Affecting factors on perceived usefulness of area-business continuity management: A perspective from employees in industrial areas in Thailand

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Abstract. The 2011 Thailand Floods heavily impacted 7 industrial complexes, in which 56.7% were Japanese companies. Many notable companies received severe damage until they had to cease their production. Area Business Continuity Management (Area-BCM) implemented in Thailand stems from this disaster which causes both private and public sectors to think about their business sustainability. The Area-BCM project is an on-going implementation in Thailand aiming to enhance collaboration among stakeholders in industrial areas for coping with upcoming threats. One of the most significant factors before launching a plan is to understand individual attitudes and perceptions pertaining to the Area-BCM project for the best practice, effective and continuous outcomes. This study aims to investigate various factors that affect the perceived usefulness (PU) about implementing Area-BCM. Our proposed research model is developed aligning with the behavioral model and factors influencing flood mitigation consisting of Subjective norms, Experience, Worry about flooding, and Flood hazard knowledge. Questionnaires were distributed to employees in the industrial areas which were flooded in 2011. The developed model was tested by Partial Least Square Structural Equation Modeling (PLS-SEM). The results consequently show that subjective norms and flood hazard knowledge significantly influence perceived usefulness. This can be implied that, in an organization, major thoughts of related people could shape individual perceptions about using a disaster management
plan. Moreover, the governmental and local authorities should be a significant force, that helps support plan implementation and educate people about disaster knowledge.

1. Introduction

The impact of natural disasters drastically damage and affect people’s lives around the world. It also affects the world economy causing an economic recession. Thailand encounters many disasters such as floods, drought, and extreme temperatures. However, disaster management; preparation, response, recovery, and mitigation; is not well provided. Thailand’s massive flood in 2011 is one of the biggest floods that impacted household, agriculture, and industry sectors. 7 industrial areas in Ayutthaya were tremendously impacted, especially Rojana and Nava Nakorn industrial complexes. Many reputable companies especially automotive manufacturers, are located in these two areas. Factories were inundated and their operations were temporarily suspended. For example, Honda stopped its production and spent over 174 days to recover from the flood impact. The flood interruption did not only impact the local or domestic economy but also the global level and many other businesses worldwide. World Bank estimated that GDP growth decreased from 4.4% to 2.9% which the economic sector created losses of around USD 46.5 billion [3]. Due to this severe flooding, the Thai government had proposed strategies and measures towards flood prevention and water management at local levels. For example, they conducted river dredging, dike, water gate, and others. The Japanese government has also participated in helping Thailand create prevention strategies and execute those plans. For instance, The Japan International Cooperation Agency (JICA) established a flood management plan of the Chao Phraya River and provided technical assistance by helping upgrade infrastructure.

Area Business Continuity Management (Area-BCM) is beneficial to many organizations. The project enables them to continue their operation or have a rapid recovery in emergency events. The project also aims to prevent upcoming threats, extend a coping capacity, and mitigate impact severity. Thailand’s flood in 2011 discloses that disaster management and coping capacity of many organizations were limited as there is no collaboration between private and public sectors in the area. Therefore, Area-BCM is an essential plan which can enhance managerial capacity in industrial parks and organizations in all countries. Area-BCM is expected to be implemented in industrial areas in Thailand. This is the collaboration among Thailand-Japan institutes, private and public sectors. The project concept involved with sustainable development goals highlights 3 major issues including technology, social science, and life & well-being science. The developed system will cover business impact analysis, development of accurate flood model, and online sharing system. To persuade stakeholders and let them perceive the knowledge of this plan, this research examines a perception in each person. Surveys relevant to users should provide a question that could examine employees’ understanding and opinions about Area-BCM.

Since there are only a few organizations implementing the Area-BCM plan or understand it well, everyone in the area should realize and correctly conduct their personal duty during a disaster situation for the plan’s effectiveness. Moreover, we would like to know willingness and intention to participate in the project. Thus, the perceived usefulness of Area-BCM is important as it can increase awareness in people and encourage them to take action. Consequently, the study focuses on investigating factors that affect the individual perceived usefulness of Area-BCM. The initial research groups are employees from the companies in industrial areas who have experienced a flood. The questionnaire was distributed through a paper-based and online platform. The research highlights the 5 essential factors that will persuade people’s behavior to respond to flood management plan. Furthermore, other information about the flood situation was asked as well. The proposed research and its structural models were tested in conformity with reliability and validity by the PLS-SEM method. The literature review is described in Section 2, following by research model and hypotheses. The research methodology is described in section 4, the significant results in Section 5 and discussion and conclusion are in the final section.

2. Literature Review
2.1. Area-Business Continuity Management

The disruption of business operation from disaster showed us tremendous losses in economics side. Thailand flood’s 2011 is the one of obvious examples that affected from local to global level. Recovery to the normal situation required long-time. It indicated many companies did not well prepare for unexpected events. In addition, it is caused by damaged machinery, insurance claims, loss of supplies, ruin transport routes, and so on [4]. Because of transportation and logistics, many industry complexes had been nearly located to the river and coastal areas which are vulnerable to face natural disasters such as flood, tsunami and coastal erosion. Therefore, risk and disaster management are needed. BCM and Business Continuity Plan (BCP) was standardized as ISO22301 [5]. These could support for enhancing resilience with an effective response to disaster. The framework includes how to respond and recover in emergency case for the individual company. Especially, it aims to achieve business continuity by considered the prioritized business' activities and essential resources [5]. Even though, results from implementing BCP/BCM showed reduced damages and rapidly restore business operation [4]. There are a small number of private companies who are interested in them. Without external problems, implementing individual BCM may be efficient to maintain the operation and resources. However, impacts on transportation routes, public utility, infrastructure, etc. are over control of the individual company. Then, BCP/BCM could become insufficient.

To strengthen the resilience of local and world economy, JICA and ASEAN Coordinating Centre for Humanitarian Assistance (AHA Centre) created the new action plan called Area business continuity plan (Area-BCP) and Area Business continuity management (Area-BCM) [4]. Continuity of organization and early recover in emergency event are focused. Area-BCP is adopted from Area Command under the National Incident Management System (NIMS) of FEMA [4]. It is a coordinated framework and direction in mitigate including response with disaster with stakeholders [4]. It aims to minimize economics losses in industrial complexes as whole. Besides critical resource management and collaboration for preparedness including prevention are issued [6]. Sharing risk information among organization is also raised for disaster communication. Area-BCM consists of five processes which are sharing risk information, determining the strategy, developing the Area-BCP, implementing measures including recovery and monitoring to continuously improve the Area BCM system [7]. These processes aim to improve capacity of company for unexpected event. Participating Area-BCM is a chance to start or raise private company’s BCM. Furthermore, it is an opportunity to enhance the strategic operation with sustainable growth of all parties [7]. Area-BCM was implemented in 3 pilot areas such as Indonesia, the Philippines and Vietnam.

2.2. Factors influencing flood mitigation behaviour

The research focuses on investigation of individual perception through Area-BCM implementing for flood management. Therefore, this topic describes five factors related to acceptance and flood mitigation behavior. Two factors; subjective norm and PU are selected based on Technology Acceptance Model (TAM). The model has good points in case of an explanation about user behavior on technology. In a few years ago, TAM was also widely used in study Social Network Services and Smartphone. However, this research did not include all TAM's factors such as Perceived Ease of Use (PEOU) and intention to use because they cannot be examined in starting phase. The other three factors are integrated from the study review of flood influencing mitigation behavior.

2.2.1. Perceived Usefulness. PU refers to an individual believes that using technology or system could increase personal job performance [8]. It is frequently mentioned in using information technology (IT) for disaster management. Many researchers discussed how technology is useful for mitigation. When people realize that technology can support them to perform any task better then they will perceive usefulness. For example, the research of Location-based mobile government services assisted people in emergency event explored social acceptance [9]. They found PU was a good predictor of behavioural intention to use services [9]. Similar to, disaster application on smart wearable devices was investigated
the adopted behavior [10]. PU was found to be a strong predictor of using disaster application. However, there are many people who hesitate to take any behavior or use IT for disaster.

2.2.2. Subjective Norm. It defined as the individual perception that most important people to one should perform the behavior or not [11]. Subjective norm could be considered in both of descriptive norms; beliefs about what is done by most people in one’s social group; and injunctive norms; one’s belief pressure others to perform behaviors; [12]. Skurka et al. [13] studied video of emergency planning for safety actions for the campus. They showed injunctive norms had significantly positive on intention to take protective behaviors in an emergency situation. It implies leader command affect to protective behavior. In case of flood risk perception, Brazil, local influence as neighbors, family and friends was a factor influence individual prevention [5]. Similar to an organization aspect, the influence among peers had directly affected to accept software for emergency management [14].

2.2.3. Experience. It seems to be an essential factor for private flood mitigation behavior. People who have experience and directly impacted likely to prepare more coping measures. Bustillos, Evers and Ribbe [5] and Siegrist and Gutscher [15] presented that flood experience had a positive relationship on flood risk perception. It also affected on flood protective decision. In addition, local people who living longer in the area had higher flood risk perception about knowledge of historical floods and vulnerable area [5]. However, a past long-time of experience can decrease individual perceptions.

2.2.4. Worry about Flooding. This factor represents individual negative feeling to flood including losses. Emotions are an important factor in decision making. Many studies revealed that worry about flooding affected to prepare private flood measures [16]. Takao et al. [17] examined the factors which affected resident preparedness for flood in Nagoya, Japan. They found that more fearful about flood had more significantly interested to take insurance and special measure. Zaleskiewicz, Piskorz, and Borkowska [18] also indicated that feeling was the most important issue for individual decision to insure themselves from flooding losses.

2.2.5. Flood Hazards Knowledge. Knowledge-based on disaster management was divided into two types. First, local knowledge or tacit knowledge is knowledge gathering from communities and developed over time such as belief and experience [19]. Second, international knowledge referred to explicit knowledge which is a process of learning or reading [19]. Providing information could influence people perceived risk and consequences. From the survey in Thailand, a disaster preparedness plan was the most preferred information before flood events [20]. In addition, specific information for different vulnerable groups was suggested for more usefulness [21]. Nox and Myles [22] presented that people who received disaster knowledge or protection information had more interest in mitigation behaviors than who did not.

3. Research Model and Hypotheses
This research aims to analyze the affecting factors on PU of Area-BCM through developed model based on factors from TAM and flood mitigation behavior. The hypotheses consist of five main factors. Model construction is shown in figure 1. The four factors include subjective norm, worry about flooding, flood hazards knowledge, experience; directly affect PU.

Following TAM, subjective norm or called social influence is a factor affecting on PU. User behavior could be affected and pressured from major people in social and authorities. Many popular technologies are widely used because it influences from one to one in social groups. Technology influencer to new users cloud be family, friends and neighbours. In addition, leaders in community or organization are also motivators on the action plan for disaster. For implementing the flood management system in industrial complexes, the individual perception could be affected by a large group of people and authorities’ encourage as well. The research of earthquake hazard preparedness model in Nepal presented that community and institutional factors were a predictor of disaster preparedness [23]. This
factor could lead people to aware of disaster impacts. Consequently, the first hypothesis of research is constructed as follow.

H1: *Subjective norm is positively related to perceived usefulness.*

In case of flood, impacts on human life and properties’ losses could affect one’s emotions and relate to others in one social group. For example, people worry that flood will become heavy inundation. To ensure continuity of business, they tend to prepare flood protection. However, many researches discussed whether worry related to protective behavior or not [17, 18, 24]. Therefore, this research would like to investigate how much is worry about flooding affect PU and protection plan for disaster. Then, the following hypothesis is set.

H2: *Worry about flooding is positively related to perceived usefulness.*

In this study, flood hazards knowledge is considered in both of tacit and explicit sides. It includes inherited behavior, flooding experience, disaster information, learning knowledge and training. It is essential to increase perception with threats information and effective self-response. Many people have known the disaster in their area, but they do not know how to respond effectively. Then, it is important to enhance knowledge with all disaster management processes. Bangladesh has frequently occurred flooding which causes losses every year. Ganguly, Nahar, and Hossain [25] found disaster knowledge management was influent factors of effective preparedness. For Area-BCM, the key issue is sharing of information to the whole area included industrial complexes, community, and public organization. It supports stakeholders preparing for upcoming threats in time. Nevertheless, flood risk with mitigation was more effective than communication without other knowledge [26]. Consequently, effective protection and response should be provided with comprehensive information. The following hypothesis is set.

H3: *Flood Hazard Knowledge is positively related to perceived usefulness.*

This research considers experience as past flood event that affect individual behavior. It is previous flood events, damages and activities in the past situation. People who have experience will obviously know effects. Survey of households in the inundated area presented flood experience was significant to flood mitigation [27]. As a consequent, experience is represented as directly factor on PU. The fourth hypothesis is following.

H4: *Experience is positively related to perceived usefulness.*

![Figure 1. Proposed research model](image)

**Figure 1. Proposed research model**
4. Research Methodology

4.1. Questionnaire Design
The questionnaire is separated into 6 parts, which is developed based on 2 factors including TAM and other factors related to flooding mitigation behavior. The first part starts with the demographics profile. It is, then, followed by questions related to flooding factors. These factors are measured by a five-point Likert scale; 5 = strongly agree, 4 = agree, 3 = neither, 2 = disagree and 1 = strongly disagree, and the personal experience questions are asked for a Yes/No response. The ranking questions are used to ask for further disaster information. The questionnaire is constructed into two languages, Thai and English. The questionnaire was also prepared in both online and paper-based forms. Then, the pilot test was conducted before launching a full-completed questionnaire. The ethics of this questionnaire was already reviewed and examined.

4.2. Data Collection
As we would like to examine individual perceived usefulness of Area-BCM for disaster management. Rule of thumb and 30-year period review about PLS-SEM are rough guideline regarding minimum sample size requirements [28, 29]. The target groups are employees with voluntary who have worked with companies in industrial complexes. Before answering, they are mentioned to watch video clip describing Area-BCM concept. Collected data will be stored as document files in an independent hard disk without exposure to third parties. Paper bases questionnaires were sent to companies. Online form was also distributed through industrial area.

4.3. Data Analysis
The structure of this developed model is examined by the PLS-SEM method which is suitable with the research and questionnaire as the sample size is small and the research objective focuses on prediction [30]. Since the measurement scale of this model structure is reflective, reliability and validity should be examined for factors’ quality. After that, the model is improved to be more effective. In a final step, a path coefficient is assessed to show significant relationships.

5. Results

5.1. Descriptive Results
From questionnaire distribution, the response rate is 67%. Over 97% gained from paper-based and others gained from an online survey. The total samples who have been working in the industrial area are 313. 32% is male and 68% is female. The major respondents around 60% are between 31-40 years old. Work position is categorized into 5 groups which 80% work as a general officer following by engineer, manager, executive, BCM or risk management and others.

In addition, the respondents were asked to rank the top three entities of disaster information. Figure 2 show the trusted source of receiving disaster information ranked by respondents. Central government is the first trusted source counted as 60% of respondents. Then, local government is the second choice following by community leaders. It indicates people rely on official authorities who provide information such as weather, situation and risk. On the other hand, there is a small number of people who believe on priest. The rank of preferred media for disaster information is shown in figure 3. Television which is easily accessible source becomes the most preferred media.
5.2. Measurement Model

At first, proposed research model is assessed measurement model. Table 1 presented correlations between factors and items which are given by outer loadings. By the criteria, it is expected to be higher than 0.7 [31]. Then, internal consistency reliability is examined and shown by composite reliability and Cronbach’s alpha which minimum acceptance is 0.7 [32]. They are used to show the degree to which individual item could reflect a factor converge in comparison to other items in different factors relationships. Convergent validity represents the common variance between items and their factors. It examined by Average Variance Extracted that should be greater than 0.5 [32]. Table 2 shows acceptable values of overall factors in both of internal consistency reliability and convergent validity. Discriminant validity which shows correlation among factors is presented in Table 3.

### Table 1. Factors loadings

| Construct                | Items                                                                 | Loadings |
|--------------------------|-----------------------------------------------------------------------|----------|
| Subjective Norm          | SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.  
                           | SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.  
                           | SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.  | 0.911    |
| Worry about Flooding     | WF1. The large flood similar as Thailand flood 2011 affects negative feelings to me.  
                           | WF2. I’m panic when facing large flood.  
                           | WF3. Flood will make serious damages to my life and properties.  | 0.841    |
| Flood Hazards Knowledge  | FHK1. I attend an evacuation training for flooding event.  
                           | FHK2. I know what to do, when I receive a warning.  
                           | FHK3. I involved in emergency planning of my company.  
                           | FHK4. I received flood hazard information.  | 0.875    |
| Experience               | EX1. Have you ever experienced flood event?  
                           | EX2. Did your home suffer from flood event?  
                           | EX3. Were your properties damaged from flood event?  | 0.876    |
| Perceived Usefulness     | PU1. Area-BCM system is beneficial for my company in terms of business continuity.  
                           | PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.  
                           | PU3. Area-BCM system enhances effectiveness in response with flooding.  
                           | PU4. Area-BCM system improves resilience of company, industrial park and community.  | 0.796    | 0.970    | 0.957    | 0.934    |

### Table 2. Cronbach’s alpha, Composite reliability and AVE

| Constructs              | Cronbach’s alpha | Composite reliability | AVE   |
|-------------------------|------------------|-----------------------|-------|
| Subjective Norm         | 0.914            | 0.946                 | 0.854 |
Table 3. Discriminant validity

|                        | Subjective Norm | Worry about Flooding | Flood Hazards Knowledge | Experience | Perceived Usefulness |
|------------------------|-----------------|----------------------|-------------------------|------------|---------------------|
| Subjective Norm        | 0.924           |                      |                         |            |                     |
| Worry about Flooding   | 0.177           | 0.859                |                         |            |                     |
| Flood Hazards Knowledge| 0.185           | 0.254                | 0.841                   |            |                     |
| Experience             | 0.001           | 0.139                | 0.087                   | 0.831      |                     |
| Perceived Usefulness   | 0.720           | 0.141                | 0.234                   | -0.014     | 0.934               |

5.3. Structural Model

PLS-SEM analysis is used to test path significant of hypothesis. To assess t-statistics, the regression parameters are analyzed based on bootstrapping of 1,000 samples. $R^2$ values report moderately predictive capability for PU. The results in Table 4 indicates subjective norm and flood hazards knowledge are directly significant on PU with $p$-value of 0.05. Then, hypotheses 1 and 3 are supported. While, worry about flooding and experience do not affect on PU. As a result, hypotheses 2 and 4 are not supported. Figure 4 shows relationships among constructs. Path significance represented as $\beta$ is shown in the model. It illustrates subjective norm and flood hazards knowledge are two main factors affecting on PU.

Table 4. $p$-values of Hypothesis test

| Hypothesis                                          | $p$-value | Supported |
|-----------------------------------------------------|-----------|-----------|
| H1: Subjective norm is positively related to perceived usefulness. | 0.000*    | Yes       |
| H2: Worry about flooding is positively related to perceived usefulness. | 0.867     | No        |
| H3: Flood Hazard Knowledge is positively related to perceived usefulness. | 0.012*    | Yes       |
| H4: Experience is positively related to perceived usefulness. | 0.675     | No        |

*path is significant at $p < 0.05$ level

Figure 4. Path significance

6. Discussion and Conclusion

From ranking questions, central government is the first trusted source of providing disaster information. The second source is local government. It shows people rely on government. Hence, they should be the main providers for necessary risk information such as risk zone and forecasting information. In addition,
community leaders come as the third source. Therefore, they could influence people who live in industrial areas. Similar to the survey in the Philippines, government and authorities were found to be the prior trusted source [33]. On the contrary, family and friends counted as 13% are less reliable than official public sources. Research institutes are not much favourite as well. It may cause from reachable channel from general people. Beside priest is added as one source because of local attitudes and individual beliefs. In Thai cultures, some people in the local area are close to the priest and obtain information. Temple has been being spiritual anchor and evacuated shelter during emergency events. As a result, there are some people who rely on priest. Moreover, reporters and their own companies are mentioned as added reliable sources. In disaster management, the government should be provider encouraging limitation of overall information. Furthermore, they are key power in driving nation policies. In case of Area-BCM project in Thailand, Public-Private Partnership including government, research institute and private company are integrated to build up resilience for business continuity. The project is already covered the whole core related stakeholders. Consequently, it will be utilized for enhancing capacity to flood management.

As same as Super Typhoon Haiyan warning [33], TV comes to the first media that people prefer to receive disaster information because it widely reaches many people. Recently, Thailand’s TV channels reported the disaster situation in more real time. Therefore, this media could be useful in sending warning information to people directly. It could help them to know update situation. TV is also one of the channels that the National Disaster Warning Center in Thailand uses to broadcast to people especially in the urban or city areas [34]. However, Haer, Botzen, and Aerts [26] presented that communicating hazards information is more effective if it provided with coping methods. As a result, disaster knowledge such as protective and response processes should be reported together with disaster news. A phone call is the second preferred media but there are not many disaster events informed by calling. It is frequently communicated channel among closed people. On the contrary, a phone call was not selected for disaster warning in typhoon Haiyan [33]. Other mentioned media are social media such as Facebook.

This research surveyed the samples who have been working in industrial complexes. Therefore, the decision on taking managerial plan does not absolutely depend on individual. However, individual attitude against Area-BCM is important because it could raise personal awareness and responsibility during emergency situation. Even though, leader can command employee, willingness is also important for more effective execution. In addition, if major people in company recognize the usefulness of flooding management, it will have influence on others’ thoughts. Consequently, the obvious results present that subjective norm is positively related to PU. It shows the same results as a survey with people living in flood risk areas, Brazil [5]. They found that local and public institution influenced household for disaster preparation [5]. Therefore, public organization should motivate people to prepare with upcoming threats. They should provide important information such as possible risk events and information. In case of private company, it should start making comprehension with leaders and then expand to the employee as top-down communication. Since major thoughts have influence as well, communication among groups of people is important to raise awareness. Moreover, stakeholders are essential to the company’s actions. If company operates good management, it could affect investment and sustainable supply chain. To enhance company’s profile image, business continuity management is the one issue to recognize. Therefore, the benefits of implementing Area-BCM should be issued to motivate users’ perceived usefulness.

Flood hazards knowledge directly affects to PU. Knowledge is beneficial for disaster management processes. Appropriated coping measures will support stakeholders to response with flood effectively. At first, receiving disaster and risk information helps people know the probability and impacts. People in vulnerable zones could catch up with the situation in time. For example, forecasting of flooding data in industrial areas could lead to preparation of company and decreasing losses. Furthermore, participating training and exercise increase individual readiness for emergency events. Participants will realize possibility of the severity and damages. Then, they will learn to perform suitable responses to mitigate damages. Information and knowledge influence people to perceive usefulness of implementing
a plan for protecting their life. In case of private companies, effective response could help them recover to normal situation in a short time with decreased loss. Therefore, providing disaster knowledge is essential in flooding management.

To summarize, flood impacted Thailand in the wide area especially in economics and industrial sectors. To mitigate losses and increase resilience, flood management in industrial complexes is necessary. Therefore, Area-BCM is implemented to eliminate these problems. Consequently, this research conducted the survey about individual opinions on before launching Area-BCM in industrial areas. The affecting factors are used to investigate and support appropriate project’s implementation. Subjective norm and flood hazards knowledge are found to be significant factors on PU. Accordingly, local authorities and top management in the area should be key leader for this project. In addition, Risk information and consequences should be communicated to vulnerable people for preparedness. Particularly, the government is found as reliable sources in sharing disaster information. Hence, they should be responsible for raising people’ knowledge and protective actions. The credible information, sharing knowledge and leader could enhance area’s sustainable and resilience to disaster. For implementing Area-BCM project with effectiveness, subjective norms and knowledge are the points to be highlighted.

This Research conducted the survey focused on the private companies in industrial area. However, Area-BCM requires collaboration from many stakeholders such as public sector, infrastructure provider and community for a fully effective plan [35]. Following the possible and potential research problems [36, 37], therefore, in future research, others’ attitudes should be surveyed. In addition, the relationships among supply chains are important to be studied because they definitely affect each other during emergency situation.

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