

Determinants of m-commerce adoption in Indonesia: a neural network approach

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Abstract. The promising number of smartphone users in Indonesia progressively drives the mobile commerce (m-commerce) development. Mobile commerce in this study presents an expanded of Unified Theory of Acceptance and Use of Technology (UTAUT) to examine key factors that affect the advanced usage of m-commerce among Indonesian smartphone users. The expanded model incorporates additional factors such as perceived risk, perceived value, and perceived enjoyment. Data was collected from 200 Indonesian users through online survey and distributed into several cities. Two nonparametric methods were used in this study to predict m-commerce adoption: principal component analysis (PCA) and artificial neural network (ANN). PCA was used to perform feature extraction in the first step while the neural networks were used to predict m-commerce adoption. The study reveals benefits from the combination of the PCA and neural network and provides some ideas for further research.

Keywords: mobile commerce (m-commerce), adoption, neural networks, Unified Theory of Acceptance and Use of Technology (UTAUT), principal component analysis (PCA)

1. INTRODUCTION

The recent Technoasia survey shows the increasing trend in smartphone users in Indonesia. Data provided by *emarketer* shows that monthly active smartphone users in Indonesia are 52.2 Million in 2015. In 2018, this number will grow to be the fourth largest in the world. Furthermore, researchers predict that the overall number of smartphone users will grow threefold from its current level to two billion in 2020. As the smartphone users increase, the growth in Mobile e-commerce commonly referred to as m-commerce cannot be ignored.

M-commerce commonly refers to the ability to purchase goods anywhere through wireless Internet-enabled devices including transactions with monetary value that are conducted via a mobile network. It will allow users to purchase products over the Internet without the use of a

PC. M-commerce is going to bring about a massive change in the way users consume products and services (Ngai & Gunasekaran, 2007). Research regarding m-commerce users has been conducted in several countries such as United States (Lee & Lee, 2007), Malaysia & China (Chong, 2013), Singapore (Anil, Ting, Moe, & Jonathan, 2003) and Jordan (Jaradat and Rababaa, 2013).

However, there is a significant different in m-commerce adoption between developed and developing countries. The maturity appeared obviously in Japan, Korea, Taiwan and Singapore rather than other countries. Therefore, to fill in the gap in the current literatures, this study is done to broader the understanding how the consumers' behavior according to m-commerce adoption, particularly in Indonesia. The research question in this

work is what factors that affect the intention to accept and the subsequent use of m-commerce among Indonesian consumers. Two nonparametric methods were used in this study to predict m-commerce adoption: principal component analysis (PCA) and artificial neural network (ANN). PCA was used to perform feature extraction in the first step while the neural networks were used to predict m-commerce adoption. Compare to traditional statistics, it is not necessary to fulfill any assumptions when applied the neural network approach for conduct the analysis. It is one of its benefits (Garson, 1998).

The aim of this study is to understand what factors fostering the adoption of m-commerce in Indonesia based on expanded of UTAUT model.

2. LITERATURE REVIEW

The effectiveness of Technology Acceptance Model and other 7 IT adoption models were reviewed by Venkatesh et al.(2003). As a result, he proposed a new model called the unified theory of acceptance and use of technology (UTAUT). This model states that four constructs are determinants of behavioral intentions and use behavior: performance expectancy, effort expectancy, social influence, and facilitating conditions. (Venkatesh, Morris, Davis, & Davis, 2003).

Table 1: Predictor Variables

Construct	Definition	Source
Social Influence	The degree to which an individual perceives that important others believe he/she should use the technology	Venkatesh et al. (2003);Amin, et al.(2008)
Effort expectancy	The degree of ease associated with technology use	Venkatesh et al. (2003)
Performance expectancy	The degree to which an individual believes that using the system will help to attain gains in job performance	Venkatesh et al. (2003)
Facilitating condition	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.	Venkatesh et al. (2003)
Perceived enjoyment	The intrinsic reward derived through the use of the technology or service studied	Lu et al (2005)
Perceived risk	Certain types of product performance, social, psychological, physical or time risk when consumer make transaction online	Wu and Wang (2005)
Perceived value	The degree to which a person believes that using a particular system would gain benefit	Büyüközkan (2009)
Intended to use	The degree to which M-commerce user's motivations intend to accept and use the system	Venkatesh et al. (2003)

The ability to make a transaction, access services or information support in making decision, or even enjoying entertainment anywhere with wireless internet handheld devices considered as added value in mobile commerce. This added value is the most important requirement for Turkish mobile commerce user (Büyüközkan, 2009).

Based on literature, the summary of predictor variables to use in this study is presented in Table 1.

3. RESEARCH METHODOLOGY

3.1 Data collection

This study used a survey questionnaire which was adopted from reliable measure in the previous study (Venkatesh et al., 2003). Data was collected randomly via online survey. The measurement was designed using a five-

point Likert. The demographic profile of the sample also collected. Such as gender, age, education, occupation, marital status, monthly income, and place.

There were 230 respondents participated in the study. Thirteen questionnaires were drop because of incomplete answers and left 217 data for further analysis.

The evaluation of internal consistency of the scale measurement and research variables by using the Cronbach's alpha was taken before distributing the questionnaire. The Cronbach's alpha reveals the value of 0.959 which is higher than 0.7. According to that, we can state that all the questions are reliable.

3.2 Principal Component Analysis

Principle Component Analysis is applied in the first stage to identify underlying factors. Factor loading is

considered very important if greater than 0.5. (Hair et al, 2010). The result from PCA is shown in Table 2.

3.3 Artificial neural networks

A neural network is effectively mapping non-linear relationship between input and output without assuming any particular distribution for the input or the output (Garson, 1998). Garson's algorithm (1991) differentiated the impact of positive connection weight on response variable to the negative one. The higher significant of the connection weight, the greater impact will occur on the network output. In order to extract knowledge from ANN, some studies employed sensitive analysis (Recknagel, et al., 1997). Sensitive analysis provides a feedback as to which input variables are the most significant relative to other input variables (Goh, 1995, Young II et al., 2007).

In this study, ANN is designed as 14-14-1 multilayer perceptron (MLPs) architecture. The predicted output is intention to use the mobile commerce. Hyperbolic Tangent sigmoid function (*tansig*) is used for activated neural transfer function. The analysis exhibits small Sum of Square Error (SSE), SSE_{training} is 0.098 while SSE_{testing} is 1.962E-005.

Table 2. Principle Component Analysis Results

Factor	Factor loading range	Eigen value	% Cum. variance
Social Influence	0.485-0.856	13.254	33.136
Effort Expectancy	0.485-0.791	3.222	41.192
Perf. Expectancy	0.535-0.761	2.245	46.804
Perceived Enjoy.	0.516-0.770	2.103	52.061
Facilitating Cond	0.498-0.652	1.878	56.757
Perceived of Risk	0.701-0.884	1.328	60.077
Perceived Value	0.583-0.791	1.256	63.217

4. RESULTS AND FINDINGS

Table 3 shows the importance of every independent variable in changing the network's model-predicted value. The relative importance is a percentage obtained by dividing the importance value by the largest importance value. The neural network result shows that perceived value is the most important factor that influences people to adopt m-commerce. It explains that the belief of obtained particular gain force individual to adopt by using mobile commerce Büyüközkan (2009). The second importance variable is social influence. The decision that individual made to adopt mobile commerce is affected by people surrounding them friends, colleagues or family members (Amin et al., 2008). The four constructs from original UTAUT model: performance expectancy, effort expectancy, social influence, and facilitating conditions are having higher percentage in relative importance value. It means

than although most of the implementation of UTAUT model for information system and e-commerce adoption, it can be applied to mobile commerce adoption. Another result shows that perceived enjoyment has higher percentage in relative importance value which explains that people intend to use mobile commerce to access social networking to enjoy or share movies, video, music or game anywhere. The related study said that adoption can be foster by experienced enjoyment (Lu et al., 2005).

Among demographic variables, occupation is the most influence factor in for people to adopt mobile commerce. The lowest influence factor is gender. Previous study that investigated mobile-commerce adoption in Chinese market using multiple regression analysis revealed similar result, see Chong (2013) for the details.

Table 3. Independent variables importance

Variable	Importance	Relative Importance
Perceived Value	.124	100.00%
Social Influence	.114	91.40%
Facilitating Cond.	.112	89.90%
Perceived of Risk	.106	85.40%
Perceived Enjoyment	.106	85.00%
Effort Expectancy	.104	83.90%
Performance Expectancy	.100	80.10%
Occupation	.059	47.50%
Age	.052	42.10%
Education	.048	38.90%
Monthly income	.027	21.60%
Place	.018	14.40%
Marital status	.015	12.30%
Gender	.015	11.90%

Compare these two results from different methods allow us to see that the non-linear, non-compensatory model can be employed to predict the mobile commerce adoption with good results.

5. DISCUSSION AND CONCLUSION

This study intended to use neural network to investigate determinant in mobile commerce adoption in Indonesia. The advantage of neural network is this approach not necessary to fulfill any assumptions for conduct the analysis compare to traditional statistics (Garson, 1998).

The study took place in Indonesia, with millions number of smartphone user. Hopefully some findings

coming from this study provides direction for mobile commerce marketer or provider who intends to enter Indonesian market. Appropriate strategies can be designed based on results.

The limitation of this study is that the data is relatively small. Future research needs to investigate determinant in some specific area of mobile commerce.

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