An Empirical Analysis of Smart Signage and Its Market Delimitation

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Abstract

This study demonstrates that ease of use, usefulness, and hedonic desires affect the intention to use smart signage, based on market delimitations. Smart signage is at an early phase of adoption and its market can be divided broadly into indoor and outdoor markets. In this study, an empirical study model was established in conjunction with the technology acceptance model (TAM), which was applied to the IT area of a smart signage map and to a hedonic model. Empirical results showed that the key hedonic attributes affecting the intention to use smart signage include information delivery for the indoor environment and emotional and entertainment content for the outdoor environment. In the future, specific guidelines can be presented to boost the usage of smart signage through an empirical study based on the identification of external factors that affect usage intention.

Keywords: Smart signage, Technology Acceptance Model (TAM), Hedonic model, Indoor/Outdoor markets

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1. Introduction

With the rapid development of information technology, modern society has witnessed the evolution and emergence of many technologies. It was in the mid-1990s that the term "digital" began to be used widely. Digital technology has affected nearly all areas of society including politics, the economy, and culture, while bringing about transformations not only in terms of simple media functionality and technologies but also in how social and cultural expressions occur [1]. The development of new information technologies has given rise to new terminologies ranging from "digital" to "smart," such as smart TVs and smartphones. As a continuation of this trend, "smart signage" appeared as the fourth generation of convergence media. Smart signage is media for which existing digital signage is given upgraded information technologies such as thinner and clearer liquid crystal displays, iris recognition technologies, augmented reality (AR), and/or object recognition, with multiple devices capable of being controlled remotely. Networking has enabled two-way or interactive content and services. As a new business opportunity, smart signage has features of space media, in which the service changes depending on the characteristics of the space. Smart signage is also recognized as a new method for delivering advertisements [2]. As smart signage is in an early phase of adoption and growth, the smart signage market is part of the digital signage market. This market can be divided into the indoor market and the outdoor market depending on where users experience smart signage. As consumers are exposed to smart signage that employs new technologies or systems, this study aims to identify the intentions behind the use of smart signage by applying the technology acceptance model (TAM), which includes psychological behavior theories regarding information technology accepters, along with hedonic elements. The characteristics of smart signage market delimitation are also reflected by applying the moderating factors of the indoor and outdoor markets where users typically experience smart signage.

1.1 The advent of Smart signage

Smart signage can be defined as "media that differentiates itself from existing digital signage by applying information technologies or smart technologies so as to display information, contents and advertisements on the signage." Existing digital signage refers to media or systems that deliver information using electronic displays in places other than the home. The value of existing digital signage lies in its ability to offer information along with advertising or promotional content to consumers who inhabit a specific space at a certain time [3]. As an evolved form of digital signage, smart signage refers to a "device that delivers diverse information and advertising content in a clearer and more realistic manner through a display panel in public and commercial places, based on a combination of various information technologies related to software, hardware, and networks as well as new, innovative technologies." Smart signage enables texts, image, and video as well as customized services and advertising to be provided through interactions with consumers based on object recognition.

1.2 Smart signage market

The signage market is divided into the indoor market and the outdoor market based on existing liquid crystal displays and LED electronic displays, respectively. The digital signage market, being at an early stage, is currently centered on the indoor market. As part of the digital

signage market, the smart signage market is equipped with the latest information technologies [4]. The indoor smart signage market is linked to promotions and advertisements of product information that can be obtained at the point of sale in an indoor store. Examples include large signage advertisements in large shopping malls such as KOEX or the CGV movie theater in Wangshipri, as well as discount stores such as Emart. Smart signage has also been installed and operated by convenient stores such as FamilyMart and GS 25, which place smart signage on the windows of their franchises. Digital panels have been installed and are operated in retail stores to disseminate internal promotion content as well as movies, music videos, and advertising content through broadcasting based on a broadband infrastructure. Multiple large walls account for the largest segment of the indoor market, which includes emergency control centers and disaster-prevention centers that control or prevent disasters in buildings or around public facilities. Recently, large multi-screen displays began to be used in lobbies or other spaces of new buildings to serve as interior décor and to offer a range of content, including promotions, building information, and advertisements.

The outdoor market for smart signage includes liquid crystal displays located in public spaces such as subways, airports, and bus shelters. Outdoor smart signage delivers advertisements and public information in addition to broadcasting warnings of disasters, which are used especially often in Japan. The previous fluorescent-backlight advertising board at the Incheon International Airport was replaced with smart signage to offer information through upgraded video imagery and to run advertisements flexibly according to the requirements of advertisers. Other examples of the outdoor market include large-scale smart signage installed in subway stations and the smart signage advertisements that can be found in the subway stations of the New Bundang Line. Smart signage is also installed in bus shelters to offer transportation information and advertisements. Compared to other countries, the Korean market for smart signage is continuously creating new relevant applications based on its cutting-edge information technologies and advanced telecommunication infrastructure.

2. Literature Review

2.1 Smart signage and consumer behavior

As a new medium, smart signage has been continuously studied both domestically and overseas. Recent smart signage studies include those focusing on the experiential value of interacting with smart signage and those examining consumers' responses to smart signage. Traditionally, it has been important for retail stores to offer a hyped-up and fun atmosphere. One study found that smart signage, when used as an atmospheric stimulus at a retail store, increases consumers' purchases, their intentions to revisit the store, and their frequency of visiting the store [5]. Smart signage is an IT convergence medium. Previous studies of smart signage presented only case studies based on existing digital signage devices; none has researched consumers' responses, attitudes, and behaviors. In this regard, this study applies the technology acceptance model (TAM), which accommodates psychological behavioral theories in explaining how users come to adopt new technologies. Davis's TAM states that the actual usage of an information system is affected by the intentions behind its use. These intentions are affected by the users' attitudes toward the system. Under the TAM theory, this attitude is determined by the two critical variables of perceived usefulness and perceived ease of use [6]. Due to the characteristics of smart signage, which is supposed to offer enjoyment and excitement to users, hedonic elements were included in this study. Therefore, the study adopted a revised form of the TAM. Based on the TAM, this study defined diverse variables

related to fundamental and inherent motivation, such as perceived enjoyment, perceived playfulness, and perceived absorption and flow depending on the researcher [7]. In his study of information systems, Chesney (2006) noted that among ease of use, usefulness, fun, and intention to use, perceived usefulness and perceived enjoyment have a significant direct influence on the intention to use, whereas perceived ease of use is negatively correlated with intention to use [8].

2.2 Market delimitation of smart signage

Market delimitation refers to the definition of a group of competing products or the scope of regions where such products are supplied. It also refers to the determination of the boundary of a market based on the competitive relationships between multiple products, including single markets, multi-sided markets, and two-sided markets [9]. As a new advertising medium, the smart signage market is not defined as being in direct competition with the TV, Internet, or mobile sectors, which are expected to be competitors. In fact, the smart signage market is based on a business ecosystem in which multiple stakeholders participate. In this ecosystem, companies inhabiting different parts of the value chain aim to achieve the common goals of efficient production and innovation through a mutually beneficial existence. Such a business ecosystem appeared recently in the mobile market based on broadcasting and communication convergence in addition to the smart signage market [10]. As an approach to market delimitation, the SSNIP (small but significant and non-transitory increases in price) method proposed by Harris and Simons (1989) assumes small but significant and non-transitory increases in the prices of goods or services and identifies whether there are substitutes to such goods or services; this method is an effort to define the market as a single market or an irrelevant market [11]. However, Evans (2008) explained that it would be difficult to apply the existing SSNIP method to the market delimitation of a two-sided market in which companies offer platforms [12].

In addition, Rochet and Tirole (2003) noted that it would be difficult to realize market delimitation for platform or convergence markets, where there are complicated interest relationships among companies and where, for instance, the loss of one company could profit another [13]. Thus, discussions and research surrounding the delimitation of a convergence market are still at an early stage, and smart signage, having the characteristics of an early convergence market, should be approached from system or policy development perspectives to promote the wider use of smart signage rather than from a market delimitation perspective focusing on competition and regulation.

3. Related Work

3.1 Research model

As a plan to stimulate the market for smart signage, this study developed a research model that can improve the intention to use signage. As a new IT medium, smart signage requires an approach involving various aspects of market delimitation and policy development to activate the market, rather than a definition of the market based on competition and regulations. In this study, users interact (use) with smart signage and evaluate its ease of use. Users that find the technology useful are considered as willing to continue using smart signage. In addition, this study derived a relevant model taking into consideration the fact that hedonic elements are necessary to obtain attention and recognition as an advertisement medium beyond ease of usage. In other words, the purpose is to provide interesting and informative advertisements or

information. Therefore, to identify the correlation with the intention to use smart signage through the revised TAM incorporating TAM and Hedonic factors, the research model was devised as in **Fig 1**. The hypothesis was established by reflecting Indoor and Outdoor control parameters that can influence the variable according to the installation location of signage dividing the market delimitation in the research model.

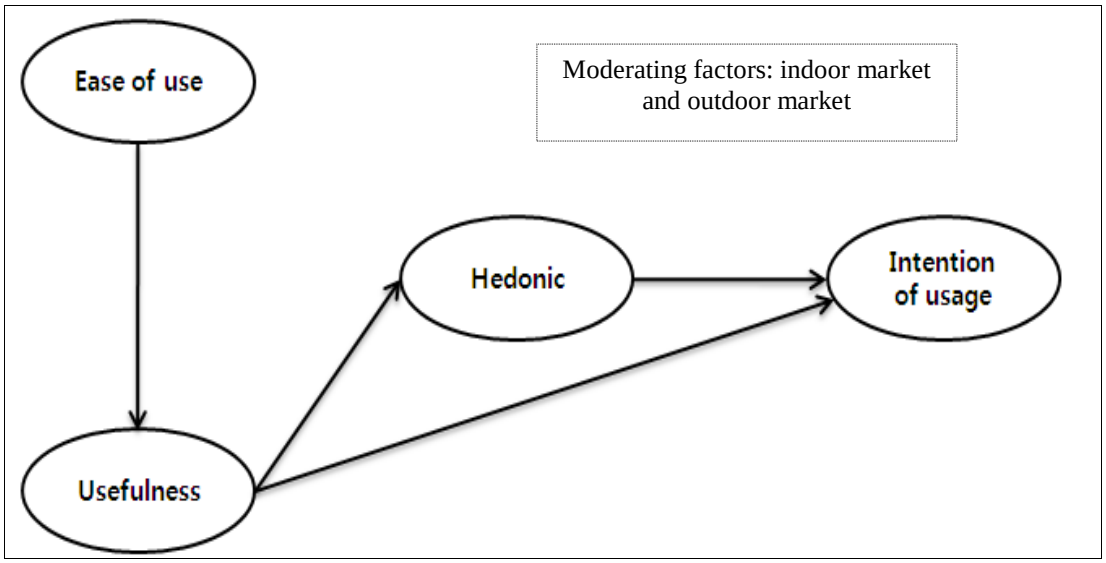


Fig. 1. Research model

The reason for selecting ease of use and usefulness in addition to external variables in the models for TAM 2 and TAM 3 were to clarify the hedonic effect clearly associated with market delimitation. Looking at the variables for TAM 2 and 3, recent smart signage applications are not clearly recognized by users as a new technique due to subjective standards and perceptions of usefulness. Therefore, ease of use and usefulness were defined based on usage by individuals unfamiliar with the technology, rather than specific workings related to computer self-efficacy, external support recognition, computer instability, and computer enjoyment typically associated with the ease of use. Furthermore, since the study on the platform was conducted to assess the probability of result quality and confirmation, including other corresponding variables was not possible.

Smart signage is a new technology and a public medium that makes it easy to approach consumers. The technology is not intended for businesses or personal computers. Of course, despite being based on interactive relations with consumers, this empirical study was conducted using research models for the effect of ease of use, usefulness and hedonic factors on the intention to use, taking into consideration Indoor and Outdoor control parameters which delimit the market into platform aspects providing advertisements and information.

3.2 Hypothesis of the research model

According to the technology acceptance model defined by Davis, perceived usefulness is affected by perceived ease of use, and most studies based on the TAM have demonstrated that ease of use directly affects usefulness. In a TAM-based study on users' selection of smartphones, it was found that ease of use affects perceptions of usefulness when users choose smartphones [14]. Several other studies reported similar findings with respect to consumers'

choice of goods or services [15].

Meanwhile, it was found in a hedonic information system that perceived enjoyment has much more of an influence on the intention to use than does perceived usefulness [16]. In a study by Davis, ease of use and usefulness, which are related to extrinsic motivation, served as important factors for technology acceptance [17]. However, Moon and Kim (2001) came to the conclusion that the hedonic elements of perceived enjoyment, which are related to fundamental motivation, have much more influence than ease of use and usefulness [18].

Moreover, entertainment values such as enjoyment and pleasure are regarded as the main behavioral beliefs that are adopted in the acceptance of multi-purpose technologies [19]. Hedonic elements significantly influence intention to use smart signage, as recent IT trends emphasize fun and entertaining features. In this regard, the hypotheses shown in **Table 1**. were established.

Table 1. Hypotheses of the Research Model

H1. For the person who experiences signage, ease of use will have a significant influence on usefulness.	
H1a	For a person who experiences indoor signage, the higher the ease of use, the higher the usefulness will be.
H1b.	For a person who experiences outdoor signage, the higher the ease of use, the higher the usefulness will be.
H2. For a person who experiences signage, usefulness will have a significant influence on hedonic values.	
H2a	For a person who experiences indoor signage, the higher the usefulness, the higher the hedonic values will be.
H2b.	For a person who experiences outdoor signage, the higher the usefulness, the higher the hedonic values will be.
H3. For a person who experiences signage, usefulness will have a significant influence on intention to use.	
H3a	For a person who experiences indoor signage, the higher the usefulness, the higher the intention to use will be.
H3b.	For a person who experiences outdoor signage, the higher the usefulness, the higher the intention to use will be.
H4. For a person who experiences signage, hedonic values will have a significant influence on intention to use.	
H4a	For a person who experiences indoor signage, the higher the hedonic values, the higher the intention to use will be.
H4b.	For a person who experiences outdoor signage, the higher the hedonic values, the higher the intention to use will be.

3.3 Operational delimitation

The questionnaire for this study was composed of four items pertaining to ease of use, four items pertaining to usefulness, four items pertaining to hedonic values, and five items pertaining to intention to use. All measurements were based on a five-point Likert scale.

3.3.1 Ease of use

Davis (1989) defined ease of use as the degree to which a person believes that using a particular IT system would be effortless, while this study defines ease of use as the degree of minimum effort required when using smart signage. Referring to earlier studies, this study devised four questionnaire items related to ease of use, ease of learning, convenience of use, and the amount of effort required.

3.3.2 Usefulness

Davis (1989) defined usefulness as the degree to which a person believes that using a particular IT system would enhance his or her job performance, while this study refers to the delimitation made in earlier studies and defines usefulness as the degree to which a user feels that using smart signage would be useful for his or her individual activities. Based on previous studies, this study devised four questionnaire items related to helpfulness for information acquisition, effectiveness for carrying out tasks, helpfulness for completing tasks, and helpfulness for performing tasks more effectively.

3.3.3 Hedonic

Lin and Bhattacherjee (2010) defined hedonic value as the degree of perceived entertainment provided by the actual experience [20], while this study refers to the delimitation made in previous studies and defines hedonic value as the degree of subjective emotional expression regarding the information and entertainment provided by the use of smart signage. Based on earlier research, this study utilizes five questionnaire items on pleasure, interest, happiness, satisfaction, and fun.

3.3.4 Intention to use

Stafford et al. (1996) defined intention to use as the degree to which a user would like to continue using or recommend to others a particular IT system [21], while this study refers to earlier work and defines intention to use as the will of a person to continue using smart signage and to recommend it to others. Based on previous work, this study devised four questionnaire items related to intention to use smart signage if available, intention to use smart signage more often, intention to use smart signage, and recommending the use of smart signage.

4. Research Methodology

4.1 Data and sample

The survey was conducted on the Internet from May 1st to May 18th, 2014. A total of 440 people responded. Even with the rather small size of the sample, the final analysis was performed by considering signage as a new technology, with a sample of 222 people after excluding 40 dishonest responses and people that had no experience with smart signage. As the data analysis method, SPSS (Statistical Package for Social Science) Ver. 19.0 statistical package program and AMOS 7.0 were used to handle the statistics of the collected data. In

addition, frequencies and percentages were calculated to identify the demographic characteristics of the research subjects. In order to verify the reliability and validity of each survey measurement item, reliability verification and exploratory factor analysis methods were used. For reliability, Cronbach's α was analyzed and a confirmatory factor analysis was performed. Lastly, a path analysis was conducted as an empirical analysis of the relationship between the factors and the intention to use. A frequency analysis was performed to identify the general characteristics of this study's research subjects. These results are shown in **Table 2**. The descriptive statistics show that over 80% of the respondents were office workers with an educational background at the college level or higher. The survey respondents were also evenly distributed across diverse age groups, ranging from persons in their 20s to those in their 60s, while 55% of the respondents were male. The males showed a frequency of responses similar to those of females.

Table 2. General Characteristics of the Survey Respondents

Item	Details	No. of response	Percentage
Gender	Male	122	55.0
	Female	100	45.0
Age	19 ~ 29	54	24.3
	30 ~ 39	70	31.5
	40 ~ 49	54	24.3
	50 ~ 59	44	19.8
Academic degree	High school graduate or below	36	16.2
	College graduate	164	73.9
	Graduate school graduate or higher	22	9.9
Job	Office worker	178	80.2
	Freelancer	14	6.3
	Private business owner	21	9.5
	Others	9	4.1
Persons who experienced smart signage	Indoor	112	50.5
	Outdoor	110	49.5
Total		222	100.0

5. Results and Analysis

5.1 Exploratory factor analysis

The validity of the variables was assessed through an exploratory factor analysis, which identifies common factors among multiple items that are used in a study and minimizes the loss of information while grouping many variables into homogeneous factors to reduce and simplify the variables. In the factor analysis, factor extraction was performed through a

principal component analysis. Factor rotation was conducted using the Varimax rotation method, which is useful for verifying statistical independence among factors. The number of extracted factors was based on an Eigenvalue of 1. The KMO measure (Kaiser Meyer Olkin) was 0.6, which is considered strict. The communality score was based on 0.4, as is widely used, and the factor loadings were based on 0.6. Bartlett's sphericity measures were all found to be statistically significant at P<.001. Cronbach's α coefficient was used to identify the reliability of each survey item on the collected questionnaires. The factor analysis and reliability analysis results are shown in **Table 3**.

Table 3. Factor Analysis and Reliability Analysis Results

Factor	Item	Factor 1	Factor 2	Factor 3	Factor 4
Ease of use	Ease of use 1	0.770	0.277	0.002	0.168
	Ease of use 2	0.829	0.135	0.149	0.154
	Ease of use 3	0.714	0.234	0.119	0.151
	Ease of use 4	0.777	-0.060	0.074	0.106
Usefulness	Usefulness 1	0.147	0.703	0.291	0.136
	Usefulness 2	0.273	0.675	0.116	0.303
	Usefulness 3	0.087	0.691	0.164	0.258
	Usefulness 4	0.098	0.746	0.176	0.229
Hedonic	Hedonic 1	0.131	0.146	0.807	0.112
	Hedonic 2	0.110	0.138	0.844	0.177
	Hedonic 3	-0.006	0.280	0.731	0.259
	Hedonic 4	0.195	0.296	0.477	0.366
Intention to use	Intention to use 1	0.153	0.246	0.115	0.764
	Intention to use 2	0.146	0.196	0.194	0.831
	Intention to use 3	0.196	0.204	0.233	0.800
	Intention to use 4	0.183	0.338	0.252	0.654
Eigen Value		2.69	2.60	2.49	2.90
Variance (%)		16.82	16.22	15.58	18.14
Total variance (%)		16.82	33.04	48.62	66.76
Crobach's α		0.818	0.790	0.807	0.866

Factor 1, consisting of items related to ease of use, is termed ease of use (communality: 0.602~0.751, explanatory power: 16.8%), while Factor 2, consisting of items related to usefulness, is termed usefulness (communality: 0.578~0.649, explanatory power: 16.2%). Factor 3, consisting of items related to hedonic value, is termed hedonic (communality: 0.488~0.774, explanatory power: 15.6%), while Factor 4, consisting of items related to intention to use, is referred to here as intention to use (communality: 0.639~0.789, explanatory

power: 18.1%). Factor loadings were all 0.4 or higher. The total cumulative explanatory power for ease of use, usefulness, hedonic value, and intention to use was 66.8%, while the reliability verification result was 0.790 ~ 0.866. Therefore, these were accepted in this study without difficulty.

5.2 Confirmatory factor analysis

A confirmatory factor analysis (CFA) was conducted to verify the goodness of fit of the measurement model. Confirmatory factor analysis refers to a process in which the convergent validity levels of measurement variables and the discriminant validity of latent variables are verified. Convergent validity shows how well each measurement variable explains the latent variables. Discriminant validity shows whether the construct concepts to be measured by the latent variables are being measured accurately. Before performing the confirmatory factor analysis, it is necessary to check the criteria to assess the goodness of fit of the model. Detailed criteria for assessing the goodness of fit of the model are as follows. The most basic measure of the overall goodness of fit is the X2 statistic, which is the only measure among indices used to assess the goodness of fit of a structural equation model subject to statistical significance verification. For the X2 statistic, X2/df is analyzed. This statistic value is calculated based on a normal distribution of the data, and the final conclusion is made in consideration of other diverse goodness of fit indices instead of relying only on the X2 value [22]. The Confirmatory factor analysis of the research model is shown in **Fig. 2**.

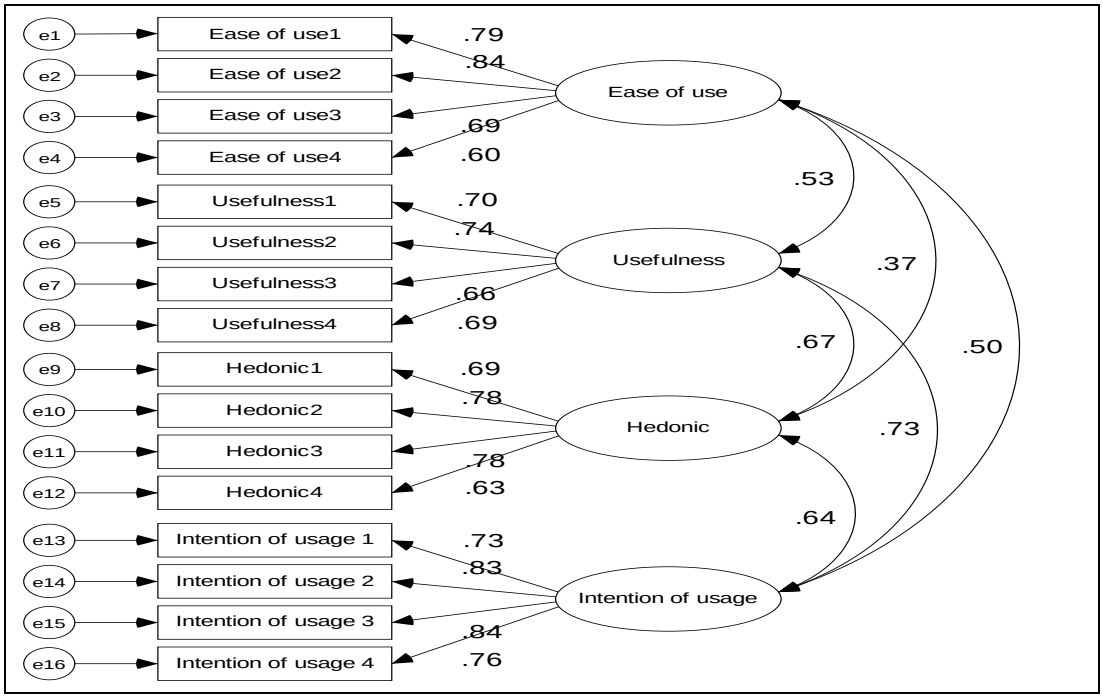


Fig. 2. Confirmatory factor analysis of the research model

5.3 Correlation analysis of the confirmatory factor analysis

A correlation analysis was conducted to determine the correlations among this study's

variables. These results are shown in **Table 4**. In the analysis, ease of use was positively (+) and significantly correlated with usefulness, hedonic value, and intention to use, while usefulness had a positive (+) significant correlation with hedonic value and intention to use. Hedonic value had a positive (+) significant correlation with intention to use.

Table 4. Correlation Analysis of the Research Model

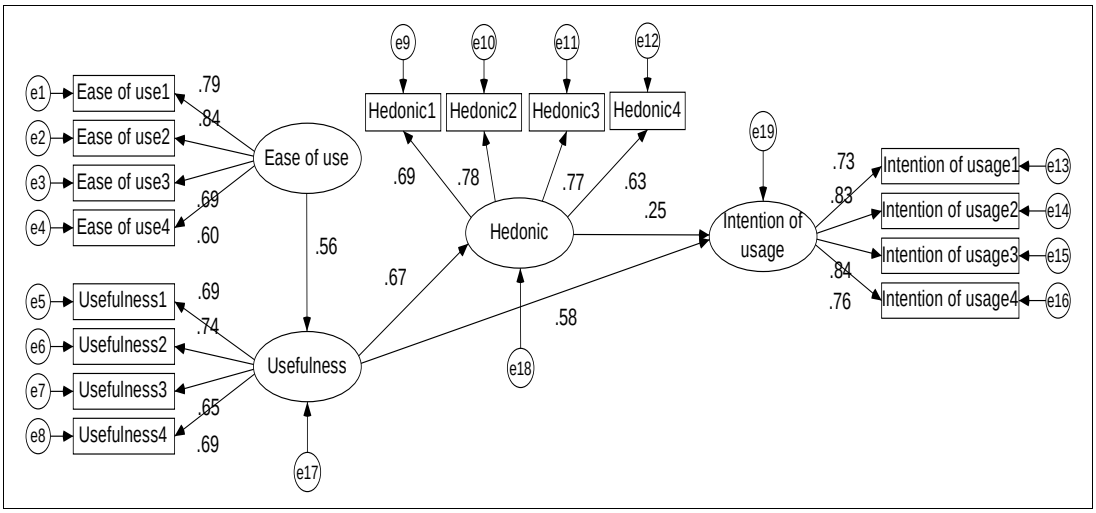
	Ease of use	Usefulness	Hedonic	Intention to use
Ease of use	1			
Usefulness	0.534***	1		
Hedonic	0.372***	0.670***	1	
Intention to use	0.504***	0.734***	0.643***	1

* p<0.05, ** p<0.01, *** p<0.001

The correlation value between ease of use and the hedonic value was 0.372 and was not statistically significant for the quantitative linear relation. The main reason is that advertisements and information are presented unilaterally because most signages are located at public places. Therefore, there were fewer sites that consumers could interact with and use directly.

5.4 Path analysis of the research model

A path analysis was conducted to estimate the goodness of fit parameters of the study model in order to verify the hypothetical study model established in this study. For parameter estimations of the path model, the structural equation method (SEM) was utilized. The path model is shown in **Fig. 3**.



X^2=154.876, df=100, p=0.000, X^2/df=1.549, GFI=0.919, RMR=0.025, AGFI=0.890, CFI=0.965, NFI=0.908, TLI=0.958, RMSEA=0.050

Fig. 3. Path analysis result

The goodness of fit indices of the path model were found to be X2/df = 1.549, which is less than 2, while the GFI, CFI, NFI, and TLI values were 0.90 or higher. RMR was 0.025, which is less than 0.05, and RMSEA was 0.050, which is less than 0.1. As demonstrated above, the acceptable range of the goodness of fit indices met the criteria. Therefore, the structural equation model of this study satisfies the goodness of fit assessment criteria. As a result of the goodness of fit assessment, it was deemed adequate for verifying the study model. Based on this analysis, hypothesis verification was conducted. This study model's hypothesis verification result is shown in **Table 5**. As the hypothesis verification results show, ease of use had a positive (+) influence on usefulness, and thus hypothesis H1 was adopted (C.R. = 6.462, p<0.001). Usefulness had a positive (+) influence on hedonic value, and hypothesis H2 was therefore adopted (C.R. = 6.871, p<0.001). As usefulness had a positive (+) influence on intention to use, hypothesis H3 was adopted (C.R. = 5.372, p<0.001). Additionally, hedonic value had a positive (+) influence on intention to use, and hypothesis H4 was therefore adopted (C.R. = 2.633, p<0.01).

Table 5. Path Coefficients of the Research Model

Hypothesis	Path	Path coefficient	Standard error	Test statistic	Adoption
H1	Ease of use⟶Usefulness	0.562	0.080	6.462***	Adopted
H2	Usefulness⟶Hedonic	0.672	0.121	6.871***	Adopted
H3	Usefulness⟶Intention to use	0.584	0.113	5.372***	Adopted
H4	Hedonic⟶Intention to use	0.250	0.080	2.633**	Adopted

* p<0.05, ** p<0.01, *** p<0.001

5.5 Moderating effect analysis and hypothesis verification among multiple groups

After classifying persons who experienced signage into indoor market (n=112) and outdoor market (n=110) consumers, a multiple-group confirmatory factor analysis was conducted to verify measurement invariance for the construct concepts. The analysis results are shown in **Table 6**.

Table 6. Measurement Invariance Analysis Results

	X^2	Df	CFI	RMSEA	ΔX^2/df	ΔX^2 Sig. Dif
Unconstrained (no constraints)	284.3	196	0.945	0.045		
Measurement weights (λ constraint)	295.4	208	0.945	0.044	11.1/12	No
Structural covariances (λ, φ constraints)	303.2	218	0.947	0.042	18.9/22	No
Measurement residuals (λ, φ, θ constraints)	329.2	234	0.940	0.043	44.9/38	No

λ : Factor loading, φ : Covariance θ : Error variance

No significant difference between the unconstrained model and the measurement weights ($\Delta X2 = 11.1$, $df = 2 < 21.0$) was found. This indicates that the two groups have the same level of recognition on the measurement tool. As the measurement invariance of the factor loadings was verified, a multiple-group path analysis was conducted for the indoor market and the outdoor market groups, as shown in **Fig. 4 and 5**, respectively.

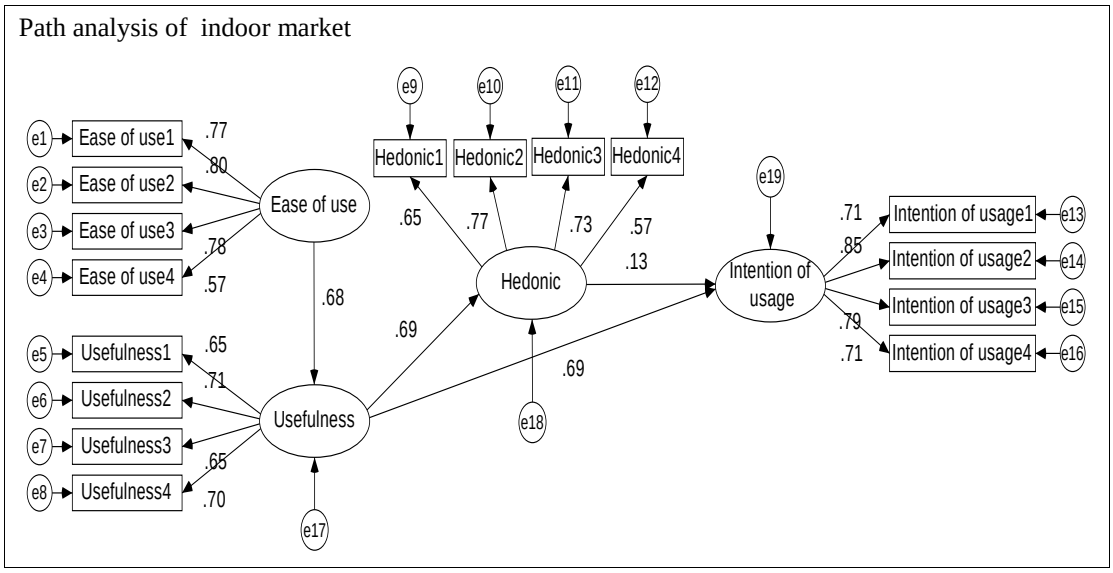
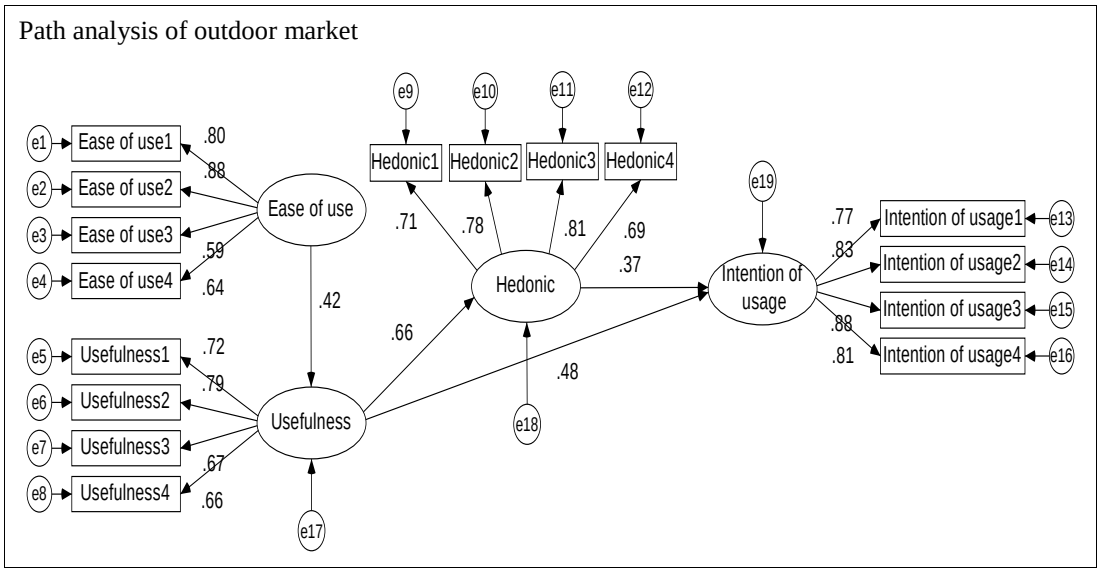


Fig. 4. Multiple-group path analysis of the indoor market



X^2(df, p)=290.832(200, 0.000), X^2/df=1.454
GFI=0.859, AGFI=0.808, CFI=0.943, NFI=0.842, TLI=0.932
RMR=0.030, RMSEA=0.045

Fig. 5. Multiple-group path analysis of the outdoor market

The goodness of fit indices of the multiple-group analysis were found to be X^2/df= 1.454, which is less than 2, while the CFI and TLI values were 0.90 or higher. RMR was 0.030, which is less than 0.05, and RMSEA was 0.045, which is less than 0.1. As demonstrated above, the range of the goodness of fit indices was acceptable, satisfying the criteria. The group-specific path analysis and hypothesis verification results based on the multiple-group analysis results are given in **Table 7**.

Table 7. Group-Specific Path Analysis Result of the Research Model

Hypothesis	Path	Group	Path coefficient	Standard error	Test statistic	Adoption
H1a	Ease of use →Usefulness	Indoor	0.675	0.119	5.015***	Adopted
H1b		Outdoor	0.423	0.109	3.644***	Adopted
H2a	Usefulness→ Hedonic	Indoor	0.688	0.184	4.546***	Adopted
H2b		Outdoor	0.657	0.163	4.996***	Adopted
H3a	Usefulness→ Intention to use	Indoor	0.689	0.194	3.932***	Adopted
H3b		Outdoor	0.481	0.141	3.567***	Adopted
H4a	Hedonic→ Intention to use	Indoor	0.134	0.130	0.939	Rejected
H4b		Outdoor	0.370	0.108	2.893**	Adopted

* p<0.05, ** p<0.01, *** p<0.001

In the indoor market, ease of use had a positive (+) influence on usefulness, and hypothesis H1a was therefore adopted. In the outdoor market, ease of use had a positive (+) influence on usefulness; hence, hypothesis H1b was adopted. In the indoor market, usefulness had a positive (+) influence on hedonic value; therefore, hypothesis H2a was adopted. In the outdoor market, usefulness had a positive (+) influence on hedonic value; hence, hypothesis H2b was adopted.

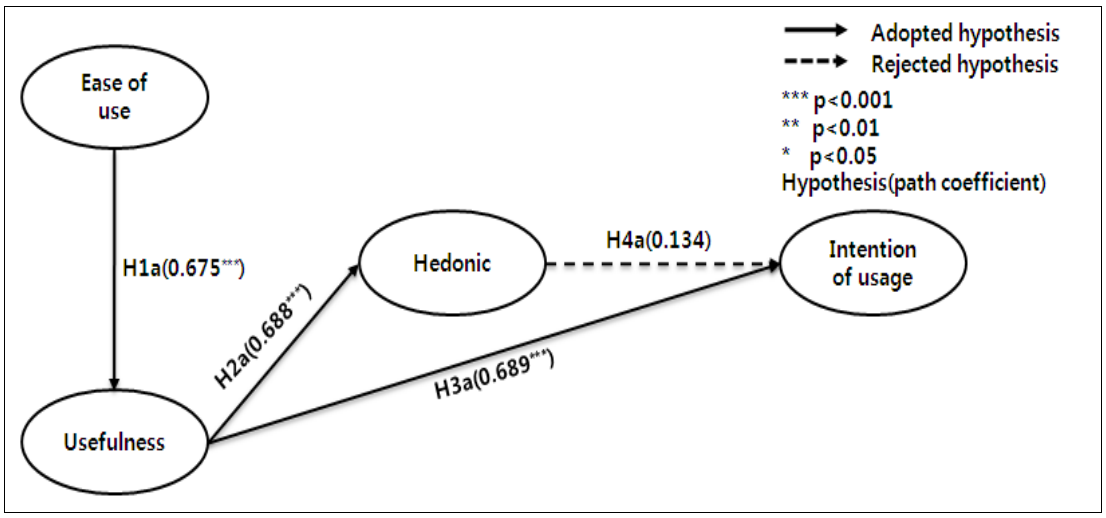


Fig. 6. Path analysis of the indoor market

In the indoor market, usefulness had a positive (+) influence on the intention to use, and therefore hypothesis H3a was adopted. In the outdoor market, usefulness had a positive (+) influence on the intention to use, and hence hypothesis H3b was adopted. In the indoor market, hedonic value had no influence on intention to use; therefore, hypothesis H4a was not supported. In the outdoor market, hedonic value had a positive (+) influence on the intention to use; hence, hypothesis H4b was adopted. The path analysis model is displayed in diagram form **(Fig. 6 and 7)** to analyze these results in more detail.

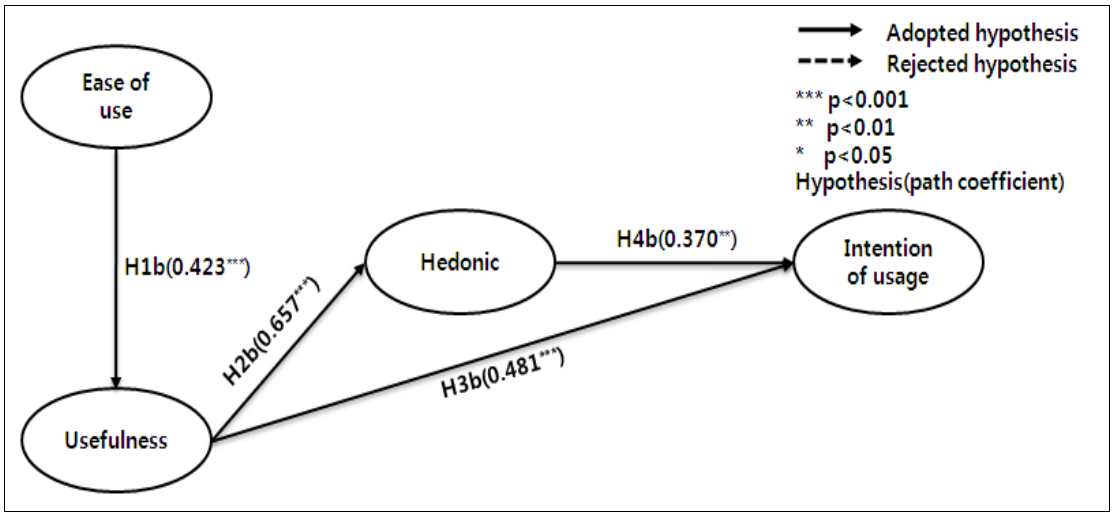


Fig. 7. Path analysis of the outdoor market

6. Conclusion

By looking at how advertisements and contents presented to consumers of smart signage, a new media incorporating IT techniques, can influence the consumers' intention to use the technology, this study conducted an empirical analysis to determine the relationship between smart signage and TAM. Especially, TAM was applied to smart signage and was used to analyze the factors of hedonic elements that differ from efficient and effective IT techniques related to the effectiveness of internal properties for business organizations as well as the performance of businesses. In this study, an empirical analysis was performed to examine the correlation between smart signage and the technology acceptance model (TAM). To this end, attempts were made to identify the path through which diverse types of smart signage content, including advertising, are affected by the intention to use and are regarded as important. In particular, factor analysis was conducted with hedonic elements, which are different from efficient and effective IT technologies that enhance an organization's internal effectiveness and job performance. As the smart signage market is in an early stage, this study focused on proposing customized measures for the vitalization of each segment of the market rather than limiting the scope to competition and regulation in a single market or between different markets. The positive (+) influence of smart signage's ease of use on the level of usefulness indicates that TAM can be applied in the same manner to the smart signage field as it is being applied to IT technologies. In other words, this study adopted hypotheses that using smart signage requires minimum effort without any difficulties and that smart signage is useful for improving the everyday lives of users. It was also confirmed that smart signage helps users

carry out tasks efficiently, as they can acquire information helpful for completing individual or organizational tasks, as demonstrated in the TAM. The positive (+) influence of smart signage's usefulness on hedonic value indicates that its usefulness in the everyday lives of users enables them to express their subjective and emotional feelings from the standpoint of information and entertainment. The positive (+) influence of usefulness on intention to use indicates that users are willing to continue using or to recommend smart signage to others when they feel that it is useful. When people use smart signage, hedonic value has a positive (+) influence on intention to use. This indicates that smart signage enables people to express their subjective and emotional feelings from the standpoint of information and entertainment while also enabling them to have a clear intention to use smart signage even to the point of recommending it to others. Ease of use, usefulness, and hedonic value are important variables influencing people to use smart signage. While application of IT technologies affects corporate organizational effectiveness and efficiency, hedonic elements affect customers' intentions to use, repurchase, revisit, and purchase goods and services in areas where new IT technologies are being applied, such as online shopping malls, video games, and mobile areas.

To analyze the market delimitation of smart signage, we established indoor market and outdoor market groups, as suggested by a group of experts, as a moderating effect of market delimitation. An indoor market is usually located inside a building, such as a shopping mall, theater, public office, or corporate building, where smart signage is installed and operated for the purpose of POS (point of sales) and POW (point of wait). An outdoor market is located outside a building, such as on store windows, at bus shelters, and at subway stations, where smart signage is installed and operated for POT (point of transit) purposes. It is more difficult to install smart signage in an outdoor market than in an indoor market, as display panels located outside a building are directly affected by sunlight. The user-group-specific path analysis of the indoor and outdoor markets of smart signage shows that influential variables, including ease of use, usefulness, and hedonic value, all have a positive (+) influence on the consequence variable of intention to use. However, the path analysis indicates that hedonic value has no influence on intention to use in an indoor market. In terms of the market delimitation of smart signage, hedonic value can serve as a factor that classifies the characteristics of the market. It was found that in an indoor market, users come to have higher intentions to use smart signage when they are provided with useful and effective content from an information perspective as compared to the entertainment elements that mainly comprise hedonic value. For example, smart signage installed in public offices or libraries should focus on user convenience, such as civil service information, indoor maps of buildings, and the location of items such as books in a library.

This study has significance in that it offers empirical evidence by applying the TAM and hedonic elements to smart signage. First, through analyses of indoor and outdoor markets which were defined from the perspective of smart signage market vitalization instead of the perspective of competition or regulation, it was found that hedonic values do not affect intention to use smart signage in an indoor market. Second, this study involved an empirical and realistic measurement of a demographically significant group of people who have experienced smart signage. Third, this study expanded the application of the TAM to fields of new technologies and businesses by applying the TAM and hedonic elements to smart signage and by studying the influence on intention to use. There may be several limitations to this study that warrant further research. First, there was a limitation in the design of the survey in terms of its ability to make a clear distinction between the survey respondents who were defined as smart signage users and existing digital signage users. Smart signage can be regarded as an area where new technologies are still being applied and assessed. Second, this

study was conducted with a survey on the Internet, using photos to describe the survey site. In the future, the survey needs to be complemented with a face to face survey. Third, researchers should attempt to identify external variables that affect the TAM, hedonic value, and intention to use so that they can be applied to the smart signage area. Lastly, it is necessary to study the advertising effect of smart signage.

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