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Innovation in Korean B2B Mobile Services from the Technological and Service-oriented Perspectives

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Summary of the Thesis

This thesis examines the characteristics of B2B mobile services in Korea, and aims to understand the dynamics of innovation from technological and service-oriented perspectives and consequently to propose a new B2B service innovation model. The thesis proposes a conceptual framework and a comprehensive approach to analyze the factors affecting mobile service innovation. The framework is approached by service innovation theory, models of innovation in services and mobile service innovation.

Firstly, the thesis combines pre-existing innovation theories with an empirical case study of Mobile Campus at two universities: UNIST and POSTECH. Mobile Campus is the B2B mobile carrier service which provides universities with various smartphone-based mobile solutions. The findings from the case study of Mobile Campus explain the key theoretical issues on service innovation related to the role of technology, service providers and institutional users. The service innovations in Mobile Campus were driven by technologies related to advanced ICT, mobile carrier's strategies and active participation of universities in the development process of Mobile Campus. The case study showed the increasing potential of mobile business opportunities in B2B. It stimulated discussion on innovation in mobile services and raised three research questions to further investigate the different dynamics of innovations.

Motivated by the research findings regarding innovations in Mobile Campus, the thesis expands the characteristics-based analysis from a single case study of mobile service innovation to a product-level innovation study of B2B mobile carrier services. The analysis begins with a study on the characteristics of B2B mobile carrier services. By using data on market introduction of new services as a service innovation indicator, 242 service products were analyzed through statistical techniques to characterize B2B mobile services in Korea. As a result, the service products were classified into seven groups based on the service characteristics: 'mobile office/education solutions', 'network solutions', 'multimedia broadcast solutions', 'business analytical solutions', 'security and safety solutions', 'payment processing solutions' and 'M2M solutions for facility management'.

The thesis clarifies how the transition from B2C to B2B has influenced mobile service innovation by addressing the research questions: *(1) How have the different dynamics of innovation evolved over time? And what factors have influenced it?*. The different dynamics of mobile service innovation have evolved during 2009-2010 by shifting innovation focus from B2C mobile services to B2B mobile services. The transition from B2C to B2B mobile services offered the framework for using paradigm change as the conceptual criteria to demonstrate how the Korean mobile sector has experienced a radical change to create service innovations. Subsequently, a scheme for distinguishing 'new' and 'improved' service characteristics was devised by applying the concept of the paradigm shift to the framework.

From the characteristics-based approach, 'new' service characteristics that emerged

after 2009-2010 are linked with radical innovation while service characteristics which existed before 2009-2010 but have been 'improved' are linked with incremental innovation. A combination of 'improved' and 'new' service characteristics is linked with semi-radical innovation. As a consequence, incremental, radical and semi-radical innovations were identified from the technological perspective by answering the research questions: *(2) What are the types of innovation in B2B mobile carrier services? How do they differ from each other?*.

In addition, the dynamic competences of mobile carriers and the increasing role of B2B mobile service users are clarified from the service-oriented perspective by addressing the research questions: *(3) How are the dynamic competences of mobile carriers and B2B customers used in the different types of innovation? And how do they interact with each other?*. Such competences of mobile carriers and institutional users lead to recombinative and customized innovations, showing two mechanisms. For the first mechanism, mobile carriers develop bundled service brands by combining the characteristics of two or more existing service products. The other mechanism is to provide the customized service characteristics for particular institutional users. The institutional users not only deliver their specific needs to mobile carriers, but also participate in the development of mobile solutions as co-producer of service innovation. Such participation brings co-produced innovation.

After the analyses, a new framework is proposed by integrating both the technological and service-oriented perspectives. The different dynamics of service characteristics lead to the identification of six integrated innovation patterns for B2B services: disruptive, transformational, breakthrough, incremental, additive and reciprocal innovations.

The findings imply that the integrated innovation patterns can be used to characterize innovations in other services. While advanced ICT becomes an enabler of innovation in IT-based service industries, service providers are still able to produce new service products easier than physical products, without direct technological development. In addition, technological, regulatory and market changes may occur frequently and have a significant impact on the characteristics of services. Such changes of service characteristics can be the motive to distinguish different types of innovation in newly emerging service sectors or in other countries.

The thesis draws some empirical implications for mobile industry actors. By understanding the different patterns of innovation, mobile carriers can take a strategic view of which technological decisions and service strategies may be most appropriate. Active co-production between mobile carriers and different industry users can bring new innovative services. To create a favorable environment for new service development, policy makers need to take into account of the central role that ICT plays in the mobile environment and develop proper plans for the industry.

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List of Acronyms and Abbreviations

AD	ADvertising
ADSL	Asymmetric Digital Subscriber Line
AED	Automated External Defibrillator
AMOLED	Active-Matrix Organic Light-Emitting Diode
AMPS	Advanced Mobile Phone Services
ANOVA	ANalysis Of VAriance
AP	Access Point
API	Application Programming Interface
ARPU	Average Revenue Per User
ASP	Application Service Provider
B2B	Business-to-Business
B2C	Business-to-Consumer
BcN	Broadband convergence Network
BEMS	Building and Energy Management System
CADNET	Cyber Attack Defense Network
CCTV	Closed Circuit Television
CDMA	Code Division Multiple Access
CDN	Contents Delivery Network
CEO	Chief Executive Officer
CIS	Community Innovation Survey
CMS	Content Management System
CRM	Customer Relationship Management
CUG	Closed Users Group
DAC	Digital-to-Analog Converter
DB	Database
DDoS	Distributed Denial of Service
DID	Direct Inward Dialing
DMB	Digital Multimedia Broadcasting
DOD	Direct Outward Dialing
DRM	Digital Rights Management
DVR	Digital Video Recorder
EDGE	Enhanced Data rates for Global Evolution
EDI	Electronic Data Interchange
EDR	Enhanced Data Rate
EMR	Electronic Medical Record

ERP	Enterprise Resource Planning
EVDO	EVolution Data Only
EVDV	EVolution Data Voice
FCC	Fixed Channel Convergence
FLV	FLash Video
FMC	Fixed Mobile Convergence
FMS	Fixed Mobile Substitution
FTA	Free Trade Agreement
G/W	Groupware
G-D	Goods-Dominant
GIS	Geographic Information System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile communications
HA	High Availability
HD TV	High Definition Television
HSDPA	High-Speed Downlink Packet Access
HSOPA	High Speed OFDM (Orthogonal Frequency Division Multiplexing) Packet Access
HSUPA	High-Speed Uplink Packet Access
HTML	HyperText Markup Language
IC	Integrated Circuit
ICC	Internet Computing Center
ICS	Internet Computing Service
ICT	Information and Communications Technology
ID	IDentification
IDC	Internet Data Center
IEEE	Institute of Electrical and Electronics Engineers
iLS	Intelligent Lighting Solution
IMT-2000	International Mobile Telecommunications-2000
IMT-Advanced	International Mobile Telecommunications-Advanced
INMARSAT	INternational MARitime SATellite
IP	Internet Protocol
IPE	Industrial Productivity Enhancement
IP TV	Internet Protocol Television
IR	Investor Relations
IS-95	Interim Standard-95
ISDN	Integrated Services Digital Network

IT	Information Technology
ITU	International Telecommunication Union
IVR	Interactive Voice Response
IX	Internet eXchange
KCC	Korea Communications Commission
KEMP	KT Enterprise Mobility Platform
KMO	Kaiser-Meyer-Olkin
KMP	KT Mobile office Platform
KRW	KoRean Won
LAN	Local Area Network
LBS	Location-Based Services
LCD	Liquid Crystal Display
LMS	Learning Management System
LPDDR	Low Power Double Data Rate
LTE	Long Term Evolution
M2M	Machine-to-Machine
MACS	MAnagement Control System
MB	Megabyte
MDM	Mobile Device Management
mDNIe	Mobile Digital Natural Image engine
MIC	Ministry of Information and Communication
MMS	Multimedia Messaging Service
MOS	Maintenance, Monitoring and Management Operating System
MOU	Memorandum Of Understanding
MP	Megapixel
MRI	Magnetic Resonance Imaging
MSP	Management Service Provider
MVP	Mobile Virtualization Platform
NFC	Near Field Communication
NGO	Non-Governmental Organization
NSD	New Service Development
OCS	Order Communications System
OpenGL ES	OpenGL for Embedded Systems
OS	Operating System
P2P/IM	Person-to-Person/Instant Messaging
PACS	Picture Archiving and Communication System
PBX	Private Branch eXchange
PC	Personal Computer

PDA	Personal Digital Assistant
PDF	Portable Document Format
PDP	Plasma Display Panel
PIMS	Production Information Management System
POS	Point Of Sales
POSTECH	POhang university of Science and TECHnology
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
R&D	Research and Development
RAM	Random Access Memory
RFID	Radio Frequency IDentification
SCM	Supply Chain Management
SD	Secure Digital
S-D	Service-Dominant
SDK	Software Development Kit
SFA	Sales Force Automation
SIM	Subscriber Identity Module
SMB	Small and Medium-sized Business
SME	Small and Medium-sized Enterprise
SMS	Short Messaging Service
SOHO	Small Office/Home Office
SPSS	Statistical Product and Service Solutions
SSL	Secure Sockets Layer
TB	Terabyte
TCP/IP	Transmission Control Protocol/Internet Protocol
u-Health	Ubiquitous Health
UI	User Interface
UIFN	Universal International Freephone Number
UNIST	Ulsan National Institute of Science and Technology
USIM	Universal Subscriber Identity Module
USN	Ubiquitous and Sensor Networks
VDI	Virtual Desktop Infrastructure
VoIP	Voice over Internet Protocol
VPC	Virtual Private Cloud
VPN	Virtual Private Network
WCDMA	Wideband Code Division Multiple Access
WiBro	Wireless Broadband
Wi-Fi	Wireless Fidelity

WiMAX	Worldwide Interoperability for Microwave Access
WIPI	Wireless Internet Platform for Interoperability
WMV	Windows Media Video
WVGA	Wide Video Graphics Array
XML	eXtensible Markup Language

CHAPTER 1. INTRODUCTION

1.1. Background

Unlike most products, service characteristics include inseparability (simultaneous production and consumption), heterogeneity (the requirement for human effort and interaction) and perishability (the inability to be kept in stock) (Lovelock, 1983; Zeithaml et al., 1985). These inherent features pose more challenges to innovation than in the case of physical goods, and thus, innovation in services should be considered differently from innovation in goods. In this regard, this thesis will focus on innovation in services by examining the Korean mobile telecommunications services.

The Korean mobile telecommunications industry has been an attractive research field (Kang et al., 1996; Yang et al., 2003; Yoo, et al., 2005; Choi et al., 2011; Hovav et al., 2011; Lee, 2012; Hobday et al., 2004; Whang and Hobday, 2011; Choung et al., 2012). Firstly, the industry has shown innovations continuously emerging. As the development of technologies is very rapidly changing, it creates new business fields and service values. Secondly, it is a good case study of investigating the close relationship between service providers, users and other players that belong to other industries as well as mobile industry. Thirdly, it has a great influence on other sectors. A number of converged products and services are being developed. For instance, Digital Multimedia Broadcasting (DMB) (convergence between broadcasting and mobile), telematics (convergence between automobile and mobile) and mobile banking (convergence between finance and mobile) represent that mobile sector induces potential business opportunities resulting in revenue rising for the industry actors that participate in. Fourthly, the government and policy institutions have heavily supported this industry by guiding the selection of next technology standards or investing in research and development in related hardware/software technologies.

Within these backgrounds, mobile telecommunications in Korea could be developed rapidly compared to other countries since the mid-1990s with the world's first introduction of Code Division Multiple Access (CDMA) mobile technology, one of the two main competing wireless standards, the other being Global System for Mobile (GSM) communications in Europe. Korea is the world's leading market for mobile phones and

mobile services, which result in various innovations.

Technology-enabled innovations seem to occur actively in the current mobile market. The rapid development of advanced hardware and software technologies related to mobile services has brought a number of service brands, expanding customer base and market size in Korea. On the other hand, mobile carriers are still active innovators as mobile service providers. They can produce many new identical brands easier than physical products, without direct technological investment. In addition, the way the mobile carriers interact with mobile service users can itself be an important source of innovation, whereas physical products often follow only technological innovation.

The main part of this thesis focuses on the dynamics of innovation in the Korean mobile telecommunications services. Starting from examining innovation in Mobile Campus, the thesis aims to identify technological and service-oriented innovations that pervade in Business-to-Business (B2B) mobile service, from the characteristics-based approach.

1.2. Research Objectives and Uniqueness

1.2.1. Research objectives

The main objective of this thesis is to understand the dynamics of innovation in the Korean B2B mobile services from both technological and service-oriented perspectives, and consequently propose a new B2B service innovation model.

Since this study integrates multiple theoretical perspectives to characterize innovation in B2B mobile services through a combination of a case study and a meso-level study, the main research objective is divided into several sub-research objectives:

(1) To evaluate whether general theories of service innovation correspond to the findings from an empirical case of Mobile Campus and to build a conceptual framework for analyzing innovations of B2B mobile carrier service from the findings

(2) To understand the dynamic characteristics of B2B mobile carrier services

(3) To develop a comprehensive understanding of the key drivers behind the innovations in the B2B mobile carrier services that have been transformed from previous B2C based mobile services, focusing on market, technology and regulation aspects

(4) To identify how innovations in B2B mobile carrier services can be obtained from the

technological and service-oriented perspectives

1.2.2. The unique points of this thesis

The unique points of this thesis can be summarized in the following three aspects.

(1) A comprehensive approach to analyze the factors affecting mobile service innovation from both technological and service-oriented perspectives

This thesis developed a comprehensive approach to analyze the factors affecting mobile service innovation. A scheme for distinguishing 'new' and 'improved' service characteristics was devised in order to identify innovation in B2B mobile services from the characteristics-based approach. The thesis clarified how the transition from B2C to B2B has influenced innovation in mobile services. Such changes in service characteristics are regarded as the crucial factors affecting mobile service innovation.

Through the development of the useful approach, the thesis contributes to the theories on the innovation and the transition from B2C to B2B. There are prior researchers who studied industrial change driven by such transition in different industries. Yeh (2001) and Finne (2003) examined the change of market focus from B2C to B2B in the industry level. Recently, researchers have approached from an institution-based view of business strategy (Kotler and Pfoertsch, 2007; Sasi and Arenius, 2008; Lam et al., 2004; Oh and Park, 2012). In particular, the transition from B2C to B2B has been highlighted in the studies of the ICT sector, analyzing the difference between mobile business environments of B2C and B2B (Blake, 2001; Leem et al., 2004).

However, none of the above prior researchers examined how this transformation from B2C to B2B has influenced the characteristics of service and what kinds of innovations have been brought into the market. Within this background, this thesis links the concept of the shift from B2C to B2B with innovation theories. As a pioneering study on innovation in the Korean B2B mobile carrier services, the thesis has identified various types of service innovations driven by the market transformation. By focusing on the case of B2B mobile service through a meso-level study, the thesis aims to provide a deeper understanding of mobile service innovation as well as the evolutionary changes of the mobile carrier services in Korea.

(2) A new framework for understanding service innovation

The thesis proposed a new framework to analyze the dynamics of service innovation by integrating technological and service-oriented perspectives. The framework includes the factors related to technologies, mobile carriers and mobile service users, which lead to various types of innovation. It explores the technological changes driven by ICT, the mobile carrier's competences to achieve service innovation, and the increasing role of institutional users as 'co-producers' of service innovation. Those factors were discussed separately in the prior case studies in the field of service innovation, but they are merged in the framework of this thesis.

Recent studies of mobile telecommunications sector have mainly focused on technological innovation (Lee et al, 2009; Forge and Bohlin, 2008; Shin et al., 2011; Shin and Jung, 2012; Takeishi and Lee, 2005; Lee, 2012). Adoption or diffusion of a new mobile technology has been one of the mainstream research (Kang et al., 1996; Grüber, 2001; Pagani, 2004; Gilbert and Han, 2005; Bouwman et al., 2007). These literatures were lacking in understanding on the intermediate features of pure services (e.g. healthcare and personal services) and physical products in the current IT-based service sectors. This thesis is differentiated from the previous studies in that it identified innovation from both technological and service-oriented perspectives.

(3) A unique methodology to analyze service innovation in the product level

In addition to proposing a useful framework, a unique analytical method was proposed. Service innovations were analyzed in the product level, by using data on market introduction of new services as an innovation output indicator. The thesis proposed a unique methodology to analyze qualitative innovation in B2B mobile services by transforming descriptive information of 242 service products into a quantitative data set for statistical analysis. The method of data extraction and data coding used in this thesis is useful when a research conducts a qualitative case study and faces difficulty in producing an adequate result from it.

Hence, the combination of a multi-perspective approach for defining service innovations and a quantitative data analysis provides the theoretical implications by developing a new framework and useful indicator to examine the dynamics of service innovations.

1.3. The Choice of B2B Mobile Carrier Service

1.3.1. Motivation and significance of B2B mobile carrier service

To make a close investigation of innovation in services and to represent both technological and service-oriented innovations, B2B mobile telecommunications service sector in Korea has been selected based on the following theoretical and empirical reasons.

Mobile service users can be largely divided into two segments[1]: individual users (hereinafter defined as B2C mobile service) and institutional or business users (hereinafter defined as B2B mobile service)[2]. Among the two, this thesis focuses on the B2B mobile service because it is one of the most promising and growing service sectors. The scope of this thesis is limited to B2B mobile carrier service for the following reasons.

Firstly, the thesis focuses on service innovation driven by mobile carriers and assumes that they are active in implementing innovations. Although with the rapid development of mobile devices, especially smartphones, mobile carriers might lose their market dominance they've been enjoying in the domestic market, they keep creating many service innovations. A smartphone is a high-performance mobile phone built on a mobile operating system, with advanced computing capability and connectivity. The smartphones can be seen a convergence of many devices such as mobile phone, Personal Digital Assistant (PDA), portable media players, digital cameras, video cameras and Global Positioning System (GPS) navigation. The trend of convergence between devices, services and technologies within and across industries not only offers a challenge to the Korean mobile carriers but also offers a breakthrough for them to continuously develop new service products in the saturated domestic market. In this regard, the selection of B2B mobile carrier service as a research object may further provide a valuable strategic direction for mobile carriers to find a new revenue source.

Secondly, as smartphone usage increases and demand for new types of mobile solutions from B2B customers grows, the Korean mobile carriers have been putting more and more efforts in expanding B2B business. Now mobile carriers are offering industry-wide business solutions to many companies and institutions in different industries such as

[1] Market segmentation is one of marketing techniques used to better attract the right customers. It divides a broad target market into smaller subsets of consumers who have a similar taste, demand and preference.

[2] Basically speaking, the main difference between B2B and B2C is who the customer is. B2C focuses on individual customer transactions, whereas B2B focuses on other businesses as the consumer (IBM iSeries Information Center).

manufacturing, wholesale and transportation. They also provide specialized solutions such as health care for human beings, and solution for higher education and distance education institutions.

Lastly, B2B mobile service sector in Korea is an appropriate case to examine innovations from both technological and service-oriented points of view. It is able to well reflect the trend towards convergence and the blurring of the boundaries between products and services. While a major product launch of B2B mobile service offerings often depends on the development of mobile device technologies, it also relies on service providers' direct competences which may not be related to technological advancement. Such an integrated way of looking at service innovation has lately attracted considerable attention in innovation studies (Coombs and Miles, 2000; Drejer, 2004; Miles, 2000; Sundbo, 2001; Gallouj, 2002). Hence, the selection of B2B mobile service sector helps to closely investigate both the technological and service-oriented characteristics of B2B mobile services from an integrated perspective.

1.3.2. Definition of B2B mobile carrier service

Since the end of 2009, mobile carriers have expanded their operations to wired/wireless convergence business such as integrated services combining mobile phone, fixed-line phone, broadband Internet, Voice over Internet Protocol (VoIP) and Internet Protocol television (IPTV) services. Korean mobile carriers such as KT and LG U+ merged their wired and wireless communication business into a single brand at the end of 2009 and in 2010, respectively. SK Telecom, the largest mobile carrier, has also expanded its business beyond the scope of the existing mobile network business by strengthening alliance with subsidiary companies (e.g. SK Broadband, SK Telink). All three mobile carriers are now integrated wired/wireless telecommunication service providers (through merger or support from subsidiaries). Therefore, the B2B mobile services include both mobile phone-based solutions (e.g. mobile office, mobile education) and a combination of mobile and fixed network solutions (e.g. Fixed Mobile Convergence (FMC) services[3]).

The three mobile carriers expanded their operations, embracing all areas from fixed,

[3] FMC is a trend in the network that cannot be distinguishable from the perspective of service users (OECD, 2012). When a service is based on both fixed and mobile networks, service users can access the data, voice, or video services without concern for how the service is actually delivered.

wireless services as well as services based on convergence (e.g. satellite broadcasting service as a communication and broadcasting convergence). In addition, the growing adoption of smartphones and focus on improving institutional productivity has given mobile carriers the opportunity to expand their revenue base by delivering specialized B2B mobile services for institutional users (e.g. corporate cloud computing, Geographic Information System (GIS) solution for advanced business analysis, smart learning and business administration solutions).

In this thesis, B2B mobile service is defined as a business solution service for institutional or business users,[4] which supports various business functions across sales and marketing, communications, general management, finance and operations through fixed and mobile network infrastructure. Therefore, B2B mobile service is also called B2B mobile solution. Such B2B mobile services are developed by various participants from different industries. Based on the fixed and mobile network provided by a mobile carrier and its subsidiaries, B2B mobile services offer third-party contents and applications, which are available on PC or smartphone made by domestic or overseas device manufacturers. Mobile office/education solutions (e.g. mobile groupware), location-based solutions (e.g. telematics), wireless telemetry solutions (e.g. remote control) and mobile solutions aimed at specific industry users (e.g. mobile finance) are often co-developed by involving manufacturers of electrical equipments, financial institutions, media companies, automobile manufacturers or construction companies.

B2B mobile services are less heterogeneous than pure services such as healthcare, education and consulting, which means that the quality of B2B mobile services is standardized. Thus, B2B mobile services launched under the brand name of the three mobile carriers above were provided for any institutional user, including large, small and medium-sized institutions or companies. Because each service brand is an independent service product, B2B mobile service users can choose several service brands and freely make a package of them according to their needs. Mobile carriers also offer service bundles with a discount price by combining two or more separate service brands.

This thesis aims to bring into focus innovation in the B2B mobile services which are

[4] In this thesis, the B2B mobile service users include various types of institutional or business users, including any size of enterprises, government, educational institutions and other public/private institutions. Thus, the scope of B2B mobile service in this thesis includes Business-to-Business (B2B) and Business-to-Government (B2G).

currently provided by mobile carriers in Korea. Their B2B mobile service products[5] are all listed in their websites. The three mobile carriers operate a website of B2B mobile service brands which are separated from that of B2C brands. The website is used not only when a service brand is introduced but also when an institutional customer applies for subscription of a service brand. Thus, transaction occurs through these websites. To promote their service products, mobile carriers upload detailed information on each service brand on the web, and respond to customer questions or concerns on-line. Any information on the market introduction of a new B2B mobile service can be collected through the mobile carriers' B2B websites. Therefore it is assumed that the service products of those websites include all the B2B mobile carrier services that have been launched in Korea. Collection of the data will be described more in Section 2.7.5.

1.4. Structure of the Thesis

Figure 1-1 depicts the structure of this thesis. The development of this study is based on three parts. The first part develops a conceptual framework based on various service innovation theories and an empirical case study. The second part analyzes technological and service-oriented innovations in B2B mobile carrier services from the characteristics-based approach. Lastly, the third part discusses the research findings from the integrated perspective and improves the framework of this thesis for future innovation studies.

Part 1 combines pre-existing innovation theories with the conceptual framework based on an empirical case of Mobile Campus. In Chapter 2, the study introduces the theories of service innovation and prior literature on mobile sector. Such innovation theories are compared with the research findings from an empirical case study of Mobile Campus in Chapter 3. Based on the findings of the case study, Chapter 3 expands the characteristics-based analysis to innovation in B2B mobile carrier services and develops a comprehensive approach to analyze the factors affecting mobile service innovation from the technological and service-oriented perspectives.

Part 2 provides the multiple analyses of innovation in the Korean B2B mobile services.

[5] Mobile service products are mobile services which were launched under the brand name of mobile carriers. Hence, a mobile service product is regarded as a mobile service brand.

It begins with Chapter 4, explaining the different types of B2B mobile carrier services with respect to their dynamic service characteristics. Chapter 5 investigates the key drivers behind the innovations in the B2B mobile carrier services, focusing on the regulation, technology and market aspects. Chapter 6 and Chapter 7 present the technological and service-oriented innovations from the characteristics-based approach.

Part 3 carries out the analysis of innovation in the B2B mobile carrier services from the integrated perspective by utilizing the innovation concepts and important issues that were covered in Part 2. Hence, Chapter 8 proposes a new framework to analyze innovation in services.

Lastly, Chapter 9 formulates the answer of the main research objective and discusses the theoretical implications and the empirical lessons.

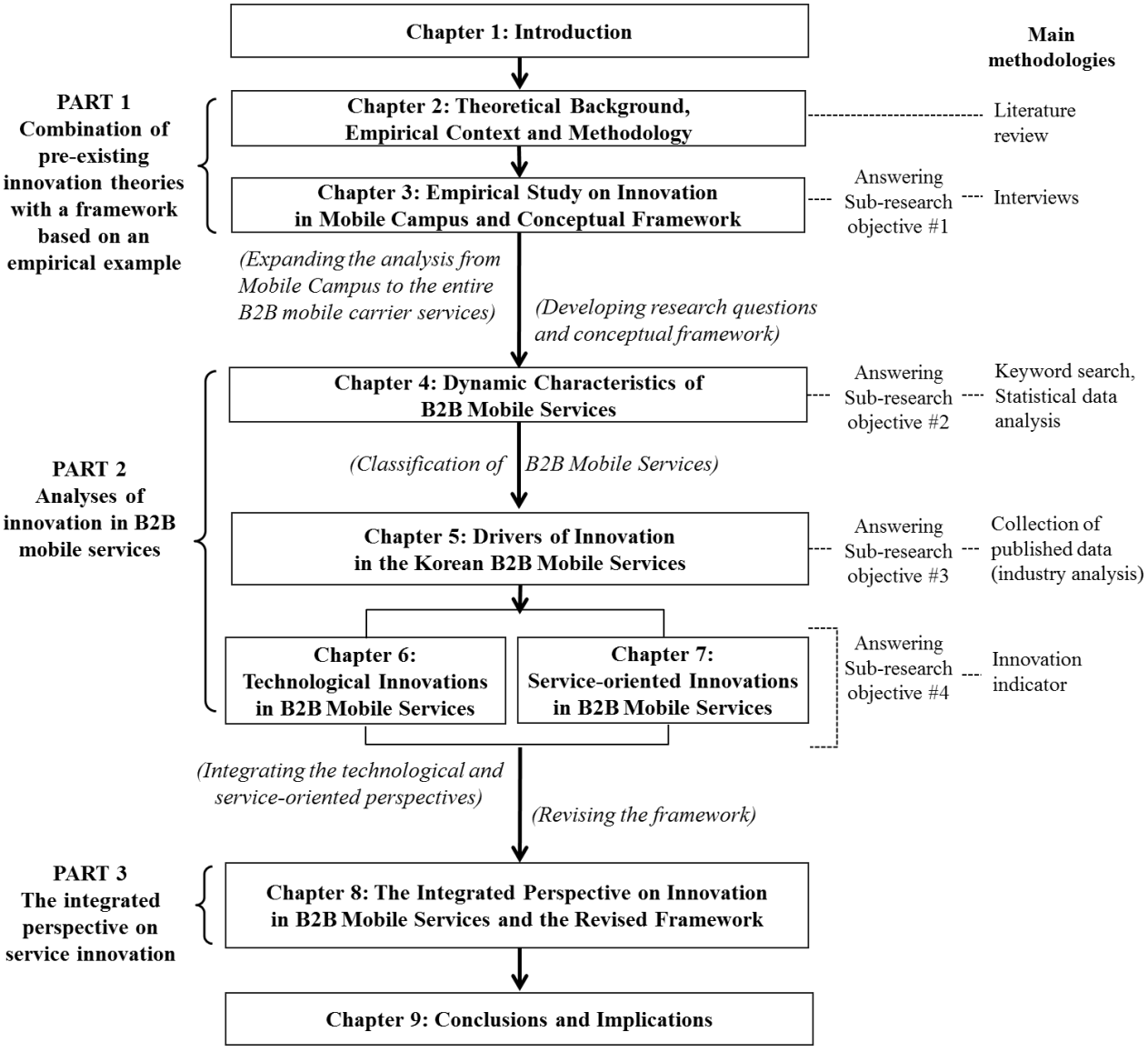

Figure 1-1. The structure of the thesis

CHAPTER 2. THEORETICAL BACKGROUND, EMPIRICAL CONTEXT AND METHODOLOGY

2.1. Introduction

The main purpose of this chapter is to review fundamental theories of service innovation and the literature related to the mobile service sector. The underlying theoretical background is based on the approaches of two main theoretical studies: studies of services and innovation studies in services. The very first perspective of the theoretical review is to look at the specificities of services which can be distinguished from physical products. Such an approach draws attention to 'services' in innovation studies that have become of great importance in recent years.

Subsequently, this chapter also signifies the role of technology, competence of service providers and user involvement in service innovation. The integrative approach enables the development of innovation concepts for mobile service sector. This acts as a theoretical basis of understanding the dynamics of innovation in mobile telecommunications services.

This chapter is divided into eight sections. Section 2.2 presents the traditional difference between products and services, more details of diversity among service sectors and in particular specificity of mobile telecommunications services. Section 2.3 presents theoretical approaches of innovation in services, including the concept of service innovation and innovation models in services. Section 2.4 reviews literature that analyzes the role of technology, competence of service providers and user involvement in service innovation. Section 2.5 reviews prior innovation studies and case studies on mobile telecommunications services. Section 2.6 summarizes the Korean mobile telecommunication market and presents how business landscape of mobile carriers has been transformed from B2C-oriented to B2B-oriented. Section 2.7 explains the research methodology established for this thesis and Section 2.8 discusses research limitations. The summary in Section 2.9 will re-emphasize the theoretical approaches to innovation in services.

2.2. Theoretical Investigation of Service

2.2.1. Significance of service

The services sector is a key engine of growth in today's global economies. However, the increase in complexity of service systems[6] represents both a challenge and an opportunity in a service-oriented economy (Caswell et. al, 2008). Given this growing interest in services, both the academic and practitioner communities have been exploring and developing the science[7], management, and engineering of services (Basole and Rouse, 2008).

Many researchers have discussed and analyzed services from various viewpoints of the nature of services. Among the various definitions of services, a widely accepted definition is that a service is "an act or performance offered by one party to another" (Kotler, 1998; Kotler and Armstrong, 2004). Although the process may be tied to a physical product, "the performance is essentially intangible and does not normally result in ownership of any of the factors of production" (Lovelock, 1996; Kotler and Dubois, 2004; Lovelock, 1983; Kotler, 2003; Perreault and McCarthy, 2005).

Services can be also broadly defined by stating that "services are deeds, processes and performances" (Zeithaml and Bitner, 2000; Vargo and Lusch, 2004). Services "include all economic activities whose output is not a physical product or construction, is generally consumed at the time it is produced, and provides added value in forms (such as convenience, amusement, timeliness, comfort, or health) that are essentially intangible concerns of its first purchaser" (Zeithaml and Bitner, 2000). Services are defined by Middleton (2001) and Singh (2008) as the purchased products through an exchange transaction which does not confer ownership but permits access to and use of a service, usually at a specific time in a specific place. According to Lovelock and Wirtz (2004), service is again defined as "an economic activity that creates value and provides benefits for customers at specific times and places by bringing about a desired change in, or on behalf of the recipient of the service". Grönroos (2007) defined services as "processes that consist of a set of activities which take place in interactions between a customer and people,

[6] A service system can be defined as a value-coproduction configuration of various entities such as people, technology, other internal and external service systems, and shared information (Spohrer, et al., 2007).

[7] Service science aims to improve the ability to create service innovation systematically. Service innovation has been evolved through value-creation mechanisms used by service system entities (Spohrer and Maglio, 2010).

goods and other physical resources, systems and/or infrastructures representing the service provider and possibly involving other customers, which aim at solving customers' problems".

2.2.2. Differences between products and services

Previous studies have discussed how services are defined and how they differ from goods. The most obvious difference between goods and services is that goods are physically produced and services are performed (Botha et al., 2005). However, the complex nature and diversity of service products has led to different perspectives to the understanding of services.

From looking at the above definitions, it is clear that service products have distinct specificities compared to physical products. There are some specificities of services that distinguish them from physical products, such as intangibility, inseparability, perishability, heterogeneity, variability and non-ownership (Lovelock, 1983; Zeithaml et al., 1985; Kotler, 2003; Perreault and McCarthy, 2005; Grönroos, 2007). These inherent features pose more challenges to innovation than in the case of physical goods, and thus, service providers should consider service products differently from physical goods.

In this section, the specificities of services are decomposed into intangibility, inseparability, perishability, heterogeneity and customer participation in the service process. Each specificity and hence its challenge will be described as follows.

(1) Intangibility (or ownership)

Services are intangible and insubstantial, which means that they cannot be touched, looked at, smelled, tested or tasted prior to the purchase. This makes it more difficult and more risky when the user decides whether to purchase the service product or not. Due to the intangibility of services potential customers "will look for evidence of service quality from the place, people, equipment, communication material, symbols, and price that they see" (Perreault and McCarthy, 2005). To deliver the stable quality of the service to the user, service provider should overcome the perceived risk and try to make the service seem more tangible.

(2) Inseparability (or Simultaneity)

Services are normally produced and consumed simultaneously while physical goods go through the process of being manufactured, stored, distributed to resellers before they are finally consumed later on (Kotler, 2003; Zeithaml and Bitner, 2000; Bouwman et al., 2008). Service products are also usually produced in the presence of customers whereas the production of physical goods are not (Perreault and McCarthy, 2005). This leaves little room for service providers to cope with an expected error. If an error occurs during manufacturing then manufacturers of physical products can take the necessary corrective measures to ensure that the customer is not exposed to the error. In case of service products, on the other hand, if a mistake or an error occurs, the customer is immediately aware of it and experiences it as it occurs (Botha et al., 2005).

(3) Perishability

Perishability refers to the fact that services cannot be stored like a tangible product (Zeithaml and Bitner, 2000; Kotler, 2003; Perreault and McCarthy, 2005). This means that a service product cannot be produced a day or a week in advance and then stored until it is needed. It has to be produced and utilized when demanded. Such perishability of services raises service provider's pressure to try to manage supply and demand. It may be hard to balance supply and demand for services particularly when the demand for services fluctuates (Perreault and McCarthy, 2005; Kotler, 2003). Zeithaml and Bitner (2000) say that due to perishability, companies need to have strong recovery strategies to regain the customer's goodwill when things go wrong.

(4) Heterogeneity (or Variability)

Heterogeneity reflects the potential for high 'variability' in service delivery (Zeithaml et al., 1985). Services are highly variable because they depend on the provider, location and the time the service is provided. For that reason, service users seek advice from other people before they select a service provider (Kotler, 2003). The heterogeneity is due to services mostly being performed by humans.

There are no two services that are exactly the same (Zeithaml and Bitner, 2000; Winer, 2004). Service performance can slightly differ between purchase occasions even if the same person performs it. Therefore, it is more difficult to control quality for services than for manufactured products (Winer, 2004). In this regard, quality control and employee

training will play a crucial role for the service provider.

(5) Customer participation in the service process

In some cases, the production of services often requires the active participation of the user in the process (Gallouj, 2002). Such user's involvement in service delivery increases the difficulty of standardizing services. In other words, the service quality can be determined by this interaction, not simply by the quality of the service provider's efforts (Winer, 2004).

2.2.3. Diversity among services

The previous section explained that unlike physical products, service specificities include intangibility (cannot be seen, felt or tasted before being purchased), inseparability (simultaneous production and consumption), heterogeneity (the requirement for human effort), perishability (the inability to be kept in stock) and customer participation in the service process (interaction with service users). However, many case studies in service sectors have shown that the degree of those specificities in one service sector is different from that of another. Thus, services are diverse and have various attributes.

Different authors have developed different classification schemes based on criteria that they view as being relevant. The most important and highly developed of these taxonomic studies is Pavitt (1984)'s well-known taxonomy, as shown in Figure 2-1. However, one of the principal limitations of this taxonomy is that it locks the whole service sector into a single category (i.e. supplier-dominated firms). Other studies have adopted the same theoretical perspective in order to identify diversity among services. Soete and Miozzo (1989) drew directly on Pavitt's taxonomy and distinguished four categories of service businesses by adopting its criteria.

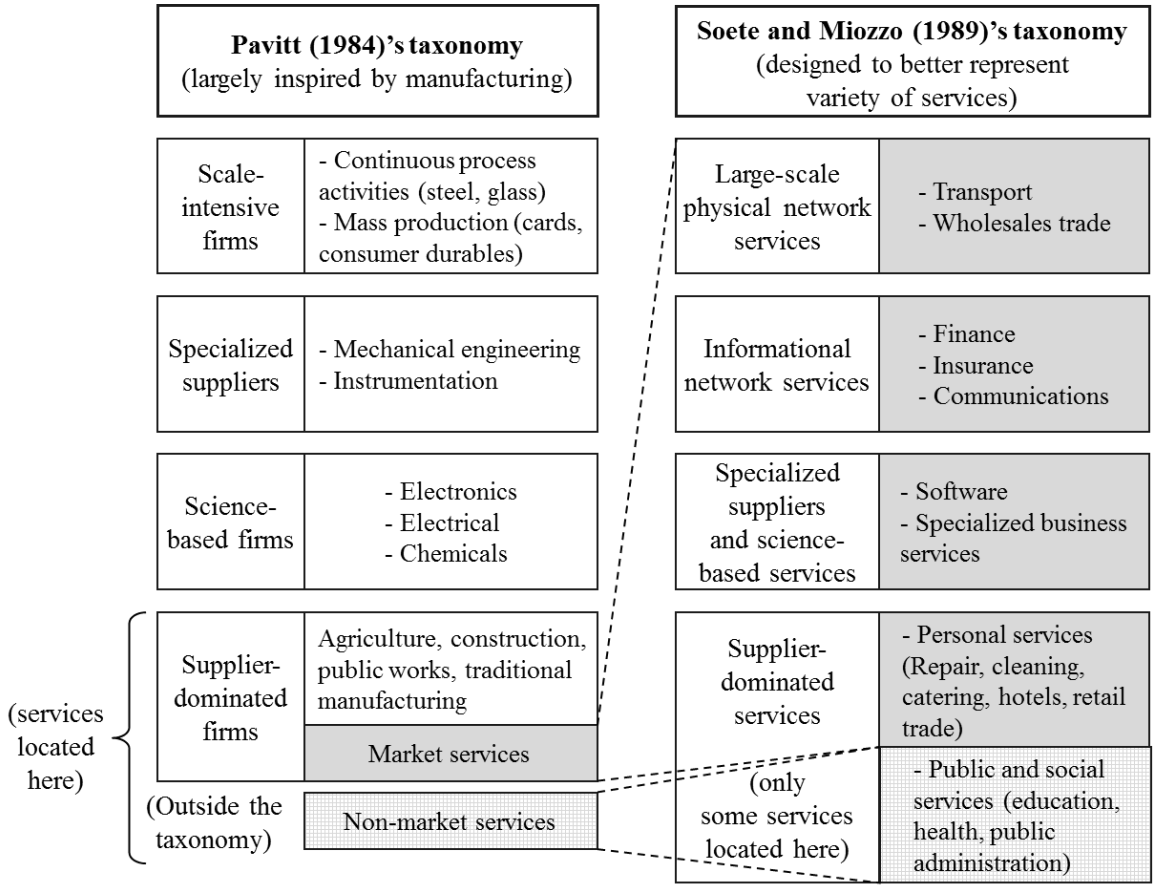

Figure 2-1. Changing views of services' taxonomy

Soete and Miozzo (1989)'s approach reminds us that the role of services was generally neglected in accounts of the classic studies of innovation. It also draws attention of this study to IT-using services such as mobile telecommunications services. In the following section, more discussions are needed to focus on the mobile telecommunications services.

Recent reviews of the literature suggest adding further types to the Soete and Miozzo's categorizations (Tether et al., 2002; Kanerva et al., 2006; Miles, 2008). This sort of type has been studied mainly through innovation surveys using countries' national industrial classification such as the Community Innovation Survey (CIS) data. The results of the survey analyses distinguish professional knowledge-based type (e.g. accountancy, legal services, advertising, and other traditional professional services), public service type (e.g. education, health care, and public administration) and interactive type (e.g. consultancy) (Evangelista, 2000; Sundbo and Gallouj, 2000; Miles, 2005).

Miles (2008) depicts how service industries vary in such areas as products. Survey data indicates that some service organizations behave very much like high-technology manufacturing. Knowledge-intensive business services are based more on professional

knowledge and by large network-based service firms while smaller service firms conform to a supplier-driven pattern (Miles, 2008).

2.3. Theoretical Approaches of Innovation in Services

2.3.1. The concept of service innovation

The concept of innovation is closely related to the work by Schumpeter (1934), who argued that innovation serves to create wealth through fulfillment of customer needs with five different types of innovation. Schumpeter's innovation concept covers five areas: (i) the introduction of a new good or a new quality of a good (product innovation); (ii) the introduction of a new method of production, including a new way of handling a commodity commercially (process innovation); (iii) the opening of a new market (market innovation); (iv) the conquest of a new source of supply of raw material or intermediate input (input innovation); and (v) the carrying out of a new organization of industry (organizational innovation) (Schumpeter, 1934). According to Schumpeter (1934), innovations represent both radical discontinuities and new combinations of existing things. Drejer (2004) demonstrates that Schumpeter's original concept on innovation is broad enough to encompass services and manufacturing.

Nonetheless, innovation in services had been poorly understood and less visible in statistics. For a long time, service innovation has been considered minimal or non-existent. In the past, the focus was especially on technology-driven innovation in manufacturing, and the impact of technologies on service process, resulting in what is called the reversed product life cycle (Barras, 1986, 1990).

However, service innovation has begun to receive more attention, and the distinction of services as opposed to products was increasingly emphasized in service innovation (, 1997). Since the first discussion on the concept of service innovation by Miles (1993), prior studies on service innovation have covered various scopes: those studying innovation in services (i.e. new or improved service products), those studying innovation in 'service processes' (i.e. new or improved ways of designing and producing services) and those studying innovation in 'service firms', or 'organizations' (i.e. organizational innovations). Nowadays, the focus is increasingly on the complexity and multi-dimensionality of modern services and manufacturing, including the bundling into 'solutions' or 'offerings' (Salter and Tether, 2006).

Within this background, the following section will look into different approaches of service innovation that have emerged in proportion to increasing attention on the importance of services.

2.3.2. Different approaches to analyzing innovation in services

Innovation in services especially has become of great importance in recent years (Miles, 1993). Studies on service innovation have been categorized into three approaches: (i) an assimilation/technologists approach, which treats services as similar to manufacturing; (ii) a demarcation/service-oriented approach, which argues that service innovation is distinctively different from innovation in manufacturing, following the dynamics and displaying features that require new theories and instruments; and (iii) a synthesis/integrative approach, which suggests that service innovation brings to the forefront hitherto neglected elements of innovation that are of relevance for manufacturing as well as services (Gallouj, 2002; Coombs and Miles, 2000; Drejer, 2004).

The oldest studies tended to take an 'assimilation/technologists' approach focusing on the introduction of technical systems into service firms and organizations (Barras, 1986, 1990; Miozzo and Soete, 2001). More recent studies have sought to highlight the distinction of service innovation. These 'demarcation/service-oriented' approaches criticize the technologist approaches for their short-sightedness, which consider innovation in services to merely adapt to manufacturing based innovation. Instead, these new approaches have developed an extended approach to innovation that includes technological innovation but also embraces other forms, such as intangible products and processes (Coombs and Miles, 2000; Gadrey et al., 1995; Sundbo, 1997; Sundbo and Gallouj, 1998; van der Aa and Elfring, 2002).

Lately, more 'synthesis/integrative' approaches have recognized the trend towards convergence and the blurring of the boundaries between products and services. This approach underestimates neither the importance of technologies nor the possible role of non-technological forms of innovation, such as organizational or managerial process innovations (Coombs and Miles, 2000; Drejer, 2004; Miles, 2000; Sundbo, 2001; Gallouj, 2002). This study contributes to the integrative approach by revising the theory to enable reasoning about recent innovations in mobile service.

2.3.3. Various models of innovation in services

The studies on service innovation have applied Schumpeter's original concept on innovation to services, encompassing the introduction of a new good (radical innovation) or a new quality of a good (incremental innovation) (Drejer, 2004; Windrum and García-Goñi, 2008; Camisón and Monfort-Mir, 2012).

Table 2-1 shows what some important studies regard as the main innovation models and how they have developed from previous models.

Table 2-1.The main models of innovation in services

Authors	Main forms of innovation	Service areas
Barras (1986)	Incremental process innovation (phase 1)	Financial, accountancy and administrative services
	Radical process innovation (phase 2)	
	Product innovation (phase 3)	
Gadrey et al. (1995)	Product/service innovations • Absolute product/service innovations • Relative product/service innovations • Tailor-made product/service innovations	Insurance services
	Architectural innovations • Product/service bundling innovations • Product/service unbundling innovations	
	Innovations based on modifications to a product or service	
	Process and organizational innovations • Innovations introduced in support of product/service innovations • Innovations associated with a product/service that remains unchanged with respect to both formal specifications and mode of delivery • Innovations associated with a product/service whose formal specifications remain unchanged but whose mode of delivery, perceived quality and marketing are to be improved	
	Innovations in methods and management • Formal management innovations • Informal management innovations	
Gallouj (2002)	Radical innovation	Insurance, cleaning, legal consultancy, catering and public services, etc.
	Ameliorative innovation	
	Incremental innovation	
	Ad hoc innovation	
	Recombinative innovation	
	Formalization innovation	

Compiled from Innovation in the Service Economy: the New Wealth of Nations (Gallouj, 2002)

Barras (1986)' argument is based on a large-scale empirical study carried out in the area of financial (banking and insurance), accountancy and public services. Gadrey et al. (1995) highlight those not captured by Barras' model. It shows the diversity of the types of possible innovation in insurance services (although the typology can be applied to all

financial services). On the other hand, Lancaster (1966) observed that products can be described as a bundle of 'service characteristics'. Lancaster's insight is that consumers do not desire a product in itself but rather the particular bundle of service characteristics that it offers. In accordance with the Lancasterian perspective, Gallouj (2002) argues that service characteristics are considered from a user's point of view, and innovation can be defined as any change affecting one or more terms of these characteristics. Gallouj (2002) distinguished innovation in services into a wide range of different forms, taking Lancaster's work (Lancaster, 1966), in which a product is defined as a set of characteristics. In the service context, six types of innovations are observed, namely (i) innovations in service products (radical / ameliorative / incremental innovations[8]), (ii) recombinative innovation which is a form of innovation that relies on the basic principles of combining or splitting service characteristics, (iii) ad hoc innovation which is a unique solution, co-produced specifically to resolve a user's problem, and (iv) formalization innovation which standardizes the service delivery system.

2.4. The Role of Technology, Competence of Service Providers and User Involvement in Service Innovation

2.4.1. Links between technological innovation and services

There are many types of relation between technology and services based on substitution, identity, determination, diffusion and production (Gallouj, 2002). For example, a technical tool can replace the front or back office, the service or service provider (substitution relation). On the contrary, a service can constitute the effective value of technology (identity relation). Such a relation can be often seen in mobile telecommunication services with wireless internet access, web fax and high definition video. For instance, web fax uses the internet to send a document by fax. Web fax users don't need a telephone line nor actual fax machine. It enables to send and receive faxes via mobile devices at any location that has internet access. Providing such a paper-free communication service can result in

[8] Radical innovation involves the creation of a totally new product. Ameliorative innovation is based on a narrow definition of improvement, which does not change the structure of the system but simply increases the value of the service. Incremental innovation emerges from the addition or removal of new elements. This type of innovation is different from ameliorative innovation because the improvement in incremental innovation can change a form of service (Gallouj, 2002).

higher satisfaction of mobile service users who benefit from mobile carrier's network technologies.

Furthermore, technological innovation and innovation in services can show the determination relation by determining the appearance of each other's innovation. Some services contribute to the diffusion of technological innovation (diffusion relation). Service firms themselves can be producers or designers of technology (production relation). In most cases, this relation is usually based on co-production.

In summary, these relations reflect that technology can replace services in whole or in part, which means that it can determine innovation in services, and conversely, that service can contribute to the diffusion, production or co-production of technological innovation (Bessant and Rush, 1995; Miles et al., 1995; Antonelli, 1995; Hales, 1997; Den Hertog, 2000).

2.4.2. Competence building of service providers

Innovation studies of service providers identified the role of a firm in managing service innovation. One common result from the studies reviewed is that client-provider alliances may provide an important way to build the competences for service providers (Sivula et al., 1997; Claycomb and Martin, 2002; Magnusson et al., 2003; Chen et al., 2007; Rajala et al., 2007).

Claycomb and Martin (2002) identified customer relationship-building practices of U.S. commercial service providers. According to them, service providers try to offer different things to different customers and build strong customer relationships for the following reasons: encouraging customers to think of the firm first when considering a purchase; providing better service; encouraging customers to speak favorably about the firm; and encouraging customers to trust the firm.

To manage service innovation, service firms follow the processes of new service design (identifying customer value and proposing a scope of offerings), service development (acquiring resources and managing service innovation projects) and service delivery (enhancing service value and sustaining revenues and growth) (Chen et al., 2007). During these processes, it may be useful for managers in knowledge-intensive business firms to analyze their client base as a source of knowledge and identify the potential learning partners. In particular, the close interaction with the customer in service delivery offers an opportunity for a service provider to absorb knowledge from the client (Sivula et al., 1997)

and help the service providers to develop innovative services (Rajala et al., 2007). Thus, clients can contribute to the development of the knowledge base of knowledge-intensive business service firms.

Apart from building customer relations, the other common findings drawn from literature review is that to achieve innovation, service firms engage in cooperative arrangements for innovation with various types of partners (Gittell, 2002; Tether, 2002; Bouwman et al., 2007)

Many service firms create new service offerings through collaborative arrangements and partnerships (Maitland et al., 2002; Olla and Patel, 2002; Hamilton and Selen, 2004; Stuart and Tax, 2004). The relationships between service providers are integral to the process of coordination and therefore are an important contributor to the outcomes when service processes are highly interdependent, uncertain, and time constrained (Gittell, 2002; Magnusson et al., 2003). Such a relationship with other firms is particularly important in service sectors where new services are relatively easily copied, but costly to develop. Because copying of innovations can be a common problem in services, service firms agree to introduce new services based on a jointly developed, common standard with other firms (Tether, 2002). Thus, innovation requires an innovative approach in the way of collaborating and sharing resources and capabilities (Bouwman et al, 2008).

2.4.3. Interaction between service providers and users

As service is dynamic and fluid in nature, it must be provided through mixing equipment with human knowledge and skills (Tether, 2003). Prior literature on user innovation in services emphasizes the interactive and co-produced nature of service (den Hertog, 2000; Gallouj, 2002; Gallouj and Weistein, 1997).

Service users have been known to be active innovators. Prior literature on user innovation in services argued that the most effective service users to incorporate in co-creation exercises are ‘lead users’, who are sources of new service ideas with high commercial potential (Oliveira and von Hippel, 2011). Gruner and Homburg (2000) reported that user involvement during the early stages of a development process significantly influenced the performance of new products. Alam (2002) suggested that the intensity of user interactions should be high during the stage of idea generation and screening. Prior literature on user innovation in services argued that user involvement is higher in Business-to-Business (B2B) than in Business-to-Consumer (B2C) services. Alam

(2006) identified service innovation through user interactions in B2B financial service sectors. Financial firms invite service users to help brainstorm new service ideas, and conduct focus groups or in-depth interviews to identify the users' changing needs. B2B service users observe a mock service delivery process and provide feedback on the merits of the product concepts. They sometimes work with a service development team so that those teams can generate new service ideas from customers.

In sum, the importance of user interaction and user involvement was emphasized in service innovation studies.

2.5. Literature Review on Mobile Service Innovation

2.5.1. Innovation studies in mobile telecommunications services

Mobile telecommunications service sector is a good research subject to study innovation because new technologies and innovative services keep being developed and launched. Such type of research is carried out through case studies of different countries such as the U.S., Finland, Japan, Korea and China. Among them, some studies have focused on key success drivers of advanced countries during the transition phase from one technology to another (e.g. from 2G to 3G) and tried to identify the country's unique success drivers vis-à-vis those of other countries (Steinbock, 2001; Palmberg, 2002). Others examined the technological catching-up strategy of latecomer countries (Fan, 2006; Whang and Hobday, 2011; Xia, 2012). Suryanegara and Miyazaki (2010a, 2010b) present analyses of technological changes from 1G/2G to 3G and from 3G towards 4G with an aim to build technology roadmap towards 4G.

One interesting fact is that the mobile carriers have expanded their business to a broad range of different industry areas that used to exist separately. As a result, convergence of devices, ICT services, technologies and different industries leads to many new innovative services and products such as mobile TV, telematics, mobile banking, and mobile learning. In order to develop these new services, mobile telecommunications industry needs to include various participants from both inside and outside the industry. Regarding different interests and motivations of participants, prior studies have tried to understand two distinctive roles of standards in the innovation and diffusion of mobile services. Firstly, standards enable multiple actors to mediate their different interests to build effective actor networks to integrate and generate technical knowledge that was critical for the successful

implementation of the infrastructure (Fomin, 1999; Funk, 1998; Lyytinen and King, 2002; Yoo et al., 2005). Secondly, standards play an important role in shaping the configuration of the actor networks by mediating the path-dependent nature of action and cognition by the actors (Arthur, 1989; David, 1985). Particularly during 2G development in Korea, standards played a significant role in sustaining path-dependencies in relationships because it helped mediate and shape the critical relationships among key actors (Yoo et al., 2005).

While supply-side studies have focused on the role of regulations and standards, demand-side studies have been conducted from the perspective of adoption or diffusion of mobile services (Grüber, 2001; Kleijnen et al., 2003; Pagani, 2004; Gilbert and Han, 2005; Hsu et al., 2007; Bouwman et al., 2007; Lin, 2011). The results show that the important determinants of adoption of mobile services include perceived usefulness, ease of use, price, and speed of use. They also show that the importance of determinants differs by age groups or segments.

From the literature reviews above, prior studies have investigated the role of both adopter-side and supply-side variables to analyze innovation in mobile services. In other words, the factors related to mobile services, devices and mobile technologies as well as personal and user-related factors influence the diffusion or innovation of mobile services (Jonsson and Miyazaki, 2004; Miyazaki and Wiggers, 2005).

2.5.2. Prior case studies of innovation in the Korean mobile telecommunications industry

The Korean mobile telecommunications industry has been an interesting research subject for innovation studies in various aspects: adoption/diffusion of innovation, technological innovation, system of innovation and innovation catch-up, which are summarized in Table 2-2.

Table 2-2. Prior case studies of Korean mobile telecommunications industry

Research interests	Details and authors
Adoption of innovation, diffusion of innovation	Mobile cellular service (Kang et al., 1996) 3G Broadband mobile service (Yang et al., 2003; Yoo, et al., 2005) Mobile internet service (Choi et al., 2011) Internet standard adoption (Hovav et al., 2011) Mobile e-book (Lee, 2012)
Technological innovation	3G and behind (3.5G) (Lee et al, 2009) 4G (Forge and Bohlin, 2008; Shin et al., 2011) Broadband convergence network (Shin and Jung, 2012) Mobile music service (Takeishi and Lee, 2005; Lee, 2012)
System of innovation	Mobile telecommunication services (Lee and Han, 2002) Asymmetric digital subscriber line service (Kim et al., 2008)
Innovation catch-up, technological catch-up	Mobile telecommunications services (Hobday et al., 2004) Mobile handset industry (Whang and Hobday, 2011) ICT industry (Choung et al., 2012)

One aspect of the studies is adoption or diffusion of innovation. For instance, the role of standard is often analyzed in promoting, enabling and constraining innovation in the Korean mobile telecommunications services such as mobile internet and 3G services (Kang et al., 1996; Yang et al., 2003; Yoo, et al., 2005; Choi et al., 2011; Hovav et al., 2011; Lee, 2012).

Secondly, the transition of mobile technologies has been an attractive research theme to identify technological innovation by providing insight into the Korean mobile environment by offering a socio-technical analysis and how it involves the dynamics of industry, regulation and technology (Lee et al, 2009; Forge and Bohlin, 2008; Shin et al., 2011; Shin and Jung, 2012; Takeishi and Lee, 2005; Lee, 2012). Forge and Bohlin (2008) insist that managed innovation with long-term programs is the key to Korea's transition towards 4G. Such a challenging goal is to assure that a general transition occurs, from early post-war growth based on cheap labor to competing on innovation and quality by use of a sophisticated, highly educated workforce and also to construct a larger service economy. Shin and Jung (2012) investigate the policy objectives of the Broadband convergence Network (BcN) from the view that broadband acts as an essential social platform that serves an ecosystem to promote and strengthen industrial innovation.

Thirdly, there are some studies that examine the Korean success in telecommunications from a systemic and dynamic perspective (Lee and Han, 2002; Kim et al., 2008). Kim et al. (2008) insist that introduction of new telecommunication services has the characteristics of a 'system of innovation,' and thus the dynamic interactions among various actors should be effectively coordinated by the market, institutional agencies or a combination of the two.

Fourthly, some innovation catch-up studies summarizes certain key lessons on innovation (Hobday et al., 2004; Whang and Hobday, 2011; Choung et al., 2012). Whang and Hobday (2011) insist that the local innovation cycle became a decisive factor in the route to global market success in the Korean handset industry. In other words, the Korean domestic mobile device manufacturers launched new products in the domestic market first, and after receiving local feedback and addressing problems, the products would be launched again in the export market.

In this regard, many prior studies examined the elements of the Korean innovation model in mobile telecommunications which are specific to Korea's socio-political condition. Korea's experiences may serve as important lessons for other countries or mobile carriers who try to introduce new mobile technologies or innovative mobile services.

2.6. Empirical Background of the Study

2.6.1. Mobile market summary

The Korean mobile telecommunication market has become saturated. As of July 2012, the total number of Korean mobile subscriptions exceeded 53 million, demonstrating that almost 100% of potential users were using mobile telecommunication services (Korea Communications Commission, 2012). Moreover, the emergence of smartphone opened up new opportunities for mobile carriers. Since Apple's iPhone was introduced in November 2009, the smartphone market has been growing very fast. According to the Korea Communications Commission (KCC), the number of smartphone subscribers in Korea stood 810,000 at the end of 2009 and exceeded 32 million as of November, 2012[9]. Figure 2-2 shows the current status of the mobile market in Korea.

[9] The total number of smartphone users was 32,041,079 as of November, 2012 (SK Telecom: 15,658,765 with 49% of market share, KT: 10,062,088 with 31% of market share, and LG U+: 6,320,226 with 20% of market share).

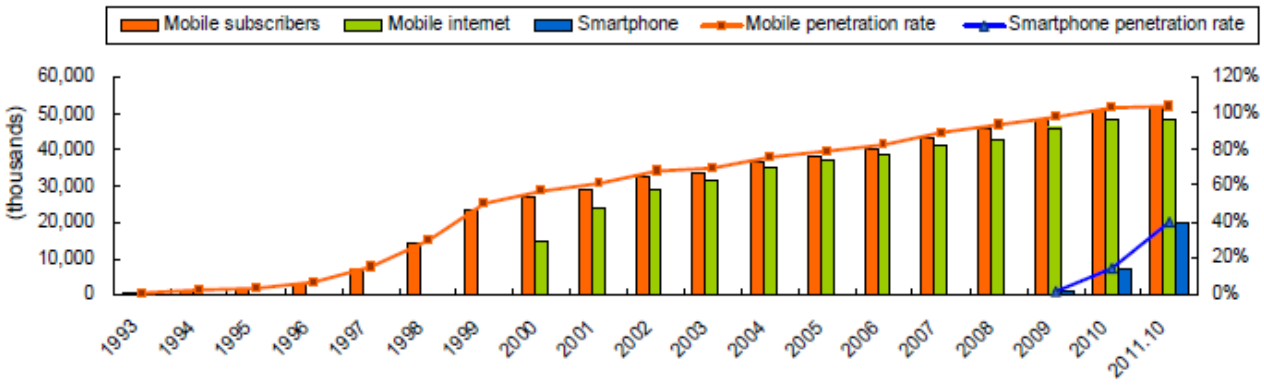

Figure 2-2. The current status of the mobile market in Korea

Source: The Korea Communications Commission (KCC)

Mobile telecommunications services in Korea are served by three mobile carriers: SK Telecom, KT and LG U+. As of June 2012, SK Telecom has a dominant position in the market with 50% market share, followed by KT with 31% and LG U+ with 19%.

The competition paradigm has transitioned very fast, from voice quality to data capacity since smartphone usage grew rapidly. Figure 2-3 shows that data traffic of three Korean mobile carriers has surged at a rapid pace over the past few years as smartphones became more popular. Mobile data traffic of the three mobile carriers jumped almost 50 times for the past two years.

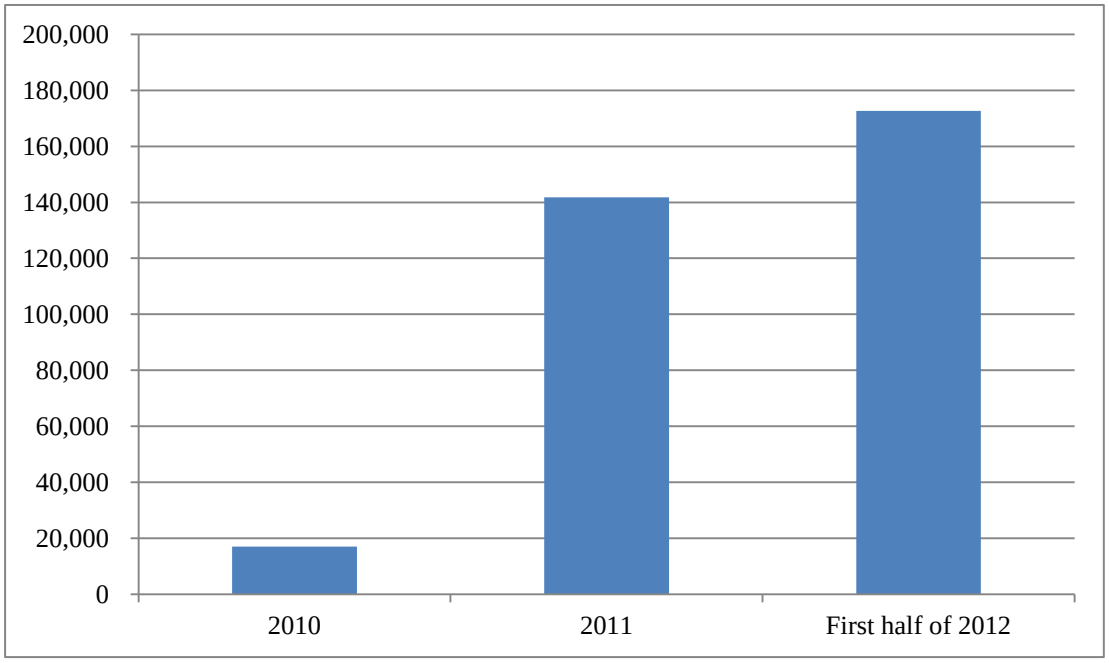

Figure 2-3. The combined mobile data traffic of the three mobile carriers

Source: The Korea Communications Commission (KCC)

The combined mobile data traffic of the three mobile carriers soared nearly 50-fold as of the first half in 2012 from two years ago (KCC, 2012). The mobile data traffic rose 8.3 times from 17,036 terabyte (TB) in 2010 to 141,803 TB in 2011. The figure marked 172,629 TB in the first half of 2012 alone, surpassing last year's figure for the full year. By company, SK Telecom saw its data traffic ascend 75.4 times from 1,130 TB in the first half of 2010 to 85,184 TB in the first half of 2012, and KT's data traffic expanded 28 times from 1,821 TB to 51,036 TB during the same period. The figure for LG U+ gained 67.9 times from 536 TB to 36,409 TB (Maeil Business Newspaper, 2012/09/20).

However, the growth of smartphone market does not mean merely increase in the sales of smartphone itself. It influences strategic directions of mobile carriers, offers various future business opportunities for them, and affects the entire mobile service industry. The struggle for further revenue in the saturated domestic market and a business opportunity for creating new mobile solutions, taking advantage of rapidly growing smartphone market, have motivated mobile carriers to shift their attention to B2B business, targeting institutional users. From 2009, they have entered B2B mobile business and the new business area started to grow rapidly by inducing increased data revenue.

2.6.2. Paradigm shift in the Korean mobile sector from B2C to B2B

There was a significant change of the Korean mobile telecommunication market behind the growth of B2B market. Firstly, government's telecom policy moved towards 'openness'. In 2005, the Korean government made it mandatory for all mobile-phone makers and content providers to use a software standard for Internet access, called WIPI (Wireless Internet Platform for Interoperability). However, the world's handset market was rapidly changing from a closed platform to an open mobile Operating System (OS). In order to keep pace with the trend, the regulation of mandatory use of WIPI was abolished as of April 2009.

As a result of the policy of openness, iPhone was launched in Korea in November 2009, and Motorola 'MOTOROI', the first Android-based phone, was introduced in February 2010. The rapid spread of smart devices accelerated the demand for high speed networks. Mobile carriers focused their efforts on offering a high-speed wireless data communication services over Long Term Evolution (LTE) network, which enables improved services for video calls, multi-player games, navigation and cloud services.

Such a paradigm shift in the mobile telecommunication industry changed the

characteristics of mobile services and accelerated the launch of many mobile solution services for enterprises. This led to a variety of radical or incrementally new B2B service products. Therefore it was considered that a significant paradigm change occurred in 2009-2010.

In this regard, the market change that occurred during 2009-2010 opened up new opportunities for mobile carriers. It has not only changed the mobile environment in Korea but it has also affected the business landscape of Korea's domestic mobile carriers. The mobile carriers are now becoming platform players. Thus, a mobile carrier now stands at the cross point where it stays at the position as a network provider, or changes to a service platform enterprise.

In this regard, the following section will present the changes that occurred in the business landscape of mobile carriers.

2.6.3. Mobile carriers' business landscape before 2009-2010

As the market becomes saturated, it becomes difficult to generate revenue from voice communication. Consequently, mobile carriers have started pursuing earnings opportunities other than voice traffic but from data revenues.

The mobile carriers facing mature mobile market and saturated basic mobile services tried to encourage potential market demand for mobile phones and to increase the Average Revenue Per User (ARPU)[10] with new multimedia data services based on broadband mobile networks. Under these efforts, a wireless internet service had offered a variety of data centric services such as e-mail, games, movie and music download, weather forecast and sports results since the early 2000s.

2.6.4 Mobile carriers' business landscape after 2009-2010

2.6.4.1. Expansion of mobile carrier's business areas

(1) B2C business expansion after 2009-2010

As part of their efforts to meet customer demands for high-speed data access, mobile carriers have focused on offering much faster and larger data streaming Long Term

[10] ARPU (Average Revenue Per User) is defined as the total wireless revenue divided by the number of mobile subscribers.

Evolution (LTE)[11] services for their early-adopting customers in recent years. In addition, mobile carriers are making an effort to develop new innovative B2C mobile services such as Location-Based Services (LBS), Digital Multimedia Broadcasting (DMB) and mobile financial services. The examples of B2C business areas of the three mobile carriers are described below.

Firstly, SK Telecom is Korea's largest fixed-mobile network provider. In order to actively respond to the accelerating trend of convergence among different technologies and industries, SK Telecom continued to strengthen the convergence, Internet and content business sector, including the foundation for platform business by expanding various platforms such as "T store", the online marketplace for mobile application, and "11 Street", the online shopping mall that links wired and wireless shopping services, into a major e-commerce marketplace. Also, it developed "T map" phone-based navigation service into an LBS platform, and built open platforms in the personal media space such as "n-screen" cloud-based media-delivery service in January 2011.

Secondly, KT is the first mobile carrier that introduced iPhone in Korea at the end of 2009, successfully changing the market landscape with a data-oriented smartphone. In 2011, KT combined its various brands into a single brand, named "Olleh" embracing all areas from fixed, wireless services as well as convergent services. In terms of convergence, KT aggressively marketed its 'Olleh TV Skylife' product by linking up with Korea Digital Satellite Broadcasting (affiliate of KT) to lead the communications and broadcasting convergence market.

Thirdly, LG Dacom Corp. and LG Powercom Corp. merged into LG U+ in 2010 to enhance operational efficiency and maximize synergy effects between wired and wireless communication business. Through this merger, LG U+ expanded its operation to fixed-line telephony service, value-added telecommunication activities, broadband network rentals, and broadband internet access service. In addition, LG U+ concentrated on setting up new business platforms and infrastructure in preparation for the convergence between devices and industries. LG U+ launched "Smart7" service which combines smart TV and IPTV, and released a cloud-based personal N-Screen service called "U+Box".

[11] LTE (Long Term Evolution) is a standard for wireless data communications technology and an evolution of the GSM/UMTS standards, and it has the ability to manage fast-moving mobiles, and support multi-cast and broadcast streams.

(2) B2B business expansion after 2009-2010

Under the fierce competition and unpredictable shifts in the business climate in the mid-2000s, the mobile carriers seeked to create more profitable segmentation in the existing market to seek further revenue. Since 2009, they began to expand B2B mobile solutions aggressively by attracting B2B customers in various industries.

As demand for mobile business solutions grew, Korea's mobile carriers have been launching a variety of new ICT-based business solutions (i.e. B2B) in the field of education, healthcare, distribution, and auto manufacturing. As part of continuous efforts to produce further revenue, the Korean mobile carriers have opened the possibility that they would consider the development of mobile solution services for institutional users as well as individual users (SK Telecom magazine, 2009).

The service products launched by mobile carriers show the most diverse range of service categories. Based on the fixed and mobile network provided by a mobile carrier and its subsidiaries, many B2B mobile carrier services can be provided by mobile carriers. The service categories contain mobile office solutions (e.g. mobile groupware), location-based solutions (e.g. telematics), wireless telemetry solutions (e.g. remote control) and mobile solutions aimed at specific industry users (e.g. mobile finance).

For instance, SK Telecom launched "Smart Office" mobile groupware solution and "Smart CEO" mobile management information solution in 2010. As of the end of 2010, it had delivered mobile office solutions to more than 600 Korean B2B customers (SK Telecom Annual Report, 2010). KT promotes B2B market with its mobile business solutions and cloud computing, and LG U+ launched the "U+ Mobile Office", which is a mobile portal service customized for institutional or business users. The solution supports the compatibility of groupware on a mobile web service. Its functions include e-mail, a schedule planner and inquiries. Thus, their B2B mobile services are developed and delivered as tailored solutions for various industries and business size. Appendix 3 introduces more examples of B2B mobile solution offerings that have been provided by SK Telecom and KT since 2009.

LG U+ also implemented "my Edu TV" IPTV which carries programs for educational purposes and a mobile advertising platform called "U+AD". It is also preparing for smart healthcare and commercial vehicle telematics services.

Table 2-3 summarizes the B2C and B2B business areas of the mobile carriers in Korea and their market share.

Table 2-3. Summary of mobile service market overview

	SK Telecom	KT	LG U+
No. of subscribers	26,678,718	16,466,099	9,947,840
Market share	50.2%	31.0%	18.7%
Main B2C business areas	4G LTE, Roaming, Online app store, Online shopping mall, Mobile music portal service, Wireless and wired internet portal, Phone-based navigation service, Mobile TV	4G LTE, Wi-Fi, (Wired/ wireless) broadband Internet service, Smart TV, House telephone service, Internet phone service, Smart home	4G LTE, Internet phone service, High-speed Internet, Digital phone, Internet HD TV, Cable TV transmission line service, Online data storage service
Main B2B business areas	Mobile prescription service, Smart learning, Corporate cloud computing, Mobile office service, Cloud-based business solution, Geographic Information System (GIS)-based solution	Leased line service and other data communication service, Call center outsourcing, Business administration solution, Customized video/ broadcasting service, Cloud computing	Internal infrastructure communication network and leased lines, Corporate cloud computing, Electronic payment, Mobile office service, Education solution, Digital media service

Source: Annual reports and Investor Relations (IR) reports of SK Telecom, KT and LG U+

2.6.4.2. Mobile carrier's view of B2B business as a longer-term growth engine

As B2C mobile penetration approached the near maximum level, a mobile carrier had to find growth from B2B. B2B mobile service market is very profitable because it is growing fast and has a large transaction volume. Thus, the ongoing business prospects in B2B mobile services such as mobile offices and cloud computing services could present a longer-term growth engine.

Thus, mobile carrier's business profitability could be influenced by the execution capability to expand into the B2B segment. For example, SK Telecom set up its strategy towards B2B business in 2009, which is called 'Industrial Productivity Enhancement (IPE)'. According to its announcement,[12] it had announced over 30 projects across private/public sectors and service/manufacturing industries as of November in 2010. In 2010, the revenue from IPE-related business has grown to 1 trillion KRW, representing 100%

[12] Source: SK Telecom, Asia Today Korea (2009/11/17), BNP Paribas Securities Asia estimates (2010/11/24)

increase from 2009. In 2011, SK Telecom collaborated with its subsidiaries (e.g. SK Broadband and SK Telink) and achieved combined B2B revenue of over 2 trillion KRW (SK Telecom Annual Report, 2011). It has an ambitious goal to target 20 trillion KRW revenue from the B2B segment by 2020.

During the analysis of mobile industry, it was found that most of the mobile carrier's B2B mobile solutions were implemented in smartphone and its various service platforms. Therefore, a higher growth rate in high-ARPU smartphone subscribers is considered to be related with increasing B2B business revenue. According to the analysis report of Korea Investment and Securities, ARPU of smartphone users is 70% higher than ARPU of other low-end phone users. In addition, smartphone has a shorter payback period than feature phones though it offers high subsidies. Figure 2-4 shows that the smartphone payback period is 11.1 months, whereas a feature phone takes 13.6 months to recover investment cost.

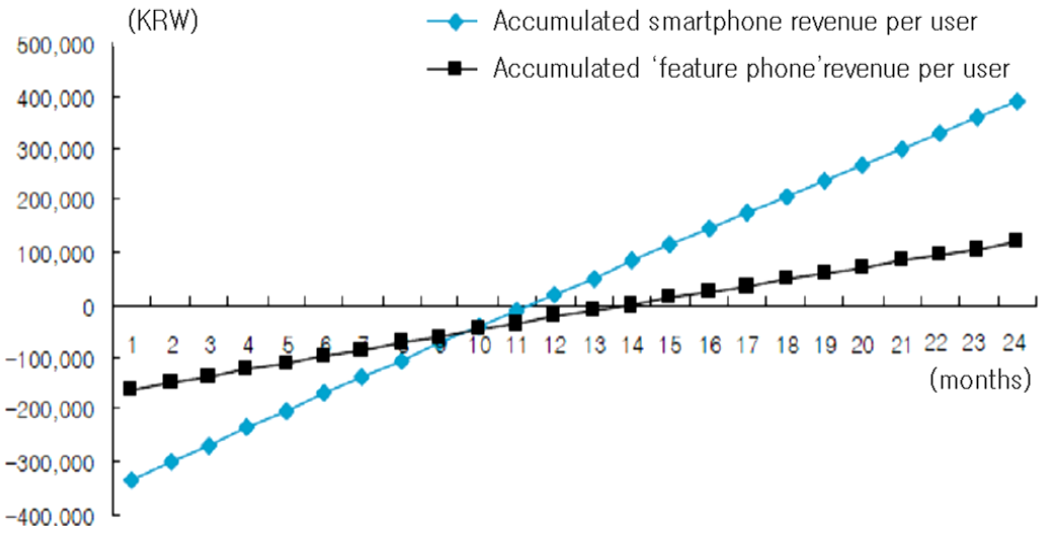

Figure 2-4. Payback[13] period of smartphone and feature phone[14]

(Source: Korea Investment & Securities Co., Ltd.)

Under such circumstance, a rapid increase in the number of high-ARPU smartphone subscribers could be one of the primary reasons for the strong growth in wireless Internet sales and monthly fees, because smartphone users generally tend to subscribe to

[13] Payback period is the period of time required for the return on an investment to "repay" the sum of the original investment (Payback period = (phone subsidy + other cost except phone subsidy) / monthly rate).

[14] A feature phone is any mobile phone that is not a smartphone. Generally used to describe low-end devices, while smartphone is used to describe high-end devices.

fixed-price data and voice plans with higher monthly basic charges.

A combination of a growing subscriber base and increasing wireless internet traffic significantly boosted sales growth of each mobile carrier in 2010. SK Telecom's revenue from wireless internet sales increased 13.2% to KRW 3.01 trillion in 2010 from KRW 2.66 trillion in 2009. The increase in mobile services revenue was due in large part to an increase in the number of smartphone users. Monthly fees' revenue increased 8.2% to KRW 4.50 trillion in 2010 from KRW 4.16 trillion in 2009, as a result of increased subscription to the service plans with higher monthly charges as well as 5.7% growth in its average subscriber base in 2010 over 2009.

On the other hand, at the end of 2009, KT was the first in Korea to introduce iPhone. It has been leading the change in the domestic mobile communications industry by creating a smartphone craze. As a result of its exclusive access to the iPhone, KT's average monthly ARPU from wireless internet services increased 22.3% to KRW 8,824 in 2010 from KRW 7,218 in 2009, whereas SK Telecom's average monthly ARPU from wireless internet services increased 7.1% from KRW 9,334 in 2009 to KRW 9,996 in 2010.

LG U+'s revenue from its data service achieved 18.6% year-on-year growth, to KRW 547 billion in 2010, as a result of the expanding smartphone business and the consequent surge in data usage. The number of subscribers has increased by 364,000, reaching 9.02 million in total on an accumulated basis, compared to 2009.

From the fact that B2B customers are heavy users of these above data services, expansion of B2B business areas would result in highly increasing revenue growth.

2.7. Methodology

2.7.1. Interviews

In order to evaluate whether the theories of service innovation correspond to the findings from an empirical case, this thesis begins with presenting an in-depth case study. For the case study, 'Mobile Campus' was chosen. In this thesis, Mobile Campus is defined as a smartphone-based mobile service that offers a variety of campus-wide applications in the areas of education, student's campus life and campus administration. The interviews were conducted in March 2011.

Information Service Team managers were interviewed, who were in charge of designing the main structure of Mobile Campus service, and the vice presidents of the two

selected universities, Ulsan National Institute of Science and Technology (UNIST) and Pohang University of Science and Technology (POSTECH). The two universities adopted the first Mobile Campus in Korea, in April and in September 2010, respectively. Those universities are early-starters of Mobile Campus. Separate interviews were conducted by means of face-to-face meetings at the universities and telephone interviews.

2.7.2. Pattern-matching technique

The information obtained from the field research was transcribed, examined and classified into several common themes (Nag et al., 2007; Miles and Huberman, 1984). For the analysis of innovation in Mobile Campus, the thesis used a pattern-matching technique that involved an iterative process of examining the correspondence between empirical evidence and service innovation theory. The primary objective of this technique is to compare the pattern that emerges from the empirical observations with the pattern that is predicted based on theory (Yin, 2009).

In this regard, this thesis reviews theoretical literature related to service innovation and establishes the theoretical basis for presenting the empirical case study. The pre-existing innovation theories were evaluated by matching the theoretical patterns of service innovation with empirical observations through interviews. Such an analytical technique is necessary to build a conceptual framework for presenting more realistic models of innovation.

2.7.3. Indicators of service innovation

The study measures the dynamics of service innovation by screening the market introduction of new services. Unlike traditional innovation indicators such as R&D expenditure and patents, new product announcement is a new output indicator that measures innovation directly. In addition, data collection can be performed without contacting firms and a researcher does not have to worry about non-response problems (Rogers, 1998; Kleinknecht et al., 2002; Becheikh et al., 2006). In addition to direct measure and no time-consuming data collection, the market introduction of new service brands has more merits. Because the data of new service brands are taken from the websites that are open to the public, the use of this information is objective and accurate.

The data of B2B mobile services was collected from the web pages of SK Telecom

(http://www.biztworld.co.kr/), KT (http://biz.olleh.com/) and LG U+ (http://biz.uplus.co.kr/). These websites are particularly designed for B2B mobile service business. The three mobile carriers announced every B2B mobile service brand that they have launched in the market. The websites contain new service announcements, a list of service brands, service description of each brand, expected benefits from service adoption, promotion events (e.g. free trial, price discount) and adoption procedures. Thus, B2B mobile service customers can search the website to find a suitable service product for their specific requirements. Also, they can subscribe to a service by registering on the website. Therefore, the mobile carriers aim to provide all the necessary information for their potential customers. The service brands collected from those adequate websites represent the entire B2B mobile carrier services in Korea.

Since this thesis attempts to classify services into several categories and to identify different innovations among them, this indicator could be an effective method to split the data by innovation types and make comparisons.

Even though the indicator based on new service counts has a shortcoming in the sense that it may not cover process innovation and a firm may refrain from announcement of new products in open sources (Kleinknecht et al., 2002), the scope of the research conducted in this thesis also include process innovation in terms of service-oriented innovation (Chapter 7). Such a combination of multiple perspectives can supplement the original shortcoming.

2.7.4. Statistical data analysis

By using data on the market introduction of new services as a service innovation indicator, the thesis examined 242 B2B mobile service products of three major Korean mobile carriers. Then, all the possible service characteristics were extracted and divided into 18 sub-categories. The 18 characteristics of 242 B2B mobile service products were converted into a set of 18 dummy variables (1=having a given characteristic, 0=not having it), producing a 242x18 data matrix.

For the statistical data analysis, two main statistical methods were used: factor analysis and cluster analysis. Factor analysis is used to reduce 18 service characteristics to a smaller set of dimensions with a minimum loss of information. Cluster analysis classifies B2B mobile service products into several groups whose characteristics are similar. Data

analyses were performed using Microsoft Excel and IBM SPSS Statistics 19[15].

The steps of statistical data analysis in this thesis can be summarized as follows.

(1) The correlation matrix of service characteristics is computed

(2) The factor loadings[16] are estimated, using principal component analysis[17] with varimax rotation[18]

(3) The loadings are rotated to make the loadings more interpretable. Rotation methods make the loadings for each factor

(4) From the factor analysis, scores are computed for each factor and saved for use as input variables in cluster analysis

(5) Hierarchical cluster analysis[19] is performed on the factor scores[20]

(6) The cluster analysis result is further analyzed with a one-way Analysis of Variance (ANOVA)[21] post-hoc test to determine the statistical differences between each service group

2.7.5. Web-based data collection and keyword search

There is incredible amount of data available online on internet. It is important for an industry analysis to be accurate and information specific while collecting this information as there are billions of pages available on internet. There could be two approaches for digging out the relevant information from internet, one of them is directly browsing the specific information from industrial, marketing or business sites and extracting the

15 IBM SPSS Statistics (formerly SPSS Statistics) is software provided by IBM for managing data and calculating a wide variety of statistics.

16 Factor loadings means correlation between the original variables and the factors, and the key to understanding the nature of a particular factor. Squared factor loadings indicate what percentage of the variance in an original variable is explained by a factor.

17 Principle component analysis is a statistical technique used to examine the interrelations among a set of variables in order to identify the underlying structure of those variables. It is also called factor analysis.

18 Varimax rotation is a change of coordinates used in principal component analysis and factor analysis that maximizes the sum of the variances of the squared loadings.

19 Hierarchical cluster analysis is a statistical method for finding relatively homogeneous clusters of cases based on measured characteristics. It starts with each case in a separate cluster and then combines the clusters sequentially, reducing the number of clusters at each step until only one cluster is left.

20 Factor score is an index of all variables, calculated by taking an average of their scores for each of the separate variables that make up the factor. It can be used for further analysis.

21 One-way analysis of variance (ANOVA) is a statistical technique for computing the difference in means both between and within groups and compares variability between groups and variables.

information from these sites. The thesis collected information on the market introduction of new B2B mobile services from the websites of three major Korean mobile carriers, SK Telecom, KT and LG U+.

Secondly, various search engines such as www.google.com, www.yahoo.com and www.altavista.com were used for modulated searching. The important aspect here is to refine the searching techniques in such a way that results are promising and relevant. For this, it is necessary to know the importance of the research and follow the guideline intellectually to reduce the efforts made and time consumed in searching.

For an accurate scheme for distinguishing various characteristics of B2B mobile carrier services, the keyword search was performed by collecting keywords related to the service characteristics from the three mobile carrier's websites and their service product catalogs. The use of web search engines also provides an effective way to identify whether a certain keyword appears before or after a specific time period.

2.7.6. Desk research (i.e., secondary research)

In order to analyze the key drivers behind the innovations in the B2B mobile carrier services, mobile telecommunication market data and information were collected from various sources such as mobile carrier's annual reports, news articles and industry reports provided by private and public research institutions. Government and telecom-related institutions usually publish a great extent of data online that can be used in the research process. Such data is related to statistical, market and policy-related aspects. The government websites are mostly free to access and contains most prominent information. Thus, this could be a cost-effective medium of gathering the information.

This study looked at the market data and then analyzed the collected information focusing on regulation, technology and market aspects in the Korean mobile telecommunication industry.

Table 2-4 summarizes the analytical procedures and methodologies of each chapter.

Table 2-4. Analytical procedures and methodologies

Research	Methodology	Expected result	Chapter
PART 1. Combination of pre-existing innovation theories with a framework based on an empirical case of Mobile Campus	Literature review	-Literature review on service innovation and mobile service industry -Overview of mobile market in Korea	2
	In-depth case study, interviews, pattern-matching technique, evaluation of previous literature	-Service innovations in *Mobile Campus* focused on the role of technology, service provider and universities -Comparisons between general theories of service innovation and the research findings from an empirical case study -Expansion of the characteristics-based analysis to *innovation in B2B mobile carrier services* -Developing a comprehensive approach and research questions	3
PART 2. Analyses of innovation in B2B mobile services	Keyword search, statistical data analysis	-Definition of the service characteristics and examination of data collected for the study -Classification of B2B mobile carrier services based on heterogeneous service characteristics -Explanation of the different types of B2B mobile carrier services and their B2B mobile service users	4
	Collection of published data (industry analysis)	-Explanation of the key drivers behind the innovations in the B2B mobile carrier services, focusing on market, technology and regulation aspects	5
	Characteristics -based approaches for service innovation	-Identification of technological innovation in B2B mobile carrier services: radical, incremental and semi-radical innovations	6
		-Identification of service-oriented innovation in B2B mobile carrier services: recombinative and customized innovations	7
PART 3. The integrated perspective on service innovation	Revision of the framework	-Discussion of the research findings from the integrated perspective by utilizing the innovation concepts and important issues that were covered in the previous chapters -Revision and proposal of a new framework	8

2.7.7. Validity and reliability

It would be argued that the research procedures relate primarily to ensuring internal validity. Three strategies were applied to strengthen the internal validity of this study. Firstly, to improve the accuracy of the empirical evidence, information and data were collected from interviews and online resources. Secondly, research questions of this thesis were tested in two ways, from the research findings in a meso-level study and from the interviews with universities in a case study. Thirdly, a pattern-matching technique (Yin, 2009; Christensen, 2006) was used to make comparisons between the theories and empirical results.

External validity refers to the extent to which the findings of one study in one context

can be generalized to other contexts (Christensen, 2006). The fact that the study was based only on a single sector might raise questions about generalizability. However, the purpose of case study research is theory building rather than theory testing (Eisenhardt and Graebner, 2007). Hence, the objective of the case study of Mobile Campus is to contribute to the process of cumulative theory building through theoretical sampling and analytical generalization. Consequently, this thesis aims to contribute to the future directions of innovation studies by building a framework in which innovation dynamics in other service sectors or in other countries can be studied.

Reliability needs to be addressed not only in relation to data collection and data analysis (Yin, 2009), but also in relation to the entire reasoning process used in producing conclusions (King et al., 1994). In practice, the issue of reliability can be resolved by making the research processes transparent (i.e., providing enough detailed information regarding the methods, rules and procedures used to gather information and draw inferences) (George and Bennet, 2005; King et al., 1994). Providing this kind of detailed information makes it possible for other researchers to understand and evaluate the procedures and methods that were used (George and Bennet, 2005) and to follow the logic through which the conclusions were obtained (King et al., 1994). To enhance reliability, the thesis disclosed the sources of data, including the identity of the interviewees, the number of interviews, the topics covered in the interviews and the duration of the interviews. Moreover, the thesis describes the analytical procedure and also explicitly presents the results of the analysis.

2.8. Research Limitations

The trend of convergence between devices, services and technologies within and across industries increases the research interest of innovations in the mobile service sector. However, this thesis may not respond to all the questions of what kinds of technologies and industry players lead to successful innovation outcomes. For instance, the framework of this thesis tries to capture the dynamic aspects of innovation in B2B mobile services, but the main industry actors in this study are mobile carriers who play an important role in providing B2B mobile solutions. Thus, the study does not look at the innovation from the systemic perspective (e.g. national/regional/sectoral systems of innovation, mobile ecosystem). For this reason, even though the scope of this study involves interaction with

service users and the impact of technologies on a service product, it does not pay much attention to the development of a collaboration network between industry actors such as mobile handset makers, equipment manufacturers and technology developers.

Methodologically, a new product announcement is chosen for the purpose of characterizing the entire B2B mobile carrier service and its innovation. Unlike traditional innovation indicators (e.g. R&D efforts, patents and patent applications), innovation in this thesis is identified by direct measure of the market introduction of new service products. Nevertheless, it may not be the best indicator of service innovation. The number of innovative services by mobile carriers does not always equal the number of innovations. This announced service innovation may have a possibility of being highly influenced by mobile carriers' marketing policies. However, the purpose of using the market introduction of new services as an innovation indicator is to examine the dynamics of service innovations. This thesis does not aim to measure the accurate number of service innovations, but it focuses on various aspects of innovation by examining the different innovation dynamics in the Korean B2B mobile service sector. Therefore, the market introduction of new service products can be an appropriate indicator to identify the dynamics aspects of service innovation in this thesis.

Lastly, although the thesis employed both qualitative (e.g. interviews) and quantitative methods (e.g. statistical data analysis) for the effective analysis, there is a chance of some errors occurring in using factor analysis due to the subjective coding of dummy variables to capture the characteristics of B2B mobile carrier service. To compensate for this, an attempt to conduct other analyses such as latent class analysis or log-linear analysis may be helpful for future studies. Another possible way can be to reflect expert opinions through in-depth interviews or an expert survey.

2.9. Summary

The main purpose of this thesis is to understand the dynamics of innovation that pervade in B2B mobile services and to propose a new B2B service innovation model. Through a close examination of literature on pre-existing innovation theories, this chapter identified several main issues related to the current B2B mobile services.

Theoretical investigation of a service provided a basis to understand the difference between physical goods and services. However, such straightforward division between

goods and services has been challenged because service sectors are heterogeneous ranging from scale intensive, science-based to supplier dominated services. The mobile telecommunications service shows intermediate features of pure services and tangible goods. Mobile phone-based services and various mobile technologies may co-exist throughout the innovation process.

As innovation in services especially has become of great importance in recent years, various approaches to service innovation have been proposed. Among the approaches, the 'synthesis/integrative' approach has recognized the trend towards convergence and the blurring of the boundaries between products and services. In the context of technology-based service innovation, this approach explains not only the importance of technologies but also the competences of service providers and user involvement in the service innovation process.

Some key issues on understanding the dynamics of service innovation are to identify the role of technology development, competence building of service providers and interaction between service providers and users. Literature review on mobile service innovation reveals that there have been various factors that influence the diffusion or innovation of mobile services: technologies related to mobile devices and services, user's perceived usefulness of mobile services, mobile carrier's strategic decision on price and promotion strategies, and user-related factors.

This thesis focuses on the integrated perspective of innovation in mobile services. Firstly, the thesis combines pre-existing innovation theories and an empirical case study focused on the role of technology, service provider and universities in innovation of Mobile Campus. It starts with interviews from two universities in Korea. Based on the interview results, the thesis evaluates whether general theories of service innovation correspond to the findings from the case study. Subsequently, this study will develop a conceptual framework for analyzing innovation in B2B mobile carrier services. The utilization of the market introduction of new service products would satisfy analysis of how innovations in heterogeneous B2B mobile carrier services can be obtained. To conduct an accurate examination of B2B mobile carrier services, descriptive information of 242 service products will be transformed into a quantitative data set for statistical analysis.

In the next chapter, the analysis of service innovations in Mobile Campus will be presented. The discussion will be based on the comparisons between general theories of service innovation and the research findings from the case study.

CHAPTER 3. EMPIRICAL STUDY ON INNOVATION IN MOBILE CAMPUS AND CONCEPTUAL FRAMEWORK

3.1. Introduction

Chapter 2 examined the theories on service innovation and reviewed the previous case studies in mobile service sector. Chapter 3 will conduct an empirical study for realistic models of innovation which can be applied to the current mobile service industry. In the context of the dynamics of service innovation, this thesis combines pre-existing innovation theories with empirical results from a specific case of B2B mobile carrier service, 'Mobile Campus'.

Based on the findings, this chapter will present a discussion regarding the dynamic aspects of innovation in Mobile Campus: technology-based, provider-driven and user-driven innovations. It will be found that service innovation in Mobile Campus would be driven by technologies related to mobile devices and services, mobile carrier's strategies and participation of universities in the development process of Mobile Campus. Subsequently, this chapter aims to evaluate whether general theories of service innovation correspond to the findings from the case study of Mobile Campus. In addition, this chapter enhances the previous characteristics-based innovation models, and then develops a conceptual framework and research questions for a study of innovation in B2B mobile services, which are currently provided to institutional and business users by mobile carriers.

This chapter consists of six sections. Section 3.2 explains the theoretical motivation of the empirical study of Mobile Campus. Section 3.3 describes the interview design. Section 3.4 presents an overview of Mobile Campus at two selected universities, UNIST and POSTECH. Section 3.5 provides empirical findings regarding innovations in Mobile Campus. Section 3.6 present insights and motivation to further investigate the different dynamics of innovations in mobile service, by comparing the theories of service innovation and the research findings from the empirical case. Section 3.7 presents the research questions motivated by the empirical research findings of Mobile Campus. Section 3.8

develops the conceptual frameworks that can explain the different dynamics of technological and service-oriented innovations. Section 3.9 summarizes the discussion of the results from this case study.

3.2. Research Background of the Empirical Study

3.2.1. The characteristics-based approach to a service

Based on the characteristics-based approach (Lancaster, 1966; Saviotti and Metcalfe, 1984; Gallouj, 2002), this study defines service characteristics as the characteristics associated with a service, which is perceived by service users in the dynamic production and consumption process of a service.

In the most general representation of a service, the service characteristics are obtained by mobilizing simultaneously internal and external competences and tangible and intangible technical characteristics (Saviotti and Metcalfe, 1984; Gallouj, 2002). The technical characteristics represent the internal structure of the technology. They are the scientific and technological knowledge 'embodied' in the set of devices used to provide the service characteristics (Gallouj, 2002). By mobilizing those technical characteristics, final service characteristics can be achieved by either improving or creating them.

On the other hand, final service characteristics are also obtained by mobilizing direct competences of service providers. Those service providers' competences may involve service-oriented competences, for instance, accumulating customer know-how and combining different knowledge and technologies either internally or externally. Those competences are sometimes mobilized directly by service providers. Another major characteristic of service provision can be found in the service user's competences mobilized through the interaction between service providers and users.

In this regard, Gallouj (2002) defines innovation as any change affecting one or more terms of these characteristics.

3.2.2. Importance of technologies in service innovation

An increasing amount of empirical evidence has been shown that technology does play a role in services (Sirilli and Evangelista, 1998). Service industries are heavy users of information technologies, and the bulk of information technology investment is actually

used by services. In this regard, many prior studies argue that the utilization of advanced technologies, notably ICT, has enabled innovation in services (Barras, 1986; Gadrey et al., 1995; Gallouj, 2002; Rai and Sambamurthy, 2006). Such technology-based innovations can be characterized by their impact on the final form of service characteristics.

Theoretical issue 1: *The use of advanced Information and Communications Technology (ICT) has an impact on the form of final characteristics of a service. Such changes in those characteristics enable innovation in services.*

3.2.3. Importance of service providers in service innovation

Previous innovation studies in service industries suggest that provider-driven innovation plays a very important role in the service sector (Miles, 1993; Djellal and Gallouj, 2005). Those studies reveal that innovation can be based on the re-use or re-combination of existing components either by combining or splitting up the characteristics of two or more existing products, which has been called recombinative innovation. Such an innovation is an easy and cost-saving form of developing new service brands because it operates not through long-term technological advancement but rather through the continuous and cumulative production of non-technological knowledge. It draws on service innovation from service provider's existing competences, but may use them creatively in combination with new ones to form a uniquely different product.

Accordingly, the following theoretical issue will be studied in this chapter.

Theoretical issue 2: *The mobilization of service provider's competences has an impact on the form of final characteristics of a service. Such changes in those characteristics enable innovation in services.*

3.2.4. Importance of users in service innovation

The theoretical issues on service innovation are furthermore supported by existing studies in terms of customer interactions and co-production (Alam, 2006; Chen et al., 2011). Service innovation turned out to be produced at the interface between a mobile carrier and a B2B mobile service user. Accordingly, the following theoretical issue will be studied in this chapter.

Theoretical issue 3: *Active interaction between service providers and users has an impact on the form of final characteristics of a service. Such changes in those characteristics enable innovation in services.*

Auh et al. (2007) define co-production as "constructive customer participation in the service creation and delivery process and clarify that it requires meaningful, cooperative contributions to the service process". Gallouj (2002) also mentioned that in 'ad hoc' innovation, innovations are often produced jointly by the service provider and the customer.

Particularly, prior innovation studies insist that B2B service users play an important role in service processes (Alam, 2006; Oliveira and von Hippel, 2011). In accordance with the service-oriented view, the value of service is co-created with the customers (Vargo and Lusch, 2004; Grönroos, 2007) which is consistent with the Service-Dominant (S-D) logic. S-D logic was not developed as a new theory but was proposed as a 'counter paradigmatic' challenge to the Goods-Dominant (G-D) logic of marketing. Lusch et al. (2008) broadened this service logic, including services marketing, relationship marketing and market orientation. Thus, service users are recognized as important sources and co-developers of innovations. In this regard, the following theoretical issue will be studied in this chapter.

Theoretical issue 4: *Service users are actively involved in the service development process as co-producers of service innovation.*

3.3. Interview Design based on the Four Theoretical Issues

3.3.1. Selection of the empirical case

For the in-depth case study, 'Mobile Campus' was selected. Mobile Campus is a smartphone-based B2B mobile carrier service which enables students and campus staffs to access campus information via a smartphone and to use various services such as mobile educational contents, e-library, mobile student identification and micro-payment.

Mobile Campus has become an attractive topic as a case study in recent years. Many case studies have been conducted to look at the transformation in education which was influenced by mobile technologies (VanDeGrift et al., 2002; Truong et al., 2002; Alexander, 2004; Mercier et al., 2004; Wentzel et al., 2005). ICT expanded the boundaries of higher

education into an ‘anytime, anywhere’ environment. Since the rise of advanced wireless networks and mobile devices, all the educational components are now available to build solutions that could help teachers to increase students’ participation and get more feedback from students in lectures (VanDeGrift et al., 2002; Truong et al., 2002).

Moreover, a combination of wireless networks, mobile communications and personal computing devices in higher education makes teaching a large class more lively and more participative, escalating transformations of the learning environment (Alexander, 2004; Mercier et al., 2004). It presents new means for students to attend lectures and communicate with peers and teachers, for faculty members to experience effective teaching, and for universities to alter the concept of campus environment.

However, prior studies focused on a narrow aspect of Mobile Campus. Most of them focused on a narrow concept of mobile education that occurred during the lecture (VanDeGrift et al., 2002; Truong et al. 2002; Alexander, 2004; Mercier et al., 2004). Others focused on very specific service types such as mobile library service on campus (Choi, 2009) and campus information service (Ishmatova, 2007).

In this thesis, Mobile Campus has a broader concept than the research scope of prior studies. It includes any solution that can be offered through mobile carrier’s networks and its mobile handset line-up. Therefore, Mobile Campus is regarded as a campus-wide service in the areas of education, student’s campus life and campus administration.

3.3.2. Selection of the case study targets

Ulsan National Institute of Science and Technology (UNIST) and Pohang University of Science and Technology (POSTECH) were selected as two sample cases of Mobile Campus services in Korea.

The two universities adopted the first Mobile Campus in Korea. UNIST signed a Memorandum of Understanding (MOU) with KT to implement the first Mobile Campus in Korea in February 2010, and the service started in April 2010. POSTECH signed an MOU with SK Telecom to establish a Mobile Campus in September 2010.

The general information of each university is presented as follows.

3.3.2.1. Ulsan National Institute of Science and Technology (UNIST)

UNIST was founded in 2009. It is a national university located in the industrial city of

Ulsan, where world-renowned industries in automotive, shipbuilding, petrochemical, and secondary cells are clustered. UNIST has 8 undergraduate and graduate schools and 4 research institutes with 1,358 students and 106 professors, and 150 administrative staffs as of Nov. 2010. Table 3-1 shows a brief description of UNIST.

Table 3-1. Introduction of UNIST

Category	Description
Full name	Ulsan National Institute of Science and Technology
Location	Located in Ulsan, a metropolitan city, where Korea's leading industries, including automotive, ship building and petrochemical, are clustered
Number of students	1,358 students, 106 professors, 150 administrative staffs (as of Nov. 2010)
Campus size	Building area 34,015.86 ㎡, total floor area: 169,132.44 ㎡, total campus area 1,010,182 ㎡
History	Sept. 2005 Signed an MOU between Ministry of Education & Human Resources Development and Ulsan Metropolitan City Sept. 2006 Set up a Taskforce in the Ministry of Education & Human Resources Development Opened in March 2009
Characteristics	Campus-wide English-only classes / Discussion-oriented lectures Strong partnership programs with a number of prestigious foreign and domestic institutions

3.3.2.2. Pohang University of Science and Technology (POSTECH)

POSTECH was founded in 1986 as the first research-oriented university in Korea. It is a young university with short history, but with the wholehearted support from POSCO, a multinational steel-making company headquartered in Pohang, POSTECH has become a top Korean and Asian university in a short time. Table 3-2 shows a brief description of UNIST.

Table 3-2. Introduction of POSTECH

Category	Description
Full name	Pohang University of Science and Technology
Location	Based in Pohang, a Mecca for the iron industry and home to POSCO (The Pohang Iron and Steel Company)
Number of students	3,097 students (1,360 undergraduates / 1,737graduates), 249 faculties (in 2010)
Campus size	378 acres (1,529,713 m^2)
History	Year Founded : 1986
Characteristics	Research-oriented university Customized education for the top 1% students nationwide

3.3.3. Designing semi-structured interviews

The field interviews were conducted in March 2011. Separate interviews were conducted towards Information Service Team managers and vice presidents of the two universities. Instead of making a formalized, limited set of questions, a pre-planned semi-structured questionnaire[22] was developed, so that additional questions could be raised during the interviews and the interviewee could give full answers to the corresponding questions. The in-depth interviews were conducted by means of face-to-face meetings and telephone interviews with the form of the semi-structured questionnaire. The respondents included those in charge of designing the main structure of mobile campus, and the vice president.

Table 3-3. Interview protocol design

Research objectives	Summary of interview questions	What to be achieved
- To understand the two universities' different Mobile Campus features and their success factors	-Overall service features of Mobile Campus -Usage condition of Mobile Campus and the time when universities started the service -Types of mobile solutions that universities are currently using/plan to use -Cost and benefit related to the adoption of Mobile Campus -Self-assessment of Mobile Campus	Will describe the overview of Mobile Campus at two universities (Section 3.4)
-To identify and analyze technology-based service innovation in Mobile Campus	-Brand names of smartphone -The number of smartphones distributed -Embedded technologies and artifacts that support the implementation of Mobile Campus -Development of contents and applications	Will evaluate whether *Theoretical issue 1: Technology-based service innovation* corresponds to the findings from Mobile Campus (Section 3.5.1)
-To identify and analyze provider-driven service innovation in Mobile Campus	-Brand names of mobile carrier -Pricing scheme for charging services of Mobile Campus -Mobilization of technological or service components by mobile carriers	Will evaluate *whether Theoretical issue 2: Provider-driven service innovation* corresponds to the findings from Mobile Campus (Section 3.5.2)
-To identify and analyze user-driven service innovation in Mobile Campus	-Motivation and objectives of adopting Mobile Campus -Plan to achieve university's vision through Mobile Campus -University's technological knowledge/skills	Will evaluate whether *Theoretical issue 3: User-driven service innovation* corresponds to the findings from Mobile Campus (Section 3.5.3)
-To identify the role of universities in innovation in Mobile Campus	-University's participation in the service development of Mobile Campus -Contribution to the distribution of Mobile Campus	Will evaluate whether *Theoretical issue 4: Service users as co-producers of service innovation* corresponds to the role of universities in Mobile Campus (Section 3.5.4)

[22] A semi-structured interview is flexible, allowing new questions. It is a qualitative method of inquiry that combines a pre-determined set of open questions.

An interview protocol was designed as a checklist of the four theoretical issues that needed to be covered as shown in Table 3-3. The interview protocol design helped to understand the two universities' different Mobile Campus features and to analyse different aspects of innovations of Mobile Campus with regard to the four theoretical issues. The list of detailed interview questions is attached in Appendix 1, and the interview answers are summarized in Appendix 2.

3.4. Overview of Mobile Campus at Two Universities

Before analyzing innovations with respect to the theoretical issues, the main features and the success factors of Mobile Campus at UNIST and POSTECH are described.The service features of each university's Mobile Campus are explained below.

3.4.1. Service features of Mobile Campus

3.4.1.1. The main features of Mobile Campus at UNIST

Mobile Campus is a smartphone-based mobile service. Figure 3-1 illustrates how Mobile Campus of UNIST is carried out.

First of all, a member of the university (e.g. students, faculty members, administrative staffs) accesses App Store, and downloads the iPhone application[23] of UNIST. After installing the application, it enables UNIST to access campus information via a smartphone or tablet PC, and to use various services such as mobile education, e-library, mobile student identification and micro-payment. Thus UNIST can benefit from fundamental systemic changes in education, campus administration and campus life.

[23] The iPhone application was developed by Biztech & Ektimo, Inc., which is an IT solution service provider for enterprises in Korea. The contents of the application include online bulletin board, campus map, academic calendar, UNIST library information, personal timetable for class schedule and campus phonebook (Available in: https://itunes.apple.com/app/unist/id403690199?mt=8).

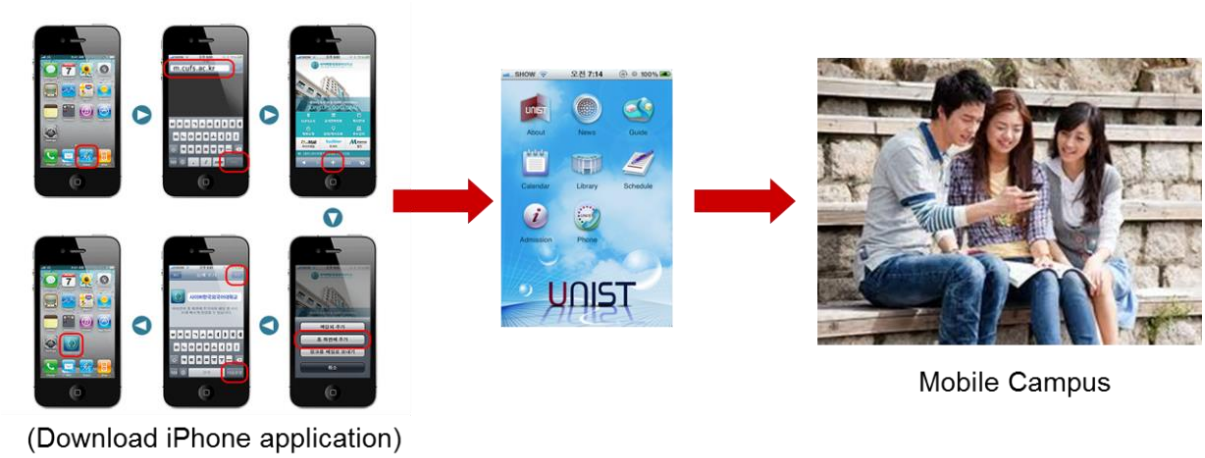

Figure 3-1. Service implementation of Mobile Campus

UNIST distributed iPhone 3GS and iPhone 4 to all members on campus including students, professors, and campus staffs. As of March 2011, iPhone was distributed to 2,000 students and 300 faculty and staff members, representing a distribution rate of 80-90%. iPad was distributed mainly for important university officials of approximately 30-40 people, including university president, vice-president, dean of departments and administrative officer. They can use iPad at a meeting.

A mobile device enables a very wide range of tasks. Mobile Campus at UNIST was especially designed for education, with the purpose of being a “paper-free campus”. UNIST pursues a face-to-face, discussion-oriented education. For example, students are requested to watch video lectures of well-known overseas professors through video clips on the smartphone ahead of class, and then professors at UNIST only provide students with supplemental lecture that those video clips do not cover. This type of education allows for students to spend more time discussing in class, instead of wasting their time taking notes.

The current services of Mobile Campus implemented at UNIST are summarized in Table 3-4.

Table 3-4. Service categories of Mobile Campus at UNIST (as of March 2011)

Service category		Contents
Education	m-Learning	-Video lectures, report submission, attendance check, lecture syllabus
Academic affairs	Academic affairs	-Scheduling business trips -Location-based authorization system, instead of doing paperwork for a documentary evidence
	Electronic approval	-Mobile working environment that enables fast and efficient work environment
Communic-ation	Voice	-Free interphone call on campus or in any Wi-Fi zones outside campus -Integrating fixed (e.g. IP phone) and mobile (e.g. smartphone)services
	Information sharing	-Email, scheduling, campus information
Campus life support	Library	-Entering the library with mobile student ID card (Student Smart Card) -Reserving a seat in the library -Automated book lending system
	Cafeteria	-Checking the menu, food image, and calorie
	ID authorization	-Entering buildings and facilities
	Micro payment	-Payment at a student cafeteria

3.4.1.2. The main features of Mobile Campus at POSTECH

The service features of Mobile Campus at POSTECH consisted of building a Wi-Fi zone throughout the campus, distribution of free smart phones on campus, and developing groupware to promote learning without time and location constraints. POSTECH distributed approximately 5,000 units of Galaxy S to all students and faculty members, and most campus members received smartphones with a distribution rate of 90%.

Mobile Campus has enhanced mobility for campus education and administration, and improved campus welfare at POSTECH. It also enables POSTECH to easily stay informed and communicate via smartphone at any time and in any place on campus. Hence, the university benefits from diverse and secure information exchanges through a wireless campus network and mobile applications. The service covers a broad range of categories including education, academic affairs, communication and information sharing, and campus life support, as shown in Table 3-5.

Table 3-5. Service categories of Mobile Campus at POSTECH (as of March 2011)

Service category	Contents
Education	-Registering for courses, mobile lecture, syllabus check, attendance/absence check
Academic affairs	-Electronic approval, mobile administration -Providing real-time working conditions for 24 hours, 365 days
Communication and information sharing	-Free interphone call on a Wi-Fi zone throughout the campus -Email, Social Network Services (SNS), campus information
Campus life support	-Student smart card, electronic library, mobile payment

3.4.2. Self-assessment of Mobile Campus by UNIST and POSTECH

Both UNIST and POSTECH achieved good and satisfactory results of implementing Mobile Campus. Five months after implementing Mobile Campus at UNIST, media and news articles have begun to announce the achievement of its Mobile Campus projects[24]. According to the interview with the vice president of UNIST, UNIST gave a strong impression to the director of Apple's Asia-Pacific headquarter saying that the case of UNIST was perfectly matched to smartphone-based mobile service in the year of beginning Mobile Campus. Since several months later than the service implementation, media outlets were racing to report that the cases of UNIST and POSTECH were very successful examples of a B2B mobile service user building up mobile infrastructure. According to news articles, UNIST was the pioneer of Korean Mobile Campus, followed by POSTECH[25].

The reason that the two universities could be assessed as successful in such a short period was due to their prompt actions to establish all necessary mobile infrastructures in advance of full implementation of Mobile Campus. In terms of the expenses, UNIST invested KRW 500 million in building the wireless network all over the campus while POSTECH spent KRW 100 million to build wireless access-point (AP) for the mobile environment. In addition, UNIST supported the expense of purchasing iPhone by funding KRW 300,000~400,000 per individual, which means that the university paid 90%, and an individual paid only 10% of the total handset price. It extended the deadline to change over

[24] Source: "Comparison of mobile infrastructures in the three Korean science and engineering universities: Flying UNIST vs. running POSTECH vs. crawling KAIST" (Daedeok Net, 2010.07.20).

[25] Source: "Smart learning and discussion-oriented lecture: Fierce competition to be Smart" (The Chosun Ilbo, 2011.02.09).

to iPhone so that students could change their mobile phones within one year from the service implementation of Mobile Campus.

Also, POSTECH and SK Telecom supported the full expense of distributing Galaxy S, and the smartphones were provided free of charge to all university members. In total, POSTECH invested KRW 4 billion to build a mobile infrastructure including smartphone distribution, mobile groupware and Wi-Fi.

In Korea, mobile phone users usually receive a contract discount when buying a new phone. If they terminate a service before the contract expires, they should pay a penalty of KRW 400,000~500,000. This could be a big obstacle to implement Mobile Campus at universities. But both universities prevented the possible complaints from students who recently bought new mobile phones by providing them with new smartphones either free or at a very low price. This service plan helped to reduce the burden of students.

Despite the fast and stable implementation of Mobile Campus, the service outcome at the moment was hard to be measured with financial figures because Mobile Campus stayed in its early phase in Korea. Instead, the relevant information could be obtained through interviews, regarding the expenses of building Mobile Campus and self-assessment, and the reasons of success/failure.

Mobile Campus at both universities were assessed as satisfactory in terms of non-quantitative service outcomes such as a strong positive impact on the university's image and reputation, and the implementation level of core and supporting programs related to Mobile Campus. According to the interviews, UNIST obtained the desired result from Mobile Campus and was very satisfied with it, in that Mobile Campus realized its vision of becoming a paper-free campus. This was possible because UNIST pursued the 'selection and concentration' policy by minimizing unnecessary investments and focusing on education-oriented Mobile Campus. POSTECH also answered that it achieved good results by fully utilizing the platform characteristics of Android. Mobile Campus at POSTECH focused on 'mobility' to cover a wide range of services from education to academic affairs. It converted its existing web contents to new mobile contents, and developed a groupware to share information on daily tasks.

Under such innovation-friendly circumstance, UNIST and POSTECH became the early adopters of Mobile Campus in Korea. The result was successful and with such a successful case of the two universities, other universities became more involved in adopting Mobile Campus.

3.4.3. Successful factors in implementing Mobile Campus

There exist several common factors that affect the successful implementation of Mobile Campus at the two universities.

First, the organizational characteristics of a university such as the ability to absorb change, ICT culture and university's vision seem to be highly linked with the adoption of service innovation. UNIST and POSTECH are Korea's well-known, world-leading universities in science and technology, with a specialty in basic sciences and practical studies. They are always interested in adopting an advanced system and are very open to innovations on campus. They tend to adopt an innovative solution earlier than competing universities, and hope to produce many academic achievements under the innovative education environment. Such an early adopter image has an important meaning to these universities because it helps them to increase their reputation. Thus, they can attract competent students, professors and researchers to their campus. For these reasons, the two universities had a strong willingness to adopt Mobile Campus.

Moreover, they benefit from a small size of a campus with a small number of campus members. Due to their specialties, they are inevitably smaller than large-scale universities having many departments. Such a small-sized campus made the process of designing, developing and launching Mobile Campus fast and effective.

Secondly, they got funding from the government or had a sufficient budget necessary to build all the necessary infrastructures. Therefore they could build the mobile infrastructure that was optimized to implement various solutions related to Mobile Campus.

In addition, UNIST signed an MOU with KT and POSTECH signed an MOU with SK Telecom to implement Mobile Campus. The mobile carriers provided the two universities with tailor-made services with respect to the status of the universities' IT infrastructure. In particular, UNIST understood well a whole picture of a smartphone-based solution. Before distributing smartphone on campus, it considered whether they had plenty of contents to be used on smartphone[26]. Such an effort to develop enough mobile contents and to build a solid network infrastructure in the initial stage resulted in success of the next stage of implementation of Mobile Campus.

Thirdly, they had clear visions and objectives of implementing Mobile Campus. UNIST

[26] "iPhone is a 'cup' and the contents are 'water' in the cup. If there is no water, then a cup doesn't have a meaning for us." said Information Service Team Manager of UNIST.

aimed to foster world-class education in science and technology. It provides English-only classes recruiting creative students and faculty from around the world. In addition, it is currently establishing strong partnership programs with a number of prestigious foreign and domestic institutions.

On the other hand, the reason for POSTECH to adopt Mobile Campus service is to catch up with the era of 'mobile'. The Information Service Team manager of POSTECH emphasized the timely adoption of Mobile Campus, saying "During the past 30 years, a computer has taken charge of administrative management. But now the mobile era has come and universities should be transformed."

3.5. Empirical Findings: Innovation in Mobile Campus

In this section, service innovations in Mobile Campus are identified focused on the role of ICT-related technologies, mobile carriers and universities. The research findings based on those aspects are interpreted as the comparative results, which are derived from an analysis that compares pre-existing innovation theories and the research findings from Mobile Campus in terms of the four theoretical issues on service innovation.

3.5.1. Theoretical issue 1: Technology-based service innovation in Mobile Campus

'Communication' and 'information sharing' are the most important values in providing mobile services. The users of low-end feature phones were able to be provided social network services, such as e-mail and instant messaging, over the wireless Internet. But the use of smartphone integrates various applications such as voice/video calling, multimedia, navigation and real-time social networking services.

In addition, the development of the next generation network (e.g. LTE) and Wi-Fi networks enables free interphone call on campus or in any Wi-Fi zones outside campus. LTE-enabled smartphone leverages the 'mobility' of a mobile device-based service, and allows a mobile carrier to provide universities with a variety of data-oriented solutions as a service provider. It offers the ability to share information and communicate with campus members at any time and in any place, regardless of the physical location on campus. For this, a security function of the mobile phone was enhanced by wiping out data in it or

reformatting it when the phone is lost.

From the university's point of view, smartphone was used as an effective communication channel to access information. Both UNIST and POSTECH took full advantage of the inherent 'mobility' of the smartphone. The universities could advance their education systems by adopting the smartphone-based learning solution. For example, students of UNIST were able to watch video lectures freely via smartphone on campus, and were taught only the supplemental part during class that the video lectures did not cover. This way of learning combines both mobile learning and in-person education, and expands educational opportunities for students, and frees them to spend more time enjoying interactive discussions and debates in class.

On the other hand, mobile platforms and applications of smartphone influenced the whole feature of campus life. The universities can conduct a document-based task using their mobile devices. For example, the groupware applications developed on Android platform allowed POSTECH to process a vast number of administrative tasks without the restriction of time and location by using smartphone (i.e. 'mobile-based digitalization' of the existing desktop-based contents). In addition, through convenient data analytical software, Mobile Campus enables the universities to effectively manage student's information, library's book database and analyze the sales of cafeteria menus. This supports the service characteristics of a mobile carrier service by collecting daily campus information, analyzing administrative data and by dealing with a large volume of data.

Smartphone enhances the value of the pre-existing service for individual service users such as mobile payment and network solutions (i.e. transaction information delivery). When these solutions are provided to universities, the service value is enhanced. For example, Mobile Campus of UNIST provides micro payment solution[27] to the university. It is a mobile transaction that can be used for digital purchase on campus such as books at a campus bookstore and meal at a student cafeteria. For this solution, Near Field Communication (NFC) is used as a key technical tool for over-the-air financial transactions. NFC provides UNIST with a quick and easy way to use micro payment service.

On the other hand, 'security' solution of campus facilities is a new service to the universities that secures the university's resources in innovative ways. For example,

[27] The micro payment solution was included in Mobile Campus by UNIST's particular offer. UNIST hoped to use a smartphone-based payment service that enabled mobile transaction of small amounts of money for a convenient campus life. This service was not included in Mobile Campus at POSTECH.

Mobile Campus enables universities to build a security management system. When campus members enter a library or important facilities, they can simply use their smartphone as an ID authorization tool. In this case, smartphone plays the role of mobile student ID card. Particularly, the security function can make the camera function on the phone not work in some areas where taking a photo is not permitted by recognizing phone number of those who enter the secured area and stopping the camera function of them. In addition, when the lecture begins, the smartphone of students in the lecture room can be automatically changed to vibration mode during the lecture.

Thus, a new service characteristic, ‘security’, appeared in Mobile Campus with support of various technologies. Such ICT-led service innovation in Mobile Campus provides the two universities with a suitable solution and creates a new service feature of campus facility security.

The findings can be illustrated from the characteristics-based approach as shown in Figure 3-2.

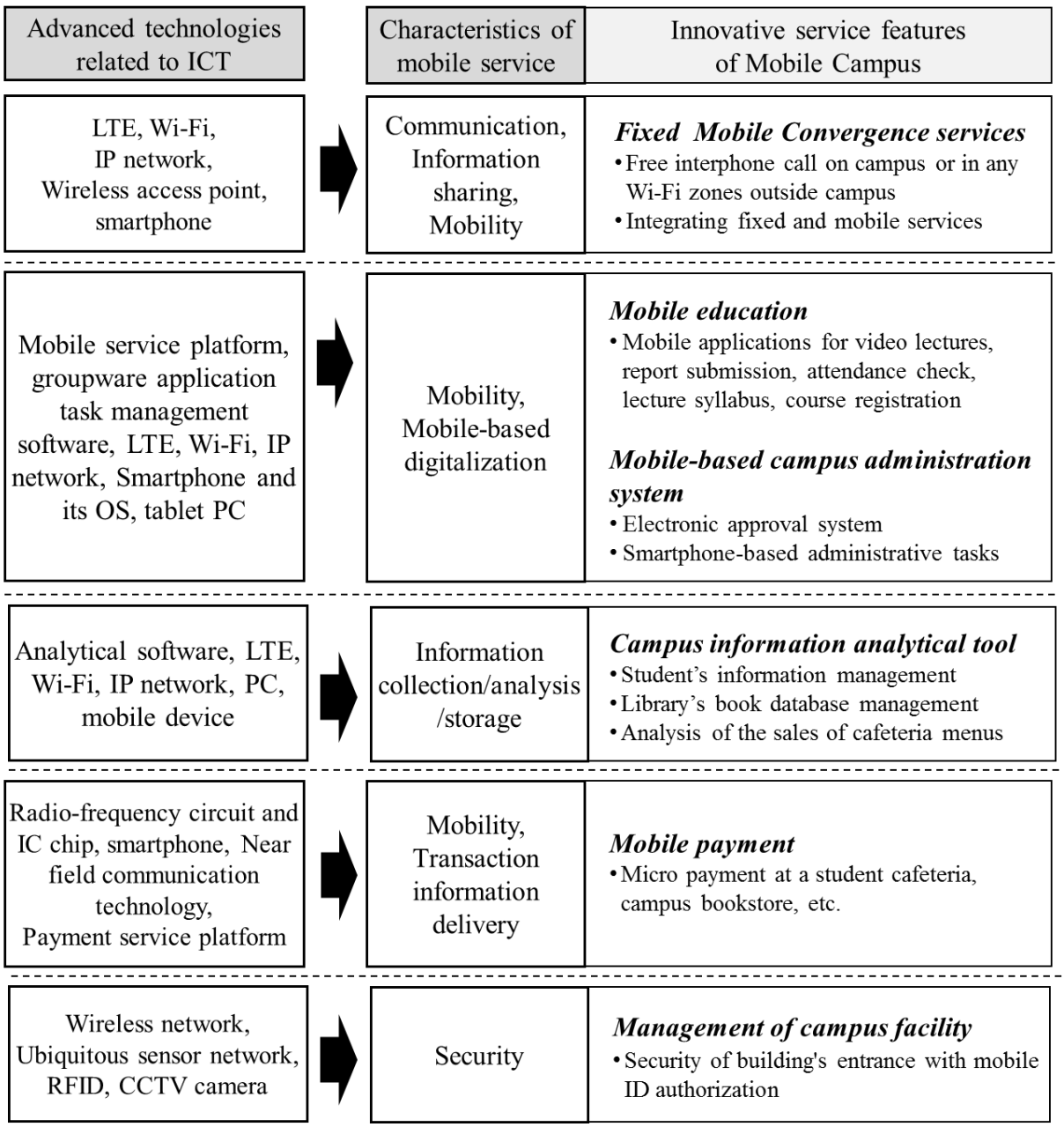

Figure 3-2. Technology-based service innovation in Mobile Campus

3.5.2. Theoretical issue 2: Mobile carrier-driven service innovation in Mobile Campus

Combining competences and internal/external technologies is helpful for mobile carriers to develop Mobile Campus at the two universities.

First of all, mobile carriers had pricing strategies for new services. For example, KT applied its existing pricing scheme for charging services of Mobile Campus. It offered one existing pricing scheme for voice, messaging and data services, which is called 'All in

ONE' with a monthly rate from 35,000 won to 95,000 won. All in ONE had several sub-price plans, so university members could choose one of them according to their preferences. For example, the monthly rate is 35,000 won per month with "KT i-slim", a recommended rate with providing 150 voice minutes, 200 text messages and 100 MB data. The total service charge is 60,000 won when it includes a subscription fee, Universal Subscriber Identity Module (USIM) fee and payment guarantee service fee. Hence, the Mobile Campus solution can be combined with the existing pricing scheme and mobile handset line, without designing a new service price package or developing a new device only for Mobile Campus.

Secondly, network build-up of mobile carriers shows the recombinative mode of service offerings. The existing technical resources were reallocated by the mobile carriers to build up the network infrastructure for Mobile Campus. New wireless Access Points (APs)[28] were installed in places where people frequently move from one zone to another, for instance near the entrance of a building or outdoors on campus. In contrast, the old APs existing on campus were insufficient to support simultaneous voice over Wi-Fi. Thus, they were reallocated in confined spaces above the third floor of a building such as classrooms, laboratories and office rooms, where people do not frequently move and remain stationary.

Lastly, Mobile Campus itself is designed as a recombinative service by integrating various service functions such as education, student's campus life support and campus administration. Thus, these service offerings are based on a combination of various mobile applications that have been provided separately to individual customers. Such campus-wide services are combined to implement the full service feature of Mobile Campus for a university.

3.5.3. Theoretical issue 3: University-driven service innovation of Mobile Campus

Through the active interaction between mobile carriers and mobile service users in the service development, the way a service user is being served a mobile service has been influenced, too. The role of mobile service users has changed from passive users, who had been served an exclusive service by a mobile carrier, to active users who express their need

[28] AP is a device that allows wireless devices to connect to a wired network using Wi-Fi. It was an important infrastructure that should be established before implementing Mobile Campus.

and desires, and develop the service that they want.

In the case of Mobile Campus, it is at the user-provider interface that innovation occurred. As a service user, UNIST clearly delivered its feedback and suggestion to the mobile carrier, and POSTECH designed its own specialized contents. The two universities have different needs for Mobile Campus as shown in Table 3-6.

As a service provider, mobile carriers understood their needs and demand for differentiated features of Mobile Campus, and provided customized service characteristics to each university. These findings are in line with the notion of 'servuction' in that service users play an important role in service design and implementation, being able to customize themselves for their particular needs and preferences.

Table 3-6. Differences of the needs for Mobile Campus between UNIST and POTECH

	UNIST	POSTECH
Vision	Paper-free campus	Building-free campus
Understanding of Mobile Campus	Mobile Campus will support the existing desktop-based environment (complementary perspective)	Mobile Campus will replace the whole desktop-based working condition with a new mobile-based system (substitute perspective)
Main concern	Education (i.e. education-oriented Smart Campus)	Education/academic affairs/campus life support (mainly administrative efficiency)

3.5.4. Theoretical issue 4: Universities as co-producers of service innovation

This section examined the role of universities who may actively participate in service innovation. As institutional customers, UNIST and POSTECH were actively involved in the service development process of Mobile Campus, for instance in developing and implementing Mobile Campus.

The types of New Service Development (NSD) provide the basis for describing innovations in the service industry (Avlonitis et al. 2001). The NSD process can be divided into several specific sub-processes. It helps to examine a detailed feature of user participation in service innovation process.

A considerable number of NSD process models were proposed in the literature (Booz et al., 1982; Cooper, 1994; Avlonitis et al., 2001; Johnson et al., 2000). This process generally involves four broad stages: (i) Idea generation and screening, (ii) Business analysis, (iii) Technical development and (iv) Launching. Each stage involves several development activities that lead to the creation of new services. NSD processes and their activities of

Mobile Campus are explained as follows.

3.5.4.1. Idea generation and screening phase

The mobile carriers often receive ideas for a new service from service users.

For example, UNIST and POSTECH had different visions and objectives towards adopting a Mobile Campus. UNIST pursued a face-to-face, discussion-oriented education with the purpose of being a ‘paper-free campus’. On the other hand, POSTECH thought that a mobile-based system will substitute the existing web-based system, setting a goal of a ‘building-free campus’. It enabled POSTECH members to easily exchange campus information and communicate via smartphone at any time and in any place on campus.

Those ideas from UNIST and POSTECH were finally translated into a full service concept of Mobile Campus.

3.5.4.2. Business analysis phase

As service users, universities clearly delivered their needs and preferences to mobile carriers. The mobile carriers then understood the market characteristics and trends, and identified service characteristics that would appeal to the users. As a result, Mobile Campus at the two universities was designed to have different service features.

3.5.4.3. Technical development phase

The technical characteristics of smartphone expand the range of user participation in designing Mobile Campus. In addition to the network infrastructure, universities may outsource the development of mobile contents and applications running on the mobile system, or develop them for their own particular needs.

For example, Mobile Campus at UNIST was especially designed for improving the quality of education. In contrast, Mobile Campus at POSTECH was designed to enable mobility for campus education, administration, and improve campus welfare. The services covered a broad range of categories including education, academic affairs, communication and information sharing, and campus life support.

In addition, POSTECH developed the mobile contents for its groupware. It converted all the existing web contents to mobile applications in order to exchange ideas and

information in the educational affairs office or to manage administrative work on campus through the groupware. This is a distinguishing feature that has not been seen before particularly in the mobile service for individual customers.

The findings revealed the reason for the active participation of universities in the fact that Android OS let POSTECH create useful applications quickly and easily. Android offers a simple Software Development Kit (SDK)[29] that creates an opportunity for service users to completely change how the final characteristics of their service look and function. The free and open platform of Android allows, and even encourages, radical change in the implementation of smartphone-based mobile services.

On the other hand, UNIST was using "Blackboard"[30], Learning Management System (LMS) based on the wired network. This education software consists of four management functions: online course delivery and management for institutions; a portal system for online campus communities; a content management system for course content; and a student assessment system to collect students' assignments and evaluate them[31]. Such systems were transformed into the mobile learning system under Wi-Fi-enabled environment so that UNIST could utilize the existing teaching and learning contents in a mobile version of Blackboard.

Hence, the university could benefit from the use of smartphones and mobile-based service platforms in teaching, research and campus administration. This change is expected to bring a paper-free campus to universities.

3.5.4.4. Launching phase

Both universities actively promoted the service to their campus members and guaranteed a fast implementation of Mobile Campus throughout the whole campus. They distributed smartphones to all members on campus including students, professors and other staffs. As of March 2011, the adoption rate of smartphones in the two universities was approximately 90%.

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[29] Software Development Kit (SDK) is a set of software development tools that allows developers to create various applications without licensing fees.

[30] Blackboard is education software developed by Blackboard Inc. It is known to be used by more than 60 percent of U.S. universities, the program allows teachers to share lecture materials with their students.

[31] Source: "Getting to know Blackboard Learn". Available in: Blackboard.com. (http://www .blackboard.com/Platforms/Learn/Products/Blackboard-Learn.aspx)

UNIST supported the expenses of purchasing iPhone by funding 90%, and an individual to pay only 10% of the total handset price. POSTECH also accelerated the distribution of free smartphones. Together with SK Telecom, they supported the full expense of distributing Galaxy S, and the smartphones were provided free of charge to all university members.

3.6. Discussion through Comparison between Pre-existing Innovation Theories and the Empirical Findings

The empirical findings that were discussed in Section 3.5 can be compared with the existing service innovation theories. Innovations in Mobile Campus were triggered by advanced ICT technologies or which were driven by an active interaction between mobile carriers and universities. The results corresponded to all the theoretical issues which were previously discussed in Section 3.2.

Table 3-7 summarizes service innovations in Mobile Campus in terms of the four theoretical issues.

Table 3-7. Comparisons between theories and the empirical findings

Theoretical issues	The different dynamics of service innovation in Mobile Campus
1.Technology -based innovation	-Near Field Communication (NFC) enables a quick and easy micro payment solution -The security function of a mobile phone has been enhanced by wiping out data in it or reformatting it when the phone is lost. -Smartphone is used as an ID authorization tool when a student enters a library, classroom or important facilities -Development of the next generation network and smartphone leverages mobility of a mobile device while processing a vast number of administrative tasks on a mobile-based system
2.Provider -driven innovation	-The existing pricing scheme is combined with Mobile Campus -The existing technical resources were reallocated to build up the network infrastructure for Mobile Campus
3.User-driven innovation	-Universities received customized services from mobile carriers by delivering their specific needs and wants and by exchanging ideas in the interface between a mobile carrier and a user
4. Service users as co-producers of innovation	-Universities actively participated in the service development process of Mobile Campus and contributed to the production of innovations

The above findings from the empirical case study of Mobile Campus gave insight into

how innovations in mobile service can be analyzed. It also offers motivations to stimulate discussion on innovation in mobile services and to raise some questions to further investigate the different dynamics of innovations.

First of all, technology-based innovations in Mobile Campus showed a high potential to discriminate different forms of service innovations from the technological perspective. Such an attempt to distinguish different types of innovation has been made by prior innovation studies (Barras, 1986; Gadrey et al., 1995; Gallouj, 2002). For instance, Gallouj (2002) describes the different modes of service innovation. 'Radical innovation' denotes the creation of a totally new product, i.e., the introduction of a new bundle of service characteristics, which is unconnected with those of an old product. 'Ameliorative innovation', by contrast, simply increases the quality of certain service characteristics. In addition, innovation can involve the addition (or elimination) of one or a few of the existing characteristics. Such a way of improving the service feature is regarded as incremental service innovation. Gallouj (2002) also described this feature of innovation as incremental innovation. In case of incremental innovation, the general structure of the system remains the same, but the system is changed through the addition of new elements to the technological characteristics and/or to the final service characteristics. Such forms of innovation have been used to present the dynamics of service innovation, but there may be a variety of forms of innovation from a perspective that is different from Gallouj (2002)'s. Hence, innovation in mobile services needs to be studied further. In order to distinguish different service innovations, there is a need for a conceptual framework for more exact criteria.

Secondly, mobile carrier-driven innovation in Mobile Campus demonstrated that mobile carriers are active innovators although many technological innovations driven by overseas smartphone, for instance Apple's iPhone, might weaken their presence in the mobile market. Since they offer industry-wide business solutions to many companies and institutions in different industries, mobile carriers may have professional knowledge and competence to keep producing innovative mobile services. In addition, the mobile carrier-driven innovation may be able to be analyzed from the service-oriented perspective by closely looking at the forms of innovation that occurs at the interface between mobile carriers and their customers.

Thirdly, the role of universities was identified in service innovation of Mobile Campus by adopting the theory of the New Service Development (NSD). The findings revealed that

the importance of user involvement should be more emphasized in service innovation studies. Prior study on service innovation also insists that user involvement is higher in B2B than in B2C services (Alam, 2006). Such active user involvement may lead to continuous innovations in mobile services. This can give valuable insight into on-going analysis of innovation in B2B mobile services in this thesis.

Fourthly, in this chapter, a university is regarded as a B2B mobile service user. The service user of B2C (e.g. individual mobile phone users) is conceptually different from that of B2B (e.g. universities adopting Mobile Campus). Particularly in the case of Mobile Campus, the service user does not mean an individual user, indicating neither a student, a professor nor a staff. It can be rather defined as a university itself, in other words a single organization, which is able to make a campus-wide decision and to participate in the new service development process on an equal level with mobile carriers. Hence, the empirical research of Mobile Campus offers motivation to expand the analysis from a single case study of mobile service innovation to a study on innovation in the entire B2B mobile carrier service.

3.7. Developing the Research Questions

Motivated by the theoretical and empirical findings discussed in the previous section, this thesis expands the analysis from a single case study of mobile service innovation to a product-level study on innovation in the entire B2B mobile carrier service. In order to carefully examine the innovations that occur in B2B mobile carrier services, there is a need to analyze innovation in service products. A product-level study allows this thesis to break down the service characteristics embedded in an innovative service product and clarify different types of innovations that pervade in B2B mobile carrier services.

This study aims to contribute to the research on the different dynamics of innovation in B2B mobile carrier services by addressing the following three research question groups:

(1) How have the different dynamics of innovation evolved over time? And what factors have influenced it?

(2) What are the types of innovation in B2B mobile carrier services? How do they differ from each other?

(3) How are the dynamic competences of mobile carriers and B2B customers used in

the different types of innovation? And how do they interact with each other?

Table 3-8 summarizes why these research questions were developed (i.e. research motivation) and how they will be answered in which sequence (i.e. chapter). Several key concepts will be used to build a conceptual framework for studying innovation in B2B mobile carrier services.

Table 3-8. Analytical structure for studying innovation in B2B mobile carrier services

Research motivation	Research questions	Key concepts for building the framework	Chapter
Further study of the factors influencing innovation in Mobile Campus	*(1) How have the different dynamics of innovation evolved over time? And what factors have influenced it?*	-Paradigm shift in the Korean mobile sector	5
The potential to discriminate different forms of service innovations in Mobile Campus	*(2) What are the types of innovation in B2B mobile carrier services? How do they differ from each other?*	-Characteristics-based approach to innovation -Technological innovation	6
The importance of user involvement in developing innovation in Mobile Campus, which was greater than B2C mobile services	*(3) How are the dynamic competences of mobile carriers and B2B customers used in the different types of innovation? And how do they interact with each other?*	-Competences of service providers -Customer involvement -Co-production of innovation -Service-oriented innovation	7

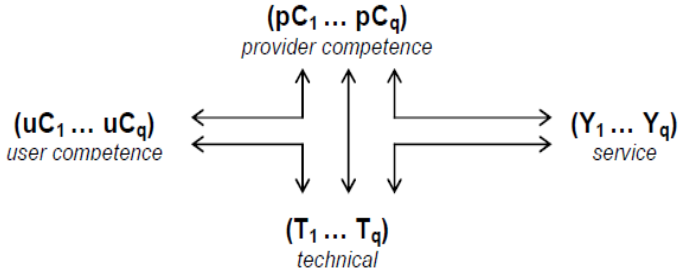
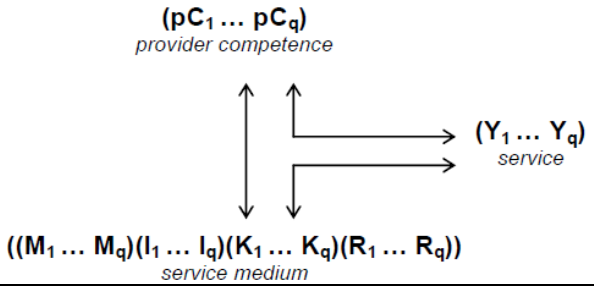
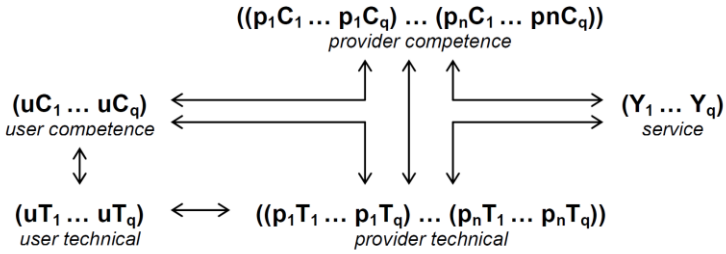
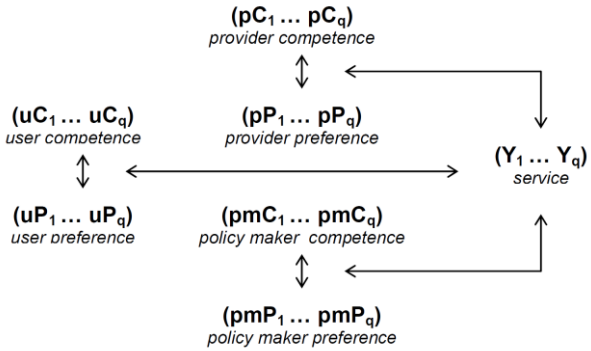
3.8. Research Framework for Studying Innovations in B2B Mobile Carrier Services

3.8.1. Enhancement of the previous characteristics-based innovation models

The characteristics-based models originated in the domain of manufacturing studies (Saviotti and Metcalfe, 1984) and migrated to the service arena (Gallouj and Weinstein, 1997), where an improved version was deemed integrative because it encompassed both goods and services (Secomandi et al., 2008). Latest developments to these models include revisions supported by case studies in specific service industries (Djellal and Gallouj, 2005; de Vries, 2006; Windrum and García-Goñi, 2008).

Table 3-9 shows the development of the characteristics-based models of services.

Table 3-9. The development of the characteristics-based models of services

Authors	Characteristics-based models
Saviotti and Metcalfe (1984)	
Gallouj and Weinstein (1997)	
Djellal and Gallouj (2005)	
de Vries (2006)	
Windrum and García-Goñi (2008)	

The initial contribution to characteristics-based models of goods and services is attributed to Saviotti and Metcalfe (1984). They insist that the product of an economic activity between providers and users can be captured in terms of two sets of characteristics, and the relationships between them: one set formed by service characteristics, which represents the outcome for users, and a set formed by technical characteristics, which represents the means through which providers supply these service characteristics. Gallouj and Weinstein (1997) transposed the model of Saviotti and Metcalfe (1984) to the context

of service innovation. They introduced different sets involved in the provision of services: provider competence, user competence and technical characteristics.

Djellal and Gallouj (2005) state that hospital services can be provided in an inter-organizational setting, where several institutions (e.g. other hospitals, private clinics, doctors in clinics, municipalities, and NGOs) jointly supply the service characteristics. Such an inter-organizational service provision is considered again by de Vries (2006), who supplements the Gallouj-Weinstein model by allowing the representation of particular technical and competence characteristics for different providers. Windrum and García-Goñi (2008) also propose the inclusion of new stakeholders by including policy makers, whose influences through preference and competence characteristics are also directly linked to the provision of the service characteristics.

The above ‘modes’ or ‘models’ of services have described the particular dynamics of characteristics in innovation theories. However, these theoretical models need to be enhanced in three ways.

Firstly, this section reviewed various ‘models of services’ deriving from the characteristics-based approach, but none of them showed how the changes in service characteristics can be linked with the types of innovation. Therefore, a new ‘model of service innovation’ needs to be proposed to clarify the relation between service characteristics and service innovation.

Secondly, the mobile service sector has been influenced by many unpredictable changes, and innovations can be driven by the radical environmental changes that take place in a certain time period. Technological and regulatory changes occur frequently in mobile sector, and they have a significant impact on the characteristics of the mobile services. Historically, the evolution from 2G to 3G network in the mid-2000s or the emergence of smartphone in the late-2000s had changed the entire paradigm in the mobile service industry. It is furthermore supported by prior studies studying the mobile service sector in that mobile regulations, standards changes, market competition and new mobile technologies influenced the diffusion and innovation in mobile services (Jonsson and Miyazaki, 2004; Miyazaki and Wiggers, 2005; Suryanegara and Miyazaki, 2010a, 2010b). However, none of the existing models included the concept of the paradigm shift which may play an important role in determining different innovation types. Within these backgrounds, a study of characteristics-based innovation needs to consider that such paradigm changes may be a key driver of innovation in mobile services.

Thirdly, the existing models of B2C services insist that service users indirectly affect the final service characteristics only through the interaction with service providers. From the case study of Mobile Campus, it was found that universities actively participated in the service development process of Mobile Campus as co-producers of service innovation. It implies that further research is necessary to clarify the increasing role of institutional users and its direct impact on the final characteristics of B2B services.

Hence, the thesis aims to enhance the existing characteristics-based innovation models through the analysis of B2B mobile carrier services. Such enhanced representation will be discussed in the next section to build a conceptual framework, which makes important contributions to the study of innovation in mobile services.

3.8.2. Building the conceptual framework

Service innovation has been identified from different perspectives using the general formulation of a service which is proposed on the basis of the theoretical review in section 4.3.1 (Saviotti and Metcalfe, 1984; Gallouj and Weinstein, 1997; Secomandi et al., 2008; Djellal and Gallouj, 2005; de Vries, 2006; Windrum and García-Goñi, 2008). In this thesis, it is assumed that the provision of new or improved service characteristics is the result of a combination of technological and service-oriented characteristics.

3.8.2.1. A framework from the technological perspective

Firstly, from the perspective of service innovation, innovation in mobile services involves utilizing different hardware and software technologies which are related to the characteristics of a service. With support of those technologies, B2B mobile solutions carry out various service functions.

The study begins with identifying two basic forms of innovation such as radical and incremental innovations, and characterizes innovations that pervade in B2B mobile carrier services. The types of service innovation can be determined by two distinctive service characteristics. The two service characteristics are identified with the distinction between ‘improved’ and ‘new’ service characteristics by adopting the criterion of whether they appeared before or after the paradigm shift of 2009-2010 (summarized in Table 3-10). The paradigm shift that occurred in the Korean mobile telecommunications market will be discussed in Chapter 5 by answering the research questions, *(1) How have the different*

dynamics of innovation evolved over time? And what factors have influenced it?

Table 3-10. Paradigm shift in the Korean mobile telecom market

Aspects	Important events during 2009-2010
Regulation	-Abolished the regulation of mandatory use of WIPI
Technology	-Evolution of mobile devices: Smartphone, Smart pad, Tablet PC, etc. -Network evolution from 3G to 4G: LTE
Market	- Rapidly growing smartphone market - Change in the basis of competition: from voice quality to data capacity
Mobile business landscape	-Integrated wired/wireless telecom service -Convergence with different industries

Source: Public sources from Korea Communications Commission (KCC), SK Telecom, KT and LG U+

The introductions of a bundle of new service characteristics are seen as a radical innovation, whereas any increase in the value or quality of certain service characteristics can lead to incremental innovation. In other words, 'new' service characteristics are linked with radical innovation, while 'improved' service characteristics are linked with incremental innovation. A combination of 'improved' service characteristics and 'new' service characteristics is linked with semi-radical service innovation. Thus, three types of service innovations can be identified: incremental, semi-radical and radical innovations.

The three forms of innovation are regarded as technology-enabled innovation because the implementation of new or improved service characteristics involves using many technologies such as network infrastructure, devices connected to it, digital contents and applications that converge different ICT fields.

To answer the research questions, *(2) What are the types of innovation in B2B mobile carrier services? How do they differ from each other?*, the following framework was developed as shown in Figure 3-3.

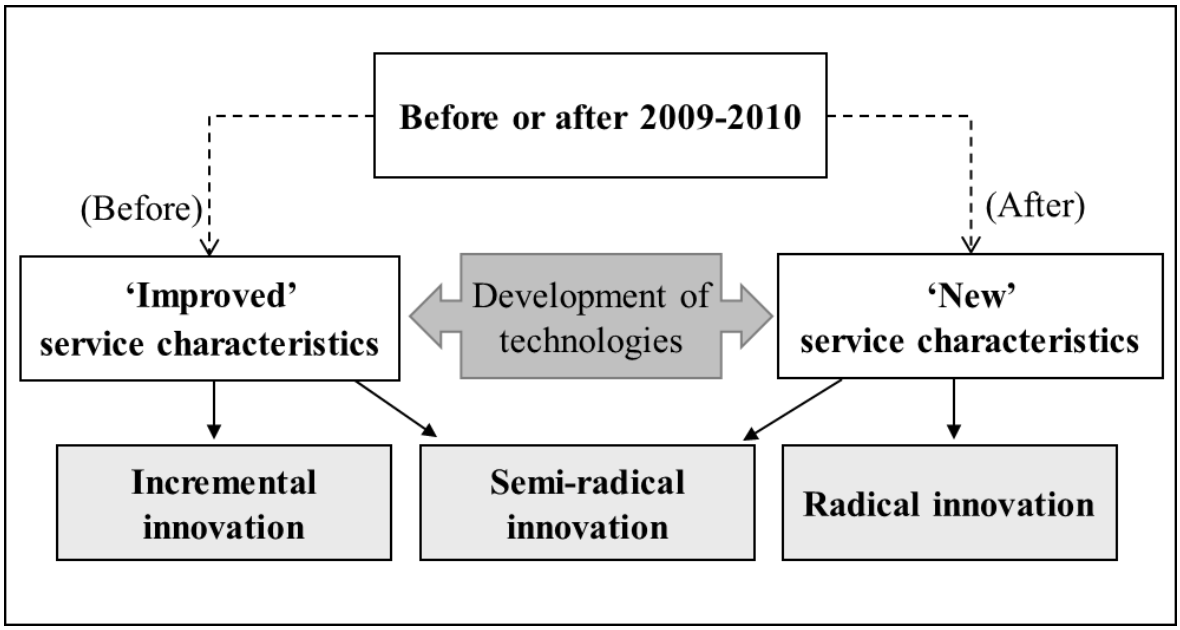


Figure 3-3. Conceptual framework for understanding technological innovation

3.8.2.2. A framework from the service-oriented perspective

Secondly, innovation in services can be obtained without directly mobilizing technological characteristics. Hence, the service-oriented aspects of innovation are included in addition to the technological perspective of innovation. This study assumes that mobile carriers and B2B service users, as service providers and users, play a dynamic role in achieving innovation by combining or splitting the existing components in service design (*'service provider-led innovation'*) or by delivering customized services for specific customers at the user/provider interface (*'service user-led innovation'*). Such capabilities of mobile carriers are represented as 'recombinative innovation' and 'customized innovation', respectively. These types of innovation may not be achieved through long-term technological advancement, but can be drawn from existing resources by utilizing them creatively in modification or combination with new ones to develop a uniquely different service product.

In this regard, this study explores the mobile carrier's dynamic capabilities for innovation in service design and delivery of B2B mobile services. As shown in Figure 3-4, the following framework was developed for service-oriented innovation, answering the research questions, *(3) How are the dynamic competences of mobile carriers and B2B customers used in the different types of innovation? And how do they interact with each other?*

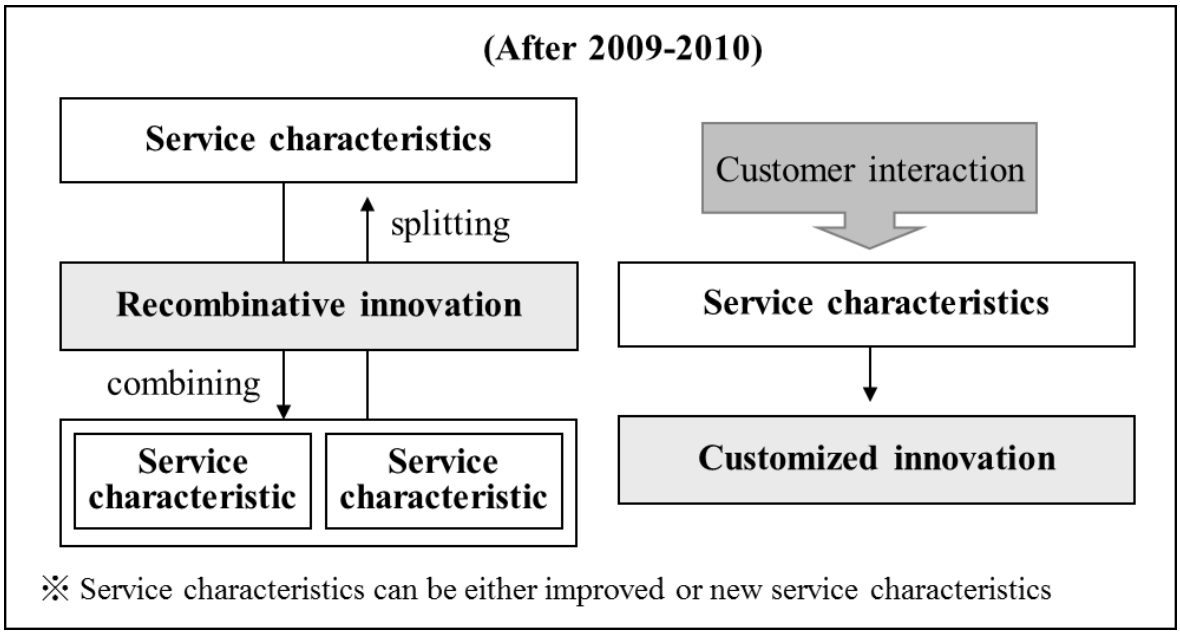


Figure 3-4. Conceptual framework for understanding service-oriented innovation

3.8.3. Definition of different innovation types

The above section established the framework for studying technological and service-oriented innovations from the characteristics-based approach. The types of service innovation highlight the existence of different dynamics of competences in designing and delivering B2B mobile carrier services. According to the competences and characteristics that were described above, five main types of service innovation are defined: incremental, radical, semi-radical, recombinative and customized innovations.

Although there are some researchers who propose very specific types of innovations, this thesis focuses on the five types of innovations. For instance, 'ameliorative innovation' of Gallouj's (2002) was reorganized and absorbed into customized innovation and incremental innovation in this thesis. In addition, semi-radical innovation is proposed in order to consider the current trend of the convergence between different technologies and services.

In this regard, this study defines technological and service-oriented innovations as shown as Table 3-11.

Table 3-11. Definition of innovation in B2B mobile services

Types of service innovation		Definition and example
Technological innovation	Incremental innovation	A service product whose main characteristics are existing but 'improved'
	Radical innovation	A service product whose main characteristics are 'new'
	Semi-radical innovation	A service product whose characteristics are combination of 'improved' and 'new' service characteristics
Service-oriented innovation	Recombinative innovation	A service product made by combining or splitting existing service characteristics
	Customized innovation	A service which is customized to meet the needs of a particular type of customers

The five dynamic forms of innovation will be discussed using the conceptual framework that was developed in this section. Before the analysis of the different dynamics of innovation in B2B mobile carrier services, the next section analyzes the B2B mobile carrier services, defining variables of their characteristics.

3.9. Summary

This chapter analyzed service innovations in Mobile Campus with respect to the issues that were discussed in pre-existing innovation theories. As a result, the findings from the case study of Mobile Campus explain the key theoretical issues on service innovation related to the role of technology, service providers and users.

Mobile Campus shows the increasing potential of mobile business opportunities in B2B. As can be seen from the case of Mobile Campus, the emergence of smartphone enables the mobile service provider to create a new innovative service. The findings from the interview results show that the current smartphone and the smartphone-based mobile services are creating new concepts such as Mobile Campus, which shifts the paradigm to mobile learning and mobile workplace. Such innovation feature driven by smartphones can be seen as a successful combination of the smartphone's technical feature, the mobile carrier's competences enabling the fixed-mobile convergence network, and the university's strong motivation of building a Mobile Campus.

From the empirical findings, this chapter found some research areas that were not fully

discovered by general theories of service innovation. This provides valuable insights and motivation for further analysis of the different dynamics of innovation in B2B mobile carrier services. In this regard, the thesis expands the analysis to the entire B2B mobile carrier services. For this, three research questions were created. The conceptual framework developed in this chapter will analyze technological and service-oriented forms of innovation in B2B mobile carrier services.

The next chapter will analyze 242 B2B mobile carrier services based on their dynamic characteristics.

CHAPTER 4. DYNAMIC CHARACTERISTICS OF B2B MOBILE SERVICES AND THEIR USERS

4.1. Introduction

In this chapter, 242 B2B mobile carrier services are analyzed in the product level. One mobile service product may have many converged service characteristics and some characteristics may show a tendency to reveal coincidently as one group of characteristics. Hence, it is necessary to divide them into sub-categories as detailed as possible in order to extract the bottom-level characteristic from a complex service feature behind an actual service product. In this regard, the structure of service characteristics is designed to consider all possible characteristics which can well represent the overall feature of services. The service characteristics will be elaborated through statistical data analyses. This analytical process gives the thesis an important conceptual basis on how to present different types of service innovations in terms of the changes in the characteristics of B2B mobile carrier services.

The results will help capture the major features of the seven B2B mobile service groups in this chapter. This chapter also analyzes what kinds of business and institutional users are using each type of B2B mobile services. Through the analyses of mobile services and their customers, this chapter aims to provide an understanding of the dynamic characteristics of B2B mobile services in Korea.

This chapter consists of six sections. First of all, the service characteristics of B2B mobile services are defined in Section 4.2. Section 4.3 collects and analyzes data of B2B mobile carrier services. The structure of service characteristics will be built as a result of conducting factor analysis and the results of cluster analysis will provide a statistical classification of B2B mobile service products into seven service groups. Section 4.4 describes the seven types of B2B mobile services. Section 4.5 presents the B2B mobile service users by service types. The fourth section summarizes the findings of this chapter.

4.2. Defining Variables of the Service Characteristics

The service characteristic is made up of more than service itself. It is the result of a

combination of various technological and service-oriented characteristics. Those characteristics may come from either service delivery process or development process of a new service. To develop a B2B mobile service brand, the service needs to be equipped with suitable devices, hardware components, applications, network connection and many relevant technologies. This section will concentrate on the 'service' characteristics of B2B mobile service, which separate from terms related to certain technologies or products (e.g. wired and wireless networks, mobile platforms, devices, OS, other hardware and software technologies related to mobile phone) and mobile carrier's capabilities (e.g. marketing know-how, pricing strategy, IT strategy, customer relations). The relation between service characteristics and technologies will be discussed later in Section 6.2.2.

The service characteristics are defined as the characteristics associated with a service, which is perceived by service users in the dynamic production and consumption process of the service. The notion seems to be similar with a service user's 'benefit' but it does not mean service 'output' such as increase in sales or market share, business profitability, cost reductions, customer loyalty, perceived image, the number of new customers and quality of workforce. It is rather similar to the 'service' feature that users perceive.

For example, GPS solutions service with the service characteristic of 'location-based' enables a transportation company to track the location of a vehicle. As the outcome of implementing this solution, B2B mobile service users can reduce the unnecessary operation cost of transportation and warehouse. In this example, the former (i.e. location-based) can be seen as a service characteristic whereas the latter (i.e. cost reduction) is not regarded as a service characteristic itself. However, such service outcomes or benefits may be partially mentioned when the thesis describes the detailed features of B2B mobile services and determines how B2B customers benefit from each B2B mobile service group in Section 4.5.

The service characteristics of B2B mobile services were identified as the first phase of the data analyses. 242 mobile service products of three major Korean mobile carriers were scrutinized: SK Telecom, KT and LG U+. Then, all service characteristic categories were extracted from those service products and were divided into sub-categories as detailed as possible. The service characteristics were broken down into 18 sub-characteristics, as shown in Table 4-1.

Each service characteristic will be discussed as follows.

Table 4-1. Definition of service characteristics

Service characteristics		Description	Examples of extracted keywords
X1	Communication	Communication and knowledge sharing with co-workers, customers, or external partners	Phone, web fax, messenger, video conference, communication
X2	Mobility	Access internal network (i.e. intranet, system) to manage tasks anytime, anywhere (i.e. when working outside or during business trips)	Remote network access, anytime, any place, mobility
X3	Mobile-based digitalization	Converting the existing web-based groupware (or system) into mobile groupware (or m-system)	Mobile groupware, mobile office, mobile system
X4	Infra maintenance	Establishment, maintenance and repair of all kinds of IT resources (i.e. network, hardware, software)	Maintenance, repair
X5	Remote control	Remote control system for equipment, facility, and device	Remote control, far-off, distant, M2M (machine-to-machine) control
X6	Automation	Automatic detecting (or monitoring) of abnormality or malfunction (i.e. virus attack, abnormal network traffic) of IT infrastructure. Automatic update, etc.	Automatic monitoring, man-less monitoring
X7	Real-time	Real-time response towards dealing with business operation. Real-time customer interaction. Real-time broadcasting, etc.	Real-time, 24 hour, all the time
X8	Data security	Security of data, application or network	Data security ,network security, contents security, backup
X9	Entrance security of buildings	Security of entrance and exit areas	Entrance security, building security
X10	Equipment security	Security of devices, equipments, or vehicles in case of loss or theft	Device security, anti-theft
X11	Information search and delivery	Collecting and searching business information such as market data, sales, finance, stocks and cash flow	Information search, information collecting, information delivery
X12	Information storage	Storing and managing a large volume of data and information	Information storage, managing data
X13	Information analysis	Analyzing the collected data and information	Analyzing, managing data, creating report, forecast
X14	e-task	Converting a manually created administration task to "e-task", i.e. a web-based system	e-approval, e-finance, e-task
X15	Location-based	Obtaining logistics info or tracking transportation	Location-based, GPS
X16	Broadcasting	Creating the customized media contents and broadcasting them through a video channel	Broadcasting channel, media contents
X17	Emergency care/ safety precaution	Safety of human beings (i.e. workers, residents) to prevent accidents	Emergency healthcare, emergency rescue
X18	Transaction information delivery	Delivering payment/transaction information via fixed-mobile network	Billing system, wireless billing device, e-payment

(1) Communication

'Communication' and 'mobility' are two basic functions of the mobile telecommunications service since its initial launch. Workers or staffs in an institution make conversation or exchange knowledge through various 'communication' means, such as fixed and mobile phone, web fax, online messenger and video conference.

(2) Mobility

A mobile phone brings 'mobility' to the telecommunication service so that workers or staffs of an institution can access internal network or system in the remote place either when they work outside an office or during business trips.

(3) Mobile-based digitalization

'Mobile-based digitalization' is the characteristic that heavily depends on a mobile device, too. It has become one of the most important features in mobile services offered via smart devices (e.g. smartphone, tablet pc and PDA). As the characteristic makes the existing web-based system transform into a mobile-based system, many ordinary task functions are being carried out through mobile devices. With a combination of 'mobility', the mobile service can offer intensive and seamless working environment because workers can deal with overall daily tasks via mobile phones at a similar level of efficiency as working on desktop.

(4) Infra maintenance

On the other hand, an institution is equipped with many kinds of IT properties, including hardware and software resources. Even a small institution may have to handle a large volume of data and information, and keep them secured from data leakage. 'Infra maintenance' of B2B mobile service helps institutional users to maintain the internal IT resources. It includes building up IT infrastructure and repairing them.

(5) Remote control

'Remote control' is the characteristic that control equipment, facility or small devices in a remote place. This characteristic is differentiated from 'mobility' in that the former handles operations of delicate machinery or a system whereas the latter offers relatively basic tasks such as remote network access.

(6) Automation

'Automation' represents any service feature that helps do tasks automatically, which are hard to do correctly by checking every detail manually. The characteristic includes automatic detecting of abnormality or malfunction of IT infrastructure such as virus attack and abnormal network traffic.

(7) Real-time

The characteristic of 'real-time' enables real-time response towards dealing with business operation. For instance, real-time delivery of business information increases the efficiency of operations planning. Institutional users having a call center can deliver mobile contents to a customer's mobile phone in real time, even while consulting with customers via voice call.

(8) Data security

In regards to security features of B2B mobile service, there are two types of security-related characteristics. 'Data security' plays a role of securing B2B customer's intangible assets such as data, application or network which may contain the confidential information.

(9) Entrance security of buildings

The other types of security feature focus on securing and protecting B2B customer's tangible assets against robbery and loss. 'Entrance security of buildings' is related to the security for a building's entrance or large facilities which are unmovable.

(10) Equipment security

'Equipment security' also plays a role of protecting B2B customer's tangible assets. It deals with devices, equipments or vehicles, which are relatively small and movable.

(11) Information search and delivery

The next following three characteristics are formed to explain the feature of informative service characteristics. First of all, 'information search and delivery' searches and collects the data and information related to business operations or administrative tasks within an institution.

(12) Information storage

When ‘information search and delivery’ gathers the appropriate data, ‘information storage’ serves the data storage space to manage a large volume of the data and information.

(13) Information analysis

‘Information analysis’ helps analyze the collected data and information and make an analysis report.

(14) e-task

As explained above, ‘mobile-based digitalization’ converts a web-based system to a mobile-based system. In contrast to ‘mobile-based digitalization’, ‘e-task’ converts a paper-based administration task which has been conducted manually into a web-based solution. Like ‘mobile-based digitalization’, this helps increase business efficiency and managerial effectiveness.

(15) Location-based

‘Location-based’ is formed as a separate form of information delivery because this characteristic plays a critical role in many B2B mobile solutions. The characteristic itself may create various business solutions, for instance, by delivering geographic information for target marketing or by offering tracking solutions for freight and logistics.

(16) Broadcasting

The various types of networks served by a mobile carrier not only provide voice and data transmission but also offer a dedicated network for broadcast transmission. With the characteristic ‘broadcasting’, institutional users can create a new type of communication channels for the purpose of internal information sharing, marketing and training employees.

(17) Emergency care/safety precaution

‘Emergency care/safety precaution’ is responsible for the safety of human resources to prevent unexpected accidents through a mobile solution.

(18) Transaction information delivery

'Transaction information delivery' plays a role for mobile carriers to deliver payment and transaction information via the fixed or mobile network.

4.3. Data Analysis of B2B Mobile Services

4.3.1. Data collection

Data was collected from the web pages of SK Telecom (http://www.biztworld.co.kr/), KT (http://biz.olleh.com/) and LG U+ (http://biz.uplus.co.kr/). Those websites provide the lineup of all B2B mobile carrier service brands for institutional users that are launched by the three mobile carriers. We regarded a service brand as one service product (e.g. SK Telecom's Smart Office, T Smart Learning, T Cloud Biz; KT's Smart Working, U Cloud Biz-Server; LG U+'s U+ Mobile Office, U+Mobile Groupware). Each service product is an independent service product, which means B2B mobile service users can subscribe to a single service separately from one another. 'Pre-made' service bundles[32] and pricing brands[33] were removed from the analysis to avoid the duplication of the same service brands or the brands that do not contain any service characteristics were removed. But those service brands will be discussed later when the focus turns to service-oriented innovations in Chapter 7.

Therefore, 242 service products were selected as a sample among the total lineup of about 300 service brands, which well represented the three mobile carriers' main B2B mobile services. Then, keywords that describe each of the 18 sub-characteristics were detected to find out which service characteristics a certain service product is based on. This task is necessary for an accurate analysis because B2B mobile services often provide integrated functions. For example, 'mobile office' services (e.g. SK Telecom's Smart Office, KT's Mobile Office, LG U+'S U+ Mobile Office) have a high tendency to be

[32] A 'pre-made' service bundle is defined as a bundle of services. Mobile carriers create a new service brand by combining two or more existing service products, and launch it under a new brand name called 'service package'. Thus, it is regarded as an independent service product. This service bundle is not designed on request of B2B mobile service users, but it is made by mobile carriers from the service provider's perspective, based on their understanding of user needs. Therefore, it is called 'pre-made' service because it is made in advance of actual demand.

[33] A pricing brand is defined as a service price that has its own brand name. It includes discount pricing and flat-rate data packages, which provide unlimited use of high-speed data communications at a fixed monthly charge.

developed by converging deferent service characteristics such as mobility, mobile-based digitalization, data security, e-task and education.

4.3.2. The descriptive features of a collection of data

First of all, the characteristics of each service product were converted into a set of 18 dummy variables (1=having a given characteristic, 0=not having it). As a result, a 242x18 matrix of dummy variables was constructed. Table 4-2 summarizes the results of descriptive statistics analysis for 18 service characteristics, including mean scores and standard deviation.

Table 4-2. Descriptive statistics of 18 service characteristics

Sub-service characteristics		Mean	Std. Deviation
X1	Communication	0.529	0.500
X2	Mobility	0.174	0.380
X3	Mobile-based digitalization	0.099	0.300
X4	Infra maintenance	0.479	0.501
X5	Remote control	0.174	0.380
X6	Automation	0.310	0.463
X7	Real-time	0.401	0.491
X8	Data security	0.355	0.480
X9	Entrance security of buildings	0.041	0.199
X10	Equipment security	0.025	0.156
X11	Information search and delivery	0.306	0.462
X12	Information storage	0.285	0.452
X13	Information analysis	0.186	0.390
X14	e-task	0.190	0.393
X15	Location-based	0.091	0.288
X16	Broadcasting	0.045	0.209
X17	Emergency care/safety precaution	0.025	0.156
X18	Transaction information delivery	0.045	0.209

Table 4-3 shows the correlations among the service characteristic variables. A correlation matrix was used to test for multicollinearity[34] among the 18 service characteristics. Multicollinearity will be diagnosed if the absolute value of the correlation between two variables is larger than 0.5.

[34] Multicollinearity is the extent to which a variable can be explained by the other variables in the analysis.

Table 4-3. Correlation matrix of 18 service characteristics

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18
X1	1.000																	
X2	.017	1.000																
X3	.119*	.542**	1.000															
X4	-.006	-.243**	-.235**	1.000														
X5	-.158**	.020	-.043	.084	1.000													
X6	-.173**	-.118*	-.103	.251**	.377**	1.000												
X7	-.157**	-.019	-.074	.211**	.160**	.491**	1.000											
X8	-.130*	-.089	.014	.394**	.093	.118*	.097	1.000										
X9	-.095	.069	.001	-.033	.343**	.220**	.084	-.154**	1.000									
X10	-.116*	-.073	.036	.007	.278**	.180**	.032	.048	-.033	1.000								
X11	-.146*	.098	.170**	-.206**	.098	.215**	.208**	-.155**	.178**	.125*	1.000							
X12	-.174**	-.024	-.056	.054	.097	.210**	.137*	.067	.145*	-.101	.296**	1.000						
X13	-.102	-.023	-.016	-.055	.061	.185**	.238**	-.022	-.046	-.008	.420**	.286**	1.000					
X14	.077	.084	.121*	-.254**	-.139*	-.120*	-.009	-.052	-.101	.058	.250**	.184**	.283**	1.000				
X15	-.134*	.045	.136*	-.188**	.007	.099	.005	-.085	-.066	.227**	.445**	-.009	.181**	.177**	1.000			
X16	-.231**	-.100	-.072	-.051	-.100	.025	.226**	-.121*	-.045	-.035	-.102	-.138*	-.104	-.106	-.069	1.000		
X17	-.062	-.073	.036	-.100	-.003	.008	-.076	-.118	-.033	.316**	.125*	-.101	-.076	.058	.319**	.093	1.000	
X18	-.231**	.162**	-.006	-.170**	-.100	-.060	-.098	-.079	-.045	-.035	.070	-.138*	-.053	-.055	.000	-.048	-.035	1.000

Notes: Total sample size = 242

* $p<0.05$ and ** $p<0.01$

The correlation matrix in Table 4-3 shows that most correlation coefficients between variables are less than 0.5, which implies that there was no multicollinearity among variables. The correlation coefficient between X2 (mobility) and X3 (mobile-based digitalization) is 0.542, but multicollinearity between two variables is not a significant problem as long as the correlation is less than 0.6[35].

The high correlation between 'mobility' and 'mobile-based digitalization' implies that 'mobile-based digitalization' has higher possibility of being provided anytime, anywhere (i.e. 'mobility'). A positive correlation exists when as one variable increases, the other variable also increases. For instance, the correlation between X15 (location-based) and X17 (Emergency care/safety precaution) or the correlation between X5 (Remote control) and X9 (Entrance security of buildings) shows a positive relationship between those two variables.

On the other hand, some characteristics are negatively correlated with other characteristics, indicating that that a characteristic has a lower tendency to be combined with others in the same service product. X1 (communication) shows negative correlation with many service characteristics, for instance X5 (remote control), X6 (automation), X7 (real-time), X8 (data security), X9 (entrance security of buildings), X10 (equipment security), X11 (information search and delivery), X12 (information storage), X15 (location-based), X16 (broadcasting) and X18 (transaction information delivery). In other words, the stronger their characteristics are, the weaker X1 (communication) becomes. This implies that many of the current B2B mobile services are high value-added services that offer various data-centric solutions.

4.3.3. Factor analysis of the service characteristics

Factor analysis was then conducted using principal component analysis with varimax rotation. After conducting factor analysis, 7 characteristics variables whose eigenvalues[36] were greater than 1 were extracted from the 18 sub-characteristics. In this way, factors can be found to represent variables with similar aspects. Table 4-4 shows several important

[35] Correlation coefficients between independent variables must be smaller than 0.6 (or -0.6) to minimize the multicollinearity. Many prior studies used 0.6 as a criterion to be a good model (Harms, 1996; Gillen and Levinson, 2004; Chen and Levinson, 2006; Bourne et al., 2010; Teeratansirikool et al., 2013).

[36] Eigenvalue is a column sum of squared loadings for a factor. It represents the amount of variance accounted for by a factor.

results.

First of all, the Kaiser-Meyer-Olkin (KMO) statistic was obtained. The KMO statistic can be calculated for multiple variables and represents the ratio of the squared correlation between variables to the squared partial correlation between variables (Kaiser, 1970). In Table 4-4, the KMO statistic was calculated for all 18 variables representing service characteristics. The KMO statistic varies between 0 and 1. A value of 0 indicates that the sum of partial correlations is large relative to the sum of correlations, indicating diffusion in the pattern of correlations (hence, factor analysis is likely to be inappropriate). In contrast, a value close to 1 indicates that patterns of correlations are relatively compact and so factor analysis should yield distinct and reliable factors. Kaiser (1974) recommends accepting values greater than 0.5 as acceptable. For the data in Table 4-4, the value is 0.588 which falls into the range of being adequate. Hence, factor analysis can be seen appropriate for the data in this thesis.

Secondly, Bartlett's test of sphericity[37] tests the null hypothesis that the difference of the means in the groups is equal to 0. Because some relationships between variables are necessary for factor analysis to work, this test is expected to be significant (i.e. it should have a significance value less than 0.05). A significant test in Table 4-4 represent that there are some relationships between the 18 variables which are included in factor analysis. For these data, Bartlett's test is highly significant ($p < 0.001$), and therefore factor analysis is appropriate.

Thirdly, the 18 variables were narrowed down to seven factors. Those seven factors were extracted by using Kaiser (1974)'s criterion of retaining factors with eigenvalues greater than 1. The fifth row from the bottom of Table 4-4 shows eigenvalues. There might be more components in the data set than the seven, but in order to determine the importance of a particular vector, the magnitude of the associated eigenvalue was looked at. Then, Kaiser (1974)'s criterion was applied to examine which factors to retain and which to discard. After calculating the eigenvalues, the seven factors having eigenvalues over 1 were left.

Fourthly, the fourth row from the bottom of Table 4-4 displays the eigenvalue in terms of the percentage of variance explained. For instance, factor 1 explains 14.2% of total variance, followed by factor 2 with 13.2% and factor 3 with 9.2%.

[37] Bartlett's test of sphericity is a statistical test for the overall significance of all correlations within a correlation matrix.

Fifthly, the last column of Table 4-4 shows communalities[38]. It means that variance is well explained by the seven factors. The result can be considered accurate when the average communality is greater than or equal to 0.6 (Field, 2000). In the thesis, the average of the communalities was found by adding them up and dividing by the number of communalities (i.e. 11.907/18 = 0.662) and none was less than 0.6. Hence, the measure in the thesis is proved adequate.

Sixthly, Varimax rotation method was selected because it is a good and general approach that simplifies the interpretation of factors (Field, 2000). For factor analysis, an iterative procedure was used to gradually find a better estimate. Rotation was converged in seven iterations. As a result, the main body of Table 4-4 shows a matrix of the factor loadings for each variable onto each factor. The variables are listed in the order of size of their factor loadings. The factors with more loadings greater than 0.4 are reliable when the sample size is larger than 150. If a factor has more loadings greater than 0.6, it is reliable regardless of sample size (Field, 2000). In Table 4-4, all factor loadings are above 0.5 and the samples consist of 242 service products which are good enough to be reliable.

Lastly, the 18 variables were reduced to the seven factors[39]. The similarity of the variables in the same factor was analyzed and was formed as the new categories of service characteristics as follows: ‘general office work supportive’, ‘facility management’, ‘location-based/security/safety’, ‘IT Infra management’, ‘seamless working condition’, ‘real-time broadcasting’ and ‘transaction information delivery’.

[38] Communality is the total amount of variance an original variable shares with all other variables included in the analysis.

[39] The difference of the three mobile carriers was not considered as a control variable because there was no difference between business size, market strategies and organizational structure related to B2B mobile service business of the three mobile carriers in Korea. In terms of business size, although SK Telecom occupies 50% market share, the three mobile carriers have a similar business size due to fixed-mobile business expansion and collaboration with their subsidiaries. In terms of mobile market strategy, they showed a very similar strategic direction because their strategies are highly affected by strategies of the competing mobile carriers. This makes them pursue almost the same strategy. In addition, each of them have a particular division specialized in B2B business. Therefore, it is concluded that the characteristics of different mobile carriers may not affect the independent variables of service characteristics and thus any potential difference may not affect the outcome of the result.

Table 4-4. Result of the factor analysis

Sub-service characteristics		Component							Commu-nalities
		General office work supportive	Facility management	Location-based/ security / safety	IT Infra management	Seamless working condition	Real-time broadcasting	Transaction information delivery	
X13	Info analysis	**.761**	-.033	-.010	.039	-.041	.102	.016	.594
X11	Info search & delivery	**.684**	.190	.278	-.211	.163	.066	.144	.678
X12	Info storage	**.629**	.224	-.237	.080	-.125	-.045	.006	.526
X14	e-task	**.564**	-.316	.128	-.141	.122	-.132	-.173	.517
X5	Remote control	.001	**.767**	.173	.165	.020	-.030	.012	.647
X9	Entrance security of buildings	.011	**.763**	-.149	-.316	.018	-.016	-.011	.704
X6	Automation	.241	**.550**	.130	.302	-.087	.398	.022	.635
X10	Equipment security	-.056	.203	**.736**	.177	-.003	-.047	.008	.619
X17	Emergency rescue/safety precaution	-.095	-.049	**.732**	-.187	-.085	.048	-.046	.594
X15	Location-based	.350	-.073	**.643**	-.109	.117	-.007	.107	.579
X8	Data security	-.010	-.064	-.020	**.841**	.049	-.057	.072	.722
X4	Infra maintenance	-.126	.128	-.120	**.688**	-.278	.115	-.142	.630
X3	Mobile-based digitalization	.019	-.051	.103	-.020	**.869**	-.024	-.113	.783
X2	Mobility	-.002	.053	-.116	-.106	**.851**	-.041	.121	.768
X16	Broadcasting	-.255	-.178	.019	-.233	-.099	**.787**	.081	.788
X7	Real-time	.283	.221	-.054	.243	.037	**.724**	-.039	.717
X18	Transaction information delivery	-.082	-.096	-.064	-.114	.100	-.168	**.809**	.726
X1	Communication	-.122	-.143	-.126	-.105	.110	-.282	**-.725**	.680
Eigenvalues		2.553	2427	1.655	1.521	1.403	1.251	1.157	
% of Variance		14.2	13.2	9.2	8.5	7.8	6.9	6.4	
KMO		.588							
Bartlett's test of sphericity		852.000							
Sig.		.000							

* Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization[40]
(Rotation converged in 7 iterations)

[40] Kaiser normalization is a process by which each row of the initial factor loading matrix is normalized by dividing by the square root of their communalities to ensure that each variable has equal influence on the rotation process. Their communalities are normalized to all equal one for the duration of the rotation.

The result of the factor analysis produces a two level hierarchy structure as presented in Figure 4-1.

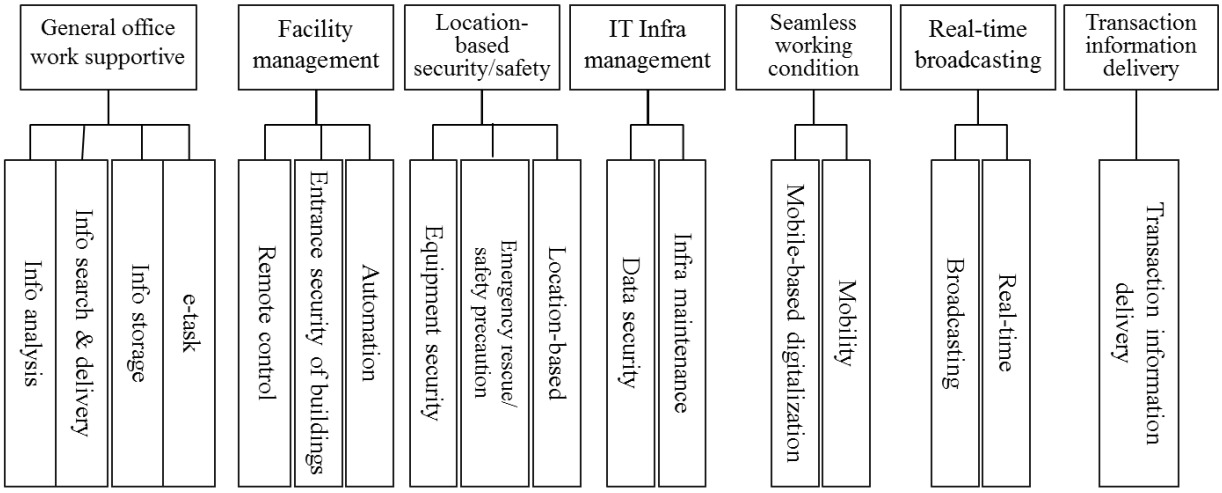


Figure 4-1. The structure of B2B mobile service characteristics

The seven new categories of B2B mobile service characteristics are described as follows.

First of all, ‘general office work supportive’ consists of the four service characteristics: ‘information analysis’, ‘information search and delivery’, ‘information storage’ and ‘e-task’. The characteristic of ‘general office work supportive’ supports daily business tasks by collecting and analyzing business information (e.g. market data, sales, finance and cash flow) or by dealing with a large volume of data. It also includes converting paper-based tasks to internet-based tasks.

‘Facility management’ is the remote control or the automatic monitoring of IT facilities. This service characteristic is supported by three low-level characteristics: ‘remote control’, ‘entrance security of buildings’ and ‘automation’.

‘Location-based/security/safety’ represents security for equipment or the safety of human beings. It often benefits from location-based information. This service characteristic includes three low-level characteristics: ‘equipment security’, ‘emergency care/safety precaution’ and ‘location-based’.

‘IT Infra management’ builds and manages IT infrastructure in an institution, and maintains an adequate level of data security. It is composed of two low-level service characteristics, ‘infra maintenance’ and ‘data security’.

‘Seamless working condition’ makes a suitable environment to conduct mobile business

by converting paper-based or internet-based tasks to the mobile-based system so that workers can do ordinary tasks without the restriction of time and location. It comprises two low-level characteristics, ‘mobility’ and ‘mobile-based digitalization’.

‘Real-time broadcasting’ provides broadcasting services on real-time basis, integrating two low-level service characteristics, ‘real-time’ and ‘broadcasting’.

Lastly, ‘transaction information delivery’ transmits the information on payment or transactions via fixed-mobile network. As explained in Table 4-3, the two service characteristics, ‘transaction information delivery’ and ‘communication’, show a negative correlation and this phenomenon is maintained in the result of the factor analysis (Table 4-4). In the last category, ‘transaction information delivery’ is strong whereas ‘communication’ is hardly revealed. Thus, this category is characterized with only ‘transaction information delivery’.

4.3.4. Cluster analysis of B2B mobile services based on service characteristics

Factor analysis reduces 18 service characteristics into seven factors. From the factor analysis, factor scores were calculated. In the next step, hierarchical cluster analysis was performed on the factor scores derived from the sub-characteristics to classify the 242 service products into proper categories. The objective of cluster analysis is to group service products into groups such that each group is as homogeneous as possible with respect to the service characteristics. The number of categories constituting it was simplified, and the service products were summarized as several groups according to the categorized service characteristics.

B2B mobile services can be grouped based on the similarity of service characteristic that constitute each service (i.e. groups with the same service characteristics). Table 4-5 represents that each B2B mobile service has strong or weak tendency towards a certain service characteristic. Thus, B2B mobile service products were classified into homogeneous groups based on the similarity of the strength of the service characteristics. For a precise result describing the most appropriate and sophisticated cluster of service groups in complex variables, several cluster analysis is performed repeatedly.

First of all, the B2B mobile services were classified into four groups as shown in Table 4-5.

Table 4-5. Result of the cluster analysis (four groups)

Service characteristics	Service classification (N=242)				One-way ANOVA	
	1(n=30)	2(n=192)	3(n=11)	4(n=9)	F value	Sig.
General office work supportive	-0.199	0.118	-1.166	-0.430	20.461	.000*
Facility management	-0.332	0.068	-0.815	**0.649**	15.305	.001†
Location-based / equipment security /safety	-0.101	-0.188	0.088	**4.237**	168.770	.000*
IT Infra management	-0.159	0.077	-1.065	**0.193**	14.714	.002†
Seamless working condition	**1.991**	-0.271	-0.453	-0.298	136.087	.000*
Real-time broadcasting	-0.278	-0.148	**3.601**	-0.314	150.027	.000*
Transaction information delivery	**1.032**	-0.178	0.372	-0.096	39.672	.000*

* P<0.001, † P<0.01

The services that have similar characteristics were grouped in the same category. The first service group shows the strongest characteristics of 'seamless working condition' and 'transaction information delivery' and comprises platform-based solutions such as mobile office, mobile education and mobile payment system. The second group is classified as communication and informative solutions based on the fixed or mobile networks. It has relatively weak service characteristics in every category but it is regarded as a mainstream service accounting for 79%[41] of the entire B2B mobile services. The third group represents real-time broadcasting solutions and the fourth group is composed of various security solutions for facilities, equipment, data and employees.

As the second analysis, the services are classified into five groups for more sophisticated analysis as shown in Table 4-6.

The first group in the previous Table 4-5 was further divided into two independent groups, which are the first and the fifth group of Table 4-6. Both service groups are offered via multi-functional wireless devices such as smartphone. However, one group (the first group in Table 4-6) offers integrated solutions including groupware functions and document management whereas the other (the fifth group) focuses on delivering transaction information via mobile carrier's networks.

[41] 192 mobile services of the second group account for 79% of the total number of B2B mobile services (i.e. 192/242 =79%).

Table 4-6. Result of the cluster analysis (five groups)

Service characteristics	Service classification (N=242)					One-way ANOVA	
	1(n=19)	2(n=192)	3(n=11)	4(n=9)	5(n=11)	F value	Sig.
General office work supportive	-0.097	0.118	-1.166	-0.430	-0.374	5.654	.000*
Facility management	-0.271	0.068	-0.815	**0.649**	-0.438	4.072	.003†
Location-based / equipment security /safety	0.010	-0.188	0.088	**4.237**	-0.291	140.184	.000*
IT Infra management	0.052	0.077	-1.065	**0.193**	-0.523	4.501	.002†
Seamless working condition	**2.878**	-0.271	-0.453	-0.298	0.459	163.272	.000*
Real-time broadcasting	0.006	-0.148	**3.601**	-0.314	-0.770	105.298	.000*
Transaction information delivery	-0.512	-0.178	0.372	-0.096	**3.700**	124.550	.000*

* P<0.001, † P<0.01

As the third step, the services are classified into six groups again, as shown in Table 4-7.

Table 4-7. Result of the cluster analysis (six groups)

Service characteristics	Service classification (N=242)						One-way ANOVA	
	1(n=19)	2(n=182)	3(n=11)	4(n=9)	5(n=11)	6(n=10)	F value	Sig.
General office work supportive	-0.097	**0.121**	-1.166	-0.430	-0.374	0.055	4.514	.001†
Facility management	-0.271	-0.129	-0.815	0.649	-0.438	**3.665**	80.621	.000*
Location-based / equipment security /safety	0.010	-0.159	0.088	**4.237**	-0.291	-0.718	118.533	.000*
IT Infra management	0.052	**0.164**	-1.065	0.193	-0.523	-1.517	10.488	.000*
Seamless working condition	**2.878**	-0.291	-0.453	-0.298	0.459	0.086	133.870	.000*
Real-time broadcasting	0.006	-0.152	**3.601**	-0.314	-0.770	-0.077	83.964	.000*
Transaction information delivery	-0.512	-0.185	0.372	-0.096	**3.700**	-0.053	99.532	.000*

* P<0.001, † P<0.01

The second group of Table 4-6 is broken down into two more separate groups in Table 4-7. The second group still remains as the main group of network-based solutions while the facility management solutions are separated from the second group and formed as the sixth

group of Table 4-7. The former deals with communication between people or organizations, the latter enables the interaction of objects, sensors and computing devices. The facility management solution would remotely monitor facilities and equipment through the fixed or mobile network as the same as network solutions (the second group), but the solution may provide a more integrated infrastructure based on a sensor network which converges sensing and networking technologies.

As the last step, the services are formed as seven groups. As the categories of service characteristics are seven in total, creating more than eight clusters would make the characteristics of each service blurred.

Table 4-8 shows that the group of network solutions (the second group of Table 4-7) is further divided into two groups. In the process, ‘business analytical solutions’ is separated from the network solutions because the solution shows relatively strong informative characteristic to help general office work by searching and analyzing relevant information whereas the main group of network solutions still focus on network connection for communication.

Therefore, the seven service groups are finally formed as below.

- Group 1: Mobile office/education solutions (n= 19)
- Group 2: Network solutions (n=151)
- Group 3: Multimedia broadcast solutions (n=11)
- Group 4: Business analytical solutions (n=31)
- Group 5: Security and safety solutions (n=9)
- Group 6: Payment processing solutions (n=11)
- Group 7: M2M solutions for facility management (n=10)

Table 4-8. Result of the cluster analysis (seven groups)

Service characteristics	Service classification (N=242)							One-way ANOVA	
	1(n= 19)	2(n=151)	3(n=11)	4(n=31)	5(n=9)	6(n=11)	7(n=10)	F value	Sig.
General office work supportive	-0.097	-0.244	-1.166	**1.902**	-0.430	-0.374	0.055	53.858	.000*
Facility management	-0.271	-0.052	-0.815	-0.508	0.649	-0.438	**3.665**	73.682	.000*
Location-based / equipment security /safety	0.010	-0.216	0.088	0.121	**4.237**	-0.291	-0.718	104.483	.000*
IT Infra management	0.052	**0.241**	-1.065	-0.210	0.193	-0.523	-1.517	10.009	.000*
Seamless working condition	**2.878**	-0.332	-0.453	-0.090	-0.298	0.459	0.086	114.792	.000*
Real-time broadcasting	0.006	-0.226	**3.601**	0.209	-0.314	-0.770	-0.077	76.139	.000*
Transaction information delivery	-0.512	-0.230	0.372	0.033	-0.096	**3.700**	-0.053	85.442	.000*
Name of service groups	**Mobile office /education solutions**	**Network solutions**	**Multimedia broadcast solutions**	**Business analytical solutions**	**Security and safety solutions**	**Payment processing solutions**	**M2M solutions for facility management**		

* P<0.001, n=number of services
The figures in the cell of service classification represent the average values.

The right-most column of Table 4-8 shows that a statistically significant cluster exists ($P<0.001$), representing an overall difference between the seven service groups. This result was further analyzed with a one-way ANOVA post-hoc test to determine whether there is a significant difference between each group. Post-hoc test was designed for additional exploration of the differences among the seven service groups to provide specific information on which service groups are significantly different from each other.

For the post-hoc test, Scheffe's[42] post-hoc test was chosen to evaluate differences among service groups. The results of the Scheffe post-hoc analysis for differences between service groups are presented in Table 4-9. The analysis indicated that business analytical solutions (Group 4) have significantly stronger 'general office work supportive' characteristic than the other service groups[43]. M2M solutions for facility management (Group 7) have significantly stronger 'facility management' characteristic than the other service groups[44]. Security and safety solutions (Group 5) have significantly stronger 'location-based/equipment security/safety' characteristic than the rest of the service groups[45]. Network solutions (Group 2) have significantly stronger 'IT Infra management' characteristic than multimedia broadcast solutions (Group 3) and M2M solutions for facility management (Group 7)[46]. Mobile office/education solutions (Group 1) have significantly stronger 'seamless working condition' characteristic than the rest of the service groups[47]. Multimedia broadcast solutions (Group 3) have significantly stronger 'real-time broadcasting' characteristic than the rest of the service groups[48]. Payment processing solutions (Group 6) have significantly stronger 'transaction information delivery' characteristic than the other service groups[49].

Hence, the classified seven groups have different service characteristics from each other. The result from the analysis indicates that there is a significant difference between pairs of groups in terms of the seven service characteristics.

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[42] Scheffe's method is a statistical test that is used to make comparisons among group means in analysis of variance (ANOVA). It tests all possible contrasts at the same time and indicates where the differences are located among the variables.

[43] See the comparison: 1~4, 2~4, 3~4, 4~5, 4~6, 4~7 (in the second row of Table 4-9).

[44] See the comparison: 1~7, 2~7, 3~7, 4~7, 5~7, 6~7 (in the third row of Table 4-9).

[45] See the comparison: 1~5, 2~5, 3~5, 4~5, 6~5, 7~5 (in the fourth row of Table 4-9).

[46] See the comparison: 2~3, 2~7 (in the fifth row of Table 4-9).

[47] See the comparison: 1~2, 1~3, 1~4, 1~5, 1~6, 1~7 (in the sixth row of Table 4-9).

[48] See the comparison: 1~3, 2~3, 3~4, 3~5, 3~6, 3~7 (in the seventh row of Table 4-9).

[49] See the comparison: 1~6, 2~6, 3~6, 4~6, 5~6, 7~6 (in the eighth row of Table 4-9).

Table 4-9. Results of the one-way ANOVA post-hoc test

Comparison	1~2	1~3	1~4	1~5	1~6	1~7	2~3	2~4	2~5	2~6	2~7	3~4	3~5	3~6	3~7	4~5	4~6	4~7	5~6	5~7	6~7	Fvalue	Sig.
General office work supportive	n.s.	*	*	n.s.	n.s.	n.s.	*	*	n.s.	n.s.	n.s.	*	n.s.	n.s.	*	*	*	*	n.s.	n.s.	n.s.	53.858	.000*
Facility management	n.s.	n.s.	n.s.	*	n.s.	*	*	*	n.s.	n.s.	*	n.s.	*	n.s.	*	*	n.s.	*	*	*	*	73.682	.000*
Location-based / equipment security /safety	n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	*	n.s.	n.s.	*	n.s.	*	*	*	n.s.	104.483	.000*
IT Infra management	n.s.	n.s.	n.s.	n.s.	n.s.	*	*	n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	*	n.s.	*	n.s.	10.009	.000*
Seamless working condition	*	*	*	*	*	*	n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	114.792	.000*
Real-time broadcasting	n.s.	*	n.s.	n.s.	n.s.	n.s.	*	*	n.s.	n.s.	n.s.	*	*	*	*	n.s.	*	n.s.	n.s.	n.s.	n.s.	76.139	.000*
Transaction information delivery	n.s.	*	n.s.	n.s.	*	n.s.	n.s.	n.s.	n.s.	*	n.s.	n.s.	n.s.	*	n.s.	n.s.	*	n.s.	*	n.s.	*	85.442	.000*

*significant (P<0.001), n.s.=not significant

(1: Mobile office/education solutions, 2: Network solutions, 3: Multimedia broadcast solutions, 4: Business analytical solutions, 5: Security and safety solutions, 6: Payment processing solutions, 7: M2M solutions for facility management)

4.3.5. Distribution of B2B mobile services by mobile carriers

Figure 4-2 shows the shares of service group. Among the total 242 service products, 151 B2B mobile service products (62%) are identified as network solutions which are currently the mainstream services, whereas 31 B2B mobile service products (13%) belong to business analytical solutions. 19 service products (8%) are identified as mobile office/education solutions, followed by payment processing solutions (5%), multimedia broadcast solutions (4%), M2M solutions for facility management (4%) and security and safety solutions (4%).

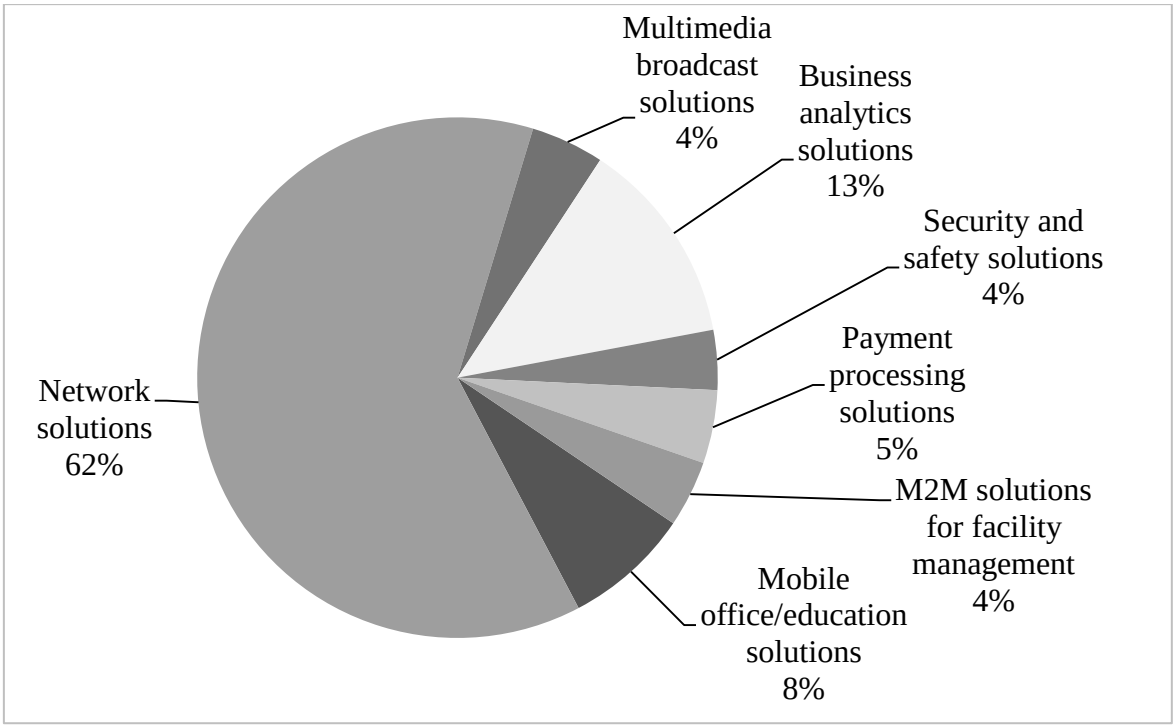

Figure 4-2. Shares of service groups in entire B2B mobile services

Such classification of the B2B mobile service products highlights the diversity of B2B mobile services provided by mobile carriers, offering a variety of service values to institutional users. Although many service groups occupied less than 10%, they may generate a larger amount of mobile data traffic than network solutions. It implies the potential growth of such service groups because mobile carriers are willing to put efforts in developing such profitable data-centric solutions.

Figure 4-3, 4-4 and 4-5 below represent the service composition of each mobile carrier by service groups. KT and LG U+ have launched network solutions service products, which are more than half of the total service products (66% and 74% respectively). On the

other hand, SK Telecom has less service products of network solutions accounting for 40% of the total. This difference may be caused by their different integration strategies of wired and wireless business. KT and LG U+ expanded their business by merging their wired and wireless communication subsidiaries into one single brand while SK Telecom has expanded its existing mobile network business by strengthening alliance with subsidiary companies (e.g. SK Broadband, SK Telink). For this reason, KT and LG U+ have been able to freely mobilize the newly absorbed business capability of wired-network by developing many integrated network services which can be delivered through both mobile and fixed networks. Instead, the service proportion of SK Telecom is more balanced. In particular, SK Telecom launched more products for diverse solutions such as business analytical solutions (21%) and mobile office/education solutions (16%) which support general office work and business operations. These findings imply the current mobile trend that a variety of mobile service platforms and mobile operating systems are pervasive in B2B mobile services, enabling diverse applications to work together under different devices and servers. In the near future, the three mobile carriers are expected to build many service platforms for a broad range of fields spanning content delivery, location-based services, mobile commerce, broadcasting and advertising.

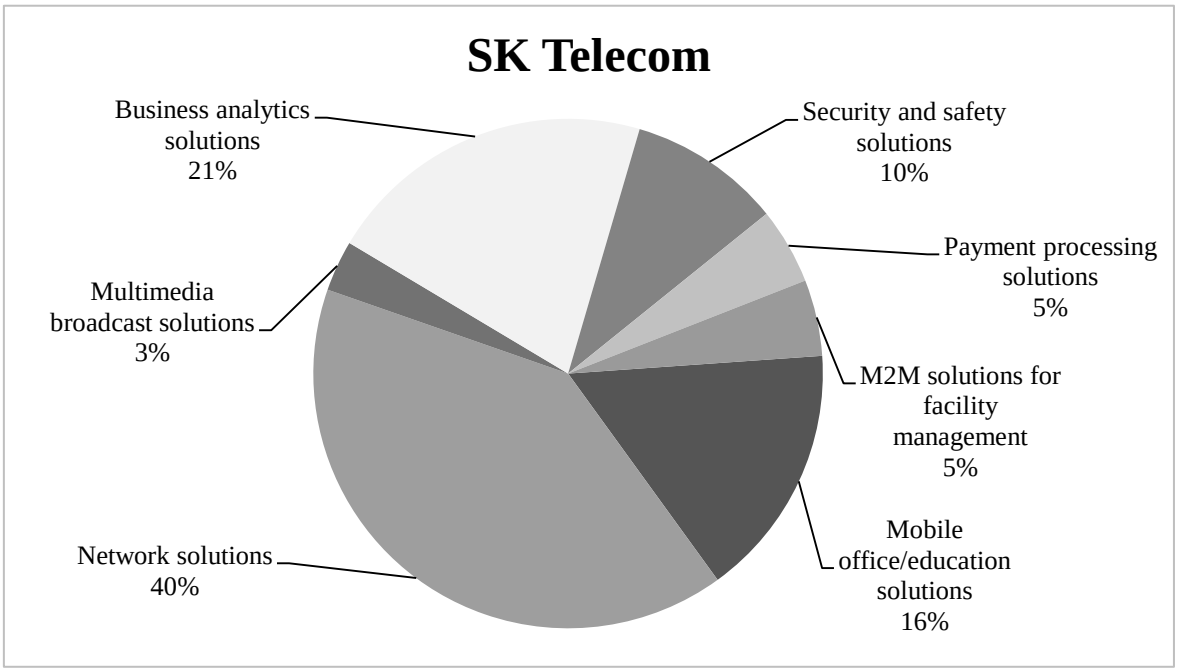

Figure 4-3. SK Telecom’s service composition by service groups

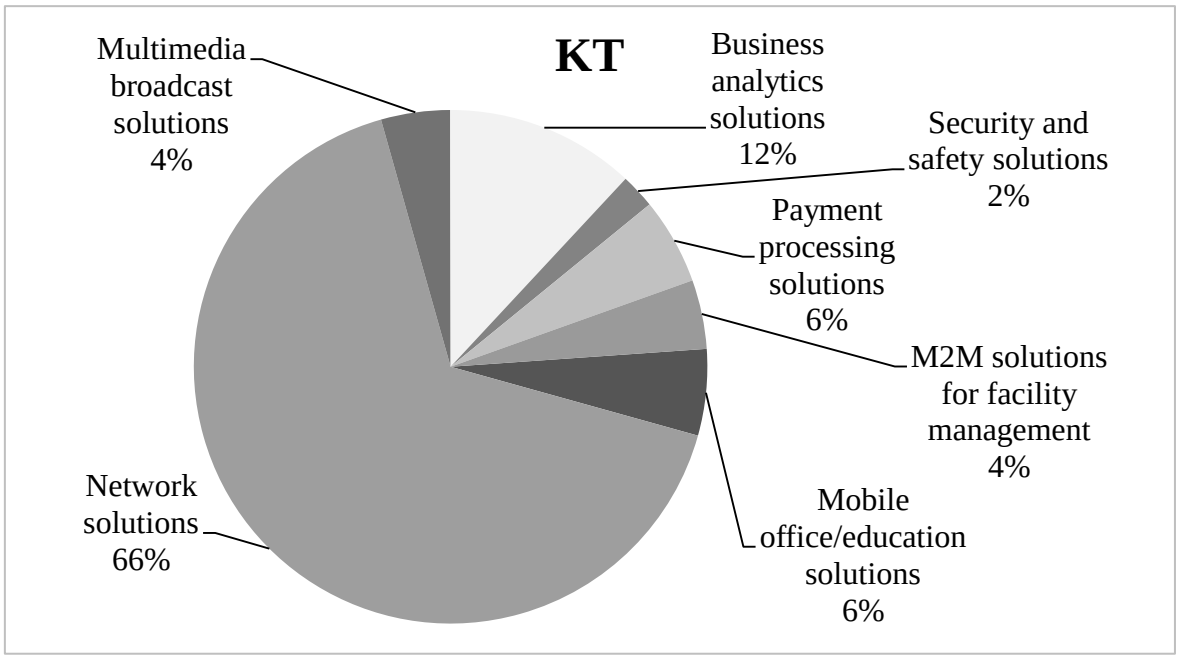

Figure 4-4. KT's service composition by service groups

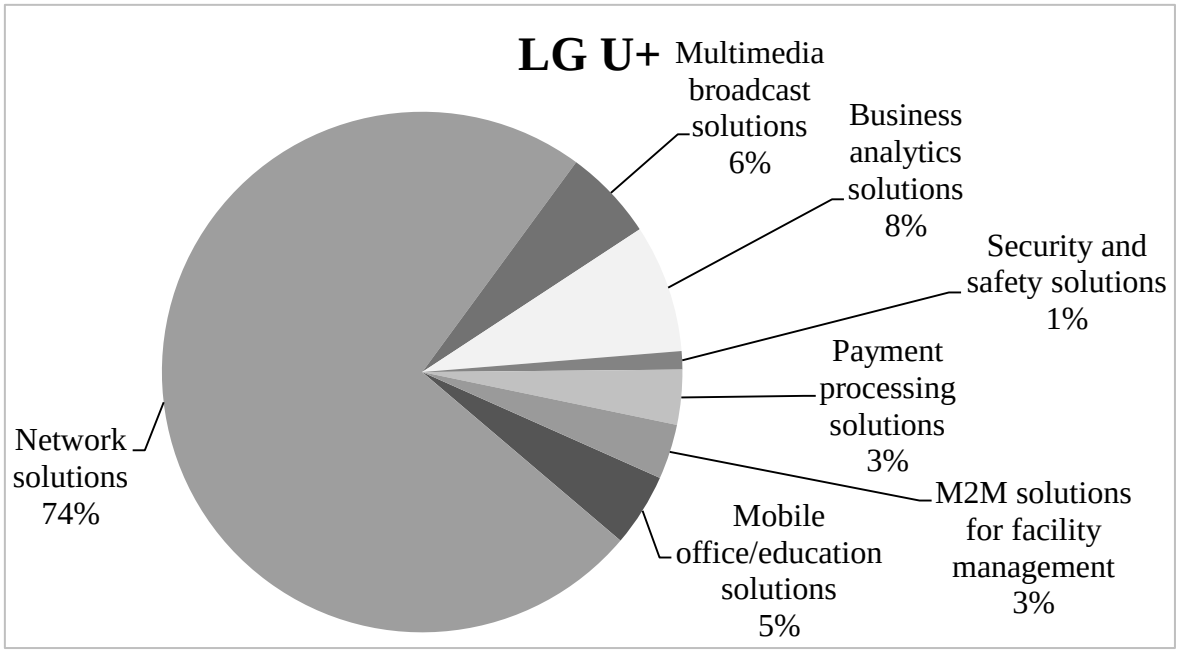

Figure 4-5. LG U+'s service composition by service groups

4.4. Types of B2B Mobile Services

4.4.1. Mobile office/education solutions (n= 19)

This service group shows very strong ‘seamless working condition’ characteristic. It changes the existing business system and alters the entire working environment by simply installing the service platform (as known as a ‘mobile office pack’) in a mobile phone. It offers various groupware functions such as email, messenger, scheduling, document management and other ordinary tasks. In other words, it is an integrated solution that enables employees to collaborate effectively towards a common goal. Such ‘mobile office’ solution helps employees to work together over geographic distances by providing tools that support communication, collaboration and the process of problem solving. Also, it can support project management functions, such as task assignments, time-managing deadlines, and shared calendars. In such a way, the existing institutional system is transformed into a mobile-based system, which allows access an internal intranet, file systems or web-based applications via smartphone. These changes benefit B2B customers in all industries because workers can carry out main business tasks such as sales, marketing, finance, communication and general management any time and in any place through their mobile devices.

Mobile education solutions are included in the service group, too. These solutions realize a new concept of the education system, which enables public/private educational institutions and publishing firms to make educational contents based on a PDF document, create e-book, give lectures on those contents, and design a new service model by connecting them with electronic paper, digital pencil or traditional print media. In addition to the creation and use of educational contents, these education solutions provide useful functions such as checking the learning performance of employees or students for each content, producing education progress reports and planning the learning schedule. Such functions can be operated at any time and in any place via a smartphone or a tablet pc.

Particularly, the mobile education service functions often show a tendency to be packaged with other mobile solutions. Most of the mobile office solutions are equipped with the mobile education platform as a basic function.

The examples of each mobile carrier’s service products are illustrated below in Table 4-10.

Table 4-10. Service products that belong to ‘mobile office/education solutions’ group

Mobile carriers	Examples of service brand names
SK Telecom (n=10)	Bizmob, Smart CEO, Parking Monitoring System, Office Pack, Smart Office, T Biz Catalog, Handistudy, T Smart Learning, Smart Dental, T Biz Hospital
KT (n=5)	KT Enterprise Mobility Platform (KEMP), KT Mobile Office Platform (KMP), Mobile Office (Solutions By Industry), Office 365, e-Library
LG U+ (n=4)	U+ Mobile Office, U+ Edu-tab, U+ Mobile Groupware, U+ Mobile Sales Support

4.4.2. Network solutions (n=151)

This service group shows weak tendencies in overall characteristics but it has relatively stronger characteristic of ‘IT Infra management’ than the two service groups ‘multimedia broadcast solutions’ and ‘M2M solutions for facility management’.

It provides stable internet access services such as a dedicated line or wireless LAN, which enable transmission of large-volume data at high speed. The solution includes both fixed and wireless networks for the purpose of voice communication (e.g. extension to extension calls, local calls and call center functions), data transmission (e.g. local area networks, enterprise private networks, voice over Internet Protocol), messaging (e.g. sending a large number of SMS, MMS messages at the same time) and international calls. By offering virtual machines, servers, storage and network, it designs a suitable working environment from the perspective of IT infra maintenance, with particular emphasis on data security. Such a use of computing resources that are delivered as a service over a network is called a cloud computing service.

It also offers a maintenance solution for networks and helps institutional users to conduct tasks more efficiently by maintaining an adequate level of data security. It can deliver computing and storage capacity to institutional users so they do not need to manage the cloud infrastructure and platform on which the application is running. The cloud computing-based service is often followed by data security solutions. It is beneficial to many B2B mobile users’ business. For example, through cloud computing, mid-size and large hospitals can process a large volume of images and video records in long-term storage from 5 to 10 years. Financial or educational service companies also benefit from saving a large volume of data files efficiently regarding effort and cost.

The examples of each mobile carrier’s service products are given below in Table 4-11.

Table 4-11. Service products that belong to ‘network solutions’ group

Mobile carriers	Examples of service brand names
SK Telecom (n=25)	Civil Petition Service, MACS System, Domestic Dedicated Line, Enterprise 070 B+, Enterprise 070 IP Centrex, Enterprise 070 SOHO, Biz Broadband LAN, Dedicated Internet Access, Unified Phone Number, FMC, Biz Video Advertising, Data Info System, USN Service Platform, FCC, PC Management, NATEON BIZ, Web Fax, MP Traveller2, Syncboard, FTA Insight, Cloud Server, Cloud Contact Center, Mscouter, T-Smoking Ban Petition Service, T Biz Community
KT (n=61)	VoIP Biz, Callbox, Smart G/W, VoIP Centrex, Internet Fax, Biz Say, ISDN PRI, Biz Innertel, DID/DOD, International Call Express, 080 UIFN, KT-800, FMC, Iplug, M2M Connectivity Services, Children Security Service, Kornet Express, Kornet Hotline, Kornet Education Network, Kornet Game Express, Dedicated Line, VPN Premium, X4biz, X4biz Plus, Internet VPN, Network Management Service, Equipment Lease Service, Managed Wireless LAN, Managed IP-PBX, Managed Green PC, INMARSAT, International Dedicated Line, Global Pass, Internet Office, Co-Location, Server Hosting, Internet Computing Service (ICS), Smart SMS, Bizmeka Video Conference, Bizmeka Web Hosting, Bizmeka Cross Shot, Bizmeka Social Insurance EDI, Bizmeka Hair/Beauty, Bizmeka Call Center, Bizmeka Call Manager, Bizmeka Video IVR, Bizmeka Health Insurance EDI, Medi-Frame, I-Frame, Residence Media Service, Bus Shelter Advertising, Smart Energy, Olleh Home Study, (Ucloud Biz)Server, (Ucloud Biz)Server+, (Ucloud Biz)VPC, (Ucloud Biz)CDN, (Ucloud Biz)DB, (Ucloud Biz)VDI, (Ucloud Biz)Storage, (Ucloud Biz)Backup
LG U+ (n=65)	U+ Dedicated Line (Basic), U+ Dedicated Line (Ethernet), U+ Dedicated Line (CCTV), U+ International Dedicated Line, U+ Managed, U+ Video Conference, U+ Biznet, U+ Biznet IX, U+ Biznet University Internet, U+ Edu Net (Elementary/Middle/High School), U+ Office Net, U+ PC Café, U+ VPN (MVP), CADNET, U+ VPN (MVP Lite), U+ Security, U+ Biz 070, U+Smart Centrix, U+ Unified Phone Number, (U+ Call Center) Smart Contact, (U+ Call Center) Cloud Call Center, (U+ Call Center) Recording Pro, (U+ Call Center) Smart Contact ASP, U+ 080, U+ 0505, U+ 0505 Fax, U+ 1636, U+ Local Call, IT Facility Service, Internet Access Service, Security Control, Secured Network, MS-ASP, Linux-ASP, Web Server Authorization Service, Server Hosting, Server Rental, Server Parking, Server Operation & Management, Data Transfer, HA Hosting, Basic Hosting, Switch Hosting, Storage Hosting, Virtualization Hosting, CDN Service, FLV Streaming Service, Cloud N, U+ Groupware, U+ Hosting (Web Hosting), U+ Hosting (Server+Application Hosting), U+ Hosting (Mail Hosting), U+ Web Fax, U+ m-Guard, U+ e-Tax, e-Contract, U+ Remote Support, U+ SMS, U+ MMS, U+ Smart Messaging, U+ Lang, U+ Smart FMS, U+ Mobile Remote Control, Wi-Fi AD, U+ iLS

4.4.3. Multimedia broadcast solutions (n=11)

This service group strongly focuses on ‘real-time broadcasting’ characteristics. It provides a dedicated broadcast line from one point to another, which is available 24 hours a day for use by a designated user. Transmitting television programs between the main broadcasting station and local branches of terrestrial broadcasters is one example of multimedia broadcast solutions. Overseas entertainment shows and sports events can be also broadcast live and watched worldwide via satellite.

In addition to delivering television services through traditional terrestrial and satellite signal, the service group provides multimedia contents over an IP-based network, known as IPTV. For example, a large institutional user can utilize IPTV for the purpose of the live broadcasting of short-term events such as conferences, seminars and promotions. In addition, an institutional user can develop its own media contents and broadcast a customized channel in real time for the purpose of delivering internal information, training employees or market its product to customers.

Like this, multimedia broadcast solution services offer the business opportunity of a highly customized and interactive service by creating the new communication, advertising or education channels for enterprises or educational institutions.

The examples of each mobile carrier’s service products are illustrated below in Table 4-12.

Table 4-12. Service products that belong to ‘multimedia broadcast solutions’ group

Mobile carriers	Examples of service brand names
SK Telecom (n=2)	IPTV CUG, Biz IPTV
KT (n=4)	Broadcasting Dedicated Line, Mugunghwa Satellite, International Broadcasting Dedicated Line, AED-Signage
LG U+ (n=5)	U+ Broadcasting, WMV Streaming, Live Broadcasting Service, U+ Edu TV, U+Media Board

4.4.4. Business analytical solutions (n=31)

This service group shows strong ‘general office work supportive’ characteristic. It resembles ‘mobile office’ solutions but processes some business tasks in more informative and analytical manners. It offers exclusive applications for institutional users by combining a business-critical database and systematic analysis tools. These database-based analytical

services not only provide web-based business information such as market data, sales, finance, stocks and cash flow, but also analyze the collected information and manage a large volume of data.

For example, retailers can analyze customer purchasing behaviors based on the sales data and establish a marketing plan. In addition to a sales-related analysis, manufacturers can computerize previous paper-based task work, and thereby develop a new production management system. Manufacturers can promptly and accurately forecast market demand and manage inventory through various analytical tools such as statistical techniques and graphic drawing skills. The analysis results can be shared on the web portal between distributors and manufacturers.

Such solutions are sometimes designed for a medical service, too. Patients can check their blood pressure or blood sugar levels by themselves at home and send the data over the phone to the hospital's medical information system. Then, the health data are automatically managed in the web, so the hospital can effectively take care of the patients with chronic diseases. The health records are viewed on the web or received via SMS on a mobile phone.

On the other hand, hospitals can be further transformed to digital hospital through the electronic consent process. It requires patients to sign the electronic consent form, for example, that gives permission for sharing their personal information with a third- party. The digital signatures may be collected electronically and this makes hospitals' administrative tasks more efficient, cost-effective and simplified.

The examples of each mobile carrier's service product are given below in Table 4-13.

Table 4-13. Service products that belong to 'business analytical solutions' group

Mobile carriers	Examples of service brand names
SK Telecom (n=13)	Biz SMS/MMS, Biz API, Business CRM, Smart Lo, OKnet, Landmap, Bus Information System, Market Analysis, Smart Sales, Cloud BEMS, Forest Fire Management, e-Consent Form, Smart Insight
KT (n=11)	Digital Operation Record Management, Bizmeka Smartbiz, Bizmeka Groupware, Bizmeka Tax Affairs, Bizmeka Human Resource Management, Bizmeka Accounting, Bizmeka POS, Bizmeka Highway, Bizmeka Food, Bizmeka u-Care, Smart Working
LG U+ (n=7)	IT Outsourcing, Web Reporting Service, U+ SCM, U+ CRM, Batch CMS, Real Time CMS, U+ Location-Based Service

4.4.5. Security and safety solutions (n=9)

This service group focuses specially on service characteristic of 'location-based/security/safety'. The main service features are security for equipment such as vehicles and mobile devices, or safety for human beings.

These features are often operated on the location-based platform. For example, a mobile device equipped with GPS sensors is installed in a transportation vehicle in order to track its path. The track record provides the location and condition information and thus theft or loss of a vehicle can be prevented in the logistics and transportation sector. In an emergency situation, a driver can simply push a button that is connected to the monitoring device, which automatically contacts a central center to take prompt action. Then, the central center can detect the location and control the engine of the vehicle.

Such a service feature of emergency rescue can be applied to personal security. For example, a school can build up the safety precautions system for school children by letting them carry a mobile phone. GPS function of the mobile phone can detect the location of children with mobile phones. The location is informed regularly and automatically to the parents or guardians. When the children press a GPS button in the mobile phone, the urgent SMS is delivered to the designated guardian.

The service feature of mobile device security belongs to this service group, too. Through this service, a B2B mobile service user can control over the institutional and employee-owned mobile devices. It can enforce institutional security policy, secure mobile access to institutional resources, and remotely lock and wipe managed devices in case of theft or loss.

The examples of each mobile carrier's service products are illustrated below in Table 4-14.

Table 4-14. Service products that belong to 'security and safety solutions' group

Mobile carriers	Examples of service brand names
SK Telecom (n=6)	NOL™, Searchon, Smart Safety, Ubi-Khan Telematics, Children Safety Plus, Smart Security
KT (n=2)	Mobile Device Management (MDM) Solution, Management Service Provider (MSP) Service
LG U+ (n=1)	U+ Media Life

4.4.6. Payment processing solutions (n=11)

This service group shows a strong characteristic of ‘transaction information delivery’ and somehow has the characteristic of ‘seamless working condition’. The services are classified into two main groups.

First of all, with a wireless terminal, institutional users can securely process credit card payments. It provides mobility to make payment at the counter, on the move or on delivery. When an institutional user enables employees to adopt the use of this specialized mobile device, they don’t have to carry an additional wireless payment terminal. In addition, payment approval can be printed by connection with receipt terminal using wireless network, or the results of those can be sent as SMS. This can make the credit card payment more convenient and efficient. Such solutions can be beneficial for retail, catering, transportation and delivery services, but they are sometimes customized for a specific industry. For example, large-sized hospitals can simplify the discharge process, and thus improve the service quality.

The other type of payment processing solution is e-payment service. When mobile applications or mobile contents such as games, musics and videos are purchased on the website, the service allows making a payment with e-money or lets a monthly phone bill include the purchasing price after SMS-based mobile authentication via mobile phone.

The examples of each mobile carrier’s service products are given below in Table 4-15.

Table 4-15. Service products that belong to ‘payment processing solutions’ group

Mobile carriers	Examples of service brand names
SK Telecom (n=3)	Desktop Wireless Billing Device, Handy Wireless Billing Device, Hospital Payment Solution
KT (n=5)	Brand Taxi, Mobile Pay-on, Wireless Payment Device, Bizmeka m-Payment, Bizmeka Cash Receipt
LG U+ (n=3)	U+ 060, U+ e-Payment, U+ Wireless Payment

4.4.7. M2M solutions for facility management (n=10)

This service group deals with ‘facility management’. The services are specifically designed for facility security and management functions. Those services focus on remote control and automatic monitoring of facilities and buildings, which do not necessarily involve direct human interaction but establish communication between devices and servers,

and thus they are called M2M solutions. Such M2M solutions offer a wide range of facility management services such as Radio Frequency Identification (RFID) entrance security, Closed Circuit Television (CCTV) and smart infrastructure services.

First of all, institutional users can check in and out of the entrance, to both track visitors entering their buildings and prevent unauthorized entrance. This would secure admission to the building of authorized people at selected times.

Secondly, institutional users can also secure their shops or counters of a remote place by using CCTV. Such a service can be useful for retails stores, shopping malls, banks, hotels, museum and public transportation.

Thirdly, the facility management services can be provided from the systematic perspective not by installing control devices but by building up a smart infrastructure. Therefore, facilities, factories and other equipments inside them are monitored and remotely controlled by an integrated operational control center through the fixed or mobile network. Such services can be applied to design Smart City, too.

The examples of each mobile carrier's service products are illustrated below in Table 4-16.

Table 4-16. Service products that belong to 'M2M solutions for facility management' group

Mobile carriers	Examples of service brand names
SK Telecom (n=3)	Entrance Control Service, Point Cam, Smart City,
KT (n=4)	Free Zone, Security Management Service, i-Cam, MOS
LG U+ (n=3)	U+ Smart CCTV, Cloud-Based IP CCTV, U+ In-House Call

4.5. B2B Mobile Service Users by Service Types

This section analyzes who use or benefit from the B2B mobile carrier services.

The mobile carriers do not announce the exact number of their B2B customers. But SK Telecom introduced a successful implementation of the B2B mobile solutions on its website (http://www.biztworld.co.kr/) and disclosed some of the users that adopted a specific service. KT and LG U+ offer the web pages (http://biz.olleh.com/ and http://biz.uplus.co.kr/), describing the features of each product, and suggest the best conditions of institutional customers to benefit from their service products in terms of the size of an institution and the industry that a B2B customer's business belongs to. Therefore,

the user characteristics of the seven service groups could be summarized by collecting and compiling the relevant information on B2B customers.

First of all, the user-related characteristics were identified according to the types of B2B mobile services. For the analysis of B2B mobile service users, this section detected keywords that describe the characteristics of the B2B mobile service users, for instance size-related words (e.g. large, small and medium-sized) and industry-related words (e.g. manufacturing, transportation, finance, healthcare and social services).

In case that a specific name of a customer is disclosed (i.e. SK Telecom's B2B customers), it is utilized as an information source. Each of the institutional customers was investigated by collecting information on its size and industrial classification.

The B2B mobile service users are described below.

4.5.1. Mobile office/education solutions

The B2B mobile service users who benefit from mobile office/education solutions are engaged in a broad range of industries including both manufacturing and service sectors. Many institutional users using mobile office solutions were proved to rely heavily on a sales-oriented business such as the sales of financial products, wholesale/retail trades and door-to-door sales. Their businesses are supported by mobile groupware, m-SFA (Sales Force Automation), m-CRM (Customer Relationship Management) and m-ERP (Enterprise Resource Planning) via smartphone or tablet PC.

Mobile carriers can offer various types of mobile office solutions by customizing the solutions according to the business requirements of different sized institutions. The mobile office solutions are provided to large institutional users with an advanced IT working environment while providing an easy, convenient mobile groupware. On the other hand, mobile education solutions are served to educational institutions or any institutional customer that requires an employee training program.

Table 4-17 shows the user information that the three mobile carriers disclosed on their website.

Table 4-17. The B2B service users of mobile office/education solutions

Mobile carrier	Examples of users and their information
SK Telecom	Amorepacific Co. (large-sized, cosmetics manufacturing and sales) KT&G (large-sized, tobacco manufacturing) Korea Exchange Bank (large-sized, financial service) Dresser Korea, Inc. (small-sized, industrial equipment manufacturing) SK Broadband, Inc.(large-sized, telecommunications) Medical and dental centers Municipal governments, for the purpose of controlling illegal parking
KT	Hospitals / Financial institutions / Educational institutions News media firms / Construction companies / Logistics firms Large institutions or small and medium-sized enterprises (SMEs) of less than 50 employees
LG U+	Manufacturers / Educational institutions / Financial institutions Delivery service providers / Communications service providers Construction companies, etc.

4.5.2. Network solutions

Network solutions are provided to B2B mobile service users that work for all kinds of industries, as shown in Table 4-18. Any B2B customer who needs a nation-wide communication network can benefit from this solution. For instance, government departments, educational institutions and media firms can be potential users of the solution because they require a large data transmission and a fast network access. A content provider is also a heavy user of this solution.

In terms of size, large institutional users usually benefit from the network solutions because they deal with a large volume of institutional data. In addition to enterprises, large hospitals adopt this solution in order to save medical image files of Magnetic Resonance Imaging (MRI) for consecutive five-year or ten-year period.

On the other hand, Small and Medium-Sized Enterprises (SMEs) also benefit by adopting this solution. Mobile carriers rent an IT system to small-sized institutional users and manage it for them. Hence, the small-sized B2B customers use a cloud server at a low price and save the IT investment cost.

Table 4-18. The B2B service users of network solutions

Mobile carrier	Examples of users and their information
SK Telecom	Large institutions / SMEs / Educational institutions / Advertising companies Municipal governments (e.g. transportation/road construction/waste administration/park greenery/disaster control/green environment divisions) The National Police Agency / The Ministry of Environment / National Land Management Government / Korea Expressway Corporation / Korea Meteorological Administration / The provincial government in South Jeolla Province Large financial institutions (e.g. Woori Investment & Securities Co., NH Investment & Securities Co., ETRADE Financial Co., Hyundai Securities Inc., Samsung Fire & Marine Insurance Co.) Travel agencies / Internet cafes / The office buildings of SK Telecom Online retailers (e.g. 11 street, CJ O Shopping, Hyundai Home Shopping)
KT	Large institutions / Small institutions of less than 20 employees Any institution that operates a call center / Any institution that manage a large volume of customer-related data (e.g. travel agency, educational institutions, sports centers) Manufacturers / Financial institutions / Educational institutions / Content providers Big restaurants / Large or medium-sized hospitals / Hotels / Taxi companies Governments and public institutions / Internet cafes / Media companies
LG U+	Financial institutions / Public institutions / Manufacturing firms SMEs whose ordinary tasks are based on cooperation with co-workers Online educational institutions / Consulting firms / Research institutions / Medical centers / Construction firms

4.5.3. Multimedia broadcast solutions

Multimedia broadcast solutions are mainly provided to the national or the regional broadcasting stations. However, any B2B customer can benefit from the solution when a dedicated network is offered for the purpose of having a live video conference or making a customized broadcasting channel.

Table 4-19 shows the users who adopt the multimedia broadcast solutions of the three mobile carriers. One distinct feature is that SK Telecom seems to have a relatively small customer base in terms of the multimedia broadcast solution. SK Telecom has shown its strength in providing overall mobile solutions to many enterprises and public institutions. However, in case of providing the multimedia broadcast solution, KT and LG U+ show a tendency of maintaining more customers that are specialized in broadcasting or educational services than SK Telecom.

Table 4-19. The B2B service users of multimedia broadcast solutions

Mobile carrier	Examples of users and their information
SK Telecom	Any institution that needs the customized broadcasting
KT	Land-based television broadcasters (e.g. KBS, MBC, SBS, EBS) Local broadcasting stations / Cable TV program providers Financial institutions / Government institutions Large institutional users
LG U+	Broadcasting stations / Educational institutions Any institution that requires a live video conference or a live seminar Apartments and various communal areas

4.5.4. Business analytical solutions

Table 4-20 shows that various types of B2B customers benefit from the database-based analytical services of this solution. For instance, an institutional user that distributes food products can adjust the stock and manage the sales so that it can maintain the freshness of the products. Healthcare service providers can analyze patients' medical data efficiently when they adopt this solution. In addition, institutional users deal with a complex market data through the business analytical solutions.

Table 4-20. The B2B service users of business analytical solutions

Mobile carrier	Examples of users and their information
SK Telecom	Public institutions / Logistics firms / Financial institutions Transportation companies / Wholesale and retail firms / Real estate agents
KT	Transportation companies / Vehicle maintenance service providers Distributors of food products / Healthcare service providers
LG U+	Large and small institutions Manufacturers / Distributors Delivery service providers / Public transportation service providers

4.5.5. Security and safety solutions

The B2B customers who use the security and safety solutions benefit from receiving location-based information. Hence, many B2B mobile service users that operate logistics-related business or possess transportation vehicles can adopt this solution. Also, an institutional user utilizes the solution to secure its IT asset, and an apartment management company can use this location based solution to provide medical information in an emergency situation.

Table 4-21 shows the B2B service users of the security and safety solutions.

Table 4-21. The B2B service users of security and safety solutions

Mobile carrier	Examples of users and their information
SK Telecom	Any large firm or any public institution Any institution that possesses transportation vehicles SK Energy (large-sized, chemical, petroleum and energy business) Social service providers / Transportation companies / Logistics firms SK Telecom (large-sized, telecommunications)
KT	Any institution that wants to secure internal IT equipment
LG U+	Apartment management companies

4.5.6. Payment processing solutions

The payment processing solutions can be provided to any franchise whose sales are large and whose store is larger than 100 square meters. In addition, hospitals and delivery service providers benefit from processing a credit card payment.

Table 4-22 summarizes the B2B service users of payment processing solutions.

Table 4-22. The B2B service users of payment processing solutions

Mobile carrier	Examples of users and their information
SK Telecom	Restaurants / Hospitals Franchise stores that provide a food delivery service (e.g. pizza, fried chicken franchises, milk delivery)
KT	Taxi / Small-sized delivery service providers (e.g. franchise laundry shops) Driver-for-hire service providers / Large department stores
LG U+	Online service providers / Medical service providers

4.5.7. M2M solutions for facility management

Table 4-23 shows the potential customers of M2M solutions for facility management.

Many off-line stores and shops can benefit from a CCTV that is one of the basic M2M solutions. In addition to securing off-line shops, the solution is provided to an institutional user that is operating its own server room or an institutional user that want to secure a building’s entrance or large facilities.

Table 4-23. The B2B service users of M2M solutions for facility management

Mobile carrier	Examples of users and their information
SK Telecom	Any institution that requires the security for a building's entrance Local governments / Amusement park Amkor Technology Korea, Inc. (large-sized, semiconductor manufacturers)
KT	Any off-line stores that requires a CCTV service (e.g. convenience stores, jewelry shops, food courts, restaurants, cosmetic shops, bookstores, supermarkets, coffee shops, beauty salons) Medical centers / Pharmacies Institutional users that operate their own server rooms
LG U+	Any institution that requires security for a building's entrance or large facilities

4.6. Summary

As a first step, the data of 242 service products was collected from the web pages of SK Telecom, KT and LG U+. The notion of 'service characteristic' was clarified by identifying the principle service characteristics. Subsequently, factor analysis was conducted to reduce the 18 service characteristics into a smaller number of factors. The characteristics of B2B mobile services were categorized as seven service characteristics: 'general office work supportive', 'facility management', 'location-based/security/safety', 'IT Infra management', 'seamless working condition', 'real-time broadcasting' and 'transaction information delivery'. In the next step, hierarchical cluster analysis was performed on the factor scores derived from the sub-characteristics to classify the 242 service products into proper categories. Through several cluster analyses, B2B mobile services were classified into seven groups that have different service characteristics. For accurate analysis, one-way ANOVA post-hoc test was conducted to determine which groups are significantly different from each other.

After investigating which service characteristics are strong in each group, the service groups were characterized as seven service groups having different characteristics: (1) Mobile office/education solutions, (2) Network solutions, (3) Multimedia broadcast solutions, (4) Business analytical solutions, (5) Security and safety solutions, (6) Payment processing solutions and (7) M2M solutions for facility management.

In summary, mobile office/educations enable B2B mobile service users to seamlessly operate an institutional system at any time and in any place. Network solutions ensure fast and stable voice and data transmission. Multimedia broadcast solutions simultaneously transmit broadcast contents. Business analytical solutions provide database-based

analytical services to manage a large volume of data. By using location-based information, security and safety solutions protect an institutional user's equipment in case of theft or loss. Payment processing solutions deliver transaction information and help B2B customer's operations to be efficient by making payment on the move or on delivery. M2M solutions for facility management secure a building's entrance or large facilities.

In addition to the classification of B2B mobile services, this chapter examined B2B mobile service users. Many enterprises and institutions benefit from B2B mobile solutions. Mobile office/education solutions and network solutions can be provided to all kinds of B2B mobile service users. Any B2B customer of any size can benefit from the two solutions. Business analytical solutions are also offered to B2B customers in a broad range of industries, in particular finance, logistics and healthcare. Multimedia broadcast solutions are provided mainly to local and national broadcasters, but educational and financial institutions can benefit from them. On the other hand, the institutional users that operate logistics-related business or possess transportation vehicles often use security and safety solutions. Payment processing solutions are offered to B2B mobile service users in many service industries, for instances hospitals and delivery service providers. M2M solutions for facility management can be used in any sized institution that requires the security for facilities. These results insist that large and small institutions in many industries are benefiting from one or more of the above B2B mobile solutions.

This chapter showed that the current B2B mobile carrier service consists of various service characteristics, which are provided to B2B mobile service users as a variety of forms of mobile solutions. The next chapter will discuss key drivers of innovation in B2B mobile carrier services by examining the impact of environmental factors on the paradigm shift during 2009-2010.

CHAPTER 5. DRIVERS OF INNOVATION IN THE KOREAN B2B MOBILE SERVICES

5.1. Introduction

This chapter conducts an analysis of the Korean mobile telecommunications industry that has experienced the paradigm change from B2C to B2B in the mobile sector by addressing the research questions: *(1) How have the different dynamics of innovation evolved over time? And what factors have influenced it?* (see Section 3.7, p. 65).

The main purpose of this chapter is to give an idea of distinguishing two kinds of service characteristics which are new or substantially improved. This criterion provides a conceptual framework of proposing three models of technological innovations in Figure 3-3 (p.71). In order to carefully examine the innovations that occur in mobile services, this chapter examines the industry paradigm shift that led to a variety of radical or incrementally new B2B service products.

Around the mid-2000s, the Korean mobile telecommunications industry experienced a significant change in the market, technology and regulation aspects. Those changes provided a basis for the transition of market focus from B2C-oriented to B2B-oriented market with a focus on the convergence with different technologies and industry applications. In this regard, ICT industry data and information are collected from various sources such as mobile carrier's annual reports, news articles and industry reports provided by government and private/public telecom policy institutions.

This chapter is divided into five sections. Section 5.2 looks at the technology aspect which contains a rapid spread of advanced hardware and software technologies related to an acceleration of B2B mobile solutions in mobile telecommunications service industry. Section 5.3 investigates the government's telecom policy that affected the industry paradigm shift. Section 5.4 compares the strategies of mobile carriers towards individual mobile service users (B2C) and institutional users (B2B), and scrutinizes the factors that affect user's decision behavior of adopting a new mobile service. Lastly, a summary is presented in Section 5.5.

5.2. Emerging Trends in ICT Development

ICT convergence enables mobile carriers to create services that deliver a new service value by bringing connectivity to more industries. Hence, this section investigates the trends related to the development of mobile service-related technologies.

5.2.1. Technology structure of ICT related to mobile service

The mobile industry encompasses all products and infrastructures that users require to access desired information and services on mobile devices such as mobile phones, smartphones and tablets. The mobile industry includes wireless network systems, mobile devices, mobile software, a variety of mobile services, and more. Therefore, mobile technologies include not only mobile network infrastructure but also contents and various application technologies.

Although the thesis focuses on a study of Korea, the Korean mobile telecommunication industry can be affected by overseas smartphone manufacturers or other foreign technologies. Within this background, data and information used in this section are collected from various sources in order to scrutinize the accurate technological trend that may influence the research scope (i.e. B2B mobile service). The core technology fields were examined from international and regional organizations/committees, technology standardization policies of Korea and other countries, and the list of promising technologies presented in news media. The main data sources are summarized as follows.

- International organizations/committees: International Telecommunication Union (ITU), Joint Technical Committee 1 of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) which is known as ISO/IEC JTC 1, Asia-Pacific Telecommunity Standardization Program (ASTAP), European Telecommunications Standards Institute (ETSI), The European Committee for Standardization (CEN), European Committee for Electrotechnical Standardization (CENELEC), Association of Radio Industries and Businesses (ARIB, Japan)
- Domestic organizations: Telecommunications Technology Association (TTA, Korea), Telecommunication Technology Committee (TTC, Korea), Electronics and Telecommunications Research Institute (ETRI, Korea)

- News media: The Electronic Times Internet (www.etnews.com), Digital Times (http://www.dt.co.kr/)

As a result, seven major areas of technology are formed. Those areas include wired/wireless infrastructure but also ICT convergence, information security technologies, digital broadcasting technologies, intelligent service software, smart contents and smart devices. In addition to data collection from the above sources, the thesis refers to the Fransman (2010)'s Layer Model in order not to omit any details of relevant technologies. His model provides visual description regarding the evolving structure of ICT industry. Fransman (2002) proposed a layer model of 'Infocommunications Industry' which is contrasted with the simplified features of the 'Old Telecoms Industry' in the 1980s (i.e. three-layer model: (1) equipment layer, (2) network layer and (3) service layer).

The rapidly growing adoption of Internet in the mid-1995 fundamentally changed the telecommunications industry. As a result, Fransman (2002) proposed more segmented layer model, comprising six layers: (1) equipment and software layer, (2) network layer (3) connectivity layer (4) navigation & middleware layer (5) applications layer and (6) customers/consuming. Since there appears to be a strong tendency towards both vertical and horizontal integration in the recent ICT industry, Fransman (2010) conceptualizes the new ICT industry in a newly revised layer model. The new model consists of four layers: (1) networked elements, (2) network operating, (3) content, applications, services, innovation platforms, search, navigation and middleware, and (4) final consumption.

The aggregation to get the Four-Layer Model from the Six-Layer Model involves two separate aggregations. The first is the aggregation of Layers II (network operation) and III (connectivity) in the Six-Layer model in order to get Layer II in the Four-Layer model. The second is the aggregation of Layers IV (navigation and middleware) and V (contents, applications and services) in the Six-Layer model in order to get Layer III in the Four-Layer model.

The reason for the first aggregation is that connectivity has been vertically-integrated by most telecoms operator incumbents (Fransman, 2011). This phenomenon also appears common in Korea. The reason for the second aggregation is that, as we will see later in this thesis, the activities of navigation (as typified by Google's offerings) – which were in Layer IV of the Six-Layer model – are intimately connected with the provision of contents, applications and services. Furthermore, middleware products are increasingly also being

provided by firms involved in navigation, contents, applications and services. It therefore makes sense to include them in one layer.

Table 5-1 shows that the above seven areas belong to every layer of Fransman (2010)'s model, implying that the technology overview of this chapter covers the actual mobile telecommunications environment in Korea.

Table 5-1. Description of the ICT industry by selected functional layers

Fransman (2010)'s Four-Layer Model		In this thesis
Layer	Functionality	Selected functional layers in B2B
Layer IV	Final consumption	(Consumption)
Layer III	Contents, applications, services (navigation, middleware)	Multimedia contents, information delivery service, various mobile applications, etc.
Layer II	Network operation	Wired/wireless infrastructure
Layer I	Networked elements (telecoms equipment, computer hardware and software, and consumer electronics)	Smart mobile devices, smartphone operating system, networking equipment, etc.

Hence, the technical trends of layer I, II and III will be presented below in terms of seven technology fields. 'Consumption' in the layer IV will be described in Section 5.4 by looking at the user's choice behavior of mobile services.

5.2.2. Technological features before 2009-2010

5.2.2.1. Technology trend in Layer I (before 2009-2010)

From the 2G-based internet phone to the 3G multimedia phone, the mobile phone has changed considerably in form and performance, enabling new services.

Figure 5-1 summarizes the evolution of mobile handsets. The mobile phone has shrunk in size, from a brick-like device to a stylish, pocket-sized device. Moreover, in the mid-2000s, it has become multi-functional, absorbing some of the capabilities of other products including cameras, video, music recorder and player, game console, and even TV.

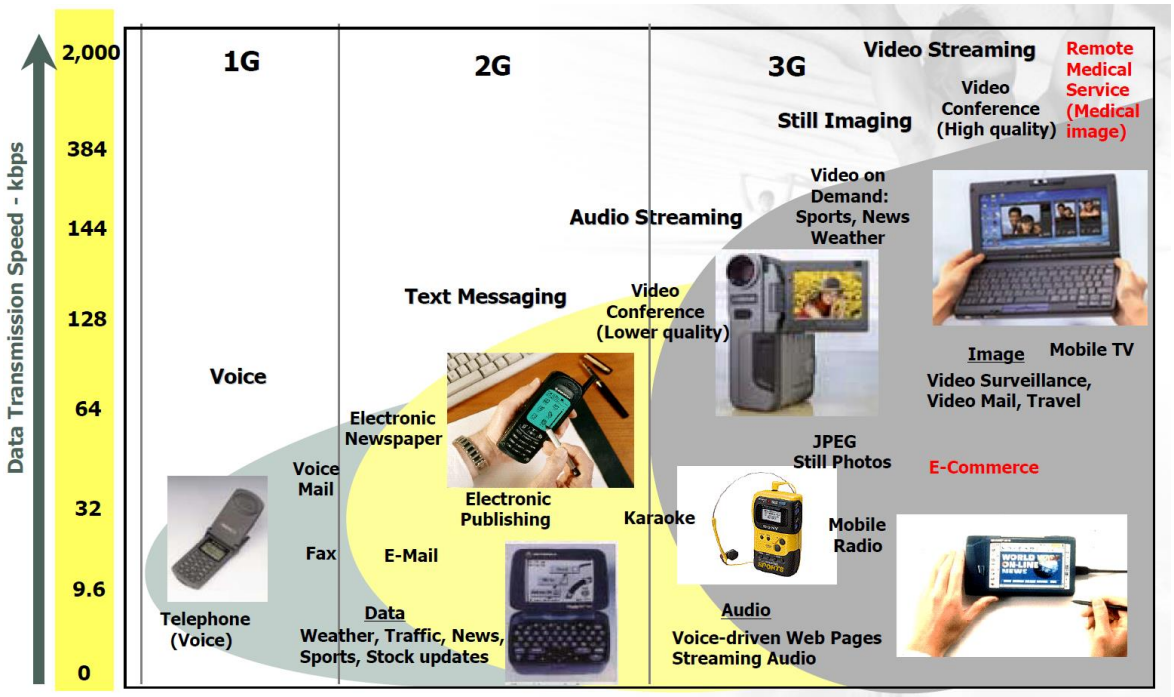

Figure 5-1. Evolution of mobile phones before 2009-2010

(Source: SK Telecom (2004), from http://www.itu.int/osg/spu/ni/futuremobile/presentations/sktele-compresentation.pdf.)

5.2.2.2. Technology trend in Layer II (before 2009-2010)

1G including Advanced Mobile Phone Services (AMPS) utilized analog signals for the air interface. Qualcomm's Channel Division Multiple Access (CDMA) and European GSM (Global Systems for Mobile communications) emerged as two standards for 2G. Since 2000, the bandwidths of wired services have increased dramatically with Asymmetric Digital Subscriber Line (ADSL) and cable services with 1–8 megabits per second (Mbps). At the same time, 2G mobile data services offered limited bandwidth and service through asynchronous Short Messaging Services (SMS) or wireless internet services (e.g. nTop, n016, ezWeb), similar to Japanese i-mode service. The increasing demand of these services urged mobile carriers to provide faster wireless connections to process multimedia data.

2.5G technologies emerged in the late 1990s offering higher data speeds while using existing 2G spectra and associated infrastructures. Within CDMA, the CDMA2000 1x standard was developed reaching transmission speed of 144 kilobits per second (Kbps). Within the GSM standard, a new service called General Packet Radio Service (GPRS) with 170 Kbps was developed. This was later augmented with Enhanced Data rates for Global Evolution (EDGE) air interface capability that offers 384 Kbps theoretical speeds.

The International Telecommunication Union (ITU) defined two global standards for 3G, which are WCDMA (Wideband-CDMA) and CDMA2000. Compared to other countries, Korea shows a unique development path in the evolution of mobile technologies (Lee et al., 2009). Firstly, the Korean mobile market switched directly to 3.5G (e.g. High-Speed Downlink Packet Access (HSDPA), Wireless Broadband (WiBro)) without making any serious investment in 3G. Based on the 802.16e standard, WiBro was exclusively developed by Korea, which is an alternative technology to 3.5G.

Figure 5-2 summarizes the evolution of mobile network technology in Korea.

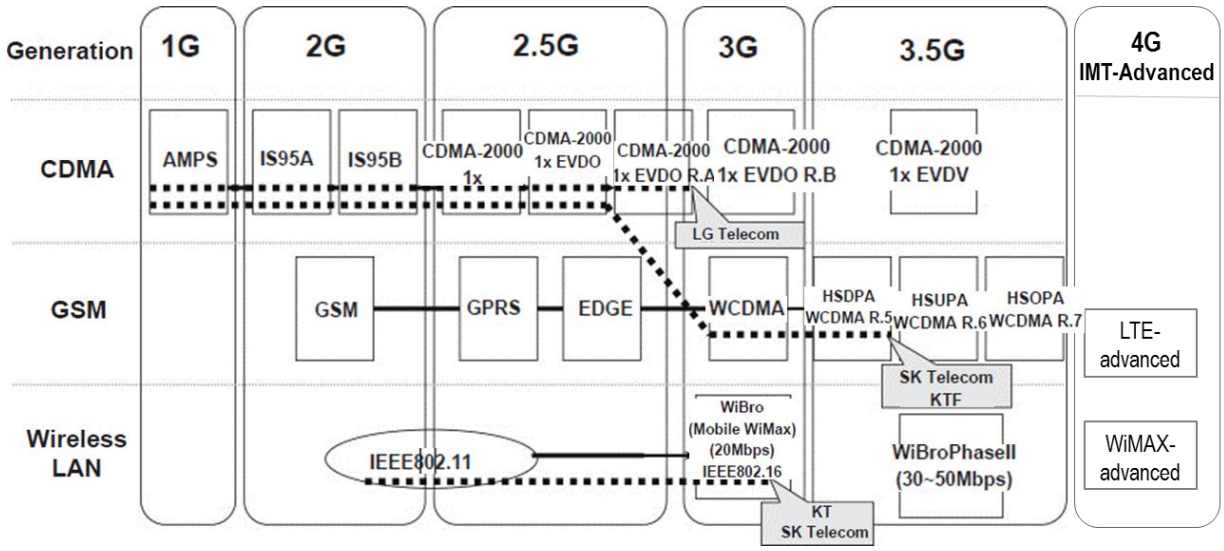

Figure 5-2. Evolution of mobile network technology

(Based on the technology evolution structure of Lee et al. (2009) and updated it.)

5.2.2.3. Technology trend in Layer III (before 2009-2010)

With the development of wireless networks with advanced mobile devices, a number of mobile network-based ubiquitous[50] applications began to emerge in the mid-2000s.

Ubiquitous Health (u-Health) was an outstanding example. There were 54 projects related to u-health in Korea between 1998 and 2007 (Ministry for Health, Welfare and Family Affairs, 2007). One of the selected subjects of the u-health pilot projects in Korea includes a mobile diabetes monitoring service. This mobile application let patients measure

[50] 'Ubiquitous' is defined as "interfaces, environments and technologies that allow users to be unaware of what it is they are using (invisible), and furthermore, to allow interactions anytime, anywhere, and by anyone" (Murata, 2009).

their blood glucose level by using a glucometer-equipped mobile phone (diabetes phone) and send it to physicians. The medical record was transmitted to a central server though CDMA communication. Using this application, the physician evaluated the change in patients' glucose level and the results of evaluation were fed back to the patient.

In 2004, the Digital Multimedia Broadcasting (DMB) satellite was launched. With the development of DMB, nationwide satellite DMB was commercialized by TU Media in 2005. DMB is a mobile television service with additional audio and data services that can be viewed on DMB cell phones, portable DMB receivers, or vehicle DMB (Shin, 2008). Consequently, availability of various digital contents became a key success factor. It includes creation or modification of any content such as audio, graphics, images and video. It is created using dedicated software and includes a variety of software designed for many mobile solutions.

In addition to those services, various multimedia and data services were developed, for instance in entertainment, business and finance applications attached to a mobile phone.

5.2.3. Technological features after 2009-2010

5.2.3.1. Technology trend in Layer I (after 2009-2010)

The most radical change in the mobile sector in Korea occurred at the end of 2009 by adopting iPhone[51]. In this section, the technology aspect of smartphone is examined by mainly focusing on two dominant smartphone brands in Korea: Apple's iPhone and Samsung's Galaxy S.

The technology features of iPhone are composed of the elements shown in Table 5-2. The hardware technologies of iPhone feature a touchscreen responding to sensors, built-in Bluetooth, internal rechargeable battery, storage, and a camera function. It also has a unique feature of software called iOS. It is the operating system that runs on iPhone and other Apple's products such as iPod and iPad. iOS acts as an intermediary between the

[51] Now SK Telecom has diverse smartphone line-up, including Galaxy S2 (Samsung), Galaxy Tab (Samsung), SU950 (LG), Droid (Motorola), Xperia X10 (Sony Ericson), BlackBerry Bold 9900 (RIM), and Desire (HTC). In addition, SK Telecom launched Apple's iPhone 4 on March 2011 and became the second iPhone carrier in Korea. After introducing iPhone to the Korean market, KT further launched diverse smartphone terminals in 2010 such as iPhone 4 (Apple), Nexus-One (HTC), Optimus-One (LGE), Desire HD (HTC) and Streak (DELL). LG U+ has diverse smartphone line-up including the Optimus Q (LG), Optimus one (LG), Optimus Mach (LG), Galaxy U (Samsung), and Mirach (Pantech), as well as the tablet PC Galaxy Tab (Samsung).

underlying hardware and the applications. It manages the device hardware and provides the technologies required to implement various applications such as phone, mail, internet, and value-added mobile services[52]. The implementation of iOS technologies can be viewed as a set of four layers. The technologies in the lower layers (Core OS and Core Services) provide low-level building blocks for applications or handle a variety of hardware-specific and system-specific tasks. The technologies of higher-level layers (Media and Cocoa Touch) are more sophisticated technologies that handle the presentation of visual and audible content or provide the high-level application behaviors.

Table 5-2. Technology features of iPhone 3GS

Hardware		Software (operating system)	
Categories	Sub-categories	Categories	Sub-categories
Display	Touch screen	Cocoa Touch layer	Apple Push Notification Service; Address Book UI Framework; In App Email; Map Kit Framework; Peer to Peer Support; UIKit Framework
Sensors and input	Proximity sensor; Ambient light sensor; Three-axis accelerometer; Physical switches on the sides		
Audio and output	Headsets with volume controls; Built-in Bluetooth 2.x+EDR; Composite or component video; Stereo audio	Media layer	Graphics Tech (Quartz, Core Animation, OpenGL ES) ; Audio Tech (AV Foundation, Core Audio, Open Audio Library); Video Tech
Battery	Internal rechargeable battery; Battery accessories	Core Services layer	Address Book; Core Data; Core Foundation; Core Location; Foundation Framework; In App Purchase; SQLite; XML Support
Camera	3.2 megapixel camera	Core OS layer	CFNetwork; Accessory Support; Security; System
Storage and SIM	Internal storage; SIM card		

Source: iPhone technology overview (http://www.apple.com/iphone/)

Galaxy S is an Android smartphone that was announced by Samsung in March 2010. The main features of hardware technology include location-based hardware, camera, Wi-Fi, touch screen, and power management. Galaxy S is based on Android, as an operating system, user interface and applications. In terms of software features, Android offers a number of Application Programming Interfaces (APIs) for developing applications for mobile devices.

[52] A value-added mobile service means the service offering beyond standard voice-centric services. This service adds value to the standard service offering (e.g. voice calls), spurring mobile subscribers to use their phone more and allowing mobile carriers to drive up their ARPU. Most data-centric services can be regarded as value-added mobile services.

The Android software environment is built on top of a Linux kernel and it includes C/C++ libraries, the Android runtime environment, an application framework and core applications. Running on top of the kernel, Android includes various C/C++ core libraries such as a media library (e.g. audio and video media), graphics libraries (e.g. 2D and 3D graphics), Secure Sockets Layer (SSL) and WebKit (i.e. integrated web browser and Internet security). The Android runtime is the engine that powers applications and, along with the libraries, forms the basis for the application framework. The application framework provides the classes used to create Android applications. It also provides a generic abstraction for hardware access and manages the user interface and application resources. All applications, of both native and third party, are built on this application layer using the same API libraries. The Android hardware and software features are summarized in Table 5-3.

Table 5-3. Technology features of Galaxy S

Hardware		Software (operating system)	
Categories	Sub-categories	Categories	Sub-categories
Processor	Samsung S5PC110 processor	Application Layer	Native Apps; Third Party Apps; Developer Apps
Display	101.6-millimetre Super AMOLED touch screen, WVGA PenTile display; TV out via headphone jack, mDNIe Via Wi-Fi	Application Framework	Location-Based Services; Content Providers; Window Manager; Activity Manager; Package Manager; Telephony; P2P/IM; Notifications; Views; Resource Manager
Battery	Lithium-ion battery, Li-ion battery	Android RunTime	Core Libraries; Dalvik Virtual Machine
Audio	Wolfson's WM8994 DAC	Libraries	Graphics; Media; SSL & WebKit; libc; SQLite; Surface Manager
Memory	512 MB of LPDDR1 RAM; microSD		
Camera	5 MP with auto focus; 720p HD video; self-, action, panorama, and smile shot; stop motion	Linux Kernel	Hardware Drivers; Power management; Process management; Memory management

Source: Meier (2009), Android technology overview (http://www.android.com/)

These hardware and software features of both iPhone OS and Android encourage mobile service providers to keep creating innovative mobile applications and diverse services for institutional customers as well as individual users. But Android is a more open and flexible platform to convert contents between devices, whereas iPhone OS has relatively high security and low compatibility with other peripheral devices.

As a result, network security became a critical issue after 2009-2010. For example, in the case of u-Health, a huge amount of bio-data is gathered and analyzed in mobile u-Health services. It utilizes a cloud server provided by mobile carriers, which allows the system to effectively store and manage bio-data. Therefore, network security should be enhanced against wireless threats for service user's authentication and data privacy for many data services.

5.2.3.2. Technology trend in Layer II (after 2009-2010)

Around 2009, the Korean mobile carriers began to invest in upgrading existing HSDPA/HSUPA networks and developing network evolution technologies such as LTE. LTE Advanced and WiMAX Advanced became the standards within 4G IMT-Advanced technologies. In 2010, SK Telecom announced 'big bang' strategy for fixed and mobile services with unlimited mobile data plans backed by investment in LTE networks. By accelerating the rollout of LTE service, the three mobile carriers completed building the nation-wide deployment of LTE network service in 2012.

On the other hand, the Korean mobile carriers have invested in building Fixed Mobile Convergence (FMC)[53] network since 2009-2010. The goal of FMC is to have all services seamlessly available from any network and with any device. Following the shift from voice to data in mobile application market, KT and LG U+ merged their fixed and mobile business respectively. In 2009, SK Telecom launched Korea's first cell-network-based Fixed Mobile Substitution (FMS)[54] service that allows mobile service users to pay the VoIP rate of KRW 39 for 3 minutes for mobile-to-fixed calls placed within their discount zone. All calls are handled by the mobile network, allowing seamless call handling as the mobile service users enter and leave their zone. In 2010, SK Telecom completed the first phase of a FMC-based mobile office solution for the Korea Meteorological Administration. This solution was the first service to meet the Korean government's guidelines for VoIP and wireless network security.

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[53] Fixed Mobile Convergence (FMC) is a specific subset of convergence that focuses on fixed and wireless networks becoming one service (OECD, 2012). The adoption of converged devices, such as those capable of seamless handover between Wi-Fi and mobile networks is a key enabler of FMC.

[54] Fixed Mobile Substitution (FMS) means the substitution of mobile services for fixed-line services (Albon, 2006). FMS services allow subscribers to use their mobile phones instead of fixed phone and to make calls at the expense of the fixed-line (Vagliasindi et al., 2006).

5.2.3.3. Technology trend in Layer III (after 2009-2010)

With the wide-spread use of smartphones, development of FMC network and the announcement of new IT technologies attached to a mobile device, there have been many developments regarding ICT convergence, information security, digital broadcasting and smart contents since 2009-2010.

U-Health service and its applications have converged healthcare, broadband and wireless mobile network and IT technologies. In implementing this service, a high-performance mobile phone (e.g. smartphone) plays a key role. Bio-signals and symptom information of a mobile phone user are captured and gathered by mobile bio-sensors and delivered to a remote server for analysis, and the results of the analysis are returned to the user for treatment (Han et al., 2010).

From the technological perspective, Korean DMB is an example of the convergence of telecommunication and broadcasting. Driven by the convergence of advanced technologies, digital TV opened a new era of broadcasting in Korea. In 2009, a trial service plan for digital switchover was established. It incorporated the computer into television viewing, creating an intelligent device that provides not only high-quality broadcast programming, but also a variety of information services much like the current networked-computers.

Since 2009, the Korean mobile carriers have opened their own mobile application stores where mobile service users purchase mobile contents such as games, decorative items, broadcasting and cartoons. This makes Layer III abundant of various industry participants and converged technologies.

5.3. Regulation and Policy Issues

Policy makers' ability to regulate properly and make right policy decisions is one of the most influential factors in the mobile sector.

5.3.1. Regulation and policy before 2009-2010

Korea's regulatory requirements had once discouraged foreign-produced smartphones from entering the domestic market. The Ministry of Information and Communication (MIC) in 2005 made it mandatory for all mobile-phone makers and content providers to use a software standard for Internet access called 'Wireless Internet Platform for Interoperability

(WIPI)'. The original purpose of this regulation was to protect the domestic market by moving away from heavy dependence on foreign technologies. The policy maker expected that the Korean WIPI may be adopted as a global standard (MIC, 2011).

While WIPI restrained overseas mobile phones from entering the domestic market, it began to cause some negative effects on the Korean mobile sector. WIPI was developed for low-function phones. It could not catch up with the development speed of mobile phone technology. It was not a suitable platform for smartphone at all. In addition, each mobile carrier applied a different WIPI standard to its mobile phone, so handset manufacturers became much more heavily dependent on mobile carrier's technological decision.

Subsequently, the price of mobile phones increased as every mobile phone had to be equipped with WIPI. Even those who did not want to use mobile internet service had to pay for the expensive data rate. Thus, mobile users had less freedom to choose service options.

5.3.2. Regulation and policy after 2009-2010

Despite the positive intention of protecting the domestic mobile manufacturers from foreign handset makers, the world's handset market was rapidly changing from a closed platform to an open platform. Since 2009-2010, the Korean government's telecom policy has moved towards 'openness'.

In order to keep pace with the trend, the regulation of mandatory use of WIPI was abolished as of April 2009. Finally, mobile carriers could freely choose a platform according to their preferences. As a result of the policy of openness, iPhone was launched in Korea in November 2009, and Motorola 'Motoroi', the first Android-based phone, was introduced in February 2010. The rapid spread of smart devices accelerated the demand for high speed networks. Subsequently, mobile carriers focused their efforts on offering a high-speed wireless data communication services over LTE network, which enables improved services for video calls, navigation and cloud services.

In March 2009, the Korea Communication Commission (KCC) reinforced a vitalization policy for mobile internet in order to promote fair competition, to improve the environment of contents development and distribution, and to offer a user-friendly service environment.

Such a regulation change influenced the characteristics of mobile services and accelerated the launch of many mobile solution services for institutional users. This led to a variety of radical or incrementally new B2B service products.

5.4. Determinants of Users' Adoption of Service Innovation and their Influence on Mobile Carrier's Strategy

The objective of this section is to identify the factors affecting users' adoption of mobile service innovation that occurred before and after 2009-2010 in Korea and to compare the difference. The result will provide the understanding of what kinds of factors determine the users' behavior of adopting an innovative mobile service and how different factors have influenced mobile service users' selection of a mobile carrier as the Korean mobile sector shift from B2C to B2B perspectives.

For an accurate analysis, mobile service market is first defined in terms of B2C and B2B market segmentations. Then, the factors affecting mobile service users' adoption behavior of service innovation are defined.

5.4.1. Determinants of adoption of service innovation before 2009-2010

5.4.1.1. B2C market segmentation before 2009-2010

Mobile carriers have introduced new market segmentation in the services market to broaden their customer base and increase revenues from the local market. They segmented B2C mobile service market by age, gender and life style and supplied different brands, prices, and service packages for each segment (Whang and Hobday, 2011).

Figure 5-3 summarizes the segmentation strategies that were adopted by all mobile carriers before 2009-2010. More than ten sub-brands were launched since 1999 to attract new customer groups.

For instance, KT ran several different segmentation groups, such as: 'Bigi' for teens with flat-rate pricing and free Short Message Service (SMS); 'Na', aimed at the young generation; 'Drama', tailored to women; and 'Main', aimed at those aged 25–35 with a high disposable income (Park and Kim, 2007).

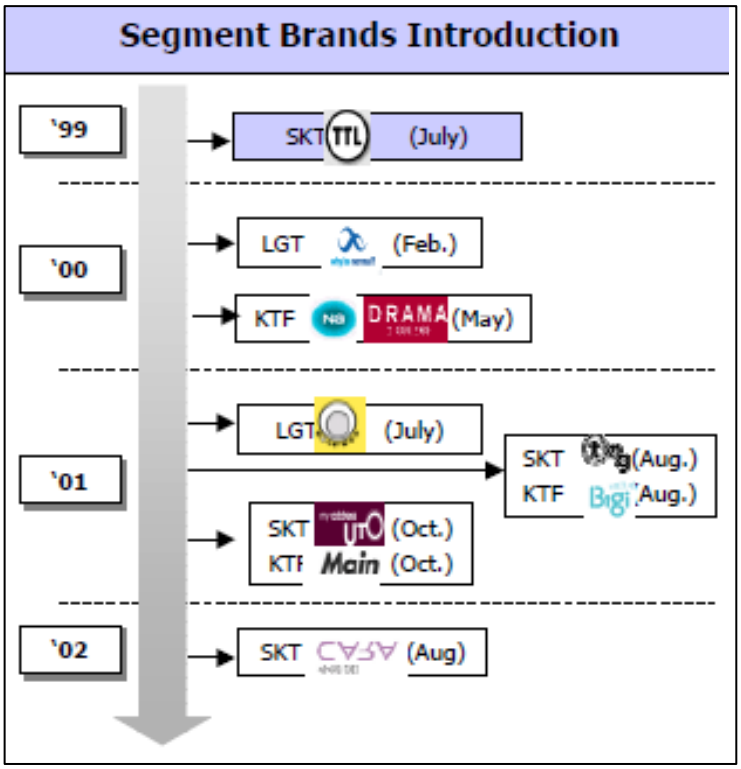

Figure 5-3. Segmented service brands of the three mobile carriers (1999-2002)
(Source: SK Telecom (2004), from http://www.itu.int/osg/spu/ni/futuremobile/presentations/sktele-compresentation.pdf.)

Such segmentation helped the Korean mobile carriers to expand the B2C customer base from a conventional market to a differentiated and sophisticated mobile market and succeeded in pioneering the highly demanding youth markets.

5.4.1.2. Case study of HSDPA

First of all, High-Speed Downlink Packet Access (HSDPA) service has been selected to identify the determinants of adoption of service innovation before 2009-2010.

HSDPA is the most prominent example which represents service innovation before 2009-2010. HSDPA is a mobile service innovation that evolved from asynchronous IMT-2000 (WCDMA). It improved the data rate and lowered the price, which were two problems of wireless internet services at that time. It also strengthened video telephony services and facilitated global roaming (Kim, 2006). SK Telecom had taken the lead over KT in the mobile telecommunication service market with over 50% of the market share in 2G service market due to its advantageous frequency band. However, SK Telecom and KT had to compete under equivalent conditions in the 2 gigahertz (GHz) band for HSDPA.

On the other hand, KT started the first nation-wide HSDPA service under the brand name of 'SHOW' on March 1, 2007. SK Telecom also launched its own nationwide HSDPA service termed '3G+' in late March of that year later than KT. At that time, KT obtained 243,000 subscribers within 48 days of its nationwide HSDPA launch. Furthermore, the total number of 'SHOW' subscribers exceeded 300,000, while SK Telecom had 225,000 subscribers for '3G+' at that time. As SK Telecom started aggressive promotion activities, competition between the two HSDPA service providers became very fierce.

5.4.1.3. Factors affecting innovation adoption behavior of B2C mobile service users

In a saturated B2C mobile service market, mobile carriers used to offer free mobile phones and price reductions in an effort to take customers away from their competitors. Also, they gained competitive advantage by differentiating their brand image from competitors.

Figure 5-4 summarizes the factors affecting innovation adoption behavior of B2C mobile service users. By examining the user behavior, the results revealed that aggressive marketing strategies and improved service quality helped mobile users to have high satisfaction and strong loyalty towards a mobile carrier. Thus, service equity established in 2G had an effect on user preferences for HSDPA service providers in the new 3G market.

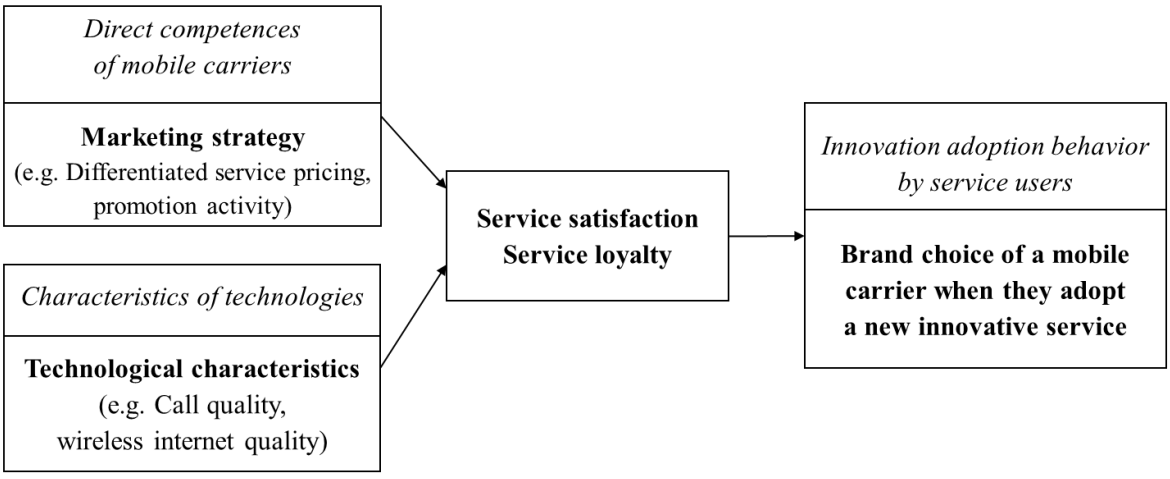

Figure 5-4. Determinants of B2C mobile service users' adoption of service innovation

However, the existing logic that was pervasive in 2G market was collapsing. Price had been traditionally related to the demand function in economics, but simple price competition scarcely led to long-term competitiveness in the Korean mobile

telecommunication industry.

Depending heavily on such a low-pricing strategy would bring high marketing costs due to aggressive promotion activities and may finally lead to decline in profit margin in the long run. Instead, continuous advance in network technology was essential to gain sustainable competitive advantage. Hence, technological competences of mobile carriers building the nationwide deployment of a new generation network service were essential before 2009-2010.

5.4.2. Determinants of adoption of service innovation after 2009-2010

5.4.2.1. B2B customer segmentation after 2009-2010

In Section 5.4.1.1, B2C mobile service market was segmented by demographic (e.g. age, gender) and psychographic criteria (e.g. service user's life style). While B2C market was segmented based on common needs of individual customers, B2B mobile service market can be segmented according to the specific business objectives of various B2B customers adopting a certain B2B mobile solution, as well as demographic and psychographic criteria. For instance, SK Telecom divides the B2B customer market into eight segments: automobile, education, retail, finance, housing, healthcare, logistics, and Small and Medium-sized Businesses (SMBs)[55]. A detailed analysis of B2B mobile service users was also conducted in Section 4.5.

Hence, the three mobile carriers developed new market segmentation for B2B customers, targeting both the private (B2B) and public (B2G) sectors. A detailed analysis of B2B mobile service users was conducted in Section 4.5.

5.4.2.2. Case study of Mobile Campus

As a second case, the adoption of Mobile Campus at UNIST and POSTECH is investigated. While the case of Mobile Campus was examined in Chapter 3, this section focuses on the determinant of service innovation adoption. Mobile Campus was chosen to reflect the trend of increasing B2B mobile solutions after 2009-2010. Mobile Campus is a smartphone-based mobile solution for universities. As a B2B service user, a university may

[55] It was said by SK Telecom's former senior vice president of service development team, Jinhong Kim (ZDNet Asia in an interview, 2010).

show different behavior of adopting service innovation from that of individual users, and a mobile carrier may consider this difference.

In the case of Mobile Campus, UNIST chose KT's iPhone because KT was the only mobile carrier that released iPhone at that time. POSTECH selected SK Telecom's Galaxy S due to the technological characteristics of Android OS which was open and a comprehensive platform for mobile devices.

5.4.2.3. Factors affecting innovation adoption behavior of B2B mobile service users

While a choice of a mobile service brand was based on a mobile carrier's reputation or brand image before 2009-2010, mobile service user's choice behavior began to depend on the handset manufacturer's brand after 2009-2010 when overseas smartphone entered the domestic market.

At the time when universities chose a suitable mobile carrier brand, the most influential factor regarding mobile carrier's competences was whether the mobile carrier had a brand new high-performance smartphone in its product lineup. UNIST regarded Apple's iPhone as the best choice, considering that iPhone was an emerging issue. Due to low smartphone penetration rate in Korea, KT was the only mobile carrier that released iPhone in 2010. On the other hand, SK Telecom's Android smartphone lineup including Galaxy A was much less competitive than that of KT having iPhone 3G. For this reason, UNIST had no option but to select KT as its service provider. Thus, KT gained an early edge of Smartphone by contracting with Apple.

Hence, mobile carriers could gain a competitive advantage by making a timely decision to contract with manufacturers. Having a brand new high-performance smartphone in their handset lineup acted as a means of differentiating their service offering. For example, Android's source code is available without charging licensing, distribution and development fees, and this allows the software to be freely modified and distributed by the manufacturers, mobile carriers or any technology developers. The new technology driven by smartphones fundamentally changed the nature of mobile service offerings after 2009-2010 by providing mobile users with unprecedented access to a lot of sources of information and new customized options.

Figure 5-5 summarizes the factors affecting innovation adoption behavior of B2B mobile service users.

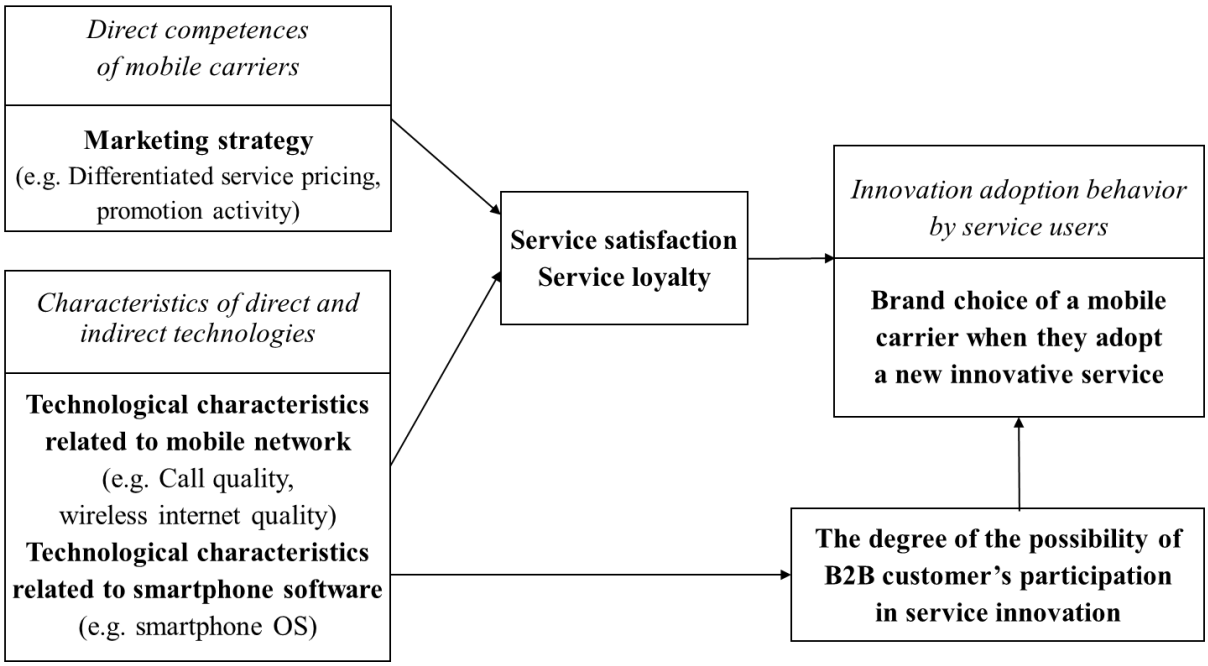

Figure 5-5. Determinants of B2B mobile service users' adoption of service innovation

Compared to the determinants of innovation adoption behavior by B2C mobile users, the selection of a mobile carrier brand in B2B mobile services can be highly influenced by the technological characteristics related to smartphone software. The technological characteristics led to B2B mobile service user's participation in service innovation. It is a new determinant, which could not be seen in the adoption behavior of B2C mobile services. For instance, POSTECH wished to increase the efficiency of campus administration by transforming the existing web-based groupware into a mobile-based campus administration system. For POSTECH, the free and open platform of Android was perceived as the best choice that could allow it to develop its own specialized mobile contents. Such technological characteristics made POSTECH decide to contract with SK Telecom having a handset lineup of Android smartphone.

The utilization of new technologies in B2B mobile services may attract more customers, so mobile carriers tend to choose carefully how they mobilize external technology that adds value to the service offering. Because the service user's choice behavior of mobile carrier brand may vary dramatically among different smartphone operating systems, a strategic positioning approach for mobile handset is necessary.

Hence, technological characteristics of B2B mobile services can expand the range of user participation in the development of new mobile services. The degree of possibility of user participation may lead to innovations driven by users. Unlike individual users, B2B

customers actively participated in the service development process. This implies an important perspective in terms of user-driven innovation in mobile services.

5.4.3. Mobile carrier's strategies to launch B2C and B2B mobile services

The service strategies regarding B2C and B2B mobile services were pursued in different ways of creating a new service brand. Although both of them are sold to the domestic market, different competences are required between B2C and B2B market.

The B2C service brands have a tendency to be developed based on the mobile carriers' pricing strategy, which positions their service brands with different prices charged to different segments according to service usage patterns of mobile users depending on duration of call or amount of data transmitted via the mobile network (SK Telecom, 2004). They have concentrated on price differentiation for the purpose of diversifying service brands, and brand creation mechanism heavily relied on service-oriented innovation.

On the contrary, B2B service brands are developed considering a diversity of market segmentations that demand different technological service features (e.g. types of solutions with applications) and have different characteristics of institutional and business users (e.g. size, industry that they belong to). Such sophisticated B2B market segmentations have served as a stepping-stone for increasing development of new service brands. The evidence is in the websites of three major Korean mobile carriers that currently introduce their all service brands line-up. They show that the number of B2B service products is much greater than that of B2C service products.

The results of this section provide the latter chapters with some ideas for producing service innovation by mobilizing mobile carrier's competences and technological characteristics of B2B mobile services. These issues will be presented in Chapter 6 (technological innovation in B2B mobile services) and Chapter 7 (service-oriented innovation in B2B mobile services).

5.5. Summary

The current mobile telecommunications landscape in Korea is characterized by intense competition in the fixed-mobile convergence marketplace and a rapid shift in power to the platform business. The mobile carriers in Korea have started pursuing earnings' growth

opportunities by continuously bringing out new mobile services and by forming new segments in the domestic market. They are transforming from network providers to providers of high-value added mobile solutions[56] for individuals (B2C) and institutional users (B2B). They are in the business of building platforms for a broad range of fields spanning content delivery, location-based services, messaging, social network services, commerce, advertising and media.

This chapter clarified how the transition from B2C to B2B has influenced mobile service innovation and what factors have influenced it in the context of technological (Section 5.2), regulatory (Section 5.3) and market changes (Section 5.4). The different dynamics of mobile service innovation have evolved during 2009-2010 by shifting innovation focus from B2C mobile services to B2B mobile services. Table 5-4 compares the different dynamics of innovation between B2C and B2B mobile services.

Table 5-4. The different dynamics of innovation between B2C and B2B mobile services

Aspects	B2C mobile services (Before 2009-2010)	B2B mobile services (After 2009-2010)
Regulatory changes	-In 2005, the Korean government made it mandatory for all mobile-phone makers and content providers to use a software standard for Internet access, called WIPI (Wireless Internet Platform for Interoperability)	-The world's handset market was rapidly changing from a closed platform to an open mobile operating system. In order to keep pace with the trend, the regulation of mandatory use of WIPI was abolished as of April 2009.
Technological changes	-Development in mobile network technologies from 2G to 3G to 3.5G	-As a result of the policy of openness, iPhone was launched in Korea in November 2009 -Network evolution from 3.5G to 4G (e.g. LTE)
Market changes	-Mobile carriers gained revenue from voice calls -The B2C service brands have a tendency to be developed based on the mobile carriers' pricing strategy -The user's selection of a mobile service was based on a mobile carrier's reputation or brand image.	-Rapidly growing smartphone market -Change in the basis of competition: from voice quality to data capacity -The mobile service user's choice behavior began to depend on the handset manufacturer's brand (Layer 1).

The transition from B2C to B2B mobile services offered a framework for using paradigm change as the conceptual criteria to demonstrate how the Korean mobile sector

[56] The current mobile services are not only for communication, they also support diverse data-centric services such as location-based mobile advertising and mobile banking solutions.

has experienced a radical change to create service innovations. There were various factors that led to service innovations in the Korean B2B mobile service market. For instance, mobile regulations and domestic policy concerns directly affected the technological and market-related factors in Korea. Since regulations moved towards the openness policy, the domestic mobile sector obtained numerous opportunities to adopt and produce many innovative services and mobile devices.

Compared to individual customers, the institutional customers have more sophisticated needs and demands. It provided for mobile carriers to produce many B2B mobile solutions to meet the specific requirements of B2B customers in various industries. In addition, the trend of convergence between devices, services and technologies within and across industries not only offered a challenge to the mobile carriers but also offered a breakthrough for them to continuously develop new service products in the saturated B2C market. The technological characteristics (e.g. smartphone and its operating system) can expand the range of user participation in the development of new B2B mobile services.

Consequently, the increasing business opportunities suggested mobile carriers to find a future growth engine in B2B. Various mobile solutions have emerged within and across industries, and consequently led to many service innovations in the Korean B2B mobile service market.

The next chapter will identify the different types of innovation in B2B mobile carrier services from the technological perspective. The service characteristics will be divided into two different types (e.g. new or improved) according to whether they appeared before or after the paradigm shift of 2009-2010. This criterion will be explained in detail in Section 6.2.2.

CHAPTER 6. TECHNOLOGICAL INNOVATIONS IN B2B MOBILE SERVICES

6.1. Introduction

Chapter 4 identified the service characteristics that constitute the B2B mobile services and grouped them into seven types based on service characteristics: mobile office/education solutions, network solutions, multimedia broadcast solutions, business analytical solutions, security and safety solutions, payment processing solutions and M2M solutions for facility management. This chapter examines the technological characteristics as well as service characteristics to capture the dynamic linkage between technological innovation and B2B mobile services.

The objective of this chapter is to identify how innovations in B2B mobile service products can be obtained with support of diverse technologies. The implementation of the current B2B mobile carrier services highly depends on advanced technical characteristics. A mobile telecommunication service shows some intermediate features of pure services and products. When it is compared to pure services (e.g. healthcare and personal services), it is standardized and mass-produced like products. It can well reflect the trend towards convergence and the blurring of the boundaries between products and services because innovation in B2B mobile carrier services may often depend on the development of mobile device technologies related to product innovations. Such an integrative approach lately attracted considerable attention. Thus, this chapter attempts to consider the changes in service characteristics driven by advanced ICT in the various layers.

Within this background, technology-enabled innovations actively occur in the current mobile market. The rapid development of advanced hardware and software technologies related to mobile services has brought a number of service brands expanding their customer base and market size in Korea. Hence, innovation in B2B mobile services will be identified from the technological perspective by addressing the research questions: *(2) What are the types of innovation in B2B mobile carrier services? How do they differ from each other?* (see Section 3.7, p. 65).

This chapter is divided into six sections. Section 6.2 reminds us the criterion to classify the types of innovations for a better understanding of the link between B2B mobile service

characteristics and the innovation types, and describes the three technological innovation models. Section 6.3 analyzes the relation between technologies and service characteristics. Then, incremental, radical and semi-radical innovations are identified in order from Section 6.4 to Section 6.6. Each of those sections looks at key technical features of the three types of technological service innovations, analyzes the role of technology in implementing those innovations, and investigates the technological innovations that occur in B2B mobile services from the characteristics-based perspective. Finally, a summary is presented in section 6.7.

6.2. Model

6.2.1. Technological models of innovation in services

The service characteristics are obtained by mobilizing simultaneously (internal and external) competences of service providers and (tangible and intangible) technical characteristics (Saviotti and Metcalfe, 1984; Gallouj, 2002). The framework in this chapter has its roots in the basic notion, developed by Saviotti and Metcalfe (1984), of a service as a combination of technological and service characteristics. In order to highlight technological models of innovation, Chapter 6 aims to focus on the role of technologies in the conceptual framework developed in Section 3.8.2.1 (pp.69~71).

As shown in Figure 3-3 (p.71), configuration between technological and service characteristics represents that the changes in mobile service characteristics are obtained through the development of direct and indirect technologies. Direct technologies such as information and communications technologies (ICT) have an effect on the characteristics of a mobile service. For instance, the development of 4G wireless network enables a faster data rate and improves the service quality. Smartphone and its operating system allow mobile service users to carry out multiple tasks using a single mobile device.

On the other hand, some industries that previously had no linkage between each other have been converged. Telematics is one of the examples of the inter-industry convergence between automobile and mobile sectors. In this thesis, any potential technology that can bring a new type of mobile services through convergence with other technologies is considered as indirect technologies.

Hence, the final service characteristics of B2B mobile service can be influenced by the utilization of direct and indirect technologies. This mode of innovation is regarded as

technological service innovation in this thesis. The different innovations will be identified by matching the theoretical patterns of service innovation with empirical evidence from the Korean B2B mobile carrier services.

6.2.2. Criterion to classify incremental and radical innovations

This section will compare the changes of the seven service characteristics (discussed in Chapter 4) before and after the paradigm shift of 2009-2010, and will distinguish between (i) 'improved' service characteristics and (ii) 'new' service characteristics. Some existing service characteristics are considerably improved when they are applied to B2B mobile carrier service, whereas some service characteristics newly appeared in providing B2B mobile solutions.

For an accurate distinction, information about the announcement of service products of the three Korean mobile carriers was gathered from the Korean IT newspapers (e.g. www.etnews.com and www.dt.co.kr), the mobile carriers' websites (e.g. Investor Relations news releases of SK Telecom, KT and LG U+) and search engines (e.g. www.google.com, www.yahoo.com). Using the advanced search technique of defining or restricting the dates of search (e.g. data range of before a specific date, after a date, or between two dates), it was tested whether a search word representing a certain service characteristic could be obtained in the online material before 2009-2010 or not. The strong service characteristic of service products are reviewed online in this way.

The third column of Table 6-1 shows the distinction between radical or improved service characteristics. Among the seven characteristics, 'location-based/security/safety', 'IT Infra management', 'real-time broadcasting' and 'transaction information delivery' are considered as improved service characteristics because they existed in B2C service but have enhanced the quality of service characteristics. 'Facility management' is regarded as a new service characteristic because it newly appeared after 2009-2010. The remaining two characteristics such as 'general office work supportive' and 'seamless working condition' are considered as having both improved and new characteristics.

Within this conceptual logic, the 'new' service characteristics that newly emerged after the paradigm shift are linked with radical service innovation. On the contrary, 'improved' service characteristics, which existed before the paradigm shift but have improved its quality, are linked with incremental service innovation. A combination of 'improved' service characteristics and 'new' service characteristics is linked with semi-radical service

innovation. Thus, three types of service innovations can be identified: incremental, semi-radical and radical innovations.

As the next step, those improved and new service characteristics were matched with service innovations. Finally, Table 6-1 presents the conceptual linkage between service characteristics and innovation types.

Table 6-1. Link between service characteristics and innovation types

Category of service group*	The most strong service characteristics	Change of characteristics	Types of innovation
Business analytical solutions	General office work supportive	Improved, new	Semi-radical innovation
M2M solutions for facility management	Facility management	New	Radical innovation
Security and safety solutions	Location-based / security / safety	Improved	Incremental innovation
Network solutions	IT Infra management	Improved	Incremental innovation
Mobile office/education solutions	Seamless working condition	Improved, new	Semi-radical innovation
Multimedia broadcast solutions	Real-time broadcasting	Improved	Incremental innovation
Payment processing solutions	Transaction information delivery	Improved	Incremental innovation

(*The B2B mobile services were classified into seven service groups having similar service characteristics in Table 4-8, p. 93.)

Before analyzing the types of technological service innovation, the following section will clarify the relation between technologies and service characteristics.

6.3. Relation between Technologies and Service Characteristics

As explained in Section 6.2, technological service innovation results from some changes of service characteristics that are enabled by technologies. This section examines how much the change of service characteristics depends on technologies and what types of technologies are involved in service characteristics. The technological characteristics are detected by collecting technology keywords related to the service groups. Thus, this section aims to provide a clear understanding of both technological and service characteristics of a certain service product.

As a first step, the list of technology keywords of the seven service group was made by

investigating the service products that belong to each service group. The keyword search was performed by collecting technology-related keywords in the mobile carrier's service product catalogs and the web pages which contain technical description of a service product. Then, for an accurate indication of technology terms, the collected technology keywords were grouped according to Fransman's Layer Model[57]. In this section, Fransman's Layer Model was used as a basis for distinguishing service characteristics of B2B mobile services: (1) service-oriented characteristics, (2) service characteristics that heavily rely on technologies and (3) a mixture of service-oriented and technology-dependent characteristics. Among the three categories, the service characteristics mainly linked with functionality of Layer III are regarded as service-oriented characteristics because this layer represents contents, applications and service offerings. In contrast, the service characteristics linked with technologies in Layer I and Layer II are regarded as technology-dependent characteristics. The service characteristics connected to technology of both Layer I (or II) and Layer III are considered as a mixture of service-oriented and technology-dependent characteristics.

Table 6-2 summarizes the technology keywords according to the service characteristics of the corresponding service groups.

Firstly, four service characteristics, 'info analysis', 'e-task', 'location-based' and 'broadcasting', can be seen as relatively service-oriented characteristics than other service characteristics due to their characteristics of high involvement of Layer III. Rich service applications and plenty of mobile contents are key to creating a high performance of those service characteristics. The characteristics may vary across B2B customers when they are delivered as various forms of customized service offerings.

Secondly, 'info storage', 'remote control', 'automation', 'equipment security', 'data security', 'mobility' and 'real-time' were regarded as technology-dependent characteristics. Those service characteristics heavily rely on wireless internet connection and network access such as CDMA2000 1x, EVDO, WCDMA, WLAN, DMB, WiBro and LTE (Layer II). For those service characteristics to become effective, they should be supported by networking hardware/software components (Layer I) to connect to various networks.

Thirdly, 'info search & delivery, 'entrance security of buildings', 'emergency rescue /

[57] Fransman (2010) conceptualizes the new ICT industry in a four-layer model, which consists of networked elements (Layer I), network operating (Layer II), content / applications / services / innovation platforms / search / navigation / middleware (Layer III) and final consumption (Layer IV).

safety precaution', 'infra maintenance', 'mobile-based digitalization' and 'transaction information delivery' were considered as a mixture of both service-oriented and technology-dependent characteristics. They are highly influenced by the involvement of Layer I and Layer II while being encouraged by the development of contents, applications and service platforms.

Within this background, the study of technological service innovation in this thesis assumes that such relations between technologies and service characteristics have a significant effect on the characteristics of B2B mobile services and it leads to a radical change in the nature of services or a constant change for improved performance of services. Each type of technological service innovations is described in detail in the following sections.

Table 6-2. Relation between technologies and service characteristics

Service group	Service characteristics		Keywords related to technology or functionality (Layer)*	Types of characteristics
Business analytical solutions	General office work supportive	Info analysis	PC (Layer I), Analytical software, Microsoft Office-based applications (Layer III)	Service-oriented
		Info search & delivery	PC (Layer I), Network access (Layer II), software program (Layer III)	Mixture
		Info storage	PC (Layer I),Network access, IDC (Layer II)	Technology-dependent
		e-task	PC, mobile phone (Layer I), Software program, mobile groupware application (Layer III)	Service-oriented
M2M solutions for facility management	Facility management	Remote control	CCTV camera, DVR, router, warning light and siren (Layer I), TCP/IP network (Layer II)	Technology-dependent
		Entrance security of buildings	Wired/wireless network, web server (Layer II) 24-hour monitoring service, online/offline IT consulting (Layer III)	Mixture
		Automation	RFID (Layer I), ubiquitous sensor network (Layer II)	Technology-dependent
Security and safety solutions	Location -based / security / safety	Equipment security	Network access server, satellite network, sensor (Layer II),	Technology-dependent
		Emergency rescue / safety precaution	Smartphone, mobile terminal (Layer I), mobile network, satellite network (Layer II), safety service platform (Layer III)	Mixture
		Location-based	Telematics platform, GPS navigation software (Layer III)	Service-oriented
Network solutions	IT Infra management	Data security	Data backup software, document conversion server, SSL (Layer I)	Technology-dependent
		Infra maintenance	IDC, network (Layer II), IT outsourcing service, consulting (Layer III)	Mixture
Mobile office/education solutions	Seamless working condition	Mobile-based digitalization	Smartphone and its OS, tablet PC (Layer I), mobile service platform, business management software (Layer III)	Mixture
		Mobility	Smartphone (Layer I), LTE, Wi-Fi, IP network (Layer II)	Technology-dependent
Multimedia broadcast solutions	Real-time broadcasting	Broadcasting	Media content delivery (Layer III)	Service-oriented
		Real-time	Broadcasting dedicated line, satellite network (Layer II)	Technology-dependent
Payment processing solutions	Transaction information delivery	Transaction information delivery	Radio-frequency circuit and IC chip, smartphone, PDA (Layer I), mobile network, local switch, value added network (Layer II), payment service platform (Layer III)	Mixture

*Layer I: networked elements / Layer II: network operating / Layer III: content, applications, services, innovation platforms, navigation and middleware, etc.

6.4. Incremental Service Innovation in B2B Mobile Services

6.4.1. Key technological features of incremental service innovation

Incremental service innovation is frequently observed in the service groups of ‘security and safety solutions’, ‘network solutions’, ‘multimedia broadcast solutions’ and ‘payment processing solutions’. B2C services such as location alert services for safety, internet access services, video streaming services and mobile payment services have been useful service features in mobile telecom service for individual users. But the value of those services characteristics became much greater in B2B mobile solutions than in the previous B2C services.

Firstly, network solution is a clear example of incremental innovation being created. Compared to network access services for individuals, those for institutional users became highly enhanced in terms of data security and infrastructure management. The B2B mobile network solution not only offers wired and wireless networks but also protects a B2B customer’s data, application and network and maintains an adequate security level.

Secondly, the service characteristic of ‘location-based/security/safety’ has been an important application feature of telematics service provided by mobile carriers since 2009-2010. Telematics, the integrated technologies of telecommunications and informatics, provides safety information such as road hazards, locations, speeds of vehicles and emergency road to support driver’s safety. In the case of B2B mobile solutions, such service characteristics have been improved by providing better positional accuracy in location-based business services and more intensified emergency rescue applications to protect institutional customers’ tangible assets and employees.

Thirdly, multimedia services that have been served to individuals have become highly customized and interactive. In particular, IPTV can provide a two-way interactive service. Interactive IPTV enables viewers participate in broadcasting. They can communicate in real time with not only a TV show host but also with other viewers. Such service can apply to education, too. The use of IPTV as an educational tool enhances interactive learning and teaching. Students can ask questions via mobile phone or internet messenger during a video lecture and receive the lecturer’s answers immediately.

Fourthly, a mobile finance service allows individuals to receive basic banking services through a mobile phone such as wired transfer and check balances as well as stock trading and credit card services. But recent B2B solutions enhanced the service function by developing wired and wireless complex payment processing devices.

Hence, the value of the services can be enhanced through advanced technologies when the characteristics of the above four groups (i.e. 'IT Infra management', 'location-based/security/safety', 'real-time broadcasting' and 'transaction information delivery') are implemented in B2B customers' institutions.

6.4.2. Role of technology in incremental service innovation

The main role of technology is to enhance and improve the quality of service characteristics. Here are the technologies that influence the service characteristics of four service groups: 'network solutions', 'security and safety solutions', 'multimedia broadcast solutions' and 'payment processing solutions'. All of these services must be influenced by the convergence of various technologies. But this chapter aims to emphasize a few important aspects to distinguish different technological features of each service group.

The following sections will show some examples of how the relevant technologies influence those services.

6.4.2.1. Network solutions

The service group, 'network solutions', mostly depends on wireless communication technologies. Although all the B2B mobile carrier services are based on the communication function of telecommunications networks, 'network solutions' are highly influenced by advanced wired and wireless communication technologies of mobile carriers.

The telecommunications networks have developed network architecture to converge multiple communications services into a single network. VoIP is one of the convergent services. It enables the existing communications services (e.g. phone calls, faxes, voice mail) to transport via the Internet, rather than the Public Switched Telephone Network (PSTN) which is designed to optimize circuit-switched voice communication. VoIP unifies the network solutions that were previously considered separate services into a single network. It carries data over an IP network like the Internet, and thus allows arbitrary and dynamic interconnection between any two domains on the Internet whenever a B2B mobile

user aims to place a call. In terms of VoIP-enabled devices, dual-mode phones[58] enable users to continue their conversations as they move between an outside cellular service and an internal Wi-Fi network, which means that it is no longer necessary to carry both a desktop phone and a cellphone.

However, such a voice and data transmission over IP network may face security management problem. As a solution, mobile carriers established nation-wide Internet Data Centers (IDCs) with an access bandwidth of 2,040G. They let servers of B2B mobile service users to be connected to internet backbone network of IDC so that they can offer network outsourcing solutions. For instance, KT offers various service products such as Co-location, Server hosting, Internet Computing Service (ICS), Network management service and Managed wireless by managing B2B mobile user's network infrastructure with the same level of its IDC. Mobile carrier's control center plays a role in monitoring operation equipment as well as the user's network, and continuously analyzing the traffic pattern. The outline of network outsourcing technology is described in Figure 6-1.

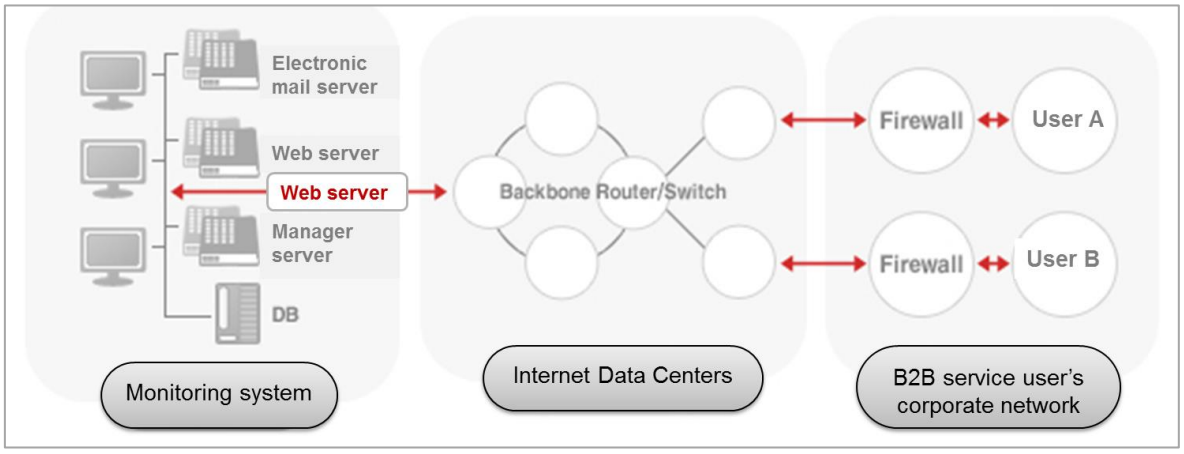

Figure 6-1. Configuration of network outsourcing

Source: KT website (http://biz.olleh.com)

In addition to managing by IDC, the security of network solutions is supported through data backup software, document conversion server and Secure Sockets Layer (SSL). For

[58] A dual-mode phone is a mobile phone containing more than one technology for voice and data communication. For instance, it can utilize both cellular and non-cellular radios to support communication between a cellular network and a local non-cellular network. VoIP enables smartphone to switch from GSM to Wi-Fi. When it is connected to GSM network, it can be used as a cellular phone. Within range of Wi-Fi network, the phone can be used as a Wi-Fi phone.

example, B2B mobile users set up secure communication with a document conversion server that supports secure document to offer wireless delivery. SSL provides communication security over the Internet when B2B mobile service users communicate across a network.

6.4.2.2. Security and safety solutions

'Security and safety solutions' are mostly supported by telematics-related technology, which provides various information to drivers such as traffic, route navigation and location based information. It is a state-of-the-art technology that combines the advantages of the integrated use of wireless internet and operational know-how. Using satellite-based GPS navigation, telematics-related technology allows B2B mobile service users to utilize various security/safety solutions through a mobile device. These include route guidance, real-time traffic information, emergency assistance and location-tracking. The outline of telematics technology is described in Figure 6-2.

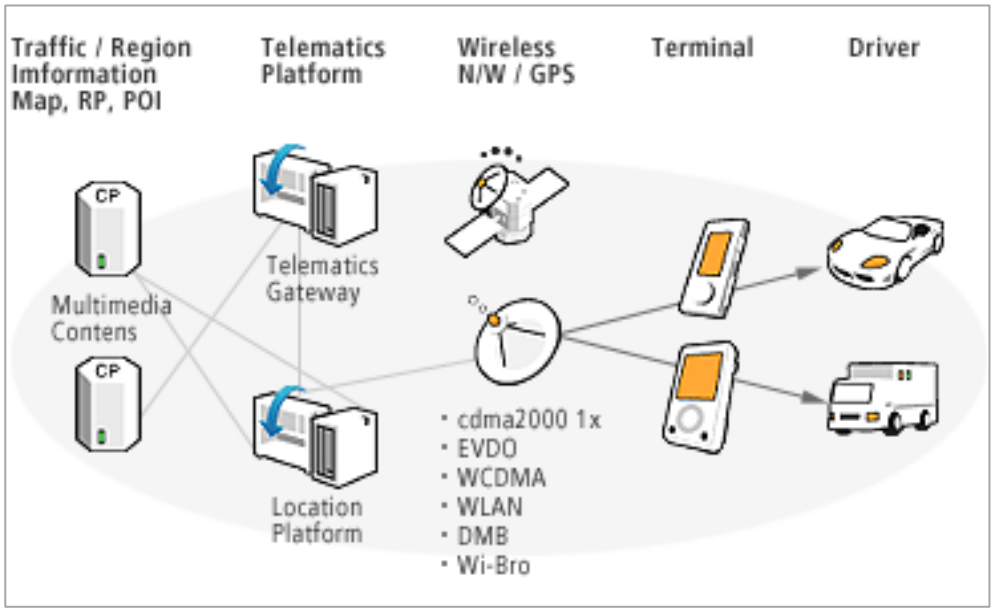

Figure 6-2. Configuration of telematics

Source: SK Telecom website (http://www.sktelecom.com)

For example, SK Telecom has begun with 'Nate Drive', the world's first handset-based telematics service brand, in March 2003. The technology helped drivers and vehicle owners get real-time traffic information and map directions. Later, vehicle diagnosis and

control service allowed B2B mobile service users to check gear performance, engine, brakes and get fuel-related information. Now telematics technology can be used in emergency rescue applications. Vehicles fitted with a remote control for automobile diagnosis prevent accidents due to mechanical failure. An automatic crash sensor may be another important application of telematics for ensuring safety while driving. The security and safety solutions also enable vehicle monitoring and tracking in case of theft. In addition, telematics technology enables Location-Based Service (LBS) on vehicles to provide location-based business information to B2B mobile users.

6.4.2.3. Multimedia broadcast solutions

Mobile carriers have developed the terrestrial wireless infrastructure integrated with satellite telecommunications as well as broadband internet resources to offer various multimedia broadcast solutions. With the development of digital broadcasting and internet technologies offering greatly increased data transmission speeds, multimedia broadcast solutions can provide upgraded communication, advertising and education channels to B2B mobile service users (e.g. internet service providers, content providers, broadcast program providers). Streaming video technology has allowed individual users to download and watch a video in real time on demand through their mobile phones.

The outline of broadcasting network infrastructure is described in Figure 6-3.

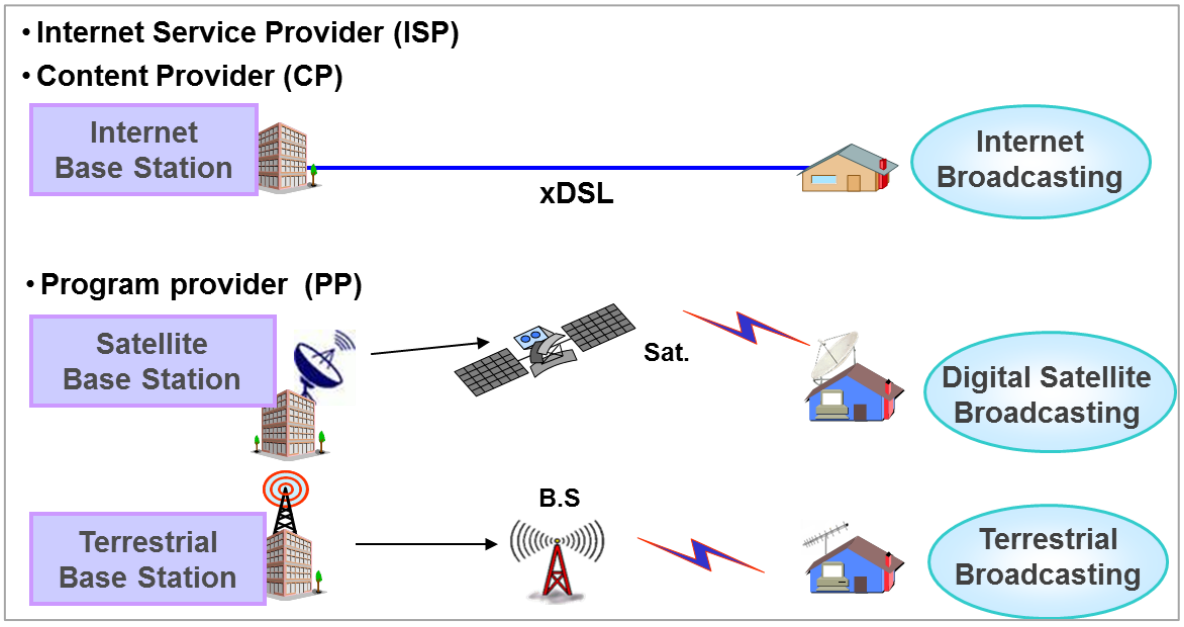

Figure 6-3. Configuration of broadcasting network

Source: KT's presentation at ITU workshop (http://www.itu.int/osg/spu/seminars/lee/NGN-SPU1.pdf)

6.4.2.4. Payment processing solutions

E-commerce service for individual users has required a transaction of monetary value through a wireless telecommunication network. But payment processing solutions for B2B mobile service users show the advancement in smart handsets (in the left part of Figure 6-4).

For instance, the device of payment function, equipped with radio-frequency circuit and integrated circuit (IC) chip, attaches to the protection cover of smartphone. This makes the solution deliver payment/transaction information easily via fixed-mobile network.

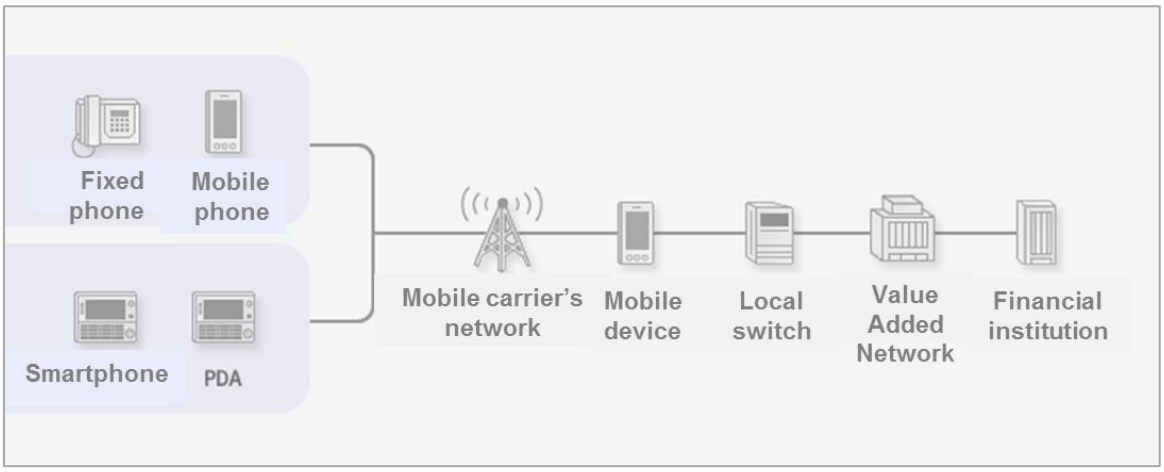

Figure 6-4. Configuration of payment processing network

Source: LG U+ website (http://biz.uplus.co.kr/)

6.4.3. Characteristics-based approach to investigate incremental service innovation

The explanations in Section 6.4.2 can be illustrated from the characteristics-based approach. In the service groups of 'network solutions', 'security and safety solutions', 'multimedia broadcast solutions' and 'payment processing solutions', various technologies play a crucial role in enhancing the service characteristics as shown in Figure 6-5.

For example, technologies related to IT Infra management and data security can increase Internet connection speed of network solutions and can promptly respond to network attack problems such as Distributed Denial of Service (DDoS) attack. This enhances the service quality of 'IT Infra management' of network solutions. With a combination of wireless communications, the development of telematics technologies

improves the service characteristic, ‘location-based/security/safety’. Digital broadcasting network technology enables high-quality, real-time broadcasting. Lastly, the characteristic of ‘transaction information delivery’ becomes more enhanced when it combines with advanced mobile devices such as smartphone. Hence, by enhancing the quality of service characteristics, service products that belong to the four service groups could be created with support of technologies.

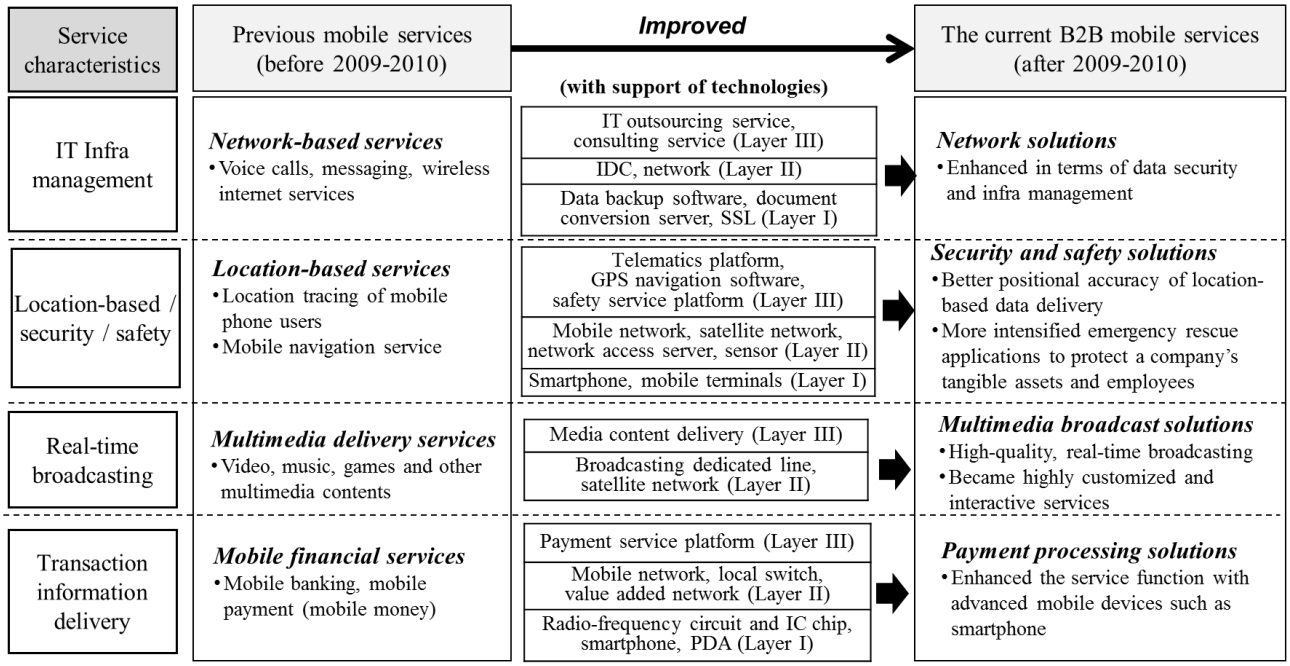

Figure 6-5. Representation of incremental innovation in B2B mobile service from the characteristics-based approach

(Layer I: networked elements / Layer II: network operating / Layer III: content, applications, services, innovation platforms, navigation and middleware, etc.)

The results above present the different dynamics of incremental service innovation among the four B2B mobile service groups. The service characteristics that have been improved due to the advanced ICT (i.e. ‘location-based/security/safety’, ‘IT Infra management’, ‘real-time broadcasting’ and ‘transaction information delivery’) bring incremental innovation to B2B mobile carrier services.

6.5. Radical Service Innovation in B2B Mobile Services

6.5.1. Key technological features of radical service innovation

'M2M solutions for facility management' is a radically new service characteristic that was not necessarily provided to individual users before 2009-2010. But now this characteristic becomes critical, particularly in leveraging the security level of institutional users.

Firstly, institutional users can control secure access and auto-monitor of a building's entrance by using an RFID card system. RFID is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking. When employees enter a building, they let their entrance cards pass near a RFID reader and the entrance record that is read by the reader is delivered to the control server via Transmission Control Protocol/Internet Protocol (TCP/IP) network.

Secondly, using CCTV, the video records are automatically sent to the server and they can simply view the stored images and video via the web or a mobile phone. In addition to monitoring CCTV, through a mobile phone, institutional users can control external connection devices such as CCTV camera, warning light and siren.

Thirdly, the integrated infrastructure based on mobile platform and a ubiquitous sensor network support a number of public administration management (e.g. management of city facilities, roadside trees and streetlights) and maintain a safe and healthy environment for the citizen.

Hence, the characteristic of M2M solutions for facility management (i.e. facility management) influenced by advanced technologies can bring radical systemic changes to institutional customers.

6.5.2. Role of technology in radical service innovation

6.5.2.1. M2M solutions for facility management

The main role of technology in implementing 'M2M solutions for facility management' is to create a totally new service characteristic.

As shown in Figure 6-6, M2M technology makes it possible to automatically monitor every aspect of an institution's IT resources, from the condition of hardware, software and

middleware to their performance on networks. For instance, data from remote devices and sensors can be collected and monitored at a central hub. By combining RFID technology with a CCTV camera, B2B mobile service users can secure important facilities.

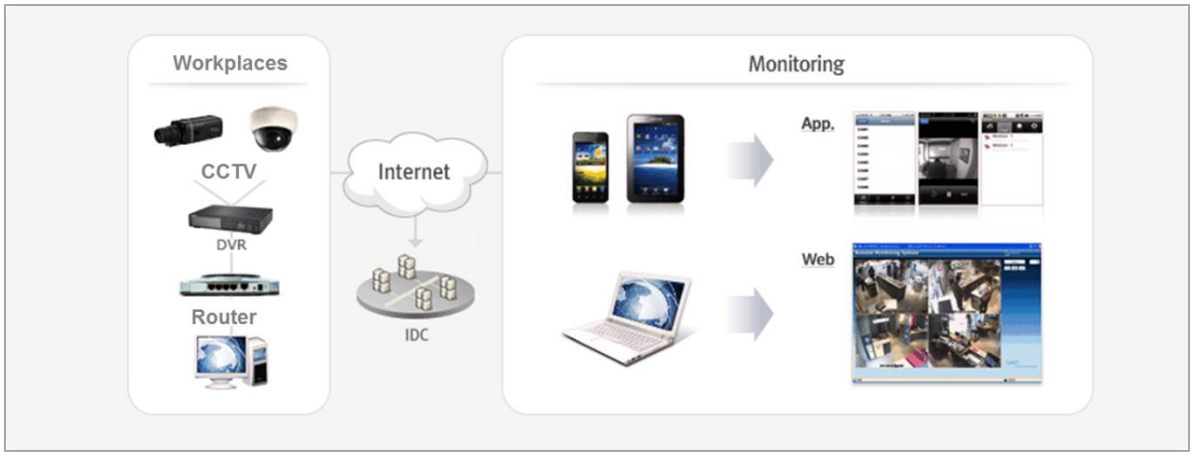

Figure 6-6. Configuration of M2M solutions technology

Source: KT website (http://biz.olleh.com)

Such solutions can also bring radical changes even in society beyond personal-level. For example, the integrated infrastructure based on mobile platform and a ubiquitous sensor network helps to design ‘Smart Campus’, ‘Smart Town’ or ‘Smart City’.

6.5.3. Characteristics-based approach to investigate radical service innovation

The appearance of a new service characteristic creates a totally new service product, i.e. radical innovation. A new service characteristic, ‘facility management’ was created by M2M technologies as shown in Figure 6-7.

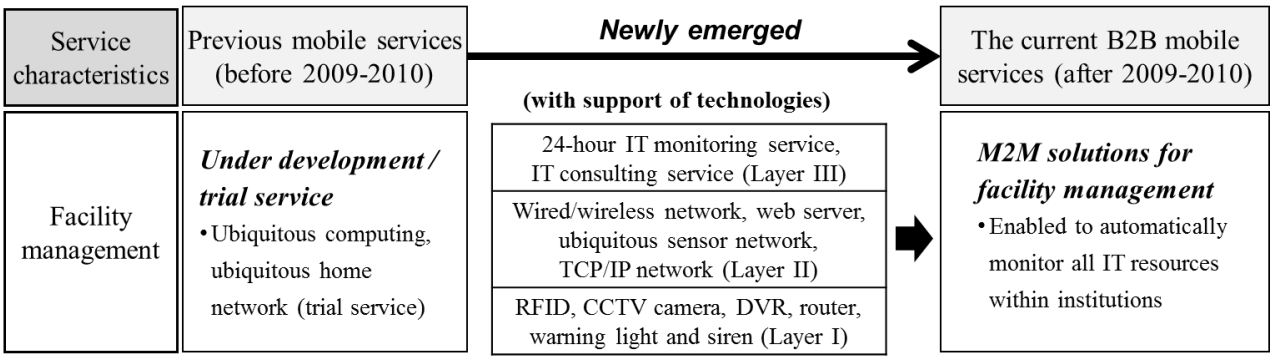

Figure 6-7. Representation of radical innovation in B2B mobile service from the characteristics-based approach

(Layer I: networked elements / Layer II: network operating / Layer III: content, applications, services, innovation platforms, navigation and middleware, etc.)

'Facility management', which was not offered to individual mobile service users in the past, has emerged to provide B2B mobile service users with a new service characteristic. Hence, the M2M solutions for facility management whose characteristic has strong 'facility management' can be referred to as 'radical innovation'.

6.6. Semi-radical Service Innovation in B2B Mobile Services

6.6.1. Key technological features of semi-radical service innovation

Firstly, 'general office work supportive' of business analytical solution is regarded as an improved characteristic in some ways, but a new characteristic in other ways. Searching information via a mobile phone was possible before 2009-2010. Data service for individual users delivered simple text, images and videos to provide information on weather, sports, stocks or traffic. However, data collection and information search has become more accurate and analytical. Hence, institutional users are now able to deal with more complex business information on market data, sales, finance, stocks, human resource data or cash flow. They can generate charts, tables and graphs using desktop applications such as Microsoft Word, Excel and HyperText Markup Language (HTML) which helps create text and images into web pages and displayed in a web browser. This analytical function can be seen as a new characteristic that emerged particularly for B2B customers.

Secondly, 'seamless working condition' characteristic of mobile office/education solution is made up of a mixture of new and improved sub-characteristics. The service platform which is called 'mobile office pack' is an integrated solution that covers

groupware and project management functions. This mobilized system radically changes the traditional work style performed during the regular working hours. Moreover it creates a flexible mobile workplace so that workers can carry out routine work anytime, anywhere.

Hence, the characteristics of business analytical solutions and mobile office/education solutions (i.e. general office work supportive, seamless working condition) have been improved or newly emerged due to advanced technologies. The improved and new characteristics can influence the quality of these services and can lead to changes in B2B customer's working environment.

6.6.2. Role of technology in semi-radical service innovation

The main roles of technology in implementing 'business analytical solutions' and 'mobile office/education solutions' are to improve the quality of service characteristics, and at the same time to create a totally new service characteristic.

6.6.2.1. Mobile office/education solutions

3G, the mobile telecommunications network before 2009-2010 provided 'mobility' to individual users watching video, playing game or downloading multimedia contents on the move. Now, the full nationwide deployment of 4G LTE network and increasing LTE-enabled smartphones enhance network speed and performance, improving mobility of workers. Mobile carriers have changed the landscape for the mobile service market by upgrading their network technologies. They have been eager to introduce a new network technology to improve connection performances. For example, in order to increase the quality of networks quickly to meet the expectations of mobile users, SK Telecom commercialized its 'Tetra-Cell' technology which doubles the number of the LTE cells and thus increases the speed of its LTE network. The enhanced mobility stimulates an opportunity for B2B service users to engage with their employees, partners, suppliers and consumers.

On the other hand, B2B service user's business has been transformed through intelligently designed mobile platforms and mobile applications. Figure 6-8 shows an example of a mobile platform.

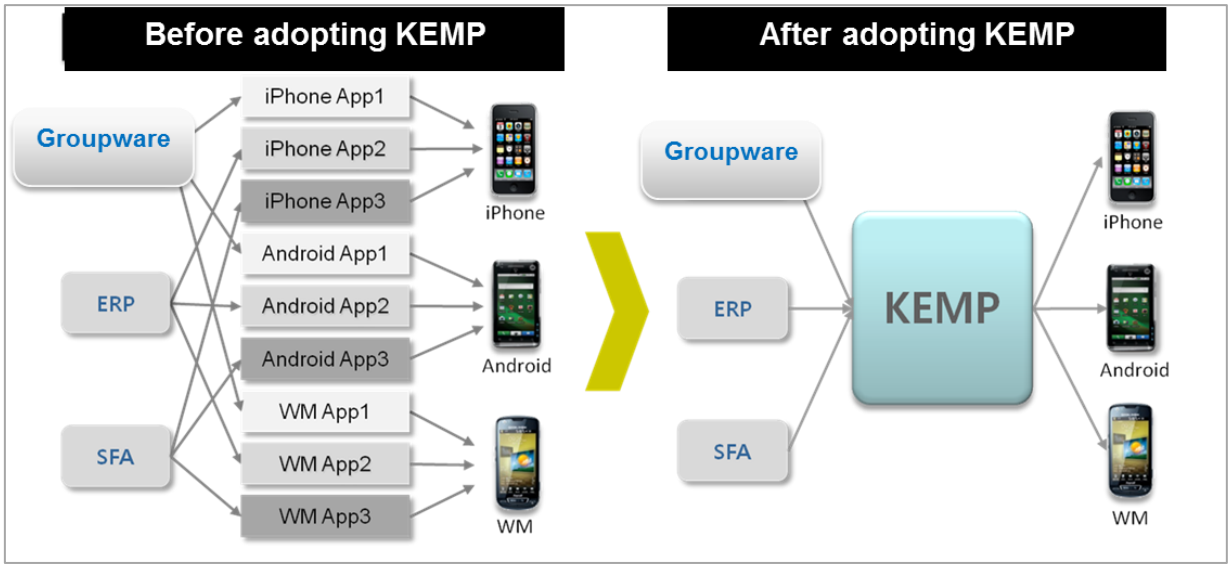

Figure 6-8. Configuration of mobile office platform

Source: LG U+ website (http://biz.uplus.co.kr/)

For example, KT has launched a mobile platform, which is called KEMP (KT Enterprise Mobility Platform) adopted from the Antenna Software, a U.S. mobile application developer, in 2010. KEMP is a robust, highly scalable and versatile mobility platform for building, deploying and managing mobile enterprise applications. Many useful web-based mobile applications are offered over this mobile platform. It also allows the same application to be propagated over disparate operating systems such as Android, iPhone or Windows Mobile. In such a way, the existing institutional system can be radically transformed to a mobile-based system such as such as m-SFA, m-CRM and m-ERP.

6.6.2.2. Business analytical solutions

While launching mobile services for institutional users, the quality of data and information delivered via a mobile network has been significantly improved. Web analytical software and solutions are offered to institutional users via an Application Service Provider (ASP) that provides computer-based services to customers over a network.

On the other hand, this change includes not only collecting information, but also compiling statistics on them and analyzing data to create a business report. U+ CRM is a cloud-based service provided by LG U+. B2B mobile service users can build up efficient

business process from sales, marketing and customer service offering, and analyze information using Microsoft Office package. Such a complex analytical function is completely different from the B2C services before 2009-2010 that used to perform simple tasks via a mobile phone such as personal scheduling and memo.

SK Telecom's 'Smart Insight' is a data mining solution that collects and analyzes public opinion on B2B customer's services/products, competitors and institutional user's public image. The data can be collected from various internet sources such as internet articles, online reviews, blog posts and comments in social network sites. Then, the collected data are analyzed by an analytical tool and reported to B2B customers either through wired network with a computer or through mobile network with a mobile phone. Figure 6-9 illustrates business analytical solution by taking an example of 'Smart Insight'.

Therefore, the radical change driven by analytical software tools makes it possible to conduct highly advanced tasks, covering the whole range of business, with high efficiency at a similar level as a desk-based work environment.

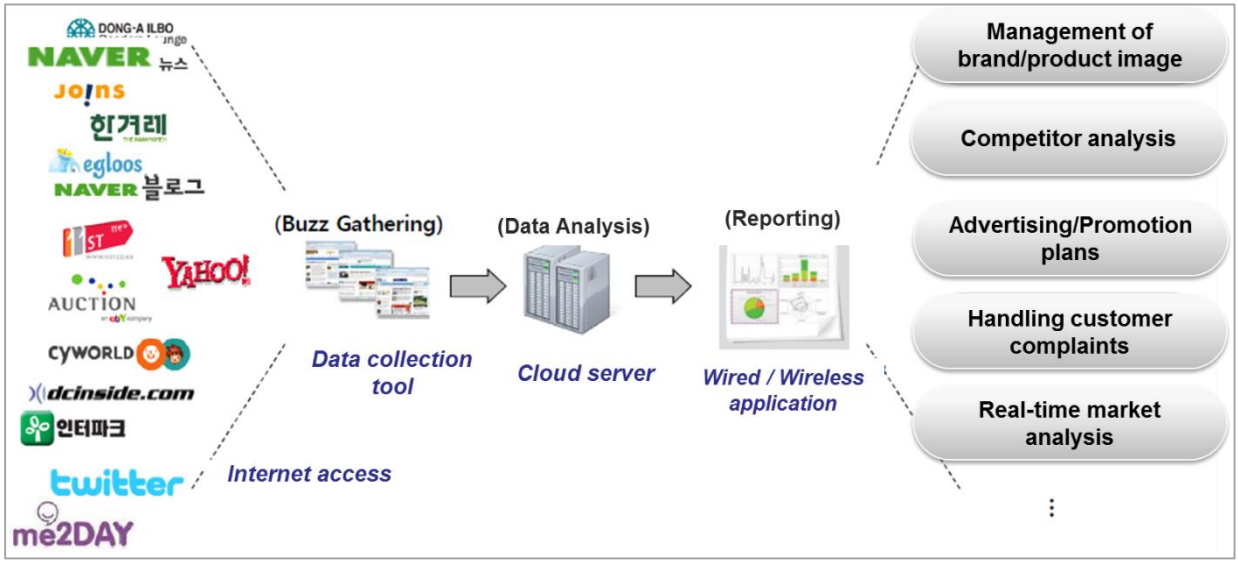

Figure 6-9. Configuration of business analytical software and application

Source: SK Telecom website (http://www.sktelecom.com)

6.6.3. Characteristics-based approach to investigate semi-radical service innovation

The service groups of 'business analytical solutions' and 'mobile office/education solutions' belong to semi-radical innovation because it enhanced the existing service

function but have also radical new characteristics to some extent as shown in Figure 6-10.

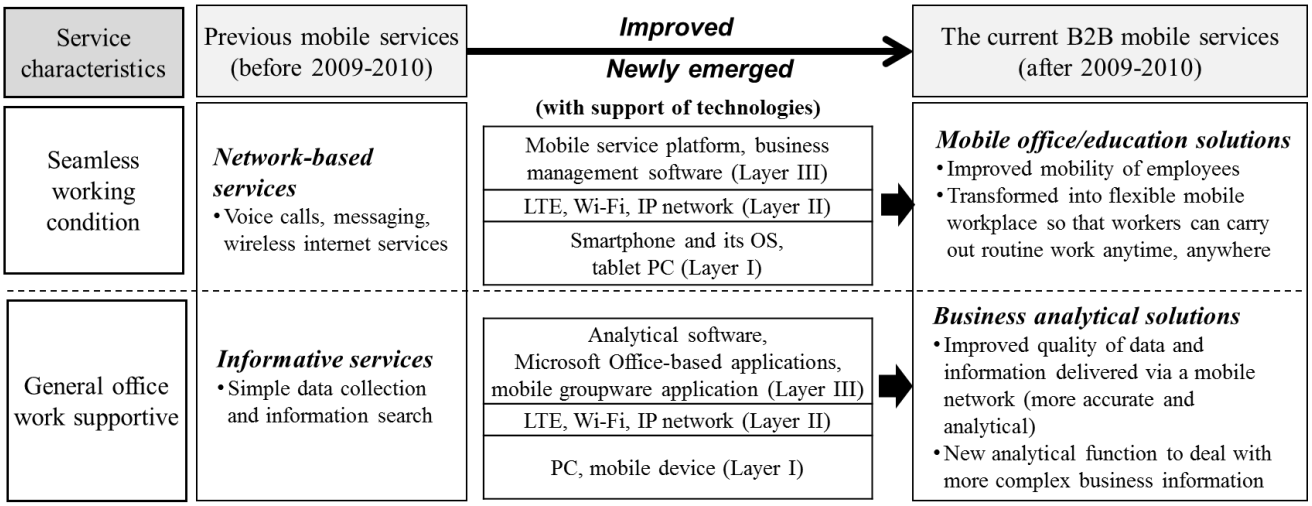

Figure 6-10. Representation of semi-radical innovation in B2B mobile service from the characteristics-based approach

(Layer I: networked elements / Layer II: network operating / Layer III: content, applications, services, innovation platforms, navigation and middleware, etc.)

The service characteristics of the two service groups, ‘general office work supportive’ and ‘seamless working condition’, are considered to show a combination of improved and new characteristics. Their service features and service quality are influenced by advanced wired/wireless technologies, mobile service platforms and analytical software tools. With support of such technologies, the two service characteristics can produce semi-radical innovations in B2B mobile carrier services. Hence, the above results present the different dynamics of semi-radical service innovation between the two B2B mobile service groups.

6.7. Summary of the Results

The goal in this chapter was to identify the different types of innovations in B2B mobile carrier services. From the characteristics-based approach, a scheme for distinguishing ‘new’ and ‘improved’ service characteristics (i.e. whether they appeared before or after the paradigm shift in the Korean mobile telecommunication market) was devised. A combination of the two kinds of service characteristics brought three service innovations, which are incremental, radical and semi-radical. And then the role of technologies was investigated to find out how technological characteristics of B2B mobile

carrier service influence service characteristics of them. As a result, the three types of innovation were identified from the technological perspective. Table 6-3 summarizes the different types of technological innovation.

Table 6-3. Definitions of technological innovation types

Types of service innovation	Definition
Incremental innovation	A service product whose main characteristics are existing but 'improved'
Radical innovation	A service product whose main characteristics are 'new'
Semi-radical innovation	A service product whose characteristics are combination of 'improved' and 'new' service characteristics

Various service characteristics bring innovation to B2B mobile carrier services. Firstly, 'improved' service characteristics bring incremental innovation to B2B mobile carrier services with support of technologies. The improved service characteristics, 'location-based/security/safety', 'IT Infra management', 'real-time broadcasting' and 'transaction information delivery', bring incremental innovation to B2B mobile carrier services with support of various software and hardware technologies such as mobile carrier's Internet Data Centers (IDCs), data security software and smart devices.

Secondly, 'new' service characteristics bring radical innovation to B2B mobile carrier services with support of technologies. The new service characteristic, 'facility management', brings radical service innovation with support of M2M technologies, for wireless sensor network system.

Lastly, a combination of 'improved' and 'new' service characteristics bring semi-radical innovation to B2B mobile carrier services with support of technologies. The service characteristics of 'general office work supportive' and 'seamless working condition', have both improved and new characteristics, bringing semi-radical innovation with support of mobile platforms and applications and analytical software tools.

Table 6-4 shows the different dynamics of technological service innovations driven by the advanced ICT among the B2B mobile service groups.

Table 6-4. Technological innovation in B2B mobile services and ICT technologies

Types of service innovation		Main category of service group	Important ICT technologies
Technological innovation	Incremental innovation	Security and safety solutions, network solutions, multimedia broadcast solutions, payment processing solutions	Mobile carrier's IDCs, data security software, telematics technologies, digital broadcasting network technologies, smart devices
	Radical innovation	M2M solutions for facility management	M2M technologies (e.g. sensor network system)
	Semi-radical innovation	Business analytical solutions, mobile office/education solutions	Mobile platforms and applications, analytical software tools

Hence, this chapter highlighted the technological models of innovation by focusing on the role of technological characteristics in the formulation of a B2B mobile service. In this chapter, the distinction between incremental, radical and semi-radical innovations has developed meaningful insights on the dynamics, validating the different dynamics of service characteristics. The technological characteristics of B2B mobile carrier services make various types of technological service innovation.

However, there may be numerous innovations that involve modest changes to the existing service but that have a quite important competitive advantage for mobile carriers. Recombinative and customized innovations are the examples. The next chapter will focus on the service-oriented innovations by providing a deep understanding of the role of mobile carriers' competences and the importance of interaction between mobile carriers and B2B mobile service users.

CHAPTER 7. SERVICE-ORIENTED INNOVATIONS IN B2B MOBILE SERVICES

7.1. Introduction

Radical changes driven by overseas smartphone might weaken mobile carriers' presence in the domestic market, but they are still active innovators in the market. The trend of convergence between devices, services and technologies within and across industries has offered a breakthrough for the Korean mobile carriers to continuously create new service products in the saturated domestic market.

Chapter 6 examined such technological features of service innovation in terms of incremental, radical and semi-radical innovations. However, such simple distinction between radical and incremental innovation may provide insufficient insight into the reasons that mobile carriers put much efforts to devise an effective pricing scheme that can appeal to the motivations of different market segments or that can target a particular segment of B2B mobile customers. In addition, a mobile carrier can produce many new identical brands easier than physical products, without direct technological development. Some service products are designed by bundling the existing service components, and they are easily launched in the market with minor effort.

Under such empirical background, this chapter supposes that there would be prominent innovations driven by the competences of mobile carriers and their customers. The competences include knowledge and know-how to mobilize different service characteristics and an ability to interact with mobile service users. Hence, this chapter aims to identify these distinctive innovations by addressing the research questions: *(3) How are the dynamic competences of mobile carriers and B2B customers used in the different types of innovation? And how do they interact with each other?* (see Section 3.7, p. 65).

The rest of this chapter is organized as follows. Section 7.2 illustrates the research model for the study. Section 7.3 presents the results of analyzing recombinative service innovation, and Section 7.4 provides the results of analyzing customized and co-produced service innovations. Section 7.5 makes a summary of the three service-oriented innovations.

7.2. Model

In order to further identify innovations in B2B mobile carrier services from the service-oriented perspective, this thesis proposes two types of innovation by focusing on the interaction between mobile carriers and B2B mobile service users: recombinative and customized innovations. Such innovations are regarded as innovation in service process, for instance innovation during the process of developing and delivering services whereas technological service innovation (e.g. incremental, radical, semi-radical innovations) is analyzed with respect to service products.

For this purpose, this chapter investigates the same service products which were analyzed in Chapter 6. The 242 B2B mobile carrier service brands are examined again with respect to recombinative and customized modes of creating service innovations. In addition, the service brands of pre-made service bundles and pricing brands which were neglected in the analysis of technological innovation will be discussed from the perspective of service-oriented innovation.

The two types of service innovation are summarized in Table 7-1.

Table 7-1. Definitions of service-oriented innovation types

Types of service innovation		Definition
Service-oriented innovation	Recombinative innovation	A service product made by combining or splitting existing service characteristics
	Customized innovation	A service which is customized to meet the needs of a particular type of customers

7.2.1. Recombinative mode of service innovation

In addition to his original concept on innovation (Section 2.3.1), Schumpeter added a definition of innovation as “new combinations” of new or existing knowledge, resources, equipment and so on. He initially phrased it as “development” and then it was defined by “the carrying out of new combinations” (Schumpeter, 1934). Henderson and Clark (1990) define this type of innovation as architectural innovation, whose basic principle relies on combining or splitting technical components. Such architectural innovation is based on the systematic re-use of existing components and changes the architecture of a product without changing its components.

Gallouj (2002) suggests a bundling-unbundling form, of which the former involves the creation of a new service product by combining the characteristics of two or more existing products. The latter form involves the creation of a new service by splitting up an existing service product and separating the characteristics into independent products. This mode of innovation is called 'recombinative' innovation, which can be similarly regarded as a product-line extension or brand extension in marketing theory. The results in this section are consistent with prior studies on marketing. Doyle (1990) defines brand extension as "the use of a brand name successfully established for one segment or channel to enter another one in the same broad market". Kotler, et al. (2001) argue that a brand extension strategy is any effort to extend a successful brand name to launch new or modified products or lines.

In order to highlight the empirical practice of the Korean mobile carriers, recombinative innovation is simplified into either recombining or splitting up of service characteristics in the conceptual framework of Section 3.8.2.2 (Figure 3-4, p. 72). As service providers, mobile carriers can directly mobilize their competences without depending on the use of external technologies. According to Prahalad and Hamel (1990), the competence is regarded as the glue that binds existing businesses. Miyazaki (1995) defines competence as a firm's capacity to generate change in regard to technologies, marketing and organizational skills and argues that competences are path-dependent and cumulative. Competence can be developed as a result of linking internal skills and activities (Snehota, 1990; Chaston et al., 2000). Hence, the concept of service providers' competence in this thesis includes the collective knowledge which is available to combine different elements from internal sources of innovation.

On the other hand, such a way of mobilizing competences may rely on a routine process. The dynamic aspect of routines can be addressed in a broad research agenda such as resources, dynamic capabilities and knowledge. A number of studies insist that they are closely interrelated with each other (Wright, et al., 2001; Fiol, 2001; Spender and Grant, 1996; Eisenhardt and Martin, 2000; Barney et al., 2001). The resources and capabilities can be viewed as bundles of tangible and intangible assets, including a firm's management skills, its organizational processes and routines, and the information and knowledge it controls.

Direct competence of mobile carriers can be derived from various sources such as a new pricing scheme and a segmentation of a new market. This thesis considers mobile

carriers' competences as the competences that can be directly mobilized by the mobile carriers themselves to develop a new service or to improve a service quality. The concept includes the competence to mobilize the existing resources and know-how.

As shown in Figure 3-4 (p.72), the final service characteristics are obtained by mobilizing the competences of a service provider. Through an analysis of B2B mobile carrier services, recombinative innovation will be examined by matching the empirical findings with the theoretical model of service innovation. A combination of two or more existing service products is expected to bring recombinative innovation, offering diverse service characteristics at the same time.

7.2.2. Customized mode of service innovation

A firm's strong relationship with the customer has been found to be very important in service-oriented companies (Berry and Parasuraman, 1991). User-producer interaction leads to successful innovations (Nahuis et al., 2012). Gallouj (2002) defines 'ad hoc' innovation as "the interactive construction of a solution to a problem posed by a given client" and argues that this mode of innovation is produced at the client-provider interface. The existence of this interface may restrain the service providers from reproducing ad hoc innovation in its original form. This form of innovations usually appears during the process of delivering a service.

However, innovation in mobile services shows a particular feature, overcoming such service-oriented disadvantage. Mobile carriers may reproduce the innovation in exactly the same form due to technical development. For instance, mobile carriers maintain a similar service quality through the wireless networking standard which is called the Institute of Electrical and Electronics Engineers (IEEE) standard. In addition, a service delivery platform, which is optimized for the delivery of a service in a given technological or network domain, enables a mobile carrier to develop many converged ICT services (e.g. IPTV).

On the other hand, the interactive nature of service innovation is particularly important in developing a customized solution for a particular customer (Gallouj and Weinstein, 1997; Gallouj, 2002). Therefore, providers must understand why the customer buys and how to participate in and contribute to the customer's value creation and align to the customer's strategies, resources and setting (Strandvik et al 2008).

Within this background, this chapter will identify customized mode of innovation by

highlighting the role of mobile carriers and B2B mobile service users. As shown in Figure 3-4, customized innovation will be identified by examining the correspondence between the empirical analysis of B2B mobile carrier services and the conceptual framework. This type of innovation is expected to explain the innovation led by active interaction between mobile carriers and B2B mobile service users.

7.3. Recombinative Service Innovation in B2B Mobile Services

7.3.1. Key features of recombinative service innovation

Network solutions service is the service group that best describes the recombinative mechanism. Many service products of the network solution can be produced under a new brand name in the same service category.

For example, for an institutional user which needs a highly intensive communication (e.g. voice communication, data transmission and messaging), mobile carriers often bundle internet phone (e.g. VoIP), mobile communication services (e.g. 3G) and wireless LAN service brands, and make those services into one service product. The dedicated hosting package is another example of recombining existing network solution brands.

Recombinative innovation occurs frequently when network solution is combined with payment processing solution or with facility management solution. For example, a mobile device designed for a payment processing solution is easily bundled with fixed-mobile communications solutions because it is equipped with not only payment data transmission but also calling and text messaging. E-payment service is also bundled with network solution products and mobile office solutions.

As a consequence, the recombinative feature of innovation in B2B mobile carrier services shows that two or more existing service brands can be combined under a new brand name. Such a mode of innovation operates continuous and cumulative production of new service brands in the same service group or a different service group.

7.3.2. Role of mobile carriers' direct competence in recombinative service innovation

The main source of recombinative innovation is derived from the mobile carriers' capability to mobilize a set of knowledge or techniques related to methodologies for

designing a service product. They have launched many service brands by bundling the existing services in order to provide an integrated service product of different functions. In addition, they have combined different service products in order to produce a synergy effect of the combined services.

There are several examples of this innovation mode. The following sections will present some examples of how mobile carriers integrate and strengthen the characteristics of B2B mobile service by combining two or more existing service products.

7.3.2.1. Converged services of 'network solutions'

Mobile carriers often bundle two or more network solutions and offer an integrated network service by enhancing 'IT infrastructure management', the main service characteristic of network solutions.

For instance, KT provides a bundled service product which is called 'Managed FMC pack' by combining its existing service product, 'Managed wireless LAN', with additional network service functions. Hence, 'Managed FMC pack' includes three independent service types: mobile communications, internet phone and wireless LAN. In addition, KT's Virtual Private Network (VPN) type service brands (e.g. 'VPN premium', 'X4biz', 'X4biz plus' and 'Internet VPN') can be packaged with network management system. These bundled service products are offered to B2B mobile service users that want to implement the mobile work environment or that need to strengthen their network security.

In addition, multiple hosting services can be offered as a single package service by integrating several different network management systems and dedicated-line services which transfer large-volume data at high speed. It is also considered as recombinative innovation.

On the other hand, the three mobile carrier's service products that offer basic phone calling services (e.g. local calls, city-to-city calls, land-to-mobile calls and international calls) can be combined with various value-added services such as a ring tone, a national toll-free number and an instant messaging for promotion.

7.3.2.2. A combination of 'mobile office' and 'network' solutions

Mobile office solutions can be combined with basic groupware functions. For example, LG U+ can provide 'U+ Mobile Office' by combining its mobile office functions and the

groupware functions of ‘U+ Groupware’. Consequently, ‘seamless working condition’, a service characteristic of mobile office solutions, is diversified into various solutions with support of FMC network. By integrating desktop-based application and mobile-based applications, B2B mobile service users can implement a more flexible working environment to manage daily tasks anytime, anywhere.

7.3.2.3. A combination of ‘mobile office’ and ‘payment processing’ solutions

‘Office pack’, one of the SK Telecom’s mobile office solutions, can be converged with e-payment solution. Such a combination of ‘seamless working condition’ (i.e. a service characteristic of mobile office solutions) and ‘transaction information delivery’ (i.e. a service characteristic of payment processing solutions) produces a synergy effect. The converged service increases the efficiency of decision making and information sharing for B2B mobile service users, and enables seamless delivery of transaction-related information via mobile network.

7.3.2.4. A combination of ‘multimedia broadcast solutions’ and ‘network solutions’

Multimedia broadcast solutions offer a dedicated broadcast line, providing ‘real-time broadcasting’ characteristic. Because the multimedia broadcast solution is based on the network, it is easily exposed to data security problems. Thus, when mobile carriers offer the multimedia broadcast solution, they often combine with additional ‘IT infrastructure management’ solution to protect the institutional data.

For example, when LG U+ provides multimedia broadcast solutions such as ‘WMV Streaming and Live Broadcasting Service’, it also offers a data security function which is called Digital Rights Management (DRM). B2B mobile service users can not subscribe to this security service alone. The DRM service is always served, together with a multimedia broadcast solution. It gives control to a B2B mobile service user that owns the digital contents and prevents its intellectual property from being copied or being converted to other formats. It is a useful function to secure an institutional user’s media file and to lessen the potential damage of a critical information leak.

Thus, a combination of the two different service characteristics, ‘real-time broadcasting’ and ‘IT infrastructure management’, makes multimedia broadcast solutions operate well through a mobile carrier’s network.

7.3.2.5. A combination of ‘payment processing’ and ‘network solutions’

Payment processing solutions show a tendency of being combined with network solutions. When a wireless payment terminal is a compatible type with a mobile phone (e.g. smartphone with multi-functions), mobile carriers are likely to offer network services so that B2B mobile service users can utilize both payment process solutions and network solutions. The multi-functional smart device provides B2B mobile service users with various mobile service features.

For instance, LG U+ suggests a bundled service to their potential customers that they may subscribe to its payment processing solution by combining ‘U+ e-Payment’ and its network solutions such as ‘Dedicated Line’, ‘U+ SMS’ and ‘U+ Groupware’.

7.3.2.6. A combination of ‘M2M solutions for facility management’ and ‘network solutions’

Like payment processing solutions, M2M solutions for facility management also show a tendency of being combined with network solutions. In other words, an ‘IT infrastructure management’ characteristic of network solutions strengthens the ‘facility management’ characteristic.

For example, when mobile carriers offer a CCTV service to manage an institution’s facilities, they often consider a storage service to save a large volume of video files recorded by the CCTV. LG U+ makes a bundled service by combining ‘Cloud-Based IP CCTV’ and a storage service. The storage service is designed for a purpose of saving video files for a maximum of 30 days.

7.3.2.7. Converged services of ‘M2M solutions for facility management’

M2M solutions for facility management can also create a service bundle of facility management solutions by combining CCTV DVRs, cameras and network facilities.

7.3.3. Characteristics-based approach to investigate recombinative service innovation

Recombinative innovation often occurs particularly in a new combination of the characteristics of ‘network solutions’, ‘mobile office solutions’ or their combination with the characteristics of other solutions, explaining the different dynamic features of service innovation driven by mobile carriers’ competences.

First of all, mobile carriers often bundle ‘network solutions’ with ‘mobile office’, ‘multimedia broadcast’, ‘payment processing’ and ‘M2M solutions for facility management’. The reason is that the network solutions show such a high tendency of combining with these solutions because they are the mainstream services in the current B2B mobile service market in Korea. Among the total 242 service products, 151 B2B mobile service products (62%) are identified as network solutions. In addition, it may not be an exaggeration to say that the four mobile solutions mentioned above are based more or less on the wired/wireless network.

A combination of network solutions and other solutions provides intensive network management systems to institutional and business users. The four characteristics of existing services such as ‘seamless working condition’, ‘real-time broadcasting’, ‘transaction information delivery’ and ‘facility management’ can be implemented under a stable IT infrastructure when they are combined with ‘IT infra management’, a characteristic of network solutions. The network solutions services help maintain a high level of data security, and its characteristic ‘IT infra management’ supports the final characteristics of the four services. Since the services are provided through mobile carriers’ wired/wireless networks, their service characteristics benefit from the combination with network solutions, when it is compared with being provided alone.

Secondly, ‘payment processing’ solutions can be bundled either with ‘network solutions’ or with ‘mobile office solutions’. This is caused by the feature of a multi-functional mobile device (i.e. smartphone). When a service builds on smartphone or a mobile computing platform, it becomes easier to include other service solutions as additional mobile applications. Thus, a ‘mobile office solution’ can be transformed to a highly integrative solution by combining ‘seamless working condition’ and ‘transaction information delivery’.

As a result, new services are produced by recombining the characteristics of two existing services (see Table 4-8, p.93), as shown in Figure 7-1.

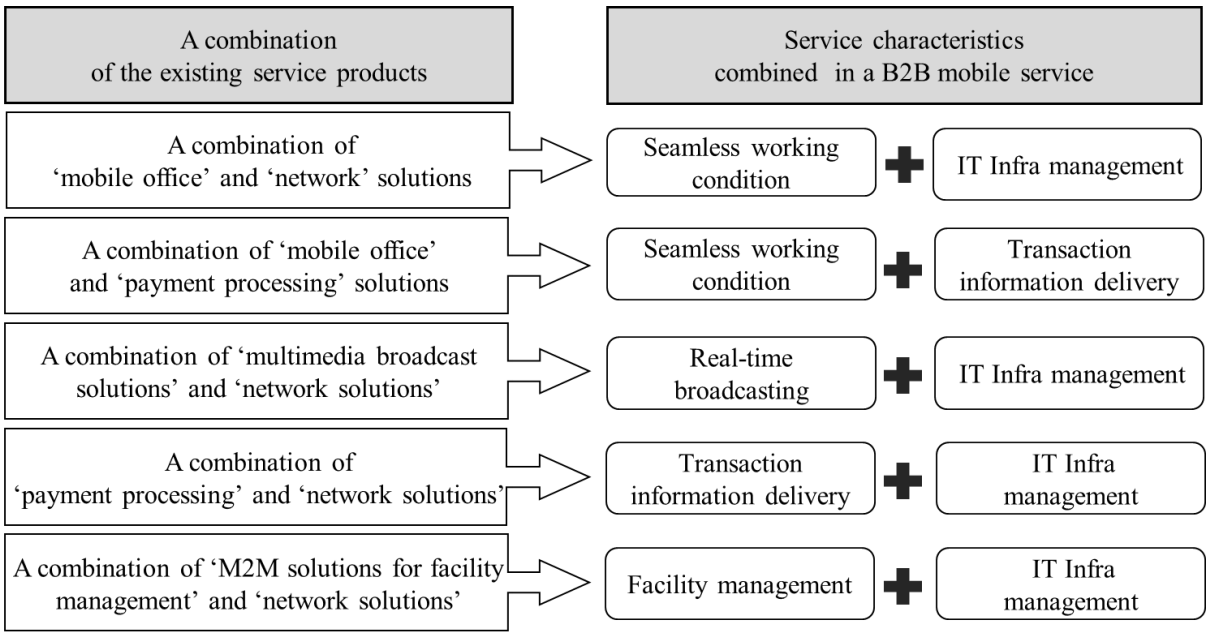

Figure 7-1. Representation of recombinative innovation in B2B mobile service from the characteristics-based approach

Such combinations of existing service products can integrate diverse service characteristics in a single service product and bring a synergy effect, allowing institutional customers to benefit from various service features at the same time. Consequently, the above results present that a combination of different service products brings recombinative innovation, offering diverse service characteristics at the same time.

7.4. Customized Service Innovation in B2B Mobile Services

7.4.1. Key features of customized service innovation

Mobile carriers have made efforts to elaborate a mobile service to satisfy a particular group of institutional customers. There are two main ways of achieving this innovation mode.

Firstly, mobile carriers provide the selection of service components which are related to subscription conditions of a service. This can be called 'adaptive customized' innovation, which is designed to meet a particular group of customers. Such innovation type prevails in pricing. B2B mobile solutions such as mobile office, multimedia broadcast and facility management provide various service options with regard to the types of software (e.g. servers, applications) and hardware (e.g. devices, IT equipments). Thus, B2B mobile

service users can choose one of those options according to their preferences.

Secondly, customized innovation can be investigated when a B2B mobile service is provided for a specific user. It is called ‘fully customized’ innovation. In the provision of B2C mobile services, mobile carriers seem to be mass-producer of standardized service products. However, they also play a role of IT consultants in providing B2B mobile services. When B2B mobile service users build up IT infrastructure or implement highly sophisticated solutions, mobile carriers can offer 1:1 consulting service. They examine the work process of institutional users, investigate the institution’s IT infrastructure including all hardware and software, and then design the customized solutions for specific users. Thus, B2B mobile service users can anticipate the entire service solution and convince themselves to successfully implement the service.

Thirdly, B2B mobile service users can participate in developing or implementing mobile solutions. They deliver their needs and demand for a specific service and help mobile carriers to create a customized service.

The specific examples of customized innovation will be presented below.

7.4.2. Importance of interaction between service provider and user in customized service innovation

Like recombinative innovation, one of the main sources of customized service innovation is mobile carriers’ capability to meet the needs of particular B2B customers. The other source of customized innovation comes from the interface between mobile carriers and B2B service users.

The following sections will present some examples of how mobile carriers satisfy different B2B customers and how they interact with B2B mobile service users.

7.4.2.1. Mobile office/education solutions

A mobile office solution comprises a mobile device (e.g. smartphone, tablet PC), mobile applications as business solutions, a mobile network (e.g. 3G, Wi-Fi, LTE) and a mobile platform. In terms of implementing the mobile platform, mobile carriers provide mobile office solutions in two customized ways with respect to the size of B2B mobile service users. Figure 7-2 shows two types of the implementation of mobile office solutions.

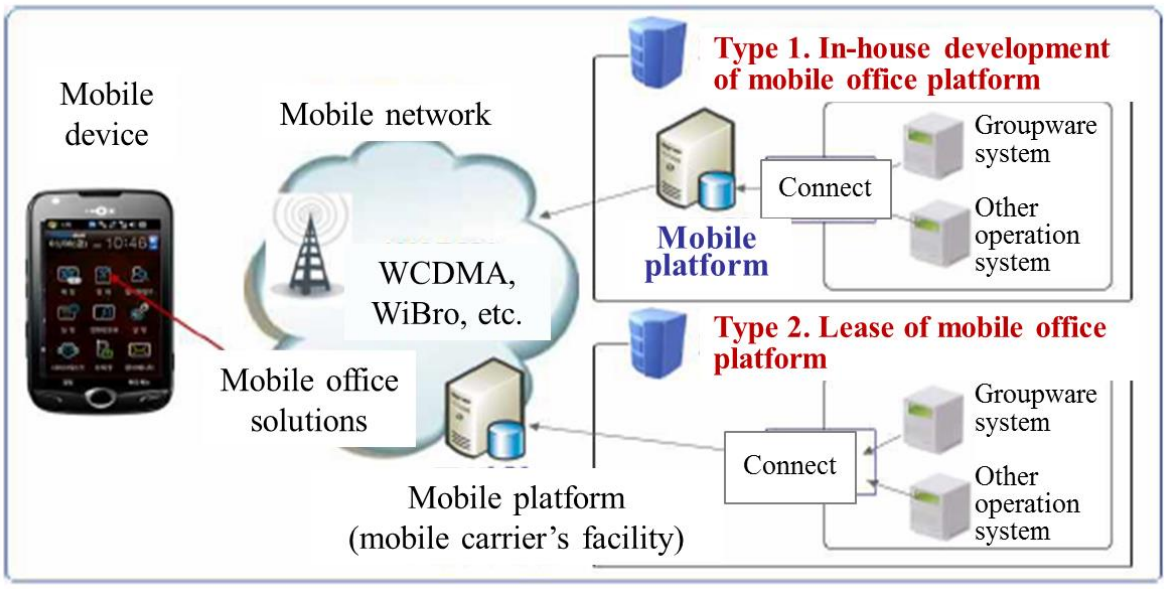

Figure 7-2. Customization of implementing mobile office solutions

Source: The National Information Society Agency (NIA), CIO Report Vol.26, 2010.

One way is an in-house development of mobile office platform in the institutional (or business) user's system, particularly in large institutional users. The other way is to rent the mobile office platform to B2B service users. Small and medium-sized institutional users that need basic groupware services can benefit from using a mobile carrier's facility and save the cost of building up mobile platform by paying a monthly rate.

In terms of service features, mobile office solutions can be categorized as groupware services (e.g. email, scheduling, electronic approval), voice communication services (e.g. free interphone in Wi-Fi zones, IP phone) and specialized solutions for specific industries. The specialized industry solutions are often customized by mobile carriers to create a mobile office solution that is tailor-made to the B2B service user's specific needs. KT provides various customized mobile office solutions by industry. The solutions are implemented by in-house development for mobile applications. KT offers the customized solutions through collaboration with external partners. It designed several service offerings such as 'mobile hospital' for medical institutions, 'sales force automation' for financial institutions, 'smart campus' for educational institutions, 'Production Information Management System (PIMS)' for construction companies, 'logistics solution' for transportation companies and 'after-service support solution' for on-site business. In addition, it provides a specialized mobile office solution for small and medium business (see Appendix 3).

SK Telecom designed ‘T Biz Hospital’ for medical institutions. The service provides doctors and nurses with easy and fast access to medical data via smartphone or tablet PC, enabling useful service platforms such as Electronic Medical Record (EMR), Order Communications System (OCS) and Picture Archiving and Communication System (PACS). SK Telecom offers further customized solutions by dividing ‘T Biz Hospital’ into two versions: for doctors and for nurses.

On other hand, a mobile carrier provides a customized mobile education solution to a specific B2B service user. When a large-sized B2B customer has a specific demand, the mobile carrier can provide customized development of educational contents. In addition, KT’s ‘e-Library’ allows B2B service users to create their own content and to digitalize it. Thus, they can co-produce the digital contents of ‘e-Library’.

7.4.2.2. Network solutions

Mobile carriers introduce many packaged services (i.e. service bundles) that are pre-defined by themselves to meet a variety of B2B customer needs and demand. They also unbundle the existing service products because a small-sized, service-centric company may not require many service functions. They may prefer a basic service function at a low price.

Figure 7-3 shows how KT customizes network solutions with respect to the size of institutional users. KT offers a variety of network services ranging from ‘Smart G/W’ for small-sized institutional users to ‘Managed IP-PBX (Private Branch Exchange)’ for large institutional users.

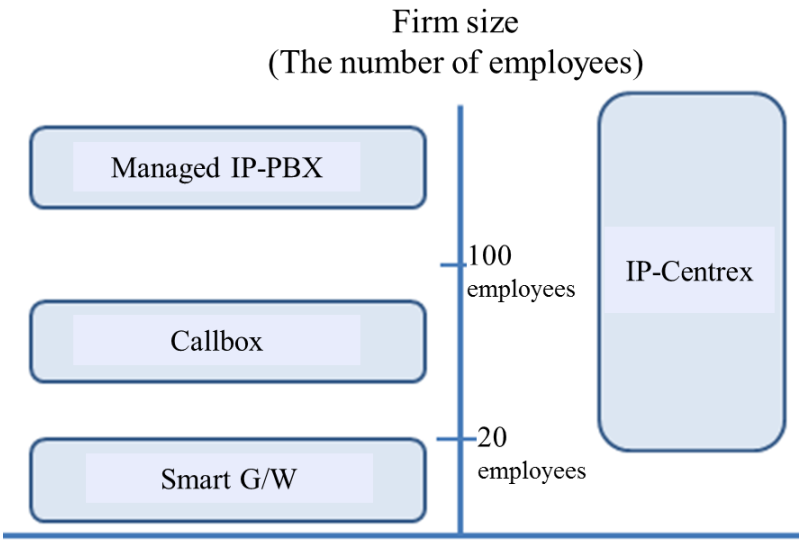

Figure 7-3. Customized network solutions with different customer sizes

Source: KT website (http://biz.olleh.com)

In addition, B2B mobile service users can choose different methods to implement network solution: an equipment built-in type and a web service type.

For example, institutional users using KT's 'Bizmeka Video Conference' can either build up a videoconferencing room within their offices by purchasing the relevant equipment such as a codec, which is a device capable of encoding and decoding a digital signal and displays (e.g. PDP, LCD), or they adopt a IP-based videoconferencing service by leasing mobile carrier's server which charges monthly fixed-rate and using a PC monitor. Figure 7-4 shows an equipment built-in type and Figure 7-5 represents a web service type of implementing the video conference solution.

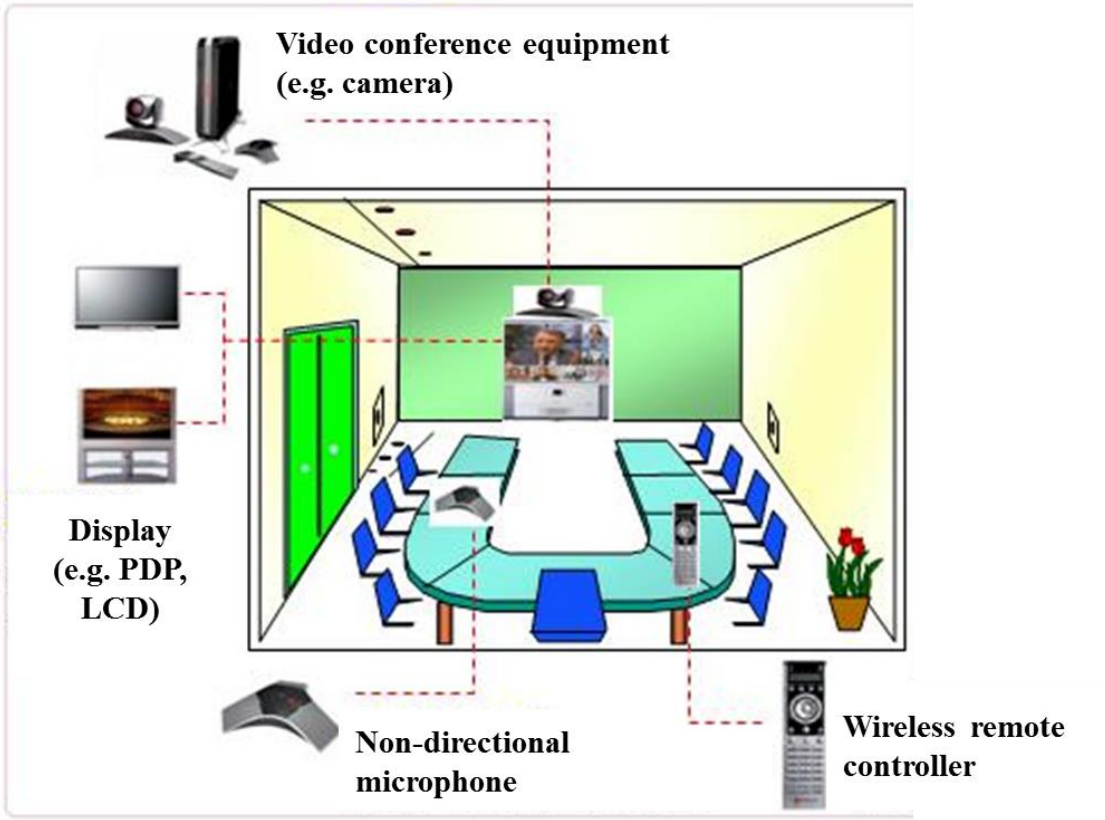

Figure 7-4. Equipment built-in type of implementing the video conference solution

Source: KT website (http://biz.olleh.com)

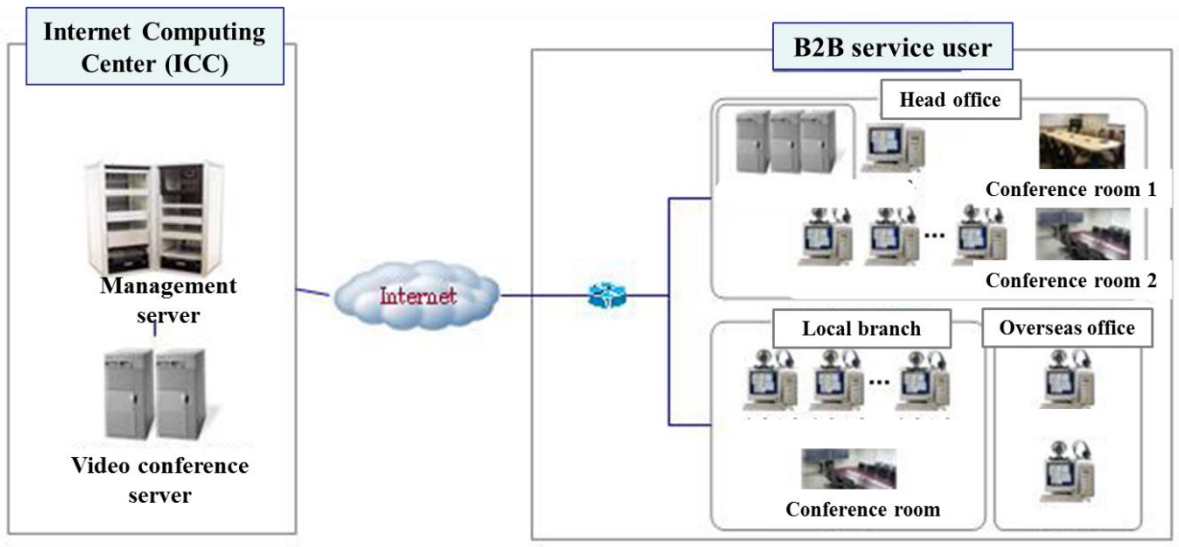

Figure 7-5. Web service type of implementing the video conference solution

Source: KT website (http://biz.olleh.com)

Hence, the institutional users are able to choose the most appropriate service price and components according to size, business purpose and office IT environment of institutional users. This would create the maximum customer benefit.

In addition to video conference between distant locations of two branches, 'Bizmeka Video Conference' offers customized video education solutions to hospitals and educational institutions. Hospitals can share medical information and it enables a real-time telemedicine service as well as a medical education forum. KT designs Internet-based distance learning courses. When its B2B customer wants to expand the internal education program by tying up with other programs of an external educational institution, KT can support to build the customized video education system for the customer.

Before B2B mobile service users adopt a cloud service, mobile carriers usually offer 1 to 1 consulting service in order to help the users to select the appropriate service type. This is considered as 'fully customized' innovation because the mobile carriers service the specialized solution for a specific customer, which may be different from a service offered to other customers. The customized consulting maximizes the efficiency of institutional user's operating IT system.

7.4.2.3. Multimedia broadcast solutions

Mobile carriers offer customized multimedia broadcast solutions that allow B2B mobile service users to create any video content that they want. Thus, B2B mobile service users can customize themselves based on their preferences. The customized contents are utilized for various purposes such as information sharing, promotion, marketing and employee training.

In addition, KT segments ‘Mugunghwa Satellite’ into several sub-service solutions to meet different demands of B2B mobile service users. For instance, KT transmits broadcasting contents between two broadcasting stations or between distant locations in an institution. It can also offer a back-up service to large-sized B2B mobile service users such as governments and financial institutions.

7.4.2.4. Business analytical solutions

This service solution show many examples of customized services.

For example, SK Telecom provides ‘Cloud BEMS (Building and Energy Management System)’ which analyzes the information on energy consumption and system operation to improve energy efficiency of institutional users. This cloud-based analytical solution can also be customized according to the needs and demand of B2B service users. For example, B2B service users’ preference of a size of the system (e.g. the number of buildings that the system covers) brings many chances for mobile carriers to provide various customized solutions.

SK Telecom’s ‘Landmap’ provides software developed by linking B2B service user’s customer information with geographical information. The B2B service user builds up the customer database on the digital map and conducts a multidimensional analysis of its customer’s information. In addition, the software can import their existing data from Excel and can automatically transform the coordinates of the Excel file data into the digital data on ‘Landmap’. Hence, B2B service users can build up their own customized database.

KT aims to develop more customized solutions to meet various user needs and to consider various industry environments. It offers various business analytical solutions for very specific industries, for instance ‘Bizmeka Food’ for distribution companies of food products, ‘Bizmeka Highway’ for vehicle maintenance service providers and ‘Bizmeka U-Care’ for healthcare service providers.

7.4.2.5. Payment processing solutions

KT provides a specialized payment processing solution for taxi companies, which is called ‘Brand Taxi’. The ‘taxi call’ program installed in a navigation device traces the location of a taxi through GPS, and delivers the location information via KT’s mobile network. The service includes a credit card payment solution. As KT possesses different types of GPS platforms and network offerings such as 3G and WiBro, it can offer the customized taxi payment processing solution that is optimal for different regions. Taxi companies can choose a suitable device type and an optimal billing method among service offerings.

7.4.2.6. M2M solutions for facility management

B2B mobile service users can be customized by choosing the range of implementing the M2M solution for facility management. They can deliver their demands to a mobile carrier, for instance, by determining the number of CCTVs that will be installed in their workplaces.

Moreover, B2B mobile service users are provided with the customized facility management system designed to meet their specific requirements so that they can carry out management of facilities by themselves.

7.4.3. Characteristics-based approach to investigate customized and co-produced service innovations

7.4.3.1. Two types of customized service innovation

The other mechanism is ‘customized’ way of mobilizing service characteristics (i.e. customized innovation). Customized innovation can be achieved when mobile carriers offer the solutions for specific industries based on a pre-defined market segment. A common example of this innovation is presented in the implementation of mobile office solutions, network solutions and M2M solutions for facility management. Mobile carriers offer an equipment built-in type (i.e. purchase of equipment and platform) to large-sized customers while they recommend a web service type (i.e. lease of facilities) for small and medium-sized customers.

An example of ‘adaptive customized’ innovation can be seen in the development of

mobile office solutions and business analytical solutions. These two solutions provide specialized services for a particular industry participant. B2B customers that use mobile carrier solutions engage in numerous business activities in various industries. Hence, mobile carriers have tried to understand those various needs and demands of B2B mobile service users. They aim to develop a broad range of business solutions that can meet their existing and potential B2B customers.

In addition, the service characteristics customized at the interface between mobile carriers and B2B mobile service users tend to bring 'fully customized' innovation to B2B mobile services. Unlike 'adaptive customized' innovation, this innovation may not be recognized until after the service has been provided to users. Such an innovation usually appears during the process of delivering a consulting service related to network solutions. Such consulting service is offered especially for a B2B customer that expresses its particular demand. Thus, a mobile carrier becomes a private consultant for the customer to find an optimal solution.

Figure 7-6 illustrates the different dynamics of customized innovation among B2B mobile service groups.

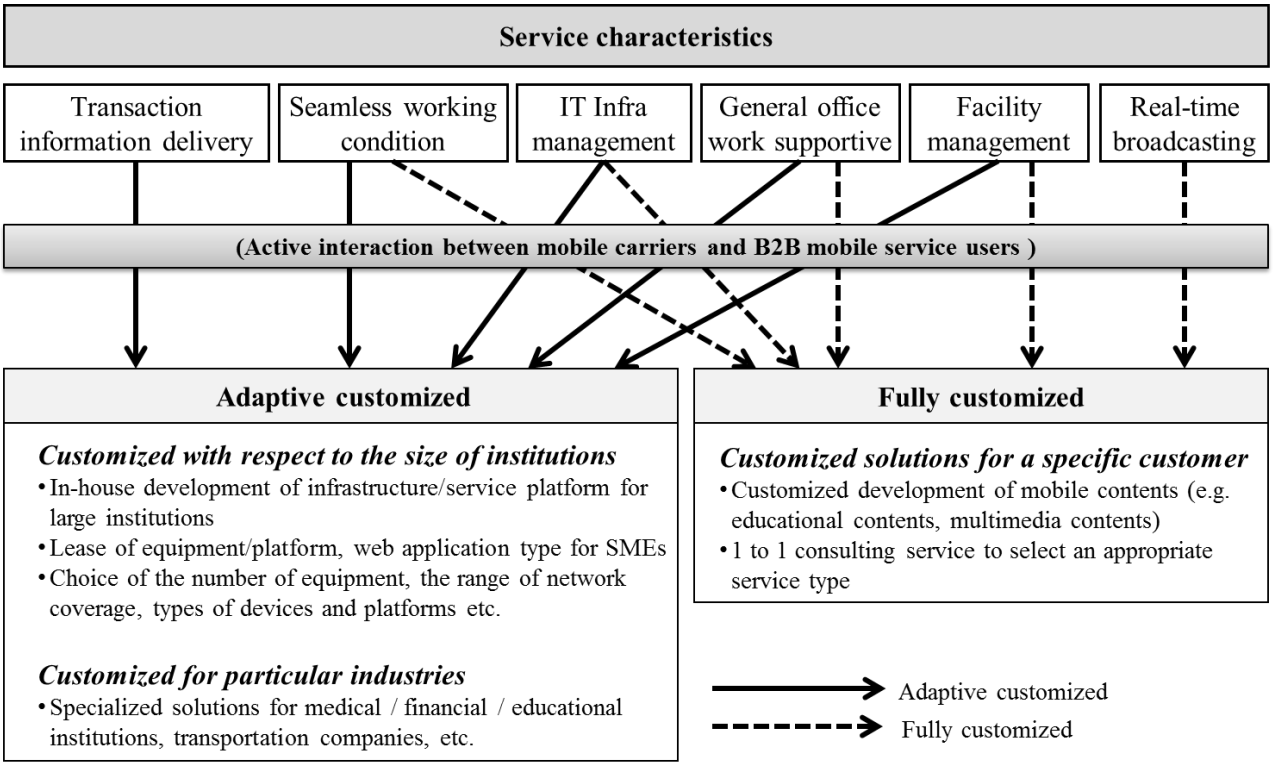

Figure 7-6. Representation of customized innovation in B2B mobile service from the characteristics-based approach

7.4.3.2. Further investigation of co-produced service innovation

The investigation of customized innovations in B2B mobile services further highlights the co-produced features of service innovation. B2B mobile service users participate in the development of a certain mobile solution such as mobile education, business analytical solutions and multimedia broadcast solutions. The similarity of the three solutions is to allow B2B mobile service users to create their own contents so that they can design the business solutions according to their preferences. Hence, active interaction between mobile carriers and institutional users brings ‘co-produced’ innovation, allowing institutional users to create a customized service characteristic through co-production with mobile carriers.

7.5. Summary of the Results

This chapter explored the dynamic competences of mobile carriers and B2B customers used in the different types of innovation from the service-oriented perspective.

The mobile carriers recombine the characteristics of the existing services or develop specific mobile solutions for a particular B2B customer. The new services are made at the interface between the mobile carriers and B2B mobile service users. B2B mobile service users not only deliver their specific needs to mobile carriers, but also participate in the development of mobile solutions as co-producer of service innovation. Hence, the mobile carriers and institutional users can interact with each other in many cases.

From the service-oriented perspective, such competences of mobile carriers and B2B mobile service users lead to ‘recombinative innovation’, ‘customized innovation’ and ‘co-produced innovation’. These service innovations highlight the role of mobile carriers and the importance of interaction with B2B mobile service users, as shown in Table 7-2.

Table 7-2. Service-oriented innovation in B2B mobile services and corresponding competences of mobile carriers and B2B customers

Types of service innovation		Main category of service group	Competences of mobile carriers and B2B customers
Service -oriented innovation	Recombinative innovation	-Network solutions -Payment processing solutions -M2M solutions for facility management -Mobile office solutions -Multimedia broadcast solutions	**Mobile carriers** -Knowledge or techniques related to methodologies for designing a service product -Know-how of utilizing the existing product line, pricing system, network, etc.
	Customized innovation	-Network solutions -Mobile office/education solutions -Multimedia broadcast solutions -Business analytical solutions -Payment processing solutions -M2M solutions for facility management	**Mobile carriers** -Understanding user needs and demand -IT consulting know-how -Marketing strategies (e.g. market segmentation and customer targeting) **B2B customers** -Clear vision and objectives of adopting the innovative mobile solution -Familiarity with smartphone and other advanced technologies
	Co-produced innovation	-Mobile education solutions -Multimedia broadcast solutions -Business analytical solutions	**Mobile carriers** -Ability to meet the specific needs of a particular B2B customer -Customer relation skills **B2B customers** -Preference for state-of-the-art technology -Advanced technological knowledge of creating mobile contents and service design according to their preferences

Firstly, mobile carriers create recombinative innovation by mobilizing the characteristics of the existing service products. They produce new service products by bundling ‘network solutions’ with many solutions such as ‘mobile office’, ‘multimedia broadcast’, ‘payment processing’ and ‘M2M solutions for facility management’. ‘Payment processing’ solutions are often combined with ‘mobile office solutions’, and thus B2B mobile service users can benefit from multiple service functions.

Secondly, customized innovation is produced at the user/producer interface. Mobile carriers develop customized service offerings to meet particular customer’s demands with respect to B2B customer’s characteristics (e.g. institution’s size and industry). Such innovation plays an important role in enriching the idea of creating diverse service

products and attracting many profitable potential B2B customers. Customized innovation allows B2B mobile service users to choose the optimal solution among the pre-defined packages made by mobile carriers. It also emphasizes the role of mobile carrier's direct competence as a private IT consultant for institutional or business users.

Thirdly, in the case of co-produced innovation, mobile carriers design a customized service for a specific B2B mobile service user. B2B mobile service users play an important role as active innovators not only by delivering their needs and preferences to mobile carriers but also by participating in service design and implementation. Such participation brings co-produced innovation. Thus, co-produced innovations make a particular service characteristic beneficial for a specific B2B mobile service user. In particular, many services can be self-provided. Since users can serve themselves in many cases, it seems reasonable to speculate that it is also possible for users to innovate with respect to the services they deliver to themselves (Oliveira and von Hippel, 2011).

These types of innovation may not be achieved through long-term R&D or technological advancement. However, service-oriented innovation can be drawn from existing resources by utilizing them creatively in modification or combination with new ones and by providing a customized service product to particular customers.

The next chapter will discuss the research findings from the integrated perspective and propose a new framework to analyze innovation in services.

CHAPTER 8. THE INTEGRATED PERSPECTIVE ON INNOVATION IN B2B MOBILE SERVICES AND THE REVISED FRAMEWORK

8.1. Introduction

The studies of service innovation conducted in this thesis have a potential of contributing to the implementation of the 'integrated perspective' on innovation by pointing out the features of service-oriented innovation that have been relatively ignored in the studies of mobile industry, compared to a technology-focused approach to innovation in the mobile sector. This approach takes the blurring boundaries between manufacturing and services into account, and thus applies integrated perspective on innovation that is not restricted to the traditional manufacturing-services dichotomy (Drejer, 2004). As mobile service and device development activities are increasingly intertwined, the distinction between manufacturing and service industries is becoming unclear in the mobile sector. The convergence trend[59] of technologies and services which have developed separately in different industries has increased new business opportunities for mobile carriers.

Within this background, it is necessary to work towards updating the research framework of this thesis to rethink the dynamics of mobile service innovation from the integrated perspective. The revised framework and the discussion of this chapter will show the potential for a new scheme to distinguish different innovations.

This chapter is structured into four sections. Section 8.2 reinterprets the research findings on the dynamics of innovation in B2B mobile services from the integrated viewpoint. Based on the discussion of Section 8.2, Section 8.3 revises and updates the framework to analyze service innovation. Section 8.4 provides a summary.

[59] Some examples of the converged service are Digital Multimedia Broadcasting (DMB) (i.e. convergence between broadcasting and mobile), telematics (i.e. convergence between automobile and mobile) and mobile banking (i.e. convergence between finance and mobile).

8.2. Rethinking the Dynamics of Innovation in B2B Mobile Services from the Integrated Perspective

8.2.1. Intermediate features of pure services and tangible products

Based on the review of prior literature[60] on the differences between products and services, this section examines how far away the mobile telecommunications service is from physical products and pure services, and discusses the distinct specificities of mobile telecommunications service.

Although products and services are fundamentally different, they are intimately and symbiotically linked (Shostack, 1984). The distinction between products (or goods) and services is not as strict as the previous studies suggested. Instead of drawing a distinction between goods and services, it makes more sense to see them as the extremes of a goods-services continuum (Bouwman et al., 2008).

Mobile telecommunications service also shows intermediate features of pure services and tangible goods. When it is compared to pure services (e.g. healthcare and personal services), the mobile service is relatively mass-produced and standardized. These features would help mobile telecommunications services to offset service-oriented disadvantages[61].

First of all, the service offering can hardly be separated from physical goods such as mobile phone, networking equipment and relevant IT devices. In order for the mobile service to be beneficial for a user, mobile devices should be provided with the service offering. The analysis of B2B mobile carrier service shows that mobile office/education solutions are based on a smartphone and its operating system. The various services of Mobile Campus (e.g. mobile education, e-library, mobile student identification and micro-payment) are all implemented through the utilization of smartphone. Hence, the development of a new mobile service is closely interrelated with the development of mobile devices.

In addition, due to the evolution of ICT standardization, mobile telecommunication services can maintain the same service qualities (e.g. call quality, wireless internet connection) in any mobile device manufactured by any handset makers. The global standard organizations, including 3GPP (the third Generation Partnership Project), 3GPP2

[60] The specificity of services which makes difference from physical products can largely consist of intangibility, inseparability, perishability, heterogeneity and customer participation in the service process (discussed in Section 2.2.1).

[61] The five specificities of services can be a challenge for service providers to achieve innovation.

(the third Generational Partnership Project 2) and ITU (International Telecommunication Union), and a domestic standardization body such as TTA (Telecommunications Technology Association, Korea) provide the technical standards in the field of telecommunications, ICT and broadcasting. Thus, standardization of mobile technologies helps to maintain the quality of mobile services.

8.2.2. Comparison of innovations in product-based services and pure service

8.2.2.1. Innovation in product-based services

The evolution of mobile device technologies influences the development of a new mobile service. The technological characteristics in various functional layers[62] have brought incremental or radical changes of service characteristics, forming the three types of innovation: incremental, radical and semi-radical innovations. Many characteristics of the B2B mobile carrier services highly depend on the functionalities of a smartphone or smart devices (e.g. tablet PC, PDA, RFID reader). Thus, the development of advanced mobile devices proved to be a catalyst for achieving service innovation.

Firstly, advanced mobile devices can bring incremental innovation. Smartphone, which is equipped with radio-frequency circuit, integrated circuit (IC) chip and payment processing platform has enhanced the characteristic of 'transaction information delivery'. Security for a vehicle or a driver has been enhanced through the utilization of a mobile device equipped with GPS sensors.

Secondly, smartphone also induces semi-radical innovation. For instance, 'mobile office/education solution' is a smartphone-based B2B mobile service. Smartphone and various applications based on its OS have enabled seamless working environment by changing the traditional work style and creating a flexible mobile workplace so that workers can carry out routine work anytime, anywhere.

Lastly, the utilization of an advanced wireless device can drive radical innovation in 'M2M solutions for facility management'. Machine-to-Machine communication between RFID readers and IP network brought radical systemic changes to institutional customers by enabling auto-monitor of a building's entrance.

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[62] Fransman (2002) proposes a four-layer model of ICT industry, which consists of networked elements (Layer I), network operating (Layer II), content / applications / services / innovation platforms / search / navigation / middleware (Layer III) and final consumption (Layer IV).

8.2.2.2. Innovation in pure services

On the contrary, B2B mobile carrier services can be characterized by service-oriented competences of mobile carriers. A mobile carrier plays the role of IT consultant as well as the technology developer of fixed and mobile networks. They offer 1:1 consulting service to a specific institutional customer in order to help find an optimal service product. They also examine the process of building IT infrastructure and provide a 24-hour monitoring service of operation equipment as well as network. Such features are very similar to a traditional consulting service. This type of services can be often seen in the service group of 'network solutions' and 'M2M solutions for facility management'.

Although the final characteristics of a new mobile service seem to rely heavily on ICT technologies, the provision of B2B mobile services often needs a mobile carrier's direct competences which may not be related to technological advancement. This makes mobile carriers achieve customized innovation, creating tailor-made solutions designed to meet their specific requirements of a particular customer.

Such service-oriented innovation may not bring a radical change to the characteristics of B2B mobile services, but it can make a particular service characteristic beneficial for a B2B mobile service user. When we consider that there exist a variety of institutional users in terms of customer size, industrial classification and market needs, customized service innovation enables mobile carriers to obtain continuous growth potential in the B2B mobile market.

8.2.3. The role of product-related technologies in service-oriented innovation

The findings from the analysis of recombinative service innovation revealed a frequent combination of 'mobile office solutions' and 'payment processing solutions', and many combinations between 'network solutions' and other B2B mobile carrier services. Such combination patterns among the mobile services may be explained by the technological characteristics related to a smartphone.

Firstly, 'mobile office solutions' show a tendency of being combined with 'payment processing solutions'. From the technological perspective, such combination pattern of the two services can be explained by multi-functional characteristics of a smartphone. In terms of hardware characteristics, smartphone can be equipped with multiple functions. Radio-frequency circuit and integrated circuit (IC) chip, which are needed for transaction

information delivery, can be attached to the protection cover of smartphone. In addition to hardware functions, smartphone operating system allows many service applications to be implemented on the smartphone-based service platform.

Secondly, mobile carriers often bundle two or more ‘network solutions’ or integrate them with other service solutions. The reason that the network solutions show such a high tendency of combining with other solutions can be found in the characteristics of a dual-mode phone. VoIP services send voice data over the internet rather than traditional public telephone networks (i.e. combination between network solutions). In terms of VoIP-enabled devices, a dual-mode phone supports communication between a cellular network and a local non-cellular network. It enables users to conveniently communicate over voice, video, and SMS between an outside cellular service and an internal Wi-Fi network. Hence, a dual-mode phone based on the converged all-IP network has had a significant impact on the development of a broader range of mobile solutions.

In addition, the technological difference between smartphone OSs can lead to the difference in institutional users’ participation level in co-produced innovation. For instance, Android OS made POSTECH actively participate in the development of Mobile Campus, whereas UNIST, the adopter of iPhone-based Mobile Campus, played a comparatively passive role.

Hence, the various service-oriented innovations driven by the competences of mobile carriers and institutional users can be newly explained in a way that regards product-related technologies as sources of the dynamics of service-oriented innovation in B2B mobile carrier services.

8.2.4. Integrated patterns of innovation in B2B mobile carrier services

This thesis analyzed innovation in B2B mobile carrier services, and as a result, five types of service innovation were identified: incremental, semi-radical, radical, recombinative and customized service innovations. They were distinguished from technological and service-oriented perspectives respectively.

Table 8-1 summarizes the types of technological and service-oriented innovations according to the seven service groups by linking the research findings of the three chapters. The seven service groups of B2B mobile carrier services (findings of Chapter 4) showed different innovation types in terms of both technological (findings of Chapter 6) and service-oriented perspectives (findings of Chapter 7).

Table 8-1. Summary of the innovation types according to service groups

Category of service groups (Chapter 4)	Types of service innovation	
	Technological perspective (Chapter 6)	Service-oriented perspective (Chapter 7)
Mobile office/education solutions	Semi-radical innovation	Recombinative innovation, Customized innovation, Co-produced innovation
Network solutions	Incremental innovation	Recombinative innovation, Customized innovation
Multimedia broadcast solutions	Incremental innovation	Recombinative innovation, Customized innovation, Co-produced innovation
Business analytical solutions	Semi-radical innovation	Customized innovation, Co-produced innovation
Security and safety solutions	Incremental innovation	(Potential of recombinative innovation)[63]
Payment processing solutions	Incremental innovation	Recombinative innovation, Customized innovation
M2M solutions for facility management	Radical innovation	Recombinative innovation, Customized innovation

When these findings are connected to each other, we can reach the conclusion that technological and service-oriented innovations are occurring in the same service groups. Such a result is presented in previous innovation studies. Gallouj (2002) insists that what is generally known as customized innovation can be included in incremental innovation. He also described that incremental innovation based on the addition of characteristics can be regarded as a form of recombinative innovation, particularly when the added characteristics originated from the existing service products. Hence, a mode of service innovation does not occur alone. Two or more types of innovation seem to co-occur with other innovations.

Figure 8-1 shows that the characteristics of B2B mobile carrier services are obtained by mobilizing simultaneously technological characteristics and the competences of mobile carriers and their customers. Those changes in service characteristics often make multiple innovations interlinked with each other in dynamic ways. Five common patterns of

[63] Service-oriented innovation in ‘security and safety solutions’ was not highlighted in Chapter 7. However, this service group also has a possibility of being bundled with ‘mobile office solutions’ or with ‘network solutions’, due to the technological characteristics of multi-functional smartphone and FMC network.

innovations were found, as presented in Figure 8-1.

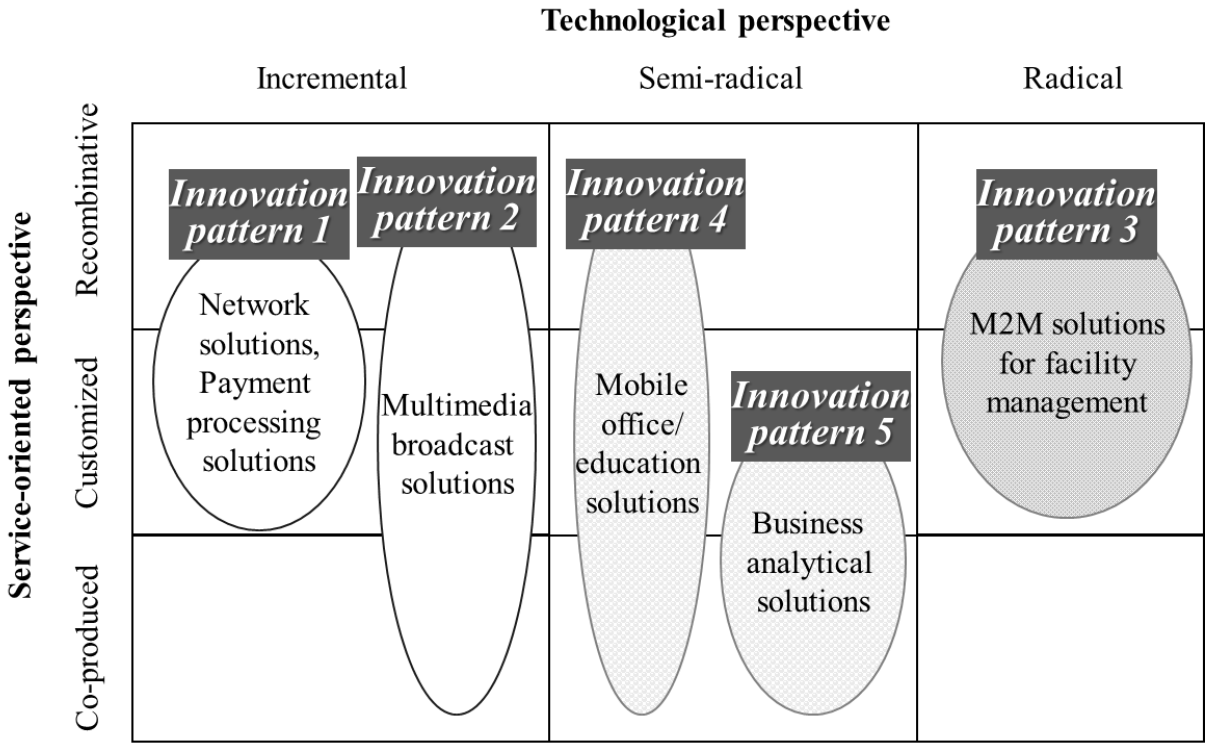

Figure 8-1. Integrated patterns of innovation in B2B mobile carrier services

First of all, recombinative and customized innovations (from the service-oriented perspective) are achieved with incremental innovation (from the technological perspective) in two B2B mobile service groups, which are network solutions and payment processing solutions. Secondly, the incremental innovation is integrated with recombinative, customized and co-produced innovations in multimedia broadcast solutions. Thirdly, recombinative, customized and radical innovations are found in the M2M solutions for facility management. Fourthly, the three service-oriented innovations are integrated with semi-radical innovation in the mobile office/education solutions. Lastly, the semi-radical innovation tends to occur in business analytical solutions, together with customized and co-produced innovations.

Therefore, there is a need to propose a new framework which can explain such patterns of innovation by integrating technological and service-oriented perspectives.

8.3. Proposing a New Framework from the Integrated Perspective

8.3.1. Revision of the conceptual framework

In Chapter 3, the thesis developed a comprehensive approach to analyze the factors affecting innovations in B2B mobile services. The service innovations were discussed from the two different perspectives. From the characteristics-based approach, a scheme for distinguishing new and improved service characteristics was devised by applying the concept of the paradigm shift to the framework. It enabled us to define incremental, radical and semi-radical innovations in the conceptual framework from the technological perspective (Figure 3-3). Then, the competences of mobile carriers and the increasing role of institutional users were clarified in mobile service innovation from the service-oriented perspective (Figure 3-4). However, the discussion on service innovation was based on the separate analyses of technological and service-oriented innovations. Therefore, the framework of the thesis needs to be revised in order to integrate the two perspectives.

To explain the integrated patterns of service innovation, a new framework was proposed to describe how a series of changes in service characteristics lead to multiple types of service innovations. Figure 8-2 presents the revised framework from the integrated perspective on service innovation.

This framework has some advantages compared to the original framework (Figure 3-3 and 3-4). First of all, it can explain the multi-directional interaction between technologies, service providers and institutional users by integrating both technological and service-oriented perspectives. It clarifies the different dynamics of characteristics of a certain product/service because innovation can be analyzed in the product level. Hence, it can cover innovation in very small service firms and can make comparisons among different service firms or among different service groups within a firm.

Consequently, six integrated patterns of innovation are created in the new framework: incremental, additive, reciprocal, disruptive, transformational and breakthrough innovations. The details of the six innovation types will be discussed in the next section.

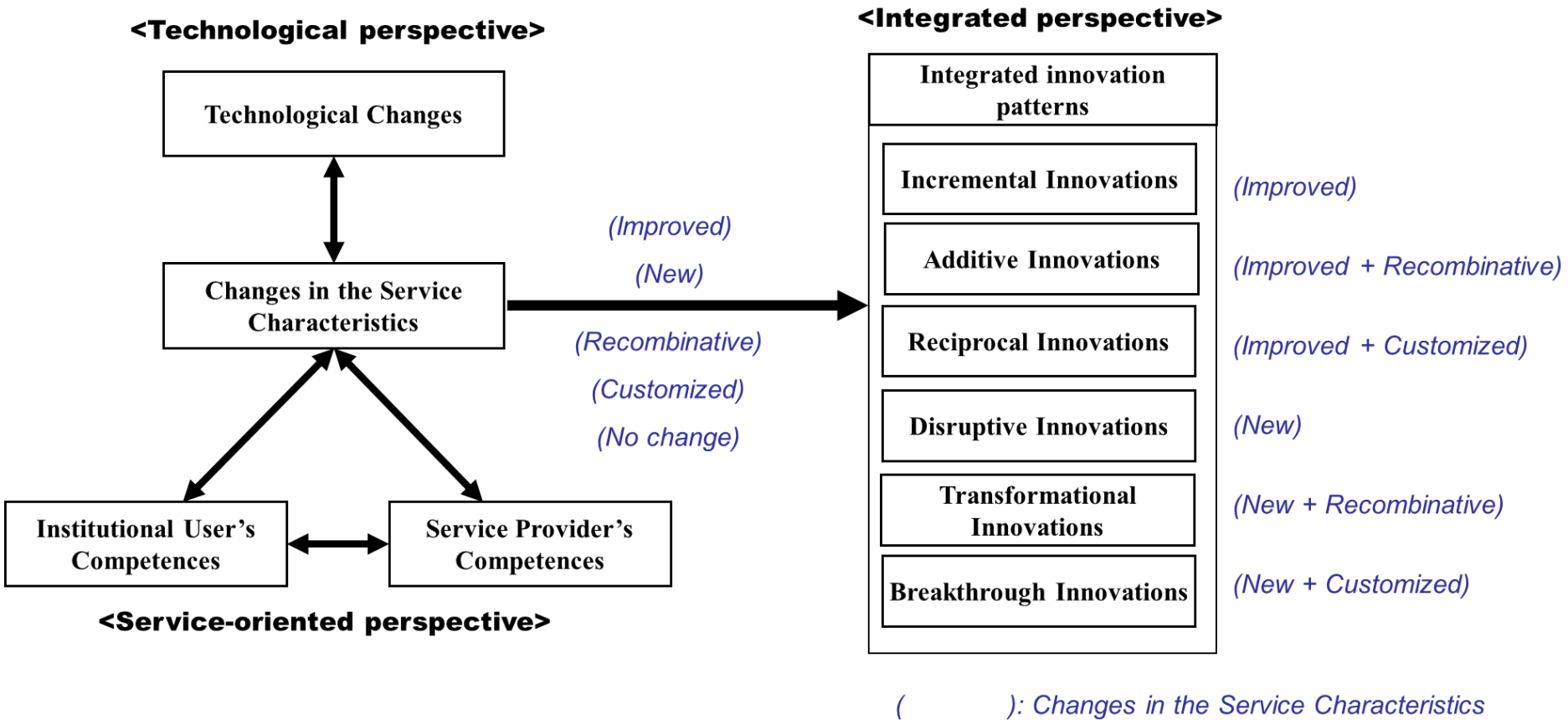

Figure 8-2. The revised conceptual framework from the integrated perspective on innovation in services

8.3.2. New types of service innovation based on the revised framework

The revised framework in this chapter helps to clarify the integrated patterns of different innovations according to the changes of the service characteristics.

From the technological perspective, the number of occasions that a change occurs in service characteristics is two: improved and new. The service characteristics can be improved or some new service characteristics newly emerge due to the technological changes.

In addition, the competences of service providers and institutional users can bring a new set of service characteristics by combining some service characteristics with others (i.e. recombinative) or by modifying them to meet particular customer's requirements (i.e. customized). Hence, from the service-oriented perspective, the number of occasions of possible changes in service characteristics is three: recombinative, customized and no change.

Such dynamic changes of the service characteristics from the two perspectives are combined with each other, and consequently produce six types of service innovation. Table 8-2 presents the integrated patterns of innovation in services.

Table 8-2. The integrated patterns of innovation in services

Changes in the service characteristics	Types of innovation	Description
Improved	Incremental	A service product whose main characteristics existed before but have been 'improved'
Improved + Recombinative	Additive	A service product made by combining or splitting its 'improved' service characteristics
Improved + Customized	Reciprocal	A service product consisting of a set of 'improved' service characteristics, which is customized to meet the needs of a particular type of customers
New	Disruptive	A service product whose main characteristics are 'new'
New + Recombinative	Transformational	A service product made by combining or splitting its 'new' service characteristics
New + Customized	Breakthrough	A service product consisting of a set of 'new' service characteristics, which is customized to meet the needs of a particular type of customers

Considering that innovation is the introduction of a good or service that is new or improved, the six innovations in this framework can be identified by using market introduction of new products/services as an innovation output indicator.

Firstly, some existing services characteristics are enhanced after a technological change, improving the service quality. It can produce a new service whose performance is higher than previous services. This type of innovation is called ‘incremental’ innovation.

Secondly, the improved service characteristics are combined with other service characteristics under a new brand name. The set of improved service characteristics can be used to launch a new service which has more service benefits than previous services. This type of innovation is called ‘additive’ innovation because the existing service characteristics have been incrementally improved through a two-dimensional change resulting in the introduction of a new service with the addition of service characteristics.

Thirdly, the improved service characteristics are changed to meet the specific requirements of institutional users. It can develop a customized service for particular institutional sizes or industries. This type of innovation is called ‘reciprocal’ innovation because the innovation is made by the interaction between service providers and institutional users.

Fourthly, there are some services characteristics that did not exist in the past but newly emerged after a significant technological change. It can produce a new service that has strong impact on market in terms of offering new service values to institutional customers. This type of innovation is called ‘disruptive’ innovation.

Fifthly, the new service characteristics are combined with other service characteristics under a new brand name. The set of new service characteristics can be combined with other service characteristics or can be split into small groups, creating a number of basic-level services. This type of innovation is called ‘transformational’ innovation because the service characteristics have been transformed from the germination stage (i.e. they did not exist before) to the development stage of many new services.

Lastly, the new service characteristics are changed to meet the specific requirements of institutional users. It can develop a customized service for a very specific customer, and the institutional customer plays a crucial role in developing the service. This type of innovation is called ‘breakthrough’ innovation because the service characteristics have undergone the most considerable change among the six innovations, in terms of technologies, service provider’s competence and institutional user’s participation in service innovation.

8.4. Summary

In this thesis, the discussion on technological and service-oriented perspectives on service innovation demonstrated that the dynamics of innovations exist in the B2B mobile services. The conceptual framework was developed through extensive research from the case study of Mobile Campus to the analysis of B2B mobile carrier services. The characteristics-based approach of this thesis reveals three competencies essential for B2B mobile services to be successful in the market: building mobile carrier's direct competences to produce a new service brand, managing direct and indirect technologies related to mobile services and mobile service user's involvement in service innovation. The final characteristics of B2B mobile service are obtained by mobilizing these three competences.

For further analysis, this chapter presented the integrated perspective on innovation and identified the five integrated patterns of innovation in B2B mobile services. Such findings enabled me to update the framework to increase the comprehension of innovation dynamics of the current B2B mobile carrier services, which integrates both technological and service-oriented perspectives.

The revised framework established a new scheme to capture innovation in services. Six types of innovation were defined according to the different dynamics of changes in service characteristics: incremental, additive, reciprocal, disruptive, transformational and breakthrough innovations. It can contribute to the general field of case studies by proposing an integration of the theoretical scopes of technological and service-oriented innovations. When we consider the current trend towards convergence of different industries and the blurring of the boundaries between products and services, the comprehensive framework may be applied to other service sectors or even manufacturing sectors.

The next chapter will provide the conclusion of the thesis.

CHAPTER 9. CONCLUSIONS AND IMPLICATIONS

This thesis identified the dynamics of service innovations in B2B mobile carrier services through in-depth examination in the mobile business solution services provided by the three Korean mobile carriers.

Chapter 9 will conclude the thesis by summarizing the research findings and by presenting the contributions of this thesis. Section 9.1 reviews and summarizes the findings of the thesis. Section 9.2 draws the implications for mobile carriers, section 9.3 for other industries and section 9.4 for policy makers. Section 9.5 presents the theoretical contribution to service innovation theory and discusses the implications for future studies.

9.1. Main Findings

9.1.1. Service innovations in Mobile Campus and active involvement of universities

The empirical study on the dynamics of innovation in B2B mobile services began with the analysis of service innovations in Mobile Campus. Different service innovations were analyzed in Mobile Campus with respect to the key theoretical issues on service innovation related to the role of technology, service providers and users.

Firstly, smartphone-based service applications were implemented by providing universities with campus-wide services such as mobile education, mobile-based campus administration system, campus information analytical tools, mobile payment and campus facility management. The advanced technologies related to mobile network, smartphone and various mobile service platforms enhanced the value of pre-existing mobile services (e.g. mobility, information sharing) or created a new service feature of campus facility security. Secondly, mobile carrier-driven innovation demonstrated that mobile carriers utilized professional knowledge and competence to offer innovative mobile solutions of Mobile Campus. Thirdly, user-driven innovation explained that universities clearly delivered feedback and suggestion to the mobile carriers and this enabled the provision of customized services. Such types of innovations in Mobile Campus showed a high potential to discriminate different forms of service innovations from the technological perspective.

In addition, the role of institutional customers is further emphasized. The universities

had clear visions and different objectives of implementing Mobile Campus. Through the high participation of the universities in the service development, the service features of Mobile Campus were implemented differently with regard to the different needs and strategies. In addition, they designed their own mobile educational contents and specialized mobile applications by using their own technological competences. Hence, the role of B2B mobile service users has changed from passive users, who had been served an exclusive service by a mobile carrier, to active users who can develop the service that they want.

From the findings from the case study, the thesis achieved the first sub-research objective: *(1) To evaluate whether general theories of service innovation correspond to the findings from an empirical case of Mobile Campus and to build a conceptual framework for analyzing innovations of B2B mobile carrier service from the findings*. Those findings inspired the research motivation of studying how innovations in B2B mobile carrier services can be analyzed from the technological and service-oriented perspectives.

9.1.2. The dynamic characteristics of the Korean B2B mobile services

The thesis expanded the analysis of mobile service innovation to a study on innovation in the entire B2B mobile carrier services in Korea. In order to achieve the second sub-research objective: *(2) To understand the dynamic characteristics of B2B mobile carrier services*, the thesis applied the characteristics-based approach to analyze the characteristics of 242 mobile service products launched by mobile carriers.

Consequently, seven service characteristics were identified. Through statistical data analysis, B2B mobile carrier services were classified into seven service groups based on those service characteristics. Mobile office/education solutions are characterized by ‘seamless working condition’ that can seamlessly conduct tasks at any time and in any place. Network solutions are characterized by ‘IT Infra management’, providing fast and stable voice and data transmission. Multimedia broadcast solutions are characterized by ‘real-time broadcasting’ that delivers broadcast contents in real time. Business analytical solutions are characterized by ‘general office work supportive’ that provides database-based analytical applications and software to manage large-volume data. Security and safety solutions are characterized by ‘location-based / equipment security /safety’ to protect an institutional user’s equipment in case of theft or loss. Payment processing solutions are characterized by ‘transaction information delivery’ that makes payment on the move or on delivery. M2M solutions for facility management are characterized by ‘facility

management' that secures a building's entrance or large facilities.

Such a variety of B2B mobile carrier services are provided to various types of enterprises and institutions in terms of size and industry.

9.1.3. Paradigm shift that drives innovation in B2B mobile services

By conducting an industry analysis, the thesis answered the first research question: *(1) How have the different dynamics of innovation evolved over time? And what factors have influenced it?* and thereby achieved the third research objective: *(3) To develop a comprehensive understanding of the key drivers behind the innovations in the B2B mobile carrier services that have been transformed from previous B2C based mobile services, focusing on market, technology and regulation aspects.*

The Korean mobile telecommunications industry experienced a significant change during 2009-2010 in the market, technology and regulation aspects. Those aspects have interacted with each other. The government's telecom policy towards 'openness' have allowed overseas smartphone to enter the domestic mobile market. The rapidly growing smartphone market has created new business opportunities for new mobile services.

Within these backgrounds, mobile carriers' business has expanded from mobile services for individual users to highly sophisticated mobile solutions for institutional and business users. With the support of advanced technologies related to fixed-mobile convergence network, smart devices and other hardware/software, the service characteristics of previous B2C service have improved or newly emerged in the recent B2B mobile solutions. Now they offer industry-wide business solutions to many companies in different industries such as manufacturing, wholesale and transportation.

Such changes provided a basis for the transition of market focus from B2C-oriented to B2B-oriented market, and consequently led to many service innovations in the Korean B2B mobile service market.

9.1.4. Various types of innovations in B2B mobile services

The original idea of defining service innovation in this thesis was based on the characteristics-based approach developed by Gallouj (2002). Service innovation can be obtained by introducing new service characteristics. In this thesis, innovation is defined as the introduction of a new service (i.e. introduction of a new service brand) whose

characteristics are new or substantially improved. It includes improvements in functional characteristics and technical abilities.

Within this background, this thesis characterized the dynamics of innovation in B2B mobile carrier services in Korea by achieving the fourth sub-research objective: *(4) To identify how innovations in B2B mobile carrier services can be obtained from technological and service-oriented perspectives*.

In the following two sections, the thesis will describe how the main findings of this study contributed to answering the second and third research questions, respectively: *(2) What are the types of innovation in B2B mobile carrier services? How do they differ from each other?* and *(3) How are the dynamic competences of mobile carriers and B2B customers used in the different types of innovation? And how do they interact with each other?*

9.1.4.1. Different innovation dynamics of B2B mobile services from the technological perspective

The technological perspective of service innovation concerned the relation between technologies and service characteristics. Figure 9-1 summarizes the innovations in B2B mobile services from the technological perspective. The characteristics-based approach enabled more sophisticated analyses of innovation in mobile services which the 'technologist approach' can not detect.

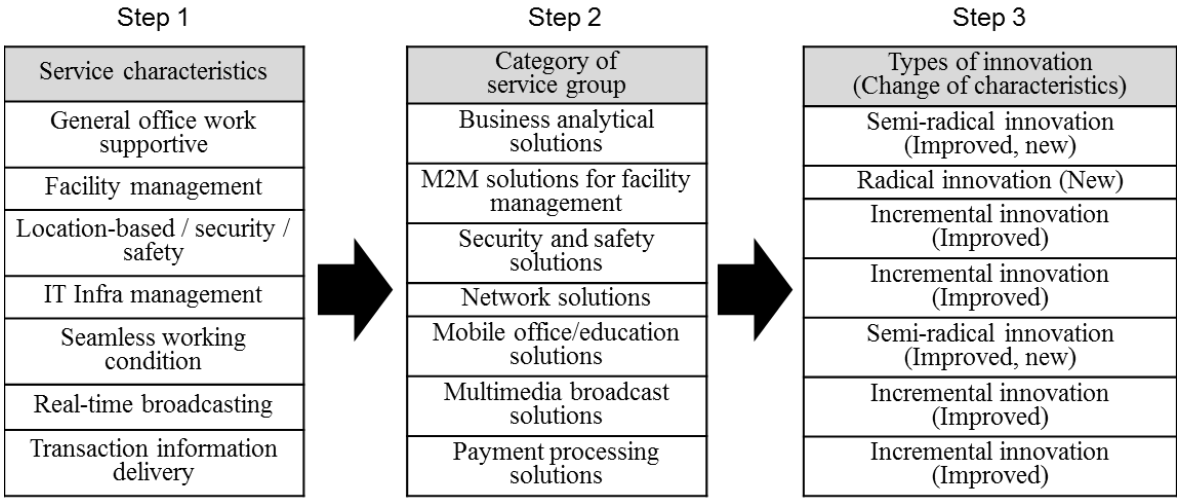

Figure 9-1. Summary of the innovations in B2B mobile services from the technological perspective

The service characteristics produced by mobilizing technological characteristics were separated by distinguishing the 'new' and 'improved' service characteristics. Those two distinctive service characteristics are identified by the criterion of whether they appeared before or after the paradigm shift during 2009-2010 (i.e. the existing characteristics of B2C mobile service but improved or the newly emerged characteristics of B2B mobile service). From this perspective, the three types of service-oriented innovations were identified: incremental, radical and semi-radical service innovations. Radical innovation implements new service features which did not exist before and bring a radical change that alters the total system. For instance, M2M technologies such as wireless sensor network system let a new service characteristic emerge in mobile solutions for facility management.

Incremental innovation also plays a very important role in the mobile carrier's business. It is a common way to develop new services in the current mobile business. In B2B mobile carrier services, incremental innovations seem to be more frequently introduced than radical innovations. Due to advanced wired/wireless network technologies and a variety of smart devices, various B2B mobile solutions such as location-based/security/safety, IT Infra management, real-time broadcasting and transaction information delivery can provide B2B mobile service users with more improved service characteristics.

Lastly, semi-radical innovation can be achieved with various technologies related to mobile service platforms and applications, not only enhancing the existing service function but also creating radically new characteristics.

9.1.4.2. The dynamic competences of mobile carriers and B2B customers in service-oriented innovation

Three service-oriented innovations, recombinative, customized and co-produced service innovations, highlight the importance of the dynamic competences of mobile carriers and B2B customers. The mobile carriers have not only technological competences but also service-oriented competences for meeting diverse B2B customer needs.

First of all, mobile carriers develop bundled service brands by combining the characteristics of two or more existing service products. Such a mechanism is frequent, easy and low-cost because it relies on re-using the existing service components. In fact, many service brands of mobile office/education solutions already launched in B2B market are the outcome of such recombinative innovation. In this way, the mobile carriers can expand their customer base by creating more and more bundled service products. In the

opposite fashion, mobile carriers may also create a basic low-specification service by separating various characteristics and turning certain elements into independent brands (i.e. unbundled service products).

Secondly, another mechanism to achieve innovation is to customize a mobile solution by providing the customized service characteristics for a particular market segment (adaptive customized innovation) or a specific user (fully customized innovation). It focuses on the importance of service user's perceived needs in providing B2B mobile solutions. B2B business can develop and deliver customized solutions for each industry based on business size and processes to help institutional customers improve productivity.

Thirdly, the thesis also examined the importance of user involvement in B2B mobile services. Service user involvement has become an important innovation source in mobile services, and it brings co-produced innovation. Co-produced innovation can result from the active participation of B2B mobile service users in service innovation. B2B mobile service users actively participate in the processes of designing, developing and implementing innovative mobile solutions, such as mobile education, business analytical solutions and multimedia broadcast solutions. Hence, they are not only consumers of B2B mobile solutions but also co-producers of service innovation.

9.1.4.3. The new types of service innovation from the integrated perspective

After the analyses, the thesis found that the dynamic changes of the mobile service characteristics from the technological and service-oriented perspectives could co-occur in the same service groups. In order to clarify such integrated patterns of service innovations, a new B2B service innovation model was proposed.

The integrated framework explained that the different dynamics of service characteristics led to the identification of six integrated innovation patterns for B2B services: disruptive innovation (new service characteristics), transformational innovation (a combination of new and recombinative service characteristics), breakthrough innovation (a combination of new and customized service characteristics), incremental innovation (improved service characteristics), additive innovation (a combination of improved and recombinative service characteristics) and reciprocal innovation (a combination of improved and customized service characteristics).

9.2. Strategic Implications for Mobile Carriers

Based on the above findings, this thesis has set out important implications for mobile carriers seeking B2B mobile services-led business opportunities. By considering the dynamic changes of the mobile service characteristics driven by technological changes and by the interaction between service providers and institutional users, the mobile carriers can take a strategic view of which technological decisions and service strategies may be most appropriate. Six strategic implications have been identified in this thesis.

Firstly, the technological innovation models in this thesis represent that the mobile service characteristics are becoming more and more enhanced in offering various mobile solutions to institutional customers, and have radically changed the B2B customer's existing working system due to advanced mobile technologies. In addition, recombinative service innovation shows that many potential service products are expected to have multiple service characteristics with various functions. Hence, it is important to understand how service characteristics are influenced by new mobile technologies and consequently, how final service features are expected to be characterized. A new B2B mobile solution can then be designed and developed for B2B customers.

Secondly, to the extent that mobile carriers pursue various technological service innovations, a new innovative B2B mobile service needs to integrate numerous technologies and service components from many external technologies as well as mobile carrier's own technical expertise. These findings imply that mobile carriers should engage in various cross-industry collaborations. Mobile carriers need to secure core technologies by strengthening internal R&D capabilities, and at the same time they should develop strategic partnerships in order to support future mobile services. This requires a strong relationship with various players such as handset manufacturers and content providers, and makes more partnership with other industry participants to develop new services. In addition, timely decision-making on investment in new HW/SW technologies related to mobile service development could yield a competitive advantage to mobile carriers.

Thirdly, mobile carriers have provided FMC network solutions since they integrated fixed and mobile network business areas. Such expansion of network service business may make mobile carriers compete with third-party network solution providers in the development of cloud computing-based mobile carrier services. However, mobile carriers have built long-term capabilities in terms of both service designs and infrastructure building, whereas other third-party network providers have focused on only on transmitting

data through fixed networks. Such advantages of mobile carriers can stem from proprietary mobile technology (e.g. 4G, LTE), established customer base and cumulative know-how of bundling network solutions with other multi-functional solution services. In addition, they need to strategically collaborate instead of competing with third-party content, device, network and service providers, by developing a revenue-sharing business model with various third-party providers.

Fourthly, service-oriented types of innovation suggest us that there is a low-cost, low-risk way to meet various needs of B2B service users. Recombinative innovations bring many opportunities for mobile carriers to produce new mobile solutions by bundling the characteristics of existing services. A diverse portfolio of bundled service products helps mobile carriers to satisfy their B2B mobile service users having complex needs, and therefore it could potentially produce many incrementally innovative service products. Mobile carriers can also create a number of mobile solutions specialized for very specific B2B customer. By making a small modification in the existing service product, a new B2B mobile solution can be designed for a particular task function.

Fifthly, in efforts to generate further revenue in a mature domestic market, mobile carriers need to find profitable B2B customers that can bring high potential revenue opportunities, considering specific usage patterns and market needs. Many enterprises and institutional users lying in different conditions may have a number of highly specific objectives. This implies that different objectives and motivations of B2B mobile service users would provide ample scope for mobile carriers to design new service products. This suggests that a mobile carrier can produce further revenue and find a huge business opportunity in various industries such as education, healthcare, manufacturing, construction, and public services. Accordingly, mobile carriers should meet B2B mobile service user’s wants more accurately than the other competing mobile carriers, and thus they can create new sources of revenue by creating new innovative B2B mobile services.

Lastly, the power balance is rapidly moving towards the user side. Particularly in the B2B mobile service market, many customized services can be created through co-production of mobile carriers and B2B customers. Unlike individual mobile service users, B2B mobile service users have a greater potential ability to make meaningful contributions to service development. Subsequently, the increasing potential of B2B mobile service sector is expected to provide a meaningful perspective of a service provider-user interface where various service innovations can be co-produced. Such an

increasing opportunity for co-production between a mobile carrier and its B2B customers help mobile carriers to achieve competitive advantage. Therefore, a mobile carrier should carefully detect the user needs and build a sustainable and profitable relationship with B2B mobile service users.

9.3. Implications for Other Industries

From the analysis results of B2B mobile service users, B2B customers in many service sectors benefit from the various mobile solutions, which are based on advanced ICT. Thus, B2B mobile solutions can play a central role in improving the productivity of the entire services sector. For instance, retail, wholesale, financial services and business service industries are the main users of ICT among the B2B customers. In particular, network solutions are the main service that enables the transformation of the existing paper-based work environment into a digitalized mobile working condition in those service sectors.

In this regard, the development of B2B mobile carrier services driven by advanced ICT can contribute to not only mobile sector but also other industry players. Therefore, other industry actors can maximize the benefit when they co-produce innovative mobile solutions with mobile service providers to increase productivity. Moreover, the convergence trend is rapidly changing paradigms of industry. There are enough opportunities for new innovative service products to be created through active co-production between mobile carriers and different industry users.

9.4 Implications for Policy Makers

From the technological perspective, the thesis highlighted that innovation in the mobile sector is achieved by utilizing advanced ICT.

Through the industry analysis, the thesis showed that standardization has laid the groundwork for the spread of domestic mobile technologies and industrial growth in mobile service sector. The development and standardization of CDMA technology in the 1990s greatly helped Korea to become an ICT powerhouse in a short period of time. Since the 2000s, domestic technologies like DMB services and WiBro successfully became international standards and the first-globally commercialized cases. Now the policy makers are facing a challenge of new IT trends (e.g. growing smartphone market, cloud computing,

ICT convergence). To strengthen Korea's technological edge in promising new sectors, such as IT convergence, policy makers and regulators should monitor these trends because traditional borders of different sectors have become blurred. They need to take into account of the central role which IT plays in the mobile environment and develop proper plans and set targets for the industry to implement.

Particularly, such convergence trends imply the significance of a collaborative ICT ecosystem among contents, platforms, networks and devices. Under these circumstances, policy makers need to make a fundamental change in IT policy focus from hardware-oriented (e.g. semiconductor, communication devices) to software-oriented (e.g. contents, applications, service platforms) in order to create new service values. In addition, they should create a favorable environment for collaborative networks between mobile carrier's businesses and B2B consumer's businesses through industrial IT convergence forums. Lastly, to propose a win-win vision for both mobile service providers and other industry players, cooperation between different regulatory authorities would be required.

9.5. Theoretical Implications and Future Research Directions

This thesis discussed technological and service-oriented innovations in mobile service sector in Korea by focusing on B2B mobile carrier services. Based on the main findings and limitations of this thesis, this final section will discuss some theoretical implications and future research directions related to the development of service innovation research.

9.5.1. Contribution to theories

One of the novel points of this thesis resides in the application of technological and service-oriented perspectives to a study of innovation in the telecommunications sector which has been mainly studied using 'technologists' approach and has treated services as similar to manufacturing in most of the previous literature studied. Under this research motivation, the thesis advanced the original characteristics-based approach developed by Gallouj (2002) and analyzed the dynamics of innovation in the mobile telecommunications service sector. Hence, the thesis could contain multi-aspects of service innovation study in mobile service sector by considering both technological and service-oriented perspectives. This implies the pervading mobile trend towards convergence between devices, services

and technologies within and across industries and the blurring of the boundaries between mobile phones and mobile phone-based services. Therefore, the research framework of this thesis could contribute to service innovation theories by proposing the generalizability of this framework.

The different types of service innovation were identified in two ways, from the research findings in a meso-level study and from the information obtained from the interviews with universities in a case study. The utilization of market introduction of new service products helped to clarify what kinds of B2B mobile services pervade in the Korean mobile service market and to distinguish different innovations. From this multiple research methods, B2B mobile services could be well defined and investigated. Hence, this thesis suggests that the research on service innovation should be grounded within a theory of practice.

Another contribution of this thesis lies on highlighting the role of B2B service users in service innovation. The importance of services innovation by users receives more and more attention. This thesis confirmed that B2B service users are active innovators in the same context as the previous studies, concluding that B2B service users played a role not just as a customer but as a co-developer of service innovation (Gruner and Homburg, 2000; Alam, 2006; Oliveira and von Hippel, 2011).

Hence, this thesis provided theoretical contribution in service innovation theory and will suggest implications for future research in the following section.

9.5.2. Implications for future studies

9.5.2.1. Implications for service innovation studies

This thesis suggests that service innovation can be studied from various perspectives (i.e. innovation in services and innovation in service processes) through various research methods such as statistical analysis and a case study method. Therefore, future studies may benefit from embracing both technological and service-oriented aspects of innovations.

Nevertheless, there is still room for adopting a much broader range of possible sources of innovation in services. The way of analyzing service innovation in this thesis focused on mobile carriers and B2B service users. In particular, the research scope was limited to B2B mobile carrier service for in-depth analysis. Others may wish to take different perspectives for other research purposes. For example, innovation is often produced through a productive collaboration with external partners. In other words, innovation can be

discussed within complex networks of mobile carriers, manufacturers, users and various third-parties.

In addition, a study of innovation of B2B customers which was driven by adopting innovative mobile solutions may be a future research topic. The thesis examined Mobile Campus as a case of B2B mobile solutions. When we consider that a university is composed of a variety of campus members, the service value of Mobile Campus may be delivered not only to an institutional user but also to end users such as students, faculty members, researchers and administrative staffs. This thesis mainly focused on innovation in the mobile carriers' service offerings for institutional users (i.e. B2B), but future research can extend its research scope to the service offerings for both B2B service users and even their customers (i.e. B2C). For instance, B2B mobile carrier services can help B2B customers, which provide end users with B2C products/services, to improve products or services. Such a nature of Business to Business to Consumer (B2B2C) is expected to provide more insight to researchers studying the dynamics of service innovations.

9.5.2.2. Generalization of the approach and framework of the thesis

This thesis contributes to the future directions of innovation studies by suggesting a framework in which innovation dynamics in other service sectors or in other countries can be studied. Firstly, the conceptual framework of this thesis is suggested for the future research that will look at the dynamic aspects of service innovation. This thesis provides in-depth study of service innovation focusing on a single country. Because direct implications for other countries cannot be drawn from a single case, future research should include a case study of other countries such as Japan in order to make the empirical results of this thesis more fruitful. The Japanese market faces problems of mobile subscriber saturation, stagnated ARPU and fierce competition as the same as in Korea. Moreover, in IT-based service sectors, technological and market changes may occur frequently and have a significant impact on the characteristics of services. Such changes of service characteristics can be the motive to distinguish different types of innovation in newly emerging sectors or in other countries. Hence, the research findings in this thesis suggest that mobile carriers in other countries can pursue a new business opportunity in various industries such as education, healthcare, manufacturing, construction, and public services. Such issues can be addressed more by future research.

In the same fashion, the research framework can be applied to other service sectors.

While advanced ICT becomes an enabler of innovation in IT-based service industries, service providers are still able to produce new service products easier than physical products, without direct technological development. The findings imply that those integrated innovation patterns can be used to characterize innovations in other service sectors. Hence, this research offers a clue to embrace the trend of convergence and integration of formerly separated technologies and services in case studies of other service industries.

Lastly, the thesis developed a conceptual framework by describing a paradigm change in the Korean mobile sector. The concept of the paradigm shift in the Korean mobile sector was used to distinguish different types of innovations. In the IT-based service industries, radical technological changes occur frequently and various service applications developed by various third parties often have a significant impact on the characteristics of future mobile services. When taking into consideration that the second, the third and the following paradigm shifts may bring more dramatic changes to the service characteristics, the conceptual framework of this thesis can offer a clue for innovation research in the future.

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Appendix 1. Interview Questions

※ This script was written to design the structure of interview questions. Although some of them were multiple choice questions or short answers, the actual interviews were conducted based on open-ended questions to encourage a full, meaningful answer. Therefore, respondents could freely deliver their knowledge and feelings.

※ The original interview questions were designed in Korean. It was translated in English for this thesis.

Dear respondent

I am undertaking research for my PhD thesis. The study investigates technological and service-oriented innovations in the Korean business-to-business (B2B) mobile carrier services.
This study aims to find out what type of service innovations pervade the whole B2B mobile carrier services and examine a case study of Mobile Campus.
Moreover, this study aims to identify the role of a university in developing and implementing Mobile Campus.
Your participation is very valuable to my research.
The information you provide will only be used for academic purposes. Thank you very much for your time and cooperation.

March, 2011
Seunghye Hong, Ph.D. candidate
Graduate School of Innovation Management, Tokyo Institute of Technology
E-mail: hong.s.aa@m.titech.ac.jp

The following questions are about your information

1. Which department do you belong to? And what is your main task?
( )

2. How long have you been engaged in this university?

1) Less than 3 years 2) 3~5 years 3) 5~10 years 4) 10~15 years

5) More than 15 years

The purpose of this part is to know the service features of Mobile Campus in the university.

1. What was the main motivation of the university adopting Mobile Campus?

① To revitalize the usage of management system for university administration or education

② To keep up with the trend of the mobile era

③ Other reasons ( )

2. When did the university adopt Mobile Campus? ( )

3. Which mobile carrier brand was selected for Mobile Campus?

① SK Telecom

② KT

③ LG U+

4. What type of mobile devices does the university select as a tool for Mobile Campus? Select all.

④ Apple's iPhone (e.g. 3G, 4G, etc.)

⑤ Android phone (e.g. Samsung's Galaxy S)

⑥ Tablet PC (e.g. iPad, Samsung's Galaxy Tab)

④ Other devices ( )

5. What was the reason that the university chose the mobile carrier and mobile device brands among many products?

① Mobile carrier-related reasons (e.g. good network quality, reasonable service price, fixed data rate)

② Mobile phone-related reasons (e.g. manufacturer's brand image, smartphone's hardware functions, operating system)

③ Other reasons ( )

5-1. Why did the university think that one brand was more attractive than the other? Or what was the reason that one brand was less attractive than the other? Please

describe in details.

( )

5-2. (To those who select Apple's iPhone) If SK Telecom had launched iPhone at the same time as KT, would the university have chosen SK Telecom as a mobile carrier brand?

( )

6. How many campus members are being served Mobile Campus? Or how many mobile devices that were contracted to serve Mobile Campus are distributed on campus?

6-1. ( ) persons (or units)

6-2. usage rate of Mobile Campus: ( )% of the total campus members.

7. Who are the beneficiaries of Mobile Campus? Select all.

And which group benefits the most from Mobile Campus?

① Students

② Professors

③ Researchers

④ Campus administrative staffs

⑤ Others ( )

8. How much is the service price that a mobile carrier charges for Mobile Campus?

① Initial membership fee: ( )

② Universal Subscriber Identity Module (USIM): ( )

③ Monthly flat rate: ( )

④ Brand name of pricing: ( )

9. How much does campus members pay for purchasing a mobile device for Mobile Campus? ( )

9-1. How does the university support the purchase of a new mobile device for Mobile Campus?

① Funded by the university or jointly funded by mobile carrier and the university

② Privately funded by campus members

③ Others (for example, partially funded by the university and the rest is charged privately)( )

10. What kinds of services are providing as part of Mobile Campus?

① Education-related (e.g. lecture video, submission of reports, attendance check, lecture information, journal search)

② Administrative (e.g. electronic approval, campus affairs)

③ Campus life support (e.g. emails, scheduling, free campus phone-call, campus information sharing)

④ Others ( )

10-1. Among those service categories, what is the main service functions of Mobile Campus?

11. How many percentages of campus members do actually benefit from Mobile Campus? (i.e. actual usage rate of Mobile Campus) ( )%

12. Were there any problems or obstacles that prevented the university from adopting Mobile Campus? (e.g. complaints from students, lack of budget)

( )

13. Before implementing Mobile Campus, how much did it cost to build up mobile infrastructure on campus?

( )

14. What did the university focus on to build up infrastructure for Mobile Campus?

① Wireless internet environment

② Fixed-mobile convergence network

③ Transformation of the existing system to mobile web-based system

④ Others ( )

15. What is the size of Wi-Fi coverage for Mobile Campus?

① Everywhere on Campus

② Campus zone and dormitories

③ Others ( )

16. How the university did transform the desktop-based existing system into mobile web-based system?

① Developed by the university alone

② Developed in cooperation with a mobile carrier or other firms.

③ Others ( )

16-1. What kinds of mobile contents and application were developed? And how many?
( )

17. What changes did Mobile Campus bring to the university in terms of education, campus administration and students' campus life? Describe the effect of Mobile Campus adoption in the following categories.

① Education: ( )
② Campus administration: ( )
③ Students' campus life: ( )
④ Others ( )

18. Are you satisfied with the service features of Mobile Campus? If there is any plan to improve or supplement the current Mobile Campus?
( )

19. What was the success factor of Mobile Campus?

① Readiness of wired/wireless infrastructure in campus
② University's strong motivation to adopt Mobile Campus
③ Many supports of the university (e.g. financial support of purchasing a mobile device)
④ Advantage of creating various applications
⑤ Successful cooperation with a mobile carrier
⑥ Others ( )

20. When Mobile Campus was designed, what was the role of the university?

20-1. Which part did the university actively participate in? (e.g. technical design to build up mobile infrastructure, strategic decision making for service development)
( )

20-2. Was a specific demand or needs of the university reflected by a mobile carrier and applied to service design of Mobile Campus?
( )

20-3. Was the customized Mobile Campus provided to the university, differentiating from Mobile Campus of other universities?
( )

21. What is the final goal for the university to achieve through Mobile Campus?
( )

21-1. Are there any plans that the university pursues in parallel with Mobile Campus in order to achieve ‘Smart Campus’?

① Establishment of e-library
② Industry-university cooperation to develop IT technology with
③ Others ( )

Appendix 2. Summary of Interview Answers

The respondents' information

Name / Occupation	Task	Career as an IT manager	Interview method	Main interview questions
Bae, J. H. (Information Service Team manager, UNIST)	IT planning and campus administrative tasks, Information security management	3~5 years at UNIST. More than 10-year working experience in related field	Face-to-face interview	Motivation, vision, success factors of adopting Mobile Campus, etc. (Question No. 1, 18~20)
Yang, Y. S. (Security Management Team manager, POSTECH)	IT maintenance and security management, Mobile system development	More than 10-year working experience	Telephone interview	
Jung, M. Y. (Vice president, UNIST)	Supporting the mission, vision and goals of UNIST	-	Face-to-face interview	Detailed description of Mobile Campus (All questions below)
Jung, Y. H. (Vice president, POSTECH)	Supporting the mission, vision and goals of POSTECH	-	Telephone interview	

Interview answers regarding Mobile Campus

Question No.	Question summary	UNIST	POSTECH
1	Main motivation of the university adopting Mobile Campus	To revitalize the usage of management system for university administration or education	To keep up with the trend of the mobile era
2	The time of adopting Mobile Campus	April 2010	September 2010
3, 4	Selection of mobile carrier/device brand	KT Apple's iPhone 3G/4G, iPad	SK Telecom and Galaxy S
5	Reasons of selection	To adopt iPhone to campus	Preference for Android OS, Samsung's brand image
6, 7, 11	The number of smartphones distributed, Service users	2,000 iPhones (distribution rate of 80-90%). All members on campus (students, professors, staffs)	5,000 units of Galaxy S (distribution rate of 90%). All members on campus
8~9	Service price	35,000 won per month	39,600 won per month
10	Types of mobile solutions that universities are currently using/plan to use	Blackboard-based mobile learning system, WiFi-enabled work environment Services for education, etc.	Electronic approval, mobile administration, Student smart card, Free interphone call, etc.
12	Difficulty of adopting Mobile Campus	No (because of distribution of free smart phones on campus)	
13~15	Cost of building up infrastructure	KRW 500 million in building the wireless network	KRW 100 million to build wireless access-point (AP)
16, 20	How to develop mobile contents and system, Role of the university	Utilized the existing teaching contents in a mobile version of *Blackboard* University participated in designing Mobile Campus	University developed the mobile contents for its groupware
17	Main service features of Mobile Campus	Mobile education	Mobile-based campus administration system
18	Service satisfaction	Very satisfied	Satisfied
19	Success factor	Early-adopter characteristics, sufficient budget, clear visions	
21	Final goal	Paper-free campus	Building-free campus

Appendix 3. Examples of B2B Mobile Service Offerings of SK Telecom and KT

(1) B2B mobile solutions provided by SK Telecom

Service name	B2B Customer	Details	Remarks
Mobile office	Dongbu CNI	- Integrated services for Dongbu Group—Intranet, e-mail, electronic approval, address book/business process integration - Offered smart phones (Android, WM-based)	- Signed in Feb 2010 - SK C&C in charge of solutions
Mobile office	KMA	- Converged wireless/fixed (VoIP, Wi-Fi), SKT in-house developed solution - Offered smart phones to 1,500 employees	- First B2G installation, Apr 2010 - Services to extend to e-mail, messenger, approval - Cooperation with SKBB
Mobile office	Hyundai Hysco	- Specialized solution embedded in smart phone (Blackberry) - Electronic settlement, inventory management, e-mail	
Mobile office	Daewoo Securities	- E-mail, customer info, trading info, internal info program - Smart phones distributed to employees (about 3,000)	
Mobile office	SK Group	- E-mail, electronic settlement, English lesson, electronic card via mobile office - Automobile remote exam, control, mobile content, nav. service	
Mobile office	Hana Bank	- SKT roaming service available around the world, through which electronic document settlement/e-mail services offered - Smart phones distributed to heads of teams/branch managers/PBs	
Mobile office	KAL / Citi Bank LIG Nex1 /KAL / Ernest & Young / KNOC / S-oil	- Blackberry (BES)-based mobile office	
Smart care	Ministry of Knowledge and Economy	- Remote treatment and health monitoring services provided to patients with chronic disease	- Pilot service in Gyunggi, Jeonnam, and Chungbuk provinces - Consortium: SEC, Samsung Life, other
Smart factory	POSCO	- Real time check and management on manufacturing process/paper works through smart phone (Blackberry) - Fixed/mobile convergence service (M2M and LBS)	- Introduced in February 2010; to continue for the next four years

Service name	B2B Customer	Details	Remarks
Yakult customer management	Korea Yakult	- Mobile solution embedded PDAs distributed to door-to-door sales agents	- Introduced in December, 2009
Smart branch	KEB	- Mobile bank branch established via video consultation and IT convergence service	
Mobile subscription system	Mirae Asset Life	- Real time communications between company-solicitor-customer possible through smart phone (android)	
Smart Learning	Chungdahm Learning	- Mobile LAN and fixed/mobile line management for digital study material/real-time class feedback - Electronic notes, attendance check, online test	- Commercialization in 3Q of 2010
Mobile campus	Dongseo Foundation	- Internet phone, LAN, Wifi network established and wireless/fixed-line convergence service offered in schools	
MIV	Samsung Renault	- Automobile remote exam, control, mobile content, nav. service	- Rolled out in 2011
MIV	CT&T	- Dev. of electric car mobile SW platform, auto network tech	
Mobile Office	POSTECH	- Provide administration and real-time academic activities using smartphone - Provide approx. 5,000 smartphones to enrolled students and faculty so that they can use mobile payment service and attendance/absence check service	- Signed an MOU in Sep. 2010 - Wireless Internet environment andwired/wireless linkage service to be completed within the year
Mobile Office	Ministry of Education, Science and Technology	- Provide e-mail, schedule management, legal information inquiry, and SNS linkage services	- Expanded after pilot service
Smart Work	Samsung Medical Center	- Provide Galaxy S to all employees (more than 5,000) to establish a mobile office environment	- Linked with U-healthcare
Smart Work	HHI	- Establish broadband wireless data telecommunication network which can be applied to mobile office and provide smartphones	- MOU signed
POSCO Zone service	POSCO	- Integrated fixed-wireless phone service for POSCO employees	- Service to be launched with KT
Smart Place	Jeju Industrial Complex	- Smart-grid network	- Consortium with KEPCO, KT, LGE

(Source: SK Telecom Annual Report, Woori I&S Industry Analysis, News announcements)

(2) B2B mobile solutions provided by KT (Source: Re-organized by Woori I&S)

Service name	B2B Customer	Details	Remarks
Mobile office	KB Securities	- Supply iPhones to employees—email, electronic settlement, messenger	
Mobile office	Daegu Techno Park	- Email, electronic settlement, intranet, scheduled management via groupware, office program	- Launched Jun 2011
Mobile office	Samsung Securities	- Convergence of fixed/mobile service—supply smart phones (“Show Ommia”) to 2,600 employees	
Mobile office	Kolon Group	- FMC mobile office; email, electronic settlement, logistics, video conf, intranet - Supply smart phones (Show Omnia) to 8,500 employees	- Signed Jan 2010
Mobile office	Hyundai Asan Hospital	- Manage patient information, list, test result, prescription via smart phone - Supply smart phones to medical staff (300)	
U City, South Gyeongsang province	Gyeongsang provincial government	- Solar cell and LED lighting control and repair via telecom network	
Incheon (Cheongna) “u-city”	Korea Land & Housing Corp	- Telecom infrastructure for ubiquitous services, including security, emergency prevention, environment, and traffic information - (“Ubi-cahn”: KT’s ”u city” platform)	- Consortium wins order Mar 2010 (totaling W51.5bn) - Consortium: LG CNS-GS E&C-KT
Asan (Baebang) “u city”	Korea Land & Housing Corp	- Telecom infrastructure for ubiquitous services, including security, emergency prevention, environment, and traffic information - (“Ubi-cahn”: KT’s ”u city” platform)	- Consortium wins order Mar 2010 (totaling W24.6bn) - Consortium: Samsung SDS-KT
Kyunggi province (Suwon) “u city”	Korea Land & Housing Corp	- Telecom infrastructure for ubiquitous services, including security, emergency prevention, environment, and traffic information - (“Ubi-cahn”: KT’s ”u city” platform)	- Consortium wins order Nov 2009 (total W17.7bn) - Consortium: LG CNS-KT
IT infrastructure outsourcing	Tongyang Group	- Operate IT network, data center, and applications; introduce mobile office - Distribute smart phones (Show Omnia) to 15,000 employees	- To be maintained 10 years - Total order W140bn
Mega-Meet	Electro Land	- Introduce video conference system available at 100 nationwide branches	

Service name	B2B Customer	Details	Remarks
Video conference	National Park Management Corp	- Video conference system	- Introduced Mar 2010 - Costs cut by W350mn in 3 years
Insurance TV	Hyundai M&F, Federal Insurance	- Insurance product briefing/premium calculation/insurance policy purchase via IPTV	- MOU signed
Smartgrid	BOMA Chicago	- Renovate old buildings in Chicago (smartgrid establishment)	- Joint work with LGE
Mobile campus	UNIST	- iPhone was distributed to 2,000 students and 300 faculty and staff members - Designed for education, pursuing a “paper-free campus”	- MOU signed in Feb. 2010 - Service launched in April 2010
U-health	Yonsei University Health System	- Patients to send personal medical information to doctors and have consultation with doctors via Internet phone	- Service expansion after pilot service
e-book service	Samsung Hospital	- Wi-Fi network and e-books for patients	- Service began on May 27
uCloud pro	SMEs	- File storage and backup service via Cloud server	- Allow access to files via smartphones
Smartgrid	MKE	- Network provider of MKE’s smartgrid project	- Consortium with GS Caltex and other companies
Wibro Shipyard	Hyundai Heavy	- Real-time biz processing, Internet/messenger at Ulsan shipyard and office	- Sep 2009
Subway management system	City Railway Corp	- Distribute smart phones (Show Omnia) to 6,450 employees – Swift response to mechanical troubles	- Jan 2010, installation W10.2bn

(Source: KT Annual Report, Woori I&S Industry Analysis, News announcements)