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Factors influencing the success of information systems in flood early warning and response systems context

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ABSTRACT

Flash flood is a natural disaster that often occurs after heavy rain, and it is getting more common nowadays. The flood early warning and response system (FEWRS) can be installed to minimize the level of damage and the number of casualties due to flood by providing accurate and reliable flood data. Unfortunately, the existing number of studies detailing on the factors affecting the efficiency of FEWRS in flood disaster is quite limited. The above issue is addressed in the current work, which involves conducting a comprehensive literature review on the factors that drive the effectiveness of information systems (IS) in FEWRS. The current analysis was based on the Wymer and Regan's standards. From the 66 factors identified from the previous studies on IS adoption, the most significant factors affecting the effectiveness of FEWRS are: system quality, information quality, user satisfaction, service quality, use, perceived usefulness, intention to use, net benefits, perceived ease of use, compatibility, user experience, relative advantage, complexity, perceived risks, educational quality, and confirmation, these factors can be constructed to the success model to address the effectiveness of FEWRS in disaster management.

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1. INTRODUCTION

Flood is a natural phenomenon caused by earthquakes, tsunamis, hurricanes, etc. [1, 2]. The rising number of flash floods has endangered the lives of villagers along the river bank due to urban modernization. Over the last two decades, flash floods have become more frequent and damaging [3], due to the climate change (greenhouse effect) [4]. It is estimated that a global loss in major coastal cities due to flood alone could exceed $1 trillion per annum by 2050 due to flood alone 2050 [3], building dike can mitigate the amount of flood damage; however, construction work can be expensive. The level of risk due to flooding is currently more severe now than that of other weather-related disasters [5], as more casualties are anticipated in the former. Previous studies have shown that structural engineering strategy alone cannot overcome flood hazard completely. Annually, the number of victims due to floods is increased. Hence, the significance of the flood early warning and response system (FEWRS) is a crucial in-flood risk. In this context of the study, it

is necessary to address the factors that contribute to the success of FEWRS in the system to improve the efficiency and effectiveness of the system [6]. Although the FEWRS has been established in which its reliability is guided by the quality of information, degree of knowledge-sharing culture, and efficacy of communication but still not dramatically efficient to those in danger. This non-structural method is assumed to help reduce the expense of flood control and the number of casualties [7]. In developing countries including those in Asia, the population level is comparatively high in the area of flood-prone rivers. Unfortunately in these countries, the potential for FEWRS is very small. Undoubtedly, the precise forecast of water movement dynamics of flood-prone areas is essential to the creation of a successful flood alarm and flood control plan. Over the last 3 decades [8, 9], Many mitigation measures (i.e programs designed to inform people about potential hazards, disaster preparedness plans, and legislation designed to limit risk by building standards) have elements of local public goods in that they provide benefits to a community as a whole. In fact, local governments play an important role in the mitigation flood risk as

The FEWRS is essentially a part of information system (IS) that can be used to minimize the risk due to flood [10]. FEWRS is used to provide instant flood information using the signal transmitted by early warning centers. According to Sättele *et al.* [11], there are three stages of flood disaster, i.e. pre-disaster, during-disaster, and post-disaster. These stages should be considered in the design of FEWRS. Of course, advance warning and pre-planning measures can be included in FEWRS to further reduce the level of damage due to flood. The advantage of IS that can deploy on the model of FEWRS will provide information on the factors affecting the success of the FEWRS. According to Baudoin *et al.* and Meyer [8, 12], information-based disaster tool such as FEWRS can be adopted to forecast and to provide recommendation to decision makers on natural disasters based on factors that contribute to the success of FEWRS [8, 13, 14]. Hence, information-based disaster tools should be able to predict the likelihood of a disaster and to provide ample time for evacuation purpose. In fact, existing FEWRSs are unable to provide information on natural disasters effectively [7, 15], and they are ineffective in mitigating flood disasters during pre-disaster, during-disaster, and post-disaster stages [16, 17]. To this end, IS academicians such as Baudoin *et al.* [8] argued that information system is useful for improving the efficiency and the effectiveness of disaster-handling activities. IS success becoming a significant problem in the IS sector. Many experiments have sought to clarify whether an organization succeeds, but what is most important for us is to consider how an IS influences organizational success. Therefore, factors affecting the effectiveness of FEWRS should be properly studied; however, the factors on this area is rather limited. A model should be developed to address the factors affecting the system's effectiveness and to evaluate the effectiveness of FEWRS [3]. The current systems are ineffective in reducing the impact of flood disaster [2, 18], mainly due to the lack of information on the factors that contribute to the success of these systems [19-25].

In this paper, the success factors affecting the FEWRS has been addressing since there are limited study focuses on this issue, the success factors help the disaster management to evaluate the system of FEWRS easily and the weak of the design of the system. Many IS models have been developed to predicting and explaining the user behavior in IS field. As such, these factors can be constructed to the success model to address the effectiveness of FEWRS in disaster management. For instance, the popular IS success model is the one proposed by DeLon & McLean (D&M) [26]. The D&M model is built by assuming that the overall system use is an indication of IS success [27], which is supported by other researchers. In such a study the issue of how we assess success is important. In 1992 William H. DeLone and Ephraim R. McLean [26] developed their first IS success model to be able to recognize and measure IS success in an e-commerce context.

Centered on a taxonomy that incorporates all the multiple metrics used to determine IS success in the IS literature, their model aims to explain how each of the suggested dimensions of IS success is linked to each other. Assume that the e-commerce environment is a specific setting for analyzing the success of DeLone and McLean's IS model, as the system itself is important for the market, without it there will be no company-customer relationship. The system is therefore not unique to the organization; it serves the client in its main application, not corporate workers. Finally, the website's features are standard, easy to interpret, and match the various dimensions of the DeLone and McLean models. Their model offers a point of starting from which to develop and improve all the further work. Researchers have shown strong interest in this model, as cited in over 300 publications aimed at explaining IS success [26, 28]. This study has been selected 16 factors form the previous study which in an IS success field to help the researchers in selecting the most relevant factors to apply in the FEWRS model [29].

2. RESEARCH METHOD

The primary aim of this study is to incorporate the most crucial factors affecting the effectiveness of IS in context of FEWRS model. In order to meet this objective, literature review on IS success adoption is conducted. The factors affecting the effectiveness of IS are taken from Hong and Kim [30]. The first step is to identify all the relevant factors. From the literature review (40 papers), there are 66 factors as shown in

Table 1 reported to date. The exclusion/inclusion criteria have been developed for the selection process. Only articles published from 2014-2019 are included in the search criter

The second step is to reorganize and alphabetize the factor, consolidate them and eliminate those repeating factors defined with different terminology. Then, the collection of unified factors was defined. This will subsequently map to the data of all authors who examined those variable and excluded the factors contained in the list at the individual level. Finally, a total of 16 factors are classified based on the frequency appeared in the literature and the relative importance of the research findings are subsequently reported.

Table 1. Factors extracted from the literature

Factors	Sources	F*	Factors	Sources	F*
System Quality	[19, 21-23, 27, 31-53]	29	Focused Immersion	[48]	1
Information Quality	[21-23, 27, 31-54]	28	Knowledge of Data Science	[47]	1
User Satisfaction	[19, 21-23, 27, 31, 33-40, 42-44, 48, 51, 53, 55-57]	26	Social Norms	[47]	1
Service Quality	[19, 21, 23, 27, 31-43, 46, 50, 51, 55, 57]	23	Stickiness Intention	[34]	1
Use	[19, 21-23, 33, 37, 40, 44, 45, 48, 50, 51, 57]	13	Behavioral Control	[47]	1
Perceived Usefulness	[19, 27, 33, 36, 37, 39, 45, 48, 49, 55, 56]	12	Computer Web Skills	[55]	1
Intention to Use	[19, 27, 31-33, 35, 38, 41, 42, 46, 47, 55]	12	Habit	[23]	1
Net Benefits	[22, 31, 33, 36, 38, 39, 44, 47]	8	Referent Network Size	[45]	1
Perceived Ease of Use	[19, 35, 48, 49, 55]	7	Flow	[45]	1
User Experience	[35, 36, 50]	3	IS Project Success	[40]	1
Compatibility	[52, 53, 58]	3	IS Utilization	[54]	1
Perceived Risks	[23, 55]	2	Perceived KMS Output Quality	[56]	1
Relative Advantage	[52, 53]	2	Goals	[54]	1
Complexity	[52, 58]	2	Challenges	[54]	1
Educational Quality	[19, 35]	2	Extrinsic Rewards	[56]	1
Confirmation	[23, 48]	2	Organizational Trust	[56]	1
Transformational Leadership	[21]	1	Attitude	[42]	1
Performance Impact	[21]	1	Management Support	[43]	1
Decision Making Process	[32]	1	Compatibility	[43]	1
Trust in Sellers	[57]	1	Perceived Behavioral Control	[43]	1
Trust in Website	[57]	1	Complexity	[43]	1
Reputation of Sellers	[57]	1	Individual Impact	[43]	1
Reputation of Website	[57]	1	Organizational Impact	[43]	1
Perceived Size of Sellers	[57]	1	managerial IT Capability	[59]	1
Perceived Size of Website	[57]	1	Technical IT Capability	[59]	1
Perceived Value	[34]	1	Relational IT Capability	[59]	1
Effort Expectancy	[27]	1	Cloud Success	[59]	1
Trust Government	[36]	1	RL Cost Effectiveness	[54]	1
Temporal dissociation	[48]	1	Social Influence	[33]	1
Relationship Commitment	[34]	1	Trust in E-government Website	[36]	1
Organizational Results	[51]	1	Firm Performance	[59]	1
Perceived Complementarity	[45]	1			
Adoption Intention	[49]	1			
Focused Immersion	[48]	1			
F* Frequency					

3. RESULTS AND ANALYSIS

In this This section presents the findings of this study. Many decision makers are unable to get the best return from FEWRS due to the lack of comprehensive understanding of factors affecting the effectiveness of IS in meeting the requirement of FEWRS. The most crucial factors affecting the effectiveness of IS in disaster management are sought in this research. As stated earlier, a total of 66 factors have been extracted. Table 2 shows the most popular factors. As seen, there are sixteen popular factors affecting IS adoption [6, 19, 21-23, 27, 31-43, 46, 50-53, 55, 57].

From Table 2, the information quality and the system quality are the most important factors. These factors determine the successful adoption of IS in both individual and organization levels. In literature, different terminologies are used to address the same factor. For instance, terms such as net benefits [51], success of IS [21], and technology characteristics [60, 61] have been used to describe the system quality along information quality. Also, the term compatibility has been used to describe the compatibility of human characteristics in using IS [60].

Table 2. Most popular success factors

Factors	Sources	Factors	Sources
System Quality	[19, 21-23, 27, 31-53]	Perceived Ease of Use	[19, 35, 48, 49, 55]
Information Quality	[21-23, 27, 31-54]	Compatibility	[52, 53, 58]
User Satisfaction	[19, 21-23, 27, 31, 33-40, 42-44, 48, 51, 53, 55-57]	User Experience	[35, 36, 50]
Service Quality	[19, 21, 23, 27, 31-43, 46, 50-53, 55, 57]	Relative Advantage	[52, 53]
Use	[19, 21-23, 33, 37, 40, 44, 45, 48, 50, 51, 57]	Complexity	[52, 58]
Perceived Usefulness	[19, 27, 33, 36, 37, 39, 45, 48, 49, 55, 56]	Perceived Risks	[23, 55]
Intention to Use	[19, 27, 31-33, 35, 38, 41, 42, 46, 47, 55]	Educational Quality	[19, 35]
Net Benefits	[22, 31, 33, 36, 38, 39, 44, 47]	Confirmation	[23, 48]

4. CONCLUSION

The flood hazard mitigation technique mainly involves the use of an engineering approach which could be costly and challenging. For example, it is difficult to find suitable areas for constructing dikes. Apparently, the risk due to flood is more severe than those due to other types of natural disasters, as excessive urbanization has led to global climate change inevitably. The FEWRS is one of the non-structural examples introduced to reduce the risk of flood hazards. The main aim of FEWRS is to save lives and to reduce the level of flood damage. However, due to information lacking, the implementation of FEWRS is still unsuccessful. To address this gap, factors affecting the success of FEWRS are identified. Information system success is one of the most crucial creations in the history of IS [26]. In most cases, organizations using FEWRS find that it is challenging to evaluate the effectiveness of these systems, as practical understanding on how quality factors are related to the use of information within the systems is rather limited. Factors such as quality, information, service, and use are commonly evaluated [23]. The goal of any information system is to improve job performance, in which improvement is only visible when a proper IT system is used.

This paper has comprehensively reviewed the existing IS success adoptions, which can help researchers to identify relevant adoption factors in the context of FEWRS. The findings of this study should have a significant effect on researchers dealing with IS. This research may be expanded by identifying the conditions most commonly followed by scientific analysts and practitioners to influence the success of the FEWRS. Such chosen factors will then be used to formulate a computational model for tablethe performance of FEWRS.

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