Journal of Theoretical and Applied Information Technology
15th July 2018. Vol.96. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

TOWARD UNDERSTANDING INDIVIDUALS' ACCEPTANCE OF INTERNET OF THINGS –BASED SERVICES: DEVELOPING AN INSTRUMENT TO MEASURE THE ACCEPTANCE OF SMART METERS

[1]GAMAL ABDULNASER ALKAWSI, [2]NOR'ASHIKIN BTE. ALI, [3]ABDULLAH ALGHUSHAMI

[1]College of Graduate Studies, The National Energy University (UNITEN), Malaysia

[2]College of Graduate Studies, The National Energy University (UNITEN), Malaysia

[3]Information Technology Department, Community College of Qatar (CCQ), Qatar

E-mail: [1]jamalmail@gmail.com, [2] shikin@uniten.edu.my, [3] abdullah.alghushami@ccq.edu.qa

ABSTRACT

The benefits of new technology can only be realized when and if the new technology is widely accepted and used. Understanding the factors that may determine of an individual's willingness to use new technology is important to improve the success rate of the implementation. The use of a smart meter as an internet-of-things based device is the focus of this study. The smart meter is a power energy saving device that aims to enable consumers to have more control of their energy usage and save money. Apparently, there is still a lack of acceptance of smart meter services among consumers. This study proposed a conceptual model using the unified theory of acceptance and use of technology (UTAUT2) as its underlying theories. A survey instrument was developed by using existing scales from prior instruments and by creating additional items, which might appear to fit the construct definition. The pilot study was conducted by distributing the survey to 32 users of a smart meter in order to evaluate the reliability and validity of the instruments prior to performance of a full scale survey. The results showed that the reliabilities of all scales in the survey instrument were above the target acceptance level.

Keywords: *IOT, Smart Meters, Technology Acceptance, UTAUT2, Smart Billing*

1. INTRODUCTION

The fast expanding advancement in information communication technology (ICT) mainly enhances the chances of providing smart applications and innovative services. It utilizes shared data from physical devices and sensors using internet to reach these devices. This has led to the Internet of Things (IoT); and has created a global infrastructure of tool for management and communication. The IoT includes the vital components of information technology (IT) including hardware, software and networks. This combination creates a powerful platform that can function as a foundation for innovative services. This technology enables the internet to reach out to the real world of physical objects in order to create a pool of connected devices or global infrastructure where sensors, machines, appliances, and wearable devices directly communicate with each other online.

The IoT has been applied to many areas of industry, including healthcare, smart cities, smart homes, power management, agriculture, industrial control and urban management. Generally, IoT is expected to transform our lives, enabling a variety of applications across industries and markets and encouraging the growth of technologies and innovative services. Globally, most of the countries around the world look forward to the promises of smart cities that concentrate on power, building and transportation. According to the report by Frost & Sullivan (2014), the expectations from smart cities' contribution show a high percentage to the overall economy at 54%, with an estimated market potential of US$392.94 billion (1). The expectations from the growth of IoT in Malaysia is beyond 2020 and estimated to reach RM42.5 billion in 2025 (2) .

However, industries from USA and some Europe countries indicated that there is a slow adoption of IoT (3–6). In Malaysia, comparing the state of adopting the IoT to the national plan and to the rate of adopting the IoT in developed countries, Malaysia is still beyond expectation. The slow adoption rate of IoT in Malaysia is also indicated by preliminary interviews conducted by researchers to understand the problem of accepting IoT-based

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

services (e.g smart meters). An application of IoT-based services is the smart meter application; the smart meters are devices that record the consumption of electricity and transmit the data to the power company for monitoring and billing. The smart meters provide timely consumption information to the relevant, systems, including power consumers. This service provided by Tenaga Nasional Berhad (TNB), is the largest power utility in Malaysia. TNB has raised the project of smart billing. In their rollout plan, they have two phases of deployment program. In the first phase of this, rollout plan, they are targeting 340,000 consumers by end of 2017. Senior Manager of the smart billing project indicated that there is a low rate of usage in the smart billing application. The statistics from the systems show that only 10% of the users are active and use the service regularly. Accordingly, the low rate of using the application reflects on the low acceptance level by individuals.

The current stream of research into the acceptance of IoT-based services shows there are restrictions in the intensive studies concerning the individual's acceptance of IoT based services in comparison with the leading theoretical and technical articles. On the other hand, only a few empirical works have defined the factors influencing the users in the form of obstacles (e.g., privacy, security, and experience) and drivers (e.g., usefulness, ease of use, and enjoyment). However, most of these studies examined the IoT-based services in general (7–11), but only a few researcher tested the specific service or product such as; electronic toll collection (ETC) (12), smart homes (13), and smart devices (14). In summary, no study has yet defined the factors influencing electricity consumers to accept IoT-based service such as smart meters.

The objectives of this study are (1) to apply the UTAUT2 to smart billing system and (2) to bring together other related factors that have been tested in prior studies into a more comprehensive model, and (3) develop an instrument to measure the acceptance of smart billing application.

The goal of this study is to increase the level of individuals acceptance of IoT-based applications, by introducing smart billing acceptance model for developers and services providers. The proposed model allows the prediction of the values of the technology, which is reflected by the level of acceptance (15). In addition, identifying the factors that influence the individual acceptance of smart meters is essential for the marketing of IoT products/services and plans to retain users. (12). Hence, it is important that developers and service providers understand the individual's perceptions towards this technology and how they perceive the IoT environment. Moreover, exploring individual intentions and investigating the factors that influence the individual beliefs at this early stage can help developers and service providers create new methods or update their strategy of managing and introducing the service for raising the acceptance level.

2. CONCEPTUAL MODEL

A conceptual framework was developed for this study and presented into two parts. The first part explains about the acceptance factors affecting electricity smart billing. The second part is about moderators and their influence on independent variables. Developing such conceptual framework assists to hypothesize and test the relationships, which will lead to improving the understanding of the phenomena.

The phenomena of technology acceptance can be best described by investigating theories of behavioral intention to use (16). The unified theory of acceptance and use of technology (UTAUT) is integrated of eight previous models of technology acceptance and is widely used to study technology adoption. Its constructs adopted in this study for few reasons.

First, the effectiveness of the model. The cognitive construct element of this model improved the predictability of variance between intent and adoption to 70% (17). Second, it is the most widely used and validated within the technology acceptance domain. More on that, it is better suited for individual studies Oliveira and Martins. Third, the progress of this model (resulting from similar studies on innovative technologies acceptance) is such that it is dominate in the domain. The model has been validated in the smart application context and seem suitable for explaining behavior in this domain.

Existing knowledge of research into acceptance of IoT-based services and applications shows a few researches investigated the acceptance of IoT-based services by individuals (18–20). These studies empirically evaluated the direct and general factors that influence individuals' intention (e.g. perceived ease of use, perceived usefulness) . No study has taken a holistic approach to empirically validate the direct and indirect factors that influence intention behavior of electricity consumers' toward using smart billing application. Smart meter is part of the IoT, but it has different implications. The technology of smart meter put on our hands an innovative tool for smart billing, with a good chance of saving electricity, however it raises privacy concern. In spite of its advantages, there is a

Journal of Theoretical and Applied Information Technology
15th July 2018. Vol.96. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

resistance by the consumers to accept this technology.

The defined factors by existence research does not include fair justification about what influence electricity consumers behavior to accept smart billing system. There is a need to go deep to understand what kind of process that motivate or deny consumers from using this technology. However, the existing research called for further studies to boost understanding of individuals' intention towards using IoT-based services. Mital and Chang (2016) stated that there might be other factors that could boost their model as there is a lack to explain the user behavioral intention (20).

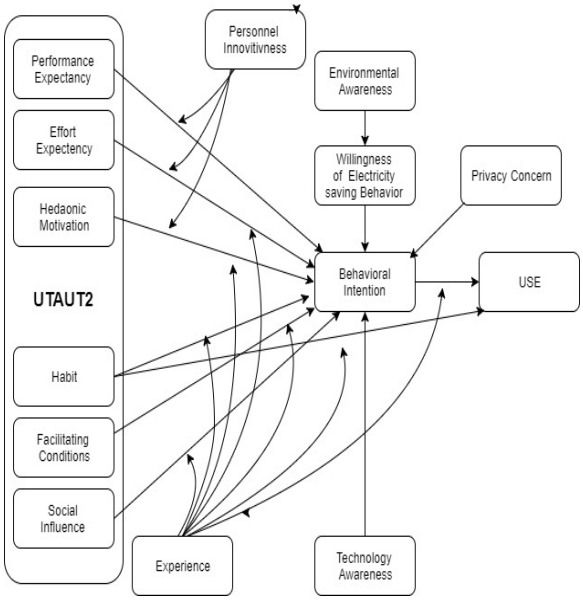

Figure 1: Conceptual Model

2.1 Factors Affecting Acceptance of Electricity Smart Billing System

There are a number of factors pertaining to user acceptance have been identified from previous research. Majority of the factors are adopted from the unified theory of acceptance and use of technology (UTAUT2)(21). Some other factors are from the previous studies that are specific to electricity consumers and smart device users.. Moving on from this is an explanation on why these factors were included into the proposed research model.

2.1.1 Performance Expectancy (PE)

According to UTAUT, the performance expectancy is defined as "the degree to which the use of new ICT/IT will help an individual to attain gains in the job performance" (22) . The performance expectancy is a multi-dimensional concept with constructs from other models. The five constructs that relate to performance expectancy are recognized as extrinsic motivation (MM), job fit (MPCU), outcome expectancy (SCT), relative advantage (DOI) and perceived usefulness (TAM and combined TAM-TPB) (22). Performance expectancy is considered the strongest predictor of behavioral intention to accept new technologies (23,24) and has been confirmed as the most important factor influencing technology acceptance(25). Furthermore, many studies in m-commerce services (26) and RFID (27,28) indicate a readiness by consumers to accept new technologies caused by performance benefits that confirm the significant role of performance expectancy on intention to accept new technologies. In addition to that, the recent surveys on investigating the adoption of new technologies such NFC technology (29) and electronic toll collection as an IoT technology (19) support the importance of performance expectancy on behavioral intention.

Based on the theoretical review and the empirical support, performance expectancy is predicted to influence behavioral intention. Thus, the proposed hypothesis is as follows:

H1. Performance expectancy will have a higher effect on behavioral intention to use smart meter for electricity billing system.

2.1.2 Effort Expectancy (EE)

Effort Expectancy is another good factor to predict the behavioral intention to accept new technology. It is defined as "the level of ease related with the use of the existing ICT/ IT systems" (22).Three similar significant constructs were found in other theories, namely, perceived ease of use (TAM), ease of use (DOI), and complexity (MPCU) (22). The empirical studies on the testing effort expectancy varies. Some have found that the effort expectancy is not significant at all (24), while other surveys have reported that the effects of effort expectancy have a significant association with behavioral intention (22). .More recently, (19,29) it was found that the perceived ease of use (effort expectancy), is an independent variable, that these factors have directly and significantly influenced users' intention to use new technologies such as NFC and IoT-based services.

In view of the above discussion, this research argues that the intention to accept smart meter for electricity smart billing is significantly influenced by the perceived difficulty to understand and to use the intended technology. Users might be

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

more likely to accept services that do not require extensive preparation or familiarization such as smart meter. This leads to the following hypothesis:

H2. Effort expectancy will have a higher effect on behavioral intention to use smart meter for electricity billing system.

2.1.3 Social Influence (SI)

Venkatesh (2003) defined Social Influence (SI) as "the degree to which a user perceives that it is important that others believe that the user should adopt and use the existing ICT/IT" (22). The influence of others is an important factor as some people are influenced by the perception of family members, friends or neighbors. Social Influence includes construct of social influence found in different theories, namely, subjective norm (TRA, TPB and C-TAM-TPB), social factors (MPCU) and image (IDT) (22). Social influence in a voluntary context seems to be unnecessary but it becomes important when people are involved in the use of other systems . Lu et al. (2005) described that social influence can be the determining force of an individual's behavioral intention to apply wireless internet services in mobile technology. In addition,, in the recent studies, social influence has been found to have a significant direct influence in predicting a user's behavioral intention to accept new technology such us NFC,RFID and IoT technology (19,26,29).

IoT-based services are at its early stage. Gao & Bai (2014) noticed that users at this level might have insufficient information about usage of the technology. Therefore, social network perception of respective technology may play an important role in the intention of acceptance. Furthermore, the Diffusion of Innovation theory (31) indicated that, individuals may be influenced by perceptions of early adopters. Based on the theoretical review and the empirical support, social influence is predicted to influence behavioral intention to accept smart meter. Thus, the proposed hypothesis is as follows:

H3. Social influence will have a higher effect on behavioral intention to use smart meter for electricity billing system.

2.1.4 Facilitating Conditions (FC)

UTAUT defined Facilitating conditions as "the degree to which an individual believes that the organizational and technical infrastructure exists to support the use of new technology systems"(22). Facilitating conditions mirror the same constructs in other models, perceived behavioral control (TPB/DTPB and combined TAM-TPB), facilitating conditions (MPCU), and compatibility (DOI) (22). Some studies found that facilitating conditions directly influenced behavioral intention (22,32,33). On the other hand, few researches described the influence of facilitating conditions as indirect, as there is only a significant impact on usage intention.(34).

In the context at the user's level, where technology is available to each consumer, the technology can differ significantly among mobile devices, technology generation and so on. In this context, facilitating conditions will influence both intention and behavior (16). Thus, facilitating conditions will be like perceived behavioral control construct in (TPB) and influence both intention and behavior (35). More empirical surveys indicated that facilitating conditions have a direct influence on behavioral intention and usage behavior (16,36).

Smart billing system is innovative and new; many electricity consumers may not be familiar with it. Smart meters systems require the users to have certain skills such as configuring and operating smart meters, computers and setting up user account in the system. If users do not have the operational skills, they may not adopt the smart billing system.

Facilitating conditions as a direct antecedent on behavioral intention will be assumed in the intended research model where high-perceived levels of technical support will influence behavioral intention and behavioral use to accept smart meter billing system. Based on the theoretical review and the empirical support, facilitating conditions are hypothesized as follows:

H4a. Facilitating conditions will have a higher effect on behavioral intention to use smart meter for electricity billing system.

H4b. Facilitating conditions will have a higher effect on behavioral use of smart meter for electricity billing system.

2.1.5 Hedonic Motivation (HM)

Hedonic Motivation (HM) is defined as ''the fun or pleasure derived from using technology.''(16). In the technology acceptance research, it has been recognized that hedonic motivation is an important determinant towards technology acceptance (37,38). Another similar important construct found in other researches, namely, perceived enjoyment which has a high effect on technology acceptances (39–41). In terms of utilities application and services, even though they are not developed to be hedonic motivations, some of them have a few entertaining features to keep users engaged. Some of the application have been designed

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

with "gamification" features (using game-like features or mechanics) to user interaction more entertaining (42).Moreover,, in the recent researches towards acceptance of IoT-based services, hedonic motivation (perceived enjoyment) has been found to have a significant influence in predicting a user's behavioral intention to accept new technology (19,43).

Based on the theoretical review and the empirical support, hedonic motivation is predicted to influence behavioral intention to accept the smart meter. Thus, the proposed hypothesis is as follows:

H5. Hedonic motivation will have a higher effect on behavioral intention to use smart meter for electricity billing system.

2.1.6 Habit (H)

M. Limayem et al (2007) (44) defined habit as "the extent to which an individual tends to perform behavior automatically because of learning". X. Venkatesh et al (2012) further discovered that habit relates to the perceptual construct that echoes the results of an individual's prior experiences.

Habit has been further defined by S. Orbell et al (2001) [42] as the automatic behaviors, which are in operation after some degree of repetition. They all came to the point that the previous experiences will affect the beliefs and behaviors. Many studies indicated habit as a good predictor of behavioral intention to accept the use of new technologies (45,46).

Morosan & DeFranco (2016) conducted a study on the intentions of consumers' to use NFC mobile payments in hotels. The study pointed out that the repetitive use of mobile devices outside hotel services can be regarded as habitual (e.g., home) As both the consumer's home environment and hotel environment are almost similar thus making it more relevant for the technological habits to be adaptable for hotel consumption setting. (45) . Thus, habit may effect the facilitating of the transfer of behavior from a broader context to more specific contexts (45,47).

In the smart billing portal, habit may happened by repetition of using of smart mobiles in other contexts, as the mechanisms that are necessary to guide users through the usage sequence are structurally similar to most smart mobile applications. Yet, the similarity in behavioral terms between smart billing application environment and other smart mobile application environment make technology habits more relevant. Thus, habit may facilitate the transfer of behavior from broader to specific application (e.g., smart billing application). Hence, the proposed hypothesis is as follows:

H6a. Consumers' habit of using smart mobile applications will have a higher effect on behavioral intention to use smart meter for electricity billing system.

H6b. Consumers' habit of using smart mobile applications will have a higher effect on behavioral use of smart meter for electricity billing system.

2.1.7 Technology Awareness (TA)

Technology awareness has been defined by (48) as "user's knowledge about the capabilities of a technology, its features, potential use, and cost and benefits, i.e., it relates to awareness-knowledge". In previous studies, the variable cognizance was used instead of awareness (49). The terminology of cognizance has been defined as a term that many labels use such as attention, consciousness, and noticing; in essence. It also represents knowledge about "facts" in the domain of information technology (50). Anderson (1985) defined cognizance as "the foundation for the initiation process as users may not contribute to the creative activity in the initiation phase of an information system unless they can comprehend the technology, the duties and responsibilities and the environment where the system will be in operation."(51).

A study was conducted by (52) on the influence of attitude, perceptions and acceptance levels of Malaysian users towards smart meters of electricity at homes. They found that demographic profiles and awareness of technology play a vital role in getting positive feedback from users about technology. Nevertheless, (53) conducted an empirical study on the relationship between awareness and behavioral intention by investigating empirically the factors influencing e-government adoption among postgraduate students, and found that awareness significantly influenced behavioral intention. Therefore, awareness is posited to be a good predictor of behavioral intention.

Smart meter is an IoT-based technology, which uses the Internet to connect different elements of hardware and software. Therefore, understanding smart meter technology features and benefits will help to reduce the level of ambiguity behind this technology

On the other hand, the nature of normal electricity meter is to measure the electricity usage without interacting with the users. Here is a situation where users are used to working with normal meters but have no knowledge about the benefits and features of smart meters technology. They will just use smart meters like the normal meters and ignore

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

using the smart billing application. Being aware of the smart meters and its benefits will further enhance the concept of electricity meters and drive the users to engage with the smart billing system. Thus, the proposed hypothesis is as follows:

H7. Technology awareness will have a higher effect on behavioral intention to use electricity smart billing system.

2.1.8 Willingness of Electricity Saving Behavior (WESB)

Electricity saving behavior is the expected effort aimed at households to reduce electricty consumption, such as turning off the light when leaving a room. The normal way of measuring the electricity saving behavior is carried out by checking on the usage of energy saving appliance or usage of electrical produced by renewable energy. (54). Lai et al. (2016) found that consumers' willingness to save electercity influences the sustaining of saving behavior by utlizing the electercity saving resources (55). This confirms that, if households have the willingness to save electricity, they will, therefore, have the intention to use the smart meters. The immediate data on electricity consumation given by smart meters can be utlized to measure electrcity consumption and assist in planning for saving.

Spence et al (2015) carried out a survey on the public perceptions of transformations to the UK energy system, The findings stressed on the effect on relationship between preparedness to reduce energy use and acceptance of demand-side management (DSM) that involves smart meters. Most respondents to the survey (58%) indicated that they were prepared to reduce current levels of personal energy use and are positively predicting the acceptance of DSM (56).

Based on previous literature and the empirical support, the willingness to accept electricity saving behavior is predicted to influence the behavioral intention to accept the smart meter system. Thus, the proposed hypothesis is as follows:

H8. Willingness of electricity saving behavior will have a higher effect on behavioral intention to use electricity smart billing system.

2.1.9 Environmental Awareness

The behavior of using electricity smart billing system is a kind of pro-enviromental behavior. Kollmuss & Agyeman (2002) defined pro-enviromental behavior as a "behavior that consciously seeks to minimize the negative impact of one's actions on the natural and built world"(57). Consuming the electricity may produce negative impacts on the environment in the future, e.g., exhaustion of electricity, ecological damage, and even global warming (58). However, (59) confirmed the result of self-power savings by using only smart meters up to 10% without changing the tariff or controlling appliances . Thus, the use of smart billing system may lead to minimizing the negative impacts on the environment in the long run.

Enviromental awareness may lead to pro-envionmental behaviors.When discovering in depth the factors influencing pro-envionmental behaviors, environmental awarness are found to be related (58,60–63) The environmental awareness reflects on the environmental perspective in a way it tells that the environmental concern is taken into consideration in the selection of products and services. This perspective has been further supported by N Zografakis et al (2010) (64). who contended that people who take cognizance of climate change are more inclined to subscribe to renewable energy and take part in energy saving activities.

If consumers are aware of the negative consequences of using electricity in the long run, they are likely to develop moral obligation of saving electricity. Conversely, if consumers are not aware of the negative consequences of electricity use, they are not likely to have the intention of saving electricity. Previous researches also highlighted the significant effect of awareness of negative consequences on personal behavior of electrcity saving (58,62,63). Similarly, it is expected that environmental awareness influences consumers electricity saving behavior by using smart billing system. Thus, the proposed hypothesis is as follows:

H 9: Environmental awareness will have a higher effect on behavioral intention to use electricity smart billing system.

2.1.10 Privacy Concerns (PC)

According to Dinev & Hart (2006) Privacy Concern is defined as the concern about opportunistic behavior related to the personal information submitted over the Internet by the respondent in particular (65). Using smart meters allow for the monitoring of user activities by measuring power consumption at specific time (e.g hours, day) not just accumulative per month like normal meters. In addition, the smart meters can be used to monitor and manage power consumption of specific appliance by interference of third party. In this case, consumers electricity usage can be monitored minutely that will cause privacy concern for consumers.This concern of privacy was confirmed by (66). A survey entitled "Internet of Things: Connected Home" was

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

conducted in 11 countries, including Malaysia on 1800 respondents who were the participants who showed a big concern over the issues of privacy and trust. The study revealed that 70% of the respondents noticed that they are either "extremely concerned" or "somewhat concerned" about the sensitive personal information being compromised, and they highlighted the need for the government to figure out how the data should be collected and managed. Privacy is generally known as "the right to be let alone". Privacy concern reflects a user's concern regarding information disclosure. Users may worry about whether service providers properly collect, store and use their personal information.

In the context of the Internet, (65) developed the Extended Privacy Calculus Model (EPCM) to test factors influencing users for willingness to provide personal information during internet transactions. The Privacy model concerns factors which significantly influences the willingness to provide personnel information. In a more specific context, in the IoT-based services (67) tested privacy concern on behavioral intention to use IoT-based services and concluded that the higher adoption rate of IoT- based services is related to the lower level of privacy concern.

Recent studies which investigated the factors influencing the adoption of IoT-based services highlighted that privacy is a major concern when making decision to accept such technology (10,13,43,68). More studies have tested the effect of privacy concern on user behavior in different contexts, such as location-based services (69), online health information system (70), and social networks (71). Furthermore, (56), confirmed signficant relationship between privacy and technology acceptance in the power management context by testing houshold perceptions.

In summary, based on the theoretical review and the empirical support, privacy concern is predicted to influence behavioral intention to accept smart meter billing system. Thus, the proposed hypothesis is as follows:

H: Privacy concerens will have a higher effect on behavioral intention to use electricity smart billing system.

2.2 Moderator

2.2.1 Experience (EX)

The word "Experience" has been defined as the user involvement into a particular technology and the accumulative skills the user gains by using the technology (72). In many research it has been found that the experience of using specific technology serve as a critical factor in determining the technology acceptance (16,73). This confirms that acceptance of technology is influenced by experiences in using the technology, whereby an experience can inform whether the technology proved beneficial and was easy to use. Thus, familiarity with intended or similar technology would result in predicting technology acceptance.

Research findings found that the higher use of the technology leads to a higher familiarity and that "people with more computer experience tend to have fewer negative feelings towards computers" (74). Venkatesh et al. (2003) confirmed that experience with a new technology influenced the strength of the effects of effort expectancy, social influence and facilitating condition on the intention to use the new information technology (22). Thus, after many years of experience with computers, the ease of use becomes less important in predicting user's behavioral intentions.

H11a. Experience will moderate the effect of effort expectancy on behavioral intention to use electricity smart billing system. .

A meta-analysis report confirmed that users with low level of experience will need facilitating conditions more than users with a higher level of experience to facilitate their use (75). Venkatesh et al. (2012) operationalized experience at three levels of passage time and they found that the experience moderator on effect of facilitating conditions on behavioral intention is not significant (21). However, in this research the experience will be assessed at one time because the smart meters were installed two years ago and the investigated experience is not only about smart meters, it also covers similar technologies. Thus, the effect of the experience moderator on the entire research model is expected to be significant, specifically on the effect of facilitating conditions on behavioral intention.

H11b. Experience will moderate the effect of facilitating conditions on behavioral intention to use electricity smart billing system.

Venkatesh et al. (2003) confirmed that the social influence will weaken with more experiences of using the technology. Users with a higher level of experience are pragmatically driven rather than social (22). Thus, the effect of social influence on behavioral intention will decrease as experience increases. Based on the experience moderator the hypothesis is as follows:

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

H11c. Experience will moderate the effect of social influence on behavioral intention to use electricity smart billing system.

Venkatesh et al. (2012) found that when the users' experience increases, the effect of hedonic motivation would be lower on behavioral intention to use technology (16). In this case, consumers will use the technology for efficiency or effectiveness purpose. Thus, the experience moderator is hypothesized as follow:

H11d. Experience will moderate the effect of hedonic motivation on behavioral intention to use electricity smart billing system.

Experience strengthens the habit, (44) highlighted that because of repeated behavior the relationship between experience and habit is created and enriched. Users with high level of experience in specific technology will allow for a cognitive lock-in to happen (76). (16) confirmed that consumers with more experience will have the habit with stronger effect on behavioral intention and use. Thus, the experience moderator is hypothesized as follows:

H11e. Experience will moderate the effect of habit on behavioral intention to use electricity smart billing system.

H11f. Experience will moderate the effect of habit on use of electricity smart billing system.

Behavioral intention to use a specific technology will diminish with more experience. Jasperson et al. (2005) pointed out that having vast experience , routine behavior becomes automatic and will be led more by the related cues (77). Resulting from this, the impact of behavioral intention on the use of technology will decline as experience increases (16). Thus, the experience moderator is hypothesized as follows:

H11g. Experience will moderate the effect of behavioral intention on the use of smart meter for electricity billing system.

Experience develops the knowledge and risk awareness. Many researches highlighted that the more experienced users, have greater trust towards the online technologies, because they are conscious of the expected risks by using such technologies (78,79). Therefore, the user with a high level of experience of smart billing system will show a higher influence of privacy concerns on behavioral intention. By contrast, users with no previous experience with similar application will have a lower effect of privacy concerns on behavioral intention. Thus, the experience moderator is hypothesized as follows:

H11h. Experience will moderate the effect of privacy concers on behavioral intention to use electricity smart billing system.

2.2.2 Personal Innovativeness (PI)

Personal innovativeness in the field of IT is defined as the desire of an individual to try out any new IT (80). Many researchers concluded that personal innovativeness could influence perceptions by using a new technology (81). (80) and (82) proposed that personal innovativeness in the IT domain can play the role of a moderator variable on the antecedents of perceptions to adopt a particular system. Xu & Gupta (2009) found that indviduals who are more innovative are likely to adopt innovation more readily than others (69). This confirms the fact that an innovative individual is more capable of cultivating positive attitudes towards the divulging of information to use the innovation compared to a less innovative individual.. In this way, the greater the personal innovativeness in the IT field, the stronger the relation between his perceptions of the technology characteristics in terms of performance expectancy and effort expectancy and the behavioral intention to use (84). Thus, the more innovative consumers will have performance expectancy and effort expectency with a strong effect on behavioral intention to use the smart billing system.

H12a: Personal innovativeness in IT will moderate the effect of performance expectancy on behavioral intention to use electricity smart billing system.

H12b: Personal innovativeness in IT will moderate the effect of effort expectancy on behavioral intention to use electricity smart billing system.

Holbrook & Hirschman (1982) found that innovativeness and novelty seeking are associated with the hedonic motivation to use any product (85). When users start to use any technology, they will focus more on its novelty and may even use it for its novelty (e.g. new functions of smart mobiles). As users with high level of innovativeness, the attractiveness of the novelty that contributes to the effect of hedonic motivation on technology use will be high and consumers will use the technology for more hedonic purpose. Therefore, a more innovative individual are more likely to novelty seeking in a way that will influence hedonic motivation perception towards the service provider. Thus, the more innovative consumers will have hedonic motivation with strong effect on behavioral intention to use the smart billing system.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

H12c: Personal innovativeness in IT will moderate the effect of hedonic motivation on behavioral intention to use electricity smart billing system.

Few studies have demonstrated that any innovation is associated with risk, and uncertainty (27,80). Thus H.Xu and S. Gupta (2009) opined that "it is reasonable to argue that personal innovativeness characterizes the risk-taking propensity that exists in certain individuals and not in others." (83). There are,of course, risks when using smart meters especially relating to the personal data of users which may be made public to other parties without consent. There is a higher possibility that more knowledgeable individuals are more likely to face higher privacy risks in a way that will influence the perception towards the service provider. Thus, the more innovative consumers will have privcy concern with strong effect on behavioral intention to use the smart billing system.

H12d: Personal innovativeness in IT will moderate the effect of privacy concern on behavioral intention to use smart meter for electricity billing system.

3. INSTRUMENT DEVELOPMENT

The research model has twelve constructs: performance expectancy, effort expectancy, social influence, habit, facilitating conditions, hedonic motivation, behavioral intention to use, and actual use. These constructs are theoretically based on the unified theory of acceptance and use of technology (UTAUT2). The other factors :technology awareness, willingness of electricity saving behavior , environmental awareness , privacy concern, and personal innovativeness are theoretically based on literature review that has been conducted on related factors and directed by preliminary study conducted earlier.

To develop the initial candidate items for all the scales in the proposed research model, all the items were adopted from prior studies and modified to fit the domain of IoT-based services. Prior to developing measurement instruments for the research model, previous research works were reviewed to ensure that a comprehensive list of measures were included from scales that were already developed and validated.

Measures of peromance expectency, effort expecctency, social influence, faciliting conditions , behavioral intention to use, and actual use were adopted from UTAUT (22), and measures of headonic motivation , and habit were adopted from UTAUT2 (16).

Other measures out from UTAUT are stemed from previous literature of IS/IT acceptance and adoption domain; technology awareness (86), personnel innovitivness (87), and privacy conceren (88). Finally, the measures realted to the elctercity saving behavior and environmental awareness were searched out of the IS research domain. Sepecfically, in energy and environment domain the list of sclaes were extracted; willingness of electercity saving behavior (89) , and environmental awareness (90).

For all the constructs, most of items used in prior studies were adopted with very few adaptations. To ensure content coverage and content fit to the domain of IoT-based services adoption and acceptance. The justifcatin of selecting entire constructs and their rational to the research phenomena were discussed in section 2.1.

The final version of the questionnaire is included in Appendix 1. Also, Table 1 illustrates the model's constructs, number of items for each construct, and the source of these items.

Table 1: Number of Items and Sources.

Construct	No.of items	Source
Performance Expectancy	3	(22)
Effort Expectancy	4	(22)
Social Influence	3	(22)
Facilitating Conditions	4	(22)
Hedonic Motivation	3	(16)
Habit	3	(16)
Technology Awareness	5	(86)
Willingness of Electricity Saving Behavior	6	(55)
Environmental Awareness	4	(55)
Privacy Concern	4	(65)
Personal Innovativeness	4	(91)
Behavioral Intention	3	(22)
TOTAL	46	

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

4. METHODOLOGY

4.1. The Pilot Study

The pilot study is an essential part of the questionaiare survey design, according to Cresswell (2017).It is important to establish the content validity of an instrument and to improve questions, format, and scales to ensure that the survey questionnaire is free of errors and ambiguities (92).

In this pilot study, the methodology started with content validity followed with a reliability test. The validation of the instrument covers content, and constructs validity. Lastly, a reliability test is used to clean up and optimize the measure of each variable.

4.2. Participants

In this pilot study, with the support of Tenaga Nasional Berhad (TNB) a sample of 40 electricity consumers from Malaysia was surveyed. The response to the questionnaires were 36 with a response rate of (90%). From the answered surveys, four were omitted as they were filled arbitrarily. The duration of the pilot survey was four weeks from 6 of October 2017 to 6 November 2017. The data showed that 66% of the respondents were males and 34% were females. The majority of the respondents were from Melacca state 53% and 38 % from Putrajaya. Most of the respondents had considerable level of education where 68% had a bachelor degree. Finally, a large portion of the respondents,90%, had more than two years of experience in using smart mobile applications.

4.3. Validity and Reliability

The validation of instrument is important before starting the main survey. The assessment of the validity of the instrument had gone through three stages. The first stage was to check the wording of the items and their clarity level. The feedback from five PhD candidates assisted in modifying the instrument during the first stage. The second stage involved two experts from the academic field and one from the industry field. The experts examined whether the items are properly representing the variables and their degree of ambiguity and redundancy. Lastly, the instrument was translated by an academic translator to the Malay language (the official language in Malaysia), and then the instrument was translated from Malay to English to ensure there is consistency between the original questionnaire and the translated one.

The reliability of the measured items used in the survey was examined using the internal consistency test Cronbach's alpha. According to Sekaran (93), the reliability of the research instrument is concerned with its consistency and stability. The internal consistency of a group of items shows the degree to which this group is homogeneous. The Cronbach's alpha test has values ranging from 0 to 1; a higher level of range implies a greater value of reliability. Values that are 0.9 and above are excellent; values of 0.8 and above are good; values of 0.7 and above are acceptable; values of 0.6 and above are questionable; and values less than 0.6 are poor(93).

Statistical Package for Social Sciences (SPSS 22) is employed to test the internal consistency of the individual items of each construct. To increase the reliability of the variable items, the "if item deleted" function was used to find the item with the lowest correlation with other items in the same group. Table 2 shows the value of Cronbach's alpha and the number of items that measure a specific variable. The table shows that all the all values of reliability are above 0.9 means excellent, except value of TA (-0.732). By applying "if item deleted" function, it was recommended to delet TA3 and TA5 for a better result. After delting these two items the reliability value of TA modfie to be e excellent, (0.956). In total, all the scales have the excellent value of reliability.

Table 2: Reliability Coefficient of Scales.

Scale	Original	Deleted Items	Modified
PE	0.977	-	0.977
EE	0.986	-	0.986
SI	0.982	-	0.982
FC	0.922	-	0.922
HM	0.974	-	0.974
H	0.954	-	0.954
TA	-0.732	TA3,TA5	0.956
WESB	0.981	-	0.981
EA	0.971	-	0.971
PC	0.982	-	0.982
PI	0.990	-	0.990
BI	0.987	-	0.987

5. DISCUSSION

This study has two axis; firstly, it proposes a model of factors influencing electricity consumers to accept the smart billing system in Malaysia. The proposed factors are mainly extracted from the unified theory of acceptance and use of technology (UTAUT2)(16), as well as from the literature of technology acceptance and electricity saving behavior. In spite of the similarity between our model and previous models, our model has many

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

distinctions. The model discusses related factors in the context of energy and IoT users. Also, the proposed model integrates factors which specficaly reflect the case of smart billing system such as technology awaeness and personal innovitvness.

There is a little knowledge related to the acceptance of the smart billing system by individuals, most of these studies did not include factors related to the energy context such as electricity saving behaviors and attitude or environmental concern (94–99).

In the other side, (100) proposed a model that is tailored to the developed societies which don not meet users' requirements in developing country such as Malaysia. The most of identified factors concern about users' personal information and consequences of using it (. e.g. risks beliefs, trusting beliefs, privacy concern, third-party access and psychological ownership). However, the privacy concern plays a role in affecting acceptance of the technology but it is not the major concern, there are other technological and personal factors balancing decision to accept such technology.

The proposed model was further extended with additional factors derived from the context of the smart billing system in the energy sector and from experience of using smart applications. The extension of the UTAUT2 model that is tailored for investigating individuals' acceptance of Internet applications, hence the proposed model. The nature of the factors in the model makes it suitable for application within the context of the Internet of things, which resides within Malaysian society.

Secondly, this study shows the process of developing the instrument to assess the research model. The proposed model and instrument development research introduced in this study offers few contributions. One of them is the development of instrument to measure the various perceptions in the adoption of smart billing system within IoT context in Malaysia.

The instrument development process involved establishing the scale reliability and validity. In the beginning, the related items were adapted from empirical papers to form the instrument. Then, the validation of the instrument's content was conducted. The validity process confirmed that the measurement scales reflect the variables of interest. There are few techniques helped researchers to validate an instrument as explained in 4.3. Subsequently, the pilot study was conducted using the instrument and collected data from 32 consumers. The reliability explained by Cronbach's alpha coefficient is the extent to which the measurement scales consistently represent the constructs. Based on the reliability test results, some items were deleted to increase the value of Cronbach's alpha. After items deleted, all the scales got the excellent value of reliability which indicats good validity and reliabilty of the instrument.

6. CONCLUSION

This study proposed a conceptual model of factors influencing electricity consumers to accept the smart billing system. The model included factors from different disciplines and perspectives. These included factors from electricity saving perspective (willingness to save electricity behavior, environmental awareness), factors derived from impact of accepting IoT-base services (Privacy concern , personnel innovativeness) , factors from perspective of accepting smart meter technology (Technology awareness), and factors from information technology acceptance and adoption theories (unified theory of acceptance and use of technology UTAUT2).

In addition, the instrument was developed to test the validity and reliability. After conducting the pilot test, the content of the instrument was modified to meet academic feedback and two items were deleted to increase the reliability of the items. Thus, the produced instrument from this study will be used to conduct the main study. The contribution of this study has developed a specific model for energy users to define factors, which influences their acceptance of smart billing system based on consumer's environment and technology characteristics. Furthermore, this study developed the related instrument and validated it empirically.

REFRENCES:

[1] 1. ROPER P. Market potential of US$731b in connected living by 2020: Frost & Sullivan. Marketing [Internet]. 2014; Available from: https://www.marketingmag.com.au/news-c/market-potential-of-us731b-in-connected-living-by-2020-frost-sullivan/

[2] 2. Halim AHA, Wai YS, Shik DMSAM, Hamzah J, Kin FGW, Amin MF, et al. National IoT Strategic Roadmap. MIMOS Berhad; 2014.

[3] 3. Daniel Castro JN& AM. How Is the Federal Government Using the Internet of Things? [Internet]. Center of Data Innovation ; 2016. Available from:

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

http://www2.datainnovation.org/2016-federal-iot.pdf

[4] 4. RedHat. The One-Word Description of the Enterprise Internet-of-Things: Deliberate [Internet]. RED HAT BLOG. RedHat; 2015. Available from: https://www.redhat.com/en/about/blog/one-word-description-enterprise-internet-things-deliberate

[5] 5. Preeti S. Why IoT Opportunities Are High, Adoption Rates Low. cxotoday.com [Internet]. 2015;(Apr 09, 2015). Available from: http://www.cxotoday.com/story/aiming-at-faster-iot-adoption-iet-panel-may-have-some-advice/

[6] 6. Hoover M. Study: IoT adoption still slow for government agencies [Internet]. INTERNET OF THINGS. Washington Technology; 2016. Available from: https://washingtontechnology.com/articles/2016/07/26/agencies-slow-iot-adoption.aspx

[7] 7. Hong HGHG. Measurement Framework for the Acceptance of Internet of Things Product. Indian J Sci Technol. 2016;9(46).

[8] 8. Fan Y. From Innovators to Power Users: The Role Of Power Usage in Driving Adoption Of the Internet Of Things (IoT). 2016;

[9] 9. Lin D, Lee CKMKM, Lin K. Research on effect factors evaluation of internet of things (IOT) adoption in Chinese agricultural supply chain. In: Industrial Engineering and Engineering Management (IEEM), 2016 IEEE International Conference on. IEEE; 2016. p. 612–5.

[10] 10. Attié E, Meyer-Waarden L. A theoretical model incorporating social influence and cognitive processes to explain the adoption of the internet of things and smart connected objects [Internet]. 2016. Available from: http://econpapers.repec.org/RePEc:hal:journl:halshs-01406423

[11] 11. Hsu C-L, Lin JC-C. An empirical examination of consumer adoption of Internet of Things services: Network externalities and concern for information privacy perspectives. Comput Human Behav. 2016;62:516–27.

[12] 12. Gao L, Bai X. A unified perspective on the factors influencing consumer acceptance of internet of things technology. Asia Pacific J Mark Logist [Internet]. 2014;26(2):211–31. Available from: http://www.emeraldinsight.com/doi/abs/10.1108/APJML-06-2013-0061

[13] 13. Coughlan T, Brown M, Mortier R, Houghton RJJ, Goulden M, Lawson G. Exploring Acceptance and Consequences of the Internet of Things in the Home. In: Green Computing and Communications (GreenCom), 2012 IEEE International Conference on. 2012. p. 148–55.

[14] 14. Mital M, Chang V, Choudhary P, Pani A, Sun Z. Adoption of cloud based Internet of Things in India: A multiple theory perspective. Int J Inf Manage [Internet]. 2016 Mar; Available from: http://linkinghub.elsevier.com/retrieve/pii/S0268401216301104

[15] 15. Bussu S. The Internet of Things: the case for public voice . Sciencewise evaluation. UK: Sciencewise; 2014.

[16] 16. Venkatesh V, Thong JYL, Xu X. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS Q. 2012;36(1):157–78.

[17] 17. Oye ND, Iahad NA, Rahim NA. The history of UTAUT model and its impact on ICT acceptance and usage by academicians. Educ Inf Technol. 2014;19(1):251–70.

[18] 18. Coughlan T, Brown M, Mortier R, Houghton RJ, Goulden M, Lawson G. Exploring Acceptance and Consequences of the Internet of Things in the Home. In: Green Computing and Communications (GreenCom), 2012 IEEE International Conference on. 2012. p. 148–55.

[19] 19. Gao L, Bai X. A unified perspective on the factors influencing consumer acceptance of internet of things technology. Asia Pacific J Mark Logist [Internet]. 2014;26(2):211–31. Available from: http://www.emeraldinsight.com/doi/abs/10.

1108/APJML-06-2013-0061
[20] 20. Mital M, Chang V, Choudhary P, Pani A, Sun Z. Adoption of cloud based Internet of Things in India: A multiple theory perspective. Int J Inf Manage [Internet]. 2016; Available from: http://www.sciencedirect.com/science/article/pii/S0268401216301104
[21] 21. Venkatesh, Viswanath., Thong, James, Y.L. & Xu X. Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. MIS Q [Internet]. 2012;36(1):157–78. Available from: http://s3.amazonaws.com/academia.edu.documents/36422124/Venkatesh_utaut2.pdf%3DUnified_theory_of_acceptance_and_use_of.pdf
[22] 22. Venkatesh V, Morris MG, Davis GB, Davis FD. acceptance of information technology: Toward a unified view. MIS Q. 2003;425–78.
[23] 23. Donaldson R. Student acceptance of mobile learning [Internet]. THE FLORIDA STATE UNIVERSITY; 2011. Available from: http://diginole.lib.fsu.edu/islandora/object/fsu:168891/datastream/PDF/view
[24] 24. Pardamean B, Susanto M. Assessing user acceptance toward blog technology using the UTAUT model. Int J Math Comput Simul. 2012;1(6):203–12.
[25] 25. Sun H, Zhang P. The role of moderating factors in user technology acceptance. Int J Hum Comput Stud. 2006;64(2):53–78.
[26] 26. Fong KK-K, Wong SKS. Factors influencing the behavior intention of mobile commerce service users: An exploratory study in Hong Kong. Int J Bus Manag. 2015;10(7):39.
[27] 27. Thiesse F. RFID, privacy and the perception of risk: A strategic framework. J Strateg Inf Syst. 2007;16(2):214–32.
[28] 28. Hossain MM, Prybutok VR. Consumer acceptance of RFID technology: An exploratory study. IEEE Trans Eng Manag. 2008;55(2):316–28.
[29] 29. Dutot V. Factors influencing near field communication (NFC) adoption: An extended TAM approach. J High Technol Manag Res. 2015;26(1):45–57.
[30] 30. Lu J, Yao JE, Yu C-S. Personal innovativeness, social influences and adoption of wireless Internet services via mobile technology. J Strateg Inf Syst. 2005;14(3):245–68.
[31] 31. Rogers Everett M. Diffusion of innovations. New York. 1995;12.
[32] 32. Marchewka JT, Liu C, Kostiwa K. An application of the UTAUT model for understanding student perceptions using course management software. Commun IIMA. 2007;7(2):93.
[33] 33. Pitchayadejanant K. Intention to use of smart phone in bangkok extended utaut model by perceived value. In: International Conference on Management (ICM 2011) Proceeding Conference Master Resources. 2011. p. 160–72.
[34] 34. Ling Keong M, Ramayah T, Kurnia S, May Chiun L. Explaining intention to use an enterprise resource planning (ERP) system: an extension of the UTAUT model. Bus Strateg Ser. 2012;13(4):173–80.
[35] 35. Ajzen I. The theory of planned behavior. Organ Behav Hum Decis Process. 1991;50(2):179–211.
[36] 36. Pahnila S, Siponen M, Zheng X. Integrating habit into UTAUT: the Chinese eBay case. Pacific Asia J Assoc Inf Syst. 2011;3(2).
[37] 37. Webster J, Martocchio JJ. Microcomputer playfulness: Development of a measure with workplace implications. MIS Q. 1992;201–26.
[38] 38. Davis FD, Bagozzi RP, Warshaw PR. Extrinsic and intrinsic motivation to use computers in the workplace. J Appl Soc Psychol. 1992;22(14):1111–32.
[39] 39. Lu H-P, Yu-Jen Su P. Factors affecting purchase intention on mobile shopping web sites. Internet Res. 2009;19(4):442–58.
[40] 40. Kim GS, Park S, Oh J. An examination of factors influencing consumer adoption of short message service (SMS). Psychol Mark. 2008;25(8):769–86.
[41] 41. Song J, Koo C, Kim Y. Investigating antecedents of behavioral

intentions in mobile commerce. J Internet Commer. 2008;6(1):13–34.

[42] 42. Deterding S, Dixon D, Khaled R, Nacke L. From game design elements to gamefulness: defining gamification. In: Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments. ACM; 2011. p. 9–15.

[43] 43. Hsu C-L, Lin JC-C. Exploring Factors Affecting the Adoption of Internet of Things Services. J Comput Inf Syst [Internet]. 2016;0(0):1–9. Available from: https://www.tandfonline.com/doi/full/10.1080/08874417.2016.1186524

[44] 44. Limayem M, Hirt SG, Cheung CMK. How habit limits the predictive power of intention: The case of information systems continuance. MIS Q. 2007;705–37.

[45] 45. Morosan C, DeFranco A. It's about time: Revisiting UTAUT2 to examine consumers' intentions to use NFC mobile payments in hotels. Int J Hosp Manag. 2016;53:17–29.

[46] 46. Lewis CC, Fretwell CE, Ryan J, Parham JB. Faculty Use of Established and Emerging Technologies in Higher Education: A Unified Theory of Acceptance and Use of Technology Perspective. Int J High Educ [Internet]. 2013;2(2):22–34. Available from: http://www.sciedu.ca/journal/index.php/ijhe/article/view/2609

[47] 47. Orbell S, Blair C, Sherlock K, Conner M. The theory of planned behavior and ecstasy use: Roles for habit and perceived control over taking versus obtaining substances. J Appl Soc Psychol. 2001;31(1):31–47.

[48] 48. Rogers EM. Diffusion of innovations. Simon and Schuster; 2010.

[49] 49. Muhammad Abubakar F, Hartini Ahmad Director AB. The Moderating Effect of Technology Awareness on the Relationship between UTAUT Constructs and Behavioural Intention to Use Technology: A Conceptual Paper. Aust J Bus Manag Res. 2013;3(2):14–23.

[50] 50. Craighead WE, Nemeroff CB. The concise Corsini encyclopedia of psychology and behavioral science. John Wiley & Sons; 2004.

[51] 51. Anderson EE. Managerial considerations in participative design of MIS/DSS. Inf Manag. 1985;9(4):201–7.

[52] 52. Garieb SL, Mohd Nasir SR, Busrah A, Yusoff M, Mat Isa CM, Hassan R, et al. PREFERENCES FOR INFORMATION DELIVERY IN USING SMART METER BYENERGY CUSTOMERS IN MALAYSIA. In: Conference on Electrical Power Supply Industry CEPSI. Bangkok Thailand; 2016.

[53] 53. Charbaji A, Mikdashi T. A path analytic study of the attitude toward e-government in Lebanon. Corp Gov Int J Bus Soc [Internet]. 2003;3(1):76–82. Available from: http://www.emeraldinsight.com/doi/10.1108/14720700310459872

[54] 54. Zhaohua Wang a, b N, , Bin Zhang a B, C JY, , Yixiang Zhang a B. Determinants and policy implications for household electricity-saving behaviour: Evidence from Beijing, China. Energy Policy. 2011;

[55] 55. Lai HC, Yu YC, Tuan YM. Electricity-Saving Behavior Antecedents : Electricity-Saving Motivations , Constraints , Knowledge and Beliefs. 2016;567–71.

[56] 56. Spence A, Demski C, Butler C, Parkhill K, Pidgeon N. Public perceptions of demand-side management and a smarter energy future. Nat Clim Chang [Internet]. 2015;5(6):550–4. Available from: http://www.nature.com/doifinder/10.1038/nclimate2610

[57] 57. Kollmuss A, Agyeman J. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environ Educ Res. 2002;8(3):239–60.

[58] 58. Wang Z, Zhang B, Yin J, Zhang Y. Determinants and policy implications for household electricity-saving behaviour: evidence from Beijing, China. Energy Policy. 2011;39(6):3550–7.

[59] 59. Choi T-S, Ko K-R, Park S-C, Jang Y-S, Yoon Y-T, Im S-K. Analysis of energy savings using smart metering system and IHD (in-home display). In: Transmission & Distribution Conference & Exposition: Asia

and Pacific, 2009. IEEE; 2009. p. 1–4.

[60] 60. Aman AHL, Harun A, Hussein Z. The influence of environmental knowledge and concern on green purchase intention the role of attitude as a mediating variable. Br J Arts Soc Sci. 2012;7(2):145–67.

[61] 61. Arlt D, Hoppe I, Wolling J. Climate change and media usage: Effects on problem awareness and behavioural intentions. Int Commun Gaz. 2011;73(1–2):45–63.

[62] 62. Fujii S. Environmental concern, attitude toward frugality, and ease of behavior as determinants of pro-environmental behavior intentions. J Environ Psychol. 2006;26(4):262–8.

[63] 63. Zhang Y, Wang Z, Zhou G. Antecedents of employee electricity saving behavior in organizations: An empirical study based on norm activation model. Energy Policy. 2013;62:1120–7.

[64] 64. Zografakis N, Sifaki E, Pagalou M, Nikitaki G, Psarakis V, Tsagarakis KP. Assessment of public acceptance and willingness to pay for renewable energy sources in Crete. Renew Sustain Energy Rev. 2010;14(3):1088–95.

[65] 65. Dinev T, Hart P. An extended privacy calculus model for e-commerce transactions. Inf Syst Res. 2006;17(1):61–80.

[66] 66. Fortinet. Fortinet Reveals "Internet of Things: Connected Home" Survey Results [Internet]. Vol. 2016. sunnyvale california: Fortinet; 2014. Available from: https://www.fortinet.com/corporate/about-us/news-events/press-releases/2014/internet-of-things.html

[67] 67. Kowatsch T, Maass W. IoT-I Deliverable-D2. 4: Social Acceptance and Impact Evaluation. 2012;

[68] 68. Al-Momani AM, Mahmoud MA, Sharifuddin M. Modeling the adoption of internet of things services: A conceptual framework. IJAR. 2016;2(5):361–7.

[69] 69. Xu H, Gupta S. The effects of privacy concerns and personal innovativeness on potential and experienced customers' adoption of location-based services. Electron Mark. 2009;19(2–3):137–49.

[70] 70. Bansal G, Zahedi F "Mariam", Gefen D. The impact of personal dispositions on information sensitivity, privacy concern and trust in disclosing health information online. Decis Support Syst [Internet]. 2010 May;49(2):138–50. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0167923610000230

[71] 71. Xu F, Michael K, Chen X. Factors affecting privacy disclosure on social network sites: an integrated model. Electron Commer Res. 2013;13(2):151–68.

[72] 72. Thompson R, Compeau D, Higgins C, Lupton N. Intentions to use information technologies: an integrative model. End User Computing Challenges and Technologies: Emerging Tools and Applications: Emerging Tools and Applications. 2007. 79-101 p.

[73] 73. Koivumäki T, Ristola A, Kesti M. The perceptions towards mobile services: an empirical analysis of the role of use facilitators. Pers Ubiquitous Comput. 2008;12(1):67–75.

[74] 74. Frye NE, Dornisch MM. When is trust not enough? The role of perceived privacy of communication tools in comfort with self-disclosure. Comput Human Behav. 2010;26(5):1120–7.

[75] 75. Notani AS. Moderators of perceived behavioral control's predictiveness in the theory of planned behavior: A meta-analysis. J Consum Psychol. 1998;7(3):247–71.

[76] 76. Murray KB, Häubl G. Explaining cognitive lock-in: The role of skill-based habits of use in consumer choice. J Consum Res. 2007;34(1):77–88.

[77] 77. Jasperson JS, Carter PE, Zmud RW. A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. MIS Q. 2005;29(3):525–57.

[78] 78. Liébana-Cabanillas F, Sánchez-Fernández J, Muñoz-Leiva F. The moderating effect of experience in the adoption of mobile payment tools in Virtual Social Networks: The m-Payment Acceptance Model in Virtual Social Networks (MPAM-VSN). Int J Inf Manage

[Internet]. 2014 Apr 1 [cited 2017 Nov 27];34(2):151–66. Available from: http://www.sciencedirect.com/science/article/pii/S0268401213001631

[79] 79. Sultan F. Consumer response to the Internet: an exploratory tracking study of on-line home users. J Bus Res [Internet]. 2002 Aug 1 [cited 2017 Nov 27];55(8):655–63. Available from: http://www.sciencedirect.com/science/article/pii/S014829630000206X?via%3Dihub

[80] 80. Agarwal R, Prasa J. A Conceptual and Operational Definition o f Personal Innovativeness in the Domain o f Information Technology. Vol. 9, Information Systems Research. 1998. p. 204–15.

[81] 81. Yi Y, Wu Z, Tung LL. How individual differences influence technology usage behaviour? Toward an integrated framework. J Comput Inf Syst. 2005;46(2):52–63.

[82] 82. Dabholkar PA, Bagozzi RP. An attitudinal model of technology-based self-service: moderating effects of consumer traits and situational factors. J Acad Mark Sci. 2002;30(3):184–201.

[83] 83. Xu H, Gupta S. The effects of privacy concerns and personal innovativeness on potential and experienced customers' adoption of location-based services. Electron Mark. 2009;19(2–3):137–49.

[84] 84. San Martín H, Herrero Á. Influence of the user's psychological factors on the online purchase intention in rural tourism: Integrating innovativeness to the UTAUT framework. Tour Manag [Internet]. 2012 Apr 1 [cited 2017 Nov 27];33(2):341–50. Available from: https://www.sciencedirect.com/science/article/pii/S0261517711000975

[85] 85. Holbrook MB, Hirschman EC. The experiential aspects of consumption: Consumer fantasies, feelings, and fun. J Consum Res. 1982;9(2):132–40.

[86] 86. Nambisan S, Agarwal R, Tanniru M. Organizational Mechanisms for Enhancing User Innovation in Information Technology. MIS Q [Internet]. 1999;23(3):365–95. Available from: http://www.jstor.org/stable/249410%5Cnhttp://www.jstor.org/stable/249468?origin=crossref

[87] 87. Agarwal R, Prasad J. A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology. Inf Syst Res. 1998;9(2):204–15.

[88] 88. Smith HJ, Milberg SJ, Burke SJ. Information privacy: measuring individuals' concerns about organizational practices. MIS Q. 1996;167–96.

[89] 89. Pagiaslis A, Krontalis AK. Green consumption behavior antecedents: Environmental concern, knowledge, and beliefs. Psychol Mark. 2014;31(5):335–48.

[90] 90. Lillemo SC. Measuring the effect of procrastination and environmental awareness on households' energy-saving behaviours: An empirical approach. Energy Policy. 2014;66:249–56.

[91] 91. Cheng D, Liu G, Qian C, Song YF. Customer acceptance of internet banking: Integrating trust and quality with UTAUT model. Proc 2008 IEEE Int Conf Serv Oper Logist Informatics, IEEE/SOLI 2008. 2008;1:383–8.

[92] 92. Creswell JW, Creswell JD. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications; 2017.

[93] 93. Sekaran U, Bougie R. Research methods for business: A skill building approach. John Wiley & Sons; 2016.

[94] 94. Wunderlich P, Veit D, Sarker S. Examination of the determinants of smart meter adoption: An user perspective. In: International Conference on Information Systems, ICIS 2012 [Internet]. 2012. p. 1941–57. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84886483376&partnerID=40&md5=963657c86bea11961c3b17ecdc3ea6de

[95] 95. Kranz J, Gallenkamp J, Picot A. Power control to the people? Private consumers' acceptance of smart meters. In: 18th European Conference on Information Systems, ECIS 2010 [Internet]. 2010. Available from: https://www.scopus.com/inward/record.uri

?eid=2-s2.0-84870642506&partnerID=40&md5=78374b5d94389cfe5f06e9a3f024c3e4

[96] 96. Alabdulkarim A, Lukszo Z, Fens TW. Acceptance of ICT -Intensive Socio-Technical Infrastructure Systems: Smart metering Case in the Netherlands Layla. 2012;(June):399–404.

[97] 97. Chou J-S, Yutami GAN. Smart meter adoption and deployment strategy for residential buildings in Indonesia. Appl Energy [Internet]. 2014;128:336–49. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-84901202816&doi=10.1016%2Fj.apenergy.2014.04.083&partnerID=40&md5=db3a054a5e2ad8a62ede6b290e6da2d1

[98] 98. Indrawati, Tohir LM. Predicting smart metering acceptance by residential consumers: An Indonesian perspective. 2016 4th Int Conf Inf Commun Technol ICoICT 2016. 2016;4(c).

[99] 99. Chen K-Y, Yeh C-F. Factors affecting adoption of smart meters in the post-Fukushima era in Taiwan: an extended protection motivation theory perspective. Behav Inf Technol [Internet]. 2017 Sep 2;36(9):955–69. Available from: https://doi.org/10.1080/0144929X.2017.1317363

[100] 100. Warkentin M, Goel S, Menard P. Shared benefits and information privacy: What determines smart meter technology adoption? J Assoc Inf Syst [Internet]. 2017;18(11):758–86. Available from: https://www.scopus.com/inward/record.uri?eid=2-s2.0-85037379191&partnerID=40&md5=2fa98d530590dc9a8f6d7483ade6c227