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The Use of Local Knowledge and its Transfer for Community Self-Protection Development in Flood Prone Residential Area

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***Abstract*—**This paper aims to study at the use of local knowledge to develop community self-protection in flood prone residential area, Ayutthaya Island has been chosen as a case study. This study tries to examine the strength of local knowledge which is able to develop community self-protection and cope with flood disaster. In-depth, this paper focuses on the influence of social network on knowledge transfer. After conducted the research, authors reviewed the strength of local knowledge and also mentioned the obstacles of community to use and also transfer local knowledge. Moreover, the result of the study revealed that local knowledge is not always transferred by the strongest-tie social network (family or kinship) as we used to believe. Surprisingly, local knowledge could be also transferred by the weaker-tie social network (teacher/ monk) with the better effectiveness in some knowledge.

***Keywords*—**Community Self-Protection Development, Flood Risk Reduction, Knowledge Transfer, Local Knowledge

I. Introduction

AYUTTHAYA Island is located on the Ayutthaya Prefecture, central part of Thailand. Flood in Ayutthaya Island is annual year flood, comes and goes every year. Even though recently not every time flood hazard is severe, therefore the community become familiar with flood and recognition of flood damage is declining. But when flood is severe, while the community is vulnerable from less awareness, flood damage can extremely harm community. Local knowledge have been devalued and discarded by modern technology and skills. Dependency on the expertise from external knowledge replaced community depended on their own wisdom and consequently community's recognition to local knowledge has been decreased gradually, generation to generation. The eventual goal of this study is to develop Ayutthaya Island community self-protection by encouraging uses of community wisdom meanwhile finding the possibility to transfer their local knowledge among community.

Social Network has been studied in this research, according to its potential function to transfer information. Thus, the study tries to examine the strength of local knowledge to stimulate community self-protection. In-depth, this paper focuses on the influence of social network on knowledge transfer.

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II. The Chosen Local Knowledge and its Strength for Community Self-Protection Development

A. The chosen local knowledge

This paper has chosen two, unique well-known, local knowledge among Ayutthaya community which are Pillar House and Ant's natural flood response knowledge.

1) Pillar House

There are several types of pillar house due to combination of modern architecture styles and traditional one. Pillar houses originally made by wood stuck on approximately 2 meters of high pillar and leave first floor space for wind to flow. This space originally takes the function as a living room for family member to sit and talk or for welcoming the guests. As a matter of flood control, it provides the impervious surface of the city which it can potentially mitigate flood severity by absorbing water and allowing water run through its flow. The roof of Pillar house is tradition with some ornaments aim for aesthetic scenery. The remaining pillar houses in Ayutthaya still could be seen many houses along the river bank round the island. Even though, the traditional one is not less vanished, but the contemporary styles still have been seen in the island. Thai community has learned to settle their houses along the river from the past. Nowadays, Pillar houses are decreasing by displacement of modern buildings. The original purpose of Pillar House, to offer chance for Ayutthaya people to live along the river blank, is vanishing.

2) Ant's Natural Flood Response

Ant's Natural Flood Response is based on the local wisdom climate forecasting. It is locally observed and experiences combining natures of plant, animal, insects, metrological and astronomical. The original of knowledge came from the needs of the local farmers who would like to predict the coming period of flood before they could start to farm their rice field or need to know the period of coming flood, so that , they can cultivate their productivity before the farms were flooded.

An early flood warning by community comprises of many natural phenomenon which needed tacit knowledge to recognize the phenomenon. If the cloud is line and clustered, there will be flood in a day. If the water's color changes to be darker mean flood will take place. If ant start to march from lower place to higher place and bring food, there will be

raining and the level of rain is depended on how high they march to and what kind of food they bring with them. If the frogs near the river make some wired and continuous noise, there will be raining in a day. If mosquitoes are increasing, there will be rain. These knowledge are supernatural and non scientific proved, but community believe in these forecasting and use in daily life rather than watch weather forecast in television which is properly more accurate.

Normally, knowledge is orally stories which were merged by fable, proverbs, song or poems. The ants and grasshopper story has been told as bedtime story long time ago. The story is about differing of ant and grasshopper behavior. Ant who always being a hard worker, keep tracking for food and bringing to his nest, even his nest is far and high. Whereas, grasshopper who is always happy with his singing. Every day he wakes up, has some dews and then goes sing a song. When the rainy season comes, ant's nest is fruitful with food meanwhile grasshopper is starving to death. Besides, the story has stimulated the children to learn not to be slack like the grasshopper, its purpose is actually hidden some hint to notice the behavior of the Ant and predict for the rain. The story is well-known among Ayutthaya Island community as an amused fable, but nowadays the hidden hint of the story may not be clearly defined when the story is told.

B. Strength of Local Knowledge for community self-protection development

1) Local technologies based on traditional, indigenous knowledge, skills of community and have been used extensively, the strength is obvious. Even non literacy can learn about local knowledge. Since it is non education required, community can easily use it as their measure to protect themselves from flood disaster without waiting for any outside supports. This is generally perfect starting for local to develop self-protection with their own wisdom.
2) Local knowledge is low cost rather than the technical one. Knowledge like Ant's Natural Flood Response does not cost at all. There is no obstacle for anyone to invent the capacity to protect oneself.
3) Local knowledge reflected the wisdom of community. In light of it, community has improved their self-esteem when they use local knowledge and even better if their knowledge is accepted by others. Familiarity with local knowledge, community has tended to participate in the activities, they are confident to use the knowledge and they are sure that they are able to do a good job from their skill. To gather community member to work together is the better future of community in flood prone area.

However, local knowledge is a individual skill which is difficult to manage and be organized. It is hard for community to express their 10 years experience. Therefore, the transfer process has not been clearly mentioned yet.

This study has raised one local knowledge transfer possibility which is *Social Network*. Later on, this study will try to find the significance of social network in local knowledge transfer and the typical social network-tie which influences on the local knowledge transfer.

III. Influence of Social Network on Local Knowledge Transferring Concept and Hypothesis

Social network analysis views social relationships in terms of nodes and ties. Nodes are the individual actors within the networks, and ties are the relationships between actors. They can be many kinds of ties between the nodes. Research in a number of academic fields have shown that social networks operate on many levels, from families up to the level of nations, and play a critical role in determining the way problems are solved, organizations are run, and the degree to which individuals succeed in achieving their goals. [1]

A. The Strength of Ties Model

In this paper nodes are person who engage in local knowledge transfer process. Person who send the knowledge called "Senders" and person who receive the knowledge called "Receiver". Namely, Receivers are the questionnaire respondents and Senders are person who respondents have learned the Pillar House and Ant's Natural Flood Response knowledge from. To define the strength of ties in Social Network, this research prioritized the ties according to the closeness as kinship shown in Fig.1.

Fig. 1 The Strength of Ties Model

My Relative- Tie includes parents, grandparents, children, etc. *My Friend- Tie* includes Friends, Co- Worker, Community, Neighborhood or one who you are not stranger and used to have any activity together but your relative. *My Esteem- Tie* is Teacher, Monk, etc. or person that you respect but not your relatives. *My Government- Tie*: is Government Official, Staff, etc.

The figure 1 show that "My Relative-Tie" is close to "Myself" the most and next is "My Community –Tie" and so on. The meaning of these figures is that the closet to "Myself" is the "Strongest- Tie". This can imply that the strongest-tie in this study is "My Relative" and the weakest – tie has been set as "My Government- Tie". Next interpretation is that "My Relative- Tie" has stronger- tie than "My Community- tie" and "My Community-tie" has stronger –tie than "My Esteem-tie" and so on. In contrary side, "My Government- Tie" has weaker-tie than "My Esteem-tie" and "My Esteem-tie" has weaker-tie than "My Community-tie" in ordering. The strength of the tie also mentioned "Myself", mean the Predictor learnt the knowledge from media as a book, newspaper, television, radio, etc., which this paper will not conclude it to be analyzed the effectiveness of transferring. Because knowledge transfer concept is knowledge transferred,

from someone to someone. Therefore, "Myself" was given 0 Level of Network tie as shows in the figure. In the same way as "Stranger", shown here to create the limitation of the ties. For Stranger, its call "An absent-tie" and this paper will not include for this analysis.

B. Community Self-Protection Level

When the knowledge was transferred to the individuals, there are two separate learning activities occuring as Perception means the way to take in information and Processing means how to deal with information. [2] Namely, not everyone has the same potential to manage the knowledge their got. Someone can perceive the knowledge but not process, whereas the other one seems to process the original knowledge and nicely invent the new knowledge. From learning process concept, this paper has combined concept of perceived and processed local knowledge that respondents got and took any action to response with the transferring process, it therefore called in this paper as "Community-Self Protection Level" which reflect Community-Self Protection Ability. This research has set the level of Community-Self Protection into 6 Levels which shown in Fig 2.

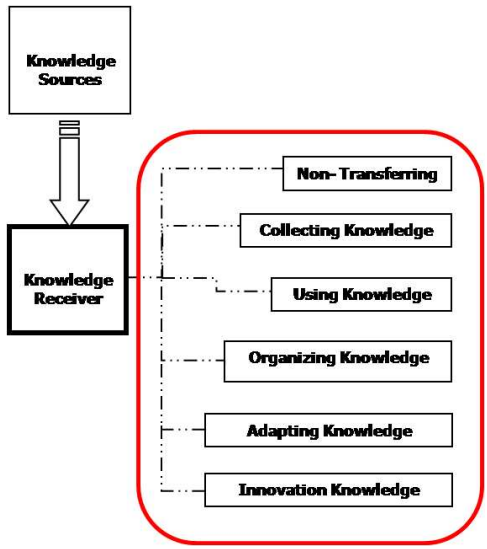

Fig 2. Flow chart of knowledge transfer and 6 levels of community self-protection

1) Level 1: Non- Transferring-Receivers do not understand anything about the knowledge at all.
2) Level 2: Collecting Knowledge -Receivers understand and believe that this knowledge is useful.
3) Level 3: Using Knowledge-Receivers understand, believe that this knowledge is useful and experienced to use this knowledge
4) Level 4: Organizing Knowledge -Receivers understand, believe that this knowledge is useful use this knowledge and will adjust or improve it in the future.
5) Level 5: Adapting Knowledge - Receivers understand and believe that this knowledge is useful and have already adopted or adjusted this knowledge before use.
6) Level 6: Innovation Knowledge -Receivers have learned about the knowledge profoundly. After all understanding and adaptation, Receivers found new knowledge based on the original one.

C. Hypotheses

David Lazer [3] Agued that Social Network has an influence on Information Transfer and in the way that the more complex, competitive, and dynamic an informational environment, the greater the value of strong ties relative to weak ties. Considering this, knowledge as pillar house and ant's natural flood response are tacit knowledge which needed understanding of culture and it limits in particular area, therefore, the hypotheses was set as "Strong- Tie Social Network has effectiveness transfer of local knowledge rather than the Weak- Tie Social Network." Namely, the strong-tie one should have influenced on the Community-Self Protection level in the higher level rather than the weak-tie one. To make the statistic prove, this paper sets the Working Hypotheses as follow;

Working Hypothesis 1

Null Hypothesis ($H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$)
: Stronger- Tie Social Network has effectiveness to transfer local knowledge in the same level as Weaker- Tie Social Network
* There is at least one pair is correct

Alternative Hypothesis ($H_1 : \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4$)
: There is different effectiveness to transfer knowledge in each social network tie
* There is at least one pair is correct

Working Hypothesis 2

Null Hypothesis ($H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$)
: Stronger- Tie Social Network has effectiveness to transfer local knowledge in the same level as Weaker- Tie Social Network
* There is at least one pair is correct

Alternative Hypothesis ($H_1 : \mu_1 > \mu_2 > \mu_3 > \mu_4$)
: Stronger – Tie Social Network has effectiveness to transfer knowledge rather than weaker- tie Social Network
* There is at least one pair is correct

μ_1 : Variable 1: The knowledge transferring effectiveness of "My Relative - Tie"
μ_2 : Variable 2: The knowledge transferring effectiveness of "My Community - Tie"
μ_3 : Variable 3: The knowledge transferring effectiveness of "My Esteem - Tie"
μ_4 : Variable 3: The knowledge transferring effectiveness of "My Government - Tie"

IV. Results and Interpretations

This research has distributed 120 copies of questionnaire to Ayutthaya Island communities, which local knowledge exists and which may clearly show how the knowledge is transferred. Data got from questionnaires were analyzed using descriptive statistics, cross tabulation analysis, ANOVA, and the simple T-test method. Moreover, from the interview with key actors who are engaged in flood reduction activity, information from interview are extremely useful and concerned by the author.

TABLE I
Existing Local Knowledge Source

Local Knowledge Sources	Pillar House		Ant's	
	No.	%	No.	%
Myself	-	-	-	-
My Relative μ_1	88	73.3%	109	90.8%
My Community μ_2	28	23.3%	-	-
My Esteem μ_3	4	3.3%	11	9.2%
My Government μ_4	-	-	-	-
Total	120	100%	120	100%

In TABLE I, Respondents have received local knowledge from the knowledge senders were classified in "My Relative-Tie"(Father, Mother, Grandfather/mother,etc.). It is not queer that the Senders should have come from "My Relative-Tie". Because of within the same family, normally people spend much time for interaction and that is the way of information are flown. However, the greatest group of sender could show just who had the most chance to transfer knowledge, does not imply the effectiveness transfer. In order to find the best knowledge transfer effectiveness sender, this research has calculated the effectiveness score by using the cross tabulation analysis between each tie of social network and the mean score of community self-protection, show in TABLE II and III.

TABLE II shows that for Pillar House knowledge, My Relative – tie is the most frequent chosen to be Sender at 88 respondents and in the same way as its effectiveness, the biggest average score is the effectiveness from the sender as My Relative –Tie at 1.92 and My Community –Tie at 1.68 and My Esteem –Tie at 1.00 in ordering. In conclusion is that $\mu 1 > \mu 2 > \mu 3$, mean that, My Relative-Tie has the best effectiveness to transfer local knowledge for Pillar House Knowledge.

TABLE II
Pillar House

Local Knowledge Sources	Community Self-Protection Score						Total	Average Score
	0	1	2	3	4	5		
My Relative μ_1	0	27	47	8	6	0	88	1.92
My Community μ_2	0	15	9	2	2	0	28	1.68
My Esteem μ_3	0	4	0	0	0	0	4	1.00
Total	0	46	56	10	8	0	120	1.83
Percentage %	0%	38.3%	46.7 %	8.3 %	6.7 %	0%	100%	

In TABLE III shows the result of Ant's Natural Flood Response. It reveals that the no. of respondents who, the most answer about the Level of knowledge transferring effectiveness is Level 3 at 69 respondents. It means that the majority of respondents understand, believe and use this knowledge to deal with flood. My Relative – tie is the most frequent chose to be Knowledge Sender at 109 frequencies. While, the biggest average score is the effectiveness from the sender as My Esteem –Tie at 2.73 and My Relative –Tie at 2.59 in ordering. In conclusion is that $\mu 3 > \mu 1$, mean that, My Esteem-Tie has the best effectiveness to transfer local knowledge for Ant's Natural Flood Response Knowledge.

TABLE II
Ant's Natural Flood Response

Local Knowledge Sources	Community Self-Protection Score						Total	Average Score
	0	1	2	3	4	5		
My Relative μ_1	0	0	64	26	19	0	109	2.59
My Esteem μ_3	0	0	5	4	2	0	11	2.73
Total	0	0	69	30	21	0	120	2.6
Percentage %	0%	0%	57.5 %	25 %	17.5 %	0%	100%	

These Tables (TABLE II-III) can also test the answer the direction of research hypotheses 2 mentioned earlier. It could concluded that Pillar House Knowledge $\mu_1 > \mu_2 > \mu_3$, Alternative Hypothesis is Accepted. Ant's Natural Flood Response Knowledge $\mu_3 > \mu_1$, Alternative Hypothesis is Rejected.

After learning that which social network ties has an influence on knowledge transfer effectiveness, in this part will analysis in-depth to prove that whether social network is statistically has an significant influence on knowledge transfer effective or not. This research sets the working hypothesis as "Social network ties have influences on the level of Community-Self Protection mean score at significant value 0.05" and had its statistical hypothesis as follow;

Null Hypothesis (H_0): $\mu_1 = \mu_2 = \mu_3$
* There is at least one pair is correct

Alternative Hypothesis (H_1): $\mu_1 \neq \mu_2 \neq \mu_3$
* There is at least one pair is correct

μ_1 = My Relative- Tie's Community Self-Protection Mean Score
μ_2 = My Community – Tie's Community Self-Protection Mean Score
μ_3 = My Esteem – Tie's Community Self-Protection Mean Score

To clarify the type of data again, in figure 3 shows the type of the data needed in the analysis and also show the relation between those data.

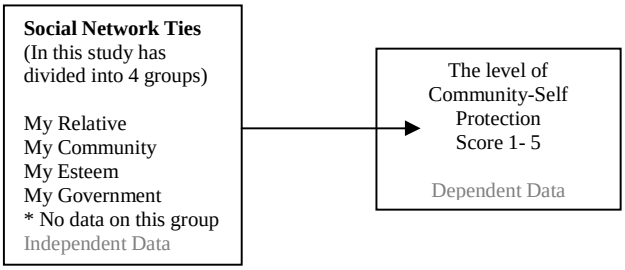

Fig. 3 The Relation between Independent and Dependent Data

It is shown that the independent data as Social Network Tie has influence on the level of Community-Self Protection score which the analysis will analyze from its mean score. TABLE II shows the data got from the questionnaires. For Pillar House Knowledge, the respondents chose 3 choices out of 4 for the social network tie and chose 4 out of 6 levels from Community-Self Protection level. To analyze the relation between independent data as group which ≥ 2 groups and dependant data as ordinal scale variable, the appropriate statistic to analyze those data is F- test (1- WAY ANOVA), compares the mean of one or more groups based on one independent variable. For, Ant's Natural Flood Response Knowledge, the respondents chose 2 choices out of 4 for the social network tie and chose 3 out of 6 levels from Community-Self Protection level. To analyze the means of two groups are statistically different from each other. T- Test analysis is appropriate to compare the means of two groups, and especially appropriate as the analysis for the posttest-only two-group randomized experimental design. Since the hypotheses 2 has been rejected from last past, Ant's Natural Flood Response will no longer explain here.

Pillar House knowledge's Alternative Hypothesis (H_1= $\mu_1 \neq \mu_2 \neq \mu_3$) is Accepted. The results from the statistical analysis reveal that for Pillar House Knowledge, there is significantly different influence of social network ties on community self-protection level after local knowledge was transferred at significant value 0.05.

In detail the ANOVA analysis show that there are no significant differences between the group's mean score. The result shown Sig. value = 0.54 which are greater than 0.05, mean that H_0 is Accepted. It can interpret that the level of Community-Self Protection is not depending on different ties of social network or, it can simply explain that, every social network ties can influence the same level of knowledge transfer effectiveness.

Even though, the statistical analysis expressed the result that way but once consider Table II, the average score of Knowledge Transfer Effectiveness in some pair's ties is completely different. Therefore this study will analyze in-depth from the Post-Hoc Comparisons to check exactly why there is not significant influence? and which pair influences which pair does not?

The result from Post Hoc Test showed that just only one pair is not significantly different which is My Relative-Tie and My Community –Tie. From the statistical analysis shows that the Sig. Value of My Relative and MY Community –tie = 0.510, greater than 0.05 which mean there is no significant difference between these two groups. It can imply that My Relative- Tie and My Community –Tie has influence on community self-protection after knowledge was transferred in the same level. Therefore, to test clearly whether social network influence on Community-Self Protection level after knowledge transferred or not, this analysis proposes to test those relations again by pair. This paper uses T-Test to analyze the influence relation in pair. To test the hypotheses no 1, 3 Working Hypotheses have set as;

Working Hypotheses 1
Null Hypothesis (H_0): $\mu_1 = \mu_2$
Alternative Hypothesis (H_1): $\mu_1 \neq \mu_2$

Working Hypotheses 2
Null Hypothesis (H_0): $\mu_1 = \mu_3$
Alternative Hypothesis (H_1): $\mu_1 \neq \mu_3$

Working Hypotheses 3
Null Hypothesis (H0): $\mu 2 = \mu 3$
Alternative Hypothesis (H1): $\mu 2 \neq \mu 3$

Working Hypotheses 1: My Relative VERSUS My Community; The T-Test analysis shown that the Sig. (2-tailed) value is 0.187, greater than 0.05, that is, there is no significant difference between the two groups. It can imply that there is no significant difference between "My Relative - Tie" group and "My Community – tie" group. The respondents who received the knowledge from those groups have no different in level of community self-protection. As the result, Null Hypothesis (H_0): $\mu_1 = \mu_2$ is Accepted.

Working Hypotheses 2: My Relative VERSUS My Esteem; The T-Test analysis shown that the Sig. (2- tailed) value is 0.028, smaller than 0.05, that is, there is significant difference between the two groups. It can imply that there is significant difference between "My Relative -Tie" group and "My Esteem – tie" group. The respondents who received the knowledge from those groups have different in level of Community-Self Protection after knowledge transferred. Alternative Hypothesis (H_1): $\mu_1 = \mu_3$ is Accepted.

Working Hypotheses 3: My Community VERSUS My Esteem; The T-Test analysis shown that the Sig. (2- tailed) value is 0.000, smaller than 0.05, that is, there is significant difference between the two groups. It can imply that there is significant difference between "My Community -Tie" group

and "My Esteem – tie" group. The respondents who received the knowledge from those groups have difference in level of Community-Self Protection after knowledge transferred. Alternative Hypothesis (H_1): $\mu_2 = \mu_3$ is Accepted.

Last, for Hypotheses stated earlier, Alternative Hypothesis (H_1): $\mu_1 \neq \mu_2 \neq \mu_3$ is Accepted. There is significantly different influence of social network ties between My Relative, My Community and My Esteem – Tie on Community-Self Protection after knowledge transferred.

V. Conclusions and Discussions

From this study, the result confirmed that social network ties have significant influence on local knowledge transfer and in each social network ties has different influence on the community's level of Community-self protection. This study found three types of social network ties which were identified as the effectiveness ties to transfer different types of local knowledge which were chosen in the study which are My Relative-Tie, My Community- Tie and My Esteem-Tie.

See the overall score comparing of those knowledge, Ant's natural Flood Response has highest average score of Knowledge Transfer Effectiveness, this can imply the good matching of social network tie and characteristic of knowledge. This also affect the opportunity of community to develop their self-protection by trying to combine the local knowledge they are holding with the fable or proverb to stimulate transferring.

Consequently, when see the effectiveness of Senders who are in My Esteem- Tie in Ant's natural Flood Response knowledge, even there were just 11 respondents, but the average score of this tie exceeded the average score of all senders. From this point lead to the confidence of this research to conclude that My Esteem- Tie is the best matching tie to transfer knowledge which merged with Fable and Proverbs. The rising of teacher and monk role in knowledge transfer for flood reduction local knowledge has seen here. This research break the common believe which many trust that local knowledge should have had only transferred within family.

Modern technologies for tackling with flood disaster have tended to be more relied by the citizen rather than before. Local knowledge as Pillar House and Ant's natural Flood Response are vanishing. Forgetting their wisdom and depending on the external support, overlook their own knowledge, caused Ayutthaya people a difficulties to live with the river like an old time. Many measurements for mitigating flood disaster in Ayutthaya Island were conducted. Recently, the notable approach for flood prone residential area is community-based flood mitigation. The use of local knowledge in flood reduction could be one factor to arouse community- self protection, since it could arouse community to participate in flood risk reduction activities, according to the proudness of their initiative wisdom. Keep transferring the local knowledge is not only preserving the intangible heritage in the Ayutthaya but also can persuade community-self protection through the disaster reduction activities as well.

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