ICT and Disaster Preparedness in Malaysia: An Exploratory Study

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Abstract: - Malaysians are increasingly finding themselves exposed to disasters especially land slides and flood. However, concern can be raised about citizen's preparedness of disasters, and the extent to which they are consequently prepared, protected and equipped to deal with emergencies that they may encounter. This paper discusses the level of disaster preparedness among Malaysians from a survey of 346 citizens to assess their perceptions of disaster issues, and their attitudes towards increasing the disaster preparedness. The findings reveal that although there is a high degree of confidence at surface level, with respondents claiming to be aware of the disaster issues and the ability to utilize many of the relevant safety methods, a deeper assessment suggests that there are several areas in which desirable knowledge and understanding is lacking. The study presents the role of ICT in the form of knowledge management systems as the recommendation for Malaysians and the Malaysian government as a tool to improve the level of disaster preparedness. The study is timely to the public especially to the local community to preempt, deal with and, ultimately, survive a disaster.

Key-Words: - disaster preparedness, knowledge, Malaysia, disaster, knowledge management systems

1 DISASTERS: THE MALAYSIAN CHAPTER

"This is an emergency, and for emergency situations, we need emergency actions…"

UN Secretary-General Ban Ki-Moon,
10 November 2007

In the last decade, disaster has emerged as an important issue. As evidenced in the headlines, terrorist attacks, natural disasters and infrastructure failures can occur without warning, creating catastrophic results for an unprepared community. Disaster is defined as incident that occurs in a sudden manner, complex in nature, resulting in the loss of lives, damages to property or the environment as well as affecting the daily activities of local community. Such incident requires the handling of resources, equipment, frequency and extensive manpower from various agencies as well as effective coordination and the possibility of demanding complex actions over a long period of time. People are becoming ever more vulnerable to disaster incidents as climate change continues.

The current climate of disasters in Malaysia suggests that an increasing occurrence land slides is caused by inadequate factors of safety at hill-site developments. For example, in the case of land slides at Ulu Klang area, unsafe walls and slopes manifested as landslides. The table 1 below shows details of several landslides at Ulu Klang and their causes.

Table 1: Chronology of Landslide at Ulu Klang and their Causes

Date	Landslide	Cause of landslide
December 1993	Block 1 of Highland Towers, Bukit Antarabangsa collapsed that cased 48 deaths	The most probable cause of collapse of the tower was due to the buckling and shearing of the rail piles foundation induced by the movement of the soil. The movement of the soil was the consequence of retrogressive landslides behind the building of Block 1. [1] Gue (2007) [2] summarized the above as: a) Design of the superstructure and materials was adequate. b) The failure of a rubble wall triggered a landslide which caused the building to collapse. The Factor of Safety (FOS) of the rubble was found to be less than 1.0, which is unsafe. c) The site is found to be tectonically stable and no active fault movements had been recorded.
May 1999	A few major landslides at Bukit Antarabangsa, fortunately no fatalities	Investigation results for the landslides at Bukit Antarabangsa by a team of engineers, geologists, hydrologists and surveyors reveals that: a) The landslides were due to high (about 66m) and steep (steeper than 35o) un-engineered filled slopes. b) These were aggravated by blockage of berm drains and cascading drains at the slopes.[2]
November 2002	The Taman Hillview landslide that caused 8 deaths.	The cause of landslide at Taman Hillview in 2002 was similar to the Highland Towers tragedy, where failure of a rubble wall again triggered a landslide. The Factor of Safety of the rubble wall in the Highland Towers was found to be less than 1.0 even without considering any presence of geological features such as relic joints etc and water table.[2]
May 2006	Landslide at Kampung Pasir - 4 deaths	Investigation of the Kampung Pasir landslide was still ongoing and no concluding cause reported. [2]

Source: Gue, S. S. & Liong C. H. (2007), "Is the Ground in Ulu Klang Unstable?", Jurutera, February 2007, page 32-33.

Malaysia is affected by monsoons and the atmospheric circulations coupled with anomalies that could bring extreme rainfalls and caused devastating floods to the tropical regions. In December 2006 and January 2007, the Northeast Monsoon brought heavy rain through series of storms that caused devastating floods in the southern region of Peninsular Malaysia particularly to Kota Tinggi, Johor. The storms that caused floods of December 2006 and January 2007 was the unusual Northeast Monsoon that blows from South China Sea and West Pacific Ocean [3]. For example, a total of 22,091 families in December 2006 and 28,747 families in January 2007 were affected [4]. O'Arbayah et al (2008) mentioned that the 2006 -2007 flood in Johor which displaced more than 312,386 residents of the state was an extraordinary event and tested everyone preparedness [3, 14, 15, 5].

Based on ADRC country report [6], wind storm, epidemic, wave surge, slides, floods, drought and wild fires are among the natural hazards likely to affect Malaysia. Some major disasters that hit Malaysia in recent years are:

Table 1: Recent disasters in Malaysia

Year	Disasters	Killed	Injured	Total Affected	Damage Cost (USDs)
2008	Flood			10210	
2008	Landslide	11	15	1422	
2007	Flood	33		158000	225m
2006	Flood	19		138000	343m
2005	Flood	17		100000	66m
2005	Mud Flood	3		2793	
2004	Flood	13	0	15000	
2005	Flash Flood	4	0	600	
2004	Tsunami	80	767	5063	14.6m
2005	Wild Fires	0	0	0	—
2004	Storm	0	0	1000	—
2004	Storm	1	0	40000	—

Source : ADRC Country Report 2008 and 2006, Retrieved from www.adrc.asia.com on 23 February, 2010.

In summary, prior work by researcher as listed above suggest that inadequate factors of safety at hill-site developments, rapid development and environmental degradation and poor knowledge understanding on geo-hazard phenomena are among the causes that result in a series of disaster incidents in Malaysia. Serious public anxiety and poor community's capability are the result of poor disaster preparedness. As such it becomes apparent that the

disaster preparedness of community is not only a concern of the community at the disaster prone area but a national agenda.

2 DISASTER PREPAREDNESS

As Malaysia develops, the citizen, government and business entities must keep pace with changes and disasters that are occurring as it affects business continuity. Disaster preparedness is an initiative that is intended to increase readiness and knowledge among the various stakeholders regarding the risks, related agencies, preventive measures and other disaster related information. It seeks to improve the overall preparedness towards a disaster or at least the type of disasters that is likely to happen at a particular locality. The goal of this research is to support 'community continuity', in other words to help communities remain resilient in the face of disaster events. FEMA recommends individual preparedness for up to 72 hours. Sustaining a community for at least 72 hours often falls to those who live or work in the community [7].

National Disaster Management Strategy (NDMS) of Malaysia is the backbone strategy to advance effective coordination and integrated approach in the building of a culture of prevention, protection/public safety in the community. Its vision is to create a safe environment for the community through disaster management and sustainable development in the 21st century. ADRC country reports that one of NDMS' main components is Community Awareness [8]. This component outlines the aim to develop a national approach to fostering and enhancing the community's awareness of risks, and encourage involvement in prevention /mitigation, preparedness, response and recovery strategy [8]. Based on this component, this research will address the need for more sustained public preparedness programs directed at local communities in disaster prone areas through a team based hands-on training [8].

In development circles today, disaster management is often treated holistically rather than as a single issue. It is an essential component of any development framework [9][17]. Disaster preparedness is a cycle within pre-disaster stage in the disaster management cycle. The phases of the disaster management cycle are described as follows:

Pre – Disaster Stage	Mitigation	Any activity that reduces either the chance of a hazard taking place or a hazard turning into disaster.
	Risk reduction	Anticipatory measures and actions that seek to avoid future risks as a result of a disaster.
	Prevention	Avoiding a disaster even at the eleventh hour.
	Preparedness	Plans or preparations made to save lives or property, and help the response and rescue service operations. This phase covers implementation/operation, early warning systems and capacity building so the population will react appropriately when an early warning is issued.
During Disaster Stage	Response	Includes actions taken to save lives and prevent property damage, and to preserve the environment during Emergencies or disasters. The response phase is the implementation of action plans.
Post Disaster Stage	Recovery	Includes actions that assist a community to return to a sense of normalcy after a disaster.

Source: United Nations Development Programme – Asia-Pacific Development Information Programme (UNDP-APDIP) and Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) – 2007 (Wattegama, 2007). [9]

Events such as the 9/11 terrorist attacks, subsequent anthrax events, the Slammer worm attack on the Internet, the London subway bombings, the 2004 tsunami, and Hurricane Katrina in 2005 have spurred interest in research in disaster preparedness [16]. Disaster preparedness and readiness are being assessed for its contribution towards supporting disaster management. Hence, identifying disaster preparedness for community continuity in disaster planning is timely [10][12][16].

In Malaysia, one of the challenges faced by state crisis management agencies is lack of fund for training to conduct disaster preparedness and readiness for the local community. While fund and budget allocation is not within the organisation's control, the effort to continuously offer preparedness programs should not take a back seat. Therefore, researchers of this study aims to act as the helping agent to this problem by conducting the research as well as attempting to modulate and assess the effectiveness of the training program.

Given the brief literature review, this paper aims to assess the level of preparedness towards disaster preparedness among Malaysians which includes general information on disasters preparedness and response. The result of this research will be constructive and beneficial to the Malaysian government especially Majlis Keselamatan Negara (National Crisis Committee) to plan for community preparedness programmes for disaster. The questions that this study raises and seeks answers to are: Are Malaysians ready to face any disasters? What are the sources of information on disasters? What can improve their level of preparedness? Hence, the objectives of this study are to examine the perceived disaster preparedness among Malaysians, to examine the source of information on disasters and to provide recommendations based on the findings.

The main discussion begins with an outline of the survey methodology and the demography of the respondent group. From this, the next section examines the sources that are utilised in order to obtain advise and informations related to disaster. The following final set of findings reveals the disaster preparedness level. The paper concludes with recommendations to improve disaster preparedness among Malaysians.

3 A Survey of Disaster Preparedness

The study sits philosophically within the positivistic or scientific research paradigm. This study was planned as a cross-sectional survey of citizens. Data was collected through semi-structured questionnaire. The unit of analysis is individuals. The study was undertaken from June 2009 to October 2009. The population for this research is Malaysian citizens. In order to gain equal participation from the citizens of all the states, the questionnaires were sent to 1000 household members in Malaysia, which includes North, West South Malaysia, East Coast and East Malaysia (Sabah & Sarawak). The respondents were randomly selected using convenient sampling and population

weighted based on their age, income, and education level.

The questionnaires were distributed through normal mails and emails to respondents. All completed questionnaires were returned to the researcher within 2 weeks to one month. The researcher received a total of 346 completed questionnaires from the total of 1000 questionnaires which were distributed to the respondents. The questions were divided in four sections. Section 1: General information about respondents, Section 2: Experience and Expectations on Disasters, Section 3: Perceived Disaster Preparedness. The questionnaire was tested and preliminary analysis done to ensure validity and reliability. Descriptive statistics using SPSS software tool was used to analyse the findings.

3.1 Profile of Respondents

As shown in table below, in terms of age group, majority of respondents were from 31 – 40 age brackets which accounted for 45 per cent. This shows the random selection is important to generalisability of the findings. Overall, in term of gender, the questionnaires were distributed evenly (Female 54% and Male 43%). Slightly more than half (60%) of the households are married individuals. Where level of educational is concerned, 66% of individuals are having university level education. Income level indicates that majority of respondents within the income RM1000 – RM4999 bracket. This study managed to collect slightly equal sizes of responses from all the regions. Finally, the Internet accessibility shows 86% of the respondents have the access.

Table 2: Respondents' Profile

Profile	Percentage (%)
Age Group	
18-30	27
31-40	45
41-50	24
51-60	3
Total	100.0
Gender	
Female	54
Male	43
No Answer	3
Total	100.0
Marital Status	
Divorced	2
Married	60
Single	37
Widowed	1
Total	100.0
Education Level	
Primary	2
Secondary	30
University	66
No Answer	1
Total	100
Income Level	
Less RM999	8
RM1000-RM4999	85
RM5000-RM10,000	6
No Answer	1
Total	100
Residency	
North Malaysia	20
West Malaysia	19
South Malaysia	15
East Coast	10
East Malaysia (Sabah & Sarawak)	32
No answer	4
Total	100
Internet Access	
Yes	86
No	13
No answer	1
Total	100

Respondents were asked to rank their personal level of concern for the specific natural disasters affecting Malaysia. The following table shows the level of concern of the respondents. The results of the survey shows that the majority of

the respondents are only concern about the specific natural disaster that may affect Malaysia. Most of the respondents are mainly concerned with disasters such as household fire, wildfire, landslide, windstorm, flood, tsunami and earthquake. Findings also shows that majority of the respondents did not give an appropriate level of concern. This reflects that they are unsure of risk posed by geo-hazard phenomena.

Table 2: Respondents' concern of the occurrence of natural disaster

Natural Disaster	Extremely Concerned %	Very Concerned %	Concerned %	Somewhat Concerned %	Not Concerned %	No Answer %
Drought	6	8	18	12	6	51
Haze	11	10	20	13	5	40
Flood	18	21	25	7	5	23
Landslide/ debris flow	12	16	28	11	5	27
Wildfire	14	16	28	11	5	27
Wind storm	14	13	26	14	7	27
Tsunami	14	13	22	14	9	22
Outbreak	13	10	13	6	3	55
Earthquake	13	12	25	12	10	28
Others	11	11	18	3	4	52

3.2 Sources of Information and Advice on Disasters

Right information is important in order to take right decision and the right time. Being prepared with right information for disaster and emergency can ensure the safety and comfort of the household members. This set of question was aimed to know whether they receive relevant information about the disaster in time. The study shows that 61% of the respondents were able to receive timely warning about the disasters in order to take necessary steps to safe their family, belongings and home in the event of a disaster. There are 31% of the respondents who have indicated that they do not receive timely and adequate information during disaster incidents. 8% of the respondents did not give any answer to this question. Figure 1 below shows this scenario.

The respondents then where asked to rank the frequency of them receiving any information or warnings related to disasters. In figure 2, the result shows that about 12% of them receive such information or warning within last 6 months and 68% of the respondents have not indicated of receiving such information or warning. The remaining 68% of the respondents did not indicate the frequency of them receiving such information. This could mean that either they have not experience any disaster in the past 5 years at their areas or maybe the

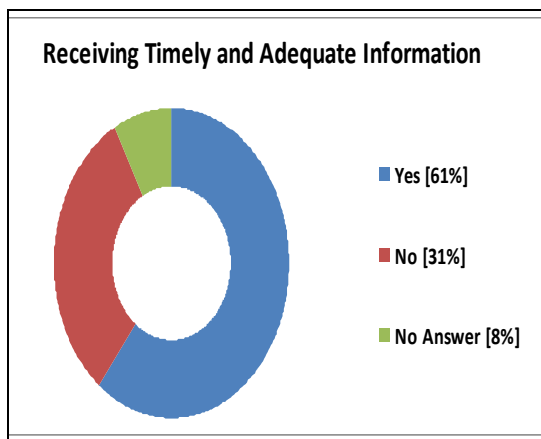information received was not relevant to them.

Figure 1: Percentage of respondents receiving timely and adequate information or warning in the event of a disaster for their safety
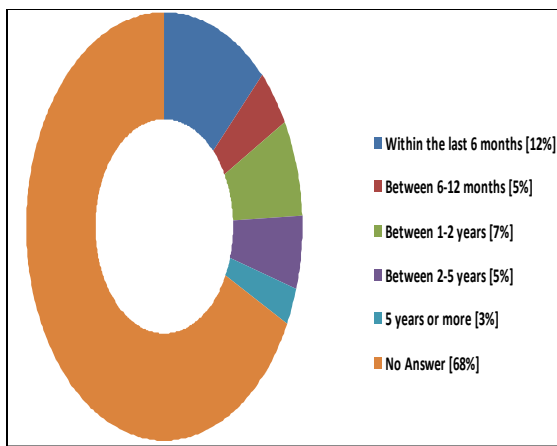

Figure 2: How recently respondents received timely and adequate information

We then analysed the preferred source of information. To develop and implement effective outreach and education activities, it is important to understand the mechanisms used for information to be disseminated to the respondents in the event of natural disaster. The finding as shown in figure 3, the respondents preferred the news from the newspaper, television and radio as their effective source of information. 25% of the respondents indicated that the most effective source of information is from television news, followed by 21% from radio news and 20% from newspaper news. Other types of information sources as listed are perceived as less effective tools as compared to television, radio and newspapers.

3.3 Perceived Disaster Preparedness

Figure 4 shows the level of disaster preparedness by the household members. The survey findings shows that 49% of the respondents perceive that they are reasonably prepared to protect their family and belongings if any of the natural disaster struck at their area of residents. 6% of the respondents have indicated that they are not prepared if any of the natural disaster events were to occur at their place of residence. 10% of the respondents left the question unanswered.
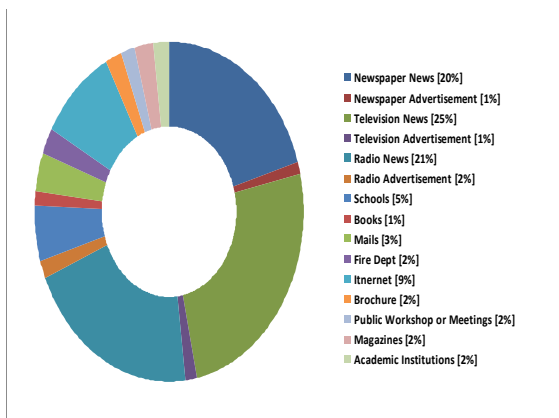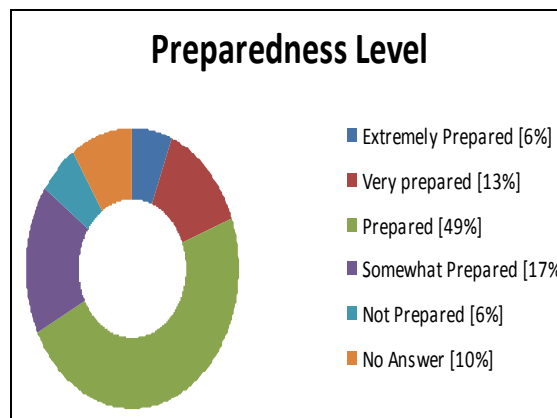
Figure 3: Preferred Source of information

Figure 4: Household Members' Level of
Preparedness

Respondents were asked about the steps they have taken and plan to take in the event of disaster or emergency. The questions are mainly to find out the awareness of the respondents of the safety measures they will take during disaster or emergency. About 37% of the respondents have attended meetings to know about what to do and how to prepare themselves in the event of natural disaster or emergency. However, about 36% of them did not attend any activities to prepare themselves. Table 3 below summarizes the respondents' participation on disaster related activities.

Table 3: Respondents' Participation in Disaster Activities to increase disaster preparedness level

Activities	Have done %	Plan to do %	Not done %	Unable to do %	No answer
Attended meetings	37	31	36	3	13
Talked to household members	27	34	24	11	4
Develop in-house plan	14	37	29	12	7
Prepare disaster supply kit	15	37	31	12	5
Household members trained in CPR	23	27	33	12	4

From the findings it is noted that majority of the respondents anticipate the possibility of disaster occurrence at their place of residence. Therefore, we assessed on their need to have adequate provisions for financial and property recovery for natural disaster is a necessary part of natural disaster preparedness. As shown in figure 6, 50% of the respondents have insurance coverage for their life and property. However 23% of the respondents have

not taken any form of insurance coverage and 27% of the respondents did not answer this part of the questionnaire.
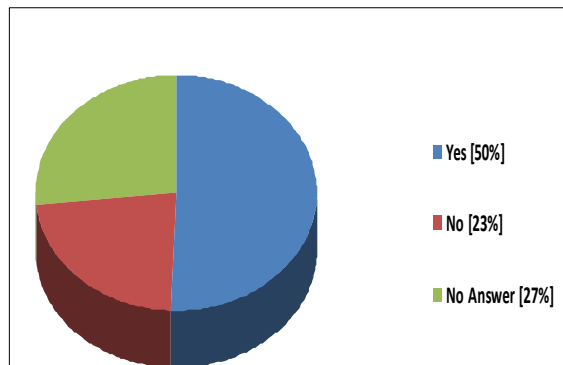

Figure 6: Respondent's with insurance coverage

4 Discussion

Although the majority of respondents claimed to be familiar and prepared for disasters, the survey findings still revealed notable segments that were lacking preparedness. The respondents are generally with the understanding that having insurance improves their preparedness towards disasters. However, knowledge-base regarding preparing themselves to face disaster is not adequate. For example, the UNDP describes that disaster preparedness includes the activities such as plans or preparations made to save lives or property, and help the response and rescue service operations, implementation/operation, early warning systems and capacity building so the population will react appropriately when an early warning is issued [7]. In addition, activities such as determining potential risk and acquiring guidelines are also important for disaster preparedness.

However, based on the study, vulnerability towards disaster still exist even though majority of the respondents

claim to be knowledgeable and confident about aspects of disaster preparedness. One of the key issues to address is that of preparedness and education. In considering the sources of their information, the majority are from media such as newspaper and not drawn from professional or official sources.

We therefore, recommend the use of information and communication technologies (ICT) in the form of Knowledge Management Systems (KMS) to improve the disaster preparedness situation in Malaysia. Chanuka Wattegama, in his report entitled ICT for Disaster Management produced by United Nations' APCICT (2007), emphasized the important role played by ICT in managing crisis. He stated that information and communications technology (ICT) can potentially play a pivotal role in disaster prevention, mitigation and management. Remote sensing for early warning is made possible by various available technologies, including telecommunication satellites, radar, telemetry and meteorology [9].

5. Knowledge Management Systems (KMS) for Disaster Preparedness

Disaster demands for certain attributes of information in timely manner for the disaster planning community to make optimal decisions. Based on various literature [9][11][12], ICT can play important role in managing the communication, coordination and data dissemination during emergency situation. This research recommends that ICT in the form of Knowledge Management Systems, in essence, plays important role in gathering and disseminating the natural disaster related

information and hence, contribute towards the crisis response initiatives.

In Malaysia, there is an urgent need of an organized common platform to capture, organize and share this knowledge and create a versatile platform. In the case of India, Ministry of Home Affairs in collaboration with UNDP (United Nations Development Programme) National Disaster Risk Management Programme built a KMS portal as an initiative to connect all government departments, statutory agencies and research organisations/institutions to share collectively and individually their expert know-how's [11].

Murphy and Jennex (2006) in their study of the use of KMS in Hurricane Katrina response concluded that KMS should be included in all crisis response [12]. Nina Mistilis and Pauline Sheldon, (2005) described that knowledge is a powerful resource to help governments, organisations & communities prevent, mitigate, plan for & recover from disasters & crises [13]. At this juncture, researcher is designing and designing a KMS for the crisis management agency at state level to improve the disaster preparedness, coordination and communication, as part of doctoral dissertation.

A knowledge management system refers to any IT based system that is "developed to support and enhance the organizational knowledge processes of knowledge creation, storage, retrieval, transfer and application" [18][24]. This definition includes expert systems, Web based group support systems, online directories etc. Gupta and Sharma (2004) divide KMS into seven major categories as follows[19]:

- Expert Systems, artificial intelligence and knowledge based management system (KBMS)
- Groupware (Computer Supported Collaborative Work)
- Document management systems
- Decision support systems (DSS) [23][25]
- Semantic networks
- Relational and Object oriented databases [22]
- Simulation tools

The practice of selectively applying knowledge from previous experiences during turbulent moments of decision making, to current and future decision making activities with the express purpose of improving the organization's effectiveness, would be possible via a KMS. In addition, we further add that given the dynamic nature of crisis situations, coupled with different inputs and requirements from various stakeholder groups, a crisis response manager and centre therein, is subject to information overload, which can prevent timely and accurate decision making. A well tested and implemented KMS in this context can help to decide what to look at, what decisions to focus on, and what decisions can be made automatically and/or in advance.

KM is an action discipline; knowledge needs to be used and applied for KM to have an impact. Crisis response relies on the use of knowledge from past situations to generate current and future response procedures. Lessons learned 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 and to ensure all relevant

issues are considered during emergency response decision making.
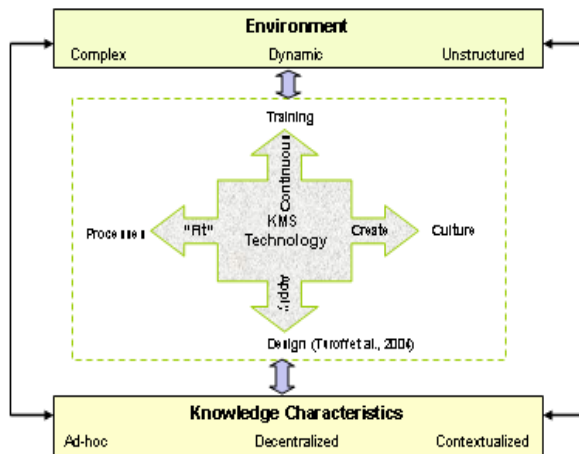
KM SYSTEM AND DISASTER MANAGEMENT MODEL

Figure 7- KM and Disaster Management [20]

Figure 7 illustrates the nature of the relationship between KM systems in support of disaster management efforts. The environment faced by emergency responders is complex, dynamic, and unstructured. This assertion echoes the work of Burnell et al. (2004). The majority of literature about emergency management information systems do not clearly state that systems designed to support emergency response, are associated to knowledge management. We argue that, based on our prior experiences, the environment faced by emergency responders forces them to deal with the following characteristics of knowledge:

- Ad hoc — knowledge within emergency responders is largely tacit and utilized as and when an emergency occurs. Individuals and groups involved in emergency response may not necessarily think about responding to a particular situation beforehand. This implies

that the knowledge that they need to respond to an emergency is ad hoc in that it is required as and when a crisis occurs.
- Decentralized — the knowledge repository to respond to a particular crisis in a consortia environment is predominantly decentralized, in a given environment.
- Contextualized — Emergency response requires responders to deal with knowledge that is highly contextualized. Every crisis is unique and requires a different set of ideas and response initiatives [21].

The model is currently being tested in the local context though our work with the Malaysian Security Council for Disaster at Selangor State.

6. Conclusion

This paper discusses the disaster preparedness level among Malaysian given the current climate of disasters. As Although the perceived level of preparedness is relatively high, we feel that there is more issues and elements that needed to be highlighted and given importance for being prepared for any disaster besides just having some life policies or knowing the disaster. We also assert that there is relationship between information and communication technology (ICT) and its impact on disaster management efforts. The academic nature of this paper recommends and stress on how ICT, manifesting itself in the form of a KMS, can enhance disaster management efforts within organisations. The paper is written based on our involvement with prior and on-going work (in Malaysia) that pertains to the use of KMS in aid of disaster management.

References

[1] Ampang Jaya Municipal Council. (1994). *Report on the Inquiry Committee in the Collapse of Block 1 and The Stability of Blocks 2 and 3 Highland Towers Condominium Hulu Klang Selangor Darul Ehsan.* Malaysia.

[2] Gue, S. S. & Liong C. H. (2007), Is the Ground in Ulu Klang Unstable?. *Jurutera*, 32-33.

[3] Chan, N.W. (2006) Increasing flood risk in Malaysia: causes and solutions. *Disaster Prevention and Management*, 6(2), 72-86.

[4] Shafie, A. (2009). *Extreme Flood Event: A Case Study on Floods of 2006 and 2007 in Johor, Malaysia*. Unpublished master's thesis, Colorado State University, Fort Collins, Colorado, USA.

[5] O'Arbayah, Daud, A.R., Surinah, A., Noorhaida, U., Shaharom, N., & Rahim, A.(2008). Public Health Preparedness And Response To Flood Disaster In Johore, Malaysia: Challenges And Lessons Learned. Community Health Journal, 12(K).

[6] ADRC Country Report 2008 & 2006, Retrieved from www.adrc.asia.com on 23 February, 2010.

[7] United Nations Development Programme. (2007). Asia-Pacific Development Information Programme (UNDP-APDIP) and Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT).

[8] NIMS Community. USA. Retrieved on July 2, 2008 from http://www.nimsonline.com/.

[9] Wattegama, C. (2007). ICT for disaster management. United Nations Development programme – Asia-Pacific Development Information Programme (UNDP-APDIP) and Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) – 2007, Thailand: Keen Media (Thailand) Co., Ltd.

[10] Mehrotra, S., Znati, T., Thompson,W. C. (2008). *Crisis management. IEEE Computer Society* , 1089-7801, 14-17.

[11] Mohanty, S., at al. (2005). *Knowledge Management in Disaster risk reduction. The Indian approach.* Ministry of Home Affairs, National Disaster Management Division, Government of India. Retrieved Feb 21, 2010 from http://www.ndmindia.nic.in/wcdr_official_documents.htm

[12] Murphy, T. and Jennex, M.E. (2006). Knowledge Management, Emergency Response, and Hurricane Katrina, *International Journal of Intelligent Control Systems*, 11(4), pp. 199-208.

[13] Mistilis, N. & Sheldon, P. (2005). Knowledge Management For Tourism Crises And Disasters, *Tourism Review International Issues*, 10, 1/2 , 39-46.

[14] Gue, S. S. & Tan, Y. C. (2006). *Landslides: Case Histories, Lesson Learned and Mitigation Measure*. Conference on Landslide, Sinkhole, Structure Failure: MYTH or SCIENCE?, Ipoh, Perak, 6-7 March 2006

[15] Gue, S.S., Karnawati, D. & Wong, S.Y. (2008), *Policy and Institutional Framework for Landslide Mitigation and Risk Reduction*, First World Landslide Forum, 18th-21st November 2008, Tokyo, Japan.

[16] Raman, M., Ryan, T., & Olfman, L. (2006). *Knowledge Management*

System for Emergency Preparedness: An Action Research Stud. Proceedings of the 39th Hawaii International Conference on System Sciences – 2006.

[17] Patton, D., and Flin, R.(1999). Disaster Stress: An Emergency Management Perspective, *Disaster Prevention and Management*, 8:4, pp. 261-267.

[18] Alavi, M., & Leidner, D. E. (2001). Review: Knowledge Management and knowledge management systems: Conceptual foundations and research issue. *MIS Quarterly*, 25(1), 107-136.

[19] Gupta, J. D., & Sharma, S. K. (2004). *Creating Knowledge Based Organizations*: IDEA Group Publishing.

[20] Dorasamy, M., Raman, M., & Kaliannan, M. (2007). Knowledge management for disaster response: Proposed framework. *Proceedings of Knowledge Management International Conference 2008 (KMICE)*.

[21] Burnell, L., Priest, J., & Durrett, J. (2004). *Developing and Maintaining Knowledge Management System for Dynamic, Complex Domains*. In J. Gupta & S. Sharma (Eds.), Creating Knowledge Based Organizations. London: IGP.

[22] Wang, T., & Ren, Y. (2009). Research on personalized recommendation based on web usage mining using collaborative filtering technique. *WSEAS Transactions on Information Science and Applications,* 6(1), 62-72.

[23] Mamoukaris, K., Makropoulos, C., & Telonis, P. (2004). Decision Support System of Training Budget Management, *WSEAS Transactions on Information Science and Applications*, 1(5), 1174.

[24] Rudas, I.J. & Horvath, L. (2006). Emphases on Human Intent and Knowledge in Management of Changes at Modeling of Products. *WSEAS Transactions on Information Science and Applications,* 3(9).

[25] Ruey, S.C., Yung, S. T., & Sau, Y. B. (2008). Using data mining to provide recommendation service. *WSEAS Transactions on Information Science and Applications*. 5(4), 459-474.