Prioritizing Telecommunications Service Policies in South Korea: An Innovation System Approach

Hongbum Kim* · Eungdo Kim** · Daeho Lee*** · Sungdo Jung**** · Hyoungdon Moon*****

Abstract

Although the telecommunications service industry has become a basic infrastructure component of the information and communication technology (ICT) industry, it is now losing its reputation as a cash cow due to achieving a saturation of service subscribers, especially in South Korea. With the exception of improving network speeds, network operators are experiencing difficulties in creating new innovations. Therefore, new innovations for the telecommunications service industry should be identified in conjunction with government policies for industry promotion. To examine the innovative capabilities of a specific industry, innovation system theories were used as a framework for research. However, existing innovation systems are limited with regard to explaining the openness of relationships and user participation which are general properties of the ICT industry. Moreover, as sources of innovative activity, additional values such as financial support and collaboration are more appropriate. This study presents a new innovation system based on innovation values. We analyze the telecommunications service industry and prioritize the importance of telecommunication policies within South Korea. An in-depth interview with experts based on the innovation system framework is conducted first. Next, innovation factors derived from the interview are applied within an analytic hierarchy process (AHP), leading to a prioritization of innovation factors for the telecommunications service industry.

Keywords : Telecommunication Service Industry, Innovation System, Analytic Hierarchy process, AHP

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1. Introduction

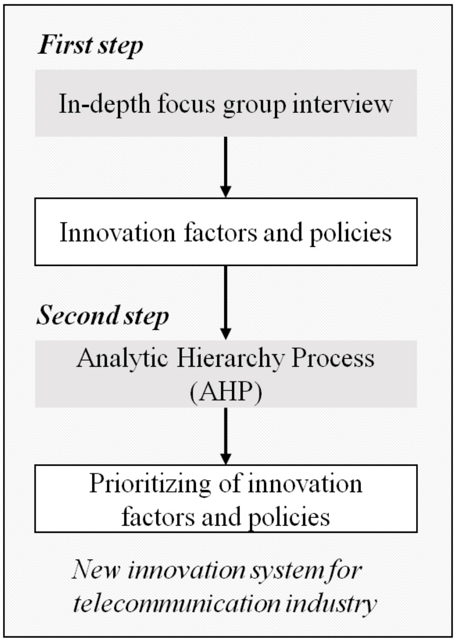
The telecommunications service industry has become a basic infrastructure component of the information and communication technology (ICT) industry. Owing to a rapidly-developed telecommunications infrastructure within the last two decades, South Korea is now one of the industry leaders in the ICT field. In the near future, the importance of telecommunication services will have grown to support emerging technologies such as the "Internet of Things", wearable devices, and "connected" cars which were primary exhibition themes at the most recent Consumer Electronics Show (CES) and Mobile World Congress (MWC).

Nevertheless, the telecommunications service industry itself is losing its reputation as a cash cow due to achieving a saturation of service subscribers, especially within the US, EU, and South Korea. With the exception of improving network speeds, network operators are experiencing difficulties in creating new innovations. With regard to emerging technologies, many firms in various industries are also interested in achieving profitability. While a variety of innovative services based on telecommunications infrastructures are being launched, not all services have been successful [Nikou and Mezei, 2013]. Therefore, new telecommunications service industry innovations should be identified in conjunction with government policies for industry promotion.

In order to examine the innovative capabilities of a specific industry, innovation system theories such as the national innovation system (NIS), sectorial innovation system (SIS), and the regional innovation system (RIS), are utilized primarily as a research framework. However, existing innovation systems are limited with regard to explaining the openness of relationships and user participation which are general properties of the ICT industry [Kim et al., 2015]. These innovation systems are particularly focused on the actors in charge of innovative activities (e.g. governments, universities, research institutes, and firms). As sources of innovative activities, various values (i.e. financial support, R&D, policies, human resources, and collaboration) are more appropriate toward examining ICT industries such as the telecommunications service industry [Kim et al., 2015]. This new perspective is reorganizing the innovative values necessary for the telecommunications service industry to encourage new innovative activities.

The purpose of this study is to examine new innovation systems based on the values constructed by Kim et al. [2015]. Using this innovation system, we analyzed the telecommunications service industry within South Korea. Specifically, we prioritized the importance of telecommunications policies being implemented by the South Korean government based on an in-depth focus group interview.

In order to analyze the telecommunications service industry, this study adopted a two-step approach. First, an in-depth interview with telecommunications service industry experts was conducted. The focus group interview was performed based on the new innovation system. Policy orientations and factors affecting the telecommunications service industry were obtained via in-depth interviews. Second, innovation factors derived from the focus group interviews were applied toward an analytic hierarchy process (AHP) methodology. Through AHP, innovation factors for the telecommunications service industry were prioritized. In particular, as significant factors, representative telecommunications policies were added to the hierarchy of the AHP model and were prioritized in terms of fixed and mobile telecommunications services shown in <Figure 1>.



〈Figure 1〉 Research Framework

The remainder of this study was as follows. The necessity for new innovation systems was explained with the innovation system being derived in Section Ⅱ. Section Ⅲ summarized the results of the focus group interviews. Section Ⅳ introduced an AHP methodology while Section Ⅴ showed the analysis results. Finally, Section Ⅵ concluded the study.

2. The Need for a New Innovation System Based on Innovation Values

Systematic properties of the innovation process have been emphasized from the perspective of the innovation systems [Edquist, 2005]. According to this framework, a firm could not individually perform innovative activities. At the center of the system, the firm organizes the trajectory of innovation through external factors and an approach to knowledge. The primary contribution of the innovation system approach was that it emphasized external environments, in a broad perspective, for the innovation activities of the firm.

The innovation system is a critical factor with regard to the innovation process, incorporating various factors such as economics, societies, politics, organizations, and institutions. Using these concepts, the innovation process could proceed through organizations which were included in various institutional systems. Organizational and institutional concepts were common factors with regard to the innovation system approach. In this context, organizations were the actors of innovation, with institutions acting as the invisible relationships between actors. For example, governments, private firms, public research institutes, and universities are representative organizations within the innovation system. Such definitions were useful classifications for redefining innovation actors and their roles.

Meanwhile, ICT industries including the telecommunications service industry exhibited different characteristics with regard to traditional industry. First, user participation in innovation activities was increased. Second, firm strategies toward openness were increased. Third, innovation values were segmented [Evans et al., 2006].

According to a matured information society and the development of hardware and software, the role of consumers grew from being passive users toward becoming innovators capable of innovation. Eric von Hippel [2005] introduced this phenomenon as user innovation, developments and improvements by individual users to meet their requirements and solve problems encountered through the use of products or services. User innovation was significant in the sense that users imparted additional value to products and services while engaging in voluntary production activities in a fast-changing market environment. Therefore, a 'user' should be considered as a primary actor within the innovation system of the ICT industry.

Additionally, a convergence between the ICT and traditional industries was the proliferation of information societies, firms which served to create new forms of value by not only concentrating on their own competencies but also by converging on the capabilities of other industries [Varian et al., 2004]. In cases of firms depending on internal transactions, they attempted to converge technologies via affiliates or subsidiary companies. As organizational boundaries within the innovation process decrease, firms more actively interact with the external environment. The extent of openness both within-industry and outside-industry has rapidly increased [Gassman, 2006; Cooper, 2008].

Finally, values of innovation within the ICT industry were segmented. While the boundaries of each industry were blurred, newly emerging values were created by opening and converging their capabilities [Varian et al., 2004]. Within the rapidly-changing business environment, new business models and services to meet consumer demands are being competitively launched. Therefore, innovation is generated not only from internal activities but also from other innovative actors. Innovations emerged from interactions between existing firms and other innovative actors and even from between specified values.

In order to reflect these environmental changes, new innovation system concepts were created by combining open innovation and user innovation with traditional innovation systems. Chesbrough [2003] suggested a new innovative approach by diversifying sources of innovation from external ideas and technologies, leading to the term "open innovation." The author argued that the development of intellectual property and the pattern of use were under a paradigm shift, therefore, open innovation was proposed as an approach to the emerging paradigm. Additionally, the author explained the difference between closed innovation and open innovation while presenting strategies toward managing intellectual property in such an era. The concept of open innovation could be compared to an existing vertical integration model that a product is led by internal R&D activities and distributed to the market. Open innovation could

〈Table 1〉 Basic Framework of Innovation System

Component	Value	Actor
Financial support	Capital support	Firm
	Financial aid to private firm	Government
	Financial aid to public research	Government
Research and development	Technology development	Firm
	Public research	University
	R&D participation	User
Collaboration activity	Creating link among actors	Government
	Network activity	Firm
	Creating link between firm and government	University
Policy environment	Supporting policy	Government
	Innovation strategy	Firm
	Shaping market demand	User
Human resource	Researcher and labor	Firm
	Expert user	User
	Expert trained	University

be defined as a way of (1) structural encouragement, exploration, and exploitation of internal and external sources within a wide range, (2) the use of a firm's capabilities and resources in order to integrate them efficiently, and (3) the utilization of such opportunities through multiple channels [Cohen and Levinthal, 1990].

Originally, a market for industrial goods has paid attention to the concept of user innovation. As a firm often plays the role of a user in the development of a new product, studies regarding user innovation are typically focused on (1) the commercial evaluation of innovative performance and (2) lead users who are actively engaged in the innovation process [von Hippel, 1986; Urban and Hippel, 1988]. Studies on user innovation within the market for consumer goods began in the 2000s when individual consumers started to play the role of the user and lead innovative processes.

Systematic approaches toward innovation were appropriate to describe environmental changes such as the increased openness of the ICT industry and user-driven innovation activities. Based on a number of literature reviews, innovative systems could be constructed by adding open innovation concepts and user innovation to the innovation system. More specific procedures with regard to building innovation systems were described by Kim et al.[2015]. In this study, the frameworks of innovation systems are summarized in <Table 1>.

3. Focus Group Interview

In order to develop new innovation strategies within the telecommunications service industry, we conducted in-depth interviews. Fifty telecommunications service experts in academia, research institutes, and industrial fields were divided into three groups for focus group interviews. These interviews were conducted in November 2013. A summary of the respondents can be observed in <Table 2>.

〈Table 2〉 Data Collection

Items		Frequency
Gender	Male	41
	Female	9
Sector	Academia	10
	Institute	20
	Industry	20
Age	20s	5
	30s	27
	40s	14
	50s	4
Experience	Under 5 years	6
	5 to 10 years	18
	Over 10 years	26
Total		50

We briefly summarized the results of the focus group interviews. The most important question asked involved determining which value the telecommunications service industry should aim for with regard to its innovation and development. Although experts sometimes suggested an enhanced quality of service (QoS), efficient use of network bandwidth, and the invention of network 'technology,' in the end, both balanced the development of the ICT ecosystem and telecommunications service improvements were chosen as the most important innovation values within the industry. That is, network operators should make an effort toward improving service quality, not only for their own profit but also for the balanced development of the ICT ecosystem as a whole.

With regard to the most critical factor hindering innovation within the telecommunications service industry, experts frequently cited government policy and regulation. As telecommunications services require high sunk costs, exhibit natural monopolistic tendencies, and are considered to be necessities as opposed to luxury goods, telecommunications services are deeply entrenched within governmental policies. Therefore, experts have predicted that innovations within the telecommunications service industry would be affected by governmental regulation of telecommunications policies.

According to the focus group interview, this study elected for network operators to improve the quality of telecommunications services and develop a balanced ICT ecosystem. Specifically, as government policy has affected innovation within the telecommunications service industry, this study additionally breaks down telecommunications policies into five representative categories: subsidy policies, spectrum policies, interconnection policies, network neutrality policies, and pricing policies, which experts have emphasized during interviews and have conducted further priority analysis.

4. Analytic Hierarchical Process

According to Satty [1980], the analytic hierarchy process (AHP) is a decision making methodology which serves to capture the knowledge, experience, and intuition of experts by making pairwise comparisons between factors consisting of hierarchical structures for decision making. AHP is widely applied within decision-making fields attributed to theoretical simplicity and applicability. Generally, AHP is useful for prioritizing multiple alternatives in cases where one should choose the most optimal alternative amid conflicting criteria, asymmetric information, and restricted resources.

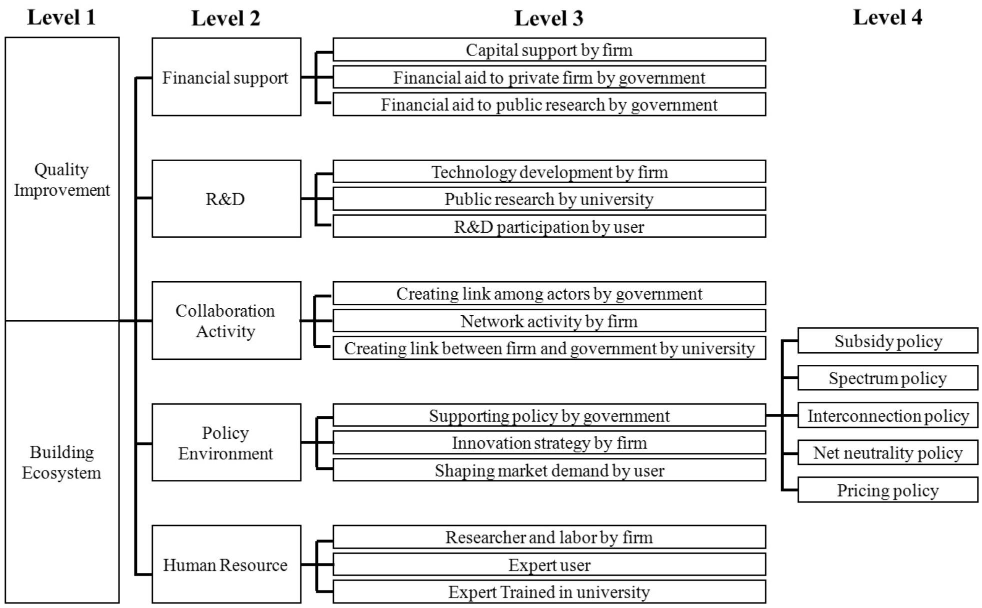
AHP weighs each lower level factor in accordance with upper level factors and constructs a pairwise matrix. Using an eigenvalue method, AHP creates one normalized priority vector for each level and finally calculates a complex priority vector for all hierarchies representing relative priorities. Decision hierarchy is structured according to the four axioms of AHP: reciprocity, homogeneity, dependency, and expectation [Satty, 1986]. In order to solve a problem via AHP, four main steps are required: (1) construction of a hierarchical tree, (2) data collection for pairwise comparisons, (3) relative weight calculations, and (4) priority ranking.

An element of the pairwise comparison matrix, a_{ij} is calculated by $w_i/w_j(i, j=1, \cdots, n)$, where the weight can be calculated via linear algebra eigenvalues. The pairwise comparison matrix A is multiplied by weight vector x, leading to $(A-nI)x=0$. As a_{ij} represents the individual judgement and has a certain degree of variation (inconsistency), $Ax=nx$ cannot be obtained. In order to solve this problem, Satty [1977] suggests the largest eigenvalue $\lambda_{\max}=\sum_{n}^{j=1}(a_{ij}w_j/w_j)$. If matrix A is consistent, the eigenvector X can be calculated by $(A-\lambda_{\max}I)X=0$.

As AHP is based on subjective judgement of pairwise comparisons, preferences should be consistent, for example, if A > B and B > C then A > C should be established. In order to examine the reliability, consistency ratio (CR) should be measured. Prior to the CR, consistency index (CI) should be obtained as follows:

$$CI=(\lambda_{\max}-n)/(n-1) \quad (1)$$

$$CR=(CI/RI)\times 100\% \quad (2)$$



<Figure 2> AHP Model of This Study

The random index (RI) denoted the average consistency index of the inverse matrix created via random numbers ranging from one to nine. If the value of CR was around 0.1, the AHP result was considered to be acceptable as a general rule [Nikou and Mezei, 2013]. <Figure 2> is an AHP model of this study. The hierarchy of this model consists of four levels. First level shows the main goal of decision making process. Quality improvement and building ecosystem are chosen as the main goals for telecommunication industry innovation by experts. Reorganized components for the new innovation system in <Table 1> are on second level. Combination sub-factors of components were on third level. Finally, as stated earlier, five telecommunications policies were added to the fourth level since supporting governmental policies were significant within the telecommunications service industry.

The questionnaire was provided to fifty experts within academia, research institutes, and industry, as shown in <Table 2>. Expert Choice 11 software was employed as a tool.

5. Result

<Table 3> presents the AHP results associated with improving telecommunications service quality. R&D yielded the highest weight (0.258), while financial support (0.242), human resources (0.183), policy environment (0.171), and collaboration activities (0.146) followed. From the analysis, R&D activities were the most important factor, while finance should also be supported to improve telecommunications service quality.

Under the third hierarchy level, firm activities such as technology development (0.118), capital support (0.106), and innovation strategies (0.072)

<Table 3> Result of AHP Analysis on Improvement of Telecommunication Service Quality

Category	Weight	Value	Weight for value	Relative weight	Priority
Financial support	0.242	Capital support by firm	0.439	0.106	2
		Financial aid to private firm by government	0.328	0.079	3
		Financial aid to public research by government	0.233	0.056	12
R&D	0.258	Technology development by firm	0.456	0.118	1
		Public research by university	0.249	0.064	8
		R&D participation by user	0.295	0.076	4
Collaboration activity	0.146	Creating link among actors by government	0.425	0.062	9
		Network activity by firm	0.225	0.033	14
		Creating link between firm and government by university	0.350	0.051	13
Policy environment	0.171	Supporting policy by government	0.179	0.031	15
		Innovation strategy by firm	0.419	0.072	5
		Shaping market demand by user	0.402	0.069	6
Human resource	0.183	Researcher and labor by firm	0.356	0.065	7
		Expert user	0.309	0.057	11
		Expert Trained in university	0.336	0.061	10

exhibited relatively high weights. Additionally, one could observe the importance of the role of government toward providing financial aid to private firms (0.079) and creating links among actors (0.062). Remarkably, users placed higher value toward aspects such as R&D participation (4th), shaping market demand (6th), and expert users (11th). With this regard, governments, firms, and users affect the improvement of telecommunications service quality.

<Table 4> reveals the AHP analysis results toward balancing the development of the ICT ecosystem. The policy environment yielded the highest weighted value (0.283), followed by collaboration activities (0.243), financial support (0.193), human resources (0.160), and R&D (0.12).

Expert opinions remarkably rated collaboration activities as being more critical than R&D toward the pursuit and development of a balanced ICT ecosystem within the telecommunications service industry. The results indicated that for a balanced development of the ICT ecosystem, solely pursuing one's own value is not significant toward keeping the telecommunications service industry afloat. However, evolving as a constellation by collaborating with other actors is necessary, in conjunction with the support of the institutional environment.

At lower levels, governmental policy support (0.115), creating links between firms and governments by universities (0.111), shaping market demand by users (0.085), and providing financial aid to private firms by governments (0.080) exhibited relatively high weight. Specifically, detailed governmental values such as policy support, financial aid to private firms, financial aid for public research, and creating links among actors held relatively high weight, similar to the second level. It is meaningful that governmental policy support is preferred over

〈Table 4〉 Result of AHP Analysis on Balanced Development of ICT Ecosystem

Category	Weight	value	Weight for value	Relative weight	priority
Financial support	0.193	Capital support by firm	0.224	0.043	12
		Financial aid to private firm by government	0.412	0.080	5
		Financial aid to public research by government	0.364	0.070	6
R&D	0.120	Technology development by firm	0.251	0.030	15
		Public research by university	0.407	0.049	11
		R&D participation by user	0.342	0.041	13
Collaboration activity	0.243	Creating link among actors by government	0.262	0.064	9
		Network activity by firm	0.281	0.069	7
		Creating link between firm and government by university	0.457	0.111	2
Policy environment	0.283	Supporting policy by government	0.408	0.115	1
		Innovation strategy by firm	0.292	0.083	4
		Shaping market demand by user	0.300	0.085	3
Human resource	0.160	Researcher and labor by firm	0.238	0.038	14
		Expert user	0.335	0.054	10
		Expert Trained in university	0.427	0.068	8

R&D activity for the development of a balanced ICT ecosystem. Furthermore, creating links between firms and universities and university-trained government experts are ranked in second and eighth place, respectively, representing the importance of universities toward developing a balanced ICT ecosystem.

This study additionally categorized and analyzed governmental policy support for the promotion of industrial innovation, which were chosen by experts during interviews, for subsidy policies, spectrum policies, interconnection policies, network neutrality policies, and pricing policies. The results of the AHP analysis on policy support for the telecommunications service industry are shown in <Table 5>.

Finally, we distinguish between fixed telecommunications services and mobile telecommunications services. Spectrum policies in the results above were not ranked with regard to their priority. However, due to their scarcity of frequency, the mobile telecommunications service industry exhibited different characteristics compared to the fixed telecommunications service industry. In order to draw out these attributes, we concentrated only on mobile telecommunications services with additional surveys applied. <Table 6> presents the AHP results for that industry.

In contrast to the former result, spectrum policies (0.380) yielded the highest weight with regard to improving telecommunications service quality within the mobile telecommunications service industry. Pricing policies, which were selected as the first priority in both fixed and mobile telecommunications service industries, ranked as only fourth. Subsidy policies (0.221) and network neutrality policies (0.199)

〈Table 5〉 Result of AHP Analysis on Supporting Policy of Telecommunication Service

Category	Weight(priority)	
	Improvement of telecommunication service quality	Balanced development of ICT ecosystem
Subsidy policy	0.122(5)	0.132(5)
Spectrum policy	0.192(3)	0.155(4)
Interconnection policy	0.183(4)	0.193(2)
Network neutrality policy	0.247(2)	0.357(1)
Pricing policy	0.256(1)	0.163(3)

〈Table 6〉 Result of AHP Analysis on Supporting Policy of Mobile Telecommunication Service

Category	Weight(priority)	
	Improvement of telecommunication service quality	Balanced development of ICT ecosystem
Subsidy policy	0.221(2)	0.197(2)
Spectrum policy	0.380(1)	0.183(3)
Interconnection policy	0.079(5)	0.098(5)
Network neutrality policy	0.199(3)	0.349(1)
Pricing policy	0.121(4)	0.173(4)

subsequently followed. With regard to developing a balanced ICT ecosystem, network neutrality policies (0.349) exhibited first priority, similar to the unified network service industry. Subsidy policies (0.197), spectrum policies (0.183), and pricing policies (0.173) followed, although the differences in preference were not significant.

6. Conclusion

In order to determine new sources of innovation within a rapidly-changing ICT environment, this study examined the telecommunications service industry based on a newly suggested innovation system. Using in-depth focus group interviews and AHP methodologies, important values within the telecommunications service industry were derived and innovation factors were prioritized with regard to the innovation system framework.

With regard to developing a balanced ICT ecosystem, experts emphasized collaborative activities. It could be explained that the telecommunications service industry which has already matured in its business development cycle should be an infrastructural role model for a balanced development of the entire ICT ecosystem, leading this development to improving the telecommunications industry quality recursively, rather than concentrating on technological innovations via intensive research and development.

Because the telecommunications service industry itself exhibits general purpose technology characteristics, it should be considered in the application of industries associated with fixed and mobile communication networks. As a two-sided market, the telecommunications service industry should leverage other industries by providing various applications in order to promote the growth of the telecommunications service industry itself. Therefore, development of the telecommunications service industry would be followed by both industrial innovations as a general concept and activation of the ICT ecosystem as characteristics unique to the industry.

In a sense, both improvement of telecommunications service quality and developing a balanced ICT ecosystem are not easily compatible. It is therefore a challenging task for firms to proceed simultaneously. This study also showed different results for the implementation of both values. While R&D and investment were chosen as critical factors for the improvement of telecommunications service quality, governmental policy support was notably important for developing a balanced ICT ecosystem.

In terms of telecommunications policy, network neutrality policies and spectrum policies exhibited high priority for their innovation value, governments should attempt to make such policies effective to invigorate the ICT ecosystem. Additionally, governments should notice that these policies are directly connected to innovative activities within the telecommunications service industry.

The contributions of this study are as follows. First, this study suggests a new innovation system framework appropriate to ICT industry. Furthermore, this study applies this framework to the practical field such as telecommunication service industry. This approach contributes to the extension of current innovation system theory. Second, level 1 and level 4 of AHP model were constructed by the result of in-depth focus group interview. This provides a mixed approach that qualitative data gathered by experts are used in quantitative methodology and that can be used in further applications.

Limitation of this study and further research are as follows. First, while this study dealt with innovation values and proposed an innovation system, specific values affecting innovation activity still exist. Therefore, it is necessary to add, refine, and elaborate innovation values and suggest comprehensive innovation systems.

Second, results of in-depth focus group interview can be deeply analyzed and provide further policy implications according to each hierarchical level using adequate qualitative research such as content analysis. Third, since in-depth focus group interview and data collection were conducted in late 2013, fast-changing telecommunication service environment may not be fully reflected although relevant innovation values are sufficiently applied to the research framework this study, Finally, effects of innovation system on the industrial and national economic growth can be revealed through various empirical studies.

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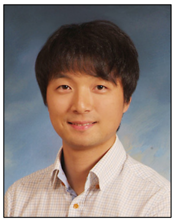

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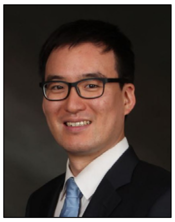

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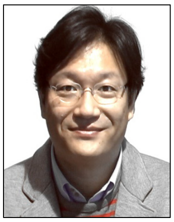

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