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Evaluating User Acceptance Of Automated Emergency Response Systems In Developing Countries Using The Technology Acceptance Model

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***Abstract*—The occurrence of disasters, be it natural or man-made, is inevitable. Mitigating against likely loss of lives and properties is a concern all emergency management professionals aim to address. In developing countries, disaster response operations are largely characterised by manual interventions rather than the use of Information and Communications Technologies (ICT). The implication is late response to distress calls and increased loss of lives and properties. Even where ICT is deployed, it is often difficult to measure the performance of such automated response operations and the level of their acceptance by end users. This informs the use of universally recognised models for measuring the perceived acceptance of such information systems. One such model used and discussed in this article is the Technology Acceptance Model (TAM), which is based on 5 metrics; the Perceived Ease of Use (PEU), Perceived Usefulness**

(PU), Perceived Attitude Towards Use (PATU); Perceived Behavioural Intention to Use (PBIU) and Perceived Job Relevance (PJR). PU measures the system's level of acceptance based on the ease of usage. PEU accesses the level of satisfaction after system is used. PATU assesses how end users respond to the use of the new system in place of currently existing system. PBIU examines the behavioral intention of end users to use the system in place of current system. PJR gauges the relevance of the system as relevant to the job functions of the end users. A structured questionnaire with questions based on these 5 metrics will be designed. Before deployment to end users, its contents will be validated by officials with no direct interest in the new system, preferably some emergency management experts from a different jurisdiction, to ensure no biased reporting. The reliability of this instrument must also be tested using reliability testing tools such as the Cronbach's Alpha Coefficient Test, and with an expected test result at 70% before the questionnaire can be said to be reliable. Using a quasi-experimental research design approach, the population or sample size will be randomly divided into a Controlled Group and an Experimental Group. A pre-test administration of the questionnaire will then be deployed on the respondents in both groups to assess the level of acceptance of the current system, while a post-test administration is repeated only on the Experimental Group after the implementation of the new system. Data collected from the pre-test and post-test questionnaire administrations are then analysed using Descriptive Analysis functionalities of any data analysis software package such as the Statistical Package for the Social Sciences (SPSS). Finally, T-test could be used to test .the data differentials of both test, as to determine which of the old and new emergency response management systems is better preferred by the end users.

***Keywords*—Emergency Response Management System, Technology Acceptance Model, Statistical Package for the Social Sciences, Descriptive Analysis, T-test, Cronbach's Alpha Coefficient Test**

1. Introduction

The occurrence of disasters, be it natural or man-made, is inevitable. Mitigating against like loss of lives and properties and hence the massive loss of revenues is the major concern of all emergency management professionals, that must be addressed.

According to Kapoor (2010), disaster is defined as a serious disruption, occurring over a relatively short time, of the functioning of a community or a society involving widespread human, material, economic or environmental loss and impacts, which exceeds the ability of the affected community or society to cope using its own resources. He further classified disasters into Natural and Man-made disasters, referring to Natural Disasters as being those physical phenomena that naturally occur, and are often caused by rapid or slow onset events such as earthquakes, landslides, floods, drought and wildfires, cyclones, and disease epidemics. Man-made disasters include those events most often caused by human errors, and often occur in or close to human settlements, such as

building collapse, famine, displaced populations, industrial accidents, transport accidents, environmental degradation, pollution and accidents.

According to Stanton, T. H. (2007), depending on the nature of the disaster, failure to successfully respond to an emergency incident can pose severe danger and risk to affected communities at-large and the personnel involved in the emergency response activities. He also stated that, as technology develops and expands in its applicability, there is now a need to create sophisticated systems and organizations for managing systems and the various tasks relating to emergency response operations.

Developing countries are largely characterised by decays in infrastructures, poor traffic networks and unplanned town planning layouts. This is a reason for poor access to incident sites, when emergency response management authorities attempt to manage the crisis. Generally, the first few hours and days after any disaster always have great importance as it affects saving human lives and mitigation of likely consequences. Thus, we now find in many nations such disaster management authorities, statutorily response for ensuring disaster occurrences are quickly nibbled in the board (GAO, 2006).

In most developing nations, emergency response operations are usually of manual interventions, with little use of Information and Communication Technologies (ICT). Benefits of automating such processes include among others, more timely response to disaster situations, availability of critical information for managing impeding crises.

In this article, the Technology Acceptance Model (TAM) is used to evaluate the level of end user acceptance of an automated emergency response management system as compared with a manually operated version.

2. Technology Acceptance Model

The Technology Acceptance Model (TAM) is one of the universally recognised models used to evaluate information systems when implementing them for benchmarking results proved difficult. One such reason for using TAM is when required primary data from existing systems which could have been used to benchmark against generated results of the new system are not available, or when available proved difficult to get from the owners of the current system.

Technology Acceptance Model (Davis, 1989) is one of the most influential models of technology acceptance, with two primary factors influencing an individual's intention to use new technology, namely the Perceived Ease-Of-Use (PEU) and Perceived Usefulness (PU). TAM is an information systems theory that models how users come to accept and use a technology**.**

Users' acceptance of a recommendation technology involves a set of variables regarding the users' experience in the use of the system that are related to the positive aspects of the interaction. User acceptance is a complex concept that goes far beyond having an attractive and easy-to-use user interface, for two systems with identical user interface might be perceived differently by users if, for example, the underlying recommendation algorithm is changed.

According to Davis (1989), people will use an application if they believe it will help them to perform a given task better than when not using the application. Also, even if users believe that a given application is useful, if the application is hard to use, then the perceived benefits of using the application will be outweighed by the effort needed to use it. Hence, he subsequently called the first variable "perceived usefulness" and the second variable "perceived ease of use", leading to the Technology Acceptance Model (TAM), which is an adaptation of the Theory of Reasoned Action (TRA) to specifically deal with the prediction of the acceptability of an information system.

The purpose of TAM is to help predict the acceptability of a tool and to identify the modifications that must be brought to the system in order to make it acceptable to users.

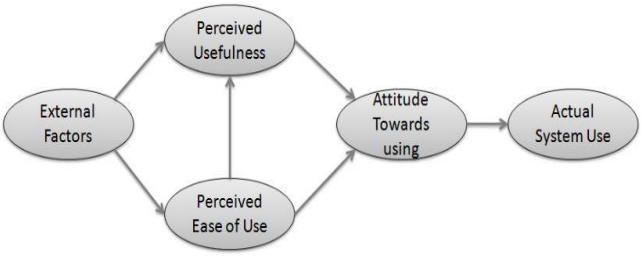

Figure 1: Acceptance Model Technology

(Source: Davis, 1989)

According to Davis (1989), the Perceived Usefulness (PU) is "the degree to which a person believes that using a particular system would enhance his or her job performance". Thin then implies that a system scoring high in perceived usefulness is one for which a user believes in the existence of a positive user-performance relationship. He defined the Perceived Ease Of Use (PEOU) as "the degree to which a person believes that using a particular system would be free from effort". He opined that effort is a limited resource that a person may allocate to the different activities he/she is performing and that if we make all other factors invariable, then a system perceived to be easier to use than another is more likely to be accepted by users.

3. Related Works

Various authors have deployed the TAM concept in evaluating user acceptance of information systems, especially when measuring their performances become difficult. Such works include the following:

Philip Fei Wu (2009), whose study investigated the factors affecting the user acceptance of emergency SMS-based alert system at a large public university in

the United States, based on the research question: *How are different motivational factors related to the intention and behavior of using emergency alert technology?* Using a mixed-methods approach, the study demonstrated a "deepening" effort in applying the technology acceptance model (TAM) to emergency response system, drawing attention to the holistic nature of motivation-behavior in technology acceptance. Results of this research show that: the concept of usefulness has multiple levels of meanings to its intended users; the ease of use is more about the users' ability to control the system behavior; and subjective norm need to be examined with relation to its originating source. Overall, the study establishes a good foundation for challenging new lines of research that more closely examine the motivations and barriers to user acceptance of emergency response technology.

Dwiputranti et al (2019) carried out a study to design an information system to improve the performance of disaster relief operations by managing the information while monitoring and evaluating humanitarian relief operations. They used the Unified Theory of Acceptance and Use of Technology (UTAUT) model to investigate and give a better understanding of the factors that affect the potential users' acceptance and use of the information system. A total of 131 different informants from different groups of potential users were used to measure performance expectancy, effort expectancy, social influence, and facilitating conditions. Descriptive statistics was deployed to analyze the reliability using Cronbach's Alpha, the validity by measuring the Confirmatory Factor Analysis (CFA), and also Structural Equation Modelling (SEM). Their results showed strong relationships between these four aspects of the measurements for the acceptance of all parties involved in the humanitarian relief operations. Specifically, the findings indicated that Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC) are latent variables, and all these variables affect the Behavioural Intention (BI) of all the parties who may use the information system in humanitarian relief operations. In conclusion, Effort Expectancy (EE) was found to be the most dominant variable that affects the behavioral intention, as it has the highest coefficients compared to the other variables.

Prasanna and Huggings (2016), in their effort to expand the knowledge base of the technology acceptance model (TAM) and close this gap in literature, adapted and integrated existing models of technology acceptance by examining how a range of technology acceptance factors could affect the acceptance of emergency operations centre information systems. They examined the relationships between several of these factors, and analysed questionnaire data from 383 end-users of four different emergency operations centre information systems using structural equation modelling. The analysis concluded that technology acceptance factors of performance expectancy, effort expectancy, social influence and information quality explained 65 percent of variance in symbolic adoption, which is a combination of mental acceptance and psychological attachment towards an information system. A number of moderating effects of age, gender, experience of use and domain experience were also identified. A mediating component, of performance expectancy, explained 49 percent of variance between facilitating conditions, information quality, effort expectancy, and resulting symbolic adoption. Their findings hence highlighted a need to re-focus technology acceptance research on both mediating and moderating effects and the importance of considering domain specific factors. Applied recommendations were also made, for successfully implementing relevant information systems.

4. Implementation Approach of the Technology Acceptance Model

To use Technology Acceptance Model (TAM) in measuring the perceived acceptance of an information system by its end users, a structure questionnaire will be designed based on 5 performance metrics, the Perceived Ease of Use (PEU), Perceived Usefulness (PU), Perceived Attitude Towards Use (PATU); Perceived Behavioural Intention to Use (PBIU) and Perceived Job Relevance (PJR). PU measures the systems/'s the level of acceptance based on the ease of usage. PEU accesses the level of satisfaction after using the system. PATU assesses how the end users respond to the use of the system in place of current system. PBIU examines the behavioural intention of the end users to use the system in place of current system. PJR gauges the relevance of the system to the job relevance of the end users.

Before deployment to the end users, the contents of the questionnaire must first be validated by some independent emergency management experts with no personal interest in a planned automated system, preferably experts from a different jurisdiction, to ensure no biased reporting. In addition, the reliability of this instrument must be tested using tools such as the Cronbach's Alpha Coefficient test, and with an expected test result at 70% before the questionnaire can be said to be reliable.

To assess the acceptance level of both the existing and new system, a quasi-experimental research design approach could be used, such that the available population size or sample will then be divided into a Controlled Group and an Experimental Group. Subsequently, a pre-test administration of the questionnaire will be deployed on the respondents in both groups to assess the level of acceptance of the current emergency response management system, and also a post-test administration repeated only on the Experimental Group after the implementation of the new system.

Data collected from both pre-test and post-test questionnaire administrations are thereafter analysed using the Descriptive Analysis functionalities of any

data analysis software package such as the Statistical Package for the Social Sciences (SPSS).

Finally, T-test could then be used to test .the differentials of both test administrations, to help determine which of either of the current or new emergency response management system is better preferred by the end users.

5. Conclusion

Using the Technology Acceptance Model to evaluate the level of end user acceptance of a developed information system is a standard practice used when data for benchmark comparison of outs from both systems prove difficult to obtain. Often, results of deploying the TAM-based questionnaire could be subjective to the extent of the scope of jurisdictions for implementing the new system. It is therefore suggested that a repeat of the implementation of the new system in a different environment and subsequent comparisons of the results of the descriptive analyses will help to offer a better conclusion of its acceptability.

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