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Empowering Smart Customer to Participate in Electricity Supply System

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ABSTRACT

In the current discussion towards a more energy efficient supply and demand in household settings, nations such as smart grid, smart meters and smart appliances are of main importance. Malaysia, developing country plan to implement Smart Grid in order to improve their power system in this country at the same time control electricity demand for the next 20 years. The successes of smart grid placement rely on consumers' acceptance of smart grid products and services. This study use technology acceptance model (TAM) as a model of research in order to test consumer's acceptance of smart grid technologies. The results suggest that it is important increase the perceived usefulness and ease of use in order to increase intention to use smart grid by customers.

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INTRODUCTION

The smart grid is one advancement technology that has been use in this era of globalization. It also is an umbrella term that covers innovation of both the communication and distribution grids. A major goal of smart grid is to allocate electricity usage evenly across the day and reduce the amount of on –peak usage (Aspinwal, Paul and Katherine, 2012)

The usage of smart grid become widely including Malaysia where Tenaga Nasional Berhad (TNB) as the electric supply system in Malaysia is preparing the effort of using this technology to reduce energy electric during the peak time. However, the implementation of smart grid in this country still new, but for the case of Malaysia, smart grid technology provides opportunity for this country to enhance the existing grid and preventing reoccurrences of major incidents.

The purpose of this study is defining the impact of perceive ease of use on perceived usefulness of smart grid among consumer. The key interest of this project is the study of factors affecting the intention to adopt as well as adoption of smart grid. Therefore, this project will evaluate the impact of perceive ease of use on perceived usefulness of smart grid towards customers, analyses the relationship between perceived usefulness and perceived ease of use with intention to use.

Literature review:

Smart grid:

According to the Smart Grid European Technology Platform (2012), "smart grid is an electricity network that can intelligently integrate the actions of all users connected to it in order to efficiently deliver sustainable, economic and secure electricity supplies".

Smart Grid is term used to cover a variety of new technology such as sensors, software and communicating devices that relay information in real time about where and how customers are using electricity. Smart meters, in particular, enables customers and utilities to see how energy use and prices change in real- time. Respond to those changes, smart meter is part of Smart Grid where it has six primary features: two-way communications; recording of interval data on energy usage where delivery of data to the utility at least daily; a disconnect switch; power quality sensing (voltage) and a two-way communications module to talk to smart thermostats; in-home displays; smart appliances and smart equipment in customer homes and businesses.

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Factor of influence customers on adoption Smart Grid:

The benefits of smart grid technologies differ for utilities and customers, but the ability to shift some energy used from peak to off-peak hours creates widespread benefits in the form of saved energy, capacity and environmental emissions that occur with large fluctuations of energy demand. Reducing energy used during peak periods reduces the overall costs of the power system. In fact, Smart Grid is renewable energy, which in nature it's quite difficult to make potential customer to shift using and adopting this technology. In IBM 2011, study that surveyed more than 10, 000 people across 15 countries, stated that over 30% of those respondents which have never heard the term of this energy and more than 60% are unaware of smart grid or smart meter. In another perspective, barriers that delay the performance of smart grid products and services are seems to be lack of market acceptance (Hans C., Karoline K.,& Mortiz L., 2012).

In total of 34% respondent gave reason for not to adopt the new technology because of it is too costly to purchase and install, and another 17 % stated that the savings on electricity would to be small. Economic benefit is the most significant motivator for generate electricity at home. (Peter, Paul M., & Katherin M., 2012). This was supported by Evanson G. Baiya (2012), who concluded that the most important adoption factor to consumers is the economic factor, and the main motivators are; the current cost energy; availability of an effective and ease to use the technology; and convenience incentive for consumers to change. All this factors are the most important thing for consumers in adopting the new technology.

For acceptance this renewable energy, consumers are very particular about the privacy issues and cost related to, and also they concern towards electricity provision to poorer and vulnerable part of the population. It shows that the designing of this smart grid and services from the beginning is the way of communicating the information to the public, and public opinion of risks are key of successful smart grid on consumer acceptance, (OECD, 2012). The other researcher found that consumers still depends on utility provider or government to keep an eye on processing system of electricity and privacy concern, is become important thing in terms of information security in smart grid system. (Amy et.al. 2012). Perceived Usefulness, Perceived Ease of Use and intention to use have strong interrelationship and it is important to increase consumer's perception of the usefulness and ease of use of smart grid to enhance consumer's participation. Enhancing of perceived electricity saving effect, eco environmental friendliness, cyber-security safety and perceived ease of use will increase perceived usefulness and also perceived eco-environment, has strong positive impact on perceived usefulness where it will increase perceptions of the smart's grid usefulness towards environmental benefits. This result showed that the awareness of the smart grid is important to the customer and will reduce customers' worries through education and smart grid promotion (Chan et.al. 2012). In Malaysia, smart grid is known as new electric energy and Malaysian still not aware about this energy. Figure 1 shows the proposed model for this study by using technology acceptance model as the baseline theory to defining impact of relationship between independent variables and the dependent variable.

Technology Acceptance Model (TAM):

As new information technologies infiltrate workplaces, home, and classrooms, researches on user acceptance of new technologies has started to receive much attention from professionals as well as academic researchers. Developers and software industries are beginning to realize that lack of user acceptance of technology can lead to loss of money and resources. In studying user acceptance and use of technology, the TAM is one of the most cited models. The Technology Acceptance Model (TAM) was developed by Davis to explain computer-usage behavior. The theoretical basis of the model was Fishbein and Ajzen's Theory of Reasoned Action (TRA).

TAM is to provide a basis for tracing the impact of external variables on internal beliefs, attitudes and intentions. It suggests that perceived ease of use and perceived usefulness are the two most important factors in explaining system use. The model does leave open the potential to incorporate perceived value impacts as antecedents of its constructs or as additional external factors. TAM model a derivative of the Theory of Reasoned Action that attempts to explain the psychological determinants of attitudes and subsequent acceptance behavior towards Information Technology (IT) in the workplace and TAM is suitable for examining perceptions, attitudes, and intentions before implementation as well as after [Vankatesh and Davis, 2000, p.286]. Additionally, TAM is consistently explains a substantial proportions of the variance about 40% in usage intentions and behavior compare to Theory of Reasoned Action and Theory of Planned Behavior (TPB) [Vankatesh and Davis, 2000, p.286]

Perceived usefulness (PU) - This was defined by Fred Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance".

Perceived ease-of-use (PEU) - Davis defined this as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989). Thus the relationship proposed in the initial TAM, the hypotheses can be stated as:

Hypothesis 1: There is a significant relationship between perceived ease of use and perceived usefulness

Hypothesis 2: There is significantly relationship between perceived usefulness, perceived ease of use with intention to use smart grid by customer

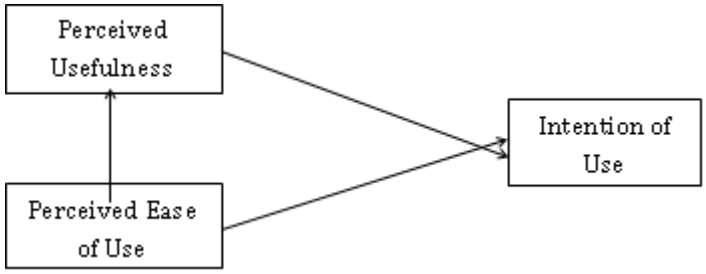

Fig. 1: Technology Acceptance Model (TAM).

Research methodology:

Survey questionnaire distributed was representing approximately to the total of 2000 academics from IPTA and IPTS in Melaka, Malaysia. Referring to Krejcie and Morgan's (1970) table, and using random sampling method, the sum of 322 subjects can represent the selected population. To ensure an effective reach to the population, the survey questionnaire distributed using both online and postal. The method used was The Statistical Package for Social Science (SPSS) 20.0 to tabulate the data gathered from the survey with appropriate statistical method. This survey consisted of several distinct sections. The first part of the survey was focused on personal information, and general opinion questions from respondents were included in the last section of this part. The second part of the survey included questions related to smart meter questions, e.g. familiarity of the smart meter. The third section was related to the acceptance of smart grid among customers by using TAM theory. The process of collecting data completed during 4 month with 356 samples was returned. From 356 respondents, valid responses were received giving a response rate 100 percent.

Table 1: Profile of Respondent's.

Characteristic	Category	Frequency	Percent
Gender	Male	204	57.3
	Female	152	42.7
Age	18-33	164	46.1
	34-45	180	50.6
	46-59	12	3.4
Residence	Rural	200	56.7
	Urban	156	43.3

Results:

Reliability Analysis (Cronbach's Alpha):

Reliability analysis is the consistency of the measurement, or the degree to which an instrument measure the same way each time it is used under the same condition with the same subjects. A benchmark of 0.70 was used as the minimum acceptable Cronbach's Alpha (Nunnally, 1978). Reliability of measure indicates the extent to which it is without bias, thus ensures the consistency of the items in the instrument (Sekaran and Bougie, 2010). Table 2 indicates the Cronbach's alpha scores are above 0.7 for all variables. Thus demonstrates that the research questionnaire is good and reliable for organization.

Table 2: Cronbach's Alpha.

Variables	Cronbach's Alpha
Perceived Usefulness	0.83
Perceived Ease of Use	0.94
Intention to Use	0.86

Correlation:

Table 3 above illustrates the relationship between three variables under technology acceptance model (TAM). The Pearson correlation between perceived usefulness, perceived ease of use and behavioral intention is equal to 1. The significant 2-tailed for three variables above is very significant that is 0.000. Additionally, the result also shows that there is positive relationship among the independent variables which are perceived usefulness and perceived ease of use with dependent variables which is behavioral intention. For perceived usefulness and behavioral intention the positive correlation coefficient is at 0.87 whereas for perceived ease of use with behavioral intention the positive correlation coefficient is at 0.902. The contribution of items perceived usefulness is 87 percent and perceived ease of use is 90 percent towards behavioral intention of customer in order to adopt this new technology.

Table 3: Correlation between Perceived Usefulness and Behavioral Intention.

Items	Perceived Usefulness	Perceived Ease of Use	Behavioral Intention
Perceived Usefulness Pearson Correlation Sig. (2-tailed) N	1	.878** .000 30	.895** .000 30
Perceived Ease Pearson Correlation Of Use Sig. (2 –tailed) N	.878** .000 30	1 30	.901** .000 30
Intention to Use Pearson Correlation Sig. (2-tailed) N	.895** .000 30	.901** .000 30	1 30

** Correlation is significant at the 0.01 level (2-tailed)

Regression:

Table 4: Results of Regression Analysis.

Dependent Variable	Independent Variables	β	t	R^2 adj	P-value
Intention to Use	Perceived Usefulness	0.46	10.91	0.86	0.00
	Perceived Ease of Use	0.50	11.99		0.00
Perceived Usefulness	Perceived Ease of Use	0.87	34.54	0.77	0.00

The estimates for the regression analyses are provided in Table 4. As suggested by the original TAM, perceived ease of use significantly influenced perceived usefulness (β= .87, p< .00) thus supporting hypotheses 1. Follow by the next variables perceived usefulness show the result significantly influence intention to use (β= .46, p< .000) whereas the same result for second variable perceived ease of use significantly towards intention to use (β= .50, p< .000). Therefore, results show that hypothesis was supporting in this study.

Discussion and Conclusion:

The smart grid TAM test showed Perceived Usefulness, Perceived Ease of Use and Behavioral Intention had strong positive relationship. Thus it is important to increase consumer's perception of the usefulness and ease of use of smart grids to enhance consumers' smart grid participation. This study helps researchers to understand the relationships between the beliefs perceived ease of use, perceived usefulness and intention to use of smart grid by users. It shows that the intention to use smart grid or smart meters depends on the attitude of the potential user. The analytical results on the importance perceived expectations show that utility should maximize both the usefulness and ease of use of smart meter since consumer satisfaction depends heavily on these two factors. The data indicate that Malaysian consumer are not confident in using complex technology and prefer simple technologies with usefulness functions.

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