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Exploring technology acceptance for mobile services

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Abstract:

Purpose: Mobile phone industries are no longer relying on voice services. It is predicted that data services are expected to be a remediation for the declining of average revenue per user (ARPU) in telecommunication market. The purpose of this paper is to find the factors that influence the acceptance/adoption of mobile services.

Design/methodology/approach: This paper utilizes quantitative method. Questionnaire were distributed to collect the data. The questionnaires are designed specifically to address the factors related to mobile services. Later on, this paper uses Analytical Hierarchical Process (AHP) and Cluster analysis to identify the factors that influence the adoption of mobile services.

Findings: The results show that ease of use and usefulness are top two factors that influence the adoption of mobile services.

Research limitations/implications: The sample for the study is relatively small. For future research, the sample should be increased. The data collection should also look into different devices and operating system of mobile phones to find if there is any significant difference in adopting mobile services.

Practical implications: This framework is expected to be able to help the mobile services provider to design better mobile services that can attract users to adopt them.

Originality/value: This is the follow on research on the previous study that employed different method. This study is to confirm and support the findings from previous study.

Keywords: mobile services, Technology Acceptance Model (TAM), technology adoption

1 Introduction

Telecommunication industries especially in mobile phones are moving into era where data and video usages will be as important as voice usages. In other words, it is slightly moving from mere communication-oriented services such as voice calls to more complex content-oriented services (Vesa, 2005). Nowadays, Mobile Phones are not used for voice services only, but also for data services such as: texts messaging, gaming, download music, payment services, etc. Therefore, the future of the mobile telecommunications is expected to count on mobile services (Carlsson et al., 2006). Mobile services are expected to be a remediation for the declining of average revenue per user (ARPU) in telecommunication market (Knutsen et al., 2005). Another study also emphasizes that the future of telecommunications sector will be depending on mobile internet services development in addition to voice services (Bouman et al., 2006). It is believed that the market of mobile data services is likely to scale up in the future. The main goal of this paper is to identify the factors affecting the adoption of mobile services and proposed a framework to enhance TAM (Technology Acceptance Model) that will represent the factors that influence mobile services adoption. This paper will try to understand how and why people adopt mobile services (Carlsson et al., 2006). The framework is expected to help industry players when designing their services and defining their current and future business models.

The second part of this paper is going to investigate the literature review from Technology Acceptance Model (TAM), Diffusion of Innovations, Technology of Planned Behavior, etc. The factors that might affect the adoption in mobile services will also be examined through literature review. The third part is going to talk about the Analytical Hierarchical Process (AHP) model of the adoption of mobile services. Part four will discuss the research methodology and data collections

method. Results and Conclusions are going to be explained in fifth and sixth part respectively.

2 Literature review

This paper studied and analyzed literature on several theoretical models and mobile services adoption to form an understanding of the concepts, theories and models that influence mobile services adoption. There have been several papers explain the concept of technology adoption. One of the widely accepted and applied models is the Technology Acceptance Model (Davis, 1989). Technology Acceptance Model (TAM) proposes that usefulness and ease of use are important factors in determining user attitude towards adopting a new technology (Malhotra & Galletta, 1999). Technology Acceptance model has been used in a number of studies on mobile services which focus on users (Amberg, 2004; Pagani, 2004; Samtani et al., 2003, Teo & Pok, 2003). Even though TAM is supposedly used to explaining the adoption of technology within organization, the constructs of the model are actually meant to be general and universal (6). TAM, as illustrated in Figure 1 below, includes 6 concepts (Malhotra & Galletta, 1999, Davis et al., 1989):

- External Variables (EV) which is defined as variables that affect perceived usefulness (PU), perceived ease of use (PEU), and Attitude toward Using.
- Perceived Usefulness (PU) which means that a person believes that using the particular system/technology will improve his or her action (Venkatesh & Davis, 2000).
- Perceived Ease of Use (PEU) which means that a person believe that using the particular system/technology will simple and not complicated (Venkatesh et al., 2003)
- Attitudes towards use (A) which is defined as the users' desirability to use the particular system/technology (Malhotra & Galletta, 1999).
- Behavioral Intention (BI) is forecasted by attitude towards use (A) combined with perceived usefulness (PU).

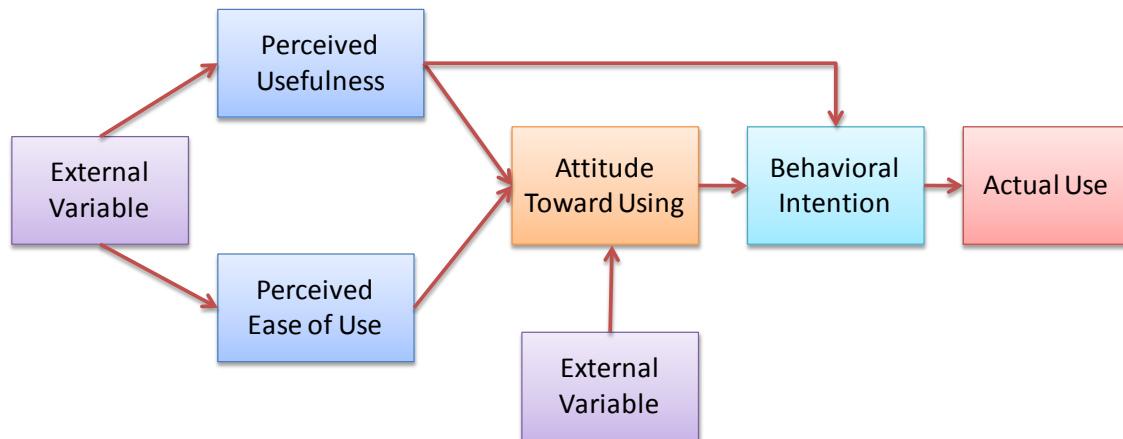


Figure 1. "Technology Acceptance Model". Source: Davis et al. (1989)

TAM model has been both extended and modified. It is believed that perceived ease of use play important role and get more attention (Venkatesh & Davis, 1996), while the perceived usefulness is believed as equally important as ease of use and lean toward service-dependent (Venkatesh & Davis, 2000). Technology Acceptance Model (TAM) has been used as a conceptual tool to identify central issues. Actually, Technology Acceptance Model is based on Theory of Reasoned Action (TRA) model (Fishbein & Ajzen, 1975). TRA is used to explain the 'reasoned action' by identifying causal relations between beliefs, attitudes, intentions, and behavior (Kwon & Chidambaram, 2000). Technology Reasoned Action (TRA) also has been applied to clarify the adoption of various technologies and applications (Liker & Sindi, 1997). Lee et al. (2003) underlined the usage of TAM in Information System field. Lee, et al. did a survey among 32 information system researchers to examine the usage of TAM for the future directions. The finding shows that TAM has been applied to communication systems, including mobile phones. However, utilizing TAM has to be really careful. Benbasat et al. (2007) stressed that researchers have to pay a lot of attention to other factors when utilizing Technology Acceptance Model (TAM) as research instruments to formulate model. Even though TAM is popular in Information System, its application is limited due to the nature of constantly changing IT environments. Authors suggested looking into more factors in order to reach more comprehensive understanding of what influences adoption of IS in order to give more useful recommendations.

After we investigated the models above, we are going to look into factors that might affect the adoption of mobile services. Those factors will be explored through

several literature reviews. In the models above, we have found several factors such as: Ease of Use, Usefulness. There are several papers that support usefulness and ease of use as important determinants of the adoption of mobile services. According to Rogers (2003), innovativeness is important because it distinguishes by individual as something new therefore leads to adoption. Kleinrock stated the benefits by using mobile phones are the ability to provide “anytime and anywhere computing”, in other word ‘mobility’ (Kleinrock, 1996). Dunlop affirmed that screen sizes (visual factors) is quite important and will improve in resolution and color yet might remain small due to the need for portability (Dunlop & Brewster, 2002). The visual factor will be improved, yet the mobility will be taken into high consideration. Social factors also affect the social interaction might be influenced by using the mobile services. Especially for young people, the adoption of the mobile services can be encouraged by a “theory of fashion” which is influenced by social environment (Ling, 2001). Lee et al. (2002) studied user acceptance of the mobile services and found that social factors significantly affect on perceived usefulness and perceived ease of use, respectively, while perceived ease of use and perceived usefulness will leads to attitude toward using.

Technological content is also being considered as factor that can affect the mobile services adoption. Technological improvement could lead to a better user experience in using the mobile services (Hyvönen & Repo, 2004). The interest in technology has been identified as factor that leads to the adoption of mobile services (Hyvönen & Repo, 2004). In his research, Pederson found two components that are important in favor for mobile service adoption. Those two components are time efficiency and financial resources/cost (Pederson, 2003). Kleijnen et al. (2004), in his paper also stated that cost, service quality and social factors will affect attitude towards use. Carlsson et al. (2006), identified that enjoyment could be a possibility that influence the adoption of mobile services. Carlsson re-emphasized this point in his other paper which stating that users will use the services if they find it’s useful or enjoyable. Carlsson et al. (2006), stated that mobile service should be changed or improved in everyday life in order for it to be adopted, used and to create enjoyment. Zhu et al. (2002), look at price and enjoyment factors that affect users’ objective to use mobile services. This paper also looks at several gratification studies to identify the factors that affect the adoption of mobile services. Leung and Wei (2000) expanded the study and recognized seven gratifications related to mobile services adoption; fashion/status,

affection/sociability, relaxation, mobility, immediate access, instrumentality, and reassurance. Holflich and Rossler (2001) conducted gratifications study on text messaging which can be categorized as mobile services and identified the following gratifications; reassurance, sociability, immediate access/availability, instrumentality, and entertainment/enjoyment. Eldridge (2001) also studied the adoption of text messaging (one of mobile services) among teenagers and found that text messaging were favorable compare to other media because it was considered quicker, cheaper, easier and more convenient to use. I-LAB-Bocconi University (2002, 2003) showed that awareness, familiarity/habit, and involvement influence attitude toward using a new service.

There are several papers out there investigating similar topic on mobile services adoption with different approach. Pederson et al. (2002) in their paper "Adoption of Mobile Services: Model Development and Cross-Service Study" proposed a framework that integrating the gratification studies and adoption behavior of domestication research into a modified version of the theory of planned behavior. For the methodology, four individual surveys were conducted to investigate the cross service differences in the adoption model. The results show significant findings in effects of attitude towards use on the intention to use mobile services. Pederson (2003) conducted another study on adoption of mobile Internet services. Pederson applied a modified version of the theory of planned behavior to the adoption behavior of early adopters of mobile commerce services. Pederson used empirical study to justify his findings. He used simple one-group posttest design in which respondents were recruited from discussion forums, bulletin boards or community groups on the webpage. Pagani (2004) formulated a model of consumer adoption of third generation mobile multimedia services by using a qualitative exploratory study comprising 24 focus groups in six markets and empirically test the proposed model on the Italian Market. The results also show significant findings on perceived usefulness, ease of use, price and speed of use. Biljon et al. (2007), proposed a model which they called MOPTAM (Mobile Phone Technology Adoption Model) to investigate the adoption of mobile phone. MOPTAM is created based on the literature reviews of several models such as: Technology Acceptance Model (TAM), Roger's diffusion Model, and Unified Theory of Acceptance and Use of Technology Model (UTAUT). They used both qualitative (interview) and quantitative (survey) methods in their methodology. The factors in the MOPTAM contribute to the construction of the model in this paper. This paper

will use quantitative (questionnaire) method which will be discussed in the next session. Yu et al. (2005) also did a research in T-commerce by utilizing Technology Acceptance Model (TAM). T-commerce is electronically mediated commerce using interactive television. It is considered as mobile services in telecommunication industry. In this sense, it has similar pattern with the mobile services in telecommunication. They identified several factors that influence the adoption in T-commerce. Those factors can also be applied to adoption of mobile services. Those attributes are perceived ease of use, perceived usefulness, perceived enjoyment, trust, attitude, normative belief of family and friends, and subjective norm.

3 AHP model for the adoption model

Analytical Hierarchical Process (AHP) is used to this particular case. AHP has been applied in wide range applications in different fields for the last 25 years (Saaty, 1990; Kodali & Chandra, 2001; Chan & Lynn, 1991). AHP is comprehensive, logical and a structured framework that requires the subjective opinion from the experts (Delphi method) in order to obtain weight for the criteria. AHP will help in the sense of simplify the decision process by categorizing multiple criteria into hierarchical process which make it easier to be evaluated (Liu et al., 2010; Drake, 1998; Saaty, 2008). Pairwise comparison among criterion is the key step in AHP process to acquire the priority weight or relative importance for each criterion in the hierarchy (Hepler & Mazur, 2007). Pairwise comparison method will compare two criteria at a time and their relation to each other. By comparing the criteria, no single criterion could dominate all other criteria in a clear-cut fashion. The favor of a single criterion is more important than the other criteria would be the result of Pairwise comparison (Yang & Shi, 2002).

From the literature review, this paper listed the factors that are going to be examined; Service Quality, Simplicity, Innovativeness, Visual Factor, Speed, Time Efficiency, Enjoyment, Cost, Mobility, Content, Habits, Technology, Social Factors, Usefulness and Ease of Use.

The top level would be the Attitude toward using which is believed will leads to the mobile services adoption. The second level that might affect the attitude toward using consists of ease of use, usefulness, social factors, technology, and habits.

Ease of use and usefulness factors have their own sub category. Ease of use consists of service quality, simplicity, visual factors, speed, and innovativeness. Usefulness comprises of cost, enjoyment, mobility, content, and time efficiency. The categorization is based on literature review and experts' judgments.

The proposed AHP model for the adoption of mobile services can be found in the following figure.

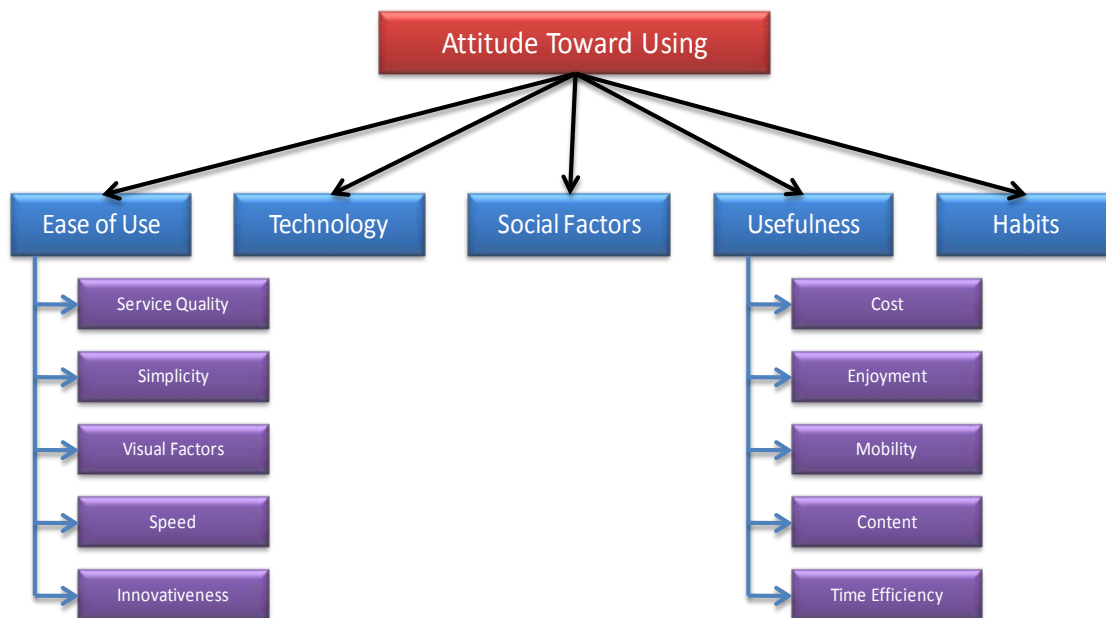


Figure 2. "AHP Model for the Adoption of Mobile Services".

4 Methodology

This paper used a quantitative method to collect the data in order to study the factors that influence the adoption of mobile services. Questionnaires were distributed to the respondents who are mobile phone users and have used mobile services. The purpose of this method is to understand correctly the user preference when the factors are identified. The respondents assigned scores to the factors that they favor better. The respondents are being asked to compare two items at a time. This method is well known as Pairwise Comparison. Pairwise Comparison Matrices (PCM) software was used after the data were collected from the respondents. The PCM software will give the mean of each factors based on the responses.

The participants are mostly university graduate students and professional workers. The participants were notified through email, phone, or face to face. The study was explained in term of the scope and explanation about the research. The questionnaires can be found in Appendix A. A total of 15 people participated in the study. All of the respondents must have at least one mobile device.

Target interviewees were people whose aged between 20 to 60 years old. The distribution of gender in this study was 33% female and 67% male.

All the respondents should have used at least short message services. Without short message services experiences, the respondents will be automatically not considered as part of the analysis. The study is not limited to specific brands and operating system of the mobile phones. The purpose of this study is to find the factors that influence the adoption of the mobile services in general. If the focus is on specific brand or operating system, the results would not be able to be generalized. Therefore, the respondents of this study use a variety of different phones and operating system.

The results will identify the factors that affect the adoption of mobile services. The factors will be integrated to the Technology Acceptance Model (Davis, 1989). The following section will explore the results from the questionnaires including the analysis.

5 Results and analysis

This section will analyze the results from questionnaires that listed the factors that influence the decision to use the mobile services. The strength of the factors was computed by using PCM software. The results from the PCM software show that ease of use, usefulness, technology and habits have impacts to the attitude toward using with the percentage of 25%, 23%, 20%, and 20% respectively. The number can be interpreted as that Ease of Use contributes 25% to the attitude toward using, and usefulness contributes 23% to the attitude toward using, while technology and habits contribute 20% to the attitude toward using. Social Factors only got 12% which can be translated as not as important as the other factors therefore the effect of social factors is not that critical. The recommended value of inconsistency is between 0.0 and 0.10 (Kocaoglu, 1983). In this paper, we are

going to use 0.1 as the border limit of the inconsistency level. There are two respondents who yielded inconsistency percentages greater than the limit (0.1).

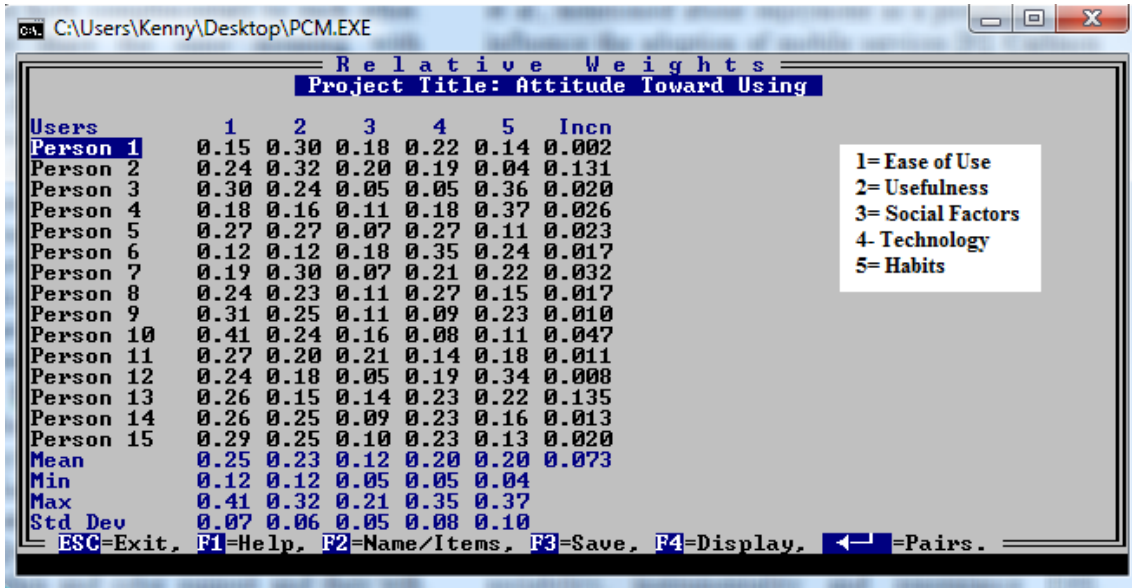


Figure 3. "Main Criteria – Attitude toward Using".

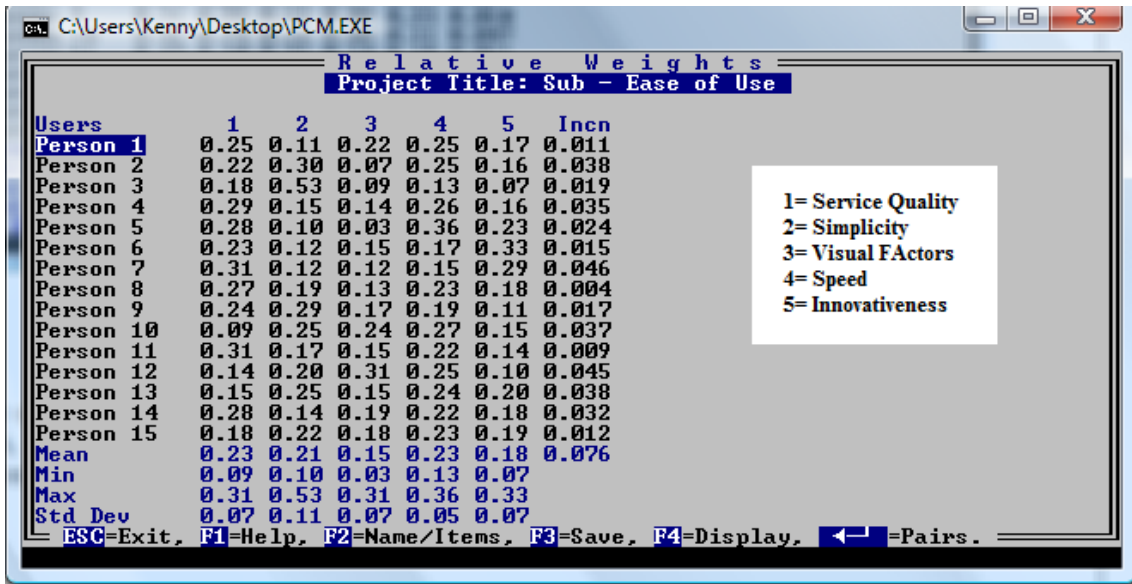


Figure 4. "Sub Criteria – Ease of Use".

The third level of the AHP show the sub criteria of ease of use and usefulness. For ease of use category, service quality, simplicity and speed show the highest percentage of 23%, 21% and 23% respectively. It means that Service quality contributes 23% to the Ease of use factor, and simplicity contributes 21% to ease

of use factor, while speed contributes 23% to the ease of use factor. Visual factors and Innovativeness do not get as high percentage as the others with only 15% and 18% respectively. All the respondents show the level of acceptable inconsistency with nobody exceeding the limit of 0.1.

The second sub criteria are related to usefulness. After the calculation by using PCM software, only cost really has significant percentages compared to enjoyment, mobility, content and time efficiency. Cost generated 27% contribution to the usefulness factor while enjoyment, mobility, and content throw in equally with the percentage of 18%, to the usefulness factor and time efficiency contributes 19% to usefulness factor. The inconsistency level of all respondents is also below the 0.1 limit.

Users	1	2	3	4	5	Incn
Person 1	0.34	0.21	0.17	0.18	0.11	0.011
Person 2	0.30	0.07	0.21	0.16	0.25	0.071
Person 3	0.27	0.16	0.22	0.09	0.27	0.017
Person 4	0.23	0.15	0.20	0.20	0.22	0.009
Person 5	0.45	0.13	0.11	0.11	0.20	0.034
Person 6	0.34	0.26	0.11	0.18	0.11	0.025
Person 7	0.14	0.27	0.25	0.18	0.16	0.019
Person 8	0.15	0.20	0.23	0.17	0.25	0.004
Person 9	0.42	0.09	0.16	0.09	0.24	0.013
Person 10	0.19	0.30	0.17	0.23	0.10	0.018
Person 11	0.15	0.21	0.23	0.15	0.25	0.003
Person 12	0.41	0.17	0.13	0.16	0.13	0.025
Person 13	0.15	0.16	0.16	0.29	0.23	0.031
Person 14	0.20	0.13	0.21	0.31	0.15	0.022
Person 15	0.29	0.13	0.16	0.19	0.24	0.006
Mean	0.27	0.18	0.18	0.18	0.19	0.071
Min	0.14	0.07	0.11	0.09	0.10	
Max	0.45	0.30	0.25	0.31	0.27	
Std Dev	0.11	0.07	0.04	0.06	0.06	

Legend:
 1= Cost
 2= Enjoyment
 3= Mobility
 4= Content
 5= Time Efficiency

Figure 5. "Sub Criteria – Usefulness".

The results from the PCM software calculation were also analyzed by using cluster analysis. Respondents who participated in the questionnaires will be clustered by using SPSS software. Since the number of respondents is only 15 people, we choose the solution of 2-3 clusters. The cluster analysis for the main criteria – attitude toward using is presented in the table below.

From the results above, we can see that if the data are grouped into 2 clusters, there is only 1 person who does not belong to cluster number 1. The majority of the data is homogenous therefore the identity of the two different groups can't be

distinguished. Same thing also happened if we grouped the data into 3 clusters. Only 2 people do not belong to the cluster number 1. The people that do not belong to the majority cluster can be assumed as outliers. One of the possible explanations of the homogenous clustering is because all the respondents are students. Therefore, they are clustered into the same group.

Person	3 Clusters	2 Clusters
A	1	1
B	1	1
C	1	1
D	1	1
E	1	1
F	2	2
G	1	1
H	1	1
I	1	1
J	3	1
K	1	1
L	1	1
M	1	1
N	1	1
O	1	1

Table 1. "Cluster Analysis for Main Criteria – Attitude toward Using".

Person	3 Clusters	2 Clusters
A	1	1
B	1	1
C	2	2
D	1	1
E	3	1
F	1	1
G	1	1
H	1	1
I	1	1
J	1	1
K	1	1
L	1	1
M	1	1
N	1	1
O	1	1

Table 2. "Cluster Analysis for Sub Criteria – Ease of Use".

Table 2 and 3 depict the cluster analysis for sub criteria of Ease of Use and sub criteria of Usefulness. For sub criteria of Ease of use, similar occurrence also happened. The majority of the data are clustered into group number 1 and only 1 person is categorized into cluster number 2. Only 2 people do not belong to cluster number 1 if we choose to categorize them into 3 clusters. . The people that do not belong to the majority cluster can be assumed as outliers. For sub criteria of Usefulness, the data clustering is very interested. 5 people belong to cluster

number 1 and 10 people belong to cluster number 2. If we investigate the data, apparently 10 people that belong to cluster number 2 are all Ph.D. students and the rest are Master students. If we choose 3 clusters, there are two people from the Ph.D. Students fit in cluster number 3. After the analysis, 2 of the people that belong to cluster number 3 are Ph.D. students from Thailand.

Person	3 Clusters	2 Clusters
A	1	1
B	2	2
C	2	2
D	2	2
E	1	1
F	1	1
G	3	2
H	2	2
I	1	1
J	3	2
K	2	2
L	1	1
M	2	2
N	2	2
O	2	2

Table 3. "Cluster Analysis for Sub Criteria – Usefulness".

6 Conclusion

This paper is built upon prior work (Phan et al., 2010; Kargin et al., 2009a; Kargin et al., 2009b). The objective was to discover the factors that influence the mobile service adoption. Quantitative method e.g. questionnaires were conducted to find the weight of each factors which were identified through literature review. The factors identified have been integrated to the TAM model to help the mobile services provider to develop a better business model or services that can attract users to use mobile services. This study may provide insights to designers and marketing experts to create better and more attractive mobile services.

From the results above, mobile services provider should focus on ease of use and usefulness. Technology improvement should be also taken into consideration to structure the attitude toward using the mobile services. Mobile services' users want something easy and free of effort to use those services. Service quality, speed and simplicity should embrace in the ease of use category. Usefulness is also very important. Mobile services providers should provide something that is useful to the users. Users do not want to spend extra money and time to use mobile services. If users find it is useless and bring no value to the life, they tend to avoid using that

kind of services. The significant finding from the results above is cost. In order to encourage people to use the mobile services, mobile services provider should not charge premium price. Price has always been a barrier for the users to use mobile services. If the price of using the services is reasonable, users will not hesitate to use it. Below is the proposed framework that can help the mobile services provider to design their services if they want users to adopt and use mobile services.

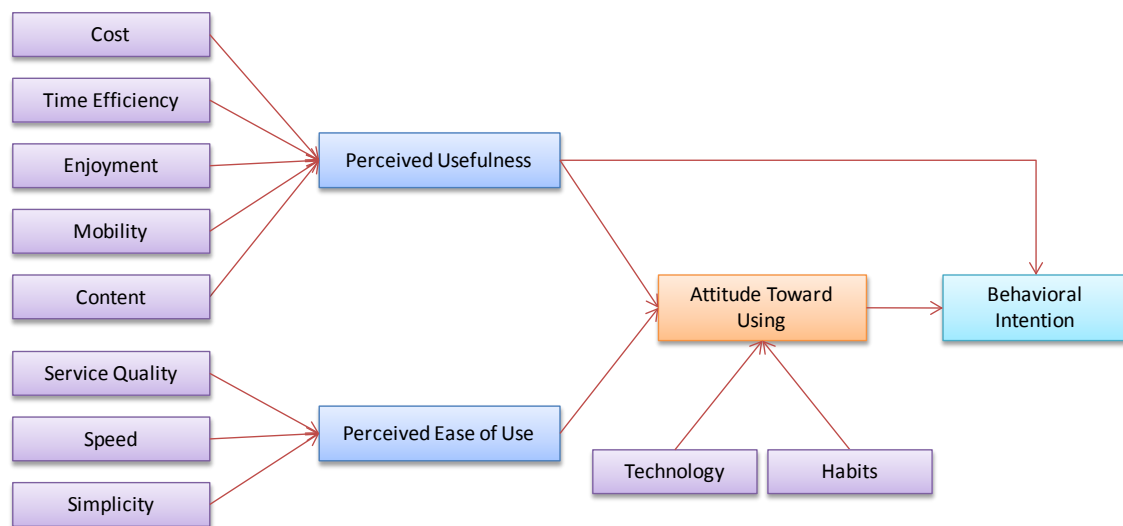


Figure 6. "Proposed Framework".

There is a limitation of this study. The sample size is quite small due to the time limitation for collecting the data. However the result from the analysis, show the similarity with the one that has been done by the author in his other classes. The other paper (Phan et al., 2010) is investigating the same matter but use different models and different data collection method. The other one use the qualitative methods to identify the most important factors. No special software was involved in the data analysis. The factors were identified and analyzed through the response during the open ended interview method. The results show slight differences with the results of this paper. Therefore, the sample size for this paper should be acceptable.

Another limitation is the classification of the factors into the AHP model. The factors classification is based on literature research. The pairwise comparison can't validate if the categorization is 100% accurate. Different people might look at those factors differently and have different opinions about the model. Thus, the classification of the factors might be different.

For future research, the data collection should also look into different devices and operating system of mobile phones to find if there is any significant difference in adopting mobile services. It could give a more comprehensive conclusion to mobile service providers. It is also suggested to collect more data to get more accurate results. The respondent that excess the limit of the inconsistency should also be excluded or revisit his/her answer. Further in depth literature review also might identify more factors that can be integrated into the AHP model. The factors classification should be justified by expert panels. There should be consensus in how did the factors organized. A second option to factors classification could be double data collection. First, we can start by asking the respondent to give their opinion about the factors. For example: the questionnaire can ask the respondents whether they think "service quality" belongs to ease of use or usefulness. Or else, asking the respondents to give the weight whether they think "service quality" is more favor in ease of use or usefulness. The respondents should give higher weight to the group that they think the factors belong to. From the results, we can find the ideal classification. Then we conduct the second data collection. The results might be more justified.

Appendix

Pairwise comparison

Name (optional):

Use pair wise comparison to quantify your judgment. Allocate a total of 100 points to express your judgment about the ratio of one criterion to the other one in pair.

Main criteria comparison

Attitude toward using

Criterion	Weight	Weight	Criterion
Ease of Use			Usefulness
Ease of Use			Social Factors
Ease of Use			Technology
Ease of Use			Habits

Usefulness			Social Factors
Usefulness			Technology
Usefulness			Habits
Social Factors			Technology
Social Factors			Habits
Technology			Habits

Sub criteria comparison

Ease of use

Criterion	Weight	Weight	Criterion
Service Quality			Simplicity
Service Quality			Visual Factors
Service Quality			Speed
Service Quality			Innovativeness
Simplicity			Visual Factors
Simplicity			Speed
Simplicity			Innovativeness
Visual Factors			Speed
Visual Factors			Innovativeness
Speed			Innovativeness

Usefulness

Criterion	Weight	Weight	Criterion
Cost			Enjoyment
Cost			Mobility
Cost			Content
Cost			Time Efficiency
Enjoyment			Mobility
Enjoyment			Content
Enjoyment			Time Efficiency

Mobility			Content
Mobility			Time Efficiency
Content			Time Efficiency

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