

A Study on the Factors Affecting Smart Phone Application Acceptance

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Abstract. In this study, to analyze the factors affecting the use of smartphone applications, research model based on UTAUT (Unified Theory of Acceptance) model was hypothesized and empirically tested. Credibility and personalization were set as factors affecting performance expectancy, and flow was added as an antecedent of usage intention. Also, strategic implications are drawn by categorizing smartphone app as two types of practical app and entertainment app and then by testing the difference between the characteristics of two types. Survey was conducted with 215 persons who has experience in using smartphone including college students and office workers. The result showed that personalization has positive effect on performance expectancy, and performance expectancy and effort expectancy have positive effect on usage intention, use behavior, and recommendation intention. Also, the factors affecting usage intention and use behavior of smartphone app were found to be different between two types of applications. Therefore, it is expected that research findings would provide strategic implications to apps developers, mobile telecom providers, and related enterprises.

Keywords: Smartphone application, Trust, Personalization, Flow, UTAUT, Usage intention

1. Introduction

There has been increasing number of people who pursue new life style of working, communicating, and playing games through smartphone[1] to the extent of emerging consumer group who “starts a day with smartphone and wraps up with smartphone” [2].

During the period from Feb. 2010 to Feb. 2011, on an average around 20,000 applications were registered in Appstore, USA[3] and 18,000 application were registered in Android Market during same period[4].

As smartphone app business is growing rapidly, many studies about Appstore platform or apps development have been conducted. However, despite of agent need, the research about factors affecting choosing and purchasing application by Smartphone users has not conducted yet.

Therefore, in this study, we investigated how major features of Smartphone application affect the acceptance of Smartphone application by users. The questions to be drawn in this study were as follows;

Question1. What makes smartphone users continuously use a certain app?

Question2. Is there any difference in user’s usage intention by per different Smartphone app types? If so, How does it differently represent the causal patterns in Question1?

2. Theoretical Background

2.1. Smartphone Applications

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Application is an abbreviated form of application program. Application program refers designed program to perform specific function towards users or other application program [5]. Mobile application means application program which is being used in mobile phone under mobile environment or is being materialized in portable personal digital assistant (PDA), and smartphone application refers as program which has been designed to be operated in smartphone and it can be installed by downloading in specific application sales outlet.

As mobile contents making environments constituted where anyone can develop application freely, the number of application registration case has been abruptly increased that accumulated registration case in Appstore in Apple increased from around 50,000 cases in Mar. 2009 to accumulated registration case 260,000 during Sept. 2010 with increases rate around 20 times. The number of accumulated registration case in Google Android Market also increased from around 4,900 cases during Mar. 2009 to the figure 98,000 cases during Sept. 2010 with increase rate around 20 times.

Also, app is a concept which continuously being changed and evolved. By now, app meant application program which has loaded in Appstore in Apple or Google Android Market. However, now apps is being extended well above smartphone, until to a range of substitutes with tablet, and further even with web.

As application field is being extended and becomes a core in business, these factors have been acting as key deciding factors while purchasing smartphone[6].

2.2. UTAUT : Unified Theory of Acceptance and Use of Technology

The research field which attracts the most attention among information technology related research can be use and adoption of new information technology. In existing technology acceptance studies, the variables related with human attitude or intention which have been handled in social psychology field are adopted, the representative research related with technology acceptance would be TRA(theory of reasoned action), TAM(technology acceptance model), and TPB(theory of planned behavior) [7,8,9].

However, there is limit in TAM enough not to support justification about various exogenous variables and relationship between variables, thus in most of research, either model has been modified as per the subjected technology or environment or only some of variables were utilized.

Venkatesh *et al.*[10] have proposed 'Unified Theory of Acceptance and Use of Technology(UTAUT)' model by integrating each factors which have been used in 8 models of earlier research about acceptance of information technology, and have recommended 3 constructs concepts which directly affected usage intention, 1 construct concept which directly affected on use, and model which integrates earlier research with 4(four) key constructs. When UTAUT has been implemented in the data same as existing model, it performed well with adjusted R^2 value 69%, where as when it was implemented in new system construction, it showed 70%(adjusted R^2) of explanatory power. This can be understood as UTAUT has been improved significantly as compared with those existing models showing explanatory power 40% in technology acceptance intention, thus it can be a model with improvement in existing limit as a more developed form.

2.3. Credibility

When we look at existing research about credibility, in the research about e-commerce during initial stage, privacy, security, and credibility have been proposed as major factors [11]. Hoffman *et al.*[11] have proposed that the most important element to have success by web merchant is to create trust with consumers by providing faith about protection of personal information and security since cyberconsumers feel they lack control over the access that web merchants have to their personal information during the online navigation process. They have asserted that for the expansion of web purchasing by consumers, securing from consumers is most essential while providing survey result in the form of questionnaire saying that the major reason why online purchase tendencies are being decreased and show unwillingness in web purchasing is that web consumer has fear in resell their personal information to other businesses and has more interest in their personal information protection. Dahlberg *et al.* [12] has studied about use of mobile payment system after adding trust concept and proposed that trust tendency affects on perceived trust, perceived usefulness and also affected on perceived usefulness. Wang *et al.*[13] has proved that in mobile service usage intention,

other than perceived usefulness and perceived ease of use, self-efficacy, perceived resources, and perceived credibility affected directly.

Like this, since smartphone app performs transaction between seller and purchaser in imaginary space just like e-commerce, with different characteristic from transaction through physical channel in offline, it has been reported that serious problems of transaction safety or leaking of personal information are prevail, thus credibility can be an important factor in opting e-transaction by consumers.

2.4. Personalization

Personalization means a degree of providing customized product, service, and information to satisfy individual needs. This implies the transformation into one-to-one marketing era during which specified product and service are provided to each individual getting out of mass marketing era when same product and services were provided to all the consumers alike. W. Hanson[14] has referred as saying “personalization is a special form of product differentiation”. As per Song Chang-Seok *et al.*[15], personalization belongs to direct interaction mode between consumers and enterprises. That means, personalization implies interaction towards both directions between enterprise and individual consumer, and enterprises understand individual consumer’s desire through participating in actual marketing process, and provide customized service, information etc. accordingly.

As has seen from the above facts, contents and services are being developed as transformed form of individually customized service.

2.5. Flow

Csikszentmihalyi[16] has introduced concept “flow” for the first time and defined it as “holistic response or optimal state of experience in human being which is felt during acting under completely observed state”. He explained that since awareness of human being becomes narrower under flow condition, unrelated perception or thinking are filtered and one would be more immersed in that specific activity. Zinkhan[17] has emphasized that flow is the most important variable related with user not only in research about internet advertisement but also in future advertisement research, and Jang, Jung-Mu *et al.*[18] has verified acceptance of service by adding flow variable in usefulness and ease of use which are variables in Technology Acceptance Model(TAM) through research about factors affecting acceptance of wireless internet service.

In this study, flow concept was introduced because continuous use of smartphone app service as interactive media such as web is closely related with flow experience, and flow has been a very important concept in understanding users of smartphone app who has to decide, search, and purchase alone in most of the situations.

3. Research Model and Hypotheses

In this study, research model and hypothesis were set to analyze usage intention and the effect on use per different app types of smartphone.

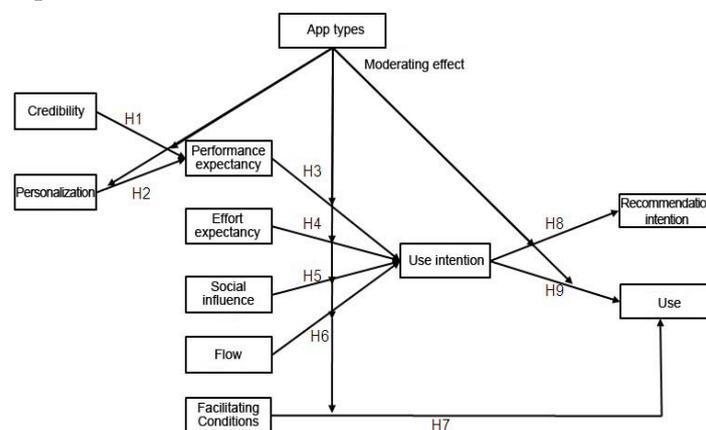


Fig. 1: Research Model

4. Research Method

4.1. Operational definition of variable

The operational definitions for the variables used in this study are as seen in Table 1.

Table. 1: Operational Definitions

Factor	Operational Definitions	Reference
Credibility	The degree of trust by users for the capability and security which enterprises can perform services which are promised with consumer.	[13, 19, 20]
Personalization	The degree of customized product, information, and service provision as per the requirements by users.	[21, 22]
Performance expectancy	The degree of belief by users to get help in improving work performance by using smartphone app service.	[8, 10, 23, 24, 25]
Effort expectancy	The degree of usefulness feeling by user while using smartphone apps service.	[8, 10, 23, 26]
Social influence	The perception degree of user that important person near him should use smartphone app.	[8, 9, 10, 23, 24, 27]
Flow	The degree of feeling fun and immersed while using smartphone apps.	[11, 18]
Facilitating conditions	The degree of belief by users that organizational or technological bases to support use of smartphone apps are existed.	[9, 10, 23, 24]
Usage intention	The intention of continuous and regular use of smartphone app in future.	[8, 9, 10]
Recommendation intention	The degree of recommendation willingness of smartphone app which is being used by user himself.	[28, 29]
App type	As per the service type of app, it is classified as practical apps and entertainment apps.	[8, 9, 10, 30]

4.2. Characteristics of Sample

During the course of study, samples were extracted targeting college students, graduate school students, and office goers who are currently using smartphone. Questionnaires were prepared through online during the period of 2 weeks starting from third week in the month of May 2011 and materials collection was carried out by receiving questionnaire through corresponding link, and then total 215 copies of questionnaires have been utilized for analysis.

The gender composition of respondents was similar in male and female both with figure 48.4% and 51.6% respectively, in regards with age group, the largest numbers were in their 20s with 65.6%, in 30s 31.6%, and 1.4% occupation were both age groups below 20 as well as in their 40s respectively. Academic qualification showed in the order of 67.4% as university graduate, lower than high school graduate 67.4%, diploma holder 9.3%, and post graduate 7.4%. As per the occupation of respondents, the highest was office goers with figure 7.1% followed by students 25.1%, others 2.8%, and housewife 0.5%. The voice communication duration with smartphone was highest in below 1 hour with figure 50.7%, 26% in below 1-2 hrs., 14.4% in below 2-4 hrs, 8.4% in below 4-10 hrs., and longer than 10 hrs. was 0.5%. Data use duration with smartphone was in the order of below 1-2 hrs. with value 31.6%, below 2-4 hrs. 27%, below 4-10 hrs. 17.2%, and longer than 10 hrs. 8.4%. The use duration of smartphone app by respondents were highest in 1-6 month with figure 71%, 6-12 months 28.8%, longer than 1 year 20%, and within one month 18.1%. Smart phone OS was found to be Android 50.7%, Apple 47.9%, Windows Mobile 0.9%, and others 0.5%.

5. Research Findings

5.1. Reliability and Validity Analysis

In this study, by using PLS, reliability analysis, internal consistency analysis, and discriminant validity analysis were carried out, and reliability and validity in PLS were evaluated by factor loadings, AVE(average variance extracted), and CR(composite reliability) factors confirmatory factor analysis(CFA) in PLS[31]. Generally, if factor loadings and AVE are higher than 0.5 and CR is higher than 0.7, it can be regarded that internal consistency and convergence validity are secured[32].

Among total 33 individual questions, two questions (social influences 2, condition for promotion 3) whose factor loading values not exceeding 0.6 were rejected, and the factor loading values of rest 31

questions were somewhere in between 0.63~0.962, all are fairly higher than 0.6, therefore it can be regarded that measurement tool is well explanatory about potential variables.

In PLS, to find out whether discriminant validity is appropriate, Average Variance Extracted (AVE) which has been proposed by Fornell and Larcker[33] was used. From Table 2, square root of AVE shows higher than 0.6 and it is also higher than other correlation coefficients, discriminant validity between composition concepts in this study could be verified.

Table 2: Analysis result of Correlation coefficient, reliability, and discriminant validity for Variables.

	Mean	S.D	CR	Credibility	Personalization	Performance expectancy	Effort expectancy	Social influence	Flow	Facilitating conditions	Use Intention	Recommendation intention	Use
Credibility	4.71	1.34	0.882	0.808									
Personalization	4.31	1.58	0.837	0.573	0.797								
Performance expectancy	5.77	1.14	0.901	0.482	0.378	0.834							
Effort expectancy	5.86	1.08	0.9	0.385	0.195	0.674	0.832						
Social influence	5.1	1.65	0.844	0.242	0.277	0.412	0.381	0.856					
Flow	4.92	1.57	0.916	0.234	0.328	0.199	0.215	0.356	0.885				
Facilitating conditions	4.51	1.48	0.858	0.515	0.617	0.347	0.268	0.426	0.395	0.819			
Usage intention	6.25	0.94	0.972	0.313	0.184	0.595	0.548	0.36	0.242	0.228	0.959		
Recommendation intention	5.95	0.99	0.934	0.381	0.283	0.518	0.472	0.39	0.333	0.325	0.703	0.908	
Use	6.18	0.99	0.9	0.283	0.158	0.507	0.501	0.36	0.328	0.222	0.713	0.693	0.904
AVE				0.653	0.636	0.695	0.693	0.732	0.783	0.67	0.92	0.825	0.818

5.2. Path analysis and Hypothesis test

To test statistical significance of hypothesis about each variable through path analysis, Bootstrap analysis was carried out. In PLS, without separately proposing model fitness, R² values of endogenous variables were used[31, 34]. In case of two-sided test, t value which becomes criteria in deciding significance becomes 1.96 at significance level 5% [35]. In this study, two-sided test was carried out. Endogenous variable R² in this study was Performance improvement expectancy 0.248, usage intention 0.409, Recommendation intention 0.495, and use 0.512 all exceeded base line 0.1[36]. Model test showed that path coefficient between 10 parameters were 0.08~0.703, t value 1.05~15.801, thus hypothesis excluding H5, H6, and H7 were adopted with significant levels and hypothesis test result of research model is tabulated in Table 3.

Table 3: Test result of research hypothesis

	Path	Path coefficient	t-value	p-value	Result	Significant level
H1	Credibility → Performance expectancy	0.394	5.579	0	Support	***
H2	Personalization → Performance expectancy	0.153	2.342	0.02	Support	*
H3	Performance expectancy → Usage intention	0.383	4.84	0	Support	***
H4	Effort expectancy → Usage intention	0.241	3.245	0.001	Support	**
H5	Social influence → Usage intention	0.08	1.26	0.209	Reject	-
H6	Flow → Usage intention	0.085	1.619	0.107	Reject	-
H7	Facilitating conditions → Use	0.062	1.05	0.295	Reject	-
H8	Usage intention → Recommendation intention	0.703	15.081	0	Support	***
H9	Usage intention → Use	0.699	13.602	0	Support	***

5.3. Difference test of Path coefficient between groups

In this study, group wise difference of path coefficient using Chin[37]'s formula for the comparison of effect on the usage intention of smartphone app by classifying group into a group who are using practical app and a group using entertainment app was analyzed. Comparison analysis result of Path coefficient per different apps type is shown in Table 4.

Table 4: Comparison analysis result of Path coefficient per different apps type

Path	Measurement item	Practical App	Entertainment App	Result
Credibility → Performance expectancy	Path coefficient	0.412***	0.373***	Practical App > Entertainment App
	Standard error	0.100	0.097	
	Sample size	83	132	
	t	2.798		
Personalization → Performance expectancy	Path coefficient	0.253**	0.090	Practical App > Entertainment App
	Standard error	0.092	0.091	
	Sample size	83	132	
	t	12.795		
Performance expectancy → Usage intention	Path coefficient	0.512**	0.376***	Practical App > Entertainment App
	Standard error	0.164	0.093	
	Sample size	83	132	
	t	7.810		
Effort expectancy → Usage intention	Path coefficient	0.097	0.302**	Practical App < Entertainment App
	Standard error	0.142	0.089	
	Sample size	83	132	
	t	-13.057		
Social influence → Usage intention	Path coefficient	0.171+	-0.059	Practical App > Entertainment App
	Standard error	0.100	0.070	
	Sample size	83	132	
	t	19.808		
Flow → Usage intention	Path coefficient	0.022	0.142*	Practical App < Entertainment App
	Standard error	0.069	0.069	
	Sample size	83	132	
	t	-12.423		
Facilitating condition → Use	Path coefficient	-0.075	0.132	Practical App < Entertainment App
	Standard error	0.069	0.089	
	Sample size	83	132	
	t	-17.965		
Usage intention → Recommendation intention	Path coefficient	0.766***	0.657***	Practical App > Entertainment App
	Standard error	0.066	0.062	
	Sample size	83	132	
	t	12.223		
Usage intention → Use	Path coefficient	0.873***	0.593***	Practical App > Entertainment App
	Standard error	0.053	0.065	
	Sample size	83	132	
	t	32.865		

6. Conclusion

In this study, the factors which affect usage intention of smartphone apps with Smart phone apps users by adding the variables of credibility, personalization, flow, and recommendation intention on UTAUT model, and difference of factors which affect use intension from two groups i.e., practical apps users and entertainment apps users were compared. The key results are summarized as below;

First, in this study, it has been proposed that the factors affecting usage intention, recommendation intention, and use of smartphone service were 7 levels of credibility, personalization, performance expectancy, social influence, flow, and promotion condition. The survey was conducted with all the age groups who have experienced smartphone. The survey subject were mainly constituted with 20-30s age group, the academic qualification of respondents were the highest in college graduate 67.4%, and the largest numbers in occupation was found as 71.6%. apps use duration of 6-12 months was the highest and Android and iOS were occupied highest in Smart phone OS. Weekly average voice communication duration was found as 50% in below 1 hr. and average data use duration a week was highest in 1-2 hrs.

Second, analysis result showed that performance expectancy and effort expectancy about smartphone apps among major variables in UTAUT model affected significantly on usage intention and usage intention also affected significantly on use. However, the hypothesis that social effect would affect usage intention significantly and promotion condition would affect smartphone use were rejected, thus it can be interpreted that since smartphone itself is being used for very personal matters, the possibility of choosing and using apps is high led by personal motivation than influenced by others. Also, because apps has many different varieties and the use purposes are also different with types, it would be difficult to draw conclusion that some variables affect usage intention via integrated analysis with only one model. As per promotion condition, it can be interpreted that support and education for the operation or understanding the app use are not required because display construction of smartphone apps is considerably intuitive and simple. For the newly added variables, it has been verified that credibility on Smart phone apps, perception degree about personalization significantly affected on performance expectancy, and it has been found that usage intention also affected

significantly on recommendation intension. For the credibility and personalization, since smartphone can be used in personal work in various aspects from information search, e-mail check up to mobile banking, it means that personal information or security issues become important in using apps, and whether service can be provided as per user's needs is being recognized as important influential factor. However, the hypothesis that flow would affect usage intention was rejected, the reason being use motivation and purpose as per different apps types are different, thereby integrally measuring various apps which have different objects could not lead in obtaining significant result.

The research result as per apps type, it has been found that the users who are using practical apps have high perception degree that it would affect performance expectancy and they believe that personalization of apps would affect performance achievement. Further, practical apps users had high intention and plan to use apps with performance achievement expectancy, and had high personal perception degree that others who are important for them should use apps. Lastly, recommendation intention was found as high when practical apps users had usage intention, and this usage intention is highly likely connected to actual use.

This study also has limitations as below;

First, Smart phone apps can be classified as at least 4 types as per its use purpose and characteristics, that is, Productivity, Entertainment, Information, and SNS, but it has been classified as just 2 types of practical characteristics and entertainment characteristics in this study, it is required to conduct follow up more detailed research about each apps type.

Second, due to limit in sample extraction method, convenience sampling method was adopted, so the result from this study cannot be generalized. Besides, most of respondents are age group of 20, 30s, the age group has not been distributed with different age groups, ultimately age wise comparison analysis could not be carried out. Therefore, range of sampling group via succeeding studies has to be extended.

7. Reference

- [1] Jung-Tae Kim. informatization essay: The readiness and prospect of 2009 IT industry. *Journal of Local Informatization*. 2009, 54: 84-91.
- [2] Gideok Kwon, Taeyun Im, Useok Choi, Seongbae Park, and Donghyeon Oh. The future of smartphone is leading. *Samsung Economic Research Institute, CEO information*. 2010, 741.
- [3] <http://www.148apps.biz>
- [4] <http://www.androlib.com>
- [5] Jae Seok Park, Pilgu Han, and Byeong Gu Kang. A study on the acceptance for mobile applications(App Store). *The Korea Society of Management information Systems*. 2009, 160-164.
- [6] Nam-Gon Choi. Smartphone, Communication and Wireless Internet. *Tongyang Securities Inc*. 2010.
- [7] Fishbein and azjen. Belief, attitude, intention, and behavior: An introduction to theory and research, *Addison-Wesley Pub*. 1975.
- [8] Gefen, D. Karahanna, E., and Straub, D. W. Trust and TAM in Online Shopping: An Integrated Model. *MIS Quarterly*, 2003, 27(1): 51-90.
- [9] Ajzen, I. The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*. 1991, 50(2): 179-211.
- [10] Venkatesh, V. Morris, M. G. Davis, G. B., and Davis, F. D. User Acceptance of Information Technology: toward a Unified View. *MIS Quarterly*, 2003, 27(3): 425-478.
- [11] Hoffman, D. L. Novak, T. P., and Peralta, M. Building Consumer Trust Online. *Communications of the ACM*, 1999, 42(4): 80-85.
- [12] Dahlberg, T. N. M., and A. Oorni. Trust Enhanced Technoloty Acceptance Model - Consuer Acceptance of Mobile Payment Solutions. *in Presentation at Stockholm Mobility Roundtable, Stockholm, Sweden*. 2003, May: 22-23.
- [13] Wang, Y. S. H. H. Lin, P. Luarn. Predicting Consumer Intention to Use Mobile Service. *Information Systems Journal*. 2006, 16(2): 157-179.
- [14] Ward Hanson. The principles of Internet Marketing. *South-Western College Publishing*. 2000.

- [15] Chang Seok Song, and Jong Chil Shin. Building Interactivity on the Internet. *Marketing Research*. 1999, 14 (3): 69-95.
- [16] Mihaly Csikszentmihalyi. Finding Flow: The Psychology of Engagement with Everyday Life. *Basic Books*. 1997.
- [17] Zinkhan, George M. Trends in advertising and advertising research: Consumer, behavior, technology, and strategy. *The Korean Journal of Advertising*. 1998, 9 (3): 141-159.
- [18] Chung-Moo Chang, Jonguk Kim, and Tae Ung Kim. Factors Influencing Mobile Internet Service Acceptance: Extension of Technology Acceptance Model Using The Flow Theory. *Asia Pacific Journal of Information Systems*. 2004, 14 (3): 94-120.
- [19] Davis, L. D. R. P. Bagozzi, and P. R. Warshaw. User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*. 1989, 35(8): 982-1002.
- [20] Dai-yon Cho, and Hyun-jung Kwon. Analysis of Trust in Internet and Mobile Commerce Adoption. *Korea Internet e-Commerce Research*. 2008, 8 (2): 151-182.
- [21] Sang-Hyeon Kim, and Sang-Hyun Oh. The Effects of Internet Shopping Mall Characteristics on Satisfaction, Trust, and Loyalty. *Asia Pacific Journal of Small Business*. 2002, 24 (2): 237-271.
- [22] Dong-Wook Jin, Sang-Hoon Kim, and Chang-Kyu Kim. The Influence of Use Purpose in Mobile Internet Service on Loyalty. *The e-Business Studies*. 2008, 9 (3): 129-157.
- [23] Thompson, R. L. Higgins, C. A., and Howell, J. M. Personal Computing: toward a Conceptual Model of Utilization. *MIS Quarterly*. 1991, 15(1): 124-143.
- [24] Moore, G. C., and Benbasat, I. Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research*. 1991, 2(3): 192-222.
- [25] Compeau, D. R., and Higgins, C. A. Computer Self-efficacy: Development of a Measure and Initial Test. *MIS Quarterly*. 1995, 19(2): 189-211.
- [26] Rogers, E. M. Diffusion of Innovations (5th ed.). *New York: Free Press*. 2003.
- [27] Taylor, S., and Todd, P. A. Understanding Information Technology Usage: a Test of Competing Models. *Information Systems Research*. 1995, 6(4): 144-176.
- [28] Fournier Susan, and Julie L. Yao, Reviving Brand loyalty: A reconceptualization within the framework of consumer-brand relationships. *International Journal of Research in Marketing*. 1997, 14: 451-472.
- [29] Gye-Soo Kim. A study Service Quality Strategy on the Internet Portal Site. *Korean Management Review*. 2002, 31 (1): 191-209.
- [30] Moez Limayem, Mohamed Khalifa, and Anissa Frini, What Makes Consumers Buy from Internet? A Longitudinal Study of Online Shopping. *IEEE Transactions on Systems, Man and Cybernetics, Part A: Systems and Humans*. 2000, 30 (4): 421-432.
- [31] Chin, W. W. The partial least squares approach for structural equation modeling. 1998.
- [32] Gefen David, Straub Detmar, and Boudreau Marie-Claude. Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of the Association for Information Systems*. 2000, 4 (7): 1-77.
- [33] Claes Fornell, and David F. Larcker. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*. 1981, 18 (3): 39-58.
- [34] Falk, R. Frank, and Miller, Nancy B. A primer for soft modeling. *University of Akron Press*. 1992.
- [35] Joseph Hair, Rolph Anderson, and Bill Black. *Multivariate Data Analysis*. Prentice Hall, 1998.
- [36] Doz, Y.L., Olk, P.M., and Ring, P.S. Formation Processes of R&D Consortia: Which Path to Take? Where Does It Lead?. *Strategic Management Journal*. 2000, 21 (3): 239-266.
- [37] Chin, W. W. Frequently Asked Questions-Partial least Squares & PLS-Graph. [Http://disc-nt.cba.uh.edu/chin/plsfaq.htm](http://disc-nt.cba.uh.edu/chin/plsfaq.htm). 2000.