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Investigating factors influencing the market success or failure of IT services in Korea

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ABSTRACT

Many information technology services have been introduced in Korea since the great success of ADSL and CDMA operations, but only a few of these services have succeeded in achieving market diffusion as well as revenue. The success or failure of IT services has significant impact on the national economy and customer welfare. Despite the importance of this sector, there are few studies on the causes underlying the market performances of IT services. This study investigated the critical factors leading to the market results of IPTV, VoIP, W-LAN, WiBro, T-DMB, and S-DMB services in Korea. Using expert surveys and AHP methods, the success or failure factors were identified and their relative weights were evaluated. The results obtained were as follows: (i) The success of such services was mainly due to meeting customer needs, low facility investment costs, service competitiveness, support of ecosystem, and active marketing activities. (ii) The absence of a business model was related to the partial success of services. (iii) Government policy affected service success or failure.

1. Introduction

Following the great success of broadband and digital mobile services through Asymmetric Digital Subscriber Line (ADSL) and Code Division Multiple Access (CDMA) operations in the late 1990s, many new Information Technology (IT) services have emerged, with some of them succeeding in terms of market performance. This rapid diffusion has brought a great deal of change and innovation in people's lives and in the structure of the industry, allowing Korea to rise as the major IT- leading nation (Lee, 2003; Korea National Information Society Agency (NIA), 2014).

The dynamic bonds between technological development, government policy, and the providers' businesses generally play adequate roles in the introduction and diffusion of new services in the IT sector (Paik, Kim, & Park, 2010). IT services require huge investments in research and development (R&D), network deployment, and marketing activities. They may be affected by linkages among stakeholders, promotional policies, or changes in regulation. The strong network effects of the industry have major impacts on customer behavior regarding adoption and usage, with the evolution or termination of a service seeing an increase or a decrease in subscriber benefits, respectively (Mohr, Sengupta, & Slater, 2009). Therefore, the success or failure of IT services has significant impacts on the national economy, customer welfare, and service providers (Ahn, Kim, & Lee, 2005).

However, not all telecommunication and broadcasting services in the Korean IT sector have experienced market success. Some, such as Internet Protocol Television (IPTV) and Voice over Internet Protocol (VoIP), were successful in terms of subscriber diffusion and revenue, but others, such as Wireless Broadband (WiBro) and Satellite-Digital Multimedia Broadcasting (S-DMB), were not. Territorial-DMB (T-DMB) and Wireless Local Area Network (W-LAN) both secured a sizeable number of users, but their revenues were poor.

New products or services were reported to have a success rate of less than 50% (Cooper & Kleinschmidt, 2011). Therefore, it is important to identify the factors affecting market performance from cases of failure, as well as success, in theoretical and practical considerations of new product development (NPD). Many studies on NPD

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have focused on firm-level or specific products (Ernst, 2002). Only a few have examined NPD from an industrial perspective, including customer, ecosystem, competition, policies, and firm activities.

Related studies have generally been carried out within two categories: (i) the diffusion factors of a particular service like Broadband or IPTV (e.g.,Lee, Park, Lee, & Brown, 2015: Yamakawa, Cadillo, & Tornero, 2012), (ii) the determinants of a failed service like WiBro (e.g., Paik et al., 2010; Park, Kim, & Nam, 2015).

However, there are few studies on the causes affecting the success or failure of major IT services from a market performance perspective (Ahn et al., 2005). To examine this, we first selected the major services that have emerged since the mid–2000 s in Korea. We then examined the success and failure factors from an industrial viewpoint, utilizing expert surveys and the Analytic Hierarchy Process (AHP) method.

2. Major IT service deployments in Korea

In the late 1990s, new fixed and mobile IT services emerged in Korea. Code Division Multiple Access (CDMA), a digital mobile telecommunication system, and Asymmetric Digital Subscriber Line (ADSL), a high-speed broadband system, were introduced in 1996 and in 1998, respectively. These services were the first to be commercially successful. Their success was due to the strong demand for broadband and mobile communication services, major investments in networks and marketing by operators, technology development strategies, and promotion policies (Choudrie & Lee, 2004; Chung & Lee, 1999; Han, 2007). Since then, the broadband and mobile communications markets have continued their rapid growth and many new services have developed, based on technological advances, government policies, and business strategies implemented in the 2000s (Korea Ministry of Science, ICT and Future Planning (MSIP), 2014).

The Korean government began implementing policies for the introduction and promotion of new services such as WiBro, S-DMB, and T-DMB through the so-called “IT 839 strategy” from 2004. Fixed-line operators launched W-LAN in 2002, VoIP in 2005, and IPTV in 2008, respectively (Korea Information Society Development Institute (KISDI), 2014). CDMA service evolved into Wideband Code Division Multiple Access (WCDMA, 3rd generation service) in 2003 and WCDMA into Long Term Evolution (LTE, 4th generation service) in 2011. ADSL service evolved into Very high data rate Digital Subscriber Line (VDSL) in 2003, Fiber To The Home (FTTH) and Hybrid Fiber Coax (HFC) based on the Broadband convergence Network (BcN) from 2004, and Giga Internet since 2011 (Korea Internet and Security Agency (KISA), 2013). Table 1 shows the core service, provider, subscriber scale, and current status of major IT services rolled out in Korea since the mid-2000s.

W-LAN, or Wi-Fi, is a fast wireless Internet service provided mainly in indoor areas or hot-spot zones by major telecommunications companies and public or private institutes. It provides the benefits of fast transmission speeds, a very low price burden, and the creation of content usage environments, but has limited coverage and intermittent connectivity (Kim & Park, 2008). W-LAN is available at an extremely low price for smartphones, desktop PCs, and laptops in homes, offices, streets, cafes, and subways in Korea. As of 2014, 79.0% of total households in Korea have such equipment at home and 83.7% of people had used the service over the past year (KISA, 2014; MSIP, 2014).

S-DMB and T-DMB were developed to provide broadcasting and multimedia services over satellite and Very High Frequency (VHF) bands, respectively. In Korea, T-DMB was available for free on smartphones and navigation devices, but this was not the case for S-DMB. TU-Media, a subsidiary of SK Telecom, provided S-DMB services, while T-DMB was operated by multiple dedicated broadcasters such as KBS, MBC, and others (Jee & Kim, 2005). S-DMB subscribers exceeded 2 million people at one point (around 4% of the total population), but low revenues due to a decrease in subscribers eventually resulted in the termination of the service in 2012. More than 10 million people (30.8% of population) were using T-DMB as of 2014, but the attractiveness of this service has decreased slightly under the influence of competing services such as Video on Demand (VoD) over 4G LTE (KISDI, 2014; MSIP, 2014).

VoIP, or Internet telephony, is an inexpensive voice and short message communication service using Internet transmission networks. The quality of the service was slightly worse than that of fixed phones, but has greatly improved over the years. Many service providers including major telecommunications companies and cable operators have entered the market (Kim et al., 2009). The service has expanded rapidly, securing 12.6 million households, around 70% of total households, by 2013 (MSIP, 2014; NIA, 2014).

WiBro is a wireless broadband service that was devised to increase data transmission speeds compared with existing mobile telecommunications and to add mobility to W-LAN in Korea. Two dedicated operators, KT and SK Telecom, launched commercial services in 2006, but deficiencies in these firms’ activities, including inadequate investments in marketing and networks, caused low diffusion levels of this service (Kim, Park, & Paik, 2014; Paik et al., 2010).

IPTV is a multimedia platform providing broadcasting and VoD services over Internet networks; it is operated by major broadband service providers such as SK Broadband, KT, and LG U+. Thanks to the high penetration rate of broadband, rich content, and the promotion of bundling services, IPTV has rapidly diffused each year, having more than 10 million households as subscribers or around 55% of total households by 2014 (KISA, 2014; MSIP, 2014).

3. Research background

Many studies have attempted to identify critical success factors underlying market performance in the field of new product development (Ernst, 2002). These studies have mainly examined the impact of organizational structure, innovation culture, personnel roles, and the environmental characteristics of NPD (Evanschitzky, Eisend, Calantone, & Jiang, 2012).

However, there are few studies on the success or failure factors influencing market performance that focus on IT services. Some studies have focused on individual services such as broadband, Internet, WiBro, and IPTV, as shown in Table 2.

Relevant factors were identified through either a socio-technical approach or a stockholder model, using the case study, Delphi, or expert survey methods. Choudrie and Lee (2004) examined the institutional drivers (government leadership, competition between providers, low prices) and socio-cultural factors (cultural, geographic, and demographic aspects) for rapid broadband diffusion in Korea. Picot and Wernick (2007) identified the role of market regulation and public policies in promoting Internet deployment across the United States, Europe, and Korea. Paik et al. (2010) derived the factors influencing the low market diffusion of WiBro in Korea, from firm activity and regulation perspectives. Yamakawa et al. (2012) focused on market demand, public policies, and firm investment to identify the success factors for broadband expansion in Peru. Adhiarna et al. (2013) extracted Radio-Frequency Identification (RFID) adoption factors in Indonesia, focusing on the market, firm activities, and public policies. Lee et al. (2015) identified IPTV market diffusion determinants in 31 countries, including competition and market size aspects. Park et al. (2015) analyzed the failure factors of Korea’s WiBro service in terms of business activities and government policies. These studies found that the critical factors influencing success and failure could be classified into such various

Table 1
New IT services in Korea since the mid-2000s.

New service	Core service	Service provider	Starting year	Max. users	Current status (as of December 2014)
W-LAN	Fast wireless Internet service mainly in indoor areas	Major telcos or public institutes	2002	2014: 79.0% (of households)	Most available for free via smartphone or notebook
S-DMB	Broadcasting and multimedia services using satellite	Dedicated operator (TU Media)	2005	2009: 200 (ten thousands of people)	Service terminated in 2012
T-DMB	Broadcasting and multimedia services using VHF bands	Dedicated operators (broadcasters)	2005	2012: 30.8% (of population)	Available for free via smartphone and navigation devices
VoIP	Voice communications over Internet network	Major telcos or cable operators	2005	2013: 1262 (ten thousands of households)	Subscriber saturation after 2013
WiBro	Fast and seamless wireless Internet service in indoor & outdoor areas	Dedicated operators (KT, SK Telecom)	2006	2012: 105 (ten thousands of people)	Subscriber decrease since 2013
IPTV	Broadcasting and multimedia services over Internet network	Major broadband operators	2007	2014: 1084 (ten thousands of households)	Annual subscriber increase

Source: KISA, 2014; KISDI, 2014; MSIP, 2014; NIA, 2014.

categories as customer needs, investments, marketing activities, competitions, and government policies, among others.

Studies on the common factors affecting performance results of various services from an industrial perspective are rare, except for Ahn et al. (2005), which examined the common failure factors of 15 services in Korea in terms of market, technology, and firm activities.

4. Research procedure and methodology

This study's purpose is to identify the success and failure factors specifically influencing major Korean IT services' market performance.

The study began with the selection of IT services for analysis; relevant factors were identified using findings from existing literature and through expert reviews, as illustrated in Fig. 1. We

Table 2
Prior studies on the success or failure factors of IT service.

Researcher	IT service	Method	The findings
Choudrie and Lee (2004)	Broadband	Secondary data analysis	Key success factors in broadband diffusion in Korea Government leadership Fierce competition Low prices due to competition Cultural, geographic, and demographic aspects
Ahn et al. (2005)	15 IT services	Case study and expert survey	Market failure factors Ineffective marketing activities Poor demand forecasting Failure to satisfy technical specifications Loss of cost advantage Loss of utility advantage Decrease of market attractiveness Insufficient or low quality of content
Picot and Wernick (2007)	Internet	Case study	Success factors in major countries Support policies for the diffusion of Internet Competition promotion policy Regulatory approach
Paik et al. (2010)	WiBro	Expert survey	Low diffusion factors in Korea Lack of investment Indistinct positioning Insufficient promotion policy
Yamakawa et al. (2012)	Broadband	Expert survey	Success factors of broadband in Peru Expand the availability of infrastructure National policy on broadband Development of effective competition Stimulating demand
Adhiarna et al. (2013)	RFID	Delphi	The factors for RFID adoption and diffusion in Indonesia RFID policy Vision of leadership RFID potential market
Lee et al. (2015)	IPTV	Secondary data analysis	Determinants of IPTV diffusion in 31 countries Broadband platform competition Pay TV market size
Park et al. (2015)	WiBro	Delphi	Failure factors in Korea Lack of demand Expensive service plan Uncertain business model Insufficient investment in facilities Limited device types Lack of content

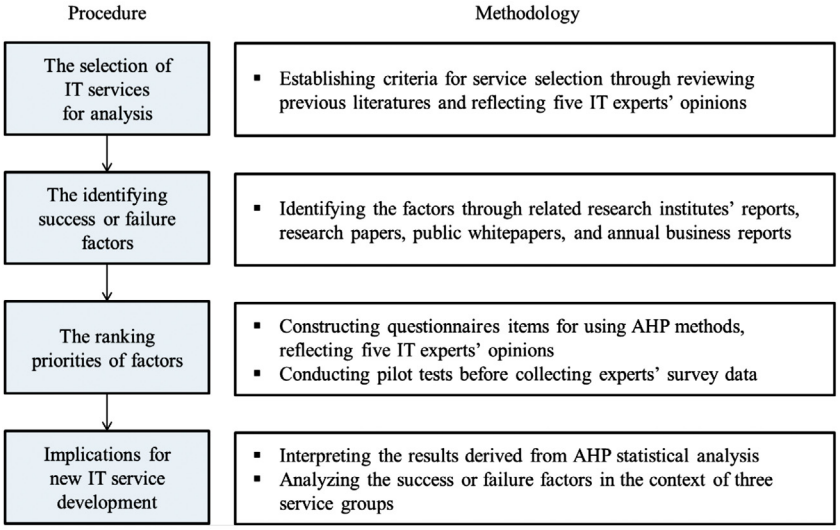

Fig. 1. Research procedure and methodology.

established criteria for service selection by reviewing previous literature (Ahn et al., 2005; Mohr et al., 2009; Urban & Hauser, 1993), and by reflecting five IT experts' opinions; these experts engaged in government-funded research institutes and universities, majored in IT business and engineering, and held a master's degree or higher qualifications, and had over ten years' job experience. We also identified the factors through related research institutes' reports and research papers (KAIT, 2015; KISA, 2013, 2014; KISDI, 2012, 2014, 2015), public whitepapers (MSIP, 2014), and annual business reports from KT or SK telecom.

The factors' relative weights were then evaluated using the Analytic Hierarchy Process (AHP) method, with data collected from expert surveys. We constructed questionnaires items for using AHP method, also reflecting the five IT experts' opinions, and conducted pilot tests on seven other experts in government, service providers, and universities before collecting experts' survey data.

Finally, we discussed the implications of these findings for the development of new IT services. We accomplished this by interpreting the results derived from the AHP statistical analysis on 60 usable survey data. We also analyzed success or failure factors in the context of three service groups.

4.1. AHP analysis method

The Analytical Hierarchy Process (AHP) method is an analytical approach used for decision-making with multi-criteria or priority identification with multi-attributes (Saaty, 1994). The AHP approach starts by setting the multi- criteria or various items necessary for achieving an overall goal, with the weight of each of these multi-items generally being obtained through expert surveys. Then pairwise comparisons for multi- criteria are conducted on a 9-point scale.

The advantages of the AHP method are as follows. First, hierarchical structure analysis makes it easy to identify the relative importance of multi-items for complex decision-making, alternative selection, and comparison. Second, it makes a systematic quantitative approach possible through the use of expert surveys and software packages, providing a method to measure items that are difficult to quantify. Finally, it can be used in various fields such as decision making, the choice of alternatives, and the identification of factors in the public and private sectors. The disadvantage of AHP is that it is difficult to secure the required evaluators and experts. This leads to significant time and money spent on evaluator workshops or expert surveys (Paik et al., 2010; Saaty, 1990, 1994).

The AHP method has been used to analyze critical success factors (CSF) (Chen & Wang, 2010; Chin, Chan, & Lam, 2008), the factors of strengths, weaknesses, opportunities, and threats (SWOT) (Kahraman, Demirel, & Demirel, 2007), promotion issues (Farid et al., 2015), and adoption factors (Adhiarna, Hwang, Park, & Rho, 2013; Nikou & Meizei, 2013).

Chen and Wang (2010) analyzed 20 critical factors of success in the information service industry in developing international markets, using the AHP method. Chin et al. (2008) identified and prioritized seven major and 17 subcritical success factors for cooperative strategies in Hong Kong industry, using the AHP method applied to expert interviews. Kahraman et al. (2007) used AHP to prioritize the sub-factors of strengths, weaknesses, opportunities, and threats of e-government strategies in Turkey. In Adhiarna et al. (2013) , AHP was applied to identify the most important factors for RFID adoption and diffusion in Indonesia. Farid et al. (2015) classified and prioritized 16 critical issues for the promotion of e-learning in Pakistan using AHP. Nikou and Mezei (2013) used AHP analysis in the evaluation of mobile services and significant adoption factors, showing that the AHP method is useful in identifying factors influencing adoption in terms of consumer preference.

4.2. The selection of IT services for analysis

For the analysis, we selected IT services introduced by major telecommunication companies and broadcasters in Korea during the 2000s that did not have customer bases from existing services. Six services satisfied the selection criteria: IPTV, VoIP, W-LAN, WiBro, T-DMB, and S-DMB.

Following Griffin and Page (1993) and Ahn et al. (2005), we classified the services into three groups: Successful group, partially successful group, and failure group. The successful group is defined as "currently active services that have good performance in subscriber scales and revenue perspectives." The partially successful group represents "currently active services that show a good performance in one aspect of subscriber scales and revenue." The failure group is defined as "terminated services or currently active services that have poor performance in both subscriber scale and revenue perspectives."

After reviewing various public documents and research papers, we classified the six services into three groups. The

Table 3
IT services classified by performance in Korea.

Service	Group	Performance	
		Subscriber scale	Revenue
IPTV	Successful	Good	Good
VoIP			
W-LAN	Partially successful		Poor
T-DMB			
WiBro	Failure	Poor	
S-DMB			

appropriateness of the services and the groups were confirmed by five senior researchers engaged by IT research institutes, universities, or industries. Table 3 shows the classified groups: (i) the successful group, consisting of IPTV and VoIP, (ii) the partially successful group, consisting of W-LAN and T-DMB, and (iii) the failure group, consisting of WiBro and S-DMB.

4.3. Expert survey for data collection

An expert survey was conducted for data collection. The survey items were established based on previous literature and a group discussion carried out by five senior researchers. Each researcher had more than ten years of research experience in an IT research institute, a university, or in the IT industry. A pairwise comparison of the 9-point scale on the survey items was conducted for AHP. Statistical analysis was performed with AHP software and Excel.

The expert survey was conducted by a survey-specialist company through h face-to-face interviews during the first half of 2014. The experts selected had a master's degree or higher and at least seven years of experience in R&D, policy, and business in IT services. 62 questionnaires were collected and 60 questionnaires excluding inadequate responses were analyzed.

Table 4 shows the characteristics of the 60 experts. Their average level of experience in IT was 15.2 years and their majors were either in IT-related engineering (58.3%) or business administration/economics (41.7%). Their affiliations were university (35.0%), IT research institute (28.3%), and industry (36.7%). Fifty-eight percent have a master's degree, whereas 42% have PhDs.

Table 4
Expert profile.

Affiliation	Proportion	Detail
University	35.0%	Seoul National University, KAIST, POSTECH, Yonsei University, Hanyang University, Korea University, Sogang University, Konkuk University, Sungkyunkwan University, etc.
IT research institute	28.3%	Electronic and Telecommunications Research Institute, Korea Internet and Security Agency, Korea Science and Technology Policy Institute, Korea Radio Promotion Agency, Korea Information Society Development Institute, Korea Science and Technology Policy Institute, etc.
Industry	36.7%	Samsung Electronics, LG, KT, SK Telecom, Samsung Economic Research Institute, LG Economic Research Institute, Samsung SDS, Technovation consulting, etc.

5. Results

5.1. Factors leading to success

According to the Korea Association for ICT promotion (KAIT, 2015), in terms of market diffusion, IPTV and VoIP both succeeded in securing more than 10 million households as subscribers in Korea as of 2014, or more than 50% of total households. These service providers obtained stable revenues over break-even points, as shown in Table 5 (KAIT, 2015; MSIP, 2014).

The high-quality broadcasting and multimedia available on demand over IPTV's digital television system have stimulated strong customer demand and brought relative advantages compared with cable television through rich content, brighter and sharper pictures, greater service and better system quality (Jang & Noh, 2011; Shin, 2009). The inability to provide real-time broadcasting in the early stages of IPTV service depressed the market. When these regulatory risks disappeared in 2008, IPTV began to absorb the demand for digital broadcasting. The usage of broadband networks as core infrastructure enables the IPTV operators to lower the expenses of facility investment. Its business model as a content platform is helpful in expanding revenue sources from monthly usage fees, charges for VoD, and advertisements over IPTV. The ecosystem, including a set-up box with the world's leading technology capability and a wide range of content available in large quantities, has supported the availability and usefulness of IPTV. Fierce competition between IPTV operators has promoted marketing activities such as the production strategy of bundling broadband, IPTV, and even mobile telecommunications services (Lee et al., 2015).

VoIP has increased the market demand for cheaper voice calls, even allowing for a small sacrifice in quality of service in Korea. As the system utilizes the network infrastructure of broadband or cable broadcasting, VoIP carriers were able to reduce the cost of network investment and provide nationwide service immediately. These economic benefits were critical factors behind the diffusion of VoIP as a replacement for the existing modes of telephony (Kim et al., 2009). The marketing competition between the carriers, including various price structures, bundling strategies, and excessive gifts, acted to promote the trend of customers switching to VoIP from fixed-line telephony. The introduction of number portability between landline and Internet telephony in 2008 has contributed to the market activation of VoIP by lowering the barriers to switching operators (Kwak & Lee, 2011).

The success factors of these services in Korea were analyzed to be sufficient customer demand, low facility investment cost, relative advantages compared with competing services, clear business models, sufficient ecosystem support, active marketing, and regulatory policy changes, as shown in Table 6.

5.2. Factors leading to partial success

W-LAN and T-DMB are both popular services, with each having an excess of 10 million subscribers in 2014; however, these

Table 5
The market performance of IPTV and VoIP in Korea (unit: ten thousand households, one billion KRW).

Service/Year		2008	2009	2010	2011	2012	2013	2014
IPTV	Subscriber	159.3	237.4	366.0	493.6	654.7	873.5	1,083.7
	Revenue	114.0	244.8	404.3	616.2	842.9	1,125.1	1,540.1
VoIP	Subscriber	206.5	666.1	902.3	1,072.6	1,160.1	1,261.9	1,245.4
	Revenue	475.8	937.4	1,116.2	1,109.1	1,068.4	1,042.7	N/S

Source: KAIT, 2015; MSIP, 2014.

Table 6
The success factors of IPTV and VoIP in Korea.

IT service	Success factor
IPTV	Customers' needs for high-quality broadcasting and multimedia on demand Relative advantage compared with cable television in content, service, and quality Investment cost reduction according to the usage of broadband network Business model with various revenues sources Support of ecosystem composed of a set-up box, content, and others Marketing activities such as bundling products Regulatory changes permitting real-time broadcasting
VoIP	Market demand for cheaper voice calls Investment cost reduction according to the utilizing broadband or cable broadcasting network Marketing competition including various price structures, bundling strategies, and others Regulatory changes permitting local number portability

services have not secured stable revenue structures in Korea, as shown in Table 7 (KISDI, 2015; MSIP, 2014). As such, these services are evaluated as partial successes.

W-LAN has experienced strong market demand for the use of wireless Internet in house and hot-spot zones via laptop, smartphone, and tablet PC in Korea. The facility investment costs for W-LAN are relatively lower than for broadband or mobile telecommunications services, so it has the advantage in terms of efficient and effective network deployment for data transmission (Kim & Park, 2008). With its positioning complementary to broadband and mobile telecommunication services, W-LAN has a weakness in its business model (Lehr & McKnight, 2003). Without improvements to its business model, W-LAN is less likely to be commercially successful (Reed & Lansford, 2014).

T-DMB has secured many outdoor users, with high demand for over-the- air or sports broadcasting access via smartphone, tablet PCs, navigation, and other devices in Korea. Because T-DMB uses the existing facilities of territorial broadcasting, the capital investment expenses were not great, meaning that the start-up burden of carriers was also not heavy (Jee & Kim, 2005). It was inferior in terms of number of channels, but had relative advantages in the almost free provision of broadcast content from territorial broadcasters compared with S-DMB. The ecosystem of T-DMB, contained the content providers and device manufacturers, which contributed to the wide adoption and use of the service. The technology development and market promotion policies, including technology standardization, helped the rapid introduction and diffusion of the service (Shin, 2006). However, T-DMB has not developed enhanced business models and the revenue source remains entirely dependent on advertising. These critical reasons are behind the partial success of the market performance of T-DMB.

The successful market diffusion of these services in Korea were analyzed to be sufficient customer demand, low facility investment cost, relative advantage over competing services, government promotion policies, and sufficient ecosystem support. On the other hand, the uncertain business model of these services results in poor revenue. Table 8 shows the partial success factors of W-LAN and T-DMB.

Table 7
The market performance of W- LAN and T-DMB in Korea (unit: one billion KRW).

Service/ Year		2008	2009	2010	2011	2012	2013	2014
W-LAN	Usage rate	7.7%	9.2%	16.4%	69.2%	76.3%	73.4%	83.7%
	Revenue	30.5	23.7	19.4	16.7	12.5	10.0	8.8
T-DMB	Usage rate	16.8%	17.5%	24.1%	25.3%	30.8%	31.1%	27.0%
	Revenue	16.0	11.0	14.5	16.9	11.6	9.5	11.9

Source: KISA, 2014; KISDI, 2015; MSIP, 2014.
Note: Devices available for T-DMB services as of 2014: more than 80 million units (MBC, 2015).

Table 8
The partial success factors of W-LAN and T-DMB in Korea.

IT service	Partial success factor
W-LAN	Demand for wireless Internet with free access via notebook and smartphone Reduction of facility investment cost due to utilization of the broadband network Uncertain business model with positioning as complementary to mobile telecom services
T-DMB	Demand for over-the-air or sport broadcasting with free access over various devices Low capital investment expenses by using the existing facilities of territorial broadcasters Relative advantages in the provision of territorial broadcasting content Support of ecosystem including content and devices Technology development and market promotion policies Absence of revenue sources apart from advertising

Table 9
The market performance of WiBro and S-DMB in Korea (unit: ten thousands households, one billion KRW).

Service/ Year		2008	2009	2010	2011	2012	2013	2014
WiBro	Subscriber	16.8	31.7	46.7	79.8	105.0	98.3	86.8
	Revenue	20.6	129.3	155.5	171.7	105.1	103.6	98.2
S-DMB	Subscriber	185.2	200.1	185.0	117.4	3.9	–	–
	Revenue	119.3	133.4	121.4	95.4	18.9	–	–

Source: KAIT, 2015; MSIP, 2014.

5.3. Factors leading to failure

WiBro and S-DMB were both evaluated as failures in terms of subscriber scales and revenue. These services both had a maximum of less than 4% of the population as subscribers and did not reach the break-even point. Subscribers to WiBro have been decreasing since 2011 and S-DMB was eventually withdrawn from the market in 2012, as shown in Table 9 (KAIT, 2015; MSIP, 2014).

The network for WiBro required high investments of more than 1 trillion KRW (1 billion US dollars), which was a heavy burden for the service providers (Paik et al., 2010). WiBro also failed to differentiate between competing services (Kim et al., 2014). Despite its relative advantages in mobility and transmission rates, when compared with WLAN and WCDMA respectively, the strengths and benefits of WiBro were not enough to appeal to operators and customers. In particular, the technological progression of WDMA to

Table 10
The failure factors of WiBro and S-DMB in Korea.

IT service	Failure factor
WiBro	High network investment expenses of more than 1 trillion KRW Failure to differentiate between competing services Failure to develop a specific business model Lack of resources and capabilities for market activities Insufficient ecosystem support, such as shortage of available devices Somewhat late regulatory changes
S-DMB	Failure to differentiate T-DMB and video-sharing websites High initial investment expense as it utilizes a dedicated satellite Weakness in ecosystem such as low cooperation with broadcasters and a shortage of dedicated devices Lack of a business model Late permission policy for territorial broadcasting

Table 11
AHP analysis results.

Group	Service	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	C.I.
Successful	IPTV	0.209	0.158	0.101	0.148	0.174	0.151	0.060	0.0257
	VoIP	0.132	0.148	0.235	0.125	0.118	0.187	0.054	0.0268
	Average	0.171	0.153	0.168	0.137	0.146	0.169	0.057	–
Partially successful	W-LAN	0.213	0.205	0.101	0.199	0.140	0.085	0.058	0.0355
	T-DMB	0.229	0.153	0.140	0.184	0.141	0.095	0.057	0.0429
	Average	0.221	0.179	0.121	0.192	0.141	0.090	0.058	–
Failure	WiBro	0.127	0.131	0.181	0.081	0.175	0.161	0.143	0.0091
	S-DMB	0.123	0.157	0.158	0.125	0.170	0.130	0.137	0.0276
	Average	0.125	0.144	0.170	0.103	0.173	0.146	0.140	–

C.I.: Consistency Index <0.1.
Factor 1: customer needs, Factor 2: facility investment cost, Factor 3: relative competiveness compared with competing services, Factor 4: business model, Factor 5: support of ecosystem, Factor 6: marketing activities, Factor 7: government policy.

LTE diluted the advantages of WiBro. Thus, the positioning of WiBro was more of a supplementary network infrastructure for WCDMA or LTE than as an independent service for customers. WiBro's service positioning was to the result of uncertain business models and passive marketing activities (Park et al., 2015). The service operators, and the WCDMA providers, were reluctant to develop business models such as business to business services, and did not concentrate their resources and capabilities on promoting market diffusion. There were few available devices, including smartphones, and this insufficient ecosystem support, lowering the usefulness and convenience of WiBro. The late regulatory changes, including the policy of granting mobile numbers, also weakened the service's competitiveness.

Unlike T-DMB, S-DMB had difficulty retransmitting over-the-air broadcasting due to government regulations. It was not easy for video-sharing websites to gain users and ensure their satisfaction in terms of content consumption. Since the service was provided via dedicated satellite, the initial investment expense of S-DMB exceeded 300 million US dollars (KISDI, 2012). Heavy facility investment had a negative impact on the business of S-DMB. The low levels of cooperation with broadcasters and the shortage of dedicated mobile devices made service competitiveness weak. The lack of a business model that included the generation of a variety of revenue streams by utilizing premium content, and the late permission to carry territorial broadcasting, were connected with the low diffusion rate.

The failure factors of these services were huge facility investment costs, relative disadvantages compared with competing services, uncertain business models, insufficient ecosystem support, passive marketing activities, and regulatory policies, as presented in Table 10.

5.4. Relative weights of the factors

To summarize Sections 5.1, 5.2, and 5.3, the factors influencing market performance were identified as follows[1]: customer needs (factor 1), facility investment cost (factor 2), relative competitiveness compared with competing services (factor 3), business model (factor 4), support of ecosystem (factor 5), marketing activities (factor 6), and government policy (factor 7). Table 11 shows the relative weights of these factors for each IT service with AHP analysis on the data collected via expert surveys.

Successful group: 'Customer needs' (0.209), 'support of ecosystem' (0.174), 'facility investment cost' (0.158), and 'marketing activities' (0.151) were ranked higher than other factors for IPTV. For VoIP, 'relative competitiveness compared with competing services' (0.235), 'marketing activities' (0.187), 'facility investment cost' (0.148), and 'customer needs' (0.132) were ranked higher than other factors. The successes of IPTV and VoIP were mainly due to customer needs, facility investment cost, service competitiveness, support of the ecosystem, and marketing activities. Government policy was not a high priority among the success factors.

Partially successful group: 'Customer needs' (0.213), 'facility investment cost' (0.205), 'business model' (0.199), and 'support of ecosystem' (0.140) were higher than other factors for W-LAN. In T-DMB, 'customer needs' (0.229), 'business model' (0.184), 'facility investment cost' (0.153), and 'support of ecosystem' (0.141) were higher than other factors. The results show that the market performances of Wireless LAN and T-DMB were mainly due to customer needs, facility investment cost, business model, and ecosystem support, in terms of the average values of the factors. Marketing activities and government policy had low priority rankings among the factors underlying partial success.

Failure group: 'Relative competitiveness compared with competing services' (0.181), 'support of ecosystem' (0.175), 'marketing activities' (0.161) and 'regulatory policy' (0.143) were ranked higher than other factors for WiBro. For S-DMB, 'support of ecosystem' (0.170), 'relative competitiveness compared with competing services' (0.158), 'facility investment cost' (0.157), and 'regulatory policy' (0.137) were ranked higher than the other factors. The results show that the market performances of WiBro and S-DMB were mainly due to facility investment cost, service competitiveness, ecosystem support, marketing activities, and government policy.

6. Conclusions

6.1. Discussion

This study explored the success and failure factors of major IT services in Korea launched between 2000 and 2010, using the AHP method with the data aggregated by an expert survey. The results indicated that service needs and capabilities, investment, competition and ecosystem, and policies were influential factors in IT services' market performance, but the effect powers of these factors differed by the services or service groups.

First, facility investment cost was derived as a key factor, ranked among the top three factors in most services. Many previous studies did not identify this as a success or failure factor (Ahn et al., 2005; Adhiarna et al., 2013; Choudrie & Lee, 2004; Lee et al., 2015; Paik et al., 2010; Picot & Wernick, 2007; Yamakawa et al., 2012). Considering that service competitiveness depends on investment costs as well as revenues, facility investment costs on the supply side are likely to be a major determinant of market performance.

[1] Each factor means its degree of influence on market performance. For example, 'customer needs' (Factor 1) in WiBro refers to customer needs' degree of influence on market performance of WiBro.

Second, customer needs, competitive advantage, and ecosystem support were important factors in market performance. Previous studies have emphasized market demand's role (Ahn et al., 2005; Adhiarna et al., 2013; Lee et al., 2015; Park et al., 2015; Yamakawa et al., 2012), but only a few studies have identified competition effect among services (Ahn et al., 2005) and ecosystem support (Park & Kim, 2016; Park et al., 2015) in a service's success or failure. As the battles between new advent services intensify, and the cooperation's role for competitiveness advantage expands, competition structure and ecosystem support will be primary concerns as research factors.

Finally, firm activities, including business modeling and marketing, and government policies, were identified as influential factors in market results. Many previous studies have indicated success or failure factors in terms of business (Ahn et al., 2005; Park et al., 2015) and policies (Adhiarna et al., 2013; Choudrie & Lee, 2004; Paik et al., 2010; Picot & Wernick, 2007; Yamakawa et al., 2012). These factors' effects on market performance will be consistently valid, considering ICT industry attributes as winner-takes-all dynamics or regulatory industry.

6.2. Summary and implications

With technological innovations, changes in customer needs, and industrial promotion policies, many IT services have been introduced in Korea, following the great success of ADSL and CDMA. However, only a few IT services succeeded in achieving significant market diffusion as well as revenue. Considering the impact of this sector on the national economy and customer welfare, it is important to learn the lessons provided by these cases of successes and failures of IT services (Ahn et al., 2005).

The purpose of this study was to derive the critical factors influencing market performance in terms of subscriber scale and revenue, focusing on a given telecommunication and broadcasting service. To achieve this, the success and failure factors influencing the market performance of IPTV, VoIP, W-LAN, T-DMB, WiBro, and S-DMB were identified through expert surveys and AHP statistical analysis. The results of this study and its implications are as follows.

First, the common factors leading to IT service market performances are facility investment cost, ecosystem support, service competitiveness, and marketing activities. (i) The facility investment costs of successful and partially successful IT services were relatively low, while those of failed IT services were extremely high. Because IPTV, VoIP, W-LAN, and T-DMB were able to utilize existing infrastructure such as the Internet network or broadcasting systems, it was possible for these services to have advantages in price. This contributed significantly to market diffusion by promoting early customer adoption. Therefore, a close review of investment costs should be performed in terms of business feasibility before making decisions to develop new IT services. (ii) The ecosystem, composed of contents-platform-network-device (CPND), was a determinant of success for IPTV, while the lack of ecosystem support was a failure factor for WiBro. The ecosystem determines service success or failure, either directly or indirectly. Thus mutual cooperation or joint development should be promoted to secure and expand ecosystem competitiveness from the early stages of the service life-cycle. (iii) According to previous studies, relative advantage in functions or benefits compared with existing or competing services was the main reason for service acceptance (Kim, Wong, Cahng, & Park, 2016; Park & Kim, 2016; Venkatesh, Morris, Davis, & Davis, 2003). The relative advantage of an IT service was connected to its service positioning and service competitiveness. The main cause of the failure of the WiBro service was an inability to create relative advantages over W-LAN and WCDMA. Relative strength through differentiation of service should be derived from consumer-oriented demand rather than from a technical fix. (iv) Active marketing activities stimulate market demand by reducing the barriers to customers' purchasing intentions. IT firms have mainly undertaken active marketing activities in highly competitive markets like IPTV and VoIP. The competition among the service providers in WiBro was very low, resulting in passive marketing activities. Active 4P marketing mixes (positioning, price, place, and promotion) should be considered in order to increase the marketability of services (Cho & Lee, 2013).

Second, it was found that it was customer needs that mainly affected the success of IT services. Services developed from technology pushes are likely to be more removed from customer needs. A demand-pull oriented service is a key success factor in subscriber diffusion. Because the usage of high-quality video content (IPTV), cheaper phone calls (VoIP), convenient wireless Internet (W-LAN), and over-air-view outdoor broadcasting (T-DMB) reflected strong customer needs, these services succeeded in securing a critical mass of users. Therefore, IT firms should reflect the core needs of customers and the service benefits they require from the early research and development stage (Mohr et al., 2009).

Third, it was identified that the absence of a business model was related to the partial success of IT services. Even if an operator was successful in securing subscribers without a clear business model, it was difficult to obtain stable revenues over the break- even point. T-DMB, highly dependent on advertising and without a specific business model, was a typical case of a successful market diffusion that was a failure in terms of revenue. The business model is at least as important as technology development; IT service providers should secure survival and growth in the market by developing proper business models that include a variety of revenue sources.

Fourth, due to the characteristics of IT as a regulated industry, government policy affected IT service success or failure. The policies on number identification for mobile VoIP in WiBro and public broadcasting retransmission in S-DMB were factors underlying their low service competitiveness with regard to utilization and function. Regulatory policies are required for consumer welfare and effective competition, but the policies for service activation should be considered according to market conditions or environmental changes.

Fifth, this study's findings can be applied in deployment decisions and market diffusion for new IT services, providing practical implications. With the advancement of IT and convergent technologies, most service providers have faced difficult decisions in selecting promising IT services to avoid investment failure. Only a few services are successful in securing critical mass and stable revenue, in spite of substantial investment in firms. Many services have experienced mismatching among market demands, business activities, and public policies. Service providers and public organizations must first consider success or failure factors in terms of market demands, firm activities and investment, the competition structure and ecosystem, and promotion and regulation policies to achieve market performance in big data analytics, the Internet of Things, and artificial intelligence, which have recently emerged as future growth engines. Reviews of such factors facilitate a reasonable decision on promoting the invested services' market success.

Finally, the findings can be understood from the perspective of behavioral economics on decision-making under risk and uncertainty (Kahneman & Tversky, 1979). Even though only a few IT innovations performed well on both subscriber and revenue aspects, new IT products or services will be planned and launched with an expectation of achieving success in the market. As a result of not applying accumulated learning from past failures, firms repeat the same decision making mistakes for new IT investments based on a cost-benefit analysis. This failure can be attributed a lack of understanding of consumer behavior. IT firms generally make investment decisions under the assumption that consumer choice is rational. However, according to the prospect theory of behavioral

economics, the choice and behavior of consumers is often affected by value functions including reference point, diminishing sensitivity, and loss aversion rather than the desire for utility maximization for reasonable choices (Kahneman, 2003). This implies that IT firms should comprehensively consider the bounded rationality of consumers, including unstable or conditional preferences, information overload, difficulties in handling uncertainties and risks, overconfidence, and a myopic attitude, as well as a cost-benefit analysis, in order to deploy investments and business strategies for new IT innovations (Colin & George, 2004; Ho, Lim, & Camerer, 2006).

6.3. Research limitations for further research

The contribution of this study is to analyze the critical success and failure factors influencing the market results of IT services in terms of customer demand, service providers' businesses, service characteristics, market competition, and government policy. Unlike the previous studies focusing on particular services such as WiBro, this study attempted to identify the common factors underlying success and failure across a range of services.

The limitations of this study for further studies are as follows:

First, this study has the limitation of analysis by expert survey. Previous studies identify and prioritize critical factors based on experts' experience and knowledge (Adhiarna et al., 2013; Chen & Wang, 2010; Chin et al., 2008; Park et al., 2015). However, perception gaps may exist between experts and consumers. The consumer's attitude from a benefit-cost perspective affects the adoption, usage, and continuance of IT service, which subsequently contributes to market performance. Identifying customer preferences and resistance to IT services, using data collected by individual surveys, contributes to an understanding of the factors that determine service success or failure. Therefore, a quantitative approach through consumer surveys would provide an avenue for further studies, and would be useful in analyzing IT services' success and failure factors based on consumer preferences or usage conditions.

Second, this study does not attempt to analyze the relationships between factors. Understanding these relationships contributes to identifying the fundamental and facilitating factors influencing market performance. This enables an understanding of the core cause of IT services' market success or failure, and an identification of the relationships among service attributes, business activities, ecosystem competitiveness, and government policies. Therefore, further studies can expand this approach to examine these relationships' structure using analytic network process (ANP), system dynamics, or structural equation model (SEM).

Third, this study does not consider changes in factors influencing market performance in market or technology dynamics. The dynamic changes in consumers' demands, market environment, government policies, and rivalry relationships are likely to influence IT services' market result. Therefore, it would also be useful for further studies to examine the determinant changes in market performance according to market dynamics, environment changes, and service growth stages.

Finally, this study only approaches the context of Korean IT service. The influential factors on IT services' market performance are likely to differ by country. National differences in these factors will be affected by GDP, population structure, culture, customer behavior, market development stage, business environments, industrial structure, and regulation (Choudrie & Lee, 2004). For example, the market results from WiBro and T-DMB highly depend on regulatory policies in Korea because the government is involved in the promotion and regulation of new IT services (Park et al., 2015). Therefore, macro- and micro-elements by country will be considered in understanding and applying IT services' market performance. These comparative studies between countries may help to generalize the determinants of IT services' success and failure. Additionally, comparative studies between other such sectors as IT and biotechnology may also provide a direction for future research.

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