STRATEGIC AND TECHNOLOGY POLICY IMPLICATIONS FOR E-GOVERNMENT: LESSONS FROM AN EMPIRICAL CASE STUDY ON INFORMATION SECURITY IN THAILAND

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Abstract: Smart card technology was first introduced in Thailand by the Thai government who planned to use the technology for the government's e-ID and e-Government projects in 2004. This situation is contrary to the introduction of smart cards by the private sector in developed countries. On the research front, this contrast provided an excellent opportunity to study the differences, if any, in factors affecting consumers' perceptions of smart card technologies. The study shows that, statistically, no demographic factors, except age, were found to have statistically significant effects on the users' decision to use smart cards. In addition, it was found that perceived convenience and security level of smart cards are the other two statistically significant factors found to affect Thai users' decisions to adopt smart card technologies. This study concludes that the key issue with respect to using smart cards in Thailand is not so much about which applications are the "right" ones to be put on the cards, but more on the matters of security of the cards. This issue is very important to Thai people as shown empirically by this study. As a result, the Thai government should put high emphasis on the security issue when planning for and implementing the smart card technologies in their e-ID and e-Government projects.

Keywords: Smart Cards, Thailand, Developing Countries, e-Government, Consumer Perception, Consumer Survey, Technology Policy Planning, Technology Implications.

In early 2002, the Thai government announced its e-Government policy, and subsequently, two of its most ambitious projects yet, the projects on e-ID and e-Citizen. For the e-ID project, the Thai government in 2004 introduced smart card technologies.

This research presents consumers' perceptions on information security in the deployment of smart cards in e-Government projects in developing countries using Thailand

as a case study. The paper is organized in the following manner. First, introduction on smart card technologies is presented. After that, the Technology Acceptance Model (TAM), on which a conceptual model for this research is based, is discussed and past research on the adoption of smart cards is reviewed. Subsequently, the conceptual framework is presented followed by the results from an empirical study. Finally, strategic implications for policy makers are discussed.

Smart Card Technologies

Smart card technologies have been revolutionizing telecommunications and financial transactions for many years. The major driving factors of the growth of smart card usage are the declining cost of smart cards and the added convenience that smart cards provide to users.

The majority of smart cards, by far, are used in the wireless telecommunications sector, where Subscriber Identity Modules (SIMs) are the major applications. Smart Cards have been specified as the access medium to the digital European mobile phone system (GSM). They are ideal because they provide secure access to the network by verifying the subscriber's identity, and they allow separation of sale of mobile phones from that of services by the network operator and service provider.[1]

There are many ways to categorize smart card technologies. However, for the purpose of this paper, only two major types of smart cards will be discussed. They are:

- "Simple" smart cards or Memory cards: These cards can store more data than the standard magnetic stripe cards. However, this type of card cannot process the information stored on it. This type of card is mainly used to store information only. The major applications of memory cards are the pre-paid pay-phone or store-valued cards.
- "Intelligent" smart cards: This type of card looks like standard plastic cards but are embedded with Integrated Circuit (IC) chip. They can securely store and process the information on the cards. This type of card cannot be reproduced and therefore is almost totally secure against fraud. Unlike the passive memory cards, "intelligent" smart cards can process, re-record, and update the information on real-time basis.

Literature Review

The framework for this research is developed based on Davis' Technology Acceptance Model (TAM).[2] According to Davis' framework, the intention to adopt new technologies (in his work, a software package) depends on two major factors, namely, perceived ease-of-use and perceived usefulness. Perceived ease-of-use reflects the extrinsic characteristics of the technology itself, while perceived usefulness reflects

the intrinsic characteristics of the technology based on the users' individual perceptions.

Over the years, the TAM framework has been revised and tailored to many specific new technologies, including the Internet, IT technologies, and many others. For this research, the TAM framework was selected because it deals directly with individual perceptions and new technologies, which are the main focus of this research.

In addition to Davis' TAM framework, this research has also incorporated other factors from previous studies on smart card adoption into its conceptual framework, including demographics and technology-specific concerns, i.e., information security, in order to test these factors in the context of developing countries.

Many of the past studies in smart cards dealt with unsuccessful attempts to introduce smart card technologies to consumers. Despite their usefulness and extensive applicability, smart cards have not gained popularity and acceptance worldwide as their supporters once claimed. In some locations, the trial implementation of smart cards was even deemed failure.[3,4,5] To this end, several researchers tried to give the explanation as to why smart cards were not accepted well in these cases.

One major case of failure in smart card implementation was the smart card trial in New York City, U.S.A., launched by Citibank, Chase, VISA and MasterCard. In an empirical study of this trial's failure, Truman, Sandoe, and Rifkin[6] found that despite the fact that the technology's relative advantages were significantly related to consumers' and merchants' acceptance, consumers and merchants were disposed against acceptance of smart card technology. In addition, they found that there was no evidence of any critical mass effects that can be used as a predictor of either consumers' or merchants' acceptance.

Another case where smart cards have failed was the case of the smart card-based retail point-of-sale system, called "Exact," which was test marketed for a full year in 1997 in the Canadian market. Plouffe, Vandenbosch, and Hulland[7] conducted a detailed case study of this trial and found that there is an unavoidable "synergistic" aspect to the diffusion of the smart card technology. Their research clearly indicates that the pure convenience and novelty elements of smart card payment are not enough in and of themselves to ensure the technology's longer-term viability and acceptance. Consumers only value smart cards if they are broadly accepted at a variety of merchants and service providers. They also found that there were no statistically significant differences in expressed adoption intent across either gender or highest achieved educational level.

In another study done by Kearns and Loy,[8] it was found that at the global level, there were still a number of issues that inhibit the widespread use of smart cards, especially

in open systems. These issues include the unsettled standards to be used for the Chip Operating System (COS), and the users' fears against security breaches and attacks of financial data which overweighed the benefits that facilitate adoptions of smart cards.

Other studies stated that obstacles to acceptance of smart cards include[9]:

- Present lack of infrastructure to support the smart card, particularly in the United States, necessitating retrofitting of equipment such as vending machines, ATMs, and telephones.

- Lack of standards to ensure interoperability among varying smart card programs.

- Unresolved legal and policy issues, such as those related to privacy and confidentiality or to consumer protection laws.

While the aforementioned empirical studies provided useful insights into the facilitators and inhibitors of smart card usage, the cases explored in these studies are mostly market trials of smart cards used in the financial and payment transactions. In addition, these past studies focused mainly on the cases of smart card usage in developed countries, such as the U.S., Canada, and the European countries.

Table 1 summarizes the factors studied in past research.

Table 1: Factors Affecting the Adoption of Smart Cards from Past Research.

Factors	Statistically Significant	Past Research
Gender	No	Plouffe, Vandenbosch, and Hulland,[10] Truman, Sandoe, and Rifkin[11]
Educational Level	No	Plouffe, Vandenbosch, and Hulland,[12] Truman, Sandoe, and Rifkin[13]
Age	Yes	Plouffe, Vandenbosch, and Hulland,[14] Truman, Sandoe, and Rifkin[15]
Income Level	Yes	Plouffe, Vandenbosch, and Hulland,[16] Truman, Sandoe, and Rifkin[17]
Security Concerns	Yes	Kearns and Loy[18]
Convenience	No	Truman, Sandoe, and Rifkin[19]

A Conceptual Framework

Unlike the past studies, this research hopes to shed some light on the consumers' perception and deployment of smart card technology in developing countries by using Thailand as a case study. In most developing countries, smart card technology was first introduced to consumers by the government, as opposed to the introduction by

the private sector in developed countries, through the implementation of electronic identification cards (e-ID). This is also the situation in Thailand, where the Thai government is currently planning for the deployment of e-ID and the implementation of electronic government regime.

This study intends to provide a unique perspective into the deployment of smart cards in developing countries. Being totally different from the optional usage of smart cards in developed countries; the usage of smart cards in Thailand was proposed to be "imposed" on all Thai citizens within the next few years. This situation does not only provide unique commercial implications for the private sector, but also important policy implications for the government and relevant stakeholders, and most importantly, to Thai citizens themselves.

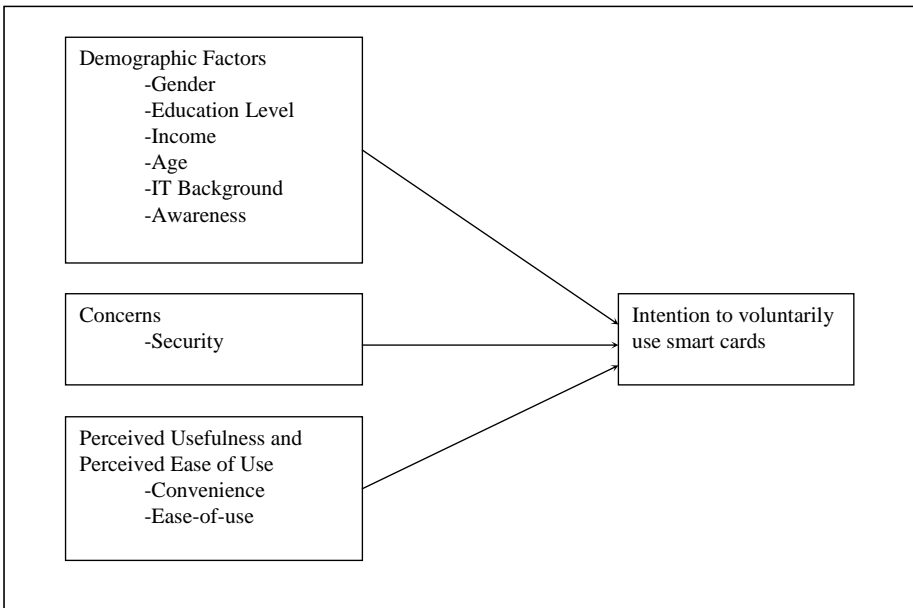This research is based on the conceptual framework presented in Figure 1.

Figure 1: A Conceptual Model.

Thailand: A Background Review on e-Government and e-ID Policies

In early 2002, the Thai government announced the e-Government policy, and subsequently, the policies on e-ID and e-Citizen. In November 2002, the Information and Communications Technology (ICT) Ministry and the Bureau of Registration Administration (BORA) said they would introduce the country's first ID card equipped with

a chip to store personal data by April 2004. The smart card would be only issued on request.[20]

The government said it would launch a pilot scheme for electronic ID cards, "smart citizen e-card," that will cost taxpayers a mere 800 million Thai Baht to see if they actually work. The cards will have a 13-digit code exactly like now, be made of plastic exactly like now, contain health records such as blood group and allergies, and hold house registration and health-card details. The government estimated they would cost about 50 to 100 Thai Baht each to produce, depending on what the market will bear; the pilot project will cover about eight million people; if successful, everyone will have a smart card within three years. The government appointed Education Minister Suvit Khunkitti to run the e-Citizen card committee.

To date, magnetic ID cards have been provided to some citizens over 15-years-old in nine selected provinces: Bangkok, Chiang Mai, Phitsanulok, Chon Buri, Nakhon Pathom, Nakhon Ratchasima, Udon Thani, Songkhla and Surat Thani. The magnetic cards cannot store information but can be used with other services such as ATM machine.

BORA Director Surachai Srisarakham said government agencies would be able to select the information that would be stored. He added that the card might also be integrated with an e-signature, a driving license, job title, membership of any organizations or be used as an e-purse or e-passport in the future.[21]

BORA expects to set up a central server, separated from the central government database server, which would allow each government agency to select information to be stored in the card and update information.[22]

BORA director noted that the card would only be offered to those who ask for it. BORA will implement the ID smart card in selected provinces as a trial. There will be a 100 Thai Baht fee for the smart card to cover production expenses. One initial benefit is that the smart card could be used as an ID to access e-services of government agencies or as an e-signature with email.

In addition, the ICT Ministry expects to issue a smart card to newborn babies and students in the future. BORA forecasts that it will take at least three to five years before the smart card system is widely used.

BORA director claimed that the Thai public would be able to more easily access government services. The new smart ID card will be able to be used for any kind of government registration service. Currently, 505 district registration offices can provide an electronic registration service, covering nine provinces. The remaining 572 offices in 67 provinces were expected to be ready by the end of 2003.[23]

Once the Cabinet approves the agenda and all 572 offices are computerized, infrastructure will be completed nationwide. After that, BORA will link to other state agencies. BORA director claimed that the use of a single ID card would save costs and is more convenient for people. The public will be able to access the services via a one-stop gateway on the Web at khonthai.com.

The government is now amending existing laws so that it can offer the new services to the people. It is hoping that by using the 13-digit identification card number to apply for any service of the state agencies will eventually lead to e-Government.

BORA, meanwhile, will gradually redistribute jobs to the district government registration offices, while the BORA itself will be a center supporting those offices. District offices do not need to submit any documents to the center, rather they will have authority to issue documents themselves, such as ID cards. Also by next year, BORA will discontinue its census forms and will transfer information into the ID card itself.

The process will start in Bangkok and further eight provinces will be transferred to the electronic system, including Chiang Mai, Chonburi, Phitsanulok, Surat Thani, Songkhla, Udon Thani, Nakhon Ratchasima, and Nakhon Pathom.

However, the private sector has already voiced concerns over the privacy of personal information. The Association of Thai Computer Industry (ATCI) honorary president Manoo Ordeedolchet said that before the project is launched, the government should clearly outline what information will be stored on the card. He also stated that the information must not be used for further processing or linked to other database systems, such as healthcare or education systems, in order to protect consumers' privacy rights.[24]

Meanwhile, BORA has also developed systems that it hopes will help it to generate income. These include its database of population, investment, and so on, which can be used by businesses. It has been pointed out that BORA plans to offer those services to business by 2004. According to BORA director, the operational cost per year is around 1.3 billion Thai Baht ($29.64 million). By having businesses accessing the databases, BORA expected that 70-80 percent of the costs, or around 800 million Thai Baht ($18.24 million) would be returned in revenue. The revenue will be derived from service fees and transactions.[25]

This year BORA will set up the National Committee on Registration Administration with some 13 organizations that issue official registration documents, such as social welfare, healthcare, revenue, transportation, passports, military and education. The committee will be chaired by the Prime Minister and will comprise 24 members including the Interior Minister and selected experts.[26]

Table 2: Demographic Data of Respondents.

Characteristics	Description	Total %	Bangkok %	CM %
Location	Bangkok	48.8	--	--
	Chiang Mai	51.2	--	--
Age	15-25	20.8	19.5	22.1
	25-40	56.5	64.6	48.8
	40-60	20.8	15.9	25.6
	>60	1.8	0	3.5
Gender	Female	63.7	65.9	61.6
	Male	36.3	34.1	38.4
Education	< Bachelor	37.1	32.9	41.1
	Bachelor	47.3	52.4	42.4
	> Bachelor	15.6	14.7	16.5
Income	< 5,000	14.4	12.2	16.5
	5,001 - 10,000	29.3	35.4	23.5
	10,001 - 25,000	36.5	43.9	29.4
	25,001 - 50,000	16.2	7.3	24.7
	50,001 - 75,000	1.2	1.2	1.2
	> 75,000	2.4	0	4.7
IT Background	Have IT Background	32.3	40.2	24.7
	No IT Background	67.7	59.8	75.3
Heard about Smart Cards Before	Yes	68.5	65.9	70.9
	No	31.5	34.1	29.1
Total Response Rate	167 out of 200			83.5

Research Methodology and Settings

This study was conducted based on three types of data collection; namely, documentary research, expert interviews, and surveys. The surveys were conducted in two major cities of Thailand, Bangkok and Chiang Mai. Bangkok is the capital of Thailand and the country's largest city. Chiang Mai is a province in the northern part of Thailand and the second largest city in the country. Both locations are selected because they are among the first selected for the smart-card trials next year.

In both locations, the respondents were general consumers who were randomly selected by volunteers and asked to fill out the surveys. In total, 167 people answered

the survey making response rate of 83.5%. The demographic data of the respondents are summarized in Table 2.

Several interviews with experts in the technological and policy-making arena were also conducted over several months. Results of these in-depth interviews provide a crosscheck with the statistical results from the surveys and therefore are able to help ensure the integrity of data in this study.

It should also be noted here that although Thai people have never used the "intelligent" smart cards before, the idea of smart cards in general is not new to them. The government has promoted the ideas of pre-paid store-valued and telephone cards for quite some time already. Moreover, credit cards both in the forms of "simple" smart cards (Memory cards) and magnetic-stripe cards are being widely used in Thailand.

Results of the Study

The findings from the surveys are briefly presented in Table 3, after which descriptive findings are provided.

Table 3: Factors Affecting Respondents' Decisions to Use Smart Cards

Construct	β	S.E.	Wald	df	Significant
Security	*.446*	*.219*	*4.160*	*1*	*.041*
Convenience	*.953*	*.280*	*11.616*	*1*	*.001*
Card fees	-.183	.142	1.658	1	.198
Location	-.672	.390	2.960	1	.085
Age	*-.738*	*.333*	*4.916*	*1*	*.027*
Gender	-.241	.382	.398	1	.528
Income	.264	.224	1.391	1	.238
Have IT background	-.529	.462	1.309	1	.253
Smart card awareness	.150	.432	.120	1	.729
Education level	-.140	.303	.212	1	.645
Constant	*2.054*	*.971*	*4.475*	*1*	*.034*

Note: (1) Nagelkerk R Square value is 0.287.
      (2) Cox & Snell R Square value is 0.210.
      (3) The overall percentage of correct prediction is 72.6%.
      (4) The bolded constructs are significant at the 95% confidence level.

Hypothesis Testing

Hypothesis 1

Demographic factors (Gender, Education Level, Income, Age, IT background, Smart card awareness) have significant relationships with the decision of users to adopt smart cards.

This hypothesis was set up to test the relationship between demographic constructs and the decision of users to adopt smart cards as mentioned in past literature to analyze if the relationships sustain in the context of Thailand.

It was found that the only demographic factor that has statistically significant effects on the decision of users to adopt smart cards is the "Age" of the respondents. The β value for "Age" construct is negative meaning that younger respondents were more likely to adopt smart cards than the older age group. No other demographic factors are found to have statistically significant effects on the decision of users to adopt smart cards.

Hypothesis 2

Perceived usefulness (i.e., convenience) has significant relationships with the decision of users to adopt smart cards.

This hypothesis was set up based on the TAM literature and conceptual framework mentioned earlier. It was found that the β value for the "Convenience" construct is positive and significant. This means that Hypothesis 2 is supported. In addition, this result shows that the higher the level of usefulness of smart cards perceived; the more likely people are to use it.

It should be mentioned that the perceived ease-of-use was not measured quantitatively since the Thai government has promoted the ease-of-use of smart cards continuously so the Thai people were strongly influenced about this factor. The brief interviews with the respondents about this factor confirmed that this influence truly exists as more than 90% of the respondents do not see the easiness of using smart cards as a potential problem.

Hypothesis 3

Security concern has significant relationships with the decision of users to adopt smart cards.

This hypothesis was established in order to test the specific feature and construct unique to smart card usage, security concerns. It was found that the β value for the "Security" construct is positive and significant. So, the Hypothesis 3 was supported.

This also shows that the higher the level of security of smart cards that people perceive; the more likely they are to use it.

Discussion

On Demographic Factors

Based on the results of this study, one interesting issue that emerged with respect to smart card adoption in every respondent group is that no demographic factors, except "Age," have statistically significant effects on the users' decision to adopt smart cards.

Young respondents tend to be more open to the idea than older respondents. This finding is consistent with previous research in this area, which found that age of consumers has statistically significant effects on the decision to adopt smart cards.

It is also worth noting that across all groups, neither gender, education level, awareness of smart card concepts, nor IT background, have statistically significant effects on the decision of users to adopt smart cards. This finding is along the line of previous research in smart card adoption.

One difference from previous research which was found in this study is the fact that, in Thailand, income levels have no statistically significant effect on the decision of users to adopt smart cards. This finding may be due to the fact that the government has continuously promoted and assured Thai people that smart card fees will be low.

On Perceived Usefulness

This research presents a different result from previous studies in terms of users' perception of usefulness of smart cards. While previous studies mentioned that users in other cases give more importance to security rather than convenience and that convenience may not contribute much to the decision of users to adopt smart cards. The result of this study shows that convenience is a statistically significant factor affecting users' decision to use smart cards.

In addition to the results of the survey, researchers also solicited respondents' comments on the government's e-ID project. More than 90% of the respondents think that the e-ID will provide convenience to them, in terms of reducing the paper work and the service time, when they use government services or deal with government agencies. Thus, the statistical finding could be supported by the fact that there is a longer waiting time to receive government services in developing countries.

On Security Concerns

While previous studies recognized that security could be an important factor in the adoption of smart cards, this research is among the first ones to show empirical evidence that security concern is a statistically significant factor influencing users' decision to adopt smart cards. This finding is important because it provides useful strategic implications for the implementation of the smart card projects in the future. It also shows that regardless of the level of development a country is at, security issue should be taken into account seriously when considering the introduction of smart cards.

Conclusion and Implications

Smart card technology was first introduced in Thailand by the Thai government who planned to use the technology for the government's e-ID and e-Government projects in 2004. This situation is contrary to the introduction of smart cards by the private sector in developed countries. On the research front, this contrast provided an excellent opportunity to study the differences, if any, in factors affecting consumers' perceptions of smart card technologies.

The study shows that, statistically, no demographic factors, except age, were found to have statistically significant effects on the users' decision to use smart cards. In addition, it was found that perceived convenience and security level of smart cards are the other two statistically significant factors found to affect users' decision to adopt smart card technologies.

To date, many government agencies in Thailand are still arguing about what information and applications should be put on the e-ID smart cards. The key issue with respect to using smart cards in Thailand is not so much about which information or applications are the "right" ones to be put on the cards, but more on the matters of security, ownership management, and privacy protection of the consumers' information on the cards. This issue is very important to Thai people as shown by this study. As a result, the Thai government should put high emphasis on the security issue when planning for and implementing the smart card technologies in their e-ID and e-Government projects.

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