Affecting Factors on Perceived Usefulness of Area-Business Continuity Management for Flood Case at Industrial Areas in Thailand

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ปัจจัยที่ส่งผลกระทบต่อการรับรู้ประโยชน์ถึงการใช้แผนความต่อเนื่องทางธุรกิจในระดับพื้นที่สำหรับกรณีน้ำท่วมในพื้นที่นิคมอุตสาหกรรมประเทศไทย

น.ส.กันต์ฤทัย มีช้าง

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรมหาบัณฑิต
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กันต์ฤทัย มีช้าง : ปัจจัยที่ส่งผลกระทบต่อการรับรู้ประโยชน์ถึงการใช้แผนความต่อเนื่องทางธุรกิจในระดับพื้นที่สำหรับกรณีน้ำท่วมในพื้นที่นิคมอุตสาหกรรมประเทศไทย. (Affecting Factors on Perceived Usefulness of Area-Business Continuity Management for Flood Case at Industrial Areas in Thailand) อ.ที่ปรึกษาหลัก : อ. ดร.ณัฏฐ์ ลีละวัฒน์

เหตุการณ์มหาอุทกภัยประเทศไทยในปี 2554 ได้ส่งผลกระทบต่อหลายภาคส่วนไม่ว่าจะเป็นครัวเรือน ภาคอุตสาหกรรม หรือกาคเกษตรกรรม โดยเฉพาะอย่างยิ่งพื้นที่อุตสาหกรรมหลายแห่งได้รับความเสียหายอย่างหนักจากเหตุการณ์น้ำท่วมดังกล่าว หลายโรงงานต้องหยุดกระบวนการผลิต ดังนั้นเหตุการณ์นี้จึงส่งผลอย่างรุนแรงต่อความสูญเสียทางเศรษฐกิจ แผนการบริหารความต่อเนื่องทางธุรกิจจึงเป็นประโยชน์ที่จะช่วยให้บริษัทลดผลกระทบจากน้ำท่วมอย่างมีประสิทธิภาพ ก่อนที่ระบบจะถูกนำไปใช้การสำรวจความคิดเห็นของผู้ที่เกี่ยวข้องในพื้นที่จึงเป็นสิ่งสำคัญ ดังนั้นงานวิจัยนี้จึงมีจุดประสงค์เพื่อสำรวจปัจจัยที่ส่งผลกระทบต่อการรับรู้ประโยชน์การใช้แผนความต่อเนื่องทางธุรกิจในระดับพื้นที่ แบบจำลองเชิงวิจัยถูกสร้างขึ้นจากแบบจำลองการยอมรับการใช้เทคโนโลยี และพฤติกรรมการลดผลกระทบจากน้ำท่วม การวิเคราะห์ผลมีการแบ่งกลุ่มข้อมูลผู้ตอบแบบสอบถามโดยใช้ข้อมูลประสบการณ์น้ำท่วมส่วนบุคคล บรรทัดฐานส่วนบุคคลถูกพบว่าเป็นปัจจัยสำคัญที่ส่งผลกระทบเชิงบวกต่อการรับรู้ประโยชน์ นอกจากนี้ความรู้เกี่ยวกับภัยน้ำท่วมส่งผลกระทบอย่างมีนัยสำคัญต่อการรับรู้ประโยชน์ ในขณะที่ความกังวลด้านน้ำท่วมเป็นปัจจัยที่ส่งผลกระทบต่อการรับรู้ประโยชน์ผ่านบรรทัดฐานส่วนบุคคลและความรู้ด้านภัยน้ำท่วม จากการสำรวจพบว่าผู้ตอบแบบสอบถามไว้วางใจแหล่งข้อมูลจากรัฐบาลในการรับข้อมูลข่าวสารด้านน้ำท่วม มากกว่านั้นผู้ตอบแบบสอบถามมีความเห็นว่าควรมีข้อมูลการเตือนภัยด้วย ทั้งนี้ผลลัพธ์จากการสำรวจยังถูกคาดหวังว่าจะเป็นแนวทางในการพัฒนาแบบจำลองระบบแผนความต่อทางเนื่องทางธุรกิจในระดับพื้นที่

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The 2011 Thailand floods widely affected many parts in Thailand such as households, industry and agriculture. Especially, industrial areas were massively damaged by floods. Many factories had to stop their operations. Therefore, it severely impacted economic losses. Area-Business Continuity Management (Area-BCM) is a useful system supporting company mitigate flood effectively. Before the system is implemented, opinion survey of related people in an area is important. Therefore, this research aims to investigate factors affecting Perceived Usefulness (PU) of the Area-BCM. The model is proposed based on Technology Acceptance Model and flood mitigation behavior. The analysis results categorized the respondents into four groups following their experience with floods. It is found that subjective norm significantly affect to PU. In addition, flood hazards knowledge significantly positively affect to PU in experienced group. On the other hand, worry about flooding indirectly affect to PU through subjective norm. Moreover, government is found to be the most trusted source by respondents in receiving disaster information. They also mentioned warning information should be provided. Furthermore, the findings are expected to be used as a guideline for developing a prototype of the Area-BCM system.

Field of Study: Industrial Engineering Student's Signature .....

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Glossary

No.	Word	Definition
1	Acceptance	"a moment by moment process of actively embracing the private events evoked in the moment without unnecessary attempts to change their frequency or form, especially when doing so would cause psychological harm." (Fletcher, L., & Hayes, S. C., 2005, p. 319)
2	Area-BCM	"a cyclic process of sharing risk information or impact estimation, determining the strategy, developing the Area BCP, implementing preparedness measures and effective recovery actions and monitoring to continuously improve the Area BCM system, in coordination among stakeholders, in order to improve the capability of effective business continuity in the area" (Baba et al., 2013, p. 298)
3	Attitude	"The degree of evaluative affect that an individual associate with using the target system in his or her job". (Davis, 1985, p. 25)
4	Behavioral intention	"Individual's subjective probability that he or she will perform a specified behavior". (Davis, 1985, p. 16)
5	Compatibility	"The degree to which an innovation is perceived as being consistent with the existing value, past experience and needs of potential adopters". (Rogers, 2010, p.15)
6	Complexity	"The degree to which an innovation is perceived as difficult to understand and use". (Rogers, 2010, p.16)
7	Effort expectancy	"The degree of ease associated with the use of the system". (Venkatesh, Morris, & Davis, 2003, p. 450)
8	Endogenous	"Variable has at least one path leading to it and represents the effects of other variables." (Wong, 2013, p. 1)

Glossary

No.	Word	Definition
9	Exogenous	"Variable has path arrows pointing outwards and none leading to it." (Wong, 2013, p. 1)
10	Facilitating conditions	"The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system". (Venkatesh et al., 2003, p. 453)
11	Image	"The degree to which use of an innovation is perceived to enhance one's status in one's social system" (Venkatesh & Davis, 2000, p. 189)
12	Inner model	"The relationships between the independent and dependent latent variables." (Wong, 2013, p. 1)
13	Job fit	"An individual believes that using a PC can enhance the performance of his or her job". (Thompson, Higgins, & Howell, 1991, p. 129)
14	Job relevance	"An individual's perception regarding the degree to which the target system is applicable to his or her job / system is capable of performing and the degree to which those tasks match their job goals". (Venkatesh & Davis, 2000, p. 191)
15	Long-term consequences of use	"Outcomes that have a pay-off in the future". (Thompson et al., 1991, p. 129)
16	Observability	"The degree to which the results of an innovation are visible to others". (Rogers, 2010, p.16)
17	Outer model	"The relationships between the latent variables and their observed indicators." (Wong, 2013, p. 1)
18	Output quality	"Consideration how well the system performs those tasks". (Venkatesh & Davis, 2000, p. 191)
19	Perceived behavioral control	"People's perception of the ease or difficulty of performing the behavior of interest". (Ajzen, 1991, p. 183)
20	Perceived consequences	"The severity of the consequences of the event". (Woon, Tan, & Low, 2005, p. 368)

Glossary

No.	Word	Definition
21	Perceived ease of use	"The degree to which an individual believes that using a particular system would be free of physical and mental effort". (Davis, 1985, p. 26)
22	Perceived probability	"The person's assessment of the probability of the threatening event". (Woon et al., 2005, p. 368)
23	Perceived response cost	"The perceived opportunity costs—monetary, time, effort—in adopting the recommended behavior". (Woon et al., 2005, p.368)
24	Perceived response efficacy	"The efficacy of the recommended behavior". (Woon et al., 2005, p. 368)
25	Perceived self-efficacy	"The person's confidence in his/her own ability to perform the recommended behavior". (Woon et al., 2005, p. 368)
26	Perceived usefulness	"The degree to which an individual believes that using a particular system would enhance his or her job performance". (Davis, 1985, p. 26)
27	Performance expectancy	"The degree to which an individual believes that using the system will help him or her to attain gains in job performance". (Venkatesh et al., p. 447)
28	Relative advantage	"The degree to which an innovation is perceived as better than the idea it supersedes". (Rogers, 2010, p.15)
29	Result demonstrability	"Tangibility of the results of using the innovation". (Venkatesh & Davis, 2000, p. 192)
30	Social influence	"The degree to which an individual perceives that important others believe he or she should use the new system". (Venkatesh et al., 2003, p. 451)
31	Subjective norm	"Person's perception that most people who are important to him think he should or should not perform the behavior in question". (Venkatesh & Davis, 2000, p. 187)

Glossary

No.	Word	Definition
32	Trialability	“The degree to which an innovation may be experimented with on a limited basis”. (Rogers, 2010, p.16)
33	Use	“Individual's actual direct usage of the given system in the context of his or her job.” (Davis, 1985, p. 25)
34	Voluntariness	“The extent to which potential adopters perceive the adoption decision to be non-mandatory”. (Venkatesh & Davis, 2000, p. 188)

Chapter 1 Introduction

This chapter describes the background of problem that consequences to do this study. It contains the flood events and their impacts in Thailand. Especially, the industrial areas are revealed the damages. Then, the Area-BCM concepts are mentioned. In addition, it includes objectives, scopes and expectations of this study. Last, the research schedule processing of work is shown.

1.1 Background and significant of the problem

Nowadays, impacts from natural disasters increasingly damage and affect to people including property around the world. In addition, it affects to economics making losses of money and GDP growth in each country (Benfield, 2012). Thailand always faces with flooding which the biggest flood extremely damages and affects to global supply chains is Thailand's flood 2011. Sixty-five from Seventy-Seven provinces were inundated (AonBenfield, 2012). 813 people were killed, 1,886,000 household were impacted, and over 2.5 million people had to displaced (Haraguchi & Lall, 2015). Moreover, the impacts affected to agricultural and 7 inundated industrial areas. These areas had 804 companies which 56.7% were Japanese's company as shown in **Table 1** (Haraguchi & Lall, 2015).

From the **Table 1**, it implies that many industrial parks located in Ayutthaya where was one of the heavily damaged provinces. Most industries affected were electronics, medical equipment, automobiles and food and beverage. Some companies had to close their business. Many of the notable companies such as Toyota, Honda, Mazda, Nissan, Mitsubishi, Sony, Nikon, Sanyo Semiconductor, Canon, Western Digital, Hitachi, Hutchinson, Microsemi, ON Semiconductor and Matsushita were temporary damaged and halted the production caused by inundated. From this interruption, it affected to automobiles and electronics supply chains worldwide (AonBenfield, 2012). Then, economics sector loss around USD 46.5 billion (Haraguchi & Lall, 2015). Almost of damages about USD 32 billion or 70% affected to private including manufacturing sectors (WorldBank, 2012). As shown in **Table 2**, although tourism had some parts of damages, but it also affected to other related sectors for example transportation, shopping and food and beverage. Finance and banking also had little damages but severe loss gain from recovery time in industrial sector expanding loan plan and new credit line. World Bank (2012) estimated that GDP growth decreased from 4.4% to 2.9%.

Table 1 List of industrial area

No.	Industrial Area	Province	Number of Companies	Number of Japanese companies	Time to finish drainage (days)
1.	Rojana Industrial Park	Ayutthaya	218	147	51
2.	Nava Nakorn Industrial Estate	Pathum Thani	190	104	53
3.	Hi-Tech Industrial Estate	Ayutthaya	143	100	44
4.	Factory Land (Wangnoi)	Ayutthaya	93	7	33
5.	Bang Pa-in Industrial Estate	Ayutthaya	84	30	35
6.	Saha Ratta Nanakorn Industrial Estate	Ayutthaya	42	35	62
7.	Bankadi Industrial Park	Pathum Thani	34	28	46
Total			804	451	

Note. Adopted from "Flood risks and impacts: A case study of Thailand's floods in 2011 and research questions for supply chain decision making," by Haraguchi, M., & Lall, U. (2015). International Journal of Disaster Risk Reduction, 14, 256-272.

In Thailand flood 2011, Rojana industrial park was the top of closed company area around 14% following by Saha Ratta Nanakorn Industrial Estate and Hi-Tech Industrial Estate 11% (Haraguchi & Lall, 2015). Heavily damaged company was Honda halting production and recovery over 174 days (Haraguchi & Lall, 2015). One of causes came from company producing key component parts as power integrated circuits (IC) was inundated. Another, it was location of the factory. After this severe flooding, Thai government had proposed strategy and measure for flood prevention covered local level, industrial areas, river dredging, dike, water gate and others water management. Japanese government was part helping Thailand as well. The Japan International Cooperation Agency (JICA) established flood management plan of the Chao Phraya River and provided technical assistance including helping upgrade infrastructure.

Table 2 Summary of damages and losses separate by sector (in Thai Baht, millions)

No.	Sub sector	Disaster Effects			Ownership	
		Damage	Losses	Total	Public	Private
Infrastructure						
1.	Water Resources Management	8,715	-	8,715	8,715	-
2.	Transport	23,538	6,938	30,476	30,326	150
3.	Telecommunication	1,290	2,558	3,848	1,597	2,251
4.	Electricity	3,186	5,716	8,902	5,385	3,517
5.	Water Supply and Sanitation	3,497	1,984	5,481	5,481	-
Production						
6.	Agriculture, Livestock, Fishery	5,666	34,715	40,381	-	40,381
7.	Manufacturing	513,881	493,258	1,007,139	-	1,007,139
8.	Tourism	5,134	89,673	94,807	403	94,405
9.	Finance and Banking	-	115,276	115,276	74,076	41,200
Social						
10.	Health	1,684	2,133	3,817	1,627	2,190
11.	Education	13,051	1,798	14,849	10,614	4,235
12.	Housing	45,908	37,889	83,797	-	83,797
13.	Cultural Heritage	4,429	3,076	7,505	3,041	4,463
Cross cutting						
14.	Environment	375	176	551	212	339
Total		630,354	795,190	1,425,544	141,477	1,284,067

Note. Adopted from "Thai Flood 2011: Rapid assessment for resilient recovery and reconstruction planning," by World Bank. (2012). Retrieved from http://documents.worldbank.org/curated/en/677841468335414861/Overview

Furthermore, JICA and ASEAN Coordinating Centre for Humanitarian Assistance (AHA Centre) created the new action plan for decreasing impacts from natural disaster called Area Business Continuity Management (Area-BCM) ((ADPC), 2017). The objectives are enhancement of collaboration between organizations including public sector, private sector, community and

especially industrial area. Plan and information sharing were developed to prevent upcoming threats, increasing coping capacity level, mitigate impact from risk and rapidly recover in case of emergency event. Area-BCM was started the implementation in 3 pilot areas including Indonesia, the Philippines and Vietnam (AHA center & Agency, 2015). As mentioned before, Area-BCM is a plan that helps organization continue operation or early recover in emergency event. Thailand flood 2011 was terrific disaster which not only affect to domestic companies but also affect to regional economy and around the world. Because of supply chain and some facilities were disrupted or shut down. It shown many organizations still have had limit about coping capacity and disaster management without collaboration between private and public sector in the area. Therefore, Area-BCM is beneficial plan for industrial park and organization in all countries. For the most advantage of implementing plan, survey related people should be produced about understanding and their opinions with Area-BCM. Since many organizations were not pretend to operate Area-BCM or operate but did not well understand enough. Organization leaders including all of staffs, others involved organization and community around organization's area should well understand and be part of planning. Moreover, everyone should realize and correctly response in personal duty for effectiveness. So, perceived usefulness of Area-BCM is important to lead people aware of taking any measures.

Owing to Area-BCM is going to implement in industrial areas in Thailand. To persuade stakeholders and let them perceived knowledge of this plan, this research examines the perception in each person. However, research survey is conducted before launching Area-BCM. The actual implementation cannot be assessed. So, the study only focuses on investigating factors which affect perceived usefulness of Area-BCM. The starting research groups are employees in companies around industrial areas that have experience with flood. Due to, this plan requires collaboration from personal level, organization, public sector up to others related in area. So, it is important to investigate the affecting factors in individual level. All parties should agree with the plan and be partial of implementing plan including adopt plan appropriately. Affecting factors may different in each person or social group. There are many studies examined the factors that influence flood mitigation behaviors. Zaalberg, Midden, Meijnders, & McCalley (2009) studied the difference of appraisal and coping with flooding between victims and nonvictims. The result shows that flooding experiences like emotions and social support were more motivation victims taking intention to adopt actions for future flood than nonvictims. Miceli, Sotgiu, & Settanni (2008) founded that male were more pretend to adopt protection behaviors

than female based on social role. In addition, receiving information about flooding and taking part in Civil Defense activities were positively relate to disaster preparedness. Furthermore, taking part in Civil Defense activities was also positively associated with receiving information about flooding with being male. However, there is a few studies investigating about personal perceived usefulness related with disaster management for mitigate impacts of company in industrial areas. In addition, there is no research using Technology Acceptance Model (TAM) for studying about disaster management system in Thailand before. It is widely used in study about acceptance of technology as program in company. However, TAM is not much used in disaster management. Previous study is research on individual factors with flood protection behavior of themselves. However, it is not found research related individual behavior on company flood management. In addition, affecting factors on flood information technology is not found. Since, the Area-BCM system will be implemented as crowdsourcing. The researcher would like to know what factors could influence perceived usefulness of plan. Then, TAM is used in studying combined with factors about flood mitigation behavior. Owing to, previous research did not study in TAM with disaster and business plan. Including, other factors could affect PU were included in the model. These factors were frequently used to study acceptance with community flood protective plan or measure, but they are never used for plan in industrial area in Thailand. Affecting factors in flood behavior may be different. In order to investigate affecting factors on perceived usefulness of employees in industrial area, technology acceptance model and flood mitigation were combined. Therefore, this study aims to examine affecting factors in perceived usefulness of implement flood management processes named Area-BCM.

Because of company proportion in studies areas and survey collaboration, the sample are almost employees in Japanese companies. Hence, this research also studies some parts of cultural assessment which is important for data analysis. Each nationality of company has different culture. So, it can affect companies' behavior and characteristics. It also has profound effect on individual behaviors and groups within organization as well. So, it must be clearly understood and well managed for achieving their goals. Organization that achieve balance in owners, employees, customers, society and government are often praised (Armenakis, Brown, & Mehta, 2011). These balance issues are frequent influenced from organization's culture. An organization's culture is created and performed by top leaders and decision-makers. Organization culture is represented in three levels which are cultural artefacts, espoused beliefs and values, and underlying assumptions (Schein, 2010). Cultural artefacts are visible structures and processes.

Espoused beliefs and values are developed formal organizational practices such as strategies, goals and policies. Underlying assumptions are thoughts, beliefs and expectations. In addition, culture could be categorized into other sides such as mechanistic and organic, adaptive and unadaptive cultures and ethical and unethical (Armenakis et al., 2011). In industry accidents, most factors are rooted in organization cultures. To improve safety and performance, organization cultures were studied (Gardner, 1999). The results shown that organization cultures and safety performance was linked (Gardner, 1999). The improvement strategies that ignore this issue will not produce in long-term (Gardner, 1999).

(Hofstede, 1983) is framework for cross-cultural communication. They model was developed based on factors analysis with worldwide survey employees. It describes the effects of society culture on individual behavior. It is used to understand the differences in cultures across countries. In addition, it covers the ways that business is done across different cultures. The original framework identified four elements affecting on national cultural differences. (Hofstede, 1983) First, individualism and collectivism is defined as “the degree to which people in a society are integrated into groups” (Hofstede, 2011, p.11). The decision including lifestyle are almost based on individual in individualism. While, collectivism prefer to value with social group and family. Second, power-distance is “the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally” (Hofstede, 2011, p.9). In low power-distance cultures, employees have desire and participate in management. On the other hand, high power, employees tend to perform in direction of hierarchy organization. Cultures of high power-distance accepts power different and shows high respect for rank including authority. Next, uncertainty avoidance indicates “to what extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations” (Hofstede, 2011, p.9). For cultures having high uncertainty avoidance, employees will think about clearly defied and formal rules to be saved. The research shown that people in uncertainty avoiding countries were more emotional and motivated by inner (Hofstede, 2011). In low uncertainty avoidance, people are rather flexible and adopt behavior easier. Fourth, masculinity and femininity defined as “the distribution of values between the genders which is another fundamental issue for any society, to which a range of solutions can be found” (Hofstede, 2011, p.12). In highly masculinity cultures, the value focus on assertiveness and material acquisition. In highly femininity cultures, the value focus on relationship among people and quality of life. Particularly, different gender could perform and working equally. Masculinity,

gender may have effects on working position. Then framework was developed and include other two dimensions as Short-Term vs. Long-Term Orientation and Restraint vs. Indulgence. Short-term orientation values in life occurred in the past and present (Hofstede, 2011). People are personal stability and steadiness. Long-Term Orientation values the events that will occur in the future (Hofstede, 2011). They are good to adapts with circumstances. Last, restraint vs. Indulgence refers the extent and tendency for a society to fulfill its desires. This framework is able to identify differences in responses to management styles, organization preferences and motivation patterns (Higgs, 1996). Managers from different cultures may behave on different styles. For example, UK members who is low uncertainty avoidance and Japanese who is high uncertainty avoidance of management team had significant differences in their purposes and processes (Higgs, 1996). UK members were almost concern in achievement and minimum rules. They also preferred in open-ended learning. On the contrary, Japanese were concern in security and structure learning. For working style survey, most US managers believed that they work as problems solver (Miroshnik, 2002). Manager will help subordinates find the ways to solve problem rather than answering their question. However, Japanese managers believed that they should give precise answer to their subordinates in order to maintain credibility and security. The differences of cultures influences on strategic decision processes were found (Builtjens & Noorderhaven, 1996). Therefore, cultural assessment is essential in order to develop effective management. It affects organization and individual employee behaviors. Culture in studied companies could influence employees as well. So, in analysis part, it is discussed.

In addition, the research is studied before launched project. So, the surveyed data will be used as suggestion for design requirements and developed user interface. Recently, technology is various developed in disaster management field. However, there are only few systems which are continuously used because of many reasons such as accessibility and user friendly. Technology is also the one important part in Area-BCM project in Thailand. Since, the project is going to develop could system in order to collaboration with disaster management for industrial areas and communities. The analysis data can be useful for design user interface. The first step in designing user interface was understand how to organize information in screens particularly critical issue (Humayoun et al., 2009). The Sahana Free and Open Source Software (FOSS) was developed as relief and rescue system for Tsunami in Sri Lanka, 2004 (Careem, De Silva, De Silva, Raschid, & Weerawarana, 2006). The core capabilities of application framework were tracking relief organizations, request management system, shelters registry and missing

persons (Careem et al., 2006) The other optional modules were provided depending on request such as child protection system and inventory control. In order to develop efficient system, the preferred modules are based on local requirement. They also suggested that system authorization from some local government was preferable because of collecting data and supporting (Careem et al., 2006). The translation sentences and native language was important as well. Moreover, different areas had different hierarchy and ontology in representing geographic location. The designing user interface for mobile and critical situation is important to handle users' attention when it is strictly required (Humayoun et al., 2009). During usage, the system should be act as an automatic process and scarcely need for cognitive resources (Humayoun et al., 2009). Other concerned aspects are accessibility and ergonomics issues when using system in critical scenarios. Therefore, this research not only investigate affecting factors of perceived usefulness, but it also uses them as a guideline about user interface in designing system for Area-BCM project. Finally, the results from affecting factors could be used for support implementation the Area-BCM project effectively. It could use as suggestion in implementing the project for private company and government. They can provide proper information encouraging acceptance the project.

1.2 Research objective

The objective of this research is to investigate the affecting factors which affect to perceived usefulness of implementing Area-BCM at industrial complexes for enhancing disaster resilience, especially for business continuity and early recovery in case of emergency event. Finally, the proposed research model will be used to describe individual behaviors on disaster information system and used as suggestion for user interface.

1.3 Scope of the study

1. Study the factors that affect to perceived usefulness of implementation preventive measures and Area-BCM in flooding event.

2. This study is survey before actual implementing Area-BCM.

3. The study covers industrial areas where were flooded in past.

4. Samples are people who have worked in the both Thai and Japanese companies at industrial areas.

5. The study covers mock-up user interface design for company's employees without the system implementation.

1.4 Expected outcomes

1. To know the affecting factors on perceived usefulness of implementing preventive measures and Area-BCM in flooded industrial areas.

2. To know the information requirements of stakeholders and be useful for developing plan in industrial areas. It could be suggestion in launching and implementing plan as well.

1.5 Expected benefits

1. The results are used for supporting implementation of Area-BCM project.

2. The study is benefit to others who develop user interface of system in Area-BCM project in industrial areas.

3. The study is benefit as guideline to researchers who will study about perceived usefulness for disaster risk reduction system.

1.6 Research process

This study started with did a lot of literature review about model related individual behavior. In addition, the factors influence flood protective behavior were reviewed. Then, the research model was developed and continuously improved. The questionnaire was properly developed including improvement. Pilot survey was conducted with students. After proposal presentation, the data will be analyzed. Next, the study will show important results and discussion as well. Finally, defense presentation will be around November as shown in the **Table 3.**

Table 3 Research schedule

No.	Activity	2018					2019											
		AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	July	AUG	SEP	OCT	NOV	Dec
1	Topic discussion																	
2	Literature review																	
3	Model development																	
4	Model improvement																	
5	Questionnaire development																	
6	Questionnaire improvement																	
6	Pilot survey																	
7	Data collection																	
8	Proposal presentation																	
11	Data analysis																	
12	User Interface Design																	
13	Discussion and conclusion																	
13	Thesis preparation																	

Chapter 2 Literature Review

This study is an examination affecting factors that involve individual behaviors of implementing Area-BCM in industrial areas. Then, this chapter describes about related theories and behavioral models. To develop proposed research model appropriately, the ten models were studied. These models are used to explain performing individual behavior, but they have different focusing point. In addition, the additional factors about flood protective behavior were explained. Lastly, concept of Area-BCM is briefly described.

2.1 Theory of Reasoned Action

Theory of Reasoned Action (TRA) or called The Fishbein Model created by (Fishbein, 1967). At first, model was used for studying behavioral performance that come from attitude. After that, the model was developed by (Ajzen & Fishbein, 1977). The theory linked between beliefs, attitudes, intentions and behavior (Davis, 1985). People decide to whether perform behavior or not through beliefs including attitudes. They divided beliefs in 2 kinds; behavioral and normative beliefs (Madden, Ellen, & Ajzen, 1992). First, behavioral beliefs refer belief about probability of consequence when behavior is performed (Madden et al., 1992). Second, normative beliefs are belief in performing which affected by others' though. Therefore, theory of Reasoned Action describes behavior intention which highlight on beliefs and attitude. The model framework is below in **Figure 1**.

Intention is influenced from attitude toward performing behavior and social influence of important person around people who intend to perform behavior, called subjective norm. This model was integrated previous disjoint theories and emphasized about relationship between beliefs, attitudes, intentions, and behavior. Theory of Reasoned Action is suitable in case of study relationship between external stimulus and performing behavior. The first important factor, attitude toward performing behavior (ATB) defined as "individual's degree of evaluative affect toward the target behavior" (Davis, 1985, p. 25). Subjective norm (SN) means the "person's perception that most people who are important to him think he should or should not perform the behavior in question" (Venkatesh & Davis, 2000, p. 187). Behavioral intention (BI) refers individual probability that he or she will perform behavior (Davis, 1985). Finally, behavior intention affects to actual behavior.

Theory of Reasoned Action is useful in describe the linkage of individual beliefs and attitude to performing behavior. Particularly, in case of people have complete volitional control

over behavior. By the way, TRA is initial theory about study individual performing behavior. The variables affecting behavior intention or actual behavior may not covered yet. If people lack volitional control, only behavioral intention will not be sufficient for determine actual behavior (Madden et al., 1992). Since, model explains causes of individual performing behavior. In recently 10 years, this model has widely used in medical field following by field of technology and business. For instance, Doswell, Braxter, Cha, and Kim (2011) tested TRA in explaining sexual behavior among African and American young teen girls. The results shown that attitudes toward engaging in early sexual behavior, norm and intention to engage in early sexual behavior were correlated and significant (Doswell, Braxter, Cha, & Kim, 2011). Mishra, Akman, & Mishra (2014) studied behavior of the adoption of Green Information Technology (GIT). They founded that attitudes toward behavior and subjective norm had positive effect on behavioral intention, including BI on behavior (Mishra, Akman, & Mishra, 2014). In addition, external factors as person related belief, sector of respondent and level of awareness also have significance with ATB (Mishra et al., 2014). In this study did not select TRA for investigate behavior of implementing Area-BCM because the attitude and belief are insufficient to describe individual behavior. Moreover, the model did not widely used for study disaster mitigation behavior.

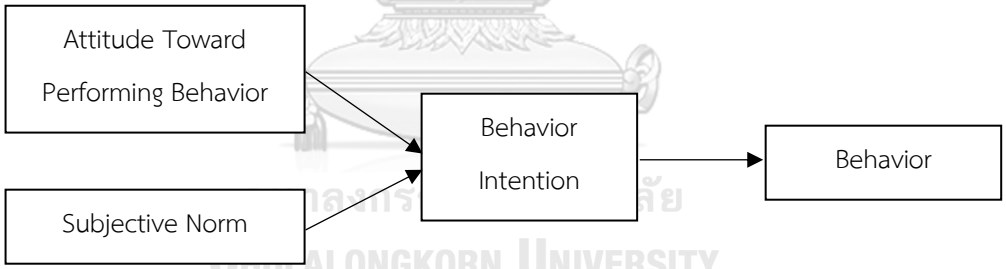

Figure 1 Theory of Reasoned Action Model

Note. Adapted from "A Comparison of the Theory of Planned Behavior and the Theory of Reasoned Action," by Madden, T. J., Ellen, P. S., & Ajzen, I. (1992). Personality and Social Psychology Bulletin, 18(1), 3-9.

2.2 Protection Motivation Theory

Protection Motivation Theory (PMT) was created by (Maddux & Rogers, 1983) and then it had developed. This theory assess individual's coping behavior when he or she face with uncertain event and risk (Woon, Tan, & Low, 2005). In 1987, Rippetoe and Rogers shown that coping behavior is directly influenced by threat appraisal and coping appraisal. In details first, threat appraisal refers person's assessment of dangerous level which occurred by threat (Woon et al., 2005). Threat appraisal consists of perceived probability and perceived consequences

(Woon et al., 2005). Perceived probability is person's assessment about probability or risk of threatening event (Woon et al., 2005). The study of understanding information systems security policy compliance, they referred to risk as threats resulting from not following policy compliance (Ifinedo, 2012). Another, perceived consequences mean person's assessment about the severity from impacts (Woon et al., 2005). For example, level of threats will imminent affect to the security of organization's information if person is noncompliance (Ifinedo, 2012). Second, coping appraisal refers person's assessment of coping ability with threatening event and potential avoiding loss or damage from threat (Woon et al., 2005). There are 3 elements of coping appraisal as perceived self-efficacy, perceived response efficacy and perceived response cost. Perceived self-efficacy, this factor assess individual's level of confident with ability to perform recommended behavior like sorts of skill or measure needed for detecting organization's information (Bandura, 1991). They mentioned that perceived self-efficacy beliefs were important factor for control human self-regulation including beliefs human in decision making and ability to face with any difficulties by individual (Bandura, 1991). Perceived response efficacy is the efficacy to perform recommended behavior as compliance or measure could effective to detecting threat (Woon et al., 2005). Last, perceived response cost refers perceived opportunity cost, time and effort for adopting recommended behavior like complying policy (Woon et al., 2005). Overall elements can show as a model below in **Figure 2**.

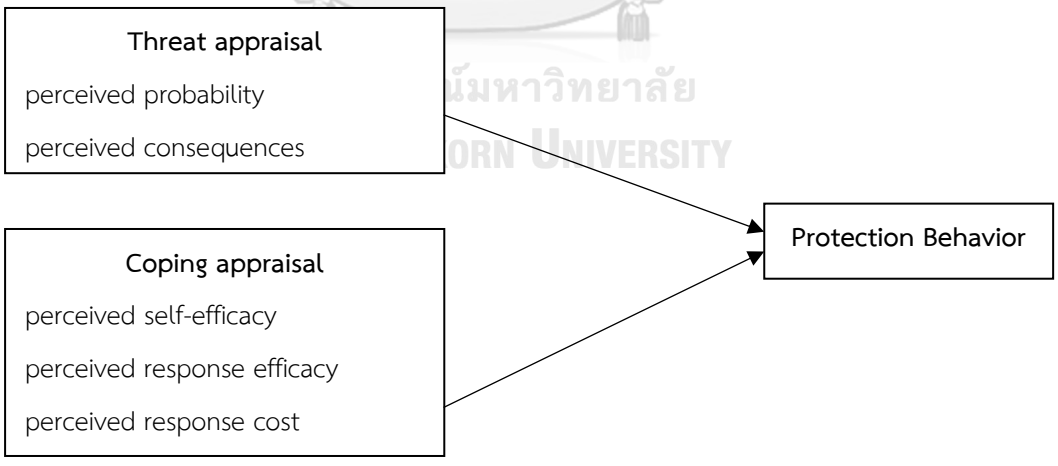

Figure 2 Protection Motivation Theory

Note. Adapted from "A protection motivation theory approach to home wireless security," by Woon, I., Tan, G.-W., & Low, R. (2005). ICIS 2005 Proceedings, 31.

Both threat appraisal and coping appraisal directly affect on protection behavior. It is useful to describe fear influencing attitudes and then behavioral changing. The model is general used for decision making related threats. In addition, it was widely used natural hazards and health protective behavior. The investigation of anti-plagiarism software's using revealed that threat appraisal and coping appraisal had strong significant to the adoption of software (Lee, Bharosa, Yang, Janssen, & Rao, 2011) However, threat appraisal had more significant than coping appraisal (Lee, 2011). It indicated that consequences from using software could well enhance their adoption. So, the benefits of adoption technology should be highlighted for motivate protective behavior. On the contrary, coping appraisal had greater predictive than threats appraisal in health-related intentions (Milne, Sheeran, & Orbell, 2000). In addition, they found that both factors were useful in predict current behavior, but future behavior was useless (Milne et al., 2000). Even though, PMT is used to predict protective behavior, it more focus on the factors involved with fear or feeling. Moreover, it does not concern about experience. Therefore, we did not decide to use it in this research.

2.3 Theory of Planned Behavior

Theory of Planned Behavior (TPB) is an extension of Theory of Reasoned Action. It was developed by Ajzen in 1985 (Madden et al., 1992). The theory describes individual performing behavior with some personal controls over the factors such as resources, abilities, time and opportunity (Kuhl & Beckmann, 2012). It is also used to predict successful probability of behavioral attempt (Kuhl & Beckmann, 2012). When people believe having some controls to perform behavior, then intention to perform behavior may be change. Madden et al. (1992) added new variable as perceived behavioral control for eliminate limitation of TRA. Perceived behavioral control (PBC) defined as perceived ease or difficult of performing behavior (Ajzen, 1991). So, these attitudes toward performing behavior, subjective norms and perceived behavioral control are 3 main factors in this theory. In addition, TPB can adopt to studying in more vary performing behavior.

From the **Figure 3**, perceived behavioral control directly effects on both behavioral intention and behavior. Moreover, behavioral intention is determined by other 2 important factors like attitude toward performing and subjective norm. Finally, behavioral intention effect to performing actual behavior.

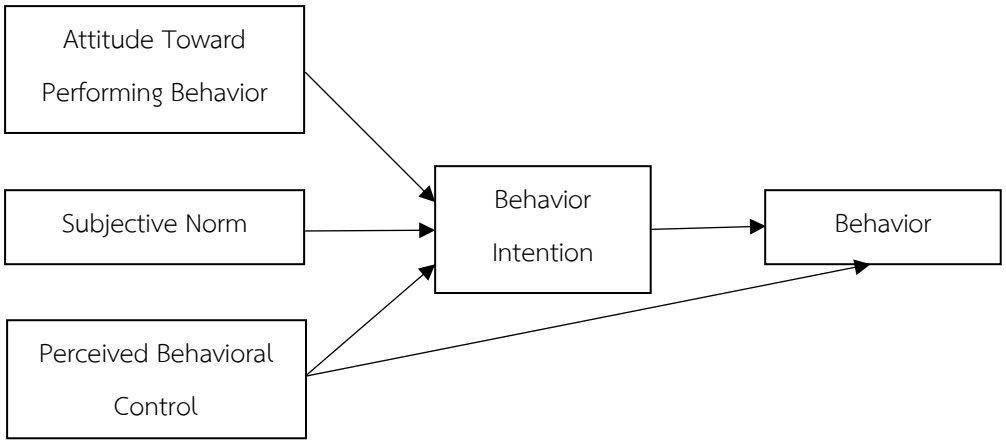

Figure 3 Theory of Planned Behavior

Note. Adapted from "A Comparison of the Theory of Planned Behavior and the Theory of Reasoned Action," by Madden, T. J., Ellen, P. S., & Ajzen, I. (1992). Personality and Social Psychology Bulletin, 18(1), 3-9.

Theory of Planned Behavior was widely used for study human actions (Ajzen, 2002). It is advantage to describing in some particular situation that behaviors are difficult to perform without volitional control. In addition, it is used for predicting user's acceptance of IT. So, perceived behavioral control represent as one factors helping predict actual behavior. However, overall framework is similar to theory of reasoned action. Only behavioral intention is sufficient to predict behavior in case of completely control. Moreover, TPB does not predict continuance of using IT. Greaves, Zibarras, & Stride (2013) used TPB for study environmental behavioral intention in a workspace. They set three scenarios as switching off PCs, using video-conference and recycling waste (Greaves, Zibarras, & Stride, 2013). The test showed that all 3 important determinants (ATB, SN, PBC) were significant for 2 scenarios which were switching off PCs and using video conference (Greaves et al., 2013). However, recycling waste, PBC is not significant (Greaves et al., 2013). The investigating of implementing Area-BCM did not use TPB because the results of model are similar to TRA. It does not describe usage behaviors of using mitigation plan for disaster like usefulness of Area-BCM.

2.4 Social cognitive theory

Social cognitive theory (SCT) demonstrates human behaviors that influenced from social environment and learning experiences (Marks, 2002). The theory was created in 1986 by Albert Bandura (Van Lange, Kruglanski, & Higgins, 2011). The theory explains behavioral change by a personal sense of control (Van Lange et al., 2011). At first, he had focused on determinant as perceived self-efficacy which refers to perceived one's capabilities to deal with target behavior

(Marks, 2002). It is about personal control or deal with problems. Self-efficacy is different in each person caused from how one's think, feel or act. Then, he developed the theory an add new key determinant as outcome expectation (Marks, 2002). It refers to judgment of probability consequence such behavior will occur (Marks, 2002). Outcome expectation can be divided in 3 kinds which are physical, social and self-evaluative. The theory framework is shown in **Figure 4.**

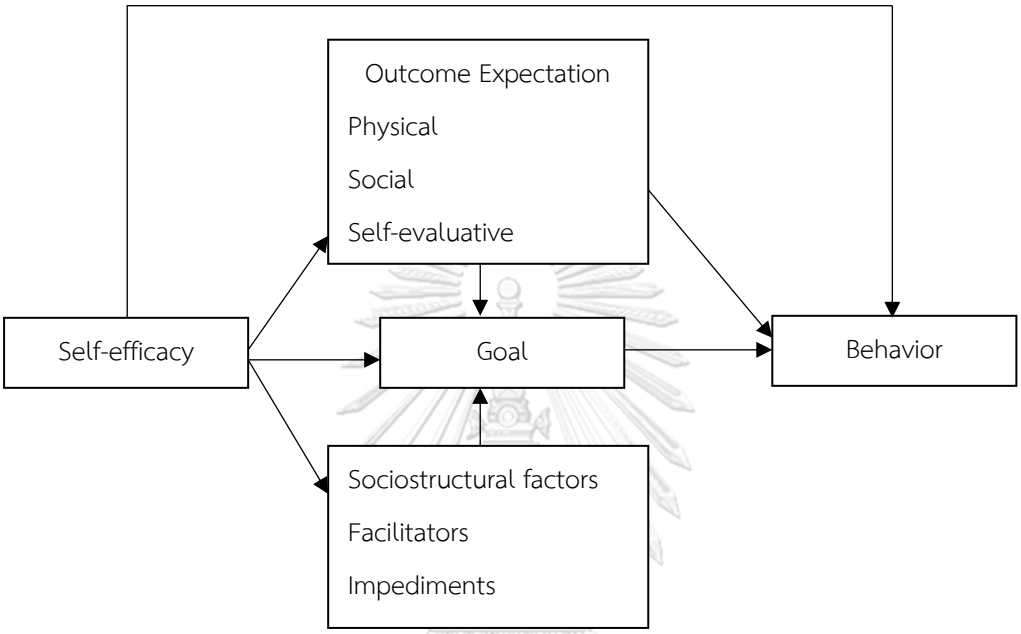

Figure 4 Social cognitive theory

Note. Adapted from "Handbook of theories of social psychology: Volume two (Vol. 2)," by Van Lange, P. A., Kruglanski, A. W., & Higgins, E. T. (2011). SAGE publications.

Self-efficacy and outcome expectation are keys factors of the model. Both directly related to behavior. Self-efficacy also influences mediated factor like goal. People who believe in themselves pretend to more motivate action. Physical outcome refers to the different from behavior change including short-term and long-term behavior (Van Lange et al., 2011). Social outcome expectation defines as expectation from social response when behavior change (Van Lange et al., 2011). Most of research showed that self-efficacy and outcome expectation are only 2 important factors for behavior change.

Social cognitive theory was used in vary ways especially in clinical, physical health and education. The theory is suitable for study behavior changing such as health practices and action plans which people already expect outcomes. SCT was used to predict physical activity and fitness in middle school children (Martin, McCaughtry, Flory, Murphy, & Wisdom, 2011). They

founded that self-efficacy, social support and gender were important determinants of behavior as physical activity (Martin et al., 2011). As mentioned before, SCT focus on social factor and self-efficacy. Therefore, it is insufficient to explain changing behaviors for protection disaster.

2.5 Technology Acceptance Model

Technology Acceptance Model (TAM) was developed from The Fishbein Model or Theory of Reasoned Action (Venkatesh & Davis, 2000). TAM describes and predicts user acceptance of technology or system for his or her target. In addition, it explains user individual intention and behavior to use technology affected by 2 significant variables (Venkatesh & Davis, 2000). It consists of perceived usefulness (PU) and perceived ease of use (PEOU) (Venkatesh & Davis, 2000). Furthermore, external variables, other factors were not mentioned in element of model such as demographic; personality characteristic; prior behavior; persuasive communication and so forth, indirectly affect to attitude toward using and actual system use through PU and PEOU. On the other hand, external variables both directly affect to PU and PEOU. These two; PU and PEOU; directly influence to attitude toward using. Moreover, PEOU has influence on PU. It implies that when technology easy to use then user will increase job performance. For performing behavior, actual system use is directly influenced from attitude towards Using. In **Figure 5** shows framework of technology Acceptance Model.

From the TAM model, the factors were defined as follow. Actual use refers individual directly using system for his or her job (Davis, 1985). Attitude toward using is defined as “the degree of evaluative affect that associates with using the target system in his or her job” (Davis, 1985, p. 25). Perceived ease of use, significantly affect to PU, is defined as “the degree to which an individual believes that using a particular system would be free of physical and mental effort” (Davis, 1985, p. 26). Last variable, Perceived usefulness means “the degree to which an individual believes that using a particular system would enhance his or her job performance” (Davis, 1985, p. 26).

TAM appropriately describes individual behavior of usage but still there are some limits such social factors were not clearly defined. Even though, social pressure may some factors driving people’s decision to use or not use technology, TAM did not include them. Since, we found that many disaster measures and technologies could support from local authorities and government (Ardaya, Evers, & Ribbe, 2017). Therefore, the implementation of Area-BCM considers

social supports such an important part. The initial TAM is still not enough for investigate individual acceptance in this study.

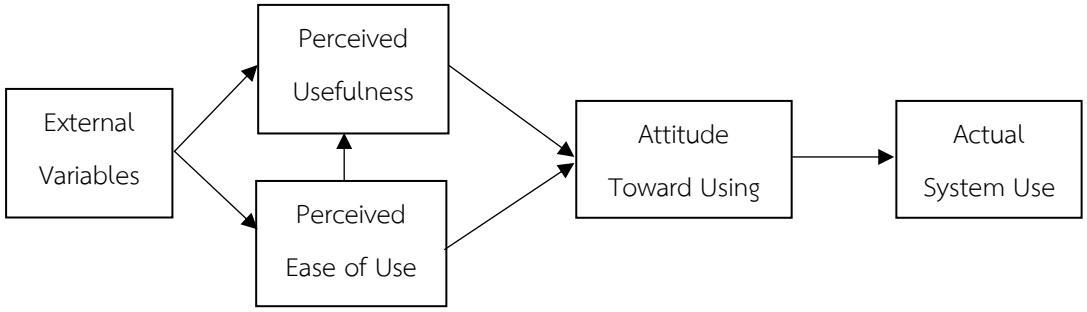

Figure 5 Technology Acceptance Model

Note. Adapted from Fred D. Davis, J. (1985). A TECHNOLOGY ACCEPTANCE MODEL FOR EMPIRICALLY TESTING NEW END-USER INFORMATION SYSTEMS: THEORY AND RESULTS. Massachusetts Institute of Technology, Massachusetts, United States.

However, Technology Acceptance Model was not stopped of development here. In 2000, Venkatesh propose an extended model called Theoretical Extension of the Technology Acceptance Model (TAM2) (Venkatesh & Davis, 2000). He developed and added a few determinants for enhance obviously predict of behavioral use. TAM2 is still used for predicting user's intention to acceptance technology. The model was changed at external variables which were limitation in previous version. The influence to perceived ease of use and perceived usefulness were divided in 2 categories which are social influence processes and cognitive instrument processes (Venkatesh & Davis, 2000). Attitude toward using is also change to intention to use. The **Figure 6** shows framework of Technology Acceptance Model 2.

The causes of accept or reject to using new technology also effect from social force. So, the model represents it as social influence processes which defined in 3 elements; subjective norm, voluntariness and image (Venkatesh & Davis, 2000). Subjective norm was defined definition in TRA. It directly influences both PU and intention to use. When influencing people around user show that they should use technology, so user pretend to use technology. Voluntariness refers to the potential adopters take the adoption decision without mandated (Agarwal & Prasad, 1997). Voluntariness affects between linkage from subjective norm to intention to use. Image define as the degree that using of new technology is perceived to increase people's job status in one's social (Venkatesh & Davis, 2000). Image is directly affected from subjective norm. In social group

of work, people who believe that he or she perform using new technology will enhance job performance, so he or she tends to outstanding or elevating status. All of these social influence processes can change by experiences over the time. Hence, experience influence on link of subjective norm and image to PU. Cognitive instrument processes were divided into 4 determinants (Venkatesh & Davis, 2000). First, job relevant refers to individual perception the degree that system is capable to his or her job and match with job goal (Venkatesh & Davis, 2000). Including, they can realize what job suiting for system. So, this determinant effect to PU. Second, output quality means how well system perform task (Venkatesh & Davis, 2000). Third, result demonstration defined as obvious results from using system or technology (Venkatesh & Davis, 2000). It has positive effect to PU implies that if people gain expected result from system, they will know usefulness of system. The last one, perceived ease of use is described in TAM above. All 4 determinants of cognitive instrument processes are influence to PU. Briefly, TAM2 describe clearly individual intention to use by add social influence and cognitive instrument processes which help us explain causes of individual use.

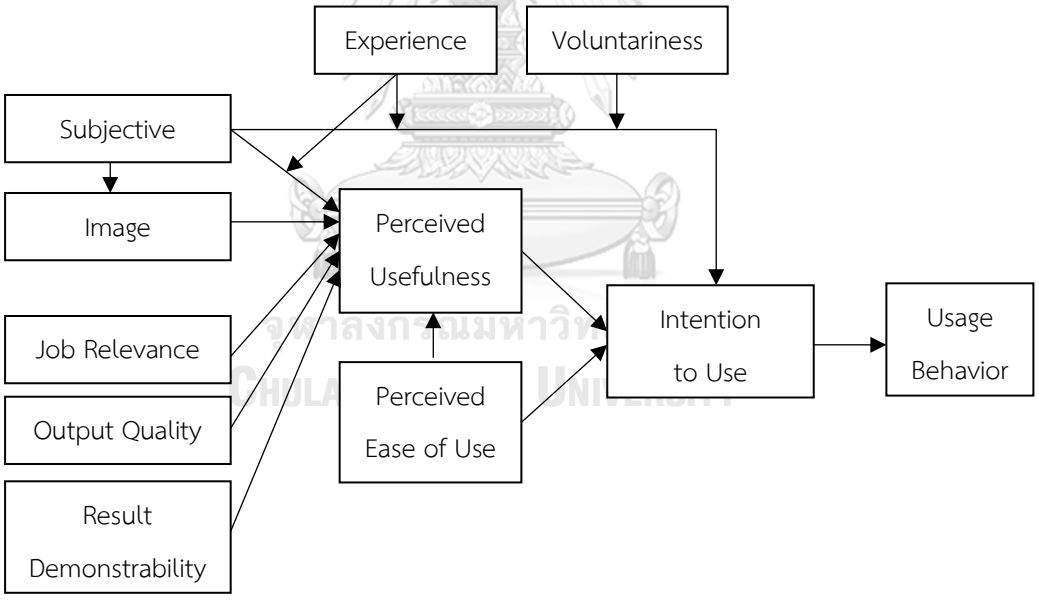

Figure 6 Technology Acceptance Model 2

Note. Adapted from "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies," by Venkatesh, V., & Davis, F. D. (2000). Management Science, 46(2), 186-204.

TAM2 was eliminated limit of TAM. So, it better describes usage behavior in case that social influence is important force in one technology over time. Almost of TAM was used in study about user acceptance new technology or system. In few years ago, it was also widely used in study social network services and smartphone such as Line and Facebook. TAM was applied with

usage of healthcare information system (Pai & Huang, 2011). The questionnaire survey among district hospital nurse (Pai & Huang, 2011). The results showed that external factors as information, service and system quality affect to intention to use through the mediating factors like PU and PEOU (Pai & Huang, 2011). For usage of social media, TAM2 was used for investigating pre-service teachers' intentions to use of social media in teaching activities (Acarli & Sağlam, 2015). The analysis founded that PU, PEOU, SN, image, job relevance, results demonstration and intention to use have significant factors on usage behavior.

The study of investigation PU on Area-BCM decide to select 2 factors in TAM2 for study individual behavior. TAM2 has good points for explanation about user behavior on technology especially in ease of use and usefulness. However, the research only focuses on PU because ease cannot be examined in this phase. In addition, subjective norm as leader supports in company and authorities support may have important role with starting implementation of Area-BCM. In perform protective behavior, experience from previous disaster is important factor as well. These factors will properly describe the intention to use Area-BCM.

2.6 Model of PC Utilization

Model of PC Utilization (MPCU) was developed by (Thompson, Higgins, & Howell, 1991). Since, computer is necessary equipment. To understand the factors that influence usage of computer effectively, this model was developed. MPCU describes the behavioral prediction of personal computer's using. The model had background theory from Triandis's theory. He demonstrated that human's behavior affected from what they would like to do, what they should do and what they had done (Thompson et al., 1991). In addition, the attitude is link to belief, feel and behavior. The main determinants of Triandis's model are social factors, affect, perceived consequences, habits and facilitating conditions (Thompson et al., 1991). Therefore, some factors of MPCU were subset of Triandis's theory and some were eliminated. All factors in MPCU directly affect to utilization of PCs. The model is shown in **Figure 7**.

Social factors directly effect to utilization of PCs which is "the individual's internalization of the reference groups' subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (Thompson et al., 1991, p. 126). It means social group think what people should do or not in some situation. For example, supervisor thinks that worker should use PCs in specific task. Next, affect defined as "the feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual

with a particular act" (Thompson et al., 1991, p. 127). In this model perceived consequences were defined into 3 determinants. First, complexity refers to "the degree to which an innovation is perceived as relatively difficult to understand and use" (Thompson et al., 1991, p. 128). It directly affects to utilization of PCs because if the innovation is difficult to adopt then user will pretend to skip using and it will be less adoption. Second of perceived consequences, job fit relates to capabilities of PCs which can enhance job performance (Thompson et al., 1991). It is similar to perceived usefulness. Third, long-term consequences of use refer to outcomes that show the results in future (Thompson et al., 1991). People may not believe that PCs could assist them in currently, but it may affect in the future. Therefore, long-term consequences are the factor that influence to utilization of PCs. Facilitating conditions were defined as "objective factors, 'out there' in the environment, that several judges or observers can agree make an act easy to do" (Thompson et al., 1991, p. 129). It may be support by training or assistance users when they feel hard to use PCs. The resistance of people who face with hard situation is one way to increase utilization as in the role of facilitating conditions.

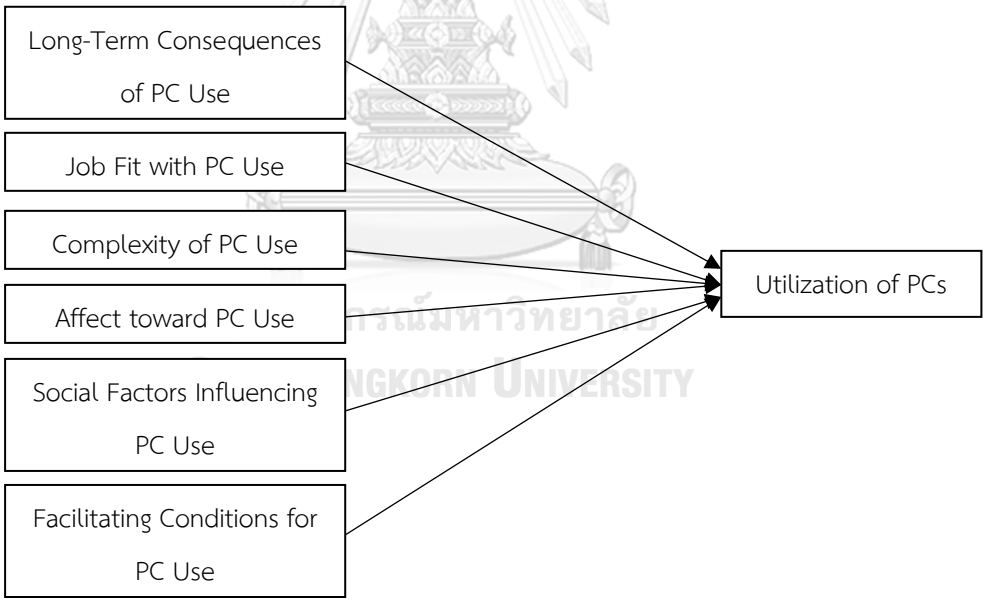

Figure 7 Model of PC Utilization

Note. Adapted from "Personal computing: toward a conceptual model of utilization," by Thompson, R. L., Higgins, C. A., & Howell, J. M. (1991). MIS quarterly, 125-143.

As the Model of PC Utilization describes adopt behavior of PCs. So, it is useful for predict individual behavior of using PCs by investigated each related determinant. However, it specific to

use on PCs behavior, then it may be not suitable for others innovation. Since 1980s, PC business had fastest growing in Saudi Arabia then MPCU was used investigating the relationship between end-users' attitudes and PC utilization (Al-Khaldi & Olusegun Wallace, 1999). The results showed that individual attitudes, personal characteristics, facilitating condition, job performance, affect and social factors had influence on PC utilization (Al-Khaldi & Olusegun Wallace, 1999). While, long-term consequence, complexity, age education, PCs owner and training were not significant factors of PC utilization (Al-Khaldi & Olusegun Wallace, 1999). The investigation of Area-BCM don't attend the factors in this model because MPCU likely to focus on usage of PCs.

2.7 Diffusion of Innovations Theory

Diffusion of Innovations Theory (DOI) was demonstrated by Rogers. It describes about spreading of new ideas to social systems. Diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 2010, p.5). There are 4 main elements of the diffusion; innovation, communication channels, time and social system (Rogers, 2002). Innovation is "an idea, practice or object that is perceived as new by an individual or other unit of adoption (Rogers, 2010, p.1). The same innovation may take action in one adopter and one situation but does not take in another adopter and difference situation. Many innovations require long time to widely spread of adoption. Perceived of Innovation depend on rate of individual adoption which influenced by 5 factors are relative advantage, compatibility, complexity, trialability and observability (Rogers, 2002). First, relative advantage refers "the degree to which an innovation is perceived as better than the idea it supersedes" (Rogers, 2010, p.15). It does not matter the innovation is advantage or not. If the innovation is more perceived, then the adoption rate will more rapidly increase. Second, compatibility define as "the degree to which an innovation is perceived as being consistent with the existing value, past experience and needs of potential adopters" (Rogers, 2010, p.15). An innovation which does not suit to the norms of social system is slower adopt than a compatible innovation. So, some innovations may rapidly spread in some social group but does not others group. Third, complexity is "the degree to which an innovation is perceived as difficult to understand and use" (Rogers, 2010, p.16). The innovation that easier to understand is more adopt than the innovation that take time or skill for learning to using it. Next factor, trialability refers "the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2010, p.16). The new ideas which are experimented pretend to more adopt because people have realize tried to use them. Conversely, new ideas that no one tried to

experiment are slower adopt. Last factor of rate adoption, observability is “the degree to which the results of an innovation are visible to others” (Rogers, 2010, p.16). The results of innovation that clearly show to others persuade social to know and adopt. In addition, the noticeable innovation which are adopted in major people is easy to find the information for adopt. It could also discuss this with the closed people who you have seen them adopt the innovation. Therefore, rate of adoption is different in individual perceived and each social system. It can more speed up by concern to the 5 important factors above.

The next element of diffusion process, communication channels refer to “the process by which participants create and share information with one another in order to reach a mutual understanding.” In addition, it means message get from one individual to another. It starts with a new idea is communicated by one person who already has experience or knowledge to another who does not adopt that new ideas before. Mass media channels such as television, newspaper and social media are rapid way to spread the innovation. However, interpersonal channels are more influent to persuade another for adopt the innovation. The new ideas are often exchange in homophilous people. Two persons who are similar in attribute like education, belief and so on are easier to share new ideas to each other and then occurs adoption. On the other hand, one of the problems in diffusion’s innovation is heterophilous. When 2 people have different background like education, work skills, social environment and so on, then communication is often ineffective. For example, some words may be technical, and some people cannot understand the meaning of words. Hence, the communication of new ideas is failed. It more effectively communicates new the ideas between 2 person who are similar.

Times is one necessary element of diffusion process. It was separate in 3 dimensions of diffusion (Rogers, 2010). First, the innovation-decision process involves with individual receive the innovation and decide to adopt or reject it. It is process of seeking information. There are 5 steps innovation-decision process; knowledge, persuasion, decision, implement and confirmation (Rogers, 2010). At first people will find information about the innovation for reduce innovation’s uncertainty and caused effect. They would like to know how it work and suit with them. At this stage, mass media channels can effectively the decision. Then, peers or closed people are influencing persuader to give them more information. New ideas from others also are influence decision stage. After that, it leads to implementation and confirmation. Second, the innovativeness of an individual unit on adoption refers to earliness or lateness that innovation is adopted. In social group, some people may earlier adopt the innovation, but some people may

lately adopt. It is because of the social status or less use of mass social channels. Members in social system are categorized in 5 groups; innovators, early adopters, early majority, late majority and laggards. The categorization is based on time that the innovation is adopted. Third, an innovation's rate of adoption in system is measurement of the number of members in system that adopt innovation by given time period. Rate of adoption is often represented in S-shaped. However, S-shaped is steeper for some innovation which slowly adopt. Because of norms, the same innovation is different rate of adoption in different social system.

Last element of diffusion process is social system which refers related units joint to solving problems and accomplish common goals such as individuals and organizations (Rogers, 2010). Social structure is different in each social system and it also affect to diffusion of innovation. The social structure represents normal human behavior in social system. Norms show individual behavior in social system. It can be a problem in diffusion when norms of social not suit to adopt some innovation. For example, polished rice is eaten by almost of Asian and United States even though whole rice is more nutritious (Rogers, 2010). In addition, opinion leaders and change agents are source of information and advice to persuade people to adopt the innovation. Influencing people can lead to spread the new ideas and make a change. The innovation can adopt or reject by decision from individual members. They may have effect from norms in system or entire social system that they conform taking decision to adopt the innovation. All of these are issues are linked between social system and diffusion process.

Diffusion of Innovations Theory is advantageous for investigate how long new ideas spread to adoption by which channels of communication in a social system. In addition, it describes how important interpersonal relationship for persuade to adopt the innovation. Peers are often influence in start taking attention with new ideas. Recently, opinion leaders are important factor to make change of behavior. It is successful to use advantage from opinion leaders in adoption. For example, medical doctors promoted weatherization of homes, and encouraging safe sex in gay communities (Robinson, 2009). Furthermore, theory indicated that different social systems are different rate of adoption because of factors like norms and education. Not only diffusion process is different but also individual behaviors are different in each innovation. No one is the same status of all new ideas. Diffusion of Innovations Theory is always used in process that need participating users in develop innovation such as computer games companies and pharmaceutical corporations (Robinson, 2009). (Mallat, 2007) used Diffusion of Innovations Theory exploring consumer adoption of mobile payments. The results

showed that relative advantage positively effects on mobile payment adoption by the reasons of avoided queues, time pressure and lack of cash (Mallat, 2007). The study of investigating perceived of use Area-BCM is not suit with DOI because Area-BCM is specific plan for coping with threats. It is not a new technology which well-known in every members of social system. Moreover, DOI focus on adoption's rate of technology like how many people use technology, how early they use technology, how long of technology spread. These are not important part in implementation of Area-BCM. Therefore, DOI is more suitable on new technology or innovation that can spread among large group of people such E-payment and E-book than disaster technology.

2.8 Decomposed Theory of Planned Behavior

(Taylor & Todd, 1995) expanded TAM and TPB in 1995. TAM is well known and widely use model in predict individual behavior of acceptance technology. However, they proposed that TAM still unclearly explain and have some limitation by 2 issues. These are (1) "whether models such as TAM are predictive of behavior for inexperienced users" and (2) whether the determinants of IT usage are the same for experienced and inexperienced users of a system (Taylor & Todd, 1995). Therefore, they added lacking determinants like social influence and perceived behavioral control (PBC) which founded significant determinants in many researches. Then they tested these issues with experienced and inexperienced group. The goals of test were to assess the expanded model and to investigate behavior of inexperienced users. Decomposed Theory of Planned Behavior (DTPB) is used for describes individual behavior in using technology but it more details with influent factors for both groups of experienced and inexperienced users. In addition, there are different influence of related factors in perform using behavior. The model has showed in **Figure 8**.

The model is based on relation from TAM and TPB but there are some different added. The meaning of each factor is defined in previous model. Subjective norm determinants behavioral intention. It was expected more influence on behavioral intention for inexperienced users because they pretend to perform intention by people in surrounded social system. Perceived behavioral control affect to both of behavioral intention and behavior. Inexperienced users with no prior experience in control, PBC may have directly affect to behavior. As mentioned in others model, behavioral intention directly affects to behavior. PU is more strong influence on attitude and behavioral intention in experience users. Furthermore, perceived

usefulness and perceived ease of use are different influent level in 2 groups. Inexperienced users were more focus on ease of use while experience users attended in usefulness of usage.

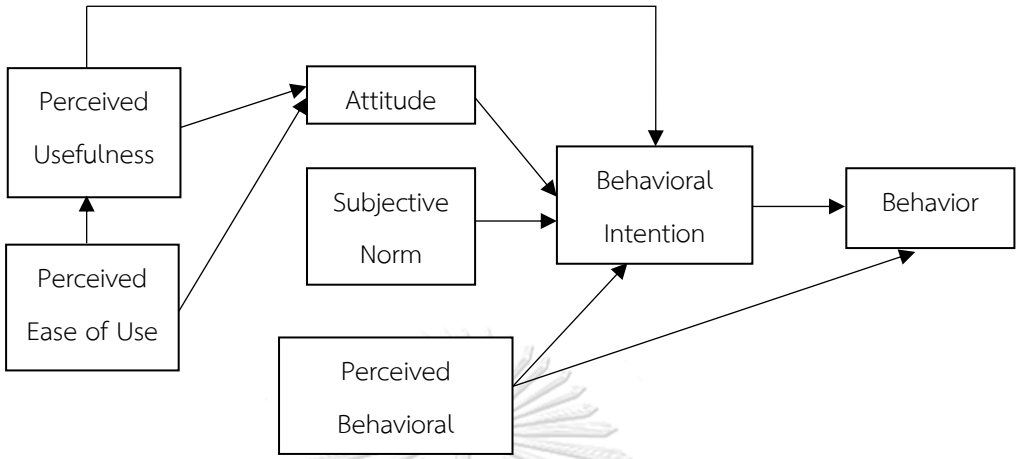

Figure 8 Decomposed Theory of Planned Behavior Model

Note. Adapted from "Assessing IT usage: The role of prior experience," by Taylor, S., & Todd, P. (1995). MIS quarterly, 561-570.

Decomposed Theory of Planned Behavior is used for describing behavior similar to TAM. It has prominent point about information technology using which focuses on effect of experience and level of strong or weak influence. Due to the factors in model may show different influence depending on user's experience. DTPB was widely used in predicting user's behavior and almost in information technology including education studies. For example, it was used for investigating the factors that predict preservice teachers' intention to use Web 2.0 technologies in classroom (Sadaf, Newby, & Ertmer, 2012). The results showed that attitude and PBC were significant factors to behavioral intention. The investigation of Area-BCM does not use DTPB because we did not highlight level of using experience on system. On the other hand, we just focus on user experience with disaster events.

2.9 Motivation Model

Robert J. Vallerand developed motivation framework, he called the Hierarchical Model of Intrinsic and Extrinsic Motivation (Vallerand, 1997). There are 2 important determinants of model. First, performing behavior in order to experience with satisfaction in activity, then it was defined as intrinsic motivation (IM) (Vallerand, 1997). Second, extrinsic motivation (EM) refers to performing behavior in order to achieve some goal like rewards (Vallerand, 1997). The model is

investigation of motivation ways in the individual like how these are related and results which affected by motivation.

In addition to IM and EM, there are other determinants in the models. First, Amotivation (AM) refers to "the relative absence of motivation, intrinsic or extrinsic" (Vallerand, 1997, p. 279). It directly affects to consequence such a behavior similar to IM and EM. Second, Social factors affect to motivation by mediators which are autonomy (interacting effectively with the environment), competence (feeling free to choose one's course of action) and relatedness (feeling connected to significant others) (Vallerand, 1997). Then, all motivation leads to outcome as behavior.

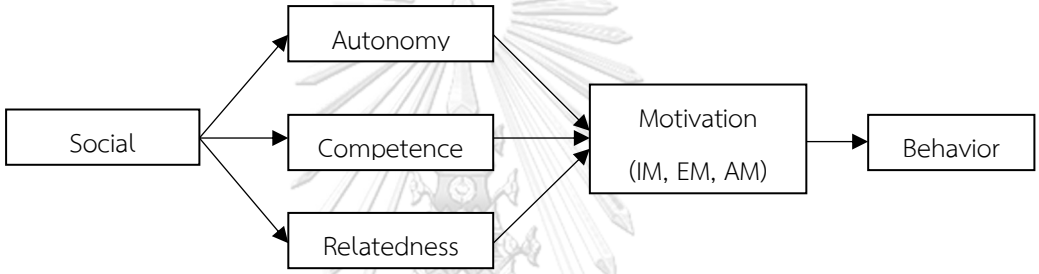

Figure 9 Motivation Model

Note. Adapted from "Toward A Hierarchical Model of Intrinsic and Extrinsic Motivation," by Vallerand, R. J. (1997). In Advances in Experimental Social Psychology Volume 29 (pp. 271-360).

Motivation model is considered in limited dimension. So, it is insufficient to describe individual motivation since the types of extrinsic motivation are different. Nevertheless, the model is useful in the studies which focus on motivational determinants and behaviors. Furthermore, the studies highlight on social factors that influent determinants to performing behavior. (Son, 2011) used motivation model for investigating employees' motivation to follow IS security policies. The survey and analysis were founded that the intrinsic motivation had more significant to employees' compliance than the extrinsic motivation (Son, 2011). Motivation model is not suitable to investigate perceived usefulness on Area-BCM because only motivation is insufficient for implementing Area-BCM. It lacks realization about usage the system.

2.10 Unified Theory of Acceptance and Use of Technology

(Venkatesh, Morris, Davis, & Davis, 2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT). It is integrated models which include eight notable models. These

are Theory of Reasoned Action, Theory of Planned Behavior, Social cognitive theory, Technology Acceptance Model, Model of PC Utilization, Diffusion of Innovations Theory, Decomposed Theory of Planned Behavior and Motivation model. All eight models are different of prominent points. Each model was widely used for studies, but selection of model sometimes may omit key points which are not included in selected model. For instance, TPB does not focus on behavior that changed by time and experience. Therefore, they combine significant points of each model for understanding the individual usage of new technology. The framework of model was showed in **Figure 10**.

The model consists of 4 key determinants which the first three determinants directly affect to behavioral intention and the another directly affect to use behavior (Venkatesh et al., 2003). First determinant, that is performance expectancy which means "the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (Venkatesh et al., 2003, p. 450). It has relation with determinants from other models such as perceived usefulness, extrinsic motivation, job-fit, relative advantage and outcome expectations (Venkatesh et al., 2003). Gender and age are moderated factor from performance expectancy to behavioral intention. Next, effort expectancy is defined as "the degree of ease associated with the use of the system" (Venkatesh et al., 2003, p. 450). It relates to perceived ease of use and complexity which is about ease to get the system, time to learn the system and so on (Venkatesh et al., 2003). Gender and age are moderator for effort expectancy, including experience. For older, it has founded that more difficult to using the system. Third, social influence refers to "the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh et al., 2003, p. 451). It performs as subjective norm, social factors and image (Venkatesh et al., 2003). Voluntariness of use is added as one moderator that relate between social influence and behavioral intention. This relation is significant when usage is mandated. The last key determinant that directly affect to use behavior is facilitating conditions. It is defined as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" (Venkatesh et al., 2003, p. 453). It is similar to perceived behavioral control and compatibility (Venkatesh et al., 2003). The two moderated influence between facilitating conditions and use behavior are age and experience. The experienced users will find alternative ways for supporting and helping of use. Furthermore, increasing age of workers tend to need more support on using system.

Since, the eight models which are mentioned before have different focuses and prominent points of factors. The Unified Theory of Acceptance and Use of Technology combine essential determinants from eight model. Then, this model is better useful for investigating behavior on technology acceptance (Venkatesh et al., 2003). UTAUT focus on analysis technology implementation in organizations (Venkatesh et al., 2003). However, some factors in UTAUT may were eliminated in other testing group. In a few years ago, the top three that UTAUT is widely used which first is usage behavior of technology and system. Second, it was used in social media which has boomed in recent year. The third, that is economics. UTAUT was used for examining determinants of online purchasing tickets from low-cost carrier (Escobar-Rodríguez & Carvajal-Trujillo, 2014). The results showed that trust, habit, price saving, facilitating conditions, performance expectancy, effort expectancy, innovativeness, hedonic motivation, and social influence were significant determinants to predict online purchasing (Escobar-Rodríguez & Carvajal-Trujillo, 2014). In addition, the most important determinants for predicting usage behavior were online purchase intention, habit and ease of use (Escobar-Rodríguez & Carvajal-Trujillo, 2014). Nevertheless, this study did not decide to use UTAUT. Due to the moderate factors as gender, age and voluntariness were not interested. Furthermore, this study highlights on using system and additional factors that affect through PU and PEOU.

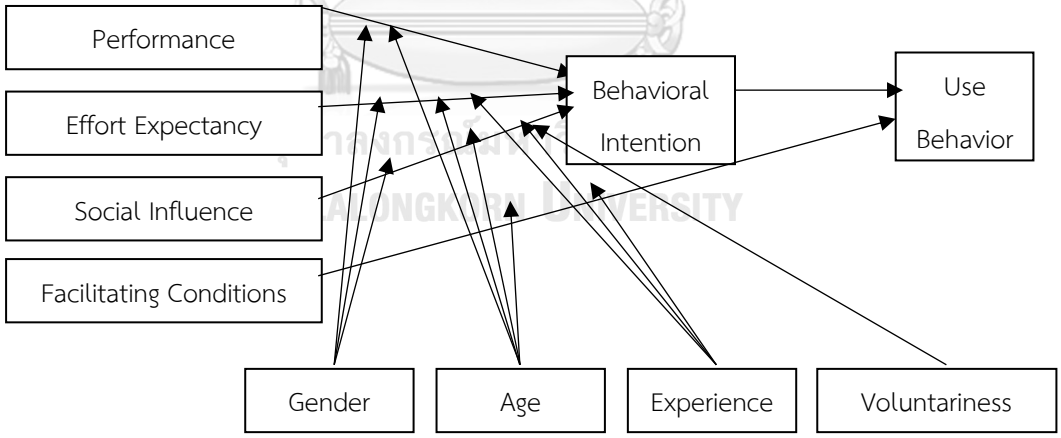

Figure 10 Unified theory of Acceptance and Use of Technology

Note. Adapted from "User acceptance of information technology: Toward a unified view," by Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. J. M. q. (2003). 425-478.

2.11 Affecting factors influence flood mitigation

Because of the storms and floods in Europe, the private households had increased implementation of flood damage mitigation measures. (Bubeck, Botzen, & Aerts, 2012) reviewed

literatures about individual flood risk perceptions and mitigation behavior by search terms in Web of Knowledge database. Risk perceptions was important factor driving private flood mitigation behavior. They defined risk perceptions into 2 dimensions as perceived probability (likelihood) and perceived consequence (severity) (Bubeck et al., 2012). Miceli, Sotgiu, and Settanni (2008) investigated disaster preparedness and flood risk perceptions in people who live in valley in north of Italy. They founded that likelihood of flood risk perceptions were positive relate with disaster preparedness (Miceli, Sotgiu, & Settanni, 2008). On the other hand, there are the studies having no significant with perceived probability such as the studies of coping flood in Germany (Thieken, Kreibich, MüLler, & Merz, 2007). The results showed perceived probability is no significant to flood mitigation behavior (Thieken et al., 2007). The flash flood awareness in southwest Virginia, perceived risk was divided into 2 issues as perceived risk to life and perceived risk to property (Knocke & Kolivras, 2007). These were represented as a perceived consequence. The results showed that perceived risk to life was cause of people pay attention to track and waring about flash flood (Knocke & Kolivras, 2007). So, perceived probability and perceived consequences were differently influent in each study. PMT explains that individual response behavior to perceived risk can be protective or nonprotective (Bubeck et al., 2012). The model indicate coping appraisal is another important key of private flood mitigation behavior (Bubeck et al., 2012). From the study of self-protect behavior, nonprotective responses like wishful thinking and denial has medium correlation with flood risk perception (Grothmann & Reusswig, 2006). While coping appraisal showed negative correlate to nonprotective but other positive with protection behavior (Grothmann & Reusswig, 2006). It can imply behavior also depend on individual coping appraisal.

In addition to flood risk perceptions, there are many factors that affect to adoption of individual protection behavior. People who have experience with real situation and directly impacted likely to prepare more coping methods. First is experience with flooding which seem to be essential factor for private mitigation behavior. Almost studies shown that experience with flooding is significantly related to individual protection behavior (Bubeck et al., 2012). The study of flood and landslide which the population living in flood risk areas in Brazil examined the influence of risk perception (Ardaya et al., 2017). From their survey and analyze, results shown that the strongest correlation on flood risk perception was flood experience which also affected on protective decision (Ardaya et al., 2017). In addition, local people who living longer in the area and had more experience with flood had higher flood risk perception in case of knowledge of

historical floods and vulnerable area (Ardaya et al., 2017). This correlation can be useful to supporting disaster management by integrated knowledge and individual experience. The assessments of people perceptions in Switzerland suggested people who had experience with flood were positively related to perceptions of flood risk (Siegrist & Gutscher, 2006). However, timing of previous flood experience may be one factor because it can assume that long time of experience from past may decrease individual perceptions (Bubeck et al., 2012). The International Commission for the Protection of the Rhine (ICPR) explained that flood awareness will be decreased after the seven years of flooding (Egli, 2002). Moreover, the long-term awareness was only catastrophic disasters (Egli, 2002). Therefore, it concludes that experience with flooding is an important factor influencing to individual protection behavior. However, it will decrease within a few years after flooding.

Emotions are one influence on decision making. Many studies revealed that worry about flooding is important factor that affect to adoption of private flood measures (Bubeck et al., 2012). Takao et al. (2004) examined the factors which affected residents with preparedness for flood in Nagoya, Japan (Takao et al., 2004). Because of the heavy rainfall, it became to the Tokai flood disaster which large damage to Nagoya city (Takao et al., 2004). The findings showed that more fearful about flood more tend to take insurance and special measure (Takao et al., 2004). Moreover, the analysis between resident's level of fear and flooding preparedness were statistically significant (Takao et al., 2004). The amount of damage in previous flood was key factor in their study as well (Takao et al., 2004).

Next, knowledge about flood is represented from risk communication and disaster knowledge. It explained whether people who get more knowledge will more prepare to flood measures or not. In addition, it could motivate mitigation behavior. Providing information may help people perceived risk and consequence. Then, it can affect intend to adopt behavior for reducing the damages. Some people have known what risk will happen their area, but they do not know how to response effectively. So, they cannot do anything, and the damages are severe as well. Many countries around the world had to face with disaster, particularly in vulnerable areas. From the survey in Thailand, disaster preparedness plan was the most preferred information following by disaster warning before flood evets (Leelawat et al., 2018). It indicated that they still lack of preparation and disaster knowledge. Therefore, individual knowledge is important issue for disaster mitigation. However, some studies found that knowledge about flood is weekly positive to flood preparedness behaviors. For example, survey of residents coping with

floods in Germany in 2002 (Thieken et al., 2007). The analysis showed that flooding experience is stronger relate with private precautions than knowledge about flood which is lower relate (Thieken et al., 2007). In addition, the survey suggested that the specific information for different groups will be useful (Thieken et al., 2007). Therefore, knowledge is not always good factor predicting individual protection behavior. In addition, people should receive risk information and coping method that is appropriate with their communities.

Socioeconomics and geographic factors are represented as age, sex, income, education and so on. Ownership founded to be small to medium influence on protection behavior (Bubeck et al., 2012). In the study of flood in Germany in 2002, ownership of building is weekly significant for flood-proofing measures (Thieken et al., 2007). Since, tenants do not have full capability to proof the building, they have to ask the permission for changing the building from owner. Lindell and Hwang investigated perceived personal risk and response in three hazards as flood, hurricane and toxic chemical release in Texas (Lindell & Hwang, 2008). From the collected data and analysis founded that socioeconomics and geographic factors were different in level of significant. Income was significantly to adoption of only wind mitigation measures (Lindell & Hwang, 2008). Female related to perceived personal risk of three hazards (Lindell & Hwang, 2008). On the other hand, income was negatively related to all three hazards (Lindell & Hwang, 2008). However, only a few factors of socioeconomics and geographic factors are insufficient for predicting private mitigation behavior. Next is obstacle for private protection which there are vary factors such as compensation from government, hopelessness, fatalism and high cost (Bubeck et al., 2012). All of these factors were negatively significant to protective behavior (Bubeck et al., 2012).

Perceived effectiveness and coping appraisal had correlation value from small to medium on mitigation behavior (Bubeck et al., 2012). The key factors that influenced motivation of coping with flooding in Netherlands were investigated (Zaalberg, Midden, Meijnders, & McCalley, 2009). The assessment was question about perspective of perceived response and self-efficacy in different coping actions (Zaalberg et al., 2009). Furthermore, impediments of coping appraisal such as lack of knowledge, insufficient time and money were asked (Zaalberg et al., 2009). The analysis in 2 groups; victims and nonvictims found that threat appraisal and coping appraisal be stronger factor for explain victim's intention to take adoptive behavior than group of nonvictims (Zaalberg et al., 2009). In conclusion, risk perceptions are almost positive to private protection behaviors, but they were sometimes weekly positive.

Even though, a lot of researches focused on investigation of factors related with flood mitigation behavior in household. This study will find intention to use disaster coping system in company in industrial area. Therefore, some factors may have different influence.

2.12 Area-Business Continuity Management

Natural disasters become more tremendous losses and damages on economics (Baba et al., 2013). When business operation is disrupted causes by natural disaster, it takes time to recover and back to normal operation (Baba et al., 2013). The recover process will require the long-time if there is no preparation for emergency events. The causes come from vary factors such as personnel, machinery and insurance claims (Baba et al., 2013). Other indirect effects to recover process were lack of demand on market share, loss of supplies and transportation difficulties (Baba et al., 2013). For example, the large disasters were the Great East Japan Earthquake and the 2011 Flood of Chao Phraya River in Thailand (Ardaya et al., 2017). These two disasters not only affected to local economics. It also affected regional and world economics because the operations were disrupted (Ardaya et al., 2017). Moreover, the supply chains were widely affected (Baba et al., 2013). So, the plan improving economics resilience had been proposed as business continuity planning (BCP) and business continuity management system (BCMS) (Ardaya et al., 2017). A business continuity plan is a documented plan that describes preparatory actions to continue or quickly re-establish core business in an emergency situation (Baba et al., 2013). It explains how to response and recover with emergency case by individual company. A business continuity management is a holistic management process (ADPC, 2017). It is identification of potential threats and impacts to business operations (ADPC, 2017). In addition, framework will be provided for building organization resilience with effective response among stakeholders (ADPC, 2017). It refers to any abilities that aim to achieve business continuity by considered the essential parts in company for protect company's production, information, equipment and employees (Ardaya et al., 2017). The BCP and BCM are standardized from ISO22301 and adopt in many companies around the world (Ardaya et al., 2017). The private company showed that BCP/BCM reduced damages and rapidly restore business operation (Baba et al., 2013). However, there are a small number of companies who are interested and implement BCP/BCM. Furthermore, the large disasters also have impacts to road as transportation route, public utility, infrastructure, surrounding area and so on. The company that implement BCM may maintain the operation and resource in company but cannot control external resources as mentioned before. So, the private company who adopt BCM may be insufficient because it

not clearly covers some resource. For instance, the resource come from surrounding areas as water and power supplies. The 2011 flood of Chao Phraya River in Thailand is an example that private company halted the operation because of lacking parts from suppliers (Haraguchi & Lall, 2015). Furthermore, it affected to world economics making tremendously losses.

ASEAN is growing development area of industry. There are many industry agglomerations in each country. In addition, they had been nearly located to river and coastal areas which are convenient transportation and vulnerable to face with natural disaster such as flood. In order to minimize economics impacts, JICA and AHA center studied about disaster risk management and developed the new concept named Area business continuity plan (Area-BCP) and Area Business continuity management (Area-BCM). It was expected to strengthen the resilience of local and world economy (Ardaya et al., 2017). First, Area-BCP is adopted from Area Command under the National Incident Management System (NIMS) of FEMA (Baba et al., 2013). NIMS is an organization managing the large incidents. They use Command System for manage teams to identify and priority critical resources among vary incidents including making coordinate actions (Baba et al., 2013). Area-BCP is a coordinated framework and direction in mitigate and response with disaster among stakeholders, private company, industrial area, local community and administrators of the relevant infrastructure (Ardaya et al., 2017). It is used for protecting company from direct and indirect damages. Particularly, it prevents company's core business and external critical resources which are necessary in supporting business operation (Baba et al., 2013). The example of internal and external resources are represented in **Table 4**. The word of Area cannot identify because it depends on the magnitude of disaster and size of stakeholder's coordination (Baba et al., 2013). So, it should be flexible. The one company implementing Area-BCP could become a bottleneck within company because the external resources are disrupted (Baba et al., 2013). So, the aim of this plan is to enable and promote business continuation of the whole industrial area. Moreover, it is expected to gain more value for development among industrial agglomeration. In conclusion, there are 2 aspects of Area-BCP concept which first is cooperation with vary sectors in area for preparedness and prevention with disaster. Another is coordination in critical resource management (Baba et al., 2013).

Table 4 Examples of internal and external resources

No.	Example	Internal Resources	External Resources
1.	Human	Manager, Workers, Employee	Public officers, Community, Neighboring Company
2.	Substance	Building and facilities, Equipment, Part and raw materials, Fuels	Energy and water supplies, transportation road, Airport, Port
3.	Finance	Money and assets, Account system, Insurance	Bank, Fund, Stock market
4.	Information	Computer systems, Business documents	Internet, Communication system

Note. Adopted from "Area Business Continuity Management, a New Opportunity for Building Economic Resilience," by Baba, H., Watanabe, T., Nagaishi, M., & Matsumoto, H. (2014). Procedia Economics and Finance, 18, 296-303.

Second, Area-BCM defined as "a cyclic process of sharing risk information or impact estimation, determining the strategy, developing the Area-BCP, implementing preparedness measures and effective recovery actions and monitoring to continuously improve the Area BCM system, in coordination among stakeholders, in order to improve the capability of effective business continuity in the area." (Baba et al., 2013, p.298) The Area-BCM cycle consist of 5 elements shown in **Figure 11**. It is a management process that helps to manage risks and early recovery of business (AHACENTRE, 2015). Area-BCM focus on improving the resilience of business in the whole area (AHACENTRE, 2015). it is promotion of coordination with other industrial agglomerations and other critical areas for common goals and quick restoration including effectively (Baba, Watanabe, Nagaishi, & Matsumoto, 2014). Participating with Area-BCM is a chance to start or raise private company's BCM (AHACENTRE, 2015). Furthermore, it is opportunities to enhance the strategic operation with business risks and sustainable growth of all parties (Baba, Watanabe, Nagaishi, & Matsumoto, 2014). Finally, the process of Area-BCM can lead to enhance the resilience of economy in the area as whole and reflect to asset value of investment (AHACENTRE, 2015).

JICA formulated the Area-BCM in three pilot areas in ASEAN as Indonesia, Philippines and Vietnam (Baba et al., 2013). These pilot areas were vulnerable to disasters such as earthquake, tsunami, flood and others (Baba et al., 2013). In addition, these areas are growing of the industrial agglomeration. After the risk assessment and business impact analysis, the project identified dominant disaster and possible scenarios of impacts in business areas (Baba et al., 2014). For instance, they did simulation from flood data in Bekasi-Karawang industry area in Indonesia. The results showed that some cities, sections of road networks and two electric substations are inundated (Baba et al., 2014). The scenarios were shown then workshop to motivate stakeholders in the areas. After that, the public and private sectors discussed about business impacts and tried to enhance disaster management capacity (Baba et al., 2014). Finally, they intend to use BCP/BCM for protect their companies (Baba et al., 2014).

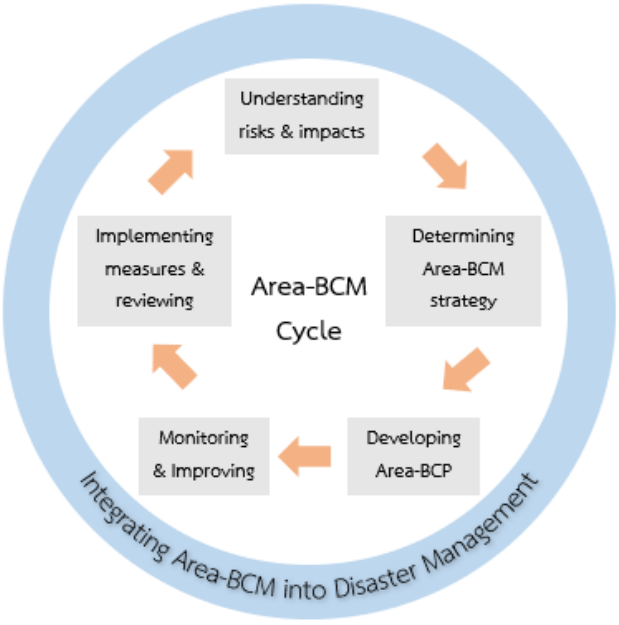

Figure 11 Area-BCM cycle

Note. Adopted from "Area Business Continuity Management, a New Opportunity for Building Economic Resilience," by Baba, H., Watanabe, T., Nagaishi, M., & Matsumoto, H. (2014). Procedia Economics and Finance, 18, 296-303.

Since, technology is an important tool dealing with disaster events. Therefore, JICA is going to establish Area Business Continuity Management (Area-BCM) system project at industrial complexes in Thailand. This is collaboration among Thailand-Japan institutes, private and public sectors. The project concept highlights on 3 major issues which are technology, social science and life & well-being science. It is analysis and design the online system using cloud to establish platform to enhance disaster resilience at industrial area in Thailand. The system covers business

impact analysis, creating precise flood model and online sharing system. It requires a coordination of stakeholders among companies, local community, infrastructure providers and government administration. The system relates with three sustainable development goals. It aims to improve economic growth, enhance safety to industrial area and communities and manage the risk of climate change. Since, this project is in the process finding collaboration. Therefore, this study would like to investigate what factors influence people to perceived usefulness of Area-BCM for enhancement of resilience.

2.13 Disaster application

Because of the disaster damages affect to human in many ways. So, the mitigation is important to decease these losses. Recently, technology is widely used to support disaster protection. For example, GIS providing visualizing data is used in spatial survey such as risk area. In addition, technology is used in forecasting probability and consequences. It supports people who live in risk area could prepare in time. GIS was combined as system to support working of counter disaster officers. It was focused on interaction between officers located at headquarter and site survey (Sakuraba, Ishida, Ebara, & Shibata, 2015). The tailed wall system showing current disaster situation was designed for resource decision support. Moreover, the system provided individual map and task through personal device (Sakuraba et al., 2015). The system design highlighted on ease of use and information handling (Sakuraba et al., 2015). Main users are government who work in specific task. The damaged report will be sent from site to each agency. Then, wall was designed to coordinate work with other agency such as government in town/city/village level (Sakuraba et al., 2015). This wall is very support decision makers particularly in current status. Technology also facilitates people communicate each other easier. It is essential in order to communicate with people during disaster situation. People could always catch up updated information. Since smart phone and social media play as important role nowadays, mobile application named AppLERT was developed and used as disaster notification in Manila, Philippines. Users can request help through application when disaster happen (Fabito, Balahadia, & Cabatlao, 2016). It supports sending report, rescue and location to all of help center, family and others. They also suggested that comprehensive information encourage emergency person manage with upcoming risk and coming timely with effectively (Fabito et al., 2016). Many messages and photos are frequently posted to social media such as Facebook and Twitter in during and after the disaster. Crowdsourcing application was used to collected disaster data for supporting disaster relief (Gao, Barbier, & Goolsby, 2011). It coordinates system among public and

organization which information and map sharing are allowed (Gao et al., 2011). Crowdsourcing is advantage which are immediately collected data from various sources (Gao et al., 2011). Even though, it can provide disaster information accurately and timely, but many applications lack of collaboration tools, needed information and security (Gao et al., 2011). Therefore, crowdsourcing application showing crisis map was developed (Gao et al., 2011). It shows visualizing data that people could select to see in map such as available service, disaster area, evacuation center, rescue request and so on. It is useful tool for human assistance.

Since, Area-BCM system is going to develop crowdsourcing application for sharing information. The users will be stakeholders in Rojana industrial area. The system is operated by collaboration among government, research institute and organization. It focuses on support private company manage with flood and share information to stakeholders. Therefore, the survey data and analyzed results from model will be used as based requirements and guideline to develop user interface.

2.14 User interface Development

The Area-BCM project is planning to develop online system platform for disaster information sharing. The system will be implemented with stakeholders in industrial area such as private company. So, the results from investigation of affecting factors could be useful for user interface design in this project. It is used as guideline developing effective interface for disaster risk reduction. In addition, the testing of preferring data would support researchers to manage interface as well. The user interface as web applications require more extensive and details in requirement engineering process because of the varies stakeholders, requirements and business processes (Escalona & Koch, 2004).

Requirements engineering is process of elicitation, specification and validation users' requirement (Escalona & Koch, 2004). In a standard software development process, requirements elicitation is tested by several methods. For example, interviewing is traditional and frequently applied technique which is able to understand the problems and get information (Escalona & Koch, 2004). Brainstorming is group meeting and collecting ideas from all of stakeholders. Questionnaire and checklist, which is used in this study, it can get information independently, but researcher have to prepare certain knowledge about problems and application for conducting questionnaire (Escalona & Koch, 2004). In case of requirements specification, prototypes are valuable tool for providing context and processes which users could more understand the whole

system. Therefore, this study will design mock-up interface based on affecting factors and survey's requirements. Validation for prototype often consist of partial set of functional requirements but provide vision of user interface. For example, the development of nursing user interface screens applied user-centered methods to elicit nurses' perception of functional requirements (Hyun, Johnson, Stetson, & Bakken, 2009). They used brainstorming about nursing document, features and function. Then, nurses and informaticians collaborated to design user interface screens for three nursing templates by using white board and post it (Hyun et al., 2009). The prototyped user interface screen was implemented in web development tool as Dreamweaver based on resulted design. After that, end-user evaluation was tested about prototype user interface by five nurses. In addition, questionnaire developed based on TAM was used for test perceptions. All nurses rated agree or strongly agree for all items excepts two; system would enable me to complete my documentation tasks more quickly and system is not missing critical data elements (Hyun et al., 2009).

Cultural differences are also important issue in user interface design. The study of culture in interface acceptance examined users' specific design preferences (Evers & Day, 1997). They developed research model combined TAM with cultural preferences such as uncertainty avoidance, collectivism and universalism. In addition, they added interface design features in questionnaire. The results shown that Asians is uncertainty avoiding group, value relationships and trust which these are different from Australians (Evers & Day, 1997). Asians prefer soft color, fixed menu, text-based and so on (Evers & Day, 1997). The important significant was cultural specific design preferences related to system usefulness (Evers & Day, 1997). The study about preferences and expectations of different cultures through Hofstede theory found some influences in user interface and Web design (Marcus & Gould, 2000). Power distance is able to affect access to information, organize information and hierarchies. For example, manager can access for all information, but it is not for non-manager. Individualism-Collectivism may different in materialism and achievement of social-political agenda including emphasize of changes. For instance, USA, which is high individualism, website features emphasis on visitors, goals and possible actions. While, Costa Rican which is low individualism highlight on nature and slogan for national agenda. Masculinity-femininity are also expressed in interface as well such as roles, gender and graphics. For high uncertainty avoidance, people prefer simplicity, clear processes, navigation schemes and redundant cues. The example of two airline website between British (low UA) and Belgium (high UA) shown differences of complexity. These issues represent the

differences for developing user interface design related cultures. Hence, it is one important issue when researcher would like to develop interface.

After the design interface based on user's requirements, the processes of interface evaluation are needed in order to help developer gain prototype feedbacks. Testing with real users could support understanding of user behavior with users state or actions. Then it could be used to improvement and develop for more fit again. The evaluation could be both of qualitative/quantitative and formative summative with different advantages. First, formative is suitable with the early stage of design which need comments from users or experts to improve the design (Stone, Jarrett, Woodroffe, & Minocha, 2005). Then, method of formative is qualitative testing. On the other hand, summative is tested with finalize design comparing with other designs. So, the method is frequently quantitative, but it can be qualitative as well (Stone et al., 2005). Qualitative method is based on observation such as interview which testing users are around 5-15 persons (Stone et al., 2005). While, quantitative method consists of more complex processes, it is metrics based (Stone et al., 2005). In Human Computer Interaction (HCI) research, there are several techniques in both of quantitative and qualitative. For example, case study is useful tool that can get requirements deeply insight small samples (Scholtz, Cilliers, & Calitz, 2010). The case study method provides questions as Why, What, How. However, the results may lack of standard distribution (Scholtz et al., 2010). Next, usability testing is method that representative samples or experts test the interface to meet usability requirements (Scholtz et al., 2010). Surveys are frequently used to explain behaviors (Scholtz et al., 2010). Open questions help interview to better understand users and more flexible. Nevertheless, problems are question related satisfaction is hard to validate (Scholtz et al., 2010). Time diaries technique is observing how user organize their time on task (Scholtz et al., 2010). For testing, users are asked to record the whole actions. It is useful for study reasonably consequent actions. Moreover, this technique provides less error of data collection. In Enterprise Resource Planning (ERP) evaluating, quantitative combined qualitative technique was used in observing users' behavior with interface (Scholtz et al., 2010). They had identified five criteria of ERP usability issues as navigation, presentation, task support, learnability and customization (Scholtz et al., 2010). Then, quantitative data was confirmed by qualitative as open questions which increase more clear details from users. Sexual health mobile application facilitated clinic management as self-testing and self-management was designed (Gkatzidou et al., 2015). The interface was tested with qualitative method by categorized participant into nine groups (Gkatzidou et al., 2015). The four key issues of interface

design requirement were privacy and security, credibility and legitimacy, user journey support and technology fit (Gkatzidou et al., 2015). The participants were interviewed in each issue. They found that privacy is the major concern especially others looking their appearing messages on phone, but security was not perceived (Gkatzidou et al., 2015). For credibility as service provider, it could enhance individual adoption to technology (Gkatzidou et al., 2015). They suggested application should provide clear information what they need to input in order to avoid error (Gkatzidou et al., 2015).

In this study, requirements elicitation was used method of questionnaire and checklist. It collects important required data from sample users. Then, mock-up prototype will be developed based on data requirements by use Axure. It is a design tool on web application providing various features to develop interface. For evaluation, research is focused on qualitative since it is initial stage of interface design. Owing to that we would like get comments from real users for improvement.

Chapter 3 Research design and methodology

3.1 Research model

The research model is developed from related factors base on TAM2. From literature review about flood mitigation behaviors, some factors are eliminated because they are not appropriately to examine perceived usefulness of Area-BCM. In addition, we added other reviewed factors that have influence on flood awareness behavior. Consequently, we have five factors describing perceived usefulness on Area-BCM in industrial areas. The propose model is shown in **Figure 12.**

3.1.1 Subjective Norm (SN)

Subjective norm or called social influence is one factor affecting on PU. It is individual behaviors affected from other's thought. In this research, we consider subjective norm into two aspects as descriptive and injunctive norms. Descriptive norms referred to beliefs about what is done by most people in one's social group (Lapinski & Rimal, 2005). On the other hand, injunctive norms referred to one's belief pressure others to perform behaviors (Lapinski & Rimal, 2005) Because of using measure of technology for disaster mitigation, user behavior could be affected from large group of people in social and pressure in authorities as well.

3.1.2 Worry About Flooding

This factor represents individual negative feeling to flood. It expresses feeling of worry that causes from damages and losses in flood event. For example, people worry that their life, family and properties will be serious damaged from the large flood. Worry could lead to preparedness behavior such as insurance purchasing in household (Takao et al., 2004). We have concerned in both past and future feelings. It will use to explain how worry feeling affect adoption behavior.

3.1.3 Flood Hazards Knowledge

Knowledge for disaster management was divided into two types. First, local knowledge which is tacit knowledge, it is knowledge gathering from communities and developed over the time including beliefs, perception and experience with disaster (Badpa, Yavar, Shakiba, & Singh, 2013). Secondly, international knowledge was referred as explicit knowledge which is a process of learning or reading through collected information by individual (Badpa et al., 2013). In this study, flood hazards knowledge is considered in both of tacit and explicit sides. It concludes inherited behavior, flooding experience, disaster information, learning knowledge and training. Individual

behavioral adoption could be affected from past experience. Moreover, hazard knowledge motivates people to aware with risk and lead to preparation. People who received disaster knowledge or disaster information about protection had more interest in mitigation behaviors than who did not (Nox & Myles, 2017). It is crucial to support information for people.

3.1.4 Experience

In this study, experience is represented about past flood disaster event which will affect to intention to adopt behavior. For example, we consider it as previous flood events, damages and activities in past situation. However, in TAM, experience refers to experience in using technology and it affects to relation between subjective norm to others. As s results, it is considered in different influence.

3.1.5 Perceived Usefulness

The definition of PU is described in literature review part. This factor shows people perceived usefulness of using Area-BCM for business continuity and disaster management. It is individual beliefs that the system will enhance organization's capacity of response with flood including other organization's goal.

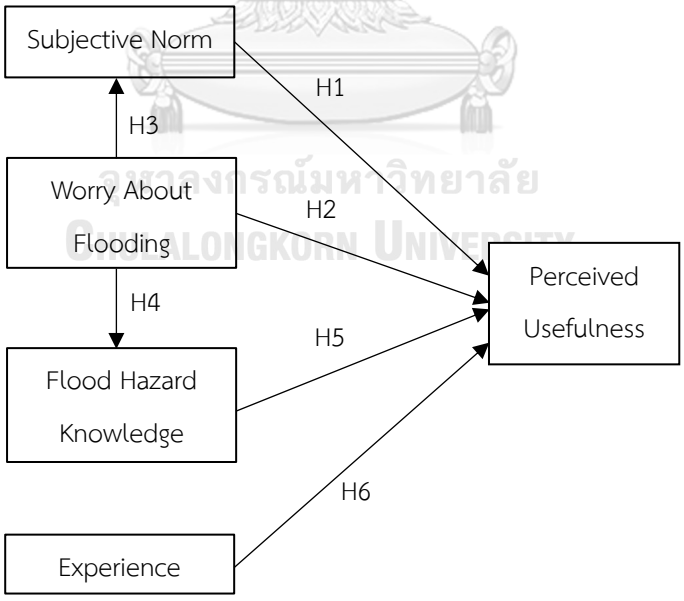

Figure 12 Proposed research model

3.2 Research hypothesis

Many popular technologies are widely used because it is trend in social groups. Family, friends and neighbors could be influencer with new users to adopt the technology. In addition,

leaders in community or organization are also motivators presenting how technology can help people coping with disaster. The video of emergency planning was produced for descripntion of safety actions and individual responsibility in campus (Skurka, Quick, Reynolds-Tylus, Short, & Bryan, 2018). The factors' testing shown that injunctive norms had significantly positive to intention to take protective behaviors (Skurka et al., 2018). This emergency video encouraged students for protection themselves. It implies leader command affect to protective behavior. For investigating homeowners' mitigation behaviors with wildfire protection, subjective norms were found to be predictors (Nox & Myles, 2017). As same as the case of flood risk perception in Brazil, local influence as neighbors, family and friends was one factor affecting prevention measures (Ardaya et al., 2017). In organization, the influence among peers had directly affected to software adoption as wll (Prasanna & Huggins, 2016). After major earthquake in Nepal, the household were survey for investigation of disaster preparedness (Adhikari, Paton, Johnston, Prasanna, & McColl, 2018). The analysis presented community and institutional factors be predictor of hazard preparedness (Adhikari et al., 2018). These resultes indicated social influence affect people to prepare for disaster. It might lead them to aware about usefulness of using any IT for disaster management. The command in organization or government policy can affect to know and learn more with mitigation system. However, there is no research using subjective norm to investigate about flood protection and business continuety in industrail area. This factor may be different in perspective of employees between usefulness of flood protection for themselve and their organization. Consequently, the research hypothesis one is construct as follow.

H1: Subjective norm positively affect on perceived usefulness.

Worry about flooding is mentioned in the studies that affect to responsive behavior with disaster. People who have fearful feeling pretend to perceive importance of measure and take insurance (Takao et al., 2004). After flood event, they found that the amount of damages had significant with taking coping measure for future flood (Takao et al., 2004). As same as the research of individual decision to insure themselves from flooding losses, feeling was the most important issue (Zaleskiewicz, Piskorz, & Borkowska, 2002). These studies indicated that feeling is related with individual protective behavior. On the other hand, the feelings of worry were examined in disaster preparedness in valley of Italy (Miceli et al., 2008). The results differently shown there was not significant relation between feelings of worry and preparedness (Miceli et al., 2008). In addition, there is no research indicated whether individual worry affect on PU in implementing management plan with company or not. So, this study would like to investigate

how worry about flooding affect PU of implementing Area-BCM project. So, we assume worry about flooding will influence PU as hypothesis2. Moreover, when people have worry, then they tend to rely and received information from others. So, major people in company and their leaders could lead them to PU. As a result, hypothesis 3 is set. Moreover, worry about flooding can motivate respondents to more preparedness. Since, they worry the future flood will impacts them. They will try to take measures for protecting themselves. As a result, hypothesis4 is defined.

H2: Worry about flooding positively affect on perceived usefulness.
H3: Worry about flooding positively affect on subjective norm.
H4: Worry about flooding positively affect on flood hazards knowledge.

Flood hazard knowledge could motivate mitigation behavior. Providing information help people perceived risk and consequence. Then, it may affect them perceived usefulness and decide using technology for disaster mitigation. Some people have known what risk will happen in their area, but they do not know how to response effectively. So, they cannot do anything, and the damages are severe. Then, it is important to raise knowledge about protecting method. In addition, the illustrate of technologies' benefits is important as well. Individual knowledge about flooding causes were found to be negative related with mitigate behavior (Botzen, Aerts, & van den Bergh, 2009). It showed people who perceived less causes were more likely to buy protection tools (Botzen et al., 2009). The survey of households in German indicated that flood hazard knowledge related with mitigation behavior (Thieken, Petrow, Kreibich, & Merz, 2006). In addition, it illustrated informing information and risk could enhance individual preparedness. Bangladesh frequently happen flooding which make losses every year. As a result, the investigation of affecting factors related flood reduction was constructed (Ganguly, Nahar, & Hossain, 2019). Disaster knowledge management was concluded to be the influent factors of effective preparedness (Ganguly et al., 2019). Flood risk communication strategies integrating social networks were proposed for prepare and encourage adaption to climate change (Haer, Botzen, & Aerts, 2016). The agent-based model was used for examining the effectiveness of individual flood risk communication and influence of social networks (Haer et al., 2016). The results revealed communication flood risk with coping method was more effective than communication without other knowledge (Haer et al., 2016). So, informing risk is not enough, but people should know how to cope with it for effective mitigation behaviors. It will be more useful if people know how to protect themselves. The survey about flood information in Thailand point

out disaster preparedness plan was the most preferred (Leelawat et al., 2018). Although, flood knowledge could affect people to protect themselves. However, flood hazards knowledge did not be surveyed affecting on PU in implementing plan in company. Therefore, flood hazard knowledge including flood information cloud affect awareness and adoption behavior. Then, this study considers it as factor affecting perceived usefulness. The following hypothesis is set.

H5: Flood Hazard Knowledge positively affect on perceived usefulness.

As the review, experience is one factor influencing protective behavior. People who have experience with real situation and directly impacted likely to prepare more coping methods. Flood experience had relationship with protective decision (Ardaya et al., 2017) Although, people who had experience were positively related to perceptions of flood risk, but it can decrease over the time (Egli, 2002; Siegrist & Gutscher, 2006). Experience was found to be the most important motivation for private precautions (Thieken et al., 2007). So, it implies they perceive usefulness of mitigation plan after they have faced with flood. Moreover, the survey of households in inundated area presented flood experience was significant factor for flood mitigation (Kreibich, Thieken, Petrow, Müller, & Merz, 2005). As we see, the individual experience has effect on protect themselves from flood. However, we do not know that individual experience will affect PU about implementing Area-BCM in industrial area or not. Then the hypothesis is defined to test the affecting.

H6: Experience positively affect on Perceived Usefulness.

3.3 Methodology

3.3.1 Items development

The questionnaire is designed on the basis of literature review about factors in TAM and affecting factors influence flood mitigation. The two factors which are selected based on TAM are subjective norm and PU. For these factors, the questionnaire will focus on asking individual attitude through perceived usefulness of using Area-BCM. These factors are variously used in study about acceptance of using technology or system. Items of PU consist of benefits related with using Area-BCM in industrial areas. For example, system enhances effectiveness in response with flooding, increase promoting among stakeholders and help company to increase resilience (Venkatesh & Davis, 2000). Subjective norm's items are one's though who are important or closed people affects to another people (Venkatesh et al., 2003). So, the question is related to major's though in company affect individual though. In addition, it likes buyers who are important for

company think that company should implement any systems in order to continue their business. Then, respondents also think that company should. Furthermore, it includes supporting from social groups and effect from other companies. Therefore, item is about if there is any supporting from others, how affect respondent intent to use plan (Venkatesh et al., 2003).

Next, three factors are additional factors from literature review about flood mitigation behavior. These are specifically used to ask individual flooding behaviors. First, experience is questions about previous experience and the number of stated questions. Items started with experienced flood which we would like to know whether people have faced with flood or not (Thieken et al., 2007). Then, the respondents are asked about experiences in term of properties and home damages (Lindell & Hwang, 2008). Moreover, the evacuation in flooding events is asked (Wouter Botzen & Van Den Bergh, 2012). In this factor, we will investigate how previous experience affect to intention to use system for flood mitigation. Second, additional factor is worry about flooding. Respondents are asked to think about future flood and then concerns with that situation (Siegrist & Gutscher, 2008; Zaalberg et al., 2009). The emotion as panic when coping flood is included in items (Zaalberg et al., 2009). In addition, they have to rate with negative feelings with large flood in past (Siegrist & Gutscher, 2008). Third, knowledge about flood hazards is related with people's protective behavior and their information. The items' contents are preparedness actions for flood events. For example, there are training participation, be a part of emergency planning and acknowledge what to do when flooding (Thieken et al., 2007). The receiving risk information is also important which enhance personal responses (Lindell & Hwang, 2008).

All items are constructed based on review (Acarli & Sağlam, 2015; Lindell & Hwang, 2008; Miceli et al., 2008; Pai & Huang, 2011; Siegrist & Gutscher, 2008; Thieken et al., 2007; Venkatesh & Davis, 2000; Venkatesh et al., 2003; Wouter Botzen & Van Den Bergh, 2012; Zaalberg et al., 2009). Each factor contains three items. Furthermore, review of model characteristics, it shown that the number of factors is average around eight and item is 27 (Ringle, Sarstedt, & Straub, 2012). It implies one factor per 3 – 4 items. This study selects the interesting questions and then adapts to fit with questionnaire of Area-BCM.

3.3.2 Questionnaire design

All items of factors except experience are measured a five-point Likert scale as; 5 = strongly agree, 4 = agree, 3 = neither, 2 = disagree and 1 = strongly disagree. Experience is

collected as yes-no questions for 4 items as well. Most of the factors' scales adopt from the original literatures. However, there are many items are modified to fit with proposed model and resulted analysis. Moreover, questionnaire consisted of ranking and opened questions. In case of response, the respondents must watch the video clip explaining Area-BCM. The additional contents were provided as video clip and article. We facilitated respondents to access these by providing of QR codes and links on the top page of questionnaire. Furthermore, briefly description was also included in the questionnaire.

The questionnaire was constructed into two languages which are Thai and English. It started development from English, then we translated it to Thai. The backing translation was checked by 2 Thai native speakers who are expert in English. In addition, the questionnaires were prepared in two forms which are google form and paper form. It composes of six parts. The questions started from asking about general information (demographics profile). Then, it follows by questions of each factor. Ranking questions are asked about disaster information. Lastly, the additional questions were asked as yes-no and open-ended questions. The first three questions are company's experience with flooding events. For example, the contamination like chemicals or sewage that company had faced in past (Thieken et al., 2007). The company's measure is asked to briefly explain as well (Thieken et al., 2007). In addition, we would like to know what is support getting from others during the flood. The impact of business continuity from neighboring industrial park is included. Finally, the system suggestion is asked to describe.

The pilot test was conducted on April 12-27, 2019. The participants were 30 Master's and undergraduate students. They were both had Thai and Foreigners. After that, some items were appropriately revised based on respondents' comments. They reported confused content and gave helpful suggestion.

3.3.3 Data collection

Owing to this study would like to examine individual perceived usefulness of Area-BCM for mitigation disaster and business continuity. This study defines target sample sizes regarding to literature review (Ringle et al., 2012). Since, rule of thumb is a rough guideline regarding minimum sample size requirements (Ringle et al., 2012). It calculates by ten multiple the maximum number of all path which are construct in outer and inner model (Hair, Sarstedt, Ringle, & Mena, 2011). Then, the value will be the rough guideline for sample sizes. However, some researches failed with this rule. To effective of adequacy of sample sizes, review of PLS-SEM between 1992 –

2011 is guideline as well. The result of average sample size is around 238 (Ringle et al., 2012). As research of 30-year period about PLS-SEM, the average sample size is 211 (Hair et al., 2011). So, the target respondents are 200 employees who have worked with companies in industrial park area. In addition, the selected area had experience with flood event. The participation in this survey is voluntary. Participants may refuse to take part in the research or exit the survey at any time without penalty. Collected data will be stored as document files in an independent hard disk without exposure to third parties. This questionnaire is under review for the ethics examination from Keio University by an authorization number [SDM-2019-E001]. Therefore, we do not collect identifying information such as respondents' name, email address, or IP address. The responses will remain anonymous. No one will be able to identify answers, and no one will know whether or not who participated in the study. The 400 paper of questionnaires were sent to the company A on May 23, 2019 and collected completed questionnaires in the July 18, 2019. The 60 paper of questionnaire were sent to the company B on May 27, 2019 and it was collected on July 4, 2019. Moreover, the online questionnaire as google form were distribute to each company inside industrial areas on May 24, 2019. The due date of online questionnaire is set on July 31, 2019.

3.3.4 Structural Equation Modeling

Structural Equation Modeling (SEM) was used to test theory and conceptual model (Hair, Sarstedt, Pieper, & Ringle, 2012). It is method which examine relationship among interesting factors (Wong, 2013). The structural equation model was divided into 2 submodels as inner model and outer model. Inner model refers the relationship between independent and dependent factors (Wong, 2013). Outer model is the relationship between factors and their indicators or called items (Wong, 2013). It is useful because it can test the relationships in higher one level which is different from first general modeling as regression analysis. In addition, factor is either endogenous or exogenous. An endogenous has at least path leading to it and show the effect of other factors (Wong, 2013). An exogenous represent path pointing outward and no one leading to it (Wong, 2013). There are several approached on SEM method. The two majors are Covariance-Based (CB) SEM and Partial Least Squares (PLS) or Variance-Based (VB) which focuses on analysis of variance (Wong, 2013). CB-SEM has been widely used in field of social science along several decades (Wong, 2013). It is data analysis for confirming or rejecting theories through testing hypothesis (Wong, 2013). It was almost used with large sample size and normal distribution. In addition, the model should be correctly specified model which appropriately

linked factors. Therefore, many industry practitioners and researchers mentioned that it is difficult to find data fitting with requirements (Wong, 2013). Moreover, PLS-SEM is soft modeling approach to SEM which is suitable for no assumptions data distribution (Wong, 2013). Then, it could be good alternative method. It is appropriate when sample size is small and research objective focuses on prediction (Hair et al., 2012). However, it has weakness in estimation of path coefficient loading which may create large mean square errors (Wong, 2013).

Since, the predictive of intention to use system for disaster mitigation is paramount in this study. The research model will be validated measurement scale based on Partial Least Squares Structural Equation Modeling (PLS-SEM). This method is using of ordinary least square technique which is minimize sum square errors (Piriyakul, 2010). It is analysis in each box which consist of one factor with their items (Piriyakul, 2010). Prior research suggested that sample size in path modeling should be 100 – 200 is a good starting point (Hoyle, 1995). In structural equation, there are two types of measurement scales which are formative and reflective. The formative is the model which direction of arrow point from item to factor (Afthanorhan, 2014). It indicates the statement is related on the cause of factor. However, this research model is reflective because the item is related on the effect of factor (Afthanorhan, 2014). So, the direction of arrow is from the factor to item. It means indicators is reflect of construct. If measurement scale is reflective, reliability and validity should be examined for factors' quality (Wong, 2013). These values will show the factors are abstract and there is no own information, but they have to use other indicators in measurement. If results show low values, it can lead to ambiguous conclusion. So, the following criteria should be assessed.

a) At first, the outer model loadings require for testing the correlations between items and factor (Wong, 2013). The value should more than 0.7 (Ponathong, 2017). The loadings are closed to 1, the factor is more reliable. Loadings at 0.7 is the level that half of variance in item is explained by its factors and is the level that explained variance must be higher that error variance (Garson, 2016). In addition, this value will be calculated in the step which as indicator reliability. Loading is coefficient factor related with item. **Equation1** shows relationship of each values (Piriyakul, 2010). If a_j in F_n represents the highest loading, then the item should be categorized into that related factor.

$$x_j = a_{j1}F_1 + a_{j2}F_2 + a_{j3}F_3 + \ldots + a_{jn}F_n \quad \text{(Equation 1)}$$

Where

x_j = indicator (item); j = 1, 2, ..., m

a_j = loading; j = 1, 2, ..., m

F_n = factor; n = 1, 2, ..., n

b) Internal consistency reliability is assessment that the questionnaire has the sufficient homogeneity which present the same understanding of respondents (Afthanorhan, 2014). It indicates combined items cloud measure factor with consistence. It examines the internal coherence of all items related to factors. For example, whether respondents do questionnaire anytime, they can answer with the consistency question. It measured by Cronbach's alpha, but it provides conservative measurement for PLS-SEM (Wong, 2013). **Equation2** presents Cronbach alpha coefficient (Ponathong, 2017). However, it limits that all items have equal outer loadings, but it is not always true (Ponathong, 2017). Consequently, the calculated value is lower than expectation. So, composite reliability was suggested to replacement (Bagozzi & Yi, 1988). It should be higher than 0.7. In exploratory research, the value higher than 0.6 is acceptable (Wong, 2013). Equation of composite reliability is represented in **Equation3**.

$$\propto = \frac{k}{k-1}\left[1 - \frac{\sum s_i^2}{s_t^2}\right] \qquad \text{(Equation2)}$$

Where

k = the number of items

S_i = Variance among questions in the factor

S_t = Total variance (in one factor)

$$\text{CR} = \frac{(\sum L)^2}{(\sum L)^2 + \sum Var(e)} \qquad \text{(Equation3)}$$

Where

L = outer loading

Var(e) = Variance ของ error

c) Convergent validity, it represents the common variance between items and their factors (Escobar-Rodríguez & Carvajal-Trujillo, 2014). It reflects the average communality for each factor (Garson, 2016). The questions or items that measure a factor should have high variance to explain the same factor (Ponathong, 2017). It is checked from evaluating of Average Variance Extracted (AVE) (Wong, 2013). It indicates how much factor explained their items in box. It is all variance of items that could be controlled by factors. The value that greater than 0.5 is confirmed (Wong, 2013). It indicated factors should explain at least half the variance of their factor (Garson, 2016). On the other hand, AVE is less than 0.5 means error variance exceed explained variance. In testing acceptance online ticket website, the acceptable value of

convergent validity is above 0.505 (Escobar-Rodríguez & Carvajal-Trujillo, 2014). Equation4 show the calculation of AVE.

$$AVE_i = \frac{1}{n}\sum_j^n (loading_{ij})^2 \qquad \text{(Equation4)}$$

Where

AVE = Average Variance Extracted; i = 1, 2, 3, …

Loading = outer loading; I = 1, 2, 3, …; j = 1, 2, 3, …, n

d) Discriminant validity is the different factors should not have high correlation. Owing to, if it high, it tends to be the same factor (Ponathong, 2017). One factor should be separated from others. However, it should have high correlation only with itself. The square root of AVE in each factor could be used to establish discriminant validity (Wong, 2013). It almost uses a table as lower left triangle of the table to show factors correlation. To confirm non-overlap factors, the first value in each column should represent the highest correlation value. **Table 5** present the summarized total criteria using for measurement model.

Table 5 Measurement criteria

Measurement	Criterion	Description	Recommendations	References
Reliability	1. Outer model loadings	To test the correlations between factors and items	≥ 0.7	Hulland 1999; Ponathong 2017
	2. Indicator reliability	To show indicator reach to our expectation	≥ 0.5	Hulland 1999; Ponathong 2018
	3. Internal consistency reliability	Examine the internal coherence of all items related to factors	≥ 0.7	Bagozzi and Yi 1988
Validity	4. Convergent validity	To show the common variance between items - their factors.	≥ 0.5	Bagozzi and Yi 1988; Wong 2013
	5. Discriminant validity	To check overlapping factors.	Higher than its squared correlation	Fornell and Larcker 1981

e) Finally, the *r*-squares (R^2) and path coefficients (β) are major criteria to evaluate the predictive relevance of structural model (Adhikari et al., 2018). R^2 is report about coefficient of determination (Wong, 2013). It describes the value between affecting factor on target factor. The value is range between 0 – 1 which higher value represent high accuracy (Adhikari et al., 2018). However, it depends on complexity of model and research discipline. In marketing research, R^2

that is above 0.75 is substantial, 0.5 is moderate and 0.25 is weak (Wong, 2013). However, all R^2 which are higher than 0.1 indicates the predictive capability of UTAUT model is satisfactory for online purchasing ticket website (Escobar-Rodríguez & Carvajal-Trujillo, 2014). In addition, modeling predictor of earthquake hazard preparedness, R^2 values of 0.67, 0.33 and 0.19 refer to be substantial, moderate and weak for model respectively (Adhikari et al., 2018). Then, research hypotheses are tested by path coefficients and significant base on one-tail t-statistic (Escobar-Rodríguez & Carvajal-Trujillo, 2014). The β values are accepted to be path even if it is higher than 0.2 (Adhikari et al., 2018). In addition, the high value indicates the good predictive power of model (Adhikari et al., 2018). Bootstrapping testing will show all significant path coefficients confirmed the predictive validity of the model (Adhikari et al., 2018). The significant level will be represented into three level which is 90%, 95% and 99%. These analysis results will show the relationship between factors.

Finally, the research model will be examined in Smart PLS 3 to assess the measurement model and evaluating structural model. The results of structural model will be confirmed. Furthermore, the affecting value and hypothesis testing will be shown in nest chapter.

Chapter 4 Results

4.1 Descriptive results

The total participants are 313 persons with total response rate 90% of both company A and B. After the questionnaires were screened the response and completion. Success rate of company A is 75%. While, company B is lower which counts as 53%. Those composed of employees from two major Japanese companies and other non-specific companies. **Figure 13** shows the number of company ratio which company A is counted as 87% because of allowance and project collaboration. Then, company B and others are 10% and 3% respectively. Female are 68% (n=214) and male are 32% (n=99). Age distribution is separated into six groups with under 20 years, 10 years period between 20 to 60 and over 60 years. As **Figure 14**, over 60% of participants are 31-40 years. There are not many participants in elder which only 12% are higher 40 years old. Similar to education level, over 60% gained college degree. Around 12% are Bachelor's degree or above following by high school (28%). There are few participants which graduated less than high school. In addition, working position is categorized into 5 groups; staff, engineer, manager, risk management and executive including others. **Figure 15** indicates that most participants are staff levels.

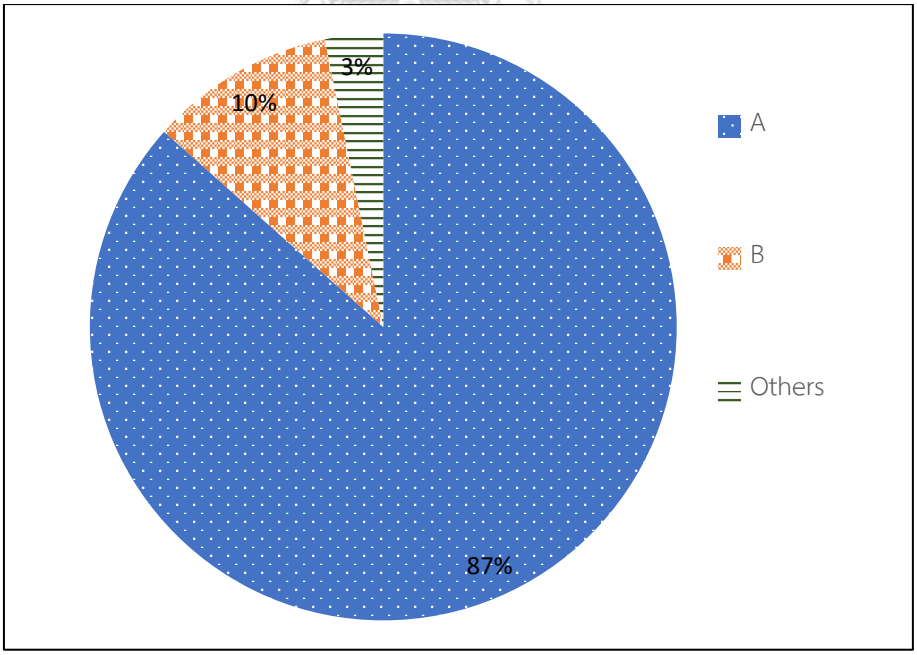

Figure 13 Company's participants ratio

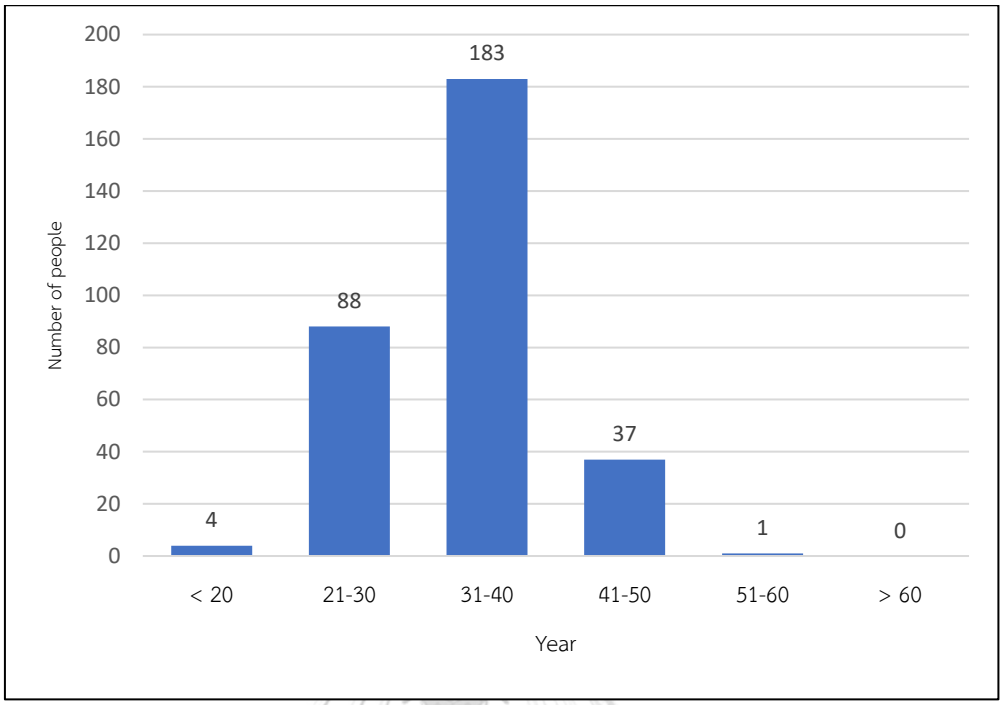

Figure 14 Age distribution

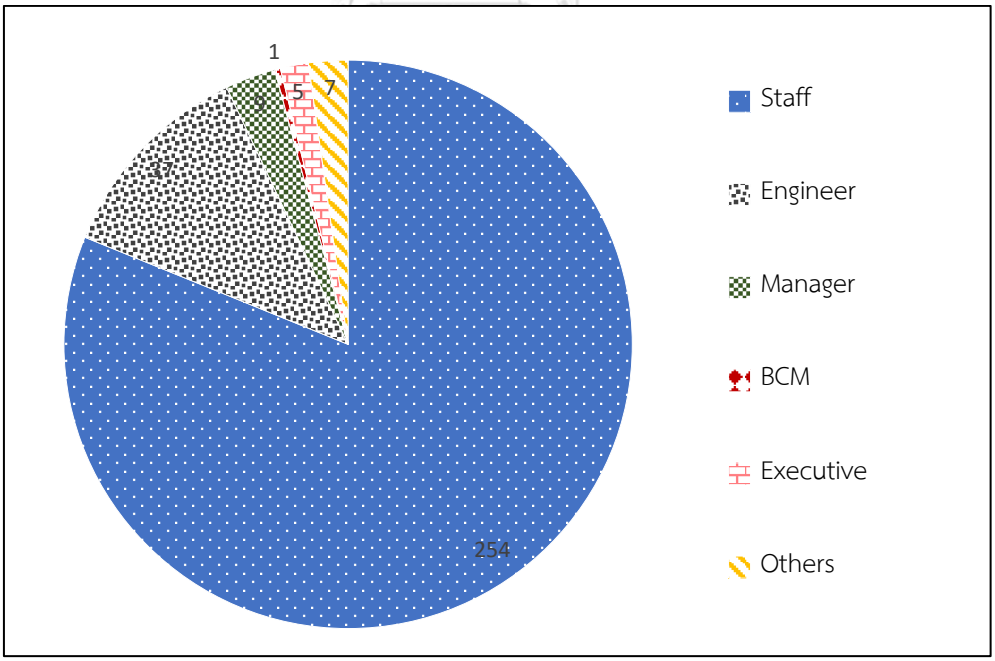

Figure 15 Working position

Table 6 Descriptive results

Variables	Frequency	Percent	Variables	Frequency	Percent
Gender			**Company**		
Male	99	31.6%	A	271	86.6%
Female	214	68.4%	B	32	10.2%
Nationality			Others	10	3.2%
Thai	312	99.7%	**Working position**		
Japanese	1	0.3%	Staff	254	81.2%
Age (year)			Engineer	37	11.8%
Less than 20	4	1.3%	Manager	9	2.9%
21-30	88	28.1%	BCM	1	0.3%
31-40	183	58.5%	Executive	5	1.6%
41-50	37	11.8%	Others	7	2.2%
51-60	1	0.3%	**Income (THB)**		
Education			Less than 10k	17	5.4%
Less than high school	21	6.7%	10k-50k	286	91.4%
High school	120	38.3%	50k-100k	9	2.9%
College	57	18.2%	Higher than 100K	1	0.3%
Bachelor	109	34.8%			
Higher than Bachelor	6	1.9%			

Table 6 show the total demographics. It illustrates that almost participants are Thai staff level in Japanese companies. Around 38% graduated from high school. Similar to the number of Bachelor's degree is 35%. In addition, majority are middle age between 20-40 years old.

Experience with flood is surveyed as four aspects whether people have experience with each issue or not. First, it is individual experience with flood event. Almost 90% of participants have flooding experience. It indicates flood frequently happen or they have lived in risk area. The next three aspects present closed ratio of experiences around 72-75%. Second is household that gained suffering from flood events as 74%. Department of Disaster Prevention and Mitigation (DDPM) reported around hundred thousand to million households suffered from flood event

every year. Particularly Thailand's floods in 2011, over five million households be in trouble. Next, heavy flood could lead to damaged properties. Therefore, 72% participants have experience about damaged properties caused by flood. Fourth, there are many people who evacuated during flood situation. It shows those faced with severe flood and their home cannot live. **Figure 16** present the number comparing experience and non-experience groups in each item. Major people in our survey have flood experience. Furthermore, we could categorize people in 4 four groups following experiences. This will help us to describe the difference of affecting factors between each group. It will be presented in the next section.

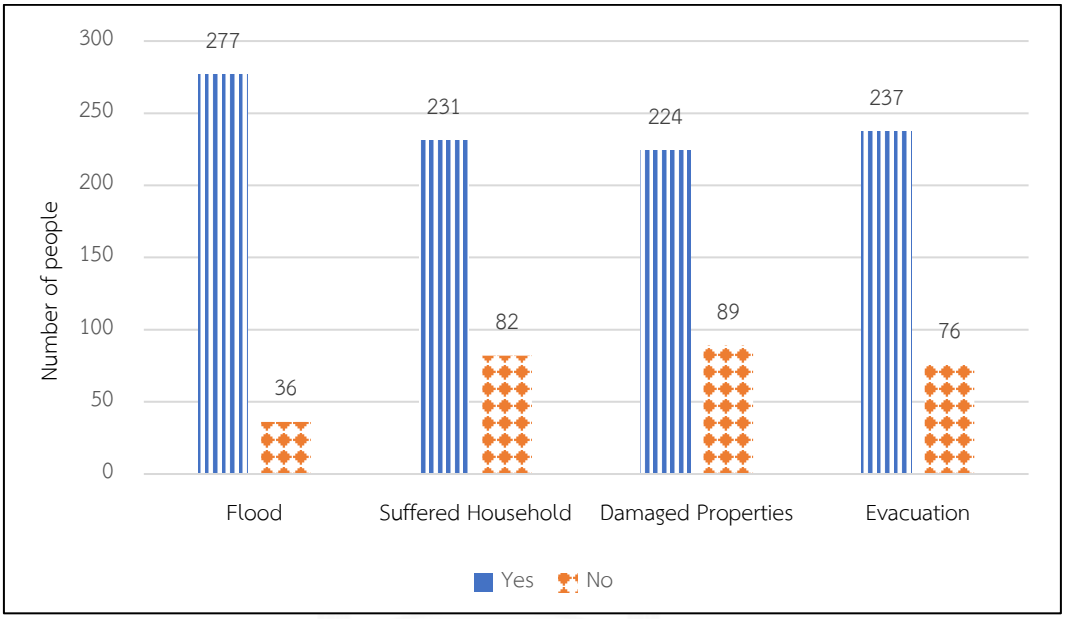

Figure 16 The number of people in each experience group

In part of required source and information, the top three entities are ranked by participants. Quality of information naturally comes from reliable source with depend on individual believes. Then, we categorize source into six major sources such as central government, local government, community leaders, family/friends/colleague, research/academic institutes and priest. The first trusted source that most people rely on is central government. Over half of people select to trust central government for receiving disaster information as first priority. It may be reason from holding quantity of information. Government always accesses weather data and hold many resources. The second trusted source is local government who know the areas very well. Community leaders is ranked in the third. They are authorities who are very close to people. Some people rely on their friends, family and research academic. However, the initial source is still government. A few people trust on priest because of Thai culture and individual believe. In addition, reporters and private company are mentioned to be trusted

source as well. **Figure 17** present the number of each source which is ranked to be top three. It obviously shows major people ranked central government, local government and community leaders to be first, second and third respectively.

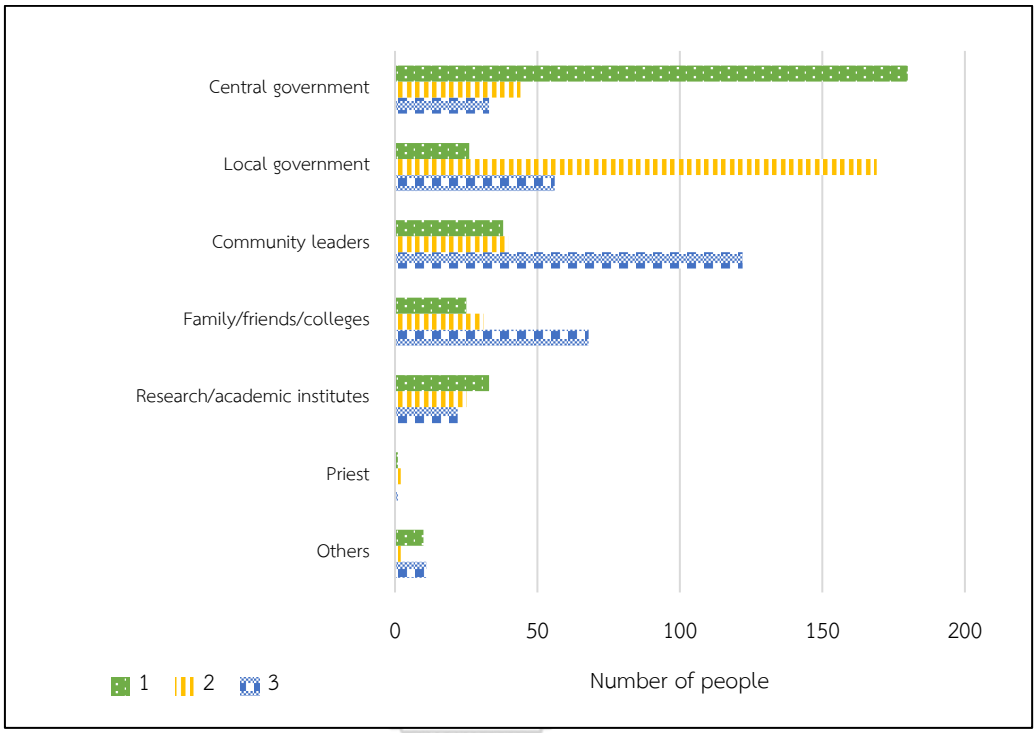

Figure 17 Rank of trusted source

Nowadays, information could access from many ways. Easy accessibility enhances people to get more knowledge faster. We categorized media into eight major types: TV, phone call, siren, SMS, radio, face to face, government website and E-mail. TV is found to be the most preferred media. It may cause from TV widely covers the whole areas and passive communication. In addition, it can access easily without complicated processes. Even, government is the most reliable source, but government website is not preferred channel for receiving disaster information. Partly due to, government website is not famous source in Thailand. Moreover, government did not highlight on direct sharing disaster information to citizens appropriately. So, official website was not promoted and contained information enough. Almost of information is frequently reported on TV through reporters. Then, it is easy channel for people to get information. Other reasons, samples' characteristics are employee level then they may not always access the internet. We can see that E-mail is gained only few amounts. Since, we did not add social media as choice. Then, some people mentioned it as preferred media. All

of these indicate participants will prefer easily and rapidly accessible source. **Figure 18** presents the number of preferred media.

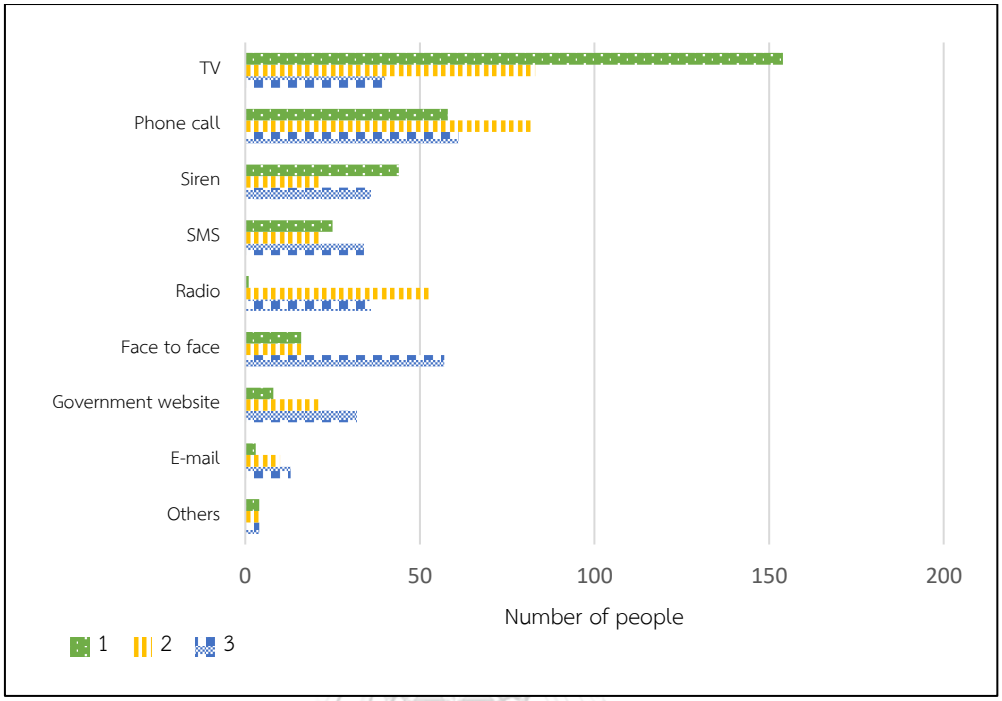

Figure 18 Rank of preferred media

Information is necessary in order to prepare and response with disaster effectively. Then, requirements' information during disaster situation is surveyed. The information is divided into twelve type. The result shows that safety of their family and friend is the most needed information. It indicates they concern with life's safety while disaster happen. So, protecting plan that support them to safe their life is necessary. In addition, communication-channel between person for safety confirmation should be available. Next, disaster warning is ranked in second because this notice people to prepare in time. Warning also decreases impacts and losses. As a result, disaster warning should be well prepared. For example, weather forecasting, river level and risk map help people know their situation and prepare appropriately. So, warning system should be developed. Third, available food and evacuation shelters present similar number. These will be important if flood becomes severe and take long period. In part of response information such as plan, infrastructure, utility and hospital have nearly needed ratio. There are not many people worry about waste caused from flood. **Figure 19** represent the whole needed information.

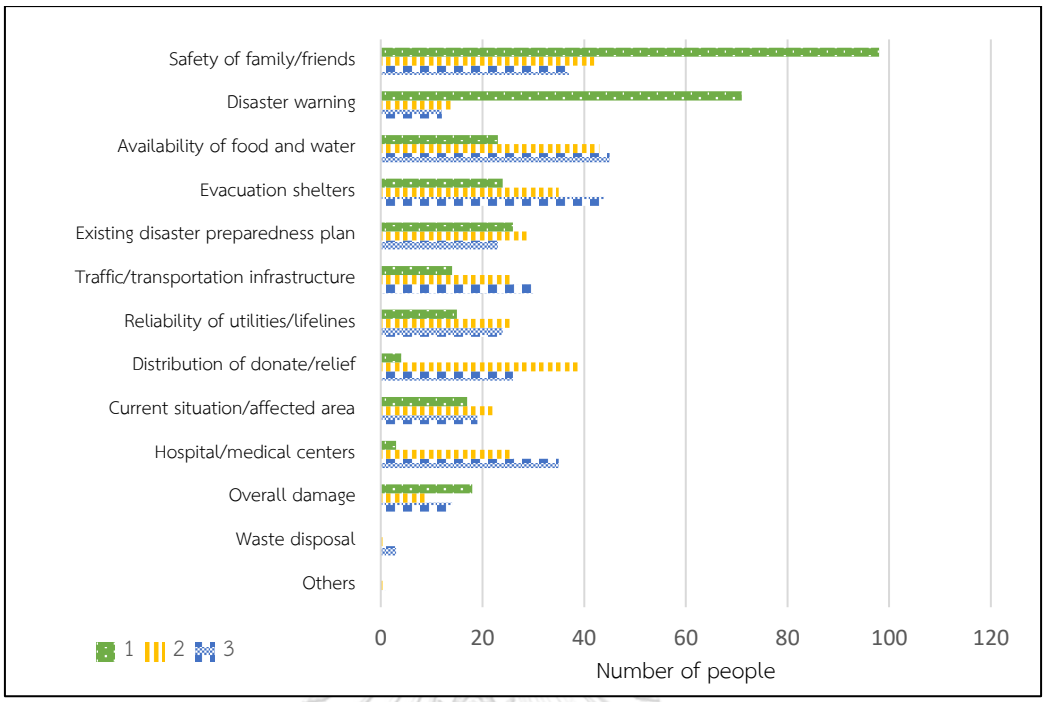

Figure 19 Rank of needed information

In the last part of questionnaire survey, the suggestion features of flood management system are asked as additional open question. From 313 respondents, this question is responded by fifty-two persons. We categorized the answers into seven issues. We found that the most requirement from respondent around 38% is warning. They commented that reliable flood warning should be send before flood happen. Major respondents also highlight on accuracy of information. In addition, warning providers should realize about lead time because people have to prepare timely. Next 27%, information from government are mentioned to be provided continuously. Especially, they focus on accessibility of information. Government should play as key role who are taking actions and provide measures. Distort information should not be communicated to company. Third, protecting plan is counted as 19%. It should be provided together with disaster warning. In addition, protecting plan should not cover only company, but respondents require to cover them. Fourth, evacuation is mentioned with 6%. During flood situation, evacuation shelters are needed from affected employees. In addition, evacuation plan is required. Forecasting data and activity are equal at 4%. Effective flood forecasting could help people prepare readiness. Environment activities such as forest planting are suggested as well. Other suggestion is floating factory. **Figure 20** is represented the ratio of suggested features. Consequently, these results will be useful in developing user interface part to fit users' requirements.

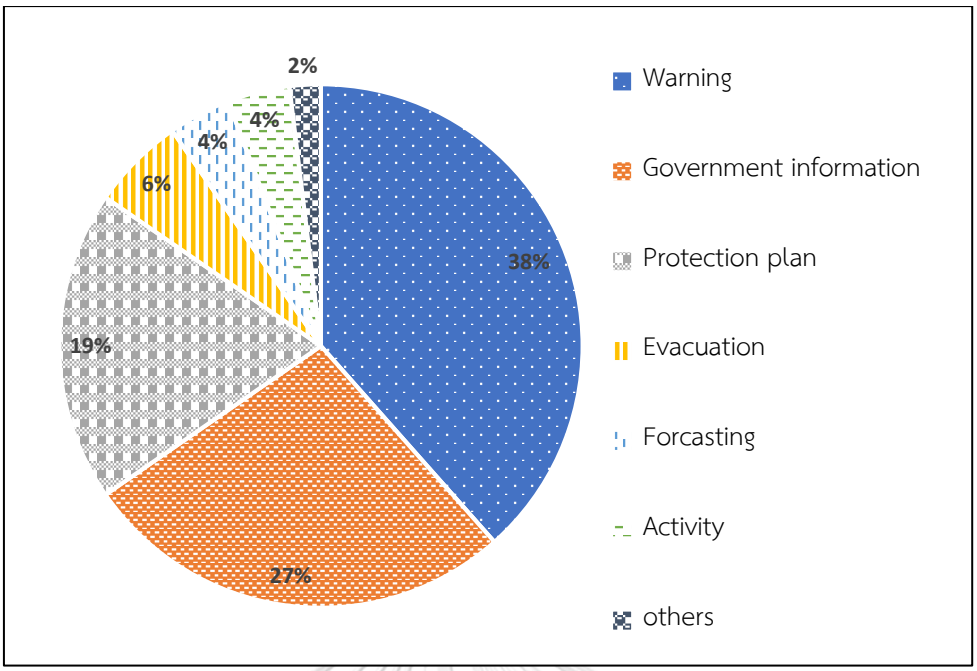

Figure 20 Suggestion features for flood management system

Next section presents analyzed results of measurement model by SmartPLS3. It checked quality of items and factors whether it meet requirements or not. In addition, it can test relationships between factors. Since, the research categorized sample in four major groups following flooding experience issues. There are flood, suffered household, damaged properties and evacuation. In each group is separated to with or without experience. Therefore, measurement and structural values will be described by groups which are measured by four criteria. Then, the model is test significant factors.

4.2 Group1: Flood

This presents the different influence between people who have experience and do not have experience with flood. The measurement criteria will be present step by step. The model is constructed in SmartPLS following developed structure. Next, four criteria are described in detail.

4.2.1 Experience

To adjust the model, we put all items for assessing qualities. It presents relationships between items and their factors. If items have correlations with any factors, it should belong to that factor. It implies the question is suitable to set in its factors. Then, the outer loadings which are expected higher than 0.7 is presented in **Table 7**.

Table 7 Outer loadings for initial model

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.81
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.87
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.89
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.91
Worry about Flooding	WF1. The large flood similar as Thailand flood 2011 affects negative feelings to me.	0.59
	WF2. I'm panic when facing large flood.	0.89
	WF3. Flood will make serious damages to my life and properties.	0.67
	WF4. I'm afraid of future flood and inundation in my company.	0.71
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.89
	FHK2. I know what to do, when I receive a warning.	0.66
	FHK3. I involved in emergency planning of my company.	0.80
	FHK4. I received flood hazard information.	0.77
Experience	EX1. Have you ever experienced flood event?	0.64
	EX2. Did your home suffer from flood event?	0.68
	EX3. Were your properties damaged from flood event?	0.67
	EX4. Have you ever experienced evacuate when flooding?	0.95
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.87
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.82
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.89
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.88

Table 7 Outer loadings for initial model (Continue)

Construct	Item	Loadings
Perceived Usefulness	PU5. It ensures that the critical infrastructure can be restored with in specified time frame in case of emergency.	0.86
	PU6. It facilitates early resumption of your operations even you are affected by flood.	0.80

Loadings is less than 0.7 will be thoroughly eliminated one by one. Then, other values are also checked whether it is better. At first, the least value of outer loadings which worry about flooding in item1 which is large flood negative feeling to individual is deleted. If it is described inside, this item is negative feelings in the past experience. While, other items in this factor is worry in the future or upcoming threats. It is not the pass emotion. As a result, this item is correlated to others in the same factor. **Table 8** presents outer one item from it was cut off. It shows all items are higher than 0.7. However, some items are nearly to 0.7. Those are meet the expected value.

Table 8 Outer loadings after eliminating one item from worry about flooding

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.82
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.87
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.89
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.91
Worry about Flooding	WF2. I'm panic when facing large flood.	0.92
	WF3. Flood will make serious damages to my life and properties.	0.68
	WF4. I'm afraid of future flood and inundation in my company.	0.72
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.90
	FHK2. I know what to do, when I receive a warning.	0.68
	FHK3. I involved in emergency planning of my company.	0.79
	FHK4. I received flood hazard information.	0.75

Table 8 Outer loadings after eliminating one item from worry about flooding (Continue)

Construct	Item	Loadings
Experience	EX1. Have you ever experienced flood event?	0.65
	EX2. Did your home suffer from flood event?	0.67
	EX3. Were your properties damaged from flood event?	0.65
	EX4. Have you ever experienced evacuate when flooding?	0.97
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.87
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.83
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.89
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.88
	PU5. It ensures that the critical infrastructure can be restored with in specified time frame in case of emergency.	0.86
	PU6. It facilitates early resumption of your operations even you are affected by flood.	0.80

Although, items of experience are lower than 0.7, but they are very close to. So, there is no item which is able to cut. However, the values are very close to 0.7. As same as items of worry about flooding and flood hazards knowledge which are lower than 0.7, but they are close to cannot cut as well. After the next step criteria are assessed. We found PU and subjective norm have similar discriminant validity. It indicates these two may do not separate each other clearly. Hence, items are reviewed again to see overall values which all should be good together. Consequently, two items from PU are eliminated which item 5 and 6 of PU. Since, items 1-4 of PU have clearly described it will be beneficial for their organization. To illustrate, Area-BCM supports company continue their business, increase cooperation among, enhance response to flood and improve resilience. On the contrary, item5 of PU is ensure that infrastructure can be quickly restored in case of flood. It may make confusing to respondents. If infrastructure could be covered but their company is severely damaged, then they cannot continue operation. As a result, company cannot manage their resource, then it makes losses. In addition, infrastructure is under government and private provider who have important to company. Then, this may relate to subject norm in concepts. Item 6 indicates it support early resumption when company is

affected by flood. In this case, it implies even company could fast start the new operation, but it may not benefit if they supply chain do not continue together. So, item 5 and 6 are deleted.

Table 9 Outer loadings after eliminating two items from PU

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.81
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.87
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.90
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.91
Worry about Flooding	WF2. I'm panic when facing large flood.	0.93
	WF3. Flood will make serious damages to my life and properties.	0.68
	WF4. I'm afraid of future flood and inundation in my company.	0.71
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.93
	FHK2. I know what to do, when I receive a warning.	0.66
	FHK3. I involved in emergency planning of my company.	0.76
	FHK4. I received flood hazard information.	0.76
Experience	EX1. Have you ever experienced flood event?	0.64
	EX2. Did your home suffer from flood event?	0.67
	EX3. Were your properties damaged from flood event?	0.64
	EX4. Have you ever experienced evacuate when flooding?	0.97
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.92
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.87
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.93
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.93

Then, next criteria which is internal consistency is examined by composite reliability and Cronbach's alpha. The values are expected to higher than 0.7. All is presented in **Table 10.** It shows that values are good. The high values of Cronbach's alpha and composite reliability show questionnaire providing high consistency. It means items in each factor should represent the consistent score. Whether, any question is asked, it should be represented the same score. In this case, all values are accepted which they have consistency. On the other hand, it implies questions have low variance.

Table 10 Internal consistency of based model

Constructs	**Cronbach's alpha**	**Composite reliability**
Subjective Norm	0.93	0.93
Worry about Flooding	0.82	0.82
Flood Hazards Knowledge	0.86	0.86
Experience	0.83	0.83
Perceived Usefulness	0.95	0.95

After that, the validity is tested which are both of consistency validity and discriminant validity. At first, consistency is evaluated by AVE which criteria is higher than 0.5. In case of discriminant validity, the relationships in their item must stronger than different factors. So, the validity of based model is shown in **Table 11**. All of values follow our expectation. It presents one factor does not related with other factors.

Table 11 Validity of based model

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.76	0.87				
Worry about Flooding	0.61	0.22	0.78			
Flood Hazards Knowledge	0.61	0.20	0.30	0.78		
Experience	0.55	-0.03	0.20	0.13	0.74	
Perceived Usefulness	0.83	0.79	0.16	0.26	0.00	0.91

As we mentioned, PU and subjective norm have similar values of discriminant. So, cross loadings are used to confirm that the two factors are separately. The criteria is the items belonging to each factors must have high value than different factor. **Table 12** presents cross loadings following criteria.

Table 12 Cross loadings

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.64**	0.11	-0.01	-0.03	0.11
Exp2	**0.67**	0.07	-0.02	0.00	0.15
Exp3	**0.64**	0.07	0.00	-0.05	0.14
Exp4	**0.97**	0.13	0.01	-0.01	0.20
Knowledge1	0.11	**0.93**	0.24	0.21	0.26
Knowledge2	0.09	**0.66**	0.19	0.18	0.14
Knowledge3	0.09	**0.76**	0.19	0.11	0.27
Knowledge4	0.11	**0.76**	0.18	0.13	0.25
Norm1	-0.05	0.17	0.63	**0.81**	0.20
Norm2	0.00	0.19	0.69	**0.87**	0.16
Norm3	0.01	0.19	0.71	**0.90**	0.18
Norm4	-0.05	0.16	0.72	**0.91**	0.22
PU1	-0.05	0.16	**0.92**	0.75	0.14
PU2	0.00	0.22	**0.87**	0.69	0.13
PU3	0.05	0.28	**0.93**	0.73	0.14
PU4	-0.01	0.27	**0.93**	0.72	0.16
Worry2	0.30	0.22	0.14	0.18	**0.93**
Worry3	0.05	0.23	0.11	0.18	**0.68**
Worry4	0.08	0.26	0.11	0.14	**0.71**

To test the data in experience and without experience group, reliability and validity in each group are separately tested. **Table 13** presents flooding experience group which almost

loadings meet the requirements. However, only some experiences are lower than expectation, but it cannot be delated. It has to contain as following based model.

Table 13 Outer loadings of experience with flood group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.81
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.87
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.91
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.93
Worry about Flooding	WF2. I'm panic when facing large flood.	0.87
	WF3. Flood will make serious damages to my life and properties.	0.70
	WF4. I'm afraid of future flood and inundation in my company.	0.72
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.84
	FHK2. I know what to do, when I receive a warning.	0.78
	FHK3. I involved in emergency planning of my company.	0.75
	FHK4. I received flood hazard information.	0.76
Experience	EX2. Did your home suffer from flood event?	0.53
	EX3. Were your properties damaged from flood event?	0.45
	EX4. Have you ever experienced evacuate when flooding?	0.92
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.92
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.88
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.93
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.94

Next, internal consistency reliability which is represented by Cronbach's alpha and composite reliability are shown in **Table 14**. Convergent validity is also presented in **Table 15** which the whole values are above 0.7. Discriminant validity is shown in the same table. It is expected that there is not high relationship between itself and others. So, all factors pass this criterion.

Table 14 Internal consistency reliability and convergent validity of experience with flood group

Constructs	**Cronbach's alpha**	**Composite reliability**
Subjective Norm	0.93	0.93
Worry about Flooding	0.82	0.81
Flood Hazards Knowledge	0.86	0.86
Experience	0.71	0.68
Perceived Usefulness	0.95	0.95

Table 15 Discriminant validity of experience with flood group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.78	0.88				
Worry about Flooding	0.59	0.19	0.77			
Flood Hazards Knowledge	0.61	0.23	0.31	0.78		
Experience	0.44	-0.02	0.16	0.07	0.67	
Perceived Usefulness	0.84	0.79	0.11	0.28	-0.02	0.91

To confirm the relationship between factors, the cross loadings are presented in **Table 16**. It shows that each factor is not overlap.

Table 16 Cross loadings of experience with flood group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.53**	0.02	-0.04	-0.01	0.09
Exp3	**0.45**	0.03	-0.01	-0.04	0.07
Exp4	**0.92**	0.07	0.00	0.00	0.15
Knowledge1	0.04	**0.84**	0.24	0.20	0.25
Knowledge2	0.06	**0.78**	0.24	0.23	0.17
Knowledge3	0.05	**0.75**	0.20	0.13	0.28
Knowledge4	0.07	**0.76**	0.20	0.14	0.27
Norm1	-0.05	0.19	0.63	**0.81**	0.18
Norm2	-0.06	0.18	0.70	**0.87**	0.14
Norm3	0.02	0.20	0.73	**0.91**	0.16
Norm4	0.01	0.22	0.73	**0.93**	0.19
PU1	-0.03	0.21	**0.92**	0.74	0.10
PU2	-0.02	0.25	**0.88**	0.69	0.08
PU3	0.00	0.28	**0.93**	0.73	0.09
PU4	-0.03	0.29	**0.94**	0.73	0.14
Worry2	0.26	0.21	0.11	0.16	**0.87**
Worry3	0.05	0.23	0.07	0.16	**0.70**
Worry4	0.02	0.27	0.07	0.12	**0.72**

After measurement model, structural model is analyzed path significant of hypothesis. To assess *t*-statistics, the regression parameters are analyzed based on bootstrapping of 1000 samples. **Table 17** shows *t*-statistic value and *p*-value at 95% significant level with two tails.

Table 17 Hypothesis test of experience with flood group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	20.26*
H2: Worry about flooding is positively related to PU.	1.07
H3: Worry about flooding is positively related to subjective norm.	2.82*
H4: Worry about flooding is positively related to flood hazards knowledge.	4.24*
H5: Flood Hazard Knowledge is positively related to PU.	2.62*
H6: Experience is positively related to PU.	0.51*

*at significant level 0.05

Subjective norm is strongly positive related to PU. Worry about flooding is positive related to subjective norm and flood hazards knowledge. On the other hand, it is not directly related to PU. It indicates that worry is indirect influence in flood experience group. However, it supports the other two factors indirectly. Flood hazard knowledge also affect PU. While, experience does not affect. Therefore, in flood experience group, subjective norm and flood hazards knowledge should be to major factor encourage people to perceived of usefulness in Area-BCM. Leaders in both of private company and government should be key authorities to focus in this topic. Including, they should support people for information and knowledge. Especially, risk and disaster management should be educated. Even, worry do not direct affect PU, but it indirectly affects to PU. Then, illustration to people about consequences and damages could support awareness in disaster as well.

4.2.2 Without experience

In non-experience with flooding, flood hazards knowledge items are less than 0.7, but they cannot be deleted as mentioned. Owing to, the structural model could not be changed in testing the same relationships. So, outer loadings of non-experience with flood is shown in **Table 18**. However, flood hazard knowledge does not meet requirements. Then, in without flooding experience, it cannot be described about significant relationship.

Table 18 Outer loadings of without flood experience group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.88
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.84
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.77
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.82
Worry about Flooding	WF2. I'm panic when facing large flood.	0.87
	WF3. Flood will make serious damages to my life and properties.	0.90
	WF4. I'm afraid of future flood and inundation in my company.	0.82
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.57
	FHK2. I know what to do, when I receive a warning.	-0.21
	FHK3. I involved in emergency planning of my company.	0.21
	FHK4. I received flood hazard information.	0.20
Experience	EX2. Did your home suffer from flood event?	0.91
	EX3. Were your properties damaged from flood event?	0.64
	EX4. Have you ever experienced evacuate when flooding?	0.88
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.95
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.85
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.96
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.82

Next, it is assessed of criteria which is internal consistency reliability showed in **Table 19**. Convergent validity and discriminant validity are presented in **Table 20**.

Table 19 Internal consistency reliability of without flood experience group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.90	0.90
Worry about Flooding	0.90	0.90
Flood Hazards Knowledge	0.85	0.14
Experience	0.86	0.86
Perceived Usefulness	0.94	0.94

Table 20 Validity of without flood experience group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.69	0.83				
Worry about Flooding	0.75	0.44	0.86			
Flood Hazards Knowledge	0.11	0.51	0.51	0.34		
Experience	0.67	0.15	0.34	0.34	0.82	
Perceived Usefulness	0.80	0.20	0.50	0.49	0.20	0.90

Cross loadings are presented in **Table 21**. Then, the model is assessed structure for hypotheses testing. *t*-statistics is showed in **Table 22.** It shows subjective norm is positively related to PU. So, major thoughts could affect people to aware as well. In case of flood hazards knowledge, it cannot be used in describing relationship because it does not meet requirements.

Table 21 Cross loadings of without flood experience group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp2	**0.91**	0.27	0.23	0.23	0.25
Exp3	**0.64**	0.13	0.06	0.02	0.33
Exp4	**0.88**	0.39	0.18	0.09	0.27

Table 21 Cross loadings of without flood experience group (Continue)

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Knowledge1	0.18	**0.57**	0.27	0.31	0.30
Knowledge2	-0.13	**-0.21**	-0.12	-0.15	-0.01
Knowledge3	0.06	**0.21**	0.14	0.02	0.16
Knowledge4	0.06	**0.20**	0.09	0.09	0.13
Norm1	0.24	0.43	0.64	**0.88**	0.43
Norm2	0.09	0.71	0.66	**0.84**	0.23
Norm3	0.06	0.53	0.60	**0.77**	0.29
Norm4	0.11	0.01	0.67	**0.82**	0.50
PU1	0.19	0.29	**0.95**	0.78	0.48
PU2	0.24	0.27	**0.85**	0.64	0.50
PU3	0.11	0.70	**0.96**	0.72	0.46
PU4	0.21	0.50	**0.82**	0.64	0.34
Worry2	0.22	0.47	0.43	0.43	**0.87**
Worry3	0.32	0.48	0.45	0.38	**0.90**
Worry4	0.34	0.38	0.41	0.33	**0.82**

Table 22 Hypothesis test of without flood experience group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	5.00*
H2: Worry about flooding is positively related to PU.	1.41
H3: Worry about flooding is positively related to subjective norm.	2.96*
H4: Worry about flooding is positively related to flood hazards knowledge.	1.03
H5: Flood Hazard Knowledge is positively related to PU.	0.38
H6: Experience is positively related to PU.	0.43

*at significant level 0.05

4.3 Group2: Suffered household

4.3.1 Experience

Table 23 shows that all values are higher than 0.7 except items from experience.

Table 23 Outer loadings of experience with suffered household group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.78
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.85
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.92
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.95
Worry about Flooding	WF2. I'm panic when facing large flood.	0.69
	WF3. Flood will make serious damages to my life and properties.	0.85
	WF4. I'm afraid of future flood and inundation in my company.	0.86
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.88
	FHK2. I know what to do, when I receive a warning.	0.73
	FHK3. I involved in emergency planning of my company.	0.76
	FHK4. I received flood hazard information.	0.66
Experience	EX1. Have you ever experienced flood event?	0.41
	EX3. Were your properties damaged from flood event?	0.39
	EX4. Have you ever experienced evacuate when flooding?	0.15
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.93
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.86
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.91
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.94

In **Table 24** presented internal consistency reliability, we can see very low Cronbach's alpha of experience. All AVEs meet the requirement except experience as well. **Table 25** shows convergent validity and discriminant validity which factors do not overlap each other.

Table 24 Internal consistency reliability of experience with suffered household group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.93	0.93
Worry about Flooding	0.84	0.84
Flood Hazards Knowledge	0.85	0.85
Experience	0.34	0.25
Perceived Usefulness	0.95	0.95

Table 25 Validity of experience with suffered household group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.77	0.88				
Worry about Flooding	0.65	0.15	0.80			
Flood Hazards Knowledge	0.58	0.25	0.35	0.76		
Experience	0.11	-0.26	-0.01	0.05	0.34	
Perceived Usefulness	0.84	0.80	0.09	0.26	-0.20	0.91

Cross loadings are presented in **Table 26**. After that, hypotheses testing is presented in **Table 27**. For people who household had suffered, subjective norm significantly affects on PU. So, supports from government is important. For example, improving infrastructure and implementing measure could enhance citizens' awareness. In addition, direct experience could affect to closed persons in same social group by communication. Worry about flooding is positive related to flood hazards knowledge. Even, worry is not directly related in experience group, it motivates knowledge. After the direct effects, people could perceive possible risk and events. So, this leads them to gain more disaster knowledge for protecting themselves.

Table 26 Cross loadings of experience with suffered household group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.41**	0.05	-0.09	-0.09	-0.06
Exp3	**0.39**	-0.04	-0.07	-0.12	0.02
Exp4	**0.15**	0.06	-0.03	-0.04	0.06
Knowledge1	-0.02	**0.88**	0.25	0.23	0.28
Knowledge2	0.13	**0.73**	0.20	0.24	0.20
Knowledge3	0.01	**0.76**	0.17	0.14	0.33
Knowledge4	0.03	**0.66**	0.15	0.14	0.26
Norm1	-0.28	0.20	0.61	**0.78**	0.14
Norm2	-0.23	0.18	0.69	**0.85**	0.09
Norm3	-0.16	0.24	0.75	**0.92**	0.11
Norm4	-0.26	0.24	0.76	**0.95**	0.16
PU1	-0.22	0.18	**0.93**	0.76	0.09
PU2	-0.17	0.23	**0.86**	0.69	0.07
PU3	-0.14	0.25	**0.91**	0.73	0.06
PU4	-0.18	0.27	**0.94**	0.75	0.12
Worry2	0.09	0.23	0.08	0.12	**0.68**
Worry3	-0.09	0.31	0.07	0.12	**0.85**
Worry4	-0.02	0.31	0.08	0.12	**0.86**

Table 27 Hypothesis test of experience with suffered household group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	21.79*
H2: Worry about flooding is positively related to PU.	0.75
H3: Worry about flooding is positively related to subjective norm.	2.07*
H4: Worry about flooding is positively related to flood hazards knowledge.	4.43*
H5: Flood Hazard Knowledge is positively related to PU.	1.65
H6: Experience is positively related to PU.	0.23

*at significant level 0.05

4.3.2 Without experience

Outer loadings for non-experience with suffered household group are shown in **Table 28**. All values are lower than 0.7.

Table 28 Outer loadings of without suffered household experience group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.30
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.28
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.26
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.26
Worry about Flooding	WF2. I'm panic when facing large flood.	0.49
	WF3. Flood will make serious damages to my life and properties.	0.39
	WF4. I'm afraid of future flood and inundation in my company.	0.31
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.33
	FHK2. I know what to do, when I receive a warning.	0.21
	FHK3. I involved in emergency planning of my company.	0.27
	FHK4. I received flood hazard information.	0.35
Experience	EX1. Have you ever experienced flood event?	0.33
	EX3. Were your properties damaged from flood event?	0.36
	EX4. Have you ever experienced evacuate when flooding?	0.57
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.26
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.26

In Table 29, as in experience group, internal consistency reliability represented by Cronbach's alpha and composite reliability pass criteria. AVEs and discriminant validity are good as well presented in **Table 30.**

Table 29 Internal consistency of without suffered household experience group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.92	0.93
Worry about Flooding	0.80	0.79
Flood Hazards Knowledge	0.89	0.88
Experience	0.67	0.69
Perceived Usefulness	0.95	0.95

Table 30 Validity of without suffered household experience group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.76	0.87				
Worry about Flooding	0.57	0.41	0.75			
Flood Hazards Knowledge	0.65	0.13	0.19	0.81		
Experience	0.44	0.03	0.25	0.22	0.66	
Perceived Usefulness	0.82	0.76	0.34	0.27	0.18	0.91

Cross loadings are presented in **Table 31**. Although, internal consistency and validity present good values but factor loadings are very low at first step. So, **Table 32** shows hypothesis in without suffered experience cannot be tested.

Table 31 Cross loadings of without suffered household experience group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.50**	0.13	0.08	0.01	0.12
Exp3	**0.56**	0.13	0.19	0.02	0.06
Exp4	**0.87**	0.18	0.11	0.03	0.26
Knowledge1	0.16	**0.91**	0.22	0.18	0.21
Knowledge2	0.23	**0.57**	0.15	0.04	0.02
Knowledge3	0.14	**0.73**	0.24	0.06	0.12
Knowledge4	0.22	**0.97**	0.25	0.12	0.20
Norm1	0.06	0.13	0.70	**0.93**	0.41
Norm2	0.09	0.21	0.69	**0.89**	0.31
Norm3	-0.02	0.09	0.63	**0.82**	0.33
Norm4	-0.03	0.02	0.63	**0.83**	0.38
PU1	0.13	0.15	**0.89**	0.72	0.31
PU2	0.17	0.23	**0.89**	0.67	0.33
PU3	0.20	0.33	**0.97**	0.71	0.32
PU4	0.17	0.27	**0.88**	0.67	0.27
Worry2	0.29	0.18	0.32	0.34	**0.92**
Worry3	0.10	0.07	0.24	0.36	**0.72**
Worry4	0.14	0.17	0.19	0.21	**0.58**

Table 32 Hypothesis test of without suffered household experience group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	8.07*
H2: Worry about flooding is positively related to PU.	0.05
H3: Worry about flooding is positively related to subjective norm.	3.81*
H4: Worry about flooding is positively related to flood hazards knowledge.	1.27
H5: Flood Hazard Knowledge is positively related to PU.	1.84
H6: Experience is positively related to PU.	1.19

*Significant at *p*-value 0.05

4.4 Group3: Damaged properties

4.4.1 Experience

Outer loadings in **Table 33** shows that all loadings are higher than 0.7, but it excepts an item from experience.

Table 33 Outer loadings of experience with damaged properties group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.88
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.92
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.92
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.91
Worry about Flooding	WF2. I'm panic when facing large flood.	0.80
	WF3. Flood will make serious damages to my life and properties.	0.90
	WF4. I'm afraid of future flood and inundation in my company.	0.90
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.85
	FHK2. I know what to do, when I receive a warning.	0.81
	FHK3. I involved in emergency planning of my company.	0.89
	FHK4. I received flood hazard information.	0.81
Experience	EX1. Have you ever experienced flood event?	0.34
	EX2. Did your home suffer from flood event?	0.89
	EX4. Have you ever experienced evacuate when flooding?	0.48
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.92
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.94
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.96
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.93

Table 34 presents composite reliability which meet the requirements except experience on Cronbach's alpha. Next, **Table 35** show expected convergent validity and discriminant validity. Only AVE in experience is lower than 0.5.

Table 34 Internal consistency reliability and convergent validity of experience with damaged properties group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.93	0.95
Worry about Flooding	0.84	0.90
Flood Hazards Knowledge	0.86	0.91
Experience	0.26	0.61
Perceived Usefulness	0.95	0.97

Table 35 Discriminant validity of experience with damaged properties group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.83	0.91				
Worry about Flooding	0.75	0.19	0.87			
Flood Hazards Knowledge	0.71	0.22	0.27	0.84		
Experience	0.38	-0.03	0.02	-0.02	0.61	
Perceived Usefulness	0.88	0.74	-0.12	0.26	-0.12	0.94

Table 36 shows cross loadings. Then, **Table 37** present hypothesis testing of damaged properties group. It shows that subjective norm and flood hazards knowledge significantly affect on PU. While, worry doses not directly affect on PU. However, it indirectly affect through subjective norm and flood hazards knowledge. So, leaders also important in this group. Their thoughts can influence others by description. Consequently, educate people with preparedness and response are required. Particularly, showing them with simulation case and consequences could support perceptions indirectly.

Table 36 Cross loadings of experience with damaged properties group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.34**	0.07	-0.03	-0.01	-0.09
Exp3	**0.89**	-0.05	-0.11	-0.02	0.03
Exp4	**0.48**	0.01	-0.05	-0.05	0.03
Knowledge1	0.03	**0.85**	0.25	0.24	0.23
Knowledge2	-0.05	**0.81**	0.23	0.23	0.18
Knowledge3	0.01	**0.89**	0.20	0.13	0.26
Knowledge4	-0.07	**0.81**	0.18	0.14	0.21
Norm1	-0.10	0.19	0.59	**0.88**	0.21
Norm2	-0.05	0.18	0.66	**0.92**	0.14
Norm3	0.04	0.21	0.70	**0.92**	0.14
Norm4	-0.02	0.22	0.71	**0.91**	0.19
PU1	-0.14	0.18	**0.92**	0.72	0.07
PU2	-0.08	0.25	**0.94**	0.65	0.05
PU3	-0.07	0.26	**0.96**	0.69	0.05
PU4	-0.15	0.27	**0.93**	0.70	0.11
Worry2	0.09	0.18	0.07	0.17	**0.80**
Worry3	0.02	0.24	0.04	0.16	**0.90**
Worry4	-0.05	0.26	0.09	0.16	**0.90**

Table 37 Hypothesis test of experience with damaged properties group

Hypothesis	*t* Statistics
H1: Subjective norm is positively related to PU.	18.32*
H2: Worry about flooding is positively related to PU.	1.48
H3: Worry about flooding is positively related to subjective norm.	2.77*
H4: Worry about flooding is positively related to flood hazards knowledge.	3.62*
H5: Flood Hazard Knowledge is positively related to PU.	2.20*
H6: Experience is positively related to PU.	1.70

*at significant level 0.05

4.4.2 Without experience

Outer loading for non-experience with damaged properties group is presented in **Table 38.** One item from flood hazards knowledge and worry about flooding are less than the expectation. However, others are good value.

Table 38 Outer loadings of without damaged properties experience group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.85
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.88
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.86
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.86
Worry about Flooding	WF2. I'm panic when facing large flood.	0.98
	WF3. Flood will make serious damages to my life and properties.	0.75
	WF4. I'm afraid of future flood and inundation in my company.	0.49
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	1.00
	FHK2. I know what to do, when I receive a warning.	0.30
	FHK3. I involved in emergency planning of my company.	0.70
	FHK4. I received flood hazard information.	0.88
Experience	EX1. Have you ever experienced flood event?	0.38
	EX2. Did your home suffer from flood event?	0.51
	EX4. Have you ever experienced evacuate when flooding?	0.90
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.91
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.90
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.96
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.87

Next, **Table 39** present the two reliability. Although Cronbach's alpha and composite reliability from experience is below 0.7 but it very close to. So, it should be pass to the next step. Validity are presented shown in **Table 40**.

Table 39 Internal consistency reliability and convergent validity of without damaged properties experience group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.92	0.92
Worry about Flooding	0.81	0.80
Flood Hazards Knowledge	0.86	0.83
Experience	0.64	0.64
Perceived Usefulness	0.95	0.95

Table 40 Validity of without damaged properties experience group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.75	0.87				
Worry about Flooding	0.59	0.26	0.77			
Flood Hazards Knowledge	0.59	0.12	0.28	0.77		
Experience	0.41	0.16	0.32	0.29	0.64	
Perceived Usefulness	0.83	0.83	0.36	0.20	0.14	0.91

Cross loadings are presented in **Table 41**. Hypothesis testing is represented in **Table 42** shows subjective norm significantly affect to PU. So, authorities should be motivator for upcoming threats. Illustrate people to perceive with their risk is important as well. There is no significance on experience. On the other hand, worry about flooding and flood hazards knowledge cannot be tested and described, because their reliability and validity are lower than expectation.

Table 41 Cross loadings of without damaged properties experience group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.38**	0.13	0.01	0.00	0.15
Exp3	**0.51**	0.13	0.11	0.16	0.11
Exp4	**0.90**	0.26	0.12	0.12	0.30
Knowledge1	0.30	**1.00**	0.20	0.13	0.27
Knowledge2	0.18	**0.30**	0.05	0.03	0.01
Knowledge3	0.18	**0.70**	0.16	0.05	0.22
Knowledge4	0.23	**0.88**	0.17	0.12	0.27
Norm1	0.14	0.09	0.71	**0.85**	0.18
Norm2	0.17	0.19	0.73	**0.88**	0.18
Norm3	0.11	0.11	0.71	**0.86**	0.23
Norm4	0.13	0.02	0.71	**0.86**	0.28
PU1	0.04	0.11	**0.91**	0.78	0.33
PU2	0.18	0.12	**0.90**	0.73	0.36
PU3	0.19	0.28	**0.96**	0.77	0.33
PU4	0.10	0.23	**0.87**	0.72	0.27
Worry2	0.40	0.26	0.31	0.23	**0.98**
Worry3	0.16	0.16	0.32	0.24	**0.75**
Worry4	0.10	0.23	0.16	0.10	**0.49**

Table 42 Hypothesis testing of without damaged properties experience group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	9.71*
H2: Worry about flooding is positively related to PU.	2.02*
H3: Worry about flooding is positively related to subjective norm.	2.11*
H4: Worry about flooding is positively related to flood hazards knowledge.	2.44*
H5: Flood Hazard Knowledge is positively related to PU.	1.22*
H6: Experience is positively related to PU.	0.45

*at significant level 0.05

4.5 Group4: Evacuation

4.5.1 Experience

In **Table 43**, all loadings are higher than 0.7 except items from experience.

Table 43 Outer loadings of experience with evacuation group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.82
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.89
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.90
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.92
Worry about Flooding	WF2. I'm panic when facing large flood.	0.76
	WF3. Flood will make serious damages to my life and properties.	0.87
	WF4. I'm afraid of future flood and inundation in my company.	0.83
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.92
	FHK2. I know what to do, when I receive a warning.	0.79
	FHK3. I involved in emergency planning of my company.	0.69
	FHK4. I received flood hazard information.	0.75
Experience	EX1. Have you ever experienced flood event?	0.45
	EX2. Did your home suffer from flood event?	0.29
	EX3. Were your properties damaged from flood event?	0.61
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.92
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.90
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.92
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.94

Table 44 shows Internal consistency, almost Cronbach's alphas show high value. However, Cronbach's alpha and composite reliability in experience show lower than 0.7 Convergent validity and discriminant validity are presented in **Table 45.**

Table 44 Internal consistency reliability of experience with evacuation group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.94	0.94
Worry about Flooding	0.86	0.86
Flood Hazards Knowledge	0.87	0.87
Experience	0.48	0.44
Perceived Usefulness	0.96	0.96

Table 45 Validity of experience with evacuation group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.78	0.89				
Worry about Flooding	0.68	0.22	0.82			
Flood Hazards Knowledge	0.63	0.26	0.31	0.79		
Experience	0.22	-0.12	-0.08	-0.09	0.47	
Perceived Usefulness	0.84	0.79	0.11	0.32	-0.13	0.92

Table 46 presented cross loadings. **Table 47** presents hypothesis of evacuation group which faced with serious flood as same as damaged properties group. It shows almost factors are significant except worry and experience to PU. Although, worry will not has directly influence on PU. However, simulating events to show damages could be indirectly beneficial. Flood hazards knowledge and subjective norm are also significant factor enhancing individual PU. Therefore, knowledge and simulation which supported by leader or government should be focused for this group.

Table 46 Cross loadings of experience with evacuation group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.45**	-0.02	-0.07	-0.04	-0.07
Exp3	**0.29**	-0.04	-0.06	-0.01	0.00
Exp4	**0.61**	-0.07	-0.06	-0.10	-0.04
Knowledge1	-0.14	**0.92**	0.29	0.28	0.25
Knowledge2	-0.02	**0.79**	0.27	0.23	0.21
Knowledge3	-0.02	**0.69**	0.22	0.14	0.26
Knowledge4	-0.10	**0.75**	0.23	0.16	0.27
Norm1	-0.15	0.23	0.63	**0.82**	0.22
Norm2	-0.10	0.22	0.71	**0.89**	0.20
Norm3	-0.05	0.23	0.73	**0.90**	0.16
Norm4	-0.14	0.24	0.73	**0.92**	0.21
PU1	-0.09	0.23	**0.92**	0.76	0.10
PU2	-0.17	0.31	**0.90**	0.70	0.09
PU3	-0.10	0.31	**0.92**	0.72	0.08
PU4	-0.12	0.32	**0.94**	0.73	0.13
Worry2	-0.01	0.23	0.08	0.18	**0.76**
Worry3	-0.13	0.25	0.10	0.21	**0.87**
Worry4	-0.05	0.28	0.09	0.16	**0.83**

Table 47 Hypothesis testing of experience with evacuation group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	19.28*
H2: Worry about flooding is positively related to PU.	1.41
H3: Worry about flooding is positively related to subjective norm.	3.024*
H4: Worry about flooding is positively related to flood hazards knowledge.	4.15*
H5: Flood Hazard Knowledge is positively related to PU.	2.72*
H6: Experience is positively related to PU.	0.89

*at significant level 0.05

4.5.2 Without experience

Table 48 present outer loadings in non-experience group with evacuation. It is found that all are less than 0.7.

Table 48 Outer loadings of without evacuation experience group

Construct	Item	Loadings
Subjective Norm	SN1. If almost workers in my company think that we should implement Area-BCM system, then I think so.	0.27
	SN2. If people supplier or buyer think company should implement Area-BCM system, then I think so.	0.27
	SN3. If other companies surrounding me implement Area-BCM system, then my company should do it too.	0.29
	SN4. If there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.	0.30
Worry about Flooding	WF2. I'm panic when facing large flood.	0.54
	WF3. Flood will make serious damages to my life and properties.	0.30
	WF4. I'm afraid of future flood and inundation in my company.	0.40
Flood Hazards Knowledge	FHK1. I attend an evacuation training for flooding event.	0.46
	FHK2. I know what to do, when I receive a warning.	-0.15
	FHK3. I involved in emergency planning of my company.	0.48
	FHK4. I received flood hazard information.	0.36
Experience	EX1. Have you ever experienced flood event?	0.22
	EX2. Did your home suffer from flood event?	0.39
	EX3. Were your properties damaged from flood event?	0.54
Perceived Usefulness	PU1. Area-BCM system is beneficial for my company in terms of business continuity.	0.27
	PU2. Area-BCM system will increase promoting cooperative approach among stakeholders of the area.	0.25
	PU3. Area-BCM system enhances effectiveness in response with flooding.	0.30
	PU4. Area-BCM system improves resilience of company, industrial park and community.	0.28

In **Table 49**, all are meet the requirements. After that, convergent validity and discriminant validity are shown in **Table 50**. Flood hazards knowledge does not follow requirement.

Table 49 Internal consistency reliability and convergent validity of without evacuation experience group

Constructs	Cronbach's alpha	Composite reliability
Subjective Norm	0.90	0.90
Worry about Flooding	0.74	0.72
Flood Hazards Knowledge	0.83	0.43
Experience	0.78	0.81
Perceived Usefulness	0.94	0.94

Table 50 Discriminant validity of without evacuation experience group

Factors	AVE	Subjective Norm	Worry about Flooding	Flood Hazards Knowledge	Experience	PU
Subjective Norm	0.70	0.84				
Worry about Flooding	0.47	0.23	0.69			
Flood Hazards Knowledge	0.26	0.07	0.39	0.51		
Experience	0.61	0.05	0.21	0.19	0.78	
Perceived Usefulness	0.79	0.79	0.33	0.17	0.10	0.89

Table 51 presents cross loadings. Then, **Table 52** shows hypothesis cannot be tested and described, because reliability and validity do not meet requirements.

Table 51 Cross loadings of without evacuation experience group

	Experience	Flood Hazards Knowledge	Perceived Usefulness	Subjective Norm	Worry about Flooding
Exp1	**0.43**	0.15	0.03	-0.03	0.07
Exp3	**0.75**	0.11	0.07	0.06	0.18
Exp4	**1.04**	0.19	0.12	0.06	0.22
Knowledge1	0.11	**0.61**	0.11	0.06	0.23
Knowledge2	0.06	**-0.20**	-0.09	-0.02	-0.11
Knowledge3	0.11	**0.63**	0.11	0.01	0.26
Knowledge4	0.15	**0.47**	0.04	0.06	0.16
Norm1	0.06	-0.01	0.63	**0.80**	0.20
Norm2	0.15	0.16	0.64	**0.79**	0.07
Norm3	0.03	0.13	0.67	**0.85**	0.21
Norm4	-0.05	-0.03	0.70	**0.89**	0.29
PU1	0.00	0.05	**0.88**	0.72	0.30
PU2	0.05	0.00	**0.80**	0.65	0.27
PU3	0.16	0.27	**0.97**	0.74	0.32
PU4	0.15	0.24	**0.90**	0.69	0.28
Worry2	0.25	0.25	0.30	0.22	**0.87**
Worry3	-0.04	0.28	0.17	0.13	**0.48**
Worry4	0.16	0.30	0.19	0.11	**0.65**

Table 52 Hypothesis of without evacuation experience group

Hypothesis	***t* Statistics**
H1: Subjective norm is positively related to PU.	7.80*
H2: Worry about flooding is positively related to PU.	1.40
H3: Worry about flooding is positively related to subjective norm.	1.61
H4: Worry about flooding is positively related to flood hazards knowledge.	1.33
H5: Flood Hazard Knowledge is positively related to PU.	0.68
H6: Experience is positively related to PU.	0.38

*Significant at *p*-value 0.05

Table 53 presents all *p*-value of hypothesis testing in each group of experience. However, data of without experience in suffered household and evacuation cannot be described because of low reliability and validity. The hypothesis testing from all model indicated that subjective norm is significant in every groups. While, flood hazards knowledge is positive related to PU in experience group. Worry about flooding indirectly affect to PU through subjective norm and flood hazards knowledge.

Table 53 Conclusion of overall hypothesis testing

Hypothesis	Group1: Flood		Group2: Suffered household		Group3: Damaged properties		Group4: Evacuation	
	With	Without	With	Without	With	Without	With	Without
H1: Subjective norm is positively related to PU.	**0.00***	**0.00***	**0.00***	**0.00***	**0.00***	**0.00***	**0.00***	**0.00***
H2: Worry about flooding is positively related to PU.	0.29	0.15	0.45	0.96	0.14	**0.04***	0.16	0.16
H3: Worry about flooding is positively related to subjective norm.	**0.00***	**0.00***	**0.04***	**0.00***	**0.01***	**0.03***	**0.00***	0.11
H4: Worry about flooding is positively related to flood hazards knowledge.	**0.00***	0.30	**0.00***	0.21	**0.00***	**0.02***	**0.00***	0.18
H5: Flood Hazard Knowledge is positively related to PU.	**0.01***	0.70	0.10	0.07	**0.02***	0.22	**0.01***	0.49
H6: Experience is positively related to PU.	0.61	0.67	0.82	0.23	0.09	0.66	0.38	0.70

*at significant level 0.05

Chapter 5 Discussion

5.1 Affecting factors

Since, respondents are divided in to four major groups. So, it shows that each group has differently significant relationships. The affecting factors are different important which depend on experience issues. However, this research cannot show more specific relationship between experience and without experience group because of sample size. As (Thieken et al., 2007), residents in three different areas of German was interviewed. The results showed experience was positive correlated in group which had more experience about flood. These experiences also affected protecting behavior such as acquisition flood information and precautionary actions. Flooding experience seemed to be the most motivation for receiving flood knowledge (Thieken et al., 2007). However, flood knowledge and precaution should be prepared in different groups for specific and suitable information. In addition, Lindell and Hwang (2008) found that hazards experience affected to perceive personal risk and adoption. Wouter Botzen and Van Den Berge (2012) also mentioned people who had flooding experience will take more interesting in flood insurance. Therefore, experience could be important factor motivating people to perceive preparedness for disaster. Because of, experience group will deeply understand for consequences and losses including emotions in that moment. Therefore, enhancing knowledge to experience group is necessary for correct mitigation. Owing to, almost of research respondents already have flood experience. They have known what are the effects and losses. Even, this research cannot identify the difference of experience, but many researches indicated it was important. Previous experience could support processes of developing Are-BCM. In case of company, they will know their capacity to flood management and critical point in business operations clearly. The pass experiences help companies specifically assess capability and effects. For example, during the flood, company will know which parts of factory will be impact and how many employees affected. In case of community, they will know how much their life affected. This information could lead to effectively develop plan. It enhances precise preparedness and decrease losses. For without experience group, they should acknowledge the possible risk and impacts.

Subjective norm is completely significant for the whole groups of respondents. Even they have experience or not, majors' thoughts and instructions have influence on individual behavior. However, this research survey in company. So, the main reasons may come from company' compliance or influencers of company. (Lindell & Hwang, 2008) found that subjective norm in both of peer groups and organizations had significant relationships to individual technology

adoption. The research of earthquake hazards preparedness in developing country showed that people decided to rely on information from their family and community in uncertain situation (Adhikari et al., 2018). In addition, it illustrated social bonding and mutual obligation for conducting rescue operations. However, there is a gap of assistance between government and citizens. So, people turned to trust on public institutions (Adhikari et al., 2018). So, company could be motivators for employee in disaster preparedness. Including, company should illustrate employees the impacts of their work and life. The plan for flood protecting should be focused by leader then expand it to employees. Local authority is an important sector leading disaster issue as well. Furthermore, government support should be provided such as disaster information, precautions and assistance. Area-BCM is a project that collaborate among three essential partners as private companies, communities and public organizations. Therefore, it is good opportunity in enhancing capacity of flood management. Especially, it is beneficial for private company which will be improved management and got support from varies agencies. These can also affect to individual people. Implementing Area-BCM is a chance to raise awareness for disaster in company. It will lead to growing of business continuity.

Next, flood hazard knowledge is significant in experience group except suffered household experience. It indicates that knowledge is important for experience people to perceive usefulness in adopt mitigation behavior. It may cause from they passed the real situation and got severe impacts without effective responses. In addition, it come from at that situation they have no flood information such as warning in order to prepare protection in time. So, they have recognized getting information and coping methods are very crucial to mitigate impact. (Thieken et al., 2007) presented that knowledge about flood hazard influenced performance of emergency measure. In addition, people who had better educated were more capable of effective performing (Thieken et al., 2007). Flood warning with specific information raises self-protection as well. (Lindell & Hwang, 2008) also found that flood information had influence on personal risk perception in different groups. Consequently, the right hazard information should be communicated to target groups by right channel for increasing adoption. (Ajzen, 2002) also suggested that tailored flood risk communication with protecting method are more effective. Therefore, preparing flood information including knowledge is very important to raise individual awareness. Area-BCM have plan to share flood information though online system to wide stakeholders. These include flood prediction, warning, responses, recovery plan, training and so on. So, educating could enhance individual PU of Area-BCM.

Worry about flooding did not directly affect in experience group at all. It implies that future flood does not affect to feelings of experience groups. They have not worry facing flood. It causes from they know the consequences and their capabilities for flood. However, worry have indirect affect on PU through subjective norm and flood hazards knowledge. It indicates worry does not lead people to perceive usefulness of taking measures, but it leads for learning and performing behaviors following norms. In addition, worry motivates them to believe on major thoughts and leaders. The results show difference from (Zaalberg et al., 2009), they found emotions both of negative and positive in flooding victims have stronger relationship to take actions than nonvictims. Owing to, victims have more perception with their risk, then it leads intention to take actions. Moreover, (Miceli et al., 2008) presented feelings of worry were related with disaster preparedness. This research on Area-BCM only shows indirect influence on PU. Even, worry do not direct affect in experience group, but it is supported in indirect as well. So, illustration impacts with knowledge and encouragement from leaders are important.

The research indicates people believe in disaster information from government. Some employees mentioned they trusted in their companies. Even, both of central and local government are selected to be reliable source but government website is not preferred media. Survey of disaster warning in Philippine presented The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) is the most trusted source of citizens (Leelawat, Mateo, Gaspay, Suppasri, & Imamura, 2014). They are the National Meteorological and Hydrological Services (NMHS) agency providing disaster protection, well-being and safety. On the other hand, TV is the first preferred media for receiving disaster information during disaster situation as same as Philippines' citizens. Government website as PAGASA becomes to the second prefer (Leelawat et al., 2014). Even, government is the most preferred, but their website is not. This implies people would like to get accurate information from government, but they cannot access the sources. It does not mean people are not preferred government channel. It is obviously seen that government communicated channel is not promoted enough. In addition, government website does not extensively contain useful disaster information. From website observation, we found that contents are quietly hard to understand and taken long time. Then, TV which is easily reached is ranked to be prefer source. The other issue may cause from samples' characteristics. The last two preferred sources as website and e-mail are online media. Consequently, if online sharing system based on Area-BCM is developed, training and workshop are required. Furthermore, the system should be promoted by leaders. For needed information during disaster, safety of friends and family are the most selected, because Thai culture is unity

of family as Philippines' survey. So, damages survey and communication among people are necessary in order to catch up situation. The safety confirmation system may be advantages. Communication channel through disaster event is important as well. Disaster warning have many mentions as well. Therefore, effective warning system is very essential for sharing information among stakeholders. It definitely impacts to people because it supports them for timely preparing and proper protecting.

5.2 Guideline for user interface development

Before the full interface of Area-BCM will be implemented, the prototype could support testing with real user which provide more saving time and costs. It saves time in changing the design until we satisfy the best version. In this chapter is separated into three parts: requirement elicitation, Area-BCM interface design and evaluation.

5.2.1 Requirement elicitation

The Area-BCM system interface design is developed based on survey requirements. The analysis results indicate that the two key factor affecting PU are Subjective Norm and Flood Hazards Knowledge. So, these two will be key point of interface design. First, the results show that subjective norm significantly affect PU. Then, accessibility information of system is limited in different levels. Company leader or high level officer will be distributor of information to their employees. They are key role who make decision to sending information with who and when. In addition, Asian cultures focuses on organization hierarchy. Consequently, the interface is designed with different accessibility from employees, leaders, government and stakeholders. Second, Flood hazards knowledge is significant in experience group. Therefore, interface should provide knowledge to user as well. In non-experience group, worry is more important. Then, illustration of possible risk and consequences should be presented in interface. In addition, the raking question asked about disaster information shows that almost respondents trust on government. Then, we design Area-BCM system interface which shows credible official information from government such as warning and announcement. Although, website is not the first preferred, but we found main reasons from accessibility, contents and promoting. Area-BCM system will be designed to fit and introduced to real users. The most needed information is safety of their friends and family. As a result, this interface risk and hazard map in order to know vulnerability area. Disaster warning is not enormous requested in raking question, but it is also suggested open question. Next, evacuation both of shelters and route are provided in interface. The open question highlights that people need accurate and timely warning from government. Moreover,

protecting plan is required. Area-BCM page, company could log in to fill their information which will be used to support during emergency situation. Area-BCM team and plan are provided insight. For cultures, we not only realize on power distance, but we also think about uncertainty avoidance. Therefore, the design try to be more comfortable and clear processes. The design focuses on show visualized data on map for ease of understanding. Furthermore, Area-BCM system emphasizes supply chain and sharing information. So, private company could share any information from website to their stakeholders including employees. These support company continuously communicate with stakeholders and manage resources. They could perceive situation and prepare in time. This system will enhance company's capacity to manage with flood and mitigate losses from disruption. To sum up, the interface is design following criteria as information requirements, security, clear processes, sharing information and task support.

5.2.2 Developing prototype

After the survey was concluded the results. Then, it is used for base in developing prototype following users' requirement. **Figure 21** shows first page of prototype interface. Private company can see their location in map with their supply chains. In left corner of heading, it will be Area-BCM logo. For concern with privacy and security as power distance, in right corner, login is provided for different level in presenting information. When user click login button, login box will pop up to fill username and password for sign in. User who log in can see more information and access their company information. The taps consist of home which user can back to the initial page. News is linked the whole lists of new providing in website. If users click contact, it will move to the bottom of page showing contact information. Facebook sign can link to the project Facebook. YouTube will link to Area-BCM system introduction video clip. Below the tap, there is breaking news which is emergency news during that times. It will show if cursor point to its **as Figure 22**. Due to forecasting was mentioned belonging to users' requirements. Weather forecasting is shown next to breaking news. The center of first page show map of Rojana industrial park. It is used to show information following users' need. They can select the information in right tap, then it will be appeared in map. Since, warning is the most required from Area-BCM system users' suggestion. As a result, warning becomes to the first. However, it is not all information user can select. Without log in, user cannot click announcement, risk map, hazard map and supply chain represented in grey button. **Figure 23** shows log in page which user can access all own information. Owing to flood information as risk and hazard information could help people know their situation and response in time. It helps people know their area will face with flood in the different level. Then, they can prepare themselves in different case. So, risk map is

added into the interface presented in **Figure 24**. In addition, hazards map also added as well. Next, emergency contact is presented in **Figure 25**. Moreover, private company could see their location of supply chain. In addition, private company will know their supply chains have impacts or not. It supports their resource management. For announcement, it will be pop up text box as **Figure 26**. This is an announcement of their own company which will send messages to their supply chain directly in order to facilitate communication between organization. Since, evacuation is also mentioned from users for flood protection system. Consequently, evacuation information is added to the map. It shows route that company can evacuate during flood to providing evacuation shelters. To delete information out of map, user can repeat the same button. In the other hand, click to reset is clear all. Lower half of page shows news related disaster and announcement from Area-BCM project. **Figure 27** shows example when user click news. It is linked to next page providing the details of news.

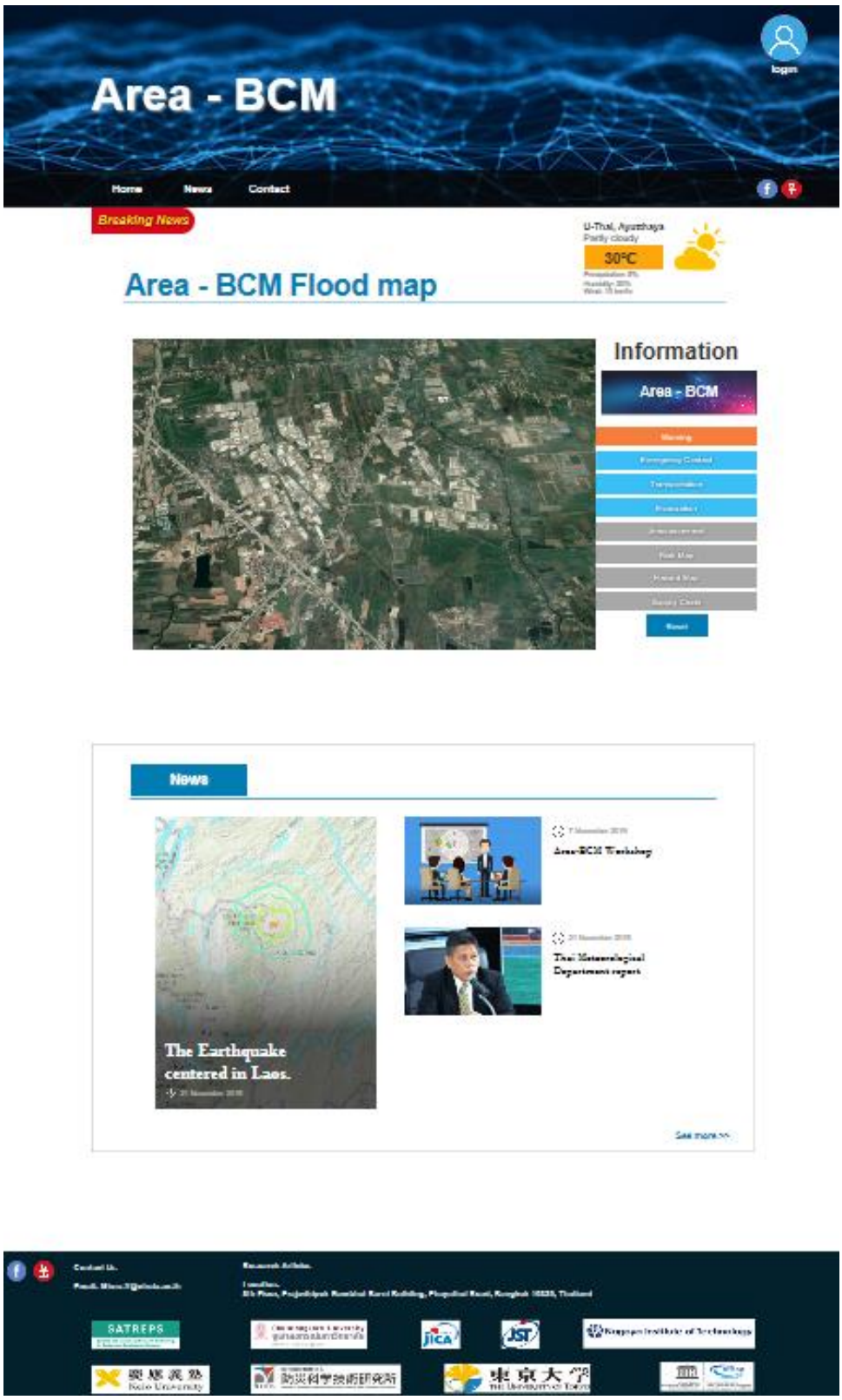

Figure 21 First page of user interface

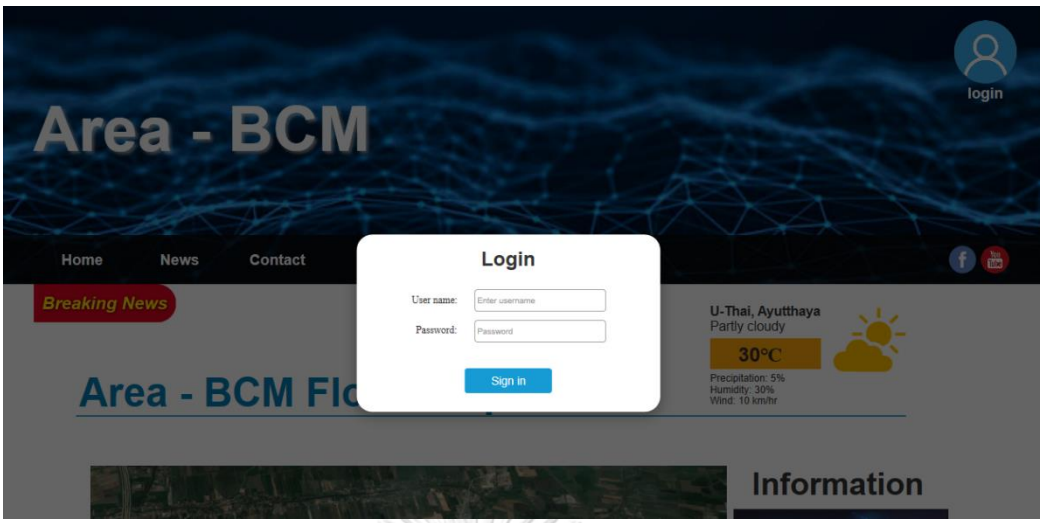

Figure 22 Log in pop up

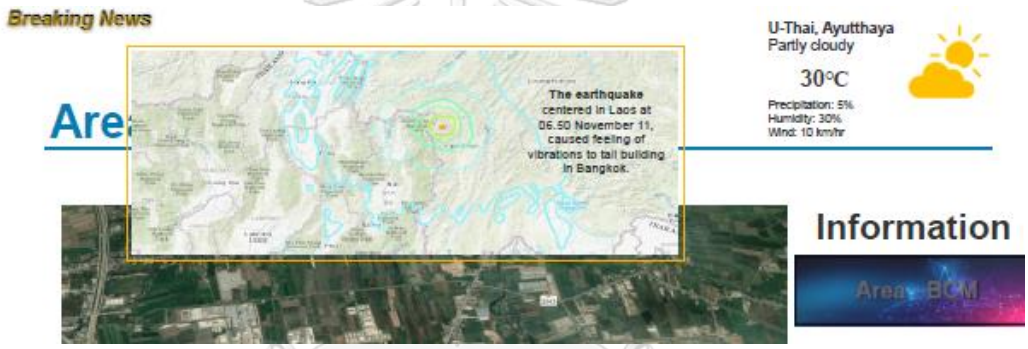

Figure 22 Breaking news

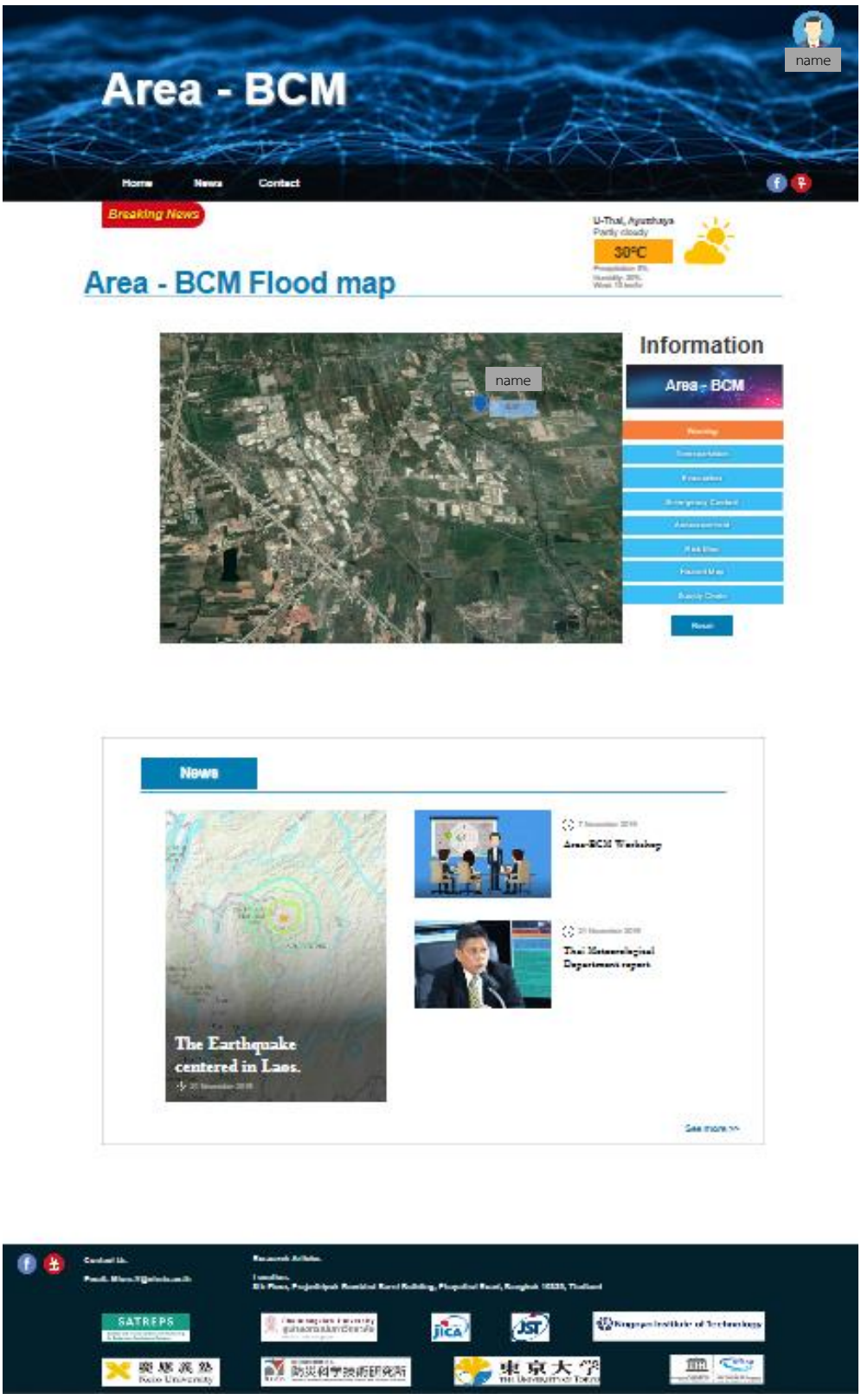

Figure 23 log in interface

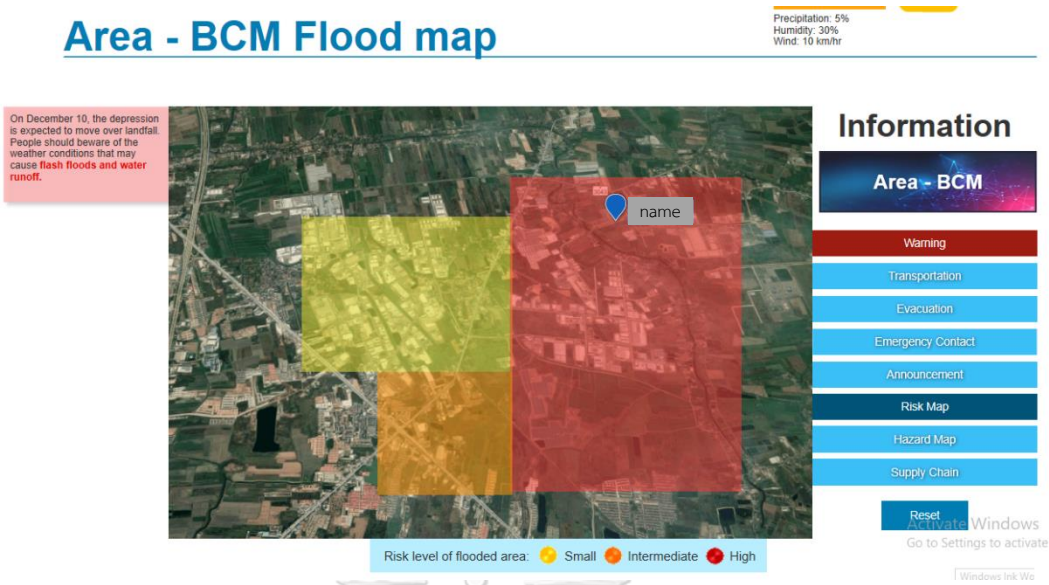

Figure 24 Information selection of warning and risk map

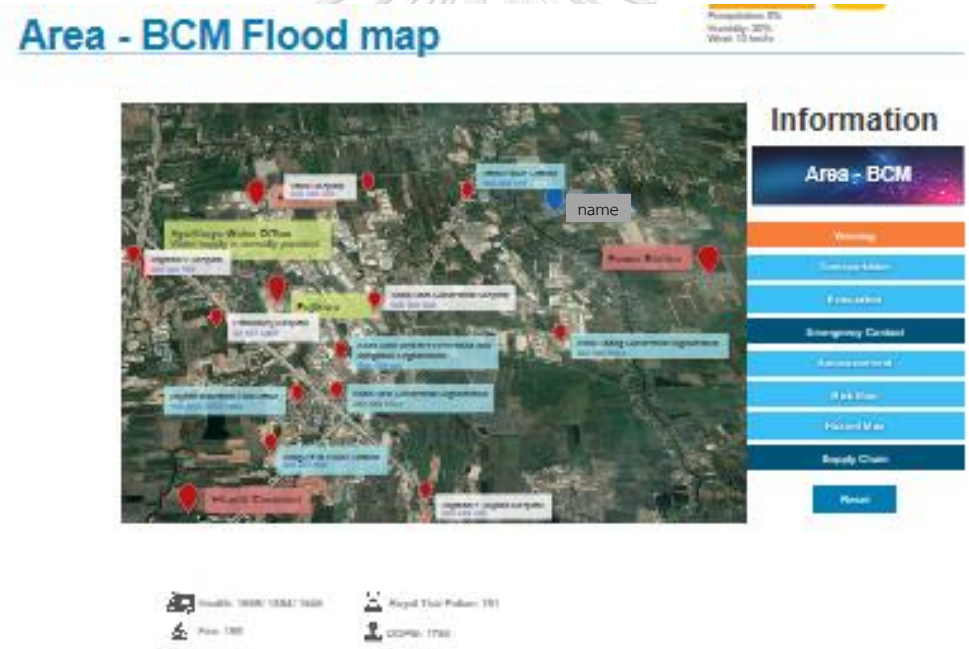

Figure 25 Information selection of emergency contact and supply chain

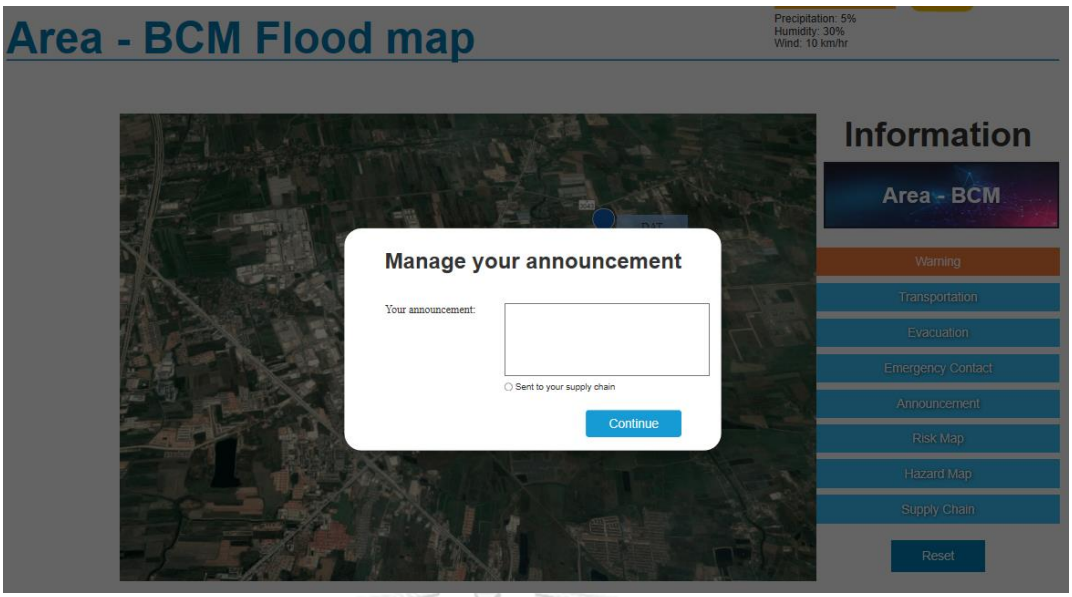

Figure 26 Information selection of announcement

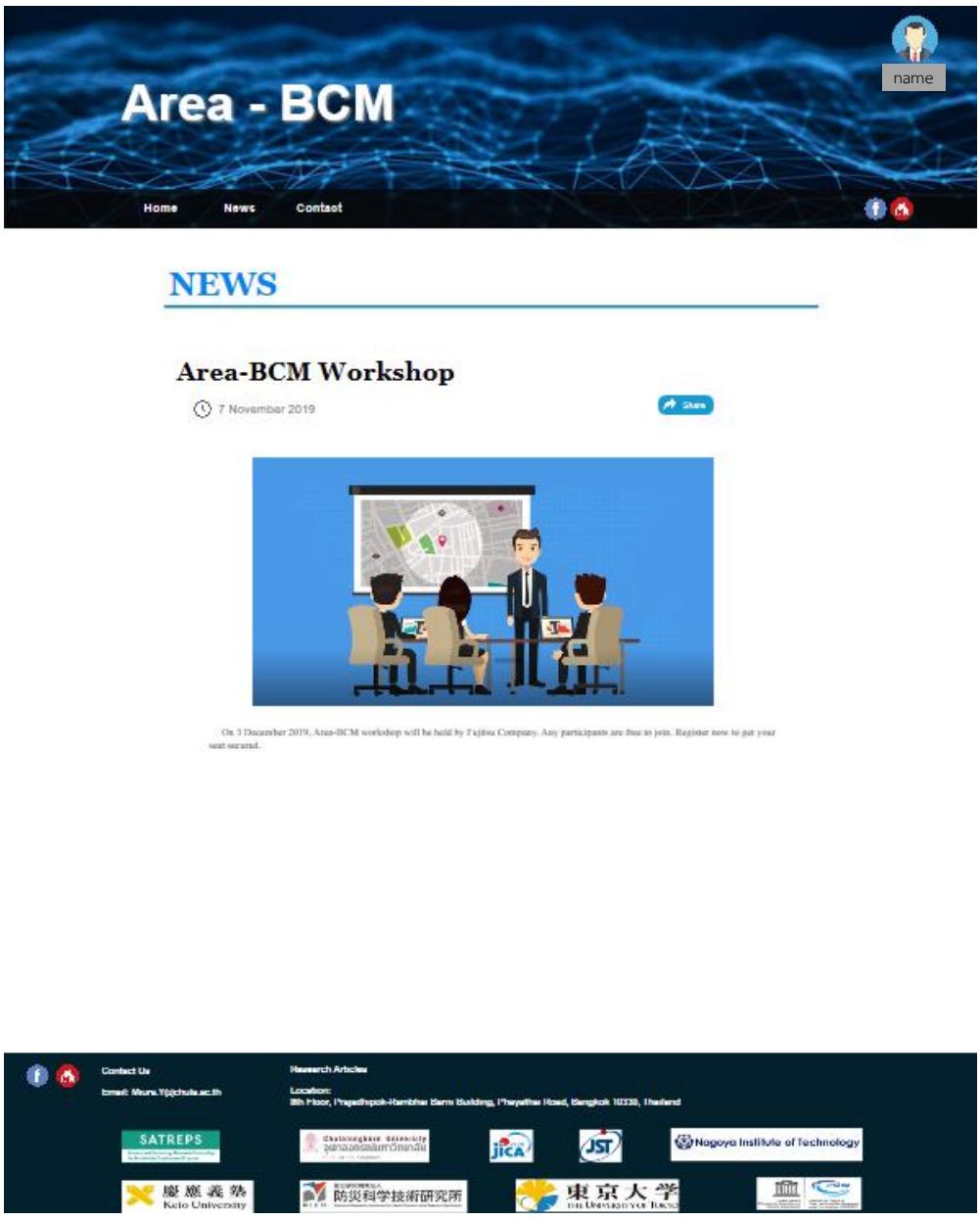

Figure 27 Detail of news linked to the first page

Since, this interface is aimed to sharing information and manage with flooding effectively. Area-BCM is provided in the right side. Company can enter to fill their information with log in. **Figure 28** presents Area-BCM page compounded of six major issues: company profile, customer, supplier, resource, business process and Area-BCM team. It supports company to prepare their plan and manage their resource in both of normal and flood situation. It also helps company manage their Area-BCM team easier.

Figure 28 Area-BCM interface

To fill each information, click on each issue will pop up which user can add their information. Company profile is shown in **Figure 29**. This is example of page to fill company location. Owing to, private company has many branches. So, filling location is advantages to

know their branches is affected from flood or not. In case of one location is affected, but another is not. Company can move the operations to safe location.

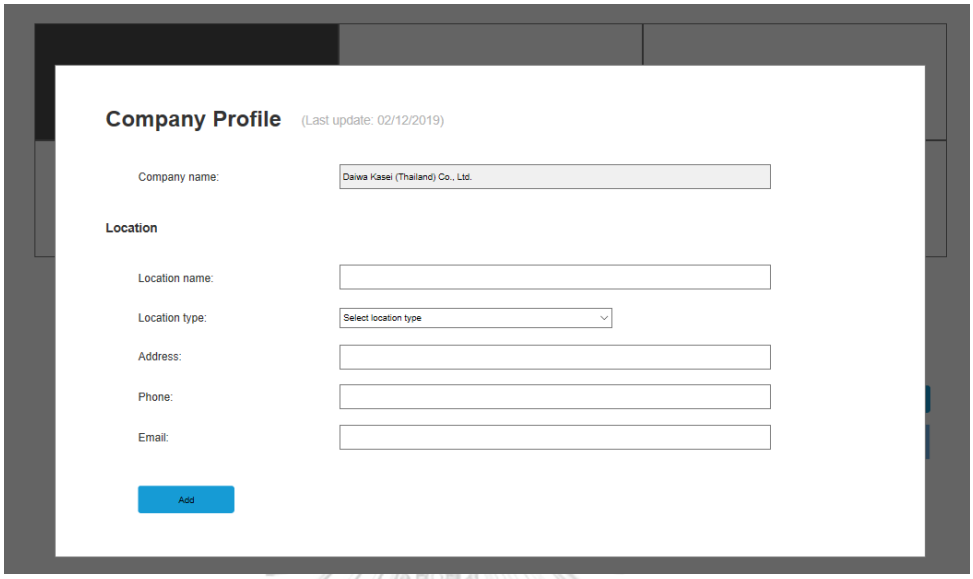

Figure 29 Pop up of filling company profile information

Figure 30 Example of company location

Figure 30 show list of company locations which are filled in. The table will show all data following we added. Users can click edit the information including delete. This supports each branch contact each other. Location helps their users knows other affected branches. **Figure 31** presents customer information that needs to fill in. For example, users can type name, contact,

location and deal products. Then, **Figure 32** shows list of customers. These help company know customer information. For example, information about risk and impacts could be shared between company and their customer.

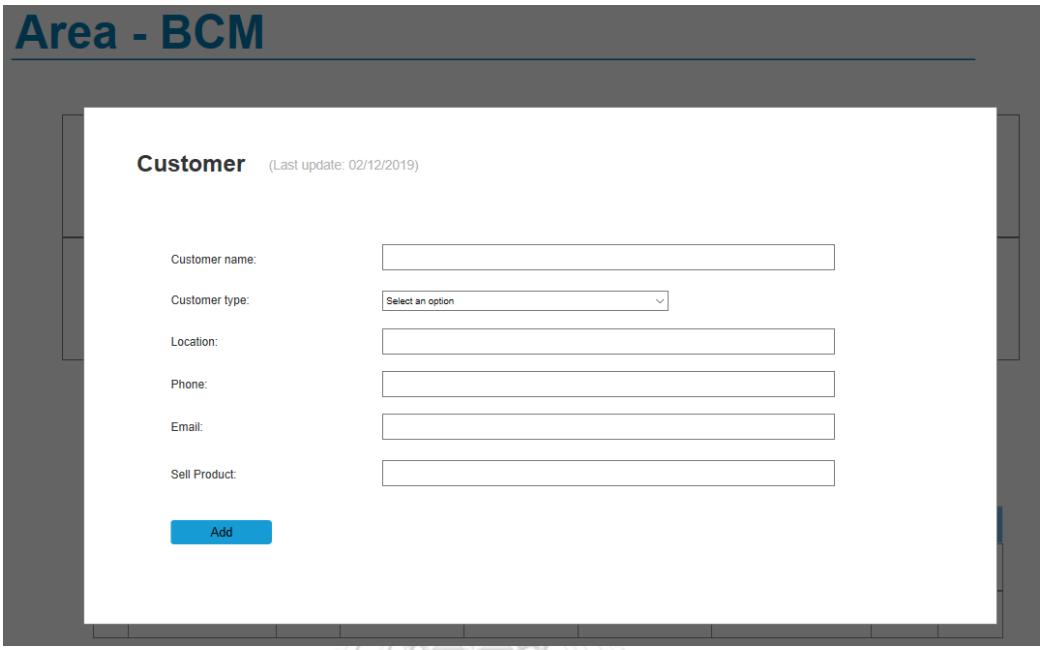

Figure 31 Pop up of filling customer information

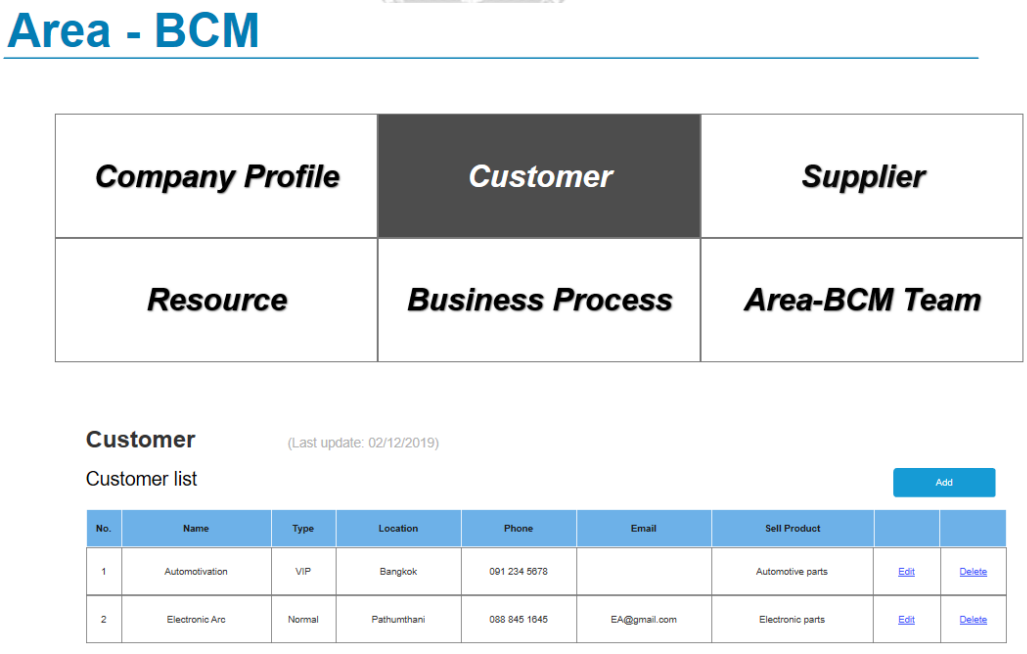

Figure 32 Example of customer

Next, supplier is also important for company. Them, their information must fill. In order to know what part that company needs from them. In addition, company could know risks of

their suppliers. **Figure 33** shows list of information that need to input. **Figure** 34 presents example of supplier.

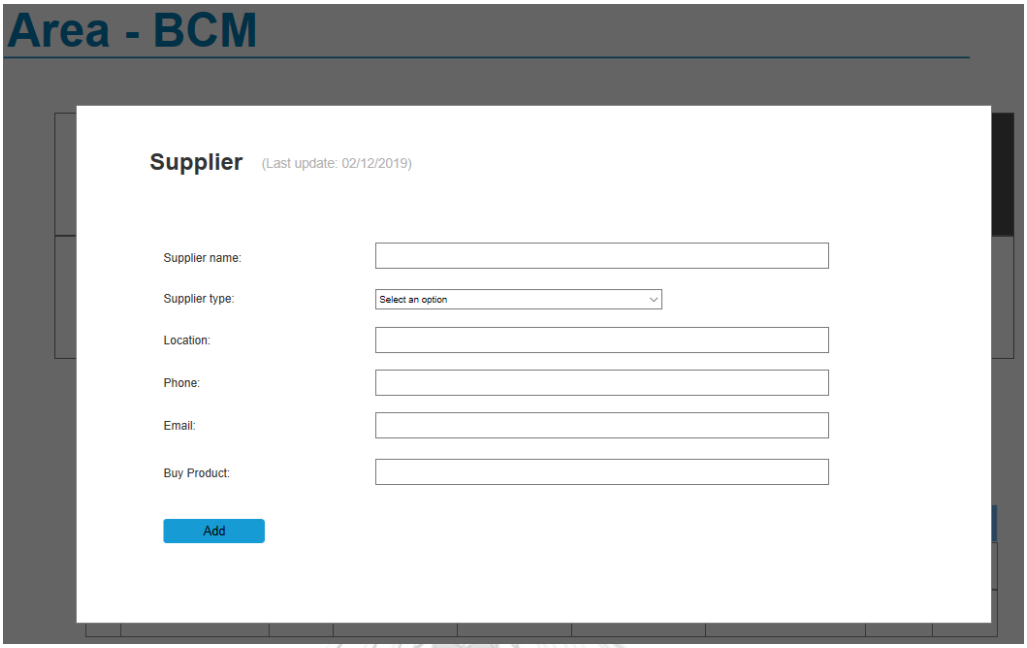

Figure 33 Pop up of filling supplier information

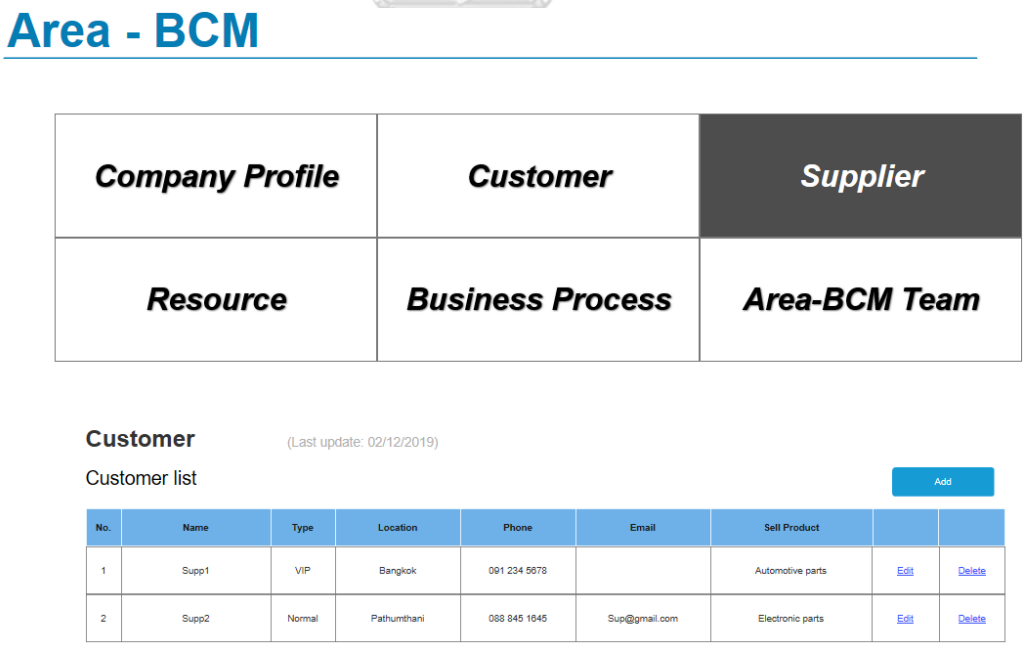

Figure 34 Example of supplier

In order to support management, filling company resource includes resource that they need in both of normal and emergency situation. In addition, the quantities of resources are required. It is useful for preparedness. **Figure 35** shows pop up in filling resources information. In **Figure 36** presents example of resource.

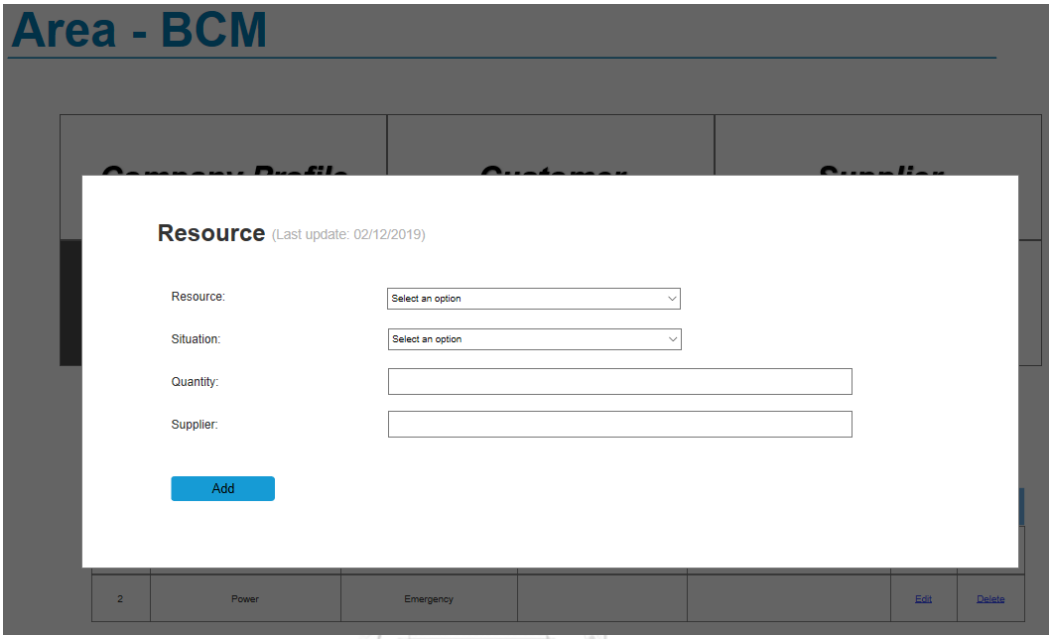

Figure 35 Pop up of filling resource information

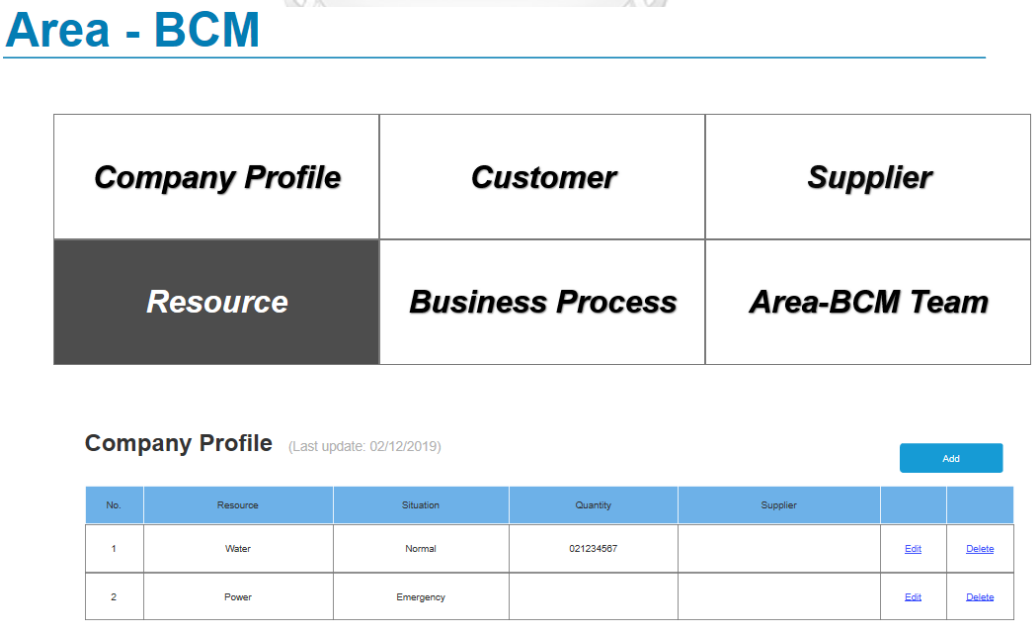

Figure 36 Example of resource

Business processes is the core important of Area-BCM system. So, it needs to fill in. This covers both of normal and emergency situation. In addition, it also needs resources that will be used in the process, leaders, location. This support the management to be easier though flood situation. **Figure 37** show pop up page to fill company processes. **Figure 38** presents example of company processes.

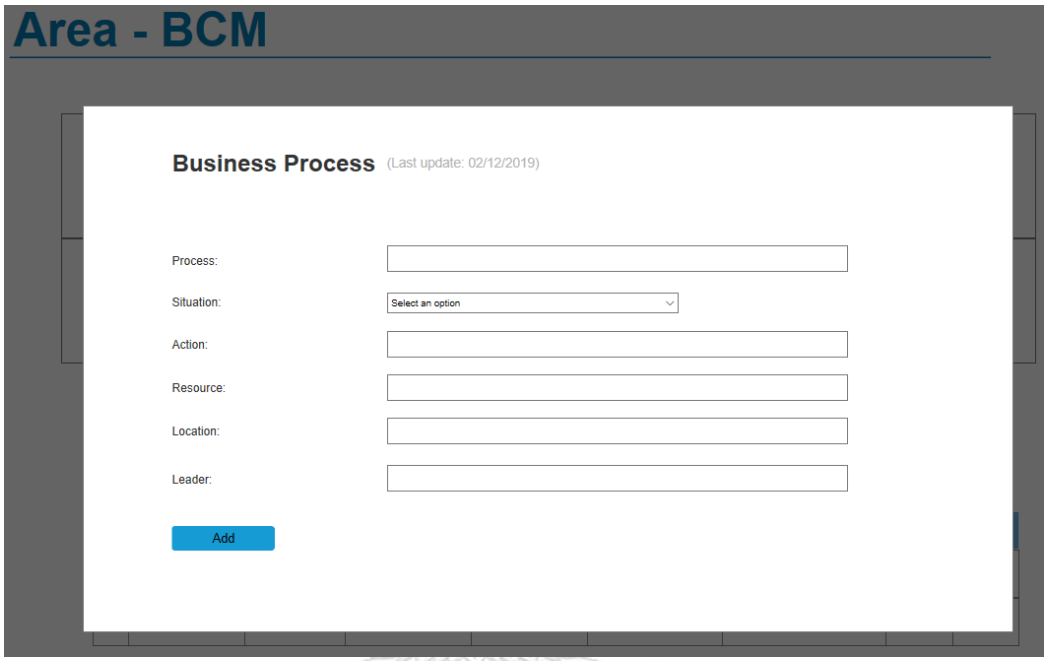

Figure 37 Pop up of filling processes information

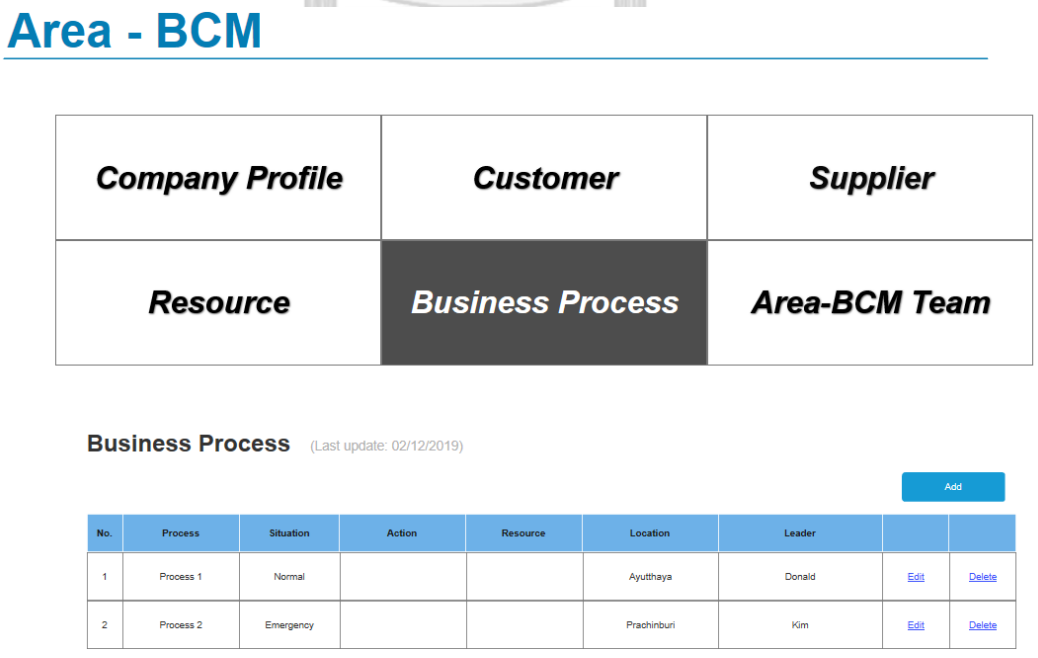

Figure 38 Example of processes

Next, the most important part is construct Area-BCM team. For initial phase, the four teams are highlighted which are management team, preparing and monitoring team, response and rescue team and recovery team. Users have to specify their working position and contact. Responsibility supports who will do what in flood situation. **Figure 39** presents pop up Area-BCM team. Then, **Figure 40** presents example of Area-BCM team.

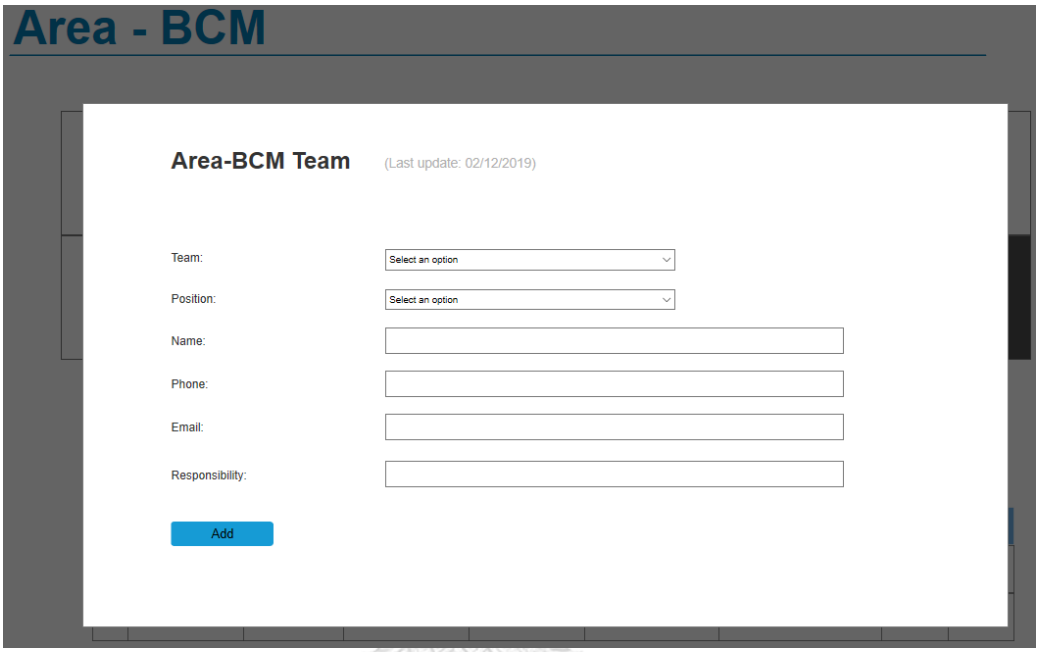

Figure 39 Pop up of filling Area-BCM team

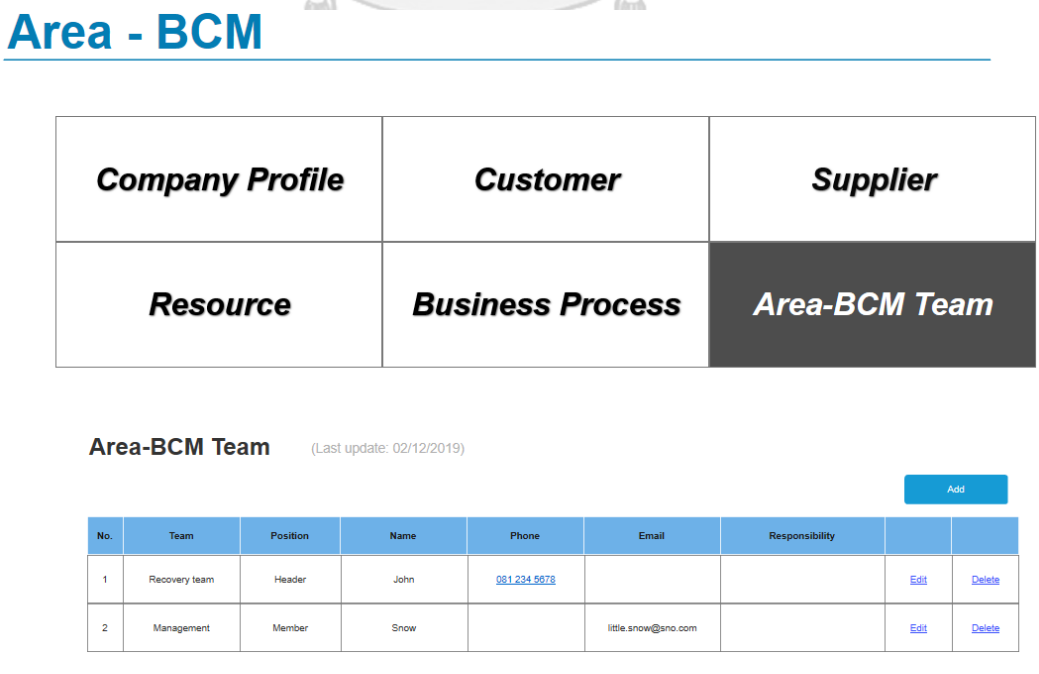

Figure 40 Example of Area-BCM team

5.2.3 Prototype evaluation

Since, Area-BCM system is staring phase of design. So, interface requires more improvement to fit with users' requirements, satisfaction and ease of use. Then, qualitative technique is suitable in order to gain comments from real users. They can deeply specify what they like and do not like. This method enhances understanding uses with flexible answers. Users are free to describe their thoughts. Developer could see the problems of users' interaction. Since, design criteria are set with information requirements, security, clear processes, sharing information and task support. Therefore, users will be interview following these issues with open question. However, because of convenience of users, 5 points Likert scale is used for rating score on ease, usefulness and willingness. The whole process is conducted in meeting room together with all target samples. **Figure 41** shows the testing room. At the beginning of implementation, the system is planned to use with management level officers. At first, the prototype is introduced to president and general manager. These two persons are key person who decide the system will be used or not. After that, they can try the features by themselves. Finally, users are interviewed and illustrated feedbacks.

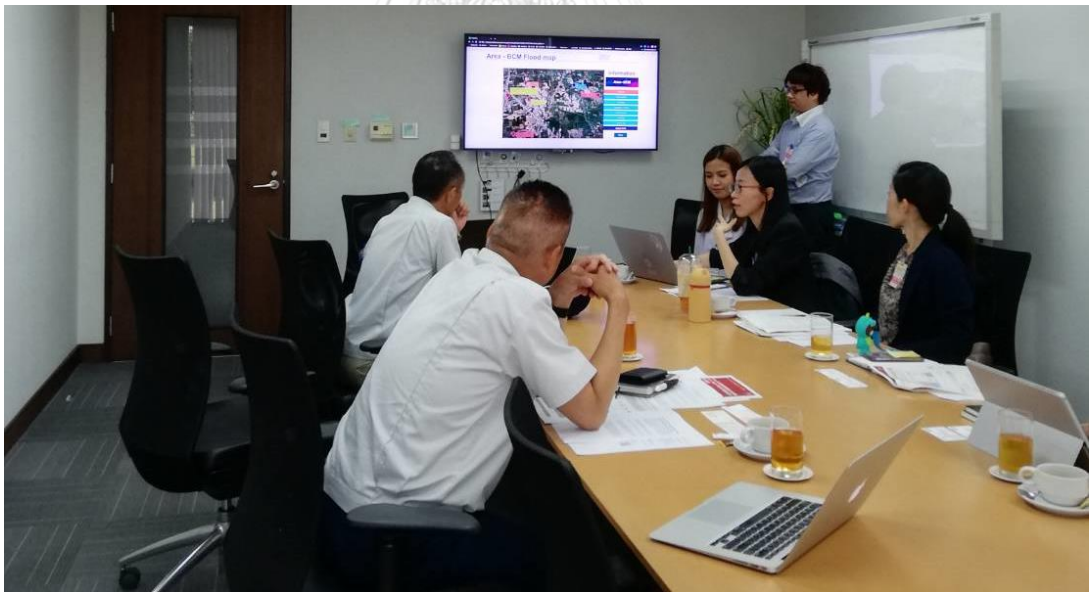

Figure 41 Prototype evaluation

First part of question is general information that ask about their experience with flood. We found that they do not have experience with flood. In addition, they are asked willingness to share information in Area-BCM project. For general opinion through prototype, the president of company agree that it is easy to use and useful system. However, in willingness to use, he rated at 3 which is neither agree nor not agree. While, general manager is not sure that it is easy to use

or not, but he strongly agrees with usefulness. In addition, general manager strongly agrees with willingness to use the system. For open questions on functions of system, they would like to know specifically which way can go to the other places. Since, the initial prototype only shows the evacuation route to evacuation shelters. So, they are mentioned with the fastest route to go to important place as hospital. In addition, presenting of route guideline and alternative route are preferred. So, the system that will be implemented should clearly identify about transportation. Including, route suggestions is useful for users. Owing to, the prototype shows supply chain in map. It provides power station and water resource, but they would like to expand to gas station and network as well. They have concern about continue communication. Furthermore, they focus on security and privacy which some parts can share to outside, but some cannot. Because of the project staring survey around Rojana industrial park, the president would like to expand to other area covering their supply chain. In Area-BCM feature, they were thinking that there are many information to fill in and it may take more time. So, the prototype should be developed that can export file from another site. Then, company do not fill many things. For overall of prototype, the president satisfied with the first page which present the information in map. Moreover, he thinks it is easy to use.

Furthermore, the prototype was tested with three experts in same processes. At first, they gave comments similar to real users which transportation should show more specific information. For example, the level of inundated routes should be represented in more different colors. In addition, vehicle type which could transportation in each route should be specified. They also suggested visualization data such as graph and ratio may support users in comparing between last and current year. Then, affected people can prepare in time. The sharing information and news should link to government as paipibat.com and others government website should be added. In the map, they think it would be useful. They prefer hazards map and risk map. One expert had no problems with graphics, color and function, but information should be updated in timeline. Another mentioned function should be careful designed following with users' needs. Map should expand community and employees' household as well. For overall, experts are satisfied with the initial design, but they would like to add more specific information.

In conclusion, prototype has been developed as a guideline before developing the Area-BCM system. It supports developer to save time and cost. In addition, it can test with the real users. Then, the suggestions and comments will bring to develop interface meeting with users' requirements.

Chapter 6 Conclusion

6.1 Research conclusion

Since Area-BCM was planned to implement at industrial area in Thailand, before the project is implemented, it is important to survey to affected people in area especially private company in order to understanding their opinions. In addition, it is used for supporting project implementation for private company and government. Therefore, this research aims to investigate the affecting factors affect perceived usefulness on Area-BCM system. Owing to there is no research study about factors on implementing flood management system as Area-BCM in industrial area in Thailand. Research factors were combined from TAM and flood mitigation behavior factor. TAM is useful for predicting of technology or system acceptance. While, reviewed factors come from survey individual behavior in community about flood technology or measures. In survey, the developed questionnaire based on model were distributed to employees who work in industrial area. Then, the samples are categorized into four main group: flood experience, suffered household, damaged properties and evacuation. The results from analysis show that subjective norm is significant in all groups. As a result, government and company's leader should be motivator who focus on flood mitigation. In addition, they should support employees for information and knowledge for decreasing losses. It is found that flood hazards knowledge is positively related to PU in group of experience. To support them coping with flood effectively, knowledge such as training and disaster information should be provided. While, worry about flooding is mediate factor between subjective norm and flood hazards knowledge on PU. It implies worry is indirect effect through these two factors. When, individual person has worry about flood, then they tend to rely or received information from others. Consequently, they have more ideas and knowledge. Then, usefulness is perceived by individual. On the other hand, people in social group may illustrate them about how to mitigate flood impacts. Then, they can realize Area-BCM project is useful. So, in worry, explain with the severely losses lead people to worry. After that leader should provide them knowledge and information. Although, experience is not found significant affect, but comparing factors among experience group show some different. As flood hazards knowledge is only significant in experience group. This implies experience encourage people to more prepare themselves to flood. However, in PU, experience is not the main that is found in this research. For implementing project, we should more focused on major

thoughts in social and leader support as subjective norm, worry and flood hazards knowledge because these factors are significant.

Next, respondents rated that they trust information from government. However, government website is not preferred. The results may come from government channel is not promoted enough. The most information that they are safety information. Moreover, they would like to get warning in the Area-BCM system including forecasting and evacuation plan. The analyzed results are used as guideline to develop prototype of Area-BCM system. So, warning is the first function add to system. Then, other information such as transportation, evacuation and so on are added to provide in map of interface. In highlight on flood hazards knowledge, risk map and hazards map are provided. Owing to, the cultures are also realized for designing. Since, power distance is focused on Asian style. Then, information can be accesses by different level of users. In addition, it also thinks about privacy and security of company. Some parts of company information will not be shown to outside. For uncertainty avoidance, the system is design based on easy and comfortable to use. From testing results with real users who have high power to decide on using system, they think it is easy to use. In addition, they satisfy with information that presents in map. However, in filling information, it has many processes.

6.2 Limitation

This research limits on survey users' opinions before implementing the Area-BCM system. So, the user cannot interact with the real system. The system is only described about concepts. Main respondents in this survey are employees in Japanese company because of collaboration and willingness. Moreover, the survey was conducted in pass inundated industrial area. Major samples are experience people. To compare between non-experience and experience group, the number of samples are small.

6.3 Future research

Future research could expand the survey to other companies for various sample covering different characteristics companies. After the project is implemented, the acceptance is should be surveyed. In addition, prototype could develop for meeting users' requirements. The transportation in map should be more specified to support users' evacuation especially route to hospital. To cover company's supply chain, disaster information in system should covered in all areas. Then, usability testing should be done with users for future development.

Appendix

QUESTIONNAIRE SURVEY OF AREA-BCM SYSTEM

You are invited to participate in a paper-based survey on the research which is Investigating Affecting Factor of Individual Intention to Use through Establishment of Area-BCM project at Industry Complexes in Thailand. This survey will ask questions about your general information, flood experience, flood risk knowledge and perception, and Area-BCM. It should take approximately 15 minutes to complete.

Participation

Your participation in this survey is voluntary. You may refuse to take part in the research or exit the survey at any time without penalty. You are free to decline to answer any particular question you do not wish to answer for any reason.

Benefits and risks

You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about to build resilient regional community and business continuity. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

Confidentiality

Your survey answers will be scanned and sent to a document file and stored in an independent hard disk drive without exposure to third parties. This survey does not collect identifying information such as your name, email address, or IP address. Therefore, your responses will remain anonymous. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study. So, it is also in any publications or presentations based on these data, and your responses to this survey will remain confidential.

Instruction

Before answering the questions, respondents ****MUST** access the link1 or scan the QR code1 for watching video clip of Area-BCM system which takes around 3 minutes. In case respondents want to understand more about Area-BCM, the second and third link including QR codes are provided.

Purpose of questionnaire

To know individual opinions and investigate the factors affecting behavioral intention on the acceptance of Area-BCM system which target respondents are stakeholders involved with industrial area.

****Must watch** **Optional contents about Area-BCM for more understanding**

QR code1: Area-BCM system QR code2: Article of Area-BCM QR code3: Video clip of Area-BCM

link1: https://youtu.be/quERTwh50qY

link2: https://bit.ly/2UOyie3

link3: https://bit.ly/2WZYcJq

Part 1 General Information (Please check ✓)

1.1 Gender

_____ Male _____ Female

1.2 Nationality

_____ Thai _____ Japanese

_____ ASEAN except Thai (_____)

_____ Others (_____)

1.3 Age

_____ Below 20 years _____ 21-30 years _____ 31-40 years

_____ 41-50 years _____ 51-60 years _____ Over 60 years

1.4 Education

_____ Less than high school _____ High school _____ College/vocational school

_____ Bachelor's degree _____ Above Bachelor's degree

1.5 Work position

_____ General worker _____ Manager _____ Executive

_____ Engineer _____ BCM or risk management team

_____ Others (_____)

1.6 Category of your business company

_____ Agro & food industry (e.g. food and beverage)

_____ Consumer products (e.g. fashion, home and office products, pharmaceuticals and personal products)

_____ Manufacturing (e.g. automotive, materials & machine, packaging, printing materials and chemicals)

_____ Property and construction (e.g. construction materials)

_____ Resources (e.g. energy and utilities)

_____ Technology (e.g. electronic components and communication technology)

_____ Others (_____)

1.7 How long have you been working in current company?

_____ 0-2 years _____ 2-5 years _____ 5-10 years _____ More than 10 years

1.8 Monthly income

_____ Under 10,000 THB _____ 10,001 – 50,000 THB

_____ 50,001 – 100,000 THB _____ Over 100,000 THB

1.9 Subdistrict of your residence

_____ Khan Ham subdistrict, Ayutthaya _____ Baan Chang subdistrict, Ayutthaya

_____ Others area (_____)

Part 2 Experience with Flooding (Please check ✓)

2.1 Have you ever experienced flood event?

_____ Yes _____ No

If yes, how many times?

_____ 1 – 3 times _____ 4 - 6 times _____ More than 6 times

2.2 Did your home suffer from flood event?

_____ Yes _____ No

If yes, how many times?

_____ 1 – 3 times _____ 4 - 6 times _____ More than 6 times

2.3 Were your properties damaged from flood event?

_____ Yes _____ No

If yes, how many times?

_____ 1 – 3 times _____ 4 - 6 times _____ More than 6 times

2.4 Have you ever experienced evacuate when flooding?

_____ Yes _____ No

If yes, how many times?

_____ 1 – 3 times _____ 4 - 6 times _____ More than 6 times

Part 3 Worry About Flooding (Please check ✓)

Please rate your level of feeling at following questions (scale 1-5).

Feelings	Strongly Agree (5)	Agree (4)	Neither (3)	Disagree (2)	Strongly Disagree (1)
3.1 I'm afraid of future flood and inundation in my company.					
3.2 The large flood similar to the one in 2011 affects negative feelings to me.					
3.3 I'm panic when facing large flood.					
3.4 Flood will make serious damages to my life and properties.					

Part 4 Flood Hazards Knowledge (Please check ✓)

Please rate your level of flooding information at following questions (scale 1-5).

Flood Hazards Knowledge	Strongly Agree (5)	Agree (4)	Neither (3)	Disagree (2)	Strongly Disagree (1)
4.1 I attend an evacuation training for flooding event.					
4.2 I know what to do, when I receive a warning.					
4.3 I involved in emergency planning of my company.					
4.4 I received flood hazard information.					

From 4.5 – 4.7, please **write the number 1, 2 and 3** in ____

4.5 Please **rank the first top three entities** that you trust as information source (1 = the most)

____ Central government ____ Local government ____ Community leaders

____ Family/friends/colleges ____ Research/academic institutes____ Priest

____ Others (_____)

4.6 Please **rank the first top three entities** that you prefer as media for receiving emergency information (1 = the most)

____ Siren ____ Phone call ____ TV

____ E-mail ____ Text message (SMS) ____ Radio

____ Government website ____ Face-to-face message ____ Others (_____)

4.7 Please **rank the first top three entities** that you want during the disaster event (1 = the most)

____ Overall damage ____ Safety of family/friends

____ Availability of food and water ____ Distribution of donate/relief

____ Waste disposal ____ Reliability of utilities/lifelines

____ Traffic/transportation infrastructure ____ Hospital/medical centers

____ Existing disaster preparedness plan ____ Disaster warning

____ Current situation/affected area ____ Availability and accessibility of

____ Others (_____) evacuation shelters

Part 5 Opinion with Area-BCM system (Please check ✓) **Make sure that you already watch the video clip of Area-BCM system which is QR code1 or link1 on the first page before answering this part

Additional description of Area-BCM system

Area Business Continuity Management plus (Area-BCM) is analyze and design the online system using cloud to establish platform to enhance disaster resilience at industrial area in Thailand. The system covers business impact analysis, creating precise flood model and online sharing system. It requires a coordination of stakeholders among companies, local community, infrastructure providers and government administration in order to improve economic growth, enhance safety to industrial area and communities and manage the risk of climate change.

Please rate your opinion with the following statement about Area-BCM system (scale 1-5)

Lists	Strongly Agree (5)	Agree (4)	Neither (3)	Disagree (2)	Strongly Disagree (1)
Perceived Usefulness					
5.1 Area-BCM system is beneficial for my company in terms of business continuity.					
5.2 Area-BCM system will increase promoting cooperative approach among stakeholders of the area.					
5.3 Area-BCM system enhances effectiveness in response with flooding.					
5.4 Area-BCM system improves resilience of company, industrial park and community.					
5.5 It ensures that the critical infrastructure can be restored with in specified time frame in case of emergency.					
5.6 It facilitates early resumption of your operations even you are affected by flood.					
Perceived Ease of Use					
5.7 Overall, I believe that the Area-BCM system is easy to use.					
5.8 For me, Area-BCM system is suit to carry out disaster management.					
5.9 The learning and implementing process of Area-BCM system should not require a lot of time.					

Lists	Strongly Agree (5)	Agree (4)	Neither (3)	Disagree (2)	Strongly Disagree (1)
Perceived Ease of Use					
5.10 If company implement Area-BCM system, they should have training about using process clearly.					
Subjective Norm					
5.11 If almost workers in my company think that we should implement Area-BCM system, then I think so.					
5.12 If people supplier or buyer think company should implement Area-BCM system, then I think so.					
5.13 If other companies surrounding me implement Area-BCM system, then my company should do it too.					
5.14 if there is supporting to my company from industrial park office, public sectors and others to implement Area-BCM system, then my company should do it.					
Behavioral Intention to Use					
5.15 I think that company should plan to implement Area-BCM system.					
5.16 I glad to learn Area-BCM system.					
5.17 I willing to use Area-BCM system.					
5.18 I predict company would use the Area-BCM+ system in the future.					

Part6 Others

Please check ✓ and answer briefly the following questions

6.1 Has your company faced any contamination (ex. “oil or petrol”, “chemicals”, “sewage or feces”) in past flood events?

_____ Yes _____ No _____ I’m not sure

If yes, please describe what kind of contamination your company faced

_____

6.2 Has your company taken any emergency measures or utilized any system (such as BCM) in past flood events?

_____ Yes _____ No _____ I’m not sure

If yes, please describe what emergency measure or system your company had

_____

6.3 Has your company had experiences of being supported by other entities for restarting company’s factories at past flooding?

_____ Yes _____ No _____ I’m not sure

If yes, please describe what kind of being supported your company had

_____

6.4 Is business continuity of neighboring Industrial Park affect you?

_____ Yes _____ No _____ I’m not sure

If yes, please describe how it affects your company

_____

6.5 Comments and suggestion for flood prevention system

_____

***** Thank you so much for your cooperation *****

Your decision to complete and return this survey will be interpreted as an indication of your agreement to participate.

Please return the completed questionnaire to distributor or Natt Leelawat, D.Eng.

Department of Industrial Engineering, Faculty of Engineering, Chulalongkorn University
254 Phayathai Road, Pathumwan, Bangkok 10330 Thailand

Contact

If you have further questions or concerns about your rights as a participant in this study, please feel free to contact responsible faculties: Dr. Natt Leelawat

Department of Industrial Engineering, Faculty of Engineering, Chulalongkorn University

254 Phayathai Road, Pathumwan, Bangkok 10330 Thailand

Tel: +66-2218-6841 or E-mail: natt.l@chula.ac.th.

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