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Effects of Knowledge Management System in Disaster Management through RFID Technology Realization

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Abstract

Based on experiences through different disasters, particularly earthquakes in Iran, we can assume that one of the main problems is lack of an exact and efficient identification system through which the victims, especially all those under the debris can be identified. Type of knowledge related to the disastrous situation and the relevant technology to handle the knowledge, which can speed up the search, rescue, relief, and as a whole Disaster Management process are highly important. In this paper, we suggest Radio Frequency Identification System used in coordination with Oracle as Data Base Management System with a dedicated network system. Finally, due to the importance of technology and knowledge type and sharing, a Knowledge Management System model is proposed. The proposed model intends to focus on knowledge, human and technology-related issues of Emergency Coordination Center. Emergency Coordination Center is Disaster Management headquarters center in which Knowledge Management System model is designed to address its relevant issues and challenges.

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1. Introduction

The concept of using the information system in disaster affected areas became the point of importance after Japan's Great Hanshin-Awaji Earthquake in 1995. All information related to the human, and non-human entities is posted and communicated within disastrous area. Several researchers emphasize the importance of Radio Frequency Identification (RFID) technology, knowledge sharing and conversion, top-level management involvement in three phases of Disaster Management (DM), namely pre, during and post [1]. Their contribution and coordination can have a significant impact on managing the disasters and save many lives. Thus, in this research paper, the focus is on three main elements of this study, including knowledge management system (KMS) for DM by RFID technology, which are discussed in their respective following sections. Finally, at the end a proposed model, which is based on these related and coordinated dimensions to contribute to the field of DM to minimize the number of casualties through an efficient decision-making process with a right and timely knowledge in hand, will be introduced [2].

2. Knowledge management system

Knowledge is often called the intellectual capital of an organization that is gained through years of experiences. A knowledge-based perspective of the organization has emerged in the strategic management literature [3-5]. In the case of this study, knowledge of local people through years of experiences, that supports how to deal with disastrous situations are valuable. However, they might not be accessible or understood by officers in charge appointed by disaster management organization, because they encompass experiences, beliefs, insights and traditional successful methods. In addition, it is worth saying that sometimes they may have failed [6]. By applying proper KMS in disaster management organizations, the aims are as follows:

- To identify tacit knowledge (local knowledge)
- To covert tacit knowledge to be explicit
- To computerize the explicit knowledge by the use of related information technology applications such as: networking and DBMS
- To integrate scientific and local knowledge

The literature review demonstrates that there are different views toward knowledge and Knowledge Management (KM) [7]. Knowledge is defined as a justified belief that increases an entity's capacity for effective action [7-13]. Knowledge may be viewed from several perspectives: 1. a state of mind, 2. an object, 3. a process, and 4. a condition of having access to information. The perspective of knowledge as a state of mind focuses on enabling individuals to expand their personal knowledge and apply it to the organization's requirements. This is the tacit knowledge, which is related to the individuals experiences, cultural values, feelings and insight [8]. In this research paper, this type of knowledge is called local knowledge or knowledge of local people in the disastrous areas. A second view defines knowledge as an object [9-11]. This perspective posits that knowledge can be viewed as a thing to be stored and manipulated. This type of knowledge is the codified, documented, structured and computerized knowledge. It could easily be stored, retrieved and manipulated by the use of respective applications such as DBMS and content management [12]. From the beginning of 1990s, the world has been talking about KM. Recent progress and modernization in information technology have an important role for KM [13]. In past literature, the definition of tacit knowledge as values, believes, personal experiences as well as definition of explicit knowledge as a codified, programmed, and documented knowledge is supported by Nonaka (1994),Alavi (2004), and Johana Salim (2005).

Therefore, in this research paper based on evidences of the past literature, we classified two main categories of knowledge types, namely local (tacit or traditional) and global (international, scientific or technological) knowledge. In the past literature, most of the researchers do agree that the knowledge originates in the human brain [15]. In this research paper, this knowledge is called local knowledge related to the experiences and knowledge of individuals and communities in regard with the disaster. The scientific knowledge which is the knowledge about science and in this study it refers to RFID technology. With the recognition of the importance of KM, researchers have paid increasing attention to KMS [7]. One of the core components of KMS is information technology and in information

technology there are several tools, applications, and systems that make KM to happen. Two vital areas have accelerated the appearance of modern KMS: network technologies and local databases [14]. The raise of networking systems has made it possible to codify, store and share certain kinds of knowledge easier and cheaper than ever before [14]. It is generally agreed by IT practitioners that there exists a continuum of data, information, and knowledge within any enterprise or society. The concept of data and the systems used to manage them began to be popular in the 1980s. Data are mostly structured, factual, and oftentimes numeric. Information, on the other hand, became a hot item for businesses in the 1990s, especially after the Internet web explosion and the successes of many search engines. Information is factual, but unstructured, and in many cases textual. Web pages and emails are good examples of information that often exists in search engines, groupware, and document management systems. Knowledge is inferential, abstract, and is needed to support business decisions. In this research paper, a conceptual model is proposed to address the knowledge capture, knowledge sharing, knowledge integration and transfer. The goal of the proposed model is to use RFID as a technology to identify the victims and the relief aid of the disaster. The proper implementation of RFID system is supported by a suggested oracle database, which is placed in disaster management headquarter and connected by a dedicated network.

3. Disaster management

In the following sub-sections the major concepts of DM are explained and Fig 1 shows the main phases of DM with their concerning KM enablers, initiatives, construct, dimensions and factors [17].

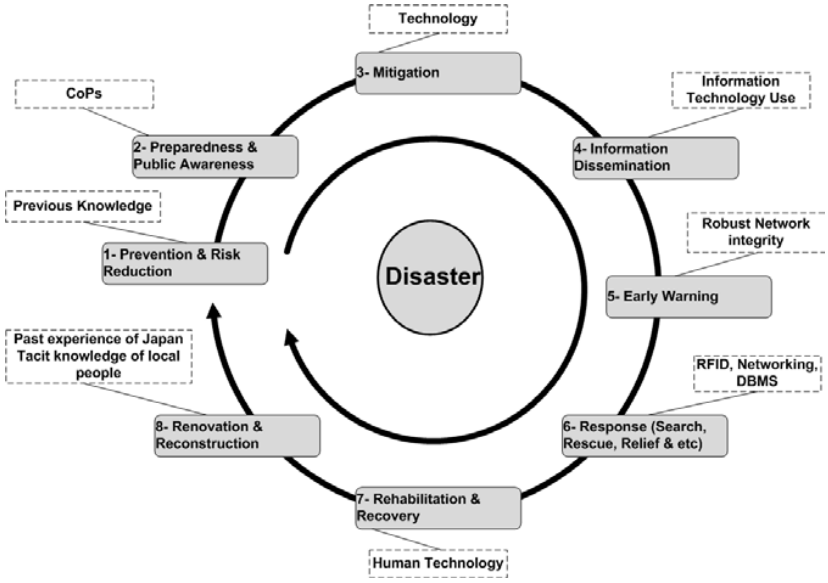

Fig 1. Different Phases of disaster management

3.1. Disaster

All those events that threaten human life and property in a way that needs a quick and emergency action are called disaster. Another definition of disaster is, a serious disruption in the functioning as a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope with using its own resources. Disasters are often described as a result of the combination of, the exposure to a hazard, the conditions of vulnerability that are present, and insufficient

capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human which isphysical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation [16].

3.2. Disaster management

Optimum Planning, Organizing, Directing, Control and the Leadership of disastrous situations are entitled as DM [17]. The proposed model of KMS, which is demonstrated in Fig 2 is composed of three dimensions, including knowledge related to DM. The technology is considered as another dimension to the model to deal with the required tools and applications related to the DM (e.g. RFID, networking, Oracle, DB2, My SQL) [12]. The main technology that is suggested to the DM policy makers is the technology of RFID. The use of RFID in DM and its related issues are discussed in the next section. Another dimension in the model is the human; this is an important dimension in this study, because it is all about human. Thus, in this research paper, the human is assumed to be one of the following stakeholders, including: 1. Victims of disaster 2. Officers in charge (first responders) 3.Managers or policy makers.

3.3. Emergency management

The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular, encompasses preparedness, response and initial recovery steps. A crisis or emergency is a threatening condition that requires urgent action. Effective emergency action can avoid the escalation of an event of a disaster. In reference to emergency management, the aim of this study is to suggest the proper coordination among proposed dimensions and their relationships. Thus, implementation of RFID technology is adapted for identification of casualties and relief aids of any disaster. Furthermore, other information technology components such as DBMS, networking, etc. have vital role in having a successful RFID implementation. In regard to the importance of the human life, there is a need of a systematic and well established system to provide timely and appropriate services to the human with the aim of saving their lives and properties. Therefore, it is suggested that all these dimensions be coordinated under the managerial platform. In this research paper, this platform is called the emergency coordinator center (ECC).

The other dimension which is important for the ECC managers is the knowledge. Thus, to address it properly, it needs to answer the following questions:

- What is the type of knowledge
- What are the sources of knowledge
- How to gain local knowledge
- How to train local people about global knowledge (use of RFID)
- What are the appropriate applications to deal with the KM to the field of DM
- How to share and convert knowledge from tacit to explicit or vice versa

Emergency management involves plans and Institutional arrangements to engage and guide the efforts of government, non-government, voluntary and private agencies in comprehensive and coordinated ways to respond to the entire spectrum of emergency needs [18]. It is assumed that the proper integration of dimensions and related component under a well-established monitoring system (ECC) contribute a lot to save many lives and properties in the disastrous zone [19].

3.4. Response

The immediate and short-term reactions of the disaster-relief community to an emergency situation are called response. It includes search and rescue operations, Medical assistance, and the early provision of food and shelter

for survivors [18]. The existence of the proper system, to have all knowledge to know how to do, what to do, for who to do, help a lot to provide timely and required responses.

3.5. Disaster management cycle

Disaster management cycle is a vital cycle through which the main and key phases of DM are undertaken. As we know there are different phases in DM, which are classified into three main categories, which are as follows:

- Pre disaster Phase
- During disaster phase (which response is also categorized in this category)
- Post disaster phase

4. Types of knowledge in disaster management

4.1. Local knowledge (referred as tacit knowledge)

Local knowledge is the knowledge that people in a given community has developed over time, and continues to develop. Local knowledge is a collection of facts which is related to the entire system of concepts, beliefs and perceptions that people hold about the world around them. This includes the way people observe and measure their surroundings, how they solve problems and validate new information. It includes the processes whereby knowledge is generated, stored, applied and transmitted to others. Localized knowledge is based on experiences, often tested over centuries of use, adapted to local culture and environment, embedded in community practices, institutions, relationships, held by individual or community, and it is dynamic and changing.

Linking community knowledge (Local Knowledge) with modern techniques to record and analyze risk-related data is one way of engaging and mobilizing community's capacity. This paper discusses the use of the RFID at the local level and the need for integrating modern technology (Referred as explicit knowledge) and indigenous knowledge (Referred as tacit knowledge) to minimize losses that result from disaster. It suggests a way to mobilize available human and technical resources in order to strengthen a good partnership between local communities and local and national institutions with the advance technological RFID related knowledge to train local people how to usethe experiences of Japan to use RFID technology in DM, specifically in relation to the earthquakes.

4.2. International knowledge (referred as explicit knowledge)

Learning lessons of RFID in DM, particularly for earthquake from Japan is important to reduce the casualties of the natural disaster. A study published in the International Journal of Innovation and Sustainable Development earlier this year claims that RFID could be used in the immediate aftermath of major disasters, like an earthquake, to help save lives. Several researches show the effectiveness of the RFID, particularly for the identification purposes. In literature, past researches demonstrate the use of RFID in earthquakes to decrease a wide array of logistical challenges such as monitoring evacuees and managing the flow of medical and other relief supplies. Therefore, due to the importance of RFID that many have attempted to apply it in disastrous situation need to be focused on in this study as core part of technology dimension of the proposed model. In the following section, the major concepts of RFID technology are discussed. At the end, conceptual model is proposed to the society which is under serious disaster impact.

5. Radio-Frequency identification

We have perceived that RFID is a strong tool for the DM. To have the most benefit from it, it is needed to know what its advantages are and drawbacks and how to overcome those disadvantages that are discussed in the literature. In the following sections, we discuss RFID briefly. Before having further discussion, in past literature RFID is defined as:

Radio-Frequency Identification (RFID) system is a communication technology to identify tagged objects uniquely by transmitting RF signals. The main components of a RFID system consist of Tags (to identify the concerned objects), Reader (capable of deducting the unique ID of tag and related information from DBMS), and Database (in this research is referred as knowledge based including all needed information and converted tacit knowledge) [21].

5.1. RFID applications

Nowadays, RFID systems play an important role in the human life. Various RFID applications in different areas solve a lot of problems in an easier and faster way. RFID technology can be used in almost all areas and fields of science. The uses of RFID systems such as: Human/Animal Identification, Supply-chain management, DM, Anti-theft Systems, Asset Management, Anesthetic Dosages, Baggage Handling, Blood Banks, Gasoline Dispensing, medical surgeries, Mother Baby Pairing, Museums, Stores Management, Manufacturing, Food safety, Hotel and Resorts, National Identification, Real Time Location Tracking System (RLTS), Retailing, Vehicle Identification, and so on [22] are more popular.

5.2. RFID in disaster management

The information requirements of disaster managers can be analyzed in two categories: Pre-disaster activities and post-disaster activities. The first group mainly focuses on the analysis and research for risk assessment, prevention and preparedness, while the second group is about effective response and recovery. Information technology is currently employed for DM to a certain degree. However, with the emerging Radio-Frequency Identification (RFID) technology, Disaster Management Information Systems present an innovative increment potential in efficiency and effectiveness in response to and recovery of disasters. Regarding the vast applications of RFID systems, when a disaster occurs, RFID can be applied to take advantages of this technology. To add that a proper implementation of the RFID needs a well established infrastructure including a speedy and robust networking system to provide timely connection among stakeholders of the entire system. In addition, oracle as DBMS tool is suggested because of its security level and robustness. Thus, an oracle database in a deductive network in the form of intranet can support the RFID implementation properly [23].

6. Conceptual model

A survey from past literature and our practical working experiences, regarding the importance of RFID effects on managing disaster suggests that we analyze and bring them together and propose the conceptual model. After revising the relevant literature, looking on concepts, dimensions, constructs and other main issues, the model, which can be implemented under DM departments, was proposed. Several studies, in past literature have shown technology as the core part of KMS. Therefore, technology was selected as one of the dimensions of this study. One of the other important dimensions of this study is the knowledge related to the DM. To answer such questions as: what are sources of knowledge about the managing disaster? What is the type of knowledge related in this study? Is it tacit? Is it explicit? Is it global or local knowledge? How to convert local knowledge to international scientific knowledge and vice versa? In addition, it is important to find out how to convert local knowledge to scientific knowledge and vice versa. Finally, the other important dimension of the proposed model is the human, because everything is for human by human. Thus, the role of human, human cultural value toward technology acceptance, human knowledge sharing behavior, his/her participation in overall functions of the ECC should be discussed under this dimension.

In this research paper, the conceptual model which is shown in Fig. 2 was developed by considering few major difficulties such as cost, cultural limitations and networking infrastructure issues. From previous researches, it is found that a suitable cooperation among main dimensions of this model including human, DM and technology could minimize the challenges and result in many advantages such as:

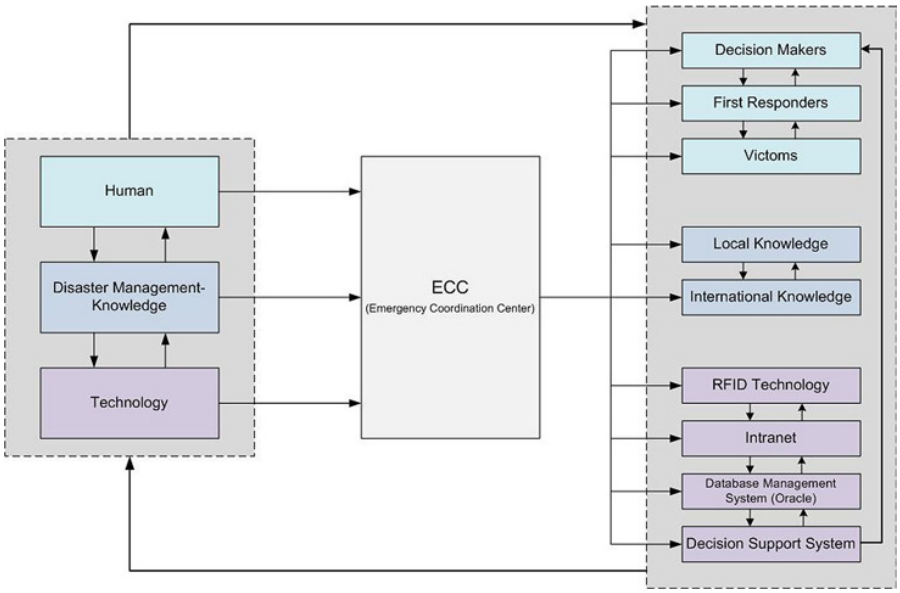

Fig 2. Proposed KMS model for ECC

Advantages of using RFID-based disaster management system:

Pre-disaster advantages:

- Applying different sensors to detect different kinds of disaster to implement pre-cautionary actions and masseurs.
- Providing information for managers for timely and right decisions making in reference to disaster prevention.

During disaster:

- Quick and reliable estimation of the severity, size, level and depths of disasters.
- Monitoring and capturing the evidence from a central unit based on each disaster.

Post-disaster advantages:

- locating the exact location of victims.
- Receiving the victim-based information for better management and decision making in relation to sources
  Limitation:

- Allocation of the aids to needy people.
- Estimation of the equipment, facilities aids and technical personnel for being dispatched to the disastrous site.
- Decreasing and shortening the time of the decision-making process.
- Increasingthe accuracy of decision-making process.

At the end, it worth to mention that Fig. 2 is the conceptual model which needs to be analyzed more, to develop arguments and hypotheses that could make it easy to implement it and find out the validity of the model. In this research, we assume that three factors namely Human, Technology and the Knowledge of DM ,which are shown in the first column of Fig 2, are interrelated with each other and they have direct relationships and effects on each

others. All these three factors are directly linked to the management of ECC which is in the second column of Fig .2. All these factors also have their own attributes which are illustrated in the third column shown in the Fig. 2. In addition, all these attributes or elements are directly connected with the ECC and have relationships among themselves as shown by arrows in Fig.2. Finally, to test relationships of all components of the model proposed in this paper, further research is needed as the model in Fig .2 could be a roadmap in this regard.

7. Conclusion

Finally, as a matter of fact and to conclude based on our experiences, Disaster Management field could have added value by proposing a KMS model to address the important issues of the DM. This study is based on our practical experiences in the DM and literature review of the RFID's importance and implications. To explore more and to find the exact and accurate result; it is needed to conduct a survey on the mentioned dimensions of the model and their relationships. Further time is needed to conduct a data collection and analysis to justify the assumed predictions of the KMS's successful implementation in disastrous situations such as earthquake, typhoon, landslide and flood.

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