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Intention to Use,
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Statistical Analysis of Effects of Extended UTAUT Variables on User Acceptance of Smart Wearable Devices and Use Behavior

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Abstract

The paper statistically analyzed effects of extended UTAUT (Unified Theory of Acceptance and Use of Technology) variables on user acceptance of smart wearable devices and use behavior on the empirical level. At this moment, looking at user intention to accept smart wearable devices would provide useful commercial and strategic implications. The PLS (partial least squares) structural equation model analysis showed that intention to use smart wearable devices depended on the level of performance expected by the consumer in utilizing smart wearable devices, on the hedonic experiences that the consumers enjoy, on the social influence that the consumer referents exert, and on the facilitating conditions available. Also it indicated that the actual use of smart wearable devices depended on the intention to use and the facilitating conditions available. For management and marketing strategies of smart wearable device providers, two factors of hedonic motivation and performance expectancy implied that consumers should experience the devices with enjoyment and get benefits by utilizing the devices. And the marketing strategies should appeal to consumers by positioning the device using experience as an adventure or a way to reduce their stress and change a negative mood. The area of smart wearable devices converged with IT and entertainment has high market growth potentiality.

1. Introduction

Mobile systems are spreading around the world through wireless internet, while the smartphones are increasing connected with smart wearable devices. The smart wearable devices are recognized as a new trend in mobile applications. The smart wearable devices, which can be called a wearable computer, aim to supplement an individual's physical ability and to use the devices without any inconvenience as if they are parts of one's body. Different types of smart wearable devices exist as a clothing type and as an attachable type which can be worn on heads, fingers, and arms etc., and potential growth of the smart wearable devices is high all around the world. According to the user expectation studies regarding Koreans and Japanese, Koreans had more recognition and needs of wearable devices than Japanese and were more willing to buy wearable devices [1]. The health care area converged with IT and entertainment has high market growth potentiality, so looking at the user intention to use smart wearable devices would provide a useful commercial and strategic implication. Using the smart wearable devices is on the rise [2, 3, 4].

Smart wearable devices are related with the advanced technology, which is the core subject of the information technology acceptance theory [5, 6, 7, 8, 9, 10]. The information technology acceptance theory is related to decision making of human's willingness to accept new technology. So technology advancement studies include variables related to human attitude. This study sets the research model using the extended UTAUT (Unified Theory of Acceptance and Use of Technology) which integrates the existing theories.

UTAUT proposed by Venkatesh et al. includes three variables (performance expectancy, effort expectancy, and social influence) [11] that affect intention to use, one variable (facilitating conditions) [6] that affects usage behavior, and four controlled variables (sex, age, experience, and voluntariness) [12, 13, 14]. In addition to UTAUT variables, this study includes additional exogenous variables such as hedonic motivation and personal innovativeness [6] which become crucial when applying technology of smart wearable devices to UTAUT.

2. The Research Model and Hypotheses

2.1. The Research Model

The extended UTAUT provides an explanation for the acceptance and use of ICTs by consumers [12, 13, 14]. To explain the future intention to use the technology and the past and present use of the technology in organizational contexts, the UTAUT posits that performance expectancy, effort expectancy, social influence, and facilitating conditions affect intention to use the technology, and that intention to use and facilitating conditions influence the actual use of the technology. Fig. 1 provides two new constructs incorporated into the extended UTAUT: hedonic motivation and personal innovativeness [15, 16]. The research model revises the definitions of the six constructs, taking into account the four previously cited constructs of the UTAUT together with two additional constructs, as illustrated in Fig. 1.

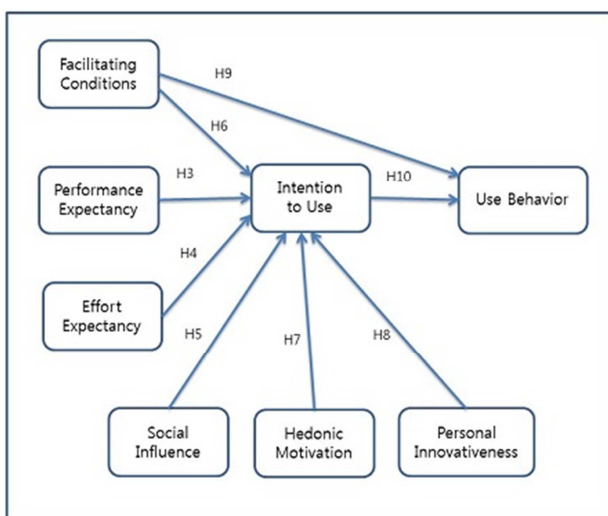


Fig. 1. The Research Model.

In this study, the extended UTAUT is applied to analyze acceptance and use of smart wearable devices by consumers. Table 1 shows operationalized definitions of constructs.

Table 1. Operationalized Definition.

Constructs	Operationalized Definitions
Performance Expectancy	The degree to which using a new technology will provide benefits to consumers in utilizing smart wearable devices
Effort Expectancy	The degree of ease/effort associated with consumer use of smart wearable devices
Social Influence	The consumers perceive that important people (e.g. family or friends) believe that they should use a particular technology
Facilitating Conditions	Consumer perception of the resources and support available to use smart wearable devices
Hedonic Motivation	Pleasure or enjoyment derived from using a new technology
Personal Innovativeness	The degree to which consumers search for and prefer use of smart wearable devices
Intention to Use	The degree of intention to use smart wearable devices in the future
Use Behavior	How often you use smart wearable devices

2.2. Hypotheses Setting

Taking into account the relationships and constructs of the extended UTAUT, the following hypotheses are put forward in respect to smart wearable devices by consumers.

2.2.1. Demographic Variables

H1: Gender differences in performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, personal innovativeness, and intention to use would exist.

H2: Differences in service experience would show different levels of performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, personal innovativeness, and intention to use.

2.2.2. UTAUT Variables

H3: The performance expectancy in the use of smart wearable devices would positively affect intention to use smart wearable devices.

H4: The effort expectancy in the use of smart wearable devices would positively affect intention to use smart wearable devices.

H5: The social influence regarding the use of smart wearable devices would positively affect intention to use smart wearable devices.

H6: The facilitating conditions perceived in the use of smart wearable devices would positively affect intention to use smart wearable devices.

2.2.3. Additional Variables

H7: The hedonic motivation experienced in the use of smart wearable devices would positively affect intention to use smart wearable devices.

H8: The personal innovativeness regarding the use of smart wearable devices would positively affect intention to use smart wearable devices.

H9: The facilitating conditions perceived in the use of smart wearable devices would positively affect use behavior.

H10: The intention to use smart wearable devices would positively affect use behavior.

2.3. Samples and Data Collection

Non-probability samplings were made to select the samples, since the population size for this study was unknown. The samples were three groups: university students at C University in Seoul and D University in the southern region of Korea, and E public officers of F City. Just before questionnaires were distributed, those questioned were explained about current smart wearable devices specifically. They completed self-reported questionnaires and voluntarily participated in responding the questionnaires. From October 5, 2015 to October 25, 2015 the final questionnaire was administered to 300 individuals. The total number of questionnaires completed by the individuals surveyed was 229 (76.3% of the total surveyed), of which the total number of questionnaires available for the data analysis was 225 (75% of the total surveyed) after eliminating those questionnaires that had not correctly been completed.

Table 2 shows demographical statistics for the questionnaires. To define the demographics of respondents, a frequency analysis and a descriptive statistics analysis were performed based on a total of 225 samples. The analysis results for the participants are shown in Table 2. There were more males (58.2%) than females (41.8%). The largest proportion of the respondents (64.4%) was aged between 20 and 29. The largest proportion of the academic background (57.8%) was college students, followed by college graduates (30.7%). Most of the occupations (57.8%) were students, followed by public servants (33.8%). There were experienced users with smart wearable devices (16%).

Table 2. Demographical Statistics.

Measure	Item	Frequency	(%)
Gender	Male	131	58.2
	Female	94	41.8
Age	20-29	145	64.4
	Others	80	35.6
Academic Background	College Students	130	57.8
	College Graduates	69	30.7
	Others	26	11.5
Occupation	Students	130	57.8
	Public Servants	76	3.8
Experience	Others	19	8.4
	Experienced Users	36	16.0
	Non-Users	189	84.0

3. Empirical Analysis

A regression analysis of latent variables was used in this research, based on the optimization technique of the partial

least squares (PLS) to elaborate a model representing relationships between the eight proposed constructs measured by many items. The PLS as a multivariate technique to test the structural model estimates the model parameters to minimize the residual variance of the whole model dependent variables, does not require any parametric conditions, and is recommended for small samples [18, 19, 20, 21, 22].

The data analysis took place through a two-stage methodology. The first stage was to develop and evaluate the measurement model and the second stage was to develop the full structural equation model.

3.1. Reliability Analysis

The study verified reliability of the model using collected data (n=225). To measure the internal coherence of all the indicators in relation to the constructs, it tested reliability between multi-item scales on 22 measurement items using SPSS 18 program. The Cronbach coefficient α values are shown in Table 3. From the table, it is shown that the Cronbach coefficients α values are between 0.868 and 0.901, all bigger than 0.7, which is recommended for confirmatory research.

Table 3. Results of Reliability Analysis.

Variables	Number of Items	Cronbach α	Standardized Cronbach α
Performance Expectancy	3	.873	.883
Effort Expectancy	3	.872	.882
Social Influence	3	.868	.880
Facilitating Conditions	3	.884	.898
Hedonic Motivation	3	.870	.878
Personal Innovativeness	4	.901	.908
Intention to Use	3	.868	.883

3.2. Validity Analysis

The study performed the exploratory factor analysis about items of the questionnaire measuring constructs of the research model. A factor extraction method was based on principal component analysis and Varimax rotation with Kaiser-normalization [16].

As illustrated in Table 4, results of the exploratory factor analysis showed that all seven initially intended factors including a dependent variable were extracted: F1 'personal innovativeness', F2 'performance expectancy', F3 'facilitating conditions', F4 'social influence', F5 'intention to use', F6 'hedonic motivation', and F7 'effort expectancy'. Each factor showed that its Eigen value was above 1 and the rate of cumulative variance showed 84.807% of the total variance. This study found that multi-collinearity did not exist. Items measuring the same construct represented prominently higher factor loadings on a single construct than other constructs (indicated by boldface).

Table 4. Results of the Exploratory Factor Analysis.

Factors	Item	F1	F2	F3	F4	F5	F6	F7
Personal Innovativeness	V1	.809	.141	.154	.065	.054	.273	.111
	V2	.894	.137	.057	.106	.081	.068	.114
	V3	.834	.000	.077	.057	.208	-.004	.131
	V4	.735	.043	.203	.181	.047	.119	.357
Effort Expectancy	V5	.265	.247	.238	.138	.103	.177	.772
	V6	.285	.181	.175	.250	.277	.128	.723
	V7	.280	.229	.157	.245	.158	.349	.708
	V8	.149	.291	.217	.754	.262	.228	.187
Social Influence	V9	.153	.272	.193	.783	.221	.250	.211
	V10	.151	.294	.179	.757	.239	.273	.222
	V11	.087	.787	.189	.270	.264	.218	.204
Performance Expectancy	V12	.113	.765	.138	.278	.274	.222	.190
	V13	.131	.783	.187	.236	.235	.243	.208
	V14	.124	.329	.175	.277	.286	.669	.212
Hedonic Motivation	V15	.169	.216	.183	.240	.226	.798	.197
	V16	.214	.266	.238	.286	.248	.718	.226
	V17	.165	.161	.839	.186	.108	.040	.156
Facilitating Conditions	V18	.091	.198	.781	.193	.116	.296	.178
	V19	.157	.078	.811	.075	.256	.140	.116
	V20	.174	.355	.210	.241	.700	.256	.181
Intention to Use	V21	.141	.272	.224	.205	.779	.257	.201
	V22	.161	.223	.189	.244	.814	.185	.120
Eigen Value		3.25	2.79	2.62	2.61	2.58	2.48	2.33
Explained Variance (%)		14.770	12.699	11.885	11.855	11.719	11.287	10.592
KMO (%)		84.807						

accepted.

4. Hypotheses Verification

4.1. T-test Verification Regarding Gender and User Experience

As illustrated in Table 5, results of the T-test verification on samples showed that no statistically significant difference between genders existed at the level of $\alpha = .05$. So H1 was rejected.

Table 5. Results of T-test between Genders.

	Levine's Equal Variance		T-test on Identity of Mean	
	F	α	t	α
Personal Innovativeness	4.508	.036	1.043	.299
Effort Expectancy	.330	.567	.780	.437
Social Influence	6.772	.011	-1.317	.190
Performance Expectancy	2.457	.120	-.292	.771
Perceived Enjoyment	8.592	.004	.401	.689
Facilitating Conditions	1.972	.163	-.020	.984
Intention to Use	5.935	.016	-1.015	.312

Among six variables three variables - effort expectancy, hedonic motivation and intention to use - showed statistically significant differences between users and non-users at the level of $\alpha = .05$, as shown in Table 6. So H2 was partially

Table 6. Results of T-test between Users and Non-Users.

	Levine's Equal Variance		T-test on Identity of Mean	
	F	α	t	α
Performance Expectancy	.051	.822	1.948	.057
Effort Expectancy	1.194	.276	3.798	.000
Social Influence	.002	.967	-1.466	.149
Facilitating Conditions	.089	.766	1.525	.134
Hedonic Motivation	.005	.941	3.432	.001
Personal Innovativeness	.359	.550	1.921	.061
Intention to Use	.176	.675	2.9425	.007

4.2. Hypotheses Verification Using the Structural Equation Model

A PLS structural equation model analysis was performed to test H3 through H10. The regression parameters were based on a bootstrapping of 100 samples but not on a sample estimator, which facilitated the computation of the t-student for each hypothesis and generalization of the results. The results shown in Table 7 indicate relationship between the different constructs. All the R-squares are higher than .10, which means that the productive capability of the model is satisfactory.

Table 7. Summary of Test Results for the PLS Structural Equation Model.

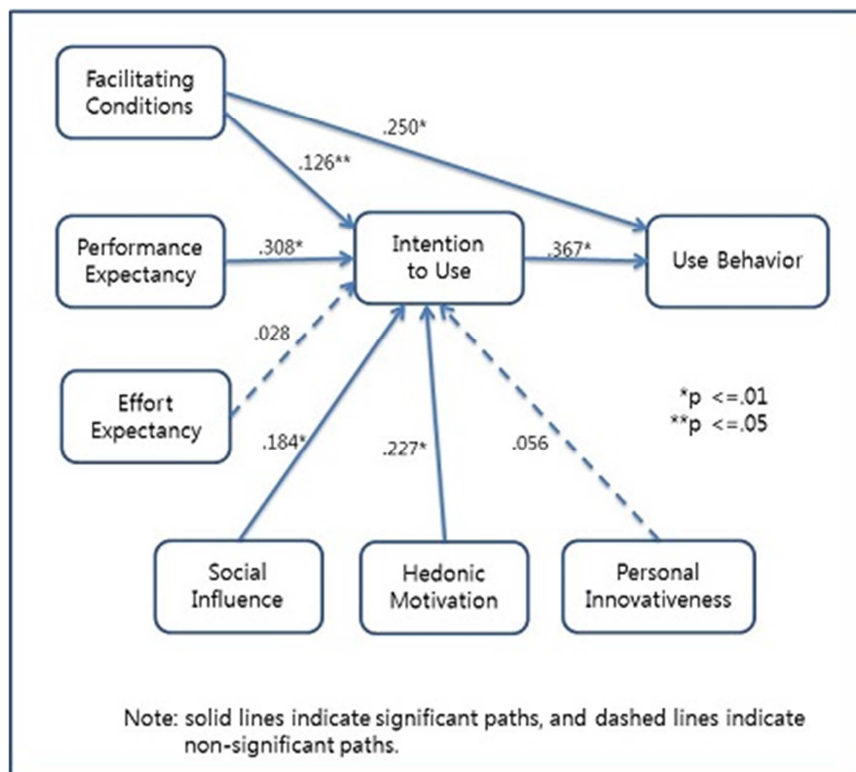
H	Path	β	P-value	Accept	Construct	R ²
H3	PE→IU	.308	.000	Yes	Intention To Use	.652
H4	EE→IU	.028	.683	No		
H5	SI→IU	.184	.009	Yes		
H6	FC→IU	.126	.021	Yes		
H7	HM→IU	.227	.001	Yes	Use Behavior	.610
H8	PI→IU	.056	.261	No		
H9	FC→UB	.250	.001	Yes		
H10	IU→UB	.367	.000	Yes		

Firstly, the results show that the main predictors of intention to use (IU), in the order of importance, are performance expectancy (PE), hedonic motivation (HM), social influence (SI) and facilitating conditions (FC). Therefore, H3, H5, H6 and H7 are accepted at the level of $\alpha = .05$. That is, intention to use smart wearable devices depends on the level of performance expected by the consumer in utilizing smart wearable devices, on the hedonic

experiences that the consumers enjoy when using the smart wearable devices, on the social influence that the consumer referents exert, and on the facilitating conditions available. However, in the hypothesized causal relationships of the proposed model, H4 and H8 are dismissed at the level of $\alpha = .05$. That is, impact of effort expectancy (EE) on intention to use (IU) and that of personal innovativeness (PI) on intention to use (IU) are not supported.

Secondly, the results highlight that main predictors of actual use behavior (UB), in the order of importance, are intention to use (IU) and facilitating conditions (FC). Therefore, H9 and H10 are accepted at the level of $\alpha = .05$. That is, it can be stated that the actual use of smart wearable devices (UB) depends on the intention to use (IU) and the facilitating conditions (FC).

Fig. 2 shows the results of the PLS structural equation model analysis.

**Fig. 2.** Results of PLS Analysis.

5. Conclusions

The area of smart wearable devices converged with IT and entertainment has high market growth potentiality. At this moment, looking at the users' intention to use smart wearable devices would provide a useful commercial and strategic implication. Based on results of this research, practical recommendation can be made to the providers of smart wearable devices regarding appropriate management and marketing strategies for improving key parts of their business model. This research explains how consumers behave

regarding use of smart wearable devices. In particular, this research aims to analyze factors that influence both consumers' intention to use and their actual use of smart wearable devices, for which a new adapted and extended version of the UTAUT is utilized.

The results show that the factor of facilitating conditions influences the intention to use and the actual use behavior, which coincides with the results of the previous studies [5, 6, 7, 8, 9, 10, 11, 16, 17] and contrasts with the findings obtained by others [12, 13, 14]. This means that consumer perceptions of supports and the resources for using smart wearable devices influence both intention to use and actual

usage. Consequently, by making supports and resources available to customers the providers had better facilitate them to purchase the smart wearable devices, so that consumers can make access to the means necessary to resolve any problem that they may encounter during the using process.

Implications of the two factors of hedonic motivation and performance expectancy can be headed for the management and marketing strategies of smart wearable device providers, which means that consumers should experience the devices with enjoyment and get benefits by utilizing them. Thus, the smart wearable devices have to be elaborated in the pleasant and beneficial way. Marketing strategies should appeal to consumers by positioning the device using experience as an adventure or a way to reduce their stress and change a negative mood.

Social influences affect intention to use; a finding that coincides with the results from some studies [1, 12, 13, 14, 23] and contrasts with the findings from others [15, 16], which means that consumers form intention to use because they imagine that their referents, such as friends, family and colleagues, think that they should use. Therefore, one of the marketing strategies for smart wearable devices should be reputation-building, in order to gain favorable opinions from referents, whether they are existing users or not, so that these persons can actively recommend using the devices to others.

Finally, the results indicate the effect of intention to use on use behavior: the greater the intention to use, the higher the probability of use behavior. Clearly, providers should aim to strengthen consumers' intention to use, which will lead to actual use of the devices. Accordingly, they need to take action on particular variables like performance expectancy, hedonic motivation, social influence and facilitating conditions to increase the intention to use the devices.

Future studies should examine that the model proposed can be applied for other kinds of smart products and services. Also it would be of interest to analyze the possible cross-cultural differences in the determinant factors that influence consumers in their intention to use and their actual use of smart wearable devices. In addition, influence of social demographic variables as moderator variables might be examined. And it would be helpful to conduct a longitudinal analysis to determine how these variables change over time.

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