have spurred interest in research in crisis/disaster/emergency management and response (henceforth referred to as disaster management).

How relevant are KMS to disaster management efforts within an institutional setting? How do people involved in disaster management perceive the role of KMS to support such initiatives? What factors influence the successful implementation and use of KMS to support crisis response initiatives that are led by institutions? These questions motivate the writing of this paper.

## 2. Knowledge and Disaster Management

A standard definition of KM does not exist. Alavi and Leidner (2001) and Jennex (2004, 2005) used an expert

panel to generate a composite definition of KM as the practice of selectively applying knowledge from previous decision-making experiences to current and future decision-making activities with the purpose of improving the effectiveness of an organisation. Alavi and Leidner (2001, p. 114) define KMS as IT-based systems developed to support and enhance the organisational processes of knowledge creation, storage/retrieval, transfer and application. They observed that not all KM initiatives implement an IT solution, but they support IT as an enabler of KM.

The implementation of KMS in organisations has diverse purposes. von Krogh (1998) takes a business perspective, stating that KMS helps increase competitiveness. Hackbarth (1998) suggests that KMS leads to greater innovation and responsiveness. Davenport and Prusak (1998) provide three reasons for KMS implementation in organisations: (i) to enhance knowledge visibility in organisations by using maps, hypertexts, yellow pages, directories and so on; (ii) to build a knowledge sharing culture, i.e. create avenues for employees to share knowledge; and (iii) to develop a knowledge infrastructure not limited to technology, thereby creating an environment that permits collaborative work. Hackbarth (1998) as well as Davenport and Prusak (1998) imply that KMS can support an organisation in planning for and managing emergencies.

Disaster management efforts at any organisation can be enhanced through an extended use of IT (Burnell *et al.*, 2004). The authors propose that a web-based information system can enhance the following aspects pertaining to disaster management for any organisation:

(i) Provide a better structure and organisation of information about emergency. This includes providing a common platform, assessable to all relevant staff.
(ii) Create an organisational memory system that permits staff to document and share information and experience about emergencies and dealing with them.
(iii) Provide an avenue that enables staff to retrieve emergency related information from anywhere, anytime and anyplace.
(iv) Enable faster information retrieval.
(v) Offer links to both external and internal information sources about disaster management.
(vi) Improve the communication process between various entities involved in disaster management through a common platform that is assessable to them.
(vii) Provide a system that serves not only as a backup to the currently used paper-based documentation but also be used to aid training, simulations, meetings, tabletops and other activities related to disaster management.

### 2.1. *Role of KMS in disaster management*

Dealing with emergency situations such as earthquakes, terror threats and other forms of natural or man-made disasters are examples of complex and dynamic environments (Kostman, 2004). The challenge for an organisation is to develop a KMS that can easily adapt to change in dealing with uncertainties (Kostman, 2004).

Tiwana (2000) suggests several attributes that KMS should have in helping organisations deal with complex and dynamic environments. These include KMS that:

(i) Provide a shared knowledge space with use of consistent and well defined vocabulary.
(ii) Model and explicitly represent knowledge.
(iii) Permit collaborative efforts between employees.
(iv) Allow reusable knowledge.
(v) Empower employees based on a knowledge sharing culture.

KM involves various events and activities and there is a significant role for IT in this effort (Davenport and Prusak, 1998). IT can support the process of knowledge creation, sharing, dissemination and creation of a useful organisational memory system to enhance emergency planning and response (Alavi and Leidner, 2001; Turoff *et al.*, 2004). KMS can assist organisations in dealing with dynamic and complex situations such as in dealing with emergencies (Burnell *et al.*, 2004; Kostman, 2004; Gupta and Sharma, 2004).

This research adapts the KMS Success Model by Jennex and Olfman (2005) as its underlying theoretical framework. Jennex and Olfman (2005) developed this model based on the Information Systems Success Model of DeLone and McLean (1992). A disaster situation is stressful and intense in nature (McEntire, 2007). Hence, the success of an emergency information system may or may not solely depend on the system, knowledge and service qualities as described by Jennex and Olfman (2005). Therefore, based on the situational approach, a new dimension called situational quality is created to represent the unique situation in which the success of an emergency information system may be influenced. Based on the three concepts of cognitive support, threat rigidity and situational awareness, this research consolidates the

KMS Success Model with factors that are unique for emergency situations.

## 3. Methodology

This study was conducted using action research methodology. Action research has been around for more than five decades with early pioneers of action research being and researchers at the Tavistock Clinic classify action research into more than 12 forms offer several major forms of action research: Canonical, IS prototyping, soft systems, participation observation, action learning, multi-view ETHICS, clinical field work and process consultation.

Action research is an accepted methodology within information systems research. Lindgren *et al.* (2004) classify action research as an interventionist method that "allows the researcher to test a working hypothesis about the phenomenon of interest by implementing and assessing change in real-world setting" (p. 441). They further assert that action research is well suited when researchers places significant emphasis on creating a change as an outcome of the research endeavor. As mentioned, the objective of this study was to design, implement and evaluate a system that could change the overall emergency preparedness communication and information and KM process within the Malaysian Association of Social Workers (MASW) (referred to as client organisation henceforth). The lead author through his direct involvement with the client organisation was aware of the issues inherent in the emergency preparedness communication and information management process between the client organisation and its immediate constituents. This led to the formulation of a working hypothesis that the design and implementation of a web-based KMS could overcome the challenges faced by the client in the context of emergency preparedness. A formal five-step canonical action research (CAR) (Susman and Evered, 1978) was used as the specific action research approach to support the study. These steps and the respective activities therein are described in the subsections that follow. The five-step process and the duration for each stage were as follows: Problem diagnosis — January to March 2008; action planning — April — November 2008; intervention — December 2008 — April 2009; evaluation — May–July 2009; specification of learning outcomes — August–October 2009.

## 4. Problem Diagnosis

### 4.1. *The client organisation*[1]

The MASW is a professional body of social work academia and practitioners working in various social work settings as well as retired social workers. They include welfare officers, medical social workers, residential / rehabilitative / custodial workers, probation and prison officers, social work lecturers / trainers / facilitators / supervisors, mental health personnel, civil society and human service staff and volunteers.

In July 1974, MASW gained affiliate membership to the International Federation of Social Workers. A year later, it was accepted as a member of the Malaysian Professional Centre, a coalition of 20 professional organisations, committed to promoting professional interests locally and internationally. MASW is also affiliated to the Commonwealth Organisation for Social Work, which was co-founded by one of MASW's past presidents.

MASW's main objective is to promote, develop and maintain professional competency in social work practice, education and research to enhance the quality and appropriateness of social services for the eventual well-being of the community. In line with this, MASW will continue to insist on the need for social work training prior to practice, to be a relevant forum for managing social problems, to be an effective resource of professional support to its members and to actively participate in networking to build partnership and cooperation with government and non-government organisations.

To achieve these objectives, MASW has been working closely with the Department of Social Welfare (DSW) and public universities, to draw up national competency standards for social work practice and education in line with IFSW recommendations. Within the context of globalisation and Malaysia's political, economic and social climate, social workers are of the view that it is urgent and necessary to enact laws and policies to accredit, license and regulate the profession in line with international benchmarks.

The concerns have been further pressured over the years by a change in recruitment policy by the government's Public Services Department (PSD) to emplace non-social work graduates into positions of social welfare officers and medical social workers since the early 1970s.

MASW, together with the DSW, has submitted a memorandum to the MWFCD calling for the endorsement of national competency standards in practice, the

[1]This section was obtained from a write-up by Ms. Elise Lee, who was the MASW President when the project was on-going.

Table 1. Features and functions recommended by potential systems users.

| No | Features and functions recommended by potential systems users (MASW members) | | | | | |
|---|---|---|---|---|---|---|
| (1) | Systems should user friendly overall | Ground level updated information | Ground level updated needs from victims | Who does what on ground level | Where professionals are needed on ground level | |
| (2) | Professionals' contacts and profile | Appeal of contribution | Link to members' resources (e.g. blogs) | Gov't disaster management initiatives | Locally available trainings | Educational section |
| (3) | Information on related areas | Rescue operation information | Information for media to report on | Links to news feeds | Links to related NGOs | |
| (4) | Community and national level info | Interagency information | Webmail to trigger e-mails to users | Bulletin/news board | Link to related NGOs | |
| (5) | National and regional coverage | Magnitude of disaster | Link to external resources | How, where and when social workers can respond | Items to be prepared for shipment | Link and news about agencies involved |
| (6) | Networking options (chat, email, etc.) | Updated news | Links to relevant news feeds in disaster management | Communication platform for MASW workers | Links to NGOs | |
| (7) | Stories of dignity | Log in | Dignified pictures of victims post a disaster | Communication platform for MASW workers | | |
| (8) | Easy access | Friendly to share and upload | Informative on disaster related issues | Platform for storing documentation on disasters | | |
| (9) | E-community | Involved users and agencies contact | Training materials and workshops on disaster management | Directory of funding organisations / NGOs, CBOs, etc. | Situation report+Newsletter | Basic organisational information |
| (10) | Items to be prepared before disaster | What to do/where to go/ who to seek for | List of shelters available post-disaster | Proper ways of storing clean water/can and dry food | Sign ups for volunteers | Systems should be able to teach members easily prepared food during disaster |
| (11) | Relevant and updated information | Authorities and other useful contacts | Simple and effective escalation process | Quick and reliable response to questions by members on disaster management | One-stop access to disaster related information | |
| (12) | List of networking amongst members | Related NGO's | List of volunteers affiliated to MASW and their area of expertise | | | |
| (13) | Educational system for members on disaster management | Links to related NGO | Link to relevant news on disasters | | | |
| (14) | Early warning about a disaster | Assisting in evacuation | Professional consoling | Helping victims in rehabilitation program | | |

Table 1. (*Continued*)

| No | Features and functions recommended by potential systems users (MASW members) | | | | |
|---|---|---|---|---|---|
| (15) | Sources to receive help during disaster | Warning alarm system when disaster happens | Guideline (dos and don'ts) | Action plan by bottom–top approach | |
| (16) | Email for communication and knowledge sharing | Forums | Motives | Uploading and downloading | Q&A |
| (17) | Q&A | Email | Links | Happening around the globe | Platform for knowledge sharing |
| (18) | | Updated info | | Links / helping to get in touch | Q&A on disaster management | Lessons learnt from disasters |
| (19) | Directory and contacts of people, government and NGO's | Available training programs, conferences, etc. / learning materials | Updates on current disasters / types of disasters and related issues | Procedures for rescue and relief operations | Programs for preventing disasters | Forum/blogs |
| (20) | Location guide and type of disaster | Contacts | How to help and what to do | Info on different types of disasters | Self evacuation procedures | |
| (21) | Main page / scenarios / activities / disaster teams | Disaster guidelines | Interagency links | Online services (contacts, enquiries, comments) | Email | |
| (22) | Main page (intro, photos, background, location and committee activities) | Disaster action plan (material aids, social support, emotional and medical support) | Interagency links | Comments | Suggestions | |

enactment of a Social Workers' Act and the establishment of a regulatory body to oversee issues of certification, licensing, continuing education, ethical behaviour and standards for competent practice and training.

In the meantime, MASW has been organising training courses on professionally accountable practice for human service workers from the social welfare department, hospitals and voluntary welfare organisations. The training programme, funded by the DSW, is to build the capability of the majority of welfare personnel who have not been professionally trained.

When the tsunami of December 2006 struck the shores of Malaysia, it also starkly emphasised the lack of experience and expertise among social workers to deal with the situation. Malaysia had never been hit by a tsunami before. This led MASW to organise a Regional Symposium in August 2007 with the support of IFSW Asia Pacific and DSW on Disaster Management and the Social Work Response. During this symposium it was also felt that IT could play a better role in adding MASW's efforts in preparing for disasters in Malaysia. It was at this point where the lead author was invited by the organisation to develop a KMS for MASW.

As a result of the above, the research team was invited for a formal meeting with 22 members of MASW who formed the strategic apex for MASW in light of disaster management and the social workers chapter in Malaysia. The meeting was held in the middle of 2008. At this meeting, the lead researcher presented his ideas about developing a web-based system to capture and assist in KM for MASW in its efforts in managing disasters. A short presentation was delivered to the attendees, the lead researcher then distributed a piece of paper to the attendees requesting that they listed as many items as possible, as to what features (from a systems perspective) they would like to see in the proposed system, in light of managing MASW's knowledge in the context of its disaster management chapter.

Table 1, provides a summary of the features requested by the MASW members ($N = 22$) to become a part of the proposed KMS, for disaster management at MASW.

The general response from attendees was that the proposed system could facilitate the disaster management communication and coordination process by

(i) Providing a common platform to document information.
(ii) Maintaining knowledge about what is happening across various NGOs in Malaysia.
(iii) Enabling a more effective documentation process for disaster-related policies.
(iv) Making people aware of who was doing what in an emergency / disaster.
(v) Providing users with disaster related knowledge that is needed rapidly.
(vi) Offering users an alternative process for sharing knowledge about disaster management.
(vii) Links to other vital resources in the context of disaster management.
(viii) Platform for communication between MASW members.

## 5. Action Planning

### 5.1. *Implementation plan*

Post meeting with the strategic apex of MASW's management team, the researchers set out on six-month timeline to develop the first prototype of the system, based on the general specifications obtained during the problem diagnosis phase of the project. At this point, the research team engaged a part-time systems developer to assist the team in developing the initial version of the system. Given that the project was driven largely by funding from the government, the costs of developing the system had to be kept minimal — and thus it was proposed that open source platforms be used to develop the working model of the system to support MASW's fundamental requirements.

It was also planned that upon completion of the initial development (at the end of the sixth-month period), the research team (with the developer) would conduct a simple demonstration of the tool to ascertain its use, benefits and any issues arising therein with regards to implementation / launching of the system to other MASW members and its affiliate entities.

The MASW strategic apex consists of members who have wide experience in the context of social worker issues particularly with regards to disaster management. However, none of the members had any in-depth experience in implementing any IT related system. In this regard, the researchers were given the full authority to take overall leadership and responsibility in implementing the system for the MASW. The President of MASW felt that this approach was the best as the researchers themselves were also official members of the association — hence were entrusted to work with and deliver a system that was in the best interest of the organisation.

### 5.2. *Systems implementation — non-technical considerations*

We used the KMS Success Model (Jennex and Olfman, 2005) to facilitate the implementation process of the

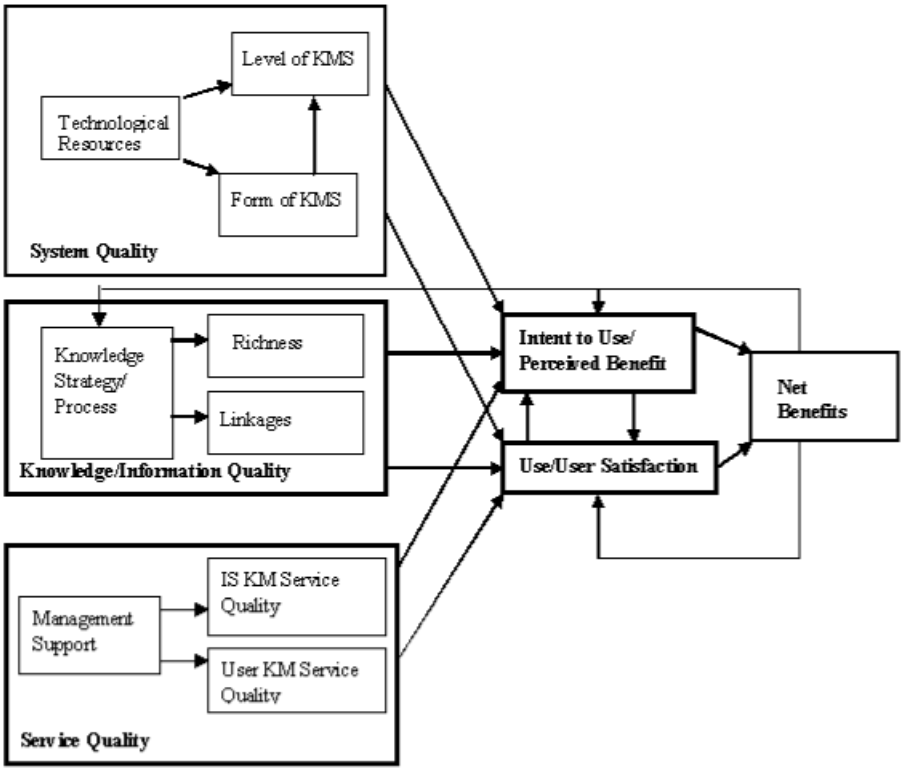


Fig. 1. KMS Success Model (Jennex and Olfman, 2005).

proposed system. The KMS Success Model is essentially an extension of the IS Success Model (DeLone and Mclean, 1992). The KMS Success Model is based on the three main concepts namely, system quality, knowledge / information quality, and service quality (Jennex and Olfman, 2005). These three concepts in turn impact the perceived and / or actual benefit and satisfaction of using the particular KM system within a given context.

The major concepts and constructs based on the model in Fig. 1 are summarised as follows[2]:

### 5.2.1. *System quality*

Refers to the ability of the KM system to support the basic KM processes of knowledge creation, storage / retrieval, transfer and application. Stated differently, this construct examines the level of the organisational memory inbuilt within a particular KM system (i.e. depicted by KM level in Fig. 1). System quality also examines how the KM system is supported by the human capital and organisational infrastructure (referred to as the KM form in Fig. 1). When combined the KM form and level make up the overall technological resources available within the organisation, to support the KM initiative.

### 5.2.2. *Knowledge / information quality*

Under this concept, Jennex and Olfman (2005) examine the strategic process inherent in the KM system. Two measured are prescribed namely richness of the system and also the linkage of the system to both internal and external knowledge sources.

### 5.2.3. *Use / user satisfaction*

Use or user satisfaction refers to the actual use of KMS and the overall satisfaction of using the system. Jennex and Olfman suggest that effectiveness of use depends on users being satisfied with the KMS.

### 5.2.4. *Perceived benefit*

This construct refers to what extent the end users of the system perceive that a particular KMS meets the user's requirements. Jennex and Olfman assert that this construct is useful when examining KMS use on a voluntary basis.

### 5.2.5. *Net impact*

Refers to the overall impact of the KMS on the individual, team and ultimately the organisation as a whole. Net

[2]Adapted from Murray E. Jennex and Iryna Zakharova, retrieved from http://www.management.com.ua/strategy/str113.html.

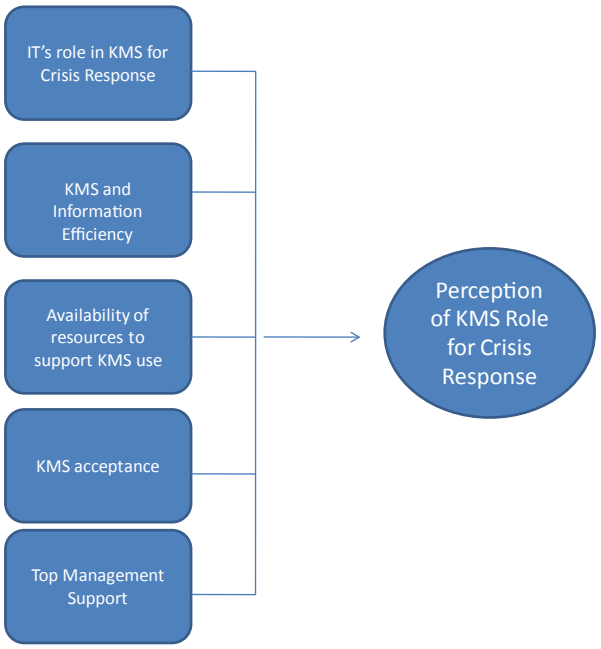


Fig. 2. Perception of KMS role for crisis response.

impact can also be used to measure if the KMS use should be continued or otherwise.

#### 5.2.6. *Service quality*

Examines the extent of end user satisfaction on the quality of the KMS. Jennex and Olfman assert that management support plays a vital role in achieving higher service quality when a KMS is used in an organisational context.

We adapted the above concepts and constructs from the KMS Success Model and based on our interviews with the MASW officials, to develop our research framework — illustrated in Fig. 2. In a nutshell, Fig. 2 suggests that five constructs namely: (i) KMS and information efficiency; (ii) Availability of resources for KMS; (iii) IT system's role in KMS; (iv) Acceptance of KMS and (v) Top management support in using KMS for crisis response efforts, can impact the perceptions on KMS use to support crisis response efforts.

A total of 19 statements based on these five constructs were developed to form our survey instrument. These statements are summarised in Table 2. The questionnaire were structured using a 5-point Likert scale that ranged from (1) "strongly disagree" to (5) "strongly agree".

The survey instrument developed during the planning stage of the project was used to assist the evaluation of the system post its launch. Details pertaining to this is discussed under the evaluation stage of the project.

### 5.3. *Systems specifications*

The MASW KMS uses the concept of content management to disseminate and facilitate information exchanges quickly, efficiently and in an orderly manner. A content management system is a computer application used to manage work flow needed to collaboratively create, edit, review, index, search, publish and archive various kinds of

Table 2. Instrument developing — Examining the perception of KMS use for disaster management in MASW.

| Construct (from Fig. 2) | Operatioanlisation of construct |
|---|---|
| (1) KMS and information efficiency | KMS provide timely information to staff |
| (2) KMS and information efficiency | KMS provide accurate and up to date information |
| (3) KMS acceptance | KMS enhance strategic planning process for teams of CRE |
| (4) KMS and information efficiency | Information of CRE can be automated, shared and retrieved from web |
| (5) KMS and information efficiency | KMS provide relevant information |
| (6) IT's role in KMS for crisis response | KMS simplifies information searching and retrieving process |
| (7) IT's role in KMS for crisis response | KMS provide links to external and internal information sources |
| (8) IT's role in KMS for crisis response | IT can enhance organisations ability to manage information during crisis |
| (9) Top management support | Top management support is needed in implementing KMS for CRE |
| (10) KMS acceptance | Difficulty in locating relevant information during crisis |
| (11) IT's role in KMS for crisis response | IT can support CRE for organisations |
| (12) KMS acceptance | Knowledge about CRE from individuals can be made online |
| (13) KMS acceptance | Knowledge about CRE from relevant groups can be made online |
| (14) KMS acceptance | Information about CRE can be converted into a web format |
| (15) KMS acceptance | CRE in organisations relies more on paper documents |
| (16) Availability of resources | Organisations have necessary resources to maintain KMS to support CRE |
| (17) KMS acceptance | Idea of trained personnel for KMS for CRE is welcomed |
| (18) Availability of resources | Organisations have necessary resources to develop KMS to support CRE |
| (19) Availability of resources | Organisations have necessary resources to update KMS to support CRE |

digital media and electronic text. The content managed may include computer files, image media, audio files, video files, electronic documents and web content. These concepts represent integrated and interdependent layers.

There are in general six types of CMS, named after their respective domains of use. They are:

(i) Enterprise CMS — Used to collaborate within an enterprise
(ii) Web CMS — Web-based application
(iii) Document management system — Storage, retrieval and sharing documents
(iv) Mobile CMS — Mobile-based platform for handheld devices
(v) Component CMS — manage content at a granular level (component)
(vi) Media CMS — Provides image, sound and video sharing advantages

The research team proposed that the MASW KMS uses a combination of web CMS and document management system on its online portal to provide up to date information on disaster management and to facilitate document sharing of relevant papers and presentations.

In future, the system may be upgraded to include media and also mobile function where the information can be accessed through multimedia and on hand-held devices.

#### 5.3.1. *Knowledge sharing using content management systems*

The MASW KMS uses the open source web CMS known as Joomla. This CMS uses templates to control the overall look and layout of a site. It provides the framework that brings together common elements, modules and components as well as providing the cascading style sheet for the site.

The administrator will be able to customise the site using back-end access and members of the knowledge portal will also be able to post and share articles and contents using controls on the front page.

This will enable common internet users to share information without having to enter complicated procedures and without prior web publishing knowledge.

The way Joomla is designed separates out the key tasks involved in producing a website for efficient maintenance of the MASW KMS.

The ease of use of this template-based system makes it easy to:

(i) Share articles across a pool of experts or members of the portal.
(ii) Automatically categorises and prioritises latest news, most viewed news and link to live news feeds.
(iii) Allows collaboration with blog updates, other webpages and interactive maps including Google Maps and Google Earth.
(iv) Can be upgraded to include more advanced features and other media platforms.
(v) Includes pre-built components such as forums, polls and blog templates.

#### 5.3.2. *Document sharing using content management systems*

Currently the Joomla template is linked with Microsoft Skydrive — an online web storage facility to share documents, presentations and spreadhseets easily across the portal. This storage enables access rights based on password protected folders to maintain copyright restrictions and privacy of documents. Joomla can also be used to facilitate links to other document management systems available on the internet.

#### 5.3.3. *Interactive feature*

Besides written documents and news, the MASW KMS is linked with some major external providers of interactive disaster monitoring data.

These sites provide live updates on worldwide disaster occurrences and embed them into Google Map layer files. By linking these files onto the KMS, anyone with access to Google Earth or Google Maps will be able to enjoy a live preview of all the disaster events happening in the world by category.

More and more interactive links like this can be programmed into the system easily as they become available to build a central knowledge depository of disaster management articles, media and interactive links.

#### 5.3.4. *The future*

As new technologies are introduced rapidly across the World Wide Web, we will be able to tap into their advantages using the current platform. There are unlimited ways of customising the template as it evolves with more components and features to provide a one-stop disaster management knowledge portal.

The vision for the system is to provide local data fed into the system using intelligent systems as to provide a better outlook of the Malaysian scene. This will promote the need for a disaster prevention tool through early detection and information sharing.

## 6. Intervention

The intervention (December 2008–April 2009) consisted of two major activities for the project team. Based on the

user requirement (gathered during the problem diagnosis) and feedback from the system developer, the initial prototype was developed between December 2008 and February 2009. During this process, the President of the MASW was updated by the project leader, on issues pertaining to development progress as well as when the system could be launched.

It was agreed by the President and the project leader that the system should be showcased and a soft launch be completed by April 2009. Given this mandate, the project team met with the key members of the MASW in mid-April to do a simple demo of the system — to obtain the initial reaction of the members on what they taught about the system. This was held over an informal session. The members were also (during the demo) given the link to the server that was hosting the system — in case they wanted to test the system on their own. The team invited the members to submit their comments over a one-week period. At the end of the time period, as no additional requests were made by the members and post approval by the President, it was agreed that the system be launched officially, during the Annual General Meeting (AGM) for MASW later that year (July 2009).

During the AGM, the project team was given a specific slot to launch the system explaining what it could do and how the system can be used by the members. The team was also allowed to gather the response from members (attending the AGM), via a formal survey (discussed in an earlier section), of their perceptions about the system that was developed. This marked the formal evaluation stage of the project.

## 7. Evaluation

Post official launch of the system, a total of 100 MASW members (and affiliates) were given a self-administered questionnaire to examine their perception if the KMS launch will actually benefit MASW in its disaster management chapter. The intention to participate in the survey was purely voluntary. A total of 68 members responded to the questionnaire (a response rate of 68%). This response rate is very good as the usual response rate in Malaysian based surveys ranging from 15–25% (Sarachek and Abdul Hamid, 1983).

Analysis of the completed questionnaire was conducted in two facets using the SPSSWIN software. First, a descriptive analysis was carried out on the 19 questions. Second, a factor analysis using Principal Component Analysis (PCA) was undertaken to validate and identify the most pertinent perceptions relative to KMS usage in crisis response efforts in Malaysia. Third, a reliability analysis using Cronbach's Alpha value was undertaken on the new dimensions that have emerged.

### 7.1. *Descriptive analysis*

Table 3 provides the means and standard deviations of the scores related to each of the questions used in the study. The mean score for the all 19 variables ranged between 3.30–4.45 points. Note that it is normal to gauge variables

Table 3. Mean and SD for 19 variables.

| No. | Variable | Mean | SD |
|---|---|---|---|
| (1) | KMS provide timely information to staff | 4.441 | 0.529 |
| (2) | KMS provide accurate and up-to-date information | 4.426 | 0.498 |
| (3) | KMS enhance strategic planning process for teams of CRE | 4.412 | 0.553 |
| (4) | Information of CRE can be automated shared and retrieved from web | 4.397 | 0.602 |
| (5) | KMS provide relevant information | 4.397 | 0.522 |
| (6) | KMS simplify information searching and retrieving process | 4.382 | 0.574 |
| (7) | KMS provide links to external and internal information sources | 4.338 | 0.536 |
| (8) | IT can enhance organisations ability to manage information during crisis | 4.265 | 0.661 |
| (9) | Top management support is needed in implementing KMS for CRE | 4.221 | 0.569 |
| (10) | Difficulty in locating relevant information during crisis | 4.221 | 0.666 |
| (11) | IT can support CRE for organisations | 4.221 | 0.750 |
| (12) | Knowledge about CRE from individuals can be made online | 4.118 | 0.702 |
| (13) | Knowledge about CRE from relevant groups can be made online | 4.118 | 0.820 |
| (14) | Information about CRE can be converted into a web format | 4.074 | 0.698 |
| (15) | CRE in organisations relies more on paper documents | 4.029 | 0.712 |
| (16) | Organisations have necessary resources to maintain KMS to support CRE | 3.853 | 1.069 |
| (17) | Idea of trained personnel for KMS for CRE is welcomed | 3.824 | 0.711 |
| (18) | Organisations have necessary resources to develop KMS to support CRE | 3.456 | 1.071 |
| (19) | Organisations have necessary resources to update KMS to support CRE | 3.368 | 1.091 |

with mean score of 3.00 and above in statistical context, and variables with mean score of lower than 3.00 would be excluded from the discussion (Lee *et al.*, 2008).

In this study, all the variables have mean score of above 3.00, hence they can be considered as significant for analysis purpose. The significance of the variables were further validated by conducting a one-sample $t$-test using 3.00 as the cut-off point (Table 3). The result also confirmed that all the 19 variables are significantly important, as the $p$-values are significant at 0.01 level, and the 95% CI are close to 0. Hence all 19 variables are useful to conduct the next analysis.

### 7.2. *Principal component analysis*

Explanatory factor analysis was used to analyse the respondents' perceptions relative to KMS usage in crisis response efforts in Malaysia. The primary reason for this is to validate the dimensionality of the attribute data and to identify a smaller number of underlying factors that account for a major amount of the variance in the original measures. In the context of this study, the aim is to measure if the underlying factors are measuring what it is intended to or there exist more dimensionality within them.

### 7.3. *Factor analysis — formation of dimensions*

The Kaiser–Meyer–Olkin measure of sampling adequacy shows the value of 0.938. Note that this value is greater than 0.60, the benchmark value (Hair *et al.*, 1998). The Bartlett's test of sphericity is large with a significant chi-square value: $\chi^2 = 7612.35$, $p < 0.0005$. The criteria suggest that it is appropriate to apply PCA to the dataset.

The eigenvalues from the PCA showed emergence of five (cumulative variance of 65.90%) components. Almost all items displayed loadings greater than the minimum criterion of 0.50 (Hair *et al.*, 1998), as shown by the rotated component matrix computation tables. The new factors / groups name is created based on the content domain of the attributes that load highly on each factor. The composition (as shown in the rotated component matrix tables) is given in Table 3. Note that the initial five dimensions are termed as KMS and information efficiency; availability of resources for KMS; IT system's role in KMS; acceptance of KMS and top management support.

### 7.4. *Reliability test*

The next course of action was to measure the reliability of the identified components. Here, four type of analysis is

Table 4. One-sample $t$-test result.

| Test value = 3.00 | $t$ | Sig. (2-tailed) | Mean difference | 95% Confidence interval of the difference | |
|---|---|---|---|---|---|
| Variables | | | | Lower | Upper |
| Organisations have necessary resources to develop KMS to support CRE | 3.352 | 0.001 | 0.435 | 0.176 | 0.694 |
| Organisations have necessary resources to update KMS to support CRE | 2.637 | 0.010 | 0.348 | 0.085 | 0.611 |
| Organisations have necessary resources to maintain KMS to support CRE | 6.694 | 0.000 | 0.855 | 0.600 | 1.110 |
| Information about CRE can be converted into a web format | 12.859 | 0.000 | 1.072 | 0.906 | 1.239 |
| Knowledge about CRE from individuals can be made online | 13.292 | 0.000 | 1.116 | 0.948 | 1.283 |
| Knowledge about CRE from relevant groups can be made online | 11.386 | 0.000 | 1.116 | 0.920 | 1.312 |
| Information of CRE can be automated, shared and retrieved from web | 19.280 | 0.000 | 1.391 | 1.247 | 1.535 |
| KMS enhance strategic planning process for teams of CRE | 21.197 | 0.000 | 1.406 | 1.273 | 1.538 |
| KMS simplify information searching and retrieving process | 20.015 | 0.000 | 1.377 | 1.240 | 1.514 |
| KMS provide timely information to staff | 22.573 | 0.000 | 1.435 | 1.308 | 1.562 |
| KMS provide accurate and up-to-date information | 23.727 | 0.000 | 1.420 | 1.301 | 1.540 |
| KMS provide relevant information | 22.196 | 0.000 | 1.391 | 1.266 | 1.516 |
| KMS provide links to external and internal information sources | 20.771 | 0.000 | 1.333 | 1.205 | 1.461 |
| Top management support is needed in implementing KMS for CRE | 17.885 | 0.000 | 1.217 | 1.082 | 1.353 |
| Idea of trained personnel for KMS for CRE is welcomed | 9.717 | 0.000 | 0.826 | 0.656 | 0.996 |
| CRE in organisations relies more on paper documents | 12.098 | 0.000 | 1.029 | 0.859 | 1.199 |
| Difficulty in locating relevant information during crisis | 15.120 | 0.000 | 1.221 | 1.059 | 1.382 |
| IT can support CRE for organisations | 13.574 | 0.000 | 1.217 | 1.038 | 1.396 |
| IT can enhance organisations ability to manage information during crisis | 15.954 | 0.000 | 1.261 | 1.103 | 1.419 |

Significant at 0.01 level.

Table 5. Factor loading and categorisation.

| Factor name | Item name | Loading | Cronbach's alpha |
|---|---|---|---|
| Factor 1: KMS and Information efficiency | Information of CRE can be automated, shared and retrieved from web | 0.913 | 0.922 |
| | KMS simplifies information searching and retrieving process | 0.844 | |
| | KMS provide timely information to staff | 0.826 | |
| | KMS enhance strategic planning process for teams of CRE | 0.806 | |
| | KMS provide accurate and up-to-date information | 0.781 | |
| | KMS provide relevant information | 0.673 | |
| Factor 2: Availability of resources for KMS | Organisations have necessary resources to update KMS to support CRE | 0.926 | 0.874 |
| | Organisations have necessary resources to develop KMS to support CRE | 0.874 | |
| | Organisations have necessary resources to maintain KMS to support CRE | 0.828 | |
| | Information about CRE can be converted into a web format | 0.617 | |
| Factor 3: IT system's role in KMS | IT can support CRE for organisations | 0.879 | 0.856 |
| | Difficulty in locating relevant information during crisis | 0.857 | |
| | CRE in organisations relies more on paper documents | 0.732 | |
| | IT can enhance organisations ability to manage information during crisis | 0.691 | |
| Factor 4: Acceptance of KMS | Top management support is needed in implementing KMS for CRE | 0.838 | 0.824 |
| | Idea of trained personnel for KMS for CRE is welcomed | 0.806 | |



given in the literature: The retest method, the alternative form method, the split-halves method and the internal consistency method. In this study, the internal consistency method was employed due to its convenience of use and also because it is a common form of reliability estimation for explanatory based studies (Elie and Madsen, 2005). Cronbach's alpha was used as the reliability coefficients to measure the homogeneity of the items within a subset of both groups. The cronbach's alpha value of 0.60 and above was used as the threshold value. This value is applicable for an explanatory-based research (Manning, 2004).

The maximised reliability coefficient for the new dimensions is also given in Table 5. The coefficients suggest that the last dimension (top management support) is not reliable as the Cronbach's alpha value cannot be computed due to single interdimension issue. Hence, only four dimensions are reported in Table 4.

The factor analysis for the perceptions on the usage of KMS for crisis relief efforts in Malaysia revealed emergence of four dimensions. In this context, relief workers in Malaysia are in the opinion that KMS will enable information management efficiency. They are also in the opinion that their organisations have the necessary resources in support of development of KMS, and that IT plays a critical role in their relief effort works. Finally, the respondents also indicated the importance of top management support for wider acceptance of KMS in crisis relief efforts in Malaysia.

The above findings are consistent with prior work on KMS in support of crisis response, as discussed in the subsections that follow.

## 8. Discussions and Lessons Learnt

The factor analysis for the perceptions on the usage of KMS for crisis relief efforts in Malaysia revealed emergence of four dimensions. In this context, relief workers in Malaysia are in the opinion that KMS will enable information management efficiency. They are also in the opinion that their organisations have the necessary resources in support of development of KMS, and that IT plays a critical role in their relief effort works. Finally, the respondents also indicated the importance of top management support for wider acceptance of KMS in crisis relief efforts in Malaysia. The above findings are consistent with prior work on KMS in support of crisis response, as discussed in the subsections that follow.

### 8.1. *Information efficiency*

The information processing theory states that the role of having accurate and up-to-date information is vital

particularly when organisations deal with a turbulent environment (Burnell *et al.*, 2004). Integrating KM processes can support managers to proactively respond to a highly turbulent environment and will benefit an organisation (Burnell *et al.*, 2004). This would include organisations that plan and prepare for emergencies and crisis response situations (Burnell *et al.*, 2004).

Lee and Bui (2000) documented vital observation with the use of a crisis response system during the massive earthquake that hit Kobe, Japan in 1995. Several key lessons for crisis management system designers based on Lee and Bui's work were identified. Relevant information should be included in the crisis response system prior to the actual crisis situation. This is to ensure that crisis responders have sufficient information to guide the decision-making processes in responding to a crisis. Lee and Bui (2000) imply that the task of gathering relevant information to support crisis response should be incorporated into part of the crisis response strategic initiative. Information from prior experiences should become part of the crisis management system. The system should somehow be able to capture both tacit and explicit knowledge about how prior crisis situations were dealt with. Lessons, which are learnt, can be used to guide future action. Lee and Bui (2000) in this regard imply that the design of any crisis response system should support some form of organisational memory component. Our findings in this regard are generally consistent with prior work in this dimension.

### 8.2. *Availability of resources*

In addition to designing relevant systems features to support crisis planning and response, researchers suggest that successful implementation of any crisis management system is contingent on how well people are trained to use such systems (Patton and Flin, 1999; Lee and Bui, 2000; Turoff, 2002). Patton and Flin, for instance, suggest that crisis management systems be incorporated into crisis response related activities such as training, simulations, drills and evacuation exercises. Turoff (1992) states that crisis management systems that are not normally used will not be used when an actual crisis situation occurs.

The majority of post 9/11 literature on crisis management is confined within the realm of commercial entities (Braverman, 2003). Developments within the domain of crisis management information systems have accelerated over the past few years, particularly after the 9/11 events (Campbell *et al.*, 2004). The authors accurately mention that issues such as resources, expertise and personnel should be addressed at the onset, prior to designing crisis management systems within the context of local and state level communities. They call for development of "a generic set of requirements" (p. 2) that can be used by both the state and local authorities to support crisis planning and response. This statement implies that an organisation's ability to survive given dynamic changes within its environment is contingent upon its ability to quickly respond to change, in a crisis mode. This includes the ability to effectively manage its knowledge resources. Burnell *et al.* (2004) assert that "an effective knowledge-based organisation is one that correctly captures, shares, applies and maintains its knowledge resources to achieve its goals" (p. 203). This echoes the view of March and Simon (1958) who state that successful organisations are able to adapt to any dynamic environment. Again the construct availability of resources to support KM efforts for crisis response is found to be significant in our findings.

### 8.3. *IT support in disaster management systems*

Research about emergency management information systems has accelerated since the 9/11 events (Campbell *et al.*, 2004). However, researchers do not use a common terminology to describe emergency management information systems. Jennex (2004) for instance, calls these systems, Emergency Information Systems (EIS). Campbell *et al.* (2004) use the term emergency response systems. Turoff (2002) uses the term Emergency Response Information Systems (ERMIS) and extends this idea to the notion of a Dynamic Emergency Response Information Systems (DERMIS) (Turoff *et al.*, 2004). Prior work in this area suggests that IT can support crisis / emergency management by virtue of proving storage architecture (Burnell *et al.*, 2004), basis to share and disseminate information during crisis moments (Lee and Bui, 2000; Turoff, 2002; Wagner, 2004) and more recently support information / knowledge sharing over networks particularly using web-based platforms (Campbell *et al.*, 2004; Jennex, 2005; Raman *et al.*, 2006). Overall, the majority of the researchers in this area seem to agree that despite different naming conventions, emergency management information systems should be designed to support emergency preparedness and guide effective response during an actual crisis situation, and IT has a crucial role to play in this context. In addition, although researchers do not explicitly link the idea of emergency management information systems to KM, the influence of the latter on emergency management systems is evident in the literature (Turoff, 2002; Burnell *et al.*, 2004; Turoff *et al.*, 2004; Murphy and Jennex, 2006).

### 8.4. *Top management support*

The KMS Success Model suggest that top management support (as an aspect of service quality), is crucial in ensuring successful KM intervention within an institutional context. Our findings suggests that this factor was not significant, based on the results from the factor analysis. This is possibly given the fact that the respondents belong to a voluntary organisation called the MASW, which is a non-profit organisation, comprising of social volunteers. MASW is organised in a non-hierarchical manner, where members are treated equally in terms of managerial contribution and power. This can be expected for voluntary organisations and thus, our results are not seen as a surprise. However, our experience in working with KMS in the context of emergency management in the US suggest that, top management support is indeed significant in determining successful use and implementation of KM systems to support such efforts, in the context of formal organisational structures, where management functions, roles and authorities are clearly defined (Raman *et al.*, 2006; Jennex and Olfman, 2006).

## 9. Conclusion

Decisions made during disasters can be improved by using knowledge from past events to generate current and future response procedures (Turoff, 2002). Analysis of past emergency events for lessons learnt and the understanding of what works best in given situations (both examples of knowledge) enables emergency managers to prepare planned responses as a counter to the stress of the emergency. Integration of KM concepts into an emergency-response system is a recent development (Jennex, 2008).We used the KMS Success Model as a basis to develop our research framework to explore if there is indeed a role for KM in supporting crisis response efforts. This framework was then used to develop a survey instrument that was administered amongst a pool of social workers in Malaysia, involved in crisis response efforts. Our findings suggest that factors such as acceptance of KMS, availability of resources to develop and maintain a KMS, role of IT in KMS for crisis response, and KMS information efficiency play a vital role in ensuring effective use of KMS for crisis response efforts.

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