Agile information-based framework for flood management

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Abstract. Flood management is another area of a complex environment where the managing process is extremely complicated. This is due to the uncontrollable aspects arise during the event including flood status, agency responsibilities, media coverage, and other unexpected activities. While the execution process taking place, the accuracy of the Standard Operation Procedure (SOP) implementation is worrying about the management. Researchers in the area of flood management have shared common worries concerning on execution of flood management plans which are (1) poor learning curve of matters pertaining to the handling of floods; (2) poor management of after-the-flood and (3) complexities of risk analysis and assessment related to the flood. Therefore, the objective of the study is to improve exiting SOP in terms of agility over its governance that needs to be revised for better planning and preparedness while dealing with flood disasters. Hence, an Agile Information-Based Framework for Flood Management was proposed as a solution to justify the concerns by using thematic analysis methodology from the data gathered via interviews, document studies, literature reviews and site visits.

1. Introduction

Flood management is a vital mechanism involving strategic coordination since every flood catastrophe differs in nature. This has been confirmed by researchers that expressed the same concern regarding flood control problems within the same domain [1]-[2]. Several mitigation processes have been implemented by the government to control and minimize the impact of the flood. These encompassed flood mitigation initiatives undertaken under the Department of Irrigation and Drainage including the construction of flood plans, cantilever walls, tidal barrages, and tidal gates. In term of law and legislation, federal and state-level flood controls are structured to mitigate flood events, including the National Land Code 1965 to ensure enforcement by States with the Land Code that requires flood prevention the Water Act 1920 to guarantee river protection and flood control arrangements, and Drainage Works Act 1954 that enable Department of Irrigation and Drainage (DID) to develop, control and support drainage systems designed to avoid flooding [3].

The key instrument for offering guidelines on controlling the possibility of floods in Malaysia is Directive No. 20. Nevertheless, the Directive provided by the National Security Council (NSC) is a high-level manual that deals with emergency prevention in a very broad context [4]. Meanwhile, academics in Malaysia have made strides in strengthening flood risk prevention through the use of
technologies contributing to supports like the Web-based community disaster management and awareness system (CEMAS), WiPNET Wireless Sensor Network Based Slope Monitoring System, Early Warning System (EWS) and the Kemaman Integrated Flood Disaster Management System [5]-[8]. Hitherto the soft scopes of flood control, which involve governance, management, operating procedure, and process, are critical to be improved as supporting technologies.

This study is exclusively aimed at enhancing the flood management mechanism by raising resilience tailored to the chaotic, complex, and special existence of flood events due to the lack of flood-related governance activities.

2. Problem Statement

The unpredictability of events and incidents, time constraint, pressure from media, operational demand, interagency conflicts, and technological limitations are the factors which contribute to the complexity of the environment in flood management. Complexity management needs both discipline and agility, where discipline is the foundation of a productive effort, and agility is the counterpart of discipline, strength, the release of agility, and invent [9]. Agile is an alternate approach that differs from the conventional process, such as the waterfall paradigm employed in a framework for software development and system development. This idea has been established and implemented in an unpredictable, constantly changing environment, because user requirements always changing. The aim is to support developers and engineers to cope with unexpected problems before, during, and after production due to regular adjustments [10].

Sharing the similarities of complex environment characteristics, agile appears to be another means of addressing a tragedy, particularly in Malaysia, while juggling the complexities of this constantly changing climate including flood management. Researchers in the area, including an article written by Marie, Matthew, Rameez, & Tony [11], have also discussed the idea of an agile approach for disaster management. Agile in this content is the complement to the practice that utilizes experience and history to respond to the current situation in order and react, change, and take advantage of unforeseen opportunities. However, the agile method as a potential solution for the control of flooding is not analyzed in-depth [11].

Along with the development process, Control Objective for Information and related Technology (COBIT), a generally recognized IT policy system and best practices, has been examined for future adoption into the development of the framework. COBIT discovery could lead to a potential framework in which Flood Management (FM) governance may be fashioned (Marini, Mohammad, Azizah, & Noor, 2013). COBIT, which has been well-accepted in the business environment as a potential mechanism for handling and monitoring information and infrastructure vulnerability in a complex business enterprise, may tend to be beneficial in the application of areas other than the business environment that includes flood management [12].

3. Methodology

For this research, a single case study was implemented by gathering pertinent information from interviews, document studies, literature reviews, and site visits at Electricity Supply Industry (ESI) as well as Land and District Office that share similar phenomena in different environment. As flood catastrophe is a complicated problem, case study analysis is the best approach that enables uncertainty to be discussed and appreciated when working with other parties. The collected data has been evaluated using a thematic coding approach to classify patterns of issues. The thematic analysis is the qualitative paradigm-based approach where data obtained would subsequently be interpreted on the basis of the theme. The thematic approach makes a more robust process with considerable benefit considering the complexity of research, implying that it does not fall within the theoretical context. To establish the theme and pattern from the information gathered during interview sessions and document study, the thematic analysis was performed to the transcription of the data. Based on the real flood catastrophe and COBIT framework the initial code was first created. The code must then be updated to determine the correct pattern, which would generate themes from the collected information. From the
generated theme, then, it will be used as the agile process in the development of the actual framework (Figure 2) while adopting the agile key values from document studies.

On top of that, an agile flood management conceptual framework (Figure 1) was established to guide the development of the actual framework (Figure 2). The conceptual framework is employed to obtain the basic principles of constructing the ideas, which will result in the comprehensive framework of discipline at the end of the study.

Figure 1 demonstrates the basic concept and serves as the principal in the development of the actual framework. The concept is to preserve the SOP and Fixed Operation Regulation (PTO) utilized by every agency, as the documentations are not advisable for adaptation to agility. However, agile key values will serve as an idea on the development of the agile process under management and governance activities that concentrating on the execution process.

The research has produced key values for areas that include essential elements in current flood management, local and international flood management, information of COBIT principles, and agile methods (Table 1). These key values enable the stakeholders in flood management to understand and incorporate the full practice and success stories of COBIT concepts in the IT sector, with regard to educating the community in flood management.

Specific analyses of agile key values in system development were established for the first time to tabulate key values from different areas of study. The based key values have been identified, constructed on similarity elements highlighted in different articles. Table 1 summarizes all the main key values that have been explored in various fields of study. Data from the table has been evaluated in detail and relation has been formed between the key values.
### Table 1. Key values from each area of study

| Area of Study | Key Values |
|---------------|------------|
| Malaysian Practices | Skilled workforce | Procedures | Centralize control | Technology Support |
|                | Communication | Collaboration | Coordination | Local Heroes |
| Disaster-Related Framework | Quick Respond | Building Resilience | Promoting local solution | Fostering inclusion |
| Potential Governance Solution (COBIT Framework) | Principles, Policies, and Information | Process | Organizational Structure | Culture, Ethics, and Behavior |
|                | Services, Infrastructure, and Applications | People, Skills, and Competencies |
| Agility Concept | Small project | Clear communication | Reassigning decision power | Social interaction |
|                | Skilled workforce | Master rule | Upper management concerns |

### 4. Result and Discussion

The study conducted on the agile concept, flood management, COBIT Principle’s, and global disaster framework, has resulted in an Agile Information-Based Framework for Flood Management as an alternative for dynamic planning. Two key suggestions on effective disaster management implementation will justify the study. They are:

1. Some elements need to consider complex circumstances. It acknowledges that the situation, and the disaster context, is unique, may differ depending upon the situations and can change over time. Accordingly, during implementation adaptive approaches are needed. Such elements are defined in the proposed framework under the "Agile Process."

2. To ensure the consistent and orderly performance of certain tasks such as the procedure when shutting down a sub-station service, a strict standard must be maintained (where flexibility is not permitted). Every disaster agency needs a lean and transparent SOP. To control the consistency of the system implemented, a systematic SOP for this specific form of disaster management is therefore necessary.

Consequently, the implementation of an agile approach into flood management might need a better study for a better understanding of the management process over its implementations. This is due to several aspects that seem to be unproductive to an agile approach for example, every type of management and administration practice would have defined a SOP to be used as a guideline. This rule will be quite specific to the limited part of the project. Thus, this form of documentation did not require agility, even when it comes to implementations. As a consequence, the conceptual framework (Figure 1) has been influential in creating the Agile-Based Information Framework for Flood Management (Figure 2) by preserving all the documentation that has been developed to manage the quality, recognized as performance management in the actual framework, and another side is allowing for flexibilities to the implementation aspect that have been addressed by agile management & governance. Figure 2 below is the proposed Agile Information-Based Framework for Flood Management adopting the COBIT Principles as a part of the critical element in the developed framework.
From a general perspective, the framework has been divided into two sections which are Performance Management and Agile Management & Governance where both are reflected the two key suggestions as highlighted above which are covering the non-productive (manage quality) and productive (agile process) of agile implementation on flood management. The two sections provided their obligations to ensure this framework corresponds to the functions. However, while the agility is extended to the execution of the process, the SOP must be carefully supervised to preserve and increase the quality of the activities. The immediate subdivision will address two main sections laid out in the Agile Information-Based Framework for Flood Management.

Figure 2: Agile information-based framework for flood management
4.1 Performance Management
The performance management is measured based on the consistency of systemic monitoring, like SOPs and PTO implemented at ESI. The SOP is a guide intended to aid in carrying out activities, including flood control, with more organized administration. Every Malaysian organization uses government-set SOPs for the management of disasters like floods. The SOP is designed to control the performance of an activity being done to make it more effective and efficient, thus delivering outcomes that favor both parties. Every organization will have PTOs or SOPs posted at an entity level on the basis of the requirements set out in the SOP by the Government to allow for effective transition and management process. This is critically needed as every organization has different function including the ESI company in disaster management. The procedures outlined at the ESI company level are more comprehensive and it highlighted the nature of the disaster and the various layers of management that have been done similarly with the other existing common SOP.

4.2 Agile Management & Governance
Agile management and governance were split down into several parts to render every operation is convenient and quick to be executed at any stage. It is designed to maximize performance and boost productivity and quality. The main agile process was divided into four categories which are (1) Risk Management, (2) Information Sharing, and (3) Education while (4) Knowledge is the key player to serve for the overall agile process.

4.3 Knowledge
Knowledge comprises an understanding, perception, and comprehension of someone or anything such as the facts, information, explanations, or skills gained through perceiving, finding, or learning by experience or education. Knowledge may apply to a topic in theory or practice. In disaster management, knowledge here refers to someone who has knowledge and experience in disaster management related specifically to flood control.

4.4 Risk Management
Risk management is one of the most important aspects of how to reduce risk. Among the measures taken to control disaster risk include flood mitigation initiatives, various laws and legislation, standard operating procedures, and several forecasting warning systems. However, in agile practices over the other complex environment, there is another aspect of risk management that close to flood risk control which includes quick response, transformational leadership, and small project management.

4.5 Information Sharing
Information sharing is one of the core pillars in agile governance and strategy and must be an organizational tradition. This culture, however, is not as easy as expected as not all agencies want to share their information and knowledge since it is very valuable for the agencies. In agile management, however, communication and coordination between agencies are extremely necessary. The use of technology and innovation will make communication and coordination faster and more efficacious between organizations. The aim of sharing information is to increase awareness so that action is taken based on information obtained. This also teaches people to use technology to reach the highest management and governance level possible.

4.6 Education
In this context, education emphasizes exposure and awareness in flood management. This is because education plays a significant role in delivering practical flood management awareness and experience. The cognitive theory is stressed because it requires the ability to obtain information, perceive, gain insight, express opinions, understand, preserve, and rethink. The primary objective is to help an individual to learn new resources, information, or new skills. Therefore, formal and informal learning
and training, including observation, hearing, and action should regularly take place in a variety of senses to make knowledge and skill more effective. A variety of considerations must be emphasized to obtain knowledge in agile flood management, including the participation of the local community as well as systemic practices and preparation in overall flood management and implementation. This is because there are only people who have experience with previous flood control or local people who engaged in flood control available with the body of knowledge.

5. Conclusion

In conclusion, the framework aims at monitoring and mitigating disaster consequences due to human actions or natural phenomena. Under existing flood management procedures, an agile framework will be incorporated due to the difficulty of scalable flood activities. The Framework is therefore designed to focus on agile key values that permit flexibility changes in management procedures to improve ESI flood management effectiveness and efficiency. The framework is intended to function in conjunction with the current disaster situation as a guideline that enables complex process improvements to be made.

A multi-domain analysis of the agile core values to be implemented in flood planning led by the theoretical model was successfully conducted with various constraints. However, there are numerous limitations should be investigated to improve the proposed framework included a thorough analysis of an agile feature in other complex fields such as hospital control, aircraft accidents, the collapse of buildings, and other related areas. It will improve the findings and implementing the proposed framework on various types of geography and topology at ESI would provide better information and improvements to the framework.

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