

Exploring Determinants of Smartwatch Diffusion Using a Value Adoption Model[†]

가치수용 모델을 활용한 스마트워치 확산 결정요인 분석

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국 문 요 약

스마트워치의 확산이 예상과는 달리 더디게 진행되고 있다. 스마트워치 공급업체들은 현재의 캐즘을 극복하기 위해 새로운 전략을 수립할 필요가 있다. 그러나 스마트워치의 어떠한 속성을 전략적으로 활용하여 시장 확산을 이루어야 하는가를 타당하게 수행한 연구는 매우 드물다. 본 연구는 스마트워치가 가져다줄 것으로 예상되는 혜택과 이를 위해 치러야 할 비용을 소비자 관점에서 분석하고, 소비자의 혁신성향이 시장 확산에 기여할 수 있는지를 살펴보았다. 이를 위해 323개의 유효데이터를 확보하여 구조방정식 분석을 실시하였다. 분석 결과, 스마트워치의 두 가지 혜택(utilitarian and hedonic)과 세 가지 비용(usability, performance, and finance)이 가치인식을 통해 사용의도에 영향을 주는 것으로 나타났다. 또한 소비자의 혁신성향이 가치인식과 사용의도의 관계를 조절하는 것으로 드러났다. 주목할 점은, 소비자들이 스마트워치가 사회적 혜택을 가져다 줄 것으로 기대할 것이라는 가설이 기각되었다는 점이다. 즉, 스마트워치 사용이 소비자에게 이미지 향상을 가져다 줄 것이라는 전략은 스마트워치 확산에 큰 기여를 하지 않을 수 있다. 스마트워치의 시장 확산을 이루기 위해서는 혁신성향이 높은 소비자들을 대상으로 소비자들이 기대하는 혜택을 활용하는 전략을 수립해야 한다.

핵심어 : 스마트워치, 캐즘, 가치수용모델, 혁신성, 가치인식

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ABSTRACT

Contrary to predictions, the market diffusion of smartwatch is proceeding slowly. Smartwatch companies should pursue new strategies to overcome this so-called chasm; however, little is known about smartwatch attributes valuable for target consumers. This study investigates beneficial and sacrificial features influencing overall perceived value of smartwatch, which in turn affects usage intention, and considers moderating effect of personal innovativeness. A total of 323 usable data were analysed using partial least squares. The results show that two benefits (utilitarian and hedonic) and three sacrifices (usability, performance, and finance) significantly impact on usage intention via perceived value. A significant effect of personal innovativeness as a moderator is also observed. Interestingly, the influence of social benefits on perceived value is not supported, which means strengthening image improvement strategies might not be appropriate for the diffusion. In order to overcome the chasm, suitable strategies should be used, and focusing on consumers who are highly innovative are strongly recommended.

Key Words : Smartwatch, Chasm, Value adoption model, Personal innovativeness, Perceived value

I. Introduction

Smartwatch, which are computerized wristwatches, have developed as a breakthrough innovation in the application area of Internet of Things (IoT). Such watches deliver new values and various experiences in daily lives (Turel et al., 2010). Specifically, smartwatch continuously aggregates users' physiological, psychological, and behavioral data from their bodies. Smartwatch then deliver the data to other devices, including smartphones or tablet PCs, as basic information for analytics, intelligence, and applications. Consequently, consumers can manage their personal lives better, for example monitoring their health conditions.

In contrast to the expectations on their launch in 2012, smartwatch adoption is in perils across the technology markets. Even though smartwatch sales volume slightly increased in 2017, growth rate of the device showed a marked decline from 27.3% to 10.3% in 2017, compared with a year ago (IDC, 2018). Consumers have not yet to find a reason to buy smartwatch as well (Hartmans, 2017). Several research institutes, however, have asserted that smartwatch market will become successful that smartwatch companies should change their existing strategies in order to overcome sluggish sales, as they did for smartphones (Hong et al., 2017).

Smartwatch suppliers can gain insights from consumers' perspective. Moore (1991) insisted that any innovation can face a chasm because of recognition differences between visionaries and pragmatists; as a result, the time frame for adoption of an innovation may vary greatly. Thus, any difference in consumers' perception of smartwatches can be a driver of a chasm. The inconsistency between the reputation of a rising star such as smartwatch and slow market diffusion can be derived from consumers' different level of perceived value of smartwatch. Hence, investigating the features influencing smartwatch adoption from consumers' perspective is crucial at this time.

Some studies investigated smartwatch adoption mainly based on Technology Acceptance Model (TAM) or United Theory of Acceptance and Use of Technology (UTAUT) (Chuah et al., 2016; Wu et al., 2016). Research with Korean sample is not exception (Lee, 2014; Son et al., 2014; Back et al., 2015; Kim and Shin, 2015; Shin and Lee, 2015; Cho and

Lee, 2016; Lee et al., 2016). TAM-based studies maintain *perceived usefulness* and *perceived ease of use* as primary predictors of intention to adopt, with some other additional variables such as subcultural appeal or visibility (Kim and Shin, 2015; Chuah et al., 2016). These studies mostly concentrate on strength points of the innovation. Even though TAM-based models are recognized as a sound framework to examine technology adoption, these have been criticized for having narrowed framework which leaves out essential determinants of technology adoption (Bagozzi, 2007; Wells et al., 2010).

A value-based adoption model (VAM) has merit because it analyses consumers' overall evaluation of an innovation in terms of multiple benefits and sacrifices regarding cognitive and affective qualities (Zeithaml, 1988). Assuming that a person tends to maximize values, VAM suggests that adoption intention is determined by the entire perceived value of an innovation. Thus, this study applies VAM to investigate smartwatch adoption, where previous research could not grasp.

Some literature has argued the role of individual characteristics such as personal innovativeness in Information and Communications Technology (ICT) adoption (Martinez-Torres et al., 2015; Ozturk et al., 2016). In particular, personal innovativeness is considered as a key moderator in technology adoption (Jeong et al., 2009). However, few studies have investigated this characteristic at the value-adoption point of view (Floh et al., 2014). Research on the moderating effect of innovativeness will extend theoretical implications in ICT device adoption literature.

The purpose of this research is to investigate how smartwatch is perceived from consumers' perspective. The study then considers how this perspective positively affects usage intention, thereby hoping to find strategies for successful smartwatch diffusion. We propose that consumers decide to use smartwatch by perceiving values after comparing beneficial and sacrificial factors. In addition, we suggest that the relationship between perceived value and adoption intention is stronger when consumers are highly innovative. Hence, this study not only identifies the characteristics of smartwatch but also offers in-depth analysis of them.

II. Theoretical background

1. Value adoption model (VAM)

The concept of VAM is based on equity theory. Equity theory posits that individuals compare inputs and outputs and then try to get rid of any inequities. This is similar to the situation where potential consumers decide to buy a new device. If an innovation is thought to bring meaningful benefits more than sacrifices, consumers might intend to adopt it. In contrast, if they believe that costs dominate benefits, the likelihood of adoption might decrease. VAM is a theoretical model which describes trade-offs between benefits and sacrifices of using a new ICT innovation (Zeithaml, 1988). Perceived value is consumers' overall assessment of a product or a service based on perceptions of its benefits and sacrifices. Cognitive comparison of what is given and what to lose influences consumers' intention to purchase. VAM has been validated from empirical studies such as IPTV, Mobile Internet, and e-book subscription adoption (Kim et al., 2007; Lin et al., 2012; Hsiao and Chen, 2017). However, few studies investigated smartwatch adoption based on VAM. Although Yang et al. (2016) used the construct of perceived value of smartwatch, they did not support their research model with theoretical background of VAM.

This study establishes three benefits (utilitarian, hedonic, and social) and three risks (usability, performance, and finance) based on VAM, considering them as important determinants of perceived value of smartwatch. These benefits are chosen because tracking one's fitness and feeling enjoyment through aesthetic design can be represented by utilitarian and hedonic functions. Social benefits are selected because wearing a watch can arouse fashionable and luxurious images. However, small display size, few available applications, and high prices can be conspicuous risks associated with smartwatch; thus, we regard these risks as sacrificial variables. In addition, this study investigates the moderating effect of personal innovativeness, which extends VAM and provides an in-depth analysis of smartwatch adoption process.

2. Perceived benefits

1) Utilitarian and hedonic benefits

The literature suggests that cognitive and emotional aspects of consumption should be

differentiated (Voss et al., 2003). In the cognitive stream, utilitarian benefits are represented as a combination of functional, instrumental, and practical benefits related to an innovation's performance. Utilitarian benefits are based on extrinsic motivation, where the purpose of use is mainly to obtain desired outcomes in terms of increased personal efficiency. In the emotional stream, hedonic benefits are defined as pleasurable experience from innovation usage (Babin et al., 1994). This definition assumes that individuals' consumption is determined by their expectations regarding their experience of a product's hedonic nature, such as its aesthetics and design. Generally, consumers seek both long-term interests (utilitarian benefits) and short-term interests (hedonic benefits) when purchasing an innovation. They are mostly satisfied if utilitarian benefits are met and become more loyal to the brand once they believe that they experience hedonic benefits (Chitturi et al., 2008).

As ICT industry has become more advanced, the importance of utility and enjoyment in terms of device usage has increased. Consumers are more attracted by outstanding innovations that have as many utilitarian and hedonic benefits as possible among a significant variety of products and services. Like other ICT products, smartwatch is notable for utilitarian and hedonic features. Smartwatch operates as hubs that enables access to messaging, weather forecasts, and many more important utilitarian benefits (Chuah et al., 2016). Touch screens together with flexible forms and band colours appropriate for daily lifestyles are obviously hedonic attractions of smartwatch.

Prior studies have proved that utilitarian benefits in terms of efficiency lead to highly perceived values of innovations. For example, utilitarian benefits are validated as important determinants of a positive attitude toward smart glasses, smartwatch and IoT services (Hsu and Lin, 2016; Kim and Shin, 2015; Rauschnabel and Ro, 2016). In addition, continuous intention to use of mobile payment services is positively influenced by utilitarian benefits (Zhou, 2013).

Similarly, a great deal of research has validated the impact of hedonic characteristics. Specifically, hedonic benefits of mobile applications are proved to be an crucial antecedents of user satisfaction, continuous usage intention, and recommendation intention (Ha and Park, 2013; Xu et al., 2015). The overall value of a hedonic digital artifact also positively predicts behavior usage and word-of-mouth intentions (Turel et al., 2010).

Thus, it is meaningful to study the utilitarian and hedonic benefits of smartwatch because such benefits can play important roles in consumers' perceived value. The more consumers notice the utilitarian and hedonic aspects of smartwatch the greater value they will place on the innovation. In this study, utilitarian benefits are defined as the degree to which adopting a new product is perceived to deliver more efficiency, while hedonic benefits are specified as the degree to which the experience of consuming a new product is pleasurable. In sum, this study hypothesizes that the utilitarian and hedonic nature of smartwatch may influence perceived value.

H1. Utilitarian benefits positively influence perceived value of smartwatch.

H2. Hedonic benefits positively influence perceived value of smartwatch.

2) Social benefits

Consumer behavior is mostly affected by social norms (Kelman, 1958; Duclos et al., 2012). Such behavior coincides with social influence, which in turn enables consumers to comply with reference groups and manage self-images within such groups (Bearden et al., 1989). Consumers buy products to define, sustain, and enhance self-images with the purpose of establishing better social status within a group. In other words, consumers care about their self-images in order to gain social approval (Kelman, 1958; Duclos et al., 2012).

Smartwatch is expected to increase consumers' social image significantly. This is because smartwatch is technologically advanced watch which differentiates oneself from those who wear a traditional watches (Kuru and Erbuğ, 2013). Unlike smartphones, the primary function of smartwatch is to collect user data and present relevant information to different devices (Chuah et al., 2016). These new technological characteristics enable consumers to perceive smartwatch as a special way of enhancing their self-images. Moreover, considering that watches have remained popular despite the dissemination of smartphones, the reason for wearing watches does not lie in checking time but in displaying high status or a wearer's own signature (Insider, 2013). These imply that smartwatch can play a role as a social-image enhancer. In effect, smartwatch reflect consumers' identities and their wealth (Choi and Kim, 2016). Thus, wearing smartwatch

can deliver social benefits as a reflection and enhancement of self-images, which expect to bring social approval.

In this regard, this study defines social benefits as the degree to which innovation usage is perceived to lift one's social desirability in one's social system (Turel et al., 2007). Consumers may buy smartwatch to provide favorable images to a reference group. They are more likely to use smartwatch as tools to strengthen their images.

H3. Social benefits positively influence perceived value of smartwatch.

3. Perceived sacrifices

1) Non-monetary sacrifices: usability and performance risks

Consumers may hesitate to buy smartwatch for several reasons. Generally, before purchase, they cognitively evaluate whether or not innovations have shortcomings. They consider sacrifices in order not to face unpleasant consequences (Bauer, 1960). These sacrificial elements that decrease perceived value of innovations mainly consist of monetary and non-monetary factors (Chang et al., 2005). Non-monetary elements represent any bothersome event occurring from the process of using innovations. This notion is mostly related to the amount of effort required to use innovations. Specifically, performance malfunction, time costs, and mental fatigue are non-monetary factors that can reduce perceived values of innovations (Zeithaml, 1988).

Smartwatch has certain usability and performance risks that consumers should be concerned about. For example, smartwatch has User Interface and User Experience (UI/UX) problems. Small displays are thought to be the feature where UI/UX innovation should achieve in order to improve user-friendly interfaces. Smartwatch's constrained interactions with visual or audial cues, as well as a few usage scenarios, make consumers wary about using it. With regard to performance risks, system reliability problems such as sudden power failure or delays in loading are main technical issues that should be steadily improved. These usability and performance risks prevent consumers from perceiving the values of smartwatch.

In this vein, this study assumes that the usability and performance risks of smartwatch

hinder perceived value of the innovation. The operational definition of these risks is as follows. Usability risks are the degree to which new technology is perceived as being hard to use in terms of its UI/UX aspects. Performance risks are defined as the degree to which individuals think that an innovation has performance problems in terms of reliability and efficiency. Thus, the present study suggests negative impacts on perceived value from these two non-monetary sacrificial perspectives.

H4. Usability risks negatively influence perceived value of smartwatch.

H5. Performance risks negatively influence perceived value of smartwatch.

2) Monetary sacrifices: financial burden

Monetary sacrifices are another aspect of perceived risks which function as barriers to consumer adoption (Teas and Agarwal, 2000; Tan and Teo, 2000; Chen and Dubinsky, 2003). Consumers usually believe that buying high-tech products is risky because of uncertainties of new technology and market trends (Sarin et al., 2003). Since high-tech products are relatively expensive, consumers cannot help but examine closely financial risks.

Consumers cognitively compare whether or not a price is reasonable before deciding to make a purchase. They perceive price fairness through comparisons of prices, including past prices, the prices paid by other consumers, and reference prices (Bolton et al., 2003; Xia et al., 2004). Once consumers believe that a price is fair, the product or service is assumed to be reasonable and acceptable. However, if a price is perceived to be unfair, not only is the perception of a product's value reduced but the adoption intention is significantly declined (Campbell, 1999; Wu and Wang, 2005). This price unfairness can lead to a financial burden for some consumers.

Many studies have proved that a financial burden is a negative predictor of perceived value. For example, high cost of innovation is negatively related to perceived value of smartwatch (Jung et al., 2016). Lee (2014) found that college students tend not to purchase a state-of-the-art smartphone when they perceive that its price and maintenance costs are relatively high. In a mobile banking context, economic considerations such as high payments (Huili and Zhong, 2011) discouraged adoption intention. Park and Kim (2016)

found that high cost of smart television usage is a positive determinant of low usage intention. Additionally, a small price increase is negatively relevant to the amount of usage decisions of multimedia on-demand services (Liao et al., 2008).

The price of smartwatch includes device cost, service fees, and extra charges for additional contents fees. These various financial factors, which individuals have to consider before deciding to purchase, can be seen as price unfairness. In other words, diverse kinds of monetary sacrifices that include additional fees, despite the limited functions compared with other similar innovations, can lessen the value of smartwatch (Morgan, 2014).

Thus, this study assumes that the relationship between perceived financial burden and consumers' favorable attitudes toward smartwatch is negative. Financial burden is defined as the degree of potential loss in buying or using innovation judged by consumers in a way that is significant to them (Martinez-Torress et al., 2015).

H6. Financial burden negatively influences perceived value of smartwatch.

4. From perceived value to usage intention

Perceived values are intangible assets profiting from consumers' perspectives. The concept of perceived value supposes overall estimations from an affective and cognitive trade-off between gains and losses. According to the prospect theory (Kahneman and Tversky, 1979), individuals make decisions based on potential outcomes contingent on gains and losses. They seek lesser losses and greater gains after setting a certain reference of the outcome. Subsequently, the overall assessment is represented as perceived value in our study. That is, this study supposes that consumers would form an overall evaluation after implicitly compare benefits and sacrifices of smartwatch.

Perceived value has been validated to have powerful explanation for adoption intention (McDougall and Levesque, 2000; Lin et al., 2012). Especially, some ICT adoption studies proved that perceived value is a critical antecedent of consumer usage intention (Chen and Lin, 2015; Hsu and Lin, 2015; Lee et al., 2015). Kim et al. (2007) state that perceived value could be a better elucidation for adoption intention than Technology Adoption

Model (TAM). This implies that verifying perceived value produces a better understanding of ICT consumption process. Indeed, perceived value fundamentally works as basis for drivers of purchase intention (Sirdeshmukh et al., 2002). In this study, perceived value is defined as the degree of consumers' overall appraisal of a product based on benefits and sacrifices (Zeithaml, 1988). From the above descriptions, the present study suggests the following hypothesis.

H7. Perceived value positively influences usage intention.

5. The moderating effect of personal innovativeness

Identifying consumers' propensities has powerful implications for understanding emerging technology diffusion (Hauser et al., 2006). According to innovation diffusion theory (Rogers, 2010), adopting an innovation differs between individuals because of their various levels of innovativeness. Personal innovativeness refers to a persistent tendency receptive to new ideas and that willingly makes decisions independently from a familiar decision-making style (Midgley and Dowling, 1978). Personal innovativeness has been studied as two constructs: general and specific innovativeness (Flynn and Goldsmith, 1993). General innovativeness describes a cognitive openness to novelty across multiple technologies, while specific innovativeness postulates an attraction to newness and a willingness to adopt innovations earlier than others. This study deals with consumer characteristics reflecting the attitudes of early adopters toward emerging technology; thus, consideration of specific innovativeness is desirable. Additionally, previous research has argued that personal innovativeness manifests itself in particular domains rather than across technologies (Hirschman, 1980; Goldsmith and Hofacker, 1991). Consequently, measuring it in our model from a domain-specific perspective is appropriate.

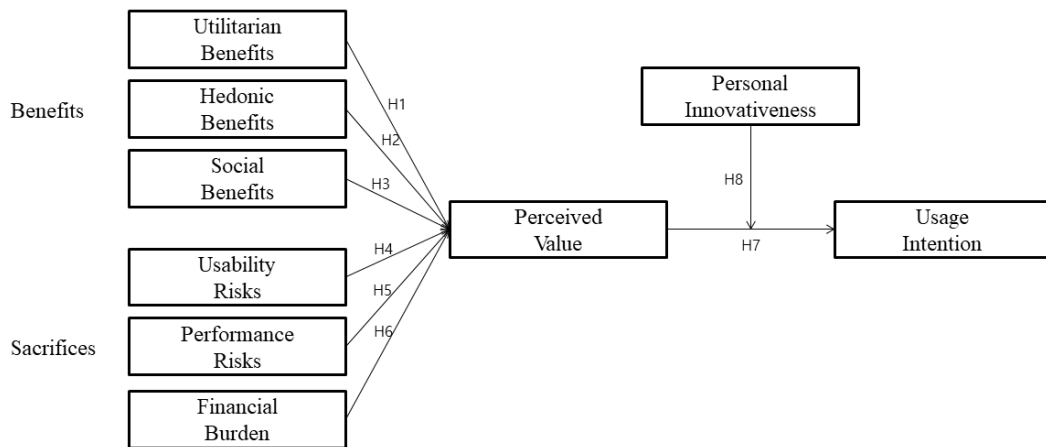
Consumer innovativeness in ICT domains is defined as "the degree to willingness of an individual to try out any new IT products or services" (Agarwal and Prasad, 1998). Highly innovative consumers tend to form beliefs about emerging technologies by aggregating information collected from diverse media. Such consumers can imagine, comprehend, and appreciate new technologies better than others (Moore, 1991; Rogers,

2010). The tendency to take risks, cope with uncertain situations, and actively find novelty arouses their desire to adopt new ICT innovation. Following from these features of innovativeness, a moderating role of personal innovativeness in the relationship between product value perception and technology adoption has been suggested (Agarwal and Prasad, 1998). The expectation of a moderating effect implies that highly innovative consumers are more likely to adopt new technology compared with those who have low degrees of innovativeness, given the same level of value perceptions of technological products.

Many studies have confirmed the moderating effects of personal innovativeness. For example, Jeong et al. (2009) found that personal innovativeness moderates the relationship between perceived need and purchase intention for mobile radio frequency identification (RFID) services. Specifically, the perceived need for a mobile RFID service has a stronger explanation for adoption intention when combined with high personal innovativeness. Moreover, personal innovativeness offsets the negative impact of perceived risks on media tablet adoption, implying that the negative relationship between perceived risks and media tablet adoption is relatively diminished for individuals with high levels of innovativeness (Yu et al., 2017). However, few articles have tested the moderating effects of consumers' characteristics with a model related to perceived value (Zauner et al., 2015). Research about the interaction effect between personal innovativeness and perceived value that amplifies the impact on behavioral intention is rare. In this study, we explore the effects of perceived value toward usage intention may be altered by consumer innovativeness; that is, highly innovative consumers are more likely to adopt smartwatch compared with less innovative consumers.

H8. Personal innovativeness moderates the relationship between perceived value of smartwatch and usage intention. Specifically, the relationship is stronger for consumers who are highly innovative.

The conceptual model examined in the present study is shown in Figure 1.



(Figure 1) The research model

III. Research Methodology

1. Data collection and respondent characteristics

This study was conducted using data collected from Korean consumers. A survey was performed by a specialized research company with face-to-face interviews. A stratified sampling method was employed ages from 20 to 39 based on Korean national census statistics of 2010. This study sampled a millennial generation because such people are more willing to adopt emerging technology like smartwatch than an older generation. Furthermore, millennial generation is considered to be narcissistic (Twenge et al., 2008), therefore they are more likely to adopt smartwatch in order not to be excluded from social group but to boost their uniqueness. A total of 392 data were collected however, after excluding 69 outliers based on boxplot analyses, the number of usable data was 323.

In the final data, the sample consists of 49.5% males and 50.5% females. Most respondents are workers (46.4%) followed by students (22.0%), housewives (13.9%), and business people (12.4%). Table 1 presents a demographic description of the respondents.

〈Table 1〉 Demographics of survey respondents

Characteristics	Frequency	Percentage
Gender		
Male	160	49.5%
Female	163	50.5%
Age (years)		
20~29	144	44.5%
30~39	179	55.4%
Occupation		
Business people	40	12.4%
Worker	150	46.4%
Student	71	22.0%
Housewives	45	13.9%
Etc.	17	5.3%

$n = 323$

2. Instrument development

All measurement items for the nine constructs were adopted from prior studies and modified appropriately for the study (see Appendix). The measurement of utilitarian benefits was based on the rationale suggested by Zhou (2013). Respondents were asked to rate how much they think about the efficiency of smartwatch. The hedonic benefits scale developed by Sweeney and Soutar (2001) was partially modified to measure pleasurable effects of smartwatch usage. The scale of social benefits adopted from Turel et al. (2010) was modified to evaluate image enhancement raised from consuming an innovation.

The usability risks scale designed by Lee et al. (2015) was adopted and modified in order to measure UI/UX inconvenience of smartwatch. Respondents were asked how much smartwatch is difficult to use. The performance risks scale was adopted from Agarwal and Teas (2001), Featherman and Pavlou (2003), and Yang et al. (2016). These items are redesigned appropriate to measure the expected performance problems of smartwatch. Respondents were asked how much they would doubt about technical function of the innovation. The measurement of financial burden was based on the rationale proposed by Martínez-Torres et al. (2015), which evaluates how much consumers feel oppressed of purchasing smartwatch.

Perceived value scale suggested by Sirdeshmukh et al. (2002) was used to assess how much consumers perceived the overall values of smartwatch. The measurement of personal innovativeness adopted from Agarwal and Prasad (1998) was used to gauge consumers'

attitude as early adopters. The scale of usage intention was originally developed by Davis (1989) and validated against Korean population (Kim & Shin, 2015; Yang et al., 2016; Yu et al., 2017). Respondents were asked to rate how much they are willing to adopt smartwatch.

IV. Results

1. Measurement model

Before evaluating the hypotheses, a validity and reliability test was performed using

〈Table 2〉 The result of a confirmatory factor analysis and scale reliability

Construct	Items	Factor loadings	AVE (> 0.5)	Composite reliability (> 0.6)	<i>Cronbach's alpha</i> (>0.7)
Utilitarian Benefits	UB1	0.949	0.917	0.971	0.955
	UB2	0.965			
	UB3	0.958			
Hedonic Benefits	HB1	0.963	0.913	0.969	0.952
	HB2	0.949			
	HB3	0.954			
Social Benefits	SB1	0.925	0.879	0.956	0.931
	SB2	0.949			
	SB3	0.939			
Usability Risks	UR1	0.696	0.702	0.875	0.854
	UR2	0.862			
	UR3	0.937			
Performance Risks	TR1	0.941	0.843	0.942	0.908
	TR2	0.881			
	TR3	0.931			
Financial Burden	FB1	0.945	0.882	0.957	0.935
	FB2	0.920			
	FB3	0.952			
Perceived Value	PV1	0.962	0.911	0.968	0.951
	PV2	0.939			
	PV3	0.963			
Personal Innovativeness	PI1	0.864	0.796	0.921	0.872
	PI2	0.913			
	PI3	0.899			
Usage Intention	UI1	0.953	0.915	0.970	0.953
	UI2	0.966			
	UI3	0.951			

SmartPLS 3.0 software. First, a confirmatory factor analysis (CFA) was conducted to examine convergent and discriminant validity. The results show that average variance extracted (AVE) and composite reliability (CR) of each item exceeds 0.7, with factor loadings above 0.60 (see Table 2). Thus, the results satisfy convergent validity (Hair et al., 2009). As shown in Table 3, discriminant validity is also fulfilled because the square roots of all the AVEs are larger than the squared correlation coefficients of each item (Hair et al., 2009). Further, all scales are demonstrated to have good reliability because each measurement of *Cronbach's alpha* is above 0.80 (Nunnally, 1978).

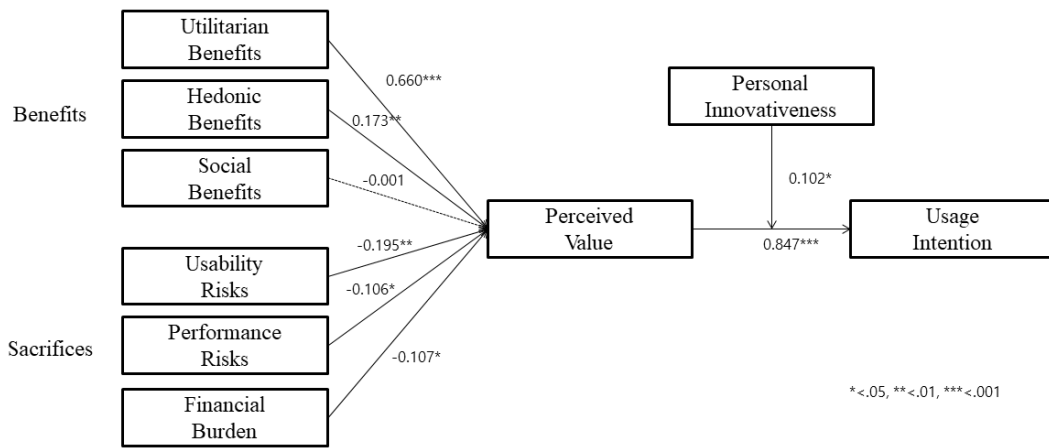
〈Table 3〉 Inter-construct correlations and square roots of AVE of constructs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Utilitarian Benefits	0.958								
(2) Hedonic Benefits	0.767	0.956							
(3) Social Benefits	0.774	0.742	0.938						
(4) Usability Risks	0.112	0.007	0.049	0.838					
(5) Performance Risks	0.008	0.024	0.051	-0.299	0.918				
(6) Financial Burden	-0.120	0.015	-0.052	-0.432	0.264	0.939			
(7) Perceived Value	0.782	0.673	0.629	-0.041	-0.067	-0.128	0.954		
(8) Personal Innovativeness	0.413	0.300	0.391	0.046	0.063	-0.074	0.409	0.892	
(9) Usage Intention	0.853	0.717	0.725	-0.054	-0.104	-0.138	0.847	0.395	0.957

Numbers in bold represent cross-loadings of constructs.

2. Hypotheses' testing

The research model was tested with structural equation modelling. As shown in Figure 2, all the hypotheses were supported except for H3. The results showed that consumers' perceived value of smartwatch is determined by two benefits (utilitarian and hedonic) and three sacrifices (usability, performance, and finance). The strongest effect on perceived value is utilitarian benefits ($\beta=0.660$, $t=8.066$, $p<0.001$) followed by usability risks ($\beta=-0.195$, $t=2.848$, $p<0.01$) hedonic benefits ($\beta=0.173$, $t=2.174$, $p<0.01$), financial burden ($\beta=-0.107$, $t=1.963$, $p<0.05$), and performance risks ($\beta=-0.106$, $t=2.049$, $p<0.05$). However, social benefits do not significantly influence perceived value ($\beta=-0.001$, $t=0.017$, $p=n.s.$). The results also indicate that perceived value positively explains smartwatch usage



(Figure 2) Summary of analysed coefficients in the research model

<Table 4> The result of the moderation effect

Path	Main model		Interaction model	
	Estimate	P	Estimate	P
Utilitarian Benefits → Perceived Value	0,660	8,182***	0,660	8,066***
Hedonic Benefits → Perceived Value	0,173	2,733**	0,173	2,714**
Social Benefits → Perceived Value	-0,001	0,017	-0,001	0,017
Usability Risks → Perceived Value	-0,195	2,842**	-0,195	2,848**
Performance Risks → Perceived Value	-0,106	2,044*	-0,106	2,049*
Financial Burden → Perceived Value	-0,107	2,019*	-0,107	1,963*
Perceived Value → Usage Intention	0,847	37,182***	0,804	24,072***
Personal Innovativeness → Usage Intention			0,073	2,095*
Perceived Value * Personal Innovativeness → Usage Intention			0,102	2,149*
R ²	0,717		0,730	
ΔR ²			0,013	
f ²			0,046	

* < .05, ** < .01, *** < .001

intention ($\beta=0.847$, $t=24.072$, $p<0.001$).

Additionally, the results prove that personal innovativeness works as a moderator (see Table 4). Namely, the research model's explanatory power significantly increases when the interaction term is included ($\Delta R^2=0.013$, $\beta=0.102$, $t=2.149$, $p<0.05$). Moreover, in order to clarify the magnitude of the moderating effect independently from the sample's size, Cohen's f^2 was examined (Cohen, 1992). Cohen's f^2 is appropriate for gauging the effect size of a particular construct in a regression model. The result of Cohen's f^2 shows that a small but significant moderating effect exists in the research model (Cohen, 1992). These results explain that the relationship between perceived value of smartwatch and usage intention is stronger for consumers who are highly innovative, thus supporting H8.

V. Discussion

The objective of this study is to examine associations between mixed consumer perceptions and low adoption of smartwatch, and suggest implications for its wide adoption. To this end, we investigate the effects of smartwatch's benefits and sacrifices on usage intention through perceived value, and a moderating effect of personal innovativeness. As a result, all the hypotheses are supported except for H3. It is possible to state that utilitarian and hedonic benefits, as well as all sacrifices, are antecedents of perceived value. Further, perceived value positively impacts on usage intention. The moderating effect of personal innovativeness is also validated. Interestingly, when comparing the mean values of benefits and sacrifices, it is clear to see that consumers place more importance on the strong features of smartwatch rather than the restricted aspects.

In hypotheses 1 and 2, this study investigates the effects of utilitarian and hedonic benefits on perceived value. Utilitarian benefits are shown to be a strong predictor of perceived value. This result agrees with prior research in that utilitarian factors explain the greater part of ICT device adoption (Venkatesh and Brown, 2001). Such an outcome suggests that consumers mainly use smartwatch for utilitarian reasons rather than other benefits. Consumers seem to place importance on utilitarian benefits when adopting smartwatch because they can experience unique characteristics of innovations such as

tracking fitness and wellness and brief checks of useful information. Such benefits deliver a more convenient lifestyle compared with smartphone usage. Thus, enabling consumers to perceive utilitarian benefits is important to increase smartwatch adoption. Hedonic benefits also positively affect perceived value. Significant hedonic benefits include many of enjoyable characteristics inherent in smartwatch. This finding is consistent with prior research about the effects of hedonic benefits on technology adoption (Chun et al., 2012; Kim and Sundar, 2014; Kesari and Atulkar, 2016). Since consumers seek pleasure when using smartwatch, hedonic benefits increase perceived value.

Note that social benefits have no significant effects on perceived value. This finding implies that wearing and using smartwatch are not factors that deliver positive images to consumers. This can be explained that smartwatch are mainly recognized as instrumental products rather than ostentatious innovations that improve social desirability. According to prior studies, some emerging technologies such as telemedicine (Croteau and Vieru, 2002) and new ways of in-app purchases (Hsu and Lin, 2015) do not have social functions. Moreover, assuming that people are not concerned about a reference group when purchasing a private product (Bearden and Etzel, 1982), smartwatch may be perceived as private innovations. Consumers may see smartwatch as personal lifelogging products rather than something to boast about; thus, they do not use these innovations for symbolic reasons.

In hypotheses 4, 5, and 6, this study confirms the effects of sacrificial components on perceived value. Notably, it is found that the impact sizes of the three risks seem to be evenly distributed and are relatively smaller than beneficial factors. Such results agree with a prior study about perceived value of wearable devices (Yang et al., 2016). The outcomes suggest that those who hesitate to adopt smartwatch do not do so because of one critical caveat. In other words, the reasons for smartwatch chasm may not solely be due to the negative features of smartwatch. Rather, less recognized of strong points may be causes of the chasm. Thus, pragmatists may not be aware of the ways in which smartwatch deliver better lifestyles, especially in terms of utilitarian and hedonic benefits.

The current study also discloses that perceived value has a significant effect on usage intention. This result is consistent with general beliefs that consumers' perceived value is a decisive antecedent of technology adoption (Chen and Lin, 2015; Hsu and Lin,

2015; Lee et al., 2015). Comprehensive evaluation based on benefits and sacrifices of smartwatch is important process for consumption. Thus, encouraging consumers to develop a perceived value about smartwatch is very important.

The moderating effect of personal innovativeness is verified as well. Consumers who perceive the value of smartwatch are more likely to use the innovation when their innovativeness levels are high. Such result is in line with previous studies that confirmed the moderation effect of personal innovativeness in technology adoption context (Jeong et al., 2009; Yu et al., 2017). We speculate that highly innovative consumers have a greater tendency to develop a view of positive value of smartwatch because they are able to visualize and imagine the use of a promising technology more effectively than consumers with low innovative (Rogers, 2010; Morgan, 2014). Thus, smartwatch usage intention may be stronger when consumers are highly innovative.

1. Implications

By confirming and extending prior findings, this study has noteworthy theoretical and practical contributions for technology adoption literature. Theoretically, this study verifies the impacts of beneficial and sacrificial factors of smartwatch on usage intention. Few studies have examined the antecedents of smartwatch adoption (Kim and Shin, 2015; Chuah et al., 2016). Moreover, studies analyzing such adoption based on VAM are rare. Thus, our current study is at the forefront of research in that it provides empirical foundations of consumers' smartwatch value perception. In particular, this study makes meaningful contributions to a broadening of technology adoption literature by applying value adoption theory.

Above all, this study identifies the moderating effect of a consumer characteristic toward new technology usage intention. There is a lack of empirical evidence, especially in perceived value studies, in spite of the importance of such research (Zauner et al., 2015; Tasci, 2016). Indeed, few studies have addressed the moderating effect of personal innovativeness between perceived value and usage intention. However, this study investigates the moderating effect by combining personal innovativeness with smartwatch value perception. This approach is valuable because it provides a more comprehensive

explanation of consumers' technology adoption behavior, thereby narrowing a research gap and enriching new ICT innovation diffusion literature.

Practically, this study offers substantial implications for smartwatch providers. Considering that smartwatch face a chasm, our study gives strategies for diffusing smartwatch successfully within the technology market by analyzing consumers' perspective. The details affecting usage intention can be used for devise developing and marketing strategies. This study proves that consumers perceive the value of smartwatch when these have utilitarian and hedonic benefits rather than social benefits. Functional benefits may be the core reason why consumers adopt smartwatch. Appeals to consumers about innovative smartwatch should be focused on utilitarian and hedonic aspects. Thus, emphasizing the special functions of smartwatch would be an efficient strategy. However, strategies to accentuate social features of smartwatch should proceed with caution. In other words, pragmatists were probably unresponsive to strategies when emphasized luxurious and fashionable aspects of smartwatch. Therefore, in order to escape from the chasm, it is recommended that viable strategies be used, such as highlighting the practical functions.

Moreover, the present study reveals that the three identified sacrifices definitely limit perceived value of smartwatch. However, the effect sizes are relatively small, suggesting that the sacrifices may not be fatal factors that delay smartwatch propagation. The reasons for a chasm may be due to the blurry and less recognized utilitarian functions of smartwatch. Plans for minimizing the sacrifices may be inadequate for the purpose of convincing pragmatists to use smartwatch. Thus, strategies emphasizing the utilitarian and hedonic benefits of smartwatch, rather than trying to supplement the sacrifices, may be more appropriate ways of bridging the chasm.

Finally, a segmentation strategy that targets consumers highly innovative would be an efficacious plan because positive word-of-mouth advertising can then be expected to spread. Word-of-mouth has significant effects on consumer behavior (Berger, 2014). Consumers are made aware of new products and persuaded to buy them through word-of-mouth. This important strategy is primarily conducted by those who are highly innovative (Van den Bulte and Wuyts, 2009). Once innovative consumers praise the performance of smartwatch, this positive impression extends to the public. Thus, strategies should focus on highly innovative consumers.

2. Limitations and future directions

As with any study, this research has some limitations that can be addressed by future research. First, this study was only conducted in Korea and almost all respondents were young people. Although awareness of high-tech products is largely domain of young people, the approach taken here may constrain general application. Future research should investigate consumer adoption with more heterogeneous samples. Second, even though this study provides fruitful insights for smartwatch adoption in terms of benefits and sacrifices, future research could identify other characteristics that impact on perceived value or technology adoption. Considering that smartwatch have various kinds of attributes, other features such as security risks need to be investigated. According to Hirschman (Hewlett-Packard, 2015), smartwatch is vulnerable to cybercriminals. Thus, security risks may significantly influence perceived value of smartwatch. Finally, there should be more efforts toward exploring moderators for efficient diffusion of smartwatch. Prior research about wearable devices shows opposing results regarding the consequences of social benefits toward adoption. Some articles claim the importance of fashionable aspects of wearable devices (Choi and Kim, 2016) while others, including this study, demonstrate non-significant effects of social benefits (Turel et al., 2010; Hsu and Lin, 2015). This inconsistency suggests the existence of moderators. Since social features differ from individuals or economic conditions, future research should deal with this issue to broaden technology adoption literature. Despite such limitations, our study contributes to a greater understanding of smartwatch adoption. This contribution offers a basis for future research about related topics.

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Appendix

Survey items by construct

Constructs	Items
Utilitarian Benefits	
UB1	Smartwatch can improve my living and working efficiently.
UB2	Smartwatch can improve my living and working effectively.
UB3	I feel that smartwatch are useful.
Hedonic Benefits	
HB1	Smartwatch is the one that I enjoy.
HB2	Smartwatch makes me want to use them.
HB3	I feel relaxed about using smartwatch.
Social Benefits	
SB1	The use of smartwatch helps me feel acceptable.
SB2	The fact that I use smartwatch makes a good impression on other people.
SB3	The use of smartwatch gives me social approval.
Usability Risks	
UR1	I cannot understand the overall interface of smartwatch.
UR2	It is difficult to learn how to use smartwatch.
UR3	It is hard to use smartwatch.
Performance Risks	
TR1	There is a possibility that performance of smartwatch will be below expectations.
TR2	I doubt that smartwatch will perform the functions that were described.
TR3	There is a chance that will be something wrong with smartwatch or not working properly.
Financial Burden	
FB1	The price of smartwatch is generally high.
FB2	The fees imposed on smartwatch service usage is expensive.
FB3	The quality-price ratio of smartwatch usage is costly.
Perceived Value	
PV1	Compared to the fee I need to pay, the use of smartwatch would offer value for money.
PV2	Compared to the effort I need to put on, the use of smartwatch would be beneficial to me.
PV3	Compared to the time I need to spend, the use of smartwatch would be worthwhile to me.
Personal Innovativeness	
PI1	If I heard about a new information technology, I would look for ways to experiment with it.
PI2	Among peers, I am usually the first to try out new information technologies.
PI3	I like to experiment with new information technologies.
Usage Intention	
UI1	I intend to use smartwatch in the future.
UI2	I expect that I would use smartwatch in the future.
UI3	I plan to use smartwatch in the future.