Comparison of the ICT Adoption Pattern: In the Case of Korea and the U.S.

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Abstract

The aim of this paper is to find out whether there is a difference in adopting and/or diffusing the information and communication technology (ICT) between countries. If there is, what are the primary factors that keep some countries from adopting and diffusing ICT while others do? To analyze the above problem, we adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) suggested by Venkatesh et al. (2003), which consists of effort expectancy, performance expectancy and social influence. We also use the innovation diffusion functions, which are known to have the S-shape and are made up of the introduction, growth, maturity and decline phases. We do not, however, consider the decline phase, because the ICT that we are considering is not believed to be in that phase. Therefore, we researched how the three factors affect adoption in the three phases. We selected the cellular phone as the ICT, because it is considered to be the most popularly used ICT and its technology has been developing rapidly. We surveyed the cellular phone adopters in Korea, and the U.S. for 15 years from 1989 to 2003. Korea, and the U.S. represent newly developed and developed countries, respectively. For the data analysis, a survival analysis was used, as it could explain the characteristics of the potential adopters or non-adopters. We found that the ICT diffusion patterns, as well as the ICT diffusion factors, of the two countries were different. Therefore, we believe that the results of our research can be used in building strategies on reducing the digital divide gaps between countries.

Key Words: innovation diffusion, digital divide

Introduction

In this paper, we want to know whether the attitudes and perceptions of newly developed countries are different from those of developed countries, whether those differences, if there are any, delay the adoption of new ICT, and what the critical factors are when it comes to adopting new ICT in newly developed countries.

In order to answer the above questions, we researched the following. First, we compared the time series data of ICT adoption in order to analyze the pattern of the ICT adoption, and found that it was different. Secondly, we studied the factors that differentiate the ICT adoption patterns. We used the UTAUT model consisting of the effort expectancy, performance expectancy and social influences based upon previous research in the field (Venkatesh et al., 2003). The research Framework is summarized in Figure 1.

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Figure 1
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Research Review

At the initial stage of research, researchers focused primarily on developing theories about the adoption of innovations by individuals (Agarwal, 2000). But what they found was that simple theories and frameworks did not fit well in the complex real-world of organizational diffusion. Therefore, they began to think that ICT diffusion should be considered differently at the individual level and the organizational level. The organizational level includes all unit levels. Researchers tried to find the critical factors for ICT adoption and found that the critical factors for organizations were completely different from those for individuals. TAM and DOI theory models both applied most readily to situations where the individual user could voluntarily decide whether or not to adopt an innovation. DOI theory identifies five perceived attributes of an innovation as influencing the adoption behavior: relative advantage,

complexity, compatibility, trialability, and observability. In contrast, TAM was created specifically to explain IT adoption, and it posits just two perceived attributes that influence adoption: usefulness and ease-of-use.

Similar research was done by Prescott and Conger (1995). Based on Swanson's model, they classified ICT into IS unit locus of impact such as CASE tools and DBMS; intra-organization locus of impact, such as Distributed DBMS document imaging system, spreadsheets, joint application design (JAD), and information center; and inter-organization locus of impact, such as EDI. For each type, they did a factor research (individual level and organizational level) and stage research (longitudinal, repeated measure). Venkatesh et al. (2003) suggested a unified model, UTAUT consisting of effort expectancy, performance expectancy and social influence and facilitating conditions.

Research Model and Hypotheses
Research Model
Venkatesh et al. (2003) suggested the United Theory of Acceptance and Use of Technology (UTAUT), which combined the most popularly used eight ICT adoption models. These adoption models are the theory of reasoned action, the technology acceptance model, the motivational model, the theory of planned behavior, a model combining the technology acceptance model and the theory of planned behavior, the model of PC utilization, the innovation diffusion theory, and the social cognitive theory. The model consists of performance expectancy, effort expectancy, social influence and facilitating conditions. Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance. Effort expectancy is defined as the degree of ease associated with the use of the system. Social inference is defined as the degree to which an individual perceives the importance of whether or not a person of a certain status should use the new system. Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. However, facilitating conditions do not apply when analyzing countries because of their different cultures; therefore we deleted the factor from our research model.

Hypotheses
Hypothesis for Diffusion Pattern
We define ICT acceptance as the monent the individual purchased the cellular phone for the first

time. To test the ICT diffusion pattern, we tested the following hypothesis.

H1: The ICT adoption curve is the same according to country.

Hypothesis for Effort Expectancy
To test the diffusion effects, we tested three factors: effort expectancy, performance expectancy, and social influences. The above three effects were tested based on country and phases. For each factor, we tested the proposed measurement. To find out the effort expectancy, we hypothesized that the variety of functions of the cellular telephone affects the adoption rate in each phase differently depending on the country.

H2-1(a): The complexity of functions of cellular phones affects the introductory phase of adoption differently depending on the type of country.
H2-1(b): The complexity of functions of cellular phones affects the growth phase of adoption differently depending on the type of country.
H2-1 (c): The complexity of functions of cellular phones affects the maturity phase of adoption differently depending on the type of country.

To find out the effort expectancy, we hypothesized that the effects of the quality of the cellular telephone affects the adoption rate in each phase differently depending on the country.

H2-2(a): Quality of cellular phones affects the introductory phase of adoption differently depending on the type of country.
H2-2(b): Quality of cellular phones affects the growth phase of adoption differently depending on the type of country.
H2-2 (c): Quality of cellular phones affects the maturity phase of adoption differently depending on the type of country.

To find out the effort expectancy, we hypothesized that the effects of the perceived ease of use of the cellular telephone affects the adoption rate in each phase differently depending on the country.

H2-3(a): Perceived ease of use of cellular phones affects the introductory phase of adoption differently depending on the type of country.
H2-3(b): Perceived ease of use of cellular phones affects the growth phase of adoption differently depending on the type of country.
H2-3 (c): Perceived use of cellular phones affects the

maturity phase of adoption differently depending on the type of country.

Hypothesis for Performance Expectancy
To find out the performance expectancy, we hypothesized that extrinsic motivation of using the cellular telephone affects the adoption rate in each phase differently depending on the country.

H3-1(a): The extrinsic motivation of using cellular phones affects the introductory phase of adoption differently depending on the type of country.
H3-1(b): The extrinsic motivation of using cellular phones affects the growth phase of adoption differently depending on the type of country.
H3-1 (c): The extrinsic motivation of using cellular phones affects the maturity phase of adoption differently depending on the type of country.

To find out the performance expectancy, we hypothesized that the effects of the perceived usefulness of the cellular telephone affects the adoption rate in each phase differently depending the country.

H3-2(a): The perceived usefulness of cellular phones affects the introductory phase of adoption differently depending on the type of country.
H3-2(b): The perceived usefulness of cellular phones affects the growth phase of adoption differently depending on the type of country.
H3-2 (c): The perceived usefulness of cellular phones affects the maturity phase of adoption differently depending on the type of country.

To find out the performance expectancy, we hypothesized that the effects of the job-fit of the cellular telephone affects the adoption rate in each phase differently depending on the country.

H3-3(a): The job-fit of cellular phones affects the introductory phase of adoption differently depending on the type of country.
H3-3(b): The job-fit of cellular phones affects the growth phase of adoption differently depending on the type of country.
H3-3 (c): The job-fit of cellular phones affects the maturity phase of adoption differently depending on the type of country.

Hypothesis for Social Influence

To find out more about social influences, we hypothesized that the effects of the word of mouth

of the cellular telephone affects the adoption rate in each phase differently depending on the country.

H4-1(a): Word of mouth on cellular phones affects the introductory phase of adoption differently depending on the type of country.
H4-1(b): Word of mouth on cellular phones affects the growth phase of adoption differently depending on the type of country.
H4-1 (c): Word of mouth on cellular phones affects the maturity phase of adoption differently depending on the type of country.

To find out social influences, we hypothesized that the social factors of cellular telephone possession affects the adoption rate in each phase differently depending on the country.

H4-2(a): The social factors on using cellular phones affect the introductory phase of adoption differently depending on the type of country.
H4-2(b): The social factors on using cellular phones affect the growth phase of adoption differently depending on the type of country.
H4-2 (c): The social factors on using cellular phones affect the maturity phase of adoption differently depending on the type of country.

To find out social influences, we hypothesized that the effects of the subjective norm of cellular telephone possession affects the adoption rate in each phase differently depending on the country. Subjective norm is defined as the perceived pressure to perform or not to perform the behavior (Ajzen, 1991).

H4-3(a): The subjective norm of cellular phones affects the introductory phase of adoption differently depending on the type of country.
H4-3(b): The subjective norm of cellular phones affects the growth phase of adoption differently depending on the type of country.
H4-3 (c): The subjective norm of cellular phones affects the maturity phase of adoption differently depending on the type of country.

Research Method
Data Collection
The survey instrument was first pilot tested by experts and modified questionnaires were mailed to 1000 individuals. In Korea, out of 1000 mailed questionnaires, 516 were returned, a 51.6% response rate. Three responses were unusable because of accuracy issues. Out of the 513 responses, 480

showed ownership of cellular phones and 33 did not. In the U.S., out of 1000 questionnaires mailed, 188 were returned, an 18.8 % response rate. One response was excluded because of accuracy issues. Out of 187, 165 responses showed ownership of cellular phones and 22 did not.

The adoption period is classified into the introduction, growth and maturity phase. The innovation diffusion cumulative curve has an expended S-shape curve, therefore, in an introduction phase, the increase rate will continuously decrease. Also, in the beginning of the growth phase, the rate will continue to increase until the end of the growth phase. In the beginning of the maturity phase, the adoption rate will abruptly decrease.

In the case of Korea, the introduction phase occurred from 1989 to the fourth quarter of 1997 with 65 sample data for nine years. The growth phase occurred from the first quarter of 1998 to the second quarter of 2000, with 307 sample data for two and a quarter years. The maturity phase occurred from the third quarter of 2000 to the first quarter of 2003, with 108 sample data for three years.

In the case of the U.S., the introduction phase occurred from the second quarter of 1992 to the fourth quarter of 1997, with 33 sample data for nine years. The growth phase occurred from the first quarter of 1998 to the second quarter of 2000, with 79 sample data for two and a quarter years. Lastly, the maturity phase occurred from the third quarter of 2000 to the first quarter of 2003 with 53 sample data for two and three quarter years.

Research Methods
Data Analysis
For reliability, Cronbach's alpha test was done, and the results are summarized in Table 7.

For Korea's data, all alpha coefficients were higher than the suggested value of 0.7 (Hair et al., 1998) except the instrument "pressure of advertisement." For U.S. data, all alpha coefficients were higher than the suggested value of 0.7.

Analysis Method
The survival analysis was used to compare the adoption rates of the countries. We used this method for the following two reasons. One is that the responses of non-adopters, as well as adopters, can be analyzed and the other is that the responses of each country, as well as the comparisons of the countries, can be obtained by this method. For Korea, the number of the uncensored subjects was 33 and the number of the censored was 480. For the U.S., the number of the uncensored subjects was 22 and the number of the censored was 165. The uncensored

data were classified as introduction, growth and maturity.

In order to compare each phase, we did the following. First, we assumed the data were censored at the end of the introduction phase, and the introduction group and non-introduction group were compared. Second, we deleted the data of the introduction phase, assumed the data were censored at the end of the growth phase, and the data of the growth phase and non-growth phase were compared. Third, we deleted the data of introduction and growth phases, and the data of the maturity phase and non-adopters were compared. The same procedures were repeated for each country.

Hypotheses Testing
Hypothesis 1 is rejected. This means that the pattern of ICT adoption is different in each country at the significance level of 0.05 (Table 1). The portions of adopters are 13.5% in Korea and 20.5 % in the U.S., for the beginning of the growth phase. However, the number of adopters increased by 472% in Korea, and 239% in the U.S., during the growth phase.

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Table 1

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The results of hypothesis 2-1(a) mean that in the U.S., introductory and growth adopters consider a variety of functions of telephones to be important, although not in the maturity phase. Adopters in Korea do not care as much as well.

The results of hypothesis 2-2(a) mean that in the U.S., introductory and growth adopters consider the quality of telephones to be important, although not in the maturity phase. In Korea, introductory and growth adopters consider quality important, but maturity adopters do not appear to care as much.

The results of hypothesis 2-3(a) mean that in the U.S., introductory and maturity adopters consider the quality for telephones to be important, although not in the growth phase. In Korea, adopters do not appear to care as much as well.

The results of Hypothesis 2 may be interpreted that the introductory adopters of the U.S. consider the quality of ICT to be more important than other effects, but the adopters of the introductory phase in Korea did not. The adopters in Korea, do not care about function. It can be assumed that such a property is the main source that allows Korea to be such an ICT-developed country.

The results of hypothesis 3-1(a) mean that in the U.S., introductory and growth adopters consider the extrinsic motivation of telephones to be important, but not in the maturity phase. In Korea, introductory

adopters consider extrinsic motivation to be important, but this matters little to growth and maturity adopters. The results of hypothesis 3-2(a) mean that in the U.S., introductory and growth adopters consider the perceived usefulness of telephones as not important, except in the maturity phase. In Korea, introductory adopters consider the perceived usefulness to be important, but growth and maturity adopters do not necessary agree.

The results of hypothesis 3-3(a) mean that in the U.S., only adopters of the maturity phase consider the job-fit of telephones to be important. In Korea, introductory adopters consider job-fit to be important but adopters of the growth and maturity do not.

The results of hypothesis 3 may be interpreted that the adopters of the introductory phase considered the performance expectancy to be more important than other effects for adoption. But, as the adoption phase proceeded, the idea of the job-fit of adopters became weaker in newly developed and developed countries.

The results of hypothesis 4-1(a) mean that in the U.S., word of mouth is not important for any phases. In Korea, introductory adopters consider word of mouth to be important, but growth and maturity adopters do not. This result can be interpreted as the following; The adopters of newly developed countries do not care for the opinions of others from the beginning.

The results of hypothesis 4-2(a) mean that in the U.S., social pressure is important only in the growth phase. In Korea, introductory adopters consider social pressure to be important, but growth and maturity adopters do not. This result can be interpreted as the following: Social pressure is important during the introductory phase in newly developed countries and in the growth phase for developed countries.

The results of hypothesis 4-3(a) mean that in the U.S., subjective norm is not important in any phase. In Korea, introductory adopters consider that subjective norm is important, but growth and maturity adopters do not. This result can be interpreted as the following. The adopters of newly developed country do not care about the judgment of others from the beginning and can be considered pragmatic.

The results of hypothesis 4 may be interpreted that the adopters of the introductory phase think social influence is more important than any other criteria for adoption. But, as the adoption phase proceeds, the idea of social influences affecting adopters become weaker for both countries. The results of the hypotheses are summarized in Table 2.

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Table 2

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Conclusion

The results of this study shed interesting light on ICT adoption. We found that the patterns of ICT adoptions are different according to country.

We found factors that differentiate the ICT adoption pattern. First, the adopters in Korea seem to be rash in adopting new ICT and this may be a positive influence in the development of the ICT industry. The critical factors of Korean adopters are performance expectancy and social influences. For them, effort expectancy seems to be less important. Furthermore, performance expectancy and social influences disappeared for adopters in the growth and maturity phases. It can be interpreted that for Korean adopters, the quality expectation is not high. It seems that they do not seriously consider the quality of technology.

The second finding is that the initial adoption time of the two countries is similar. It means there is no time gap in the introduction of new ICT among countries. We can infer the following fact from this phenomenon: the digital divide can by caused not by diffusion of ICT among countries but by the internal environments. This is meaningful, because finding the cause is useful in reducing the digital divide gap. The third find is that the adopters of developed countries are very reasonable and consistent. They consider all facets of diffusion effects in the introduction and the growth phases. One remarkable phenomenon is that they do not consider technology factors in the maturity phase. We deduct the reason for this is that they assume the technology is trustworthy, because many people already use ICT products.

The limitations of this research are as follows. First, Korea suffered the Asian financial crisis, and the adoption pattern seems to have been affected by this. Second, only one country represents each category. For future research, analysis of other newly developed countries is needed. However, we believe the results of this research can be used in building strategies of ICT adoption on a macro level.

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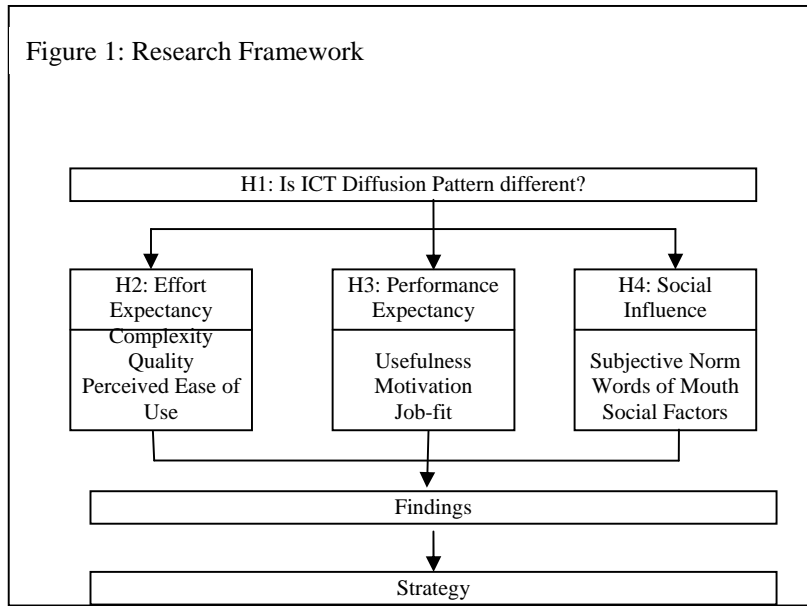< References can be provided upon request>

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Figure 1: Research Framework

Table 1: Comparison of ICT Diffusion Pattern

Countries	Wald. value	Significance	Results
Korea v.s. U.S.	4.153	0.04	different

Table 2: Results of Analysis

Category	Sub-Category	Factors	Instruments	Findings (South Korea)			Findings (U.S.)		
				Intro.	Growth	Maturity	Intro.	Growth	Maturity
Diffusion Effects	Effort Expectancy	Complexity	Variety of Functions	No	No	No	Yes	Yes	No
		Quality	Security, Speed, Sound	No	No	No	Yes	Yes	No
		PEOU	Easy to Use	No	No	No	Yes	No	No
	Performance Expectancy	Extrinsic Motivation	Better Life	Yes	No	No	yes	Yes	No
		Perceived Usefulness	Increase Income	Yes	No	No	No	No	Yes
		Job-Fit	Reduce Job Load	Yes	No	No	Yes	Yes	No
	Social Influence	Word of Mouth	Pressure from Neighbors	Yes	No	No	No	No	No
		Social Factors	Pressure from Advertisement	Yes	No	No	No	Yes	No
		Subjective Norm	Percentage of Neighbors	Yes	No	No	No	No	No