Development of an Instrument to Measure Smart Card Technology Acceptance

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ABSTRACT

Recently smart card is used all over the world in different applications such as financial, telecommunication, network, and physical access where the security is considered very crucial. User acceptance is very significant in successful implementation of smart card technology. Thus, in order to investigate the user adoption of the technology, the instrument to identify the user acceptance is needed. The aim of this study is to develop an instrument to measure the user acceptance of smart card technology in Iran environment. Factors which can affect on user acceptance are presented and discussed.

Keywords
Smart card, acceptance, adoption, security, technology, satisfaction, external variables.

1.0 INTRODUCTION

Smart card is a simple plastic card just as a size of credit card with a microprocessor and memory chip embedded inside the smart card (Rankl & Effing, 2003). Smart card has a lot of function such as manage files, compute process, perform cryptography algorithm, and store data. There are a lot of advantages to use of smart cards for variety of daily tasks such as stored value, securing information and physical assets, e-commerce, personal finance, health care, network security, and physical access.

Understanding the factors which can affect on user acceptance of information technology is very important and it can be used for designing better methods, evaluating, and predicting how users will react to new technology can be developed (Dillon & Morris, 1996). In addition, user acceptance is very critical for successful implementation of smart card technology as the underlying issues which demand more control, security, usefulness, flexibility and ease of use (Rankers et al., 2001; Argy & Bollen, 1999).

Generally, acceptance means an antagonism to the term rejection and it means the positive decision to use an innovation (Simon, 2001). Some previous researches developed theories and models to explain and analyze user adoption and each of these theories finds out different factors to clarify and describe the user acceptance. The question about user acceptance is related to both researchers and practitioners who want to presage which technologies will prove suitable for an organization (Dillon & Morris, 1996). This study which is currently in progress is going to develop an instrument to examine the smart card technology acceptance.

2.0 METHODOLOGY

In order to be able to develop an instrument we need to identify the items which we want to measure so we require an adoption model, understanding the factors' definition and create relative questions. To achieve this aim, the instrument is designed based on a review of the smart card and related technologies literature and also acceptance models concepts. The design process consists of using known existing instruments, choosing appropriate items, creating new items as necessary.

Both English and Persian languages are chosen for each question in the survey to make the survey understandable for all respondents and the online survey is preferred to be available

for all participants. Additionally, survey includes information about the instrument's purpose and information about how the data will be used. This survey can assist to explore the relationships and interrelationships between independent variables and dependent variables in the adoption model.

3.0 RESEARCH MODEL

The model which this study is going to use is a combination of Theory of Planed Behavior (Ajzen, 1985), Technology Acceptance Model (Davis, 1986), Diffusion of Innovation Theory (Rogers, 1995), Extension of Technology Acceptance Model (Venkatesh & Davis, 2000), Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh. et al., 2003), and the model which was used in a research by Hui Min Lee et al. (2003). Figure 1 shows a schematic view of this model.

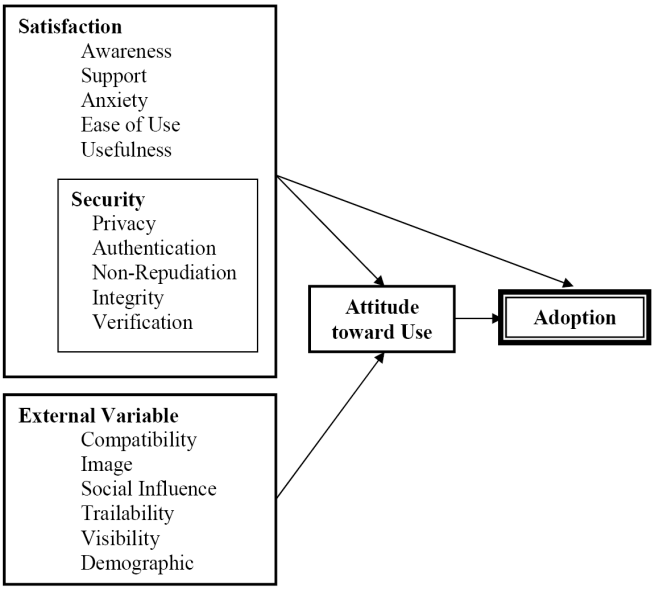

Figure 1: Research Model (Taherdoost, et al. 2009)

3.1 Factors

With the purpose of recognizing the meaning and description of items which are included in the research model and also finding known existing instruments, we need the factors' definition and their sources. Table 1 shows factors which were used in this research model with their definition, and their sources.

Table 1: *Factors Involved in the Study*

Variable (Factor)	Definition	Source(s)
Awareness	*The degree to which an individual are aware about the technology.*	Al-Alawi & Al-Amer (2006) Bandura (1982)
Support	*The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.*	Bailey & Pearson (1983) Al-Gahtani et al . (2007)
Anxiety	*The degree to which users are worried about using technology.*	Bailey & Pearson (1983) Igbaria. et al (1996)
Ease of Use	*The degree to which a person believes that using a particular system is free of effort.*	Davis (1989) Bailey & Pearson (1983)
Usefulness	*The degree to which a person believes that using a particular system would enhance his or her job performance.*	Davis (1989) Venkatesh & Davis (2000) Bailey & Pearson (1983)
Security	*The degree to which a person feels that security is important to them and believes that using smart card is secure.*	Bailey & Pearson (1983) Vijayasarathy (2004)
Compatibility	*The degree to which the innovation is perceived to be consistent with the potential users' existing values, previous experiences and needs.*	Sonnenwald. et al (2001) Rogers (2003) Karahanna et al. (1999)
Image	*The degree to which use of an innovation is perceived to enhance one's image or status in one's social system.*	Moore & Benbasat (1991) Venkatesh & Davis (1996, 2000)
Social Influence	*The degree to which an individual perceives that it is important others believe he or she use the new system.*	Ajzen (1985) Venkatesh & Davis (1996, 2000)
Traibility	*The degree to which an innovation may be experimented with before adoption.*	Roger (1995, 2003)
Visibility	*The degree to which the results of an innovation are visible and communicable to others.*	Rogers (1995, 2003) Moore &Benbasat (1991) Karahanna et al. (1999)
Demographic	*Age, Gender, Education, Experience*	Agarwal & Prasad (1997, 1999) Venkatesh & Morris (2000) Taylor & Todd (1995)

4.0 SURVEY DESIGN

The key elements of instrument are proper introductory and initial statements, demographics, and directions are integrated on each of the tools is developed. A questionnaire was designed including multiple measures of each of the twenty concepts of our model. The concepts were measured by the subjects representing their agreement with a set of statements using a five-point scale ranging from "strongly disagree" "strongly agree". It contains two main sections. The first section is demographic which include question about respondents' age, gender, educational level, experience, and smart card usage. The second section itself is divided to five core heading based on the research model, namely: Satisfaction, Security, External Variables, Attitude toward Use, and Adoption. Each of these

core titles has its own sub headings which will be discussed as follows.

4.1 Satisfaction

Satisfaction of the computer system will have a direct consequence on usage (Igbaria and Parasuraman, 1989). Bailey and Pearson (1983) defined satisfaction as ‘‘in a given situation, is the sum of one’s feelings or attitudes towards a variety of factors affecting that situation’’. Satisfaction contains two question created by the researchers. They are as folllows:

- I will recommend smart card to others.
- Overall, I am satisfied with smart card.

4.1.1 Usefulness

Individuals who believed that using smart card systems could lead to positive results also tended to have a more favorable attitude towards it. In addition, there is an experiential support for the relationship between perceived usefulness and attitude towards use (Agarwal and Prasad, 1999; Moon and Kim, 2001). Usefulness is measured using five items indicating the original scope of time saving, quality, efficiency, improvement, and usefulness of Davis (1989) adapted to this study setting. For example,

- Smart card will enable me to accomplish tasks more quickly (save time).
- Using smart card can improve services (faster speed, convenience, and security).

4.1.2 Ease of Use

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 (Davis, 1986). Ease of use is measured using items from the original items of Davis et al. (1989). The items are as follows:

- Learning to operate smart card is easy for me.
- I find it takes a lot of effort to become skilful at using the smart card.

4.1.3 Support

Vendor support has similar representation to the Facilitating condition of UTAUT model. Former studies have recognized organizational support as one of the crucial factors affecting successful adoption of system (Fuerst & Cheney, 1982; Igbaria et al., 1995; Igbaria, 1993; Igbaria et al., 1997). Support measures are based upon Battacherjee (2000) and Taylor and Todd (1995) and some items created by the researchers. Among others, are:

- The smart card services and equipments are available to me when I need them.
- A person (or group) is available for assistance with smart card difficulties.

4.1.4 Awareness

Awareness about technology will result in users to look forward to try technology and at the same time enjoy the various benefits that the system provides (Al-Alawi & Al-Amer, 2006). Having a general knowledge and knowing what characteristics, features and benefits the smart card technology has is an important concern and it can affect on intention to adopt the technology. Awareness is measured by using five objects which are all formed by the researchers. For example,

- I would welcome smart card system if I was aware more about it.
- Being aware about the smart card system and services is important in order to use it.

4.1.5 Anxiety

Anxiety toward computers is described as the apprehension, or even the fear, an individual has toward the possibility to have to use a computer (Venkatesh, 2000). Anxiety related to the computer system will have negative effects on both fun and usefulness (Igbaria. et al, 1996). Anxiety include six items which are all created by the researchers. For example,

- Smart card is not safe, and someone could steal my information.
- It scares me to think that I could lose a lot of information using the system by losing the smart card.

4.2 Security

Some studies have stated that users’ concern about security has increased and it has been known as one of the most major factor for technology adoption. There are several reasons one requires security in a smart card system. Security in smart card has five principles namely; Privacy, Non-Repudiation, Authentication, Integrity, Verification. Although Security itself contains five items but each of these principles has two items for measurement which are produced by the researchers, such as:

- Smart card systems are trustworthy.
- Security will be important when using smart card.

4.2.1 Privacy

Privacy is defined as the act of ensuring the nondisclosure of data between two parties from third party. The item used in the study is as follows:

- I trust in the ability of a smart card system to protect my privacy.

4.2.2 Non-Repudiation

Non-repudiation is described as confirmation of the origin of data is exchanged in transaction or in other word certain transaction, that is performed, never could be denied by party. The item is as follows:

- I believe that in smart card if a certain transaction is performed, it never could be denied by party.

4.2.3 Authentication

It is identified as the process which specifying identity of person .In fact it specifies that someone or something is who or what it is claims to be. Below is the item considered in the study.

- Only authorized individuals are able to access to confidential information.

4.2.4 Integrity

Integrity is defined as the correctness of message that transmitted from the original to the recipient. Below is the item considered in the study.

- I believe that smart card prevents accidental loss of data and data decay.

4.2.5 Verification

In smart card technology, verification is defined as confirmation the identity of cardholder before using a card. The study item is as follows:

- I believe that smart card is able to confirm the identity of cardholder before using a card.

4.3 External Variables

We note that there is no clear pattern with respect to the choice of the external variables considered. Table 2 shows the external variables which are identified in previous studies.

Table 2: *External Variables*.

Researchers	External Variables
Karahanna et al. (1999)	• Compatibility • Visibility
Igbaria et al. (1997)	• Training
Agarwal & Prasad (1997, 1999)	• Level of Education • Prior Similar Experiences, Participation in Training
Venkatesh & Davis (1996, 2000)	• Subjective Norms • Image
Venkatesh & Morris (2000)	• Gender • Experience
Taylor & Todd (1995)	• Affect of Experience

In the proposed research model, visibility, triability, social influence, image, compatibility, and demographic are the external variables for the study.

4.3.1 Visibility

It was originated from the observability which was created in Diffusion of Innovation Theory by Rogers (2003). The acceptance process can also be facilitated if the technical system proposed is visible in the organization (Moore and Benbasat 1991). The measures for visibility are based on research by Hui Min Lee et al. (2003). Example of the item is as follows.

- Unsure whether smart card will generate the desired returns in terms of profit.

4.3.2 Triability

Trialability is rooted in Diffusion of Innovation Theory and is said to facilitate the adoption. In other word it means, try the technology to see what it could do before deciding whether to use new technology. The measurement items for triability were created by the researchers, such as:

- I am really willing to use smart card system if I was able to use smart card on a trial basis.

4.3.3 Social Influence

It is described as the person's perception that most people who are important to him think he should or should not perform the behavior in question (Ajzen, 1985). In this survey it contains three items same to the items used by Mathieson (1991), Battacherjee (2000), Venkatesh and Davis (2000), and Taylor and Todd (1995). Examples are as follows.

- People who influence my behavior would think that I should use smart card system.
- People whose opinion I value prefer me to use smart card system.

4.3.4 Image

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 (Aubert & Hamel 2001). Image is measured using two items almost identical to the items used by Hui Min Lee et al. (2003). Below is one example of the items.

- Persons who use smart card have more prestige than those who do not.

4.3.5 Compatibility

Compatibility is quality of an innovation that fits easily into the values and routine of an individual. It includes two measurement objects developed by the researcher. For example,

- There is no compatibility problems related to the smart card services I use.

4.4 Attitude Toward Using

Attitude involves judgment whether the behavior is good or bad and whether the user is in favor of or against performing it (Leonard. et al, 2004). The measure of attitude toward using is very similar to those used by Davis (1989), Taylor and Todd (1995). Example of the item is as follows:

- I believe that using smart card is a wise idea.

4.5 Adoption

Generally, adoption or acceptance is defined as an antagonism to the term refusal and it means the positive decision to use an innovation (Simon, 2001). Adoption is measured using four items almost identical to the items used by Battacherjee (2000), Mathieson (1991), and Yu et al. (2005). Examples of items are as below.

- I intend to use smart card in the early future.
- I predict I would use the smart card in the early future.

5. CONCLUSION

The purpose of this study was to develop an instrument to assess and measure the user acceptance of smart card technology which can assist to identify the important factors contributing to increase the user acceptance of the technology. Iranian culture which is an index for the users' familiarity or their previous experiences with the related technology has influenced on intention to adopt smart card. In the study, culture was represented by image, social influence, and triability. In addition, this study may aid to examine the respondents' treatment and acceptance of smart card technology and test the smart card adoption model. This instrument could be used by policy makers and stakeholders who need to investigate and examine the user acceptance of smart card technology.

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