An Examination of Smart Card Technology Acceptance Using Adoption Model

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Abstract. Among the fast growing usage of new technologies, smart card technology has an outstanding growth and making its way worldwide into the hands and wallets of everyone. In fact, smart cards greatly improve the comfort and security of any transaction. It is important to note that consumer acceptance and confidence are vital for the further development of smart card technology or in other words, we can say that acceptance has been viewed as a function of user involvement in smart card systems development. Understanding the factors that influence user acceptance of information technology is of interest both to researchers in a variety of fields as well as procurers of technology for large organizations. Adoption of smart card technologies should not be made simply, knowing the customers perception of and behavioral intention to use technology should be a key in the decision making process. The purpose of this study is to develop an adoption model of using smart card technology.

Keyword: Smart card, acceptance, technology, security, satisfaction

1. Introduction

A smart card is a plastic card with an embedded microprocessor chip, capable of storing a significant amount of data and performing basic computing operations. Most smart cards resemble the size of a standard credit card [22]. Smart cards are secure devices that enable positive user identification and they are multi-functional, cost effective devices that can be easily adapted for both physical and logical access. Logical access control concerns such familiar principles as password checking or the more sophisticated cryptographic mechanisms for authentication such as windows logon, network authentication, biometric storage and etc. Physical access control relates to ID (identification) badges and building access control. Smart card makes possible sophisticated and portable data processing applications.

Without realizing it, these plastic cards have become a very important part of our life. It is important to note that consumer acceptance and confidence are crucial for the further development of smart card technology as the underlying issues which demand more control, security, usefulness, flexibility and ease of use [6][20][21].

Generally, acceptance is defined as an antagonism to the term refusal and it means the positive decision to use an innovation [25]. The question about user acceptance is related to all researchers who want to presage which technologies will prove appropriate for an organization [14]. User acceptance is very significant to the successful implementation of any new technology such as smart card. In order to be able to investigate and examine the user acceptance of smart card technology, we need to identify the important factors which can affect on user adoption and then having a technology acceptance model. Several researches developed theories and models to describe and analyze user acceptance and each of these models determines different factors to explain user acceptance. This study combines previous studies and develop a model to investigate the user acceptance about smart card technology.

2. Literature review

The aim of this part is to provide a review of present literature of some adoption models and theories regarding acceptance which have been
used to develop a smart card acceptance model. User acceptance is defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support.

2.1. Innovation diffusion theory (IDT)

It is one of the popular and enduring conceptualization of innovation adoption behavior. Perhaps the principal theoretical perspective on technology acceptance is innovation diffusion theory, which has been applied at both individual [24] and organizational levels of analysis. Diffusion theory offers a conceptual framework for discussing acceptance at a global level [14]. Rogers [23] argued, diffusion of innovative technology is highly related to communication channels, individuals, organizational members, and social system. According to Rogers [23] diffusion theory posits five characteristics of innovations that affect their diffusion which are: relative advantage, compatibility, complexity, triability, observability.

The model which was used in a research by [15] and based upon diffusion of innovation theory [23] includes eight constructs namely relative advantage, perceived ease of use, compatibility, triability, visibility, image, result demographic, and voluntariness.

2.2. The technology acceptance model (TAM)

It is one of the most widely used models of information technology acceptance; it was introduced by [12]. The goal of TAM is to predict information system adoption and identify design problems before users have experience with a system. The model suggests that when users are presented with a new software package, a number of factors influence their decision about how and when they will use it. TAM states that users’ adoption of information technology is dependent on their perceived ease of use and perceived usefulness of the technology. Several empirical studies have recommended that TAM could be integrated with other acceptance and diffusion theories, thereby including variables related to both human and social factors and improving its predictive and explanatory power (e.g., [26][28]).

2.3. Extension of technology acceptance model (TAM2)

The extension of technology acceptance model (TAM2) was introduced by [28]. They suggested that combination of technology acceptance model with other information technology acceptance models or adding other factors could be helpful to improve the specificity and explanatory utility in a specific area. TAM2 extended TAM by including factors that are job relevance, output quality, result demonstrability and two social issues namely subjective norm, and image which influence perceived usefulness.

2.4. Unified theory of acceptance and use of technology (UTAUT)

It aims to explain user intentions to use an information system and subsequent usage behavior. It is widely used in the field of information and communication technology acceptance modeling. It consists of four key constructs namely performance expectancy, effort expectancy, social influence, and facilitating conditions which are direct determinants of usage intention and behavior [30]. Gender, age, experience, and voluntariness of use are posited to mediate the impact of the four key constructs on usage intention and behavior [30].

3. Conceptual framework

This research model is developed based on Technology Acceptance Model (TAM) [12], Diffusion of Innovation Theory [23], Unified Theory of Acceptance and Use of Technology (UTAUT) [30], Extension of Technology Acceptance Model (TAM2) [28] and the model which was used in a research by [15]. Fig.1 shows a schematic view of this model.

The model consists of four parts. The first part is satisfaction which is effected by usefulness, ease of use, support, awareness, anxiety and security. The second part is external variables that includes triability, image, social influence, compatibility, visibility and demographic. Attitude toward use which is influenced by satisfaction and external variables is the third component and finally the adoption section as a last part of the model.
Figure 1. Adoption model

Table 1 shows the variables and their source(s) which have been used in the proposed model.

Table 1. Variables and their source(s)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Source(s)</th>
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<tbody>
<tr>
<td>Compatibility</td>
<td>Rogers [24]</td>
</tr>
<tr>
<td>Image</td>
<td>Moore and Benbasat [19] Venkatesh and Davis [27][28]</td>
</tr>
<tr>
<td>Triability</td>
<td>Roger [23][24]</td>
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4. Dimensions

Satisfaction of the computer system will have a direct effect on usage [16]. The measure of computer satisfaction was developed from the comprehensive tool reported by [8]. From that list we utilized four factors: support, ease of use, security, usefulness.

Users like and plan to use the system more frequently as the system becomes an easy one to use. A broader view of ease of use includes elements such as ease of learning, ease of control, and understandability [13]. On the other hand, individuals who believed that using smart card systems could lead to positive outcomes also tended to have a more favorable attitude towards it [1][18]. Additionally, some studies have reported that users’ concern about security has increased and it has been known as one of the most significant factor for technology acceptance [31]. There are several reasons one requires security in a smart card system. The principles being enforced are: privacy, non-repudiation, authentication, integrity, verification. In this list [8], training is included and as we know training will result awareness, so in this study we are going to add “awareness” as well. Awareness about technology cause users to look forward to try technology and at the same time enjoy the various benefits that the system provides [4]. Having a general knowledge and knowing what features and benefits the smart card technology has is a significant issue and it can affect on intention to adopt the technology. Awareness refers to the effort in providing knowledge and improving understanding of any technology.

Furthermore, anxiety related to the computer system will have negative effects on both fun and usefulness [17]. When ask about the major disadvantages of smart card, the most frequently concerns are about privacy, in terms of criminals or unauthorized persons getting access to the information on the card in some manner, illegal and unauthorized using of smart card when it is lost.

According to [7], adoption may be facilitated if the use of the innovation improves the image of the user, so as prestige and other valued attributes to culture in relation to the use of the innovation that are directly related to the adoption rate. In addition, behavior is instigated by one’s desire to act as how others act or think one should act which is named social influence [10].
The adoption process can also be facilitated if the technical system proposed is visible in the organization [19] and if an innovation fits easily into the values and routine of an individual. Rogers [24] discussed the compatibility of the innovation with the values, culture and practices of individuals.

It should not be forgotten that population characteristics which are used to classify people for statistical purposes, such as age, gender, education and experience can affect on users’ judgment that whether an innovation is good or bad. For example, computer skills were more easily learned by younger person than by older person [11]. Besides, as the education level of users increase, their intention to use smart card systems will increase. Moreover, previous experience is a determinant of behavior [2]. We predict that those who have used smart card or other similar technologies before have more favorable attitudes towards use smart card technology than those who have not used.

Table 2 shows factors which have been used in this study with their definition.

<table>
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<tr>
<th>Factors</th>
<th>Definition</th>
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<tr>
<td>Awareness</td>
<td>The degree to which an individual are aware about the technology.</td>
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<tr>
<td>Support</td>
<td>The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.</td>
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<tr>
<td>Anxiety</td>
<td>The degree to which users are worried about using technology.</td>
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<tr>
<td>Ease of Use</td>
<td>The degree to which a person believes that using a particular system is free of effort.</td>
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<tr>
<td>Usefulness</td>
<td>The degree to which a person believes that using a particular system would enhance his or her job performance.</td>
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<tr>
<td>Security</td>
<td>The degree to which a person feels that security is important to them and believes that using smart card is secure.</td>
</tr>
<tr>
<td>Compatibility</td>
<td>The degree to which the innovation is perceived to be consistent with the potential users’ existing values, previous experiences and needs.</td>
</tr>
<tr>
<td>Image</td>
<td>The degree to which use of an innovation is perceived to enhance one’s image or status in one’s social system.</td>
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5. Discussion and conclusion

The purpose of this study was to develop an adoption model of smart card technology and to identify the important factors contributing to increase the user acceptance to design the model.

Both practitioners and researchers have a strong interest in understanding why people accept information technology so that better methods for designing, evaluating, and predicting how users will respond to new technology can be developed [14].

Lack of user acceptance is a significant barrier to the success of new information systems. In fact, users are often unwilling to use information systems which, if used, would result in impressive performance gains. Therefore, user acceptance has been viewed as the pivotal factor in determining the success or failure of any information system project [12]. Adoption of smart card technologies should not be made simply, knowing the customers perception and behavioral intention to use technology should be key in the decision-making process. Smart card technology is not well defined in some countries then it is not used in a wide range.

An application’s features play an important role in determining whether individuals involved in an activity will use it or not [30]. Technology should be introduced to people and they have to be aware of its characteristics, features, and advantages. Although user awareness is important, educating and supporting the end users is also significant. In addition, culture plays vital role in technology acceptance. Cultural differences that exist between different countries may affect on their understanding and utilization of technology.
Most of the acceptance model focuses on specific case studies and the literature review revealed no existing model investigating smart card acceptance related. The current literature, which specifically addresses acceptance of smart card technology, and their usage and implementation, is somewhat sketchy. It is the intent of this study to provide important information that will present a backbone for future study into the problems surrounding the acceptance of information technology and specially smart card technology. The proposed model could be used by policy makers and stakeholders to investigate and examine the user acceptance of smart card technology.

6. References


