Service Innovation in Digital Contents Industry: A Case of Korean Online Games[41]

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Abstract The paper presents and empirically tests a framework of service innovation systems capable of studying interactions between users, service providers, contents developers and network providers in the digital contents (DC) industry. The framework is tested against a case study that traces the growth of the online game industry in Korea since its introduction. From the results of this application, the framework is developed into an innovation model of the DC industry. The model offers several advantages over other approaches in understanding the dynamics in the DC industry. Most importantly, it provides a single unified basis within which to analyze both service innovation resulting from users and publishers as well as manufacturing innovation induced by contents developers, platform holders and network providers. The distinction between service and manufacturing innovation is important in many ways, for instance in selecting proper government policy tools for promotion or regulation of the DC industry. Second, the model clarifies impacts of network externalities that are characteristics of the DC industry. Third, the Korean online game industry has experienced both radical innovation during the beginning period and non-radical innovation throughout the maturation period. The model developed herein is able to illustrate several types of non-radical innovations that are crucial to the sustainable development of the DC industry.
Key words service innovation, digital contents, online game, Korean case, government policy

1 Introduction

Why and how have particular nations succeeded in providing so much scientific invention and market innovation, leading to the diffusion and use of technology, while other countries has had so many difficulties? [1, p. 117] Theorists such as Porter, Freeman, Lundvall and Nelson equipped with different models of the national innovation system (NIS) have attempted to answer this question. Their basic answer is that every country has different conditions, from natural and human resources to social and legal institutions, and these different conditions produce national differences in innovation patterns, directions and magnitudes. However, most articles on NIS have centered on manufacturing innovation systems. Recently, articles examining innovation in service sectors have applied these results in trying to find similarities and differences between manufacturing innovation and service innovation patterns.

Since late 1990's, the online game industry in Korea has grown very rapidly. Today, it is well known that Korea leads the world in terms of online game production and publication. Also, the game industry leads Korean DC industry. This paper using a case study that traces introduction and growth of the online game industry in Korea, introduces a framework for studying innovation in the DC industry. This framework is developed into a model of innovation systems in the DC industry, investigating how the online game industry in Korea has developed through innovations in game production and service sectors.

In the following section, a framework of the service innovation system presented by [2] is reviewed, and is modified according to idiosyncratic features of the online game industry. The modified framework is capable of studying interactions between users, service providers (publishers), content developers and network providers in the DC industry. In section 3, a historical case of Korean online games is introduced and the modified framework is applied to the case. In section 4, an innovation model of the DC industry, of which the value-chain has manufacturing players as well as service players, is presented. The model clarifies peculiar patterns and directions of industrial innovation in the DC industry. In particular, it clarifies major differences of service innovation and manufacturing innovation. Within this distinction clarified, it is possible to highlight necessary conditions of the 'virtuous cycle' by which players in the value-chain cooperate for mutual development. Finally, with these systems clearly in place, the government's role in encouraging the success of the DC industry is examined. At the conclusion, policy implications of the Korean case are analyzed. Especially, some new policy tools for

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the DC industry are suggested.

2 Framework for Innovation System of DC Industry

2.1 The characteristics approach

Lancaster [3] observed that products, both material goods and immaterial services, can be described in terms of 'service characteristics' embodying good/service bundles. Saviotti and Metcalfe [4] extended Lancaster's observation, and applied it to the study of manufacturing innovation. They argued that service characteristics are related to a set of 'technical characteristics'. The set of technical characteristics are directly related to the technologies on which the products are based. Innovation is the means by which firms improve the set of technical characteristics and, thus, the service characteristics delivered to consumers.

Gallouj and Weinstein [2] generalized work by Saviotti and Metcalfe which suggested that innovation can be thought of in terms of change affecting one or more aspects of the set of characteristics of a good. Extending Saviotti and Metcalfe, they proposed that for service, as shown in Figure 1 the overall set of characteristics includes a number of subsets including:[42]

- the final use characteristics ([Y]) which are determined by how the user see the service in term of its price, level of performance, technical complexity and so on.
- the technical characteristics ([T]) which are made up of the technical systems necessary to deliver the service including tangible aspects such as particular machines and codified procedures or routines
- the complementary sets of competences needed by the provider ([C]) of the service and the customer ([C']) necessary to coordinate the delivery and use of the service as it is currently configured.

Gallouj and Weinstein, in order to study the impact of innovation on service providers, supposed an integrated service provider model which, utilizing technical characteristics of a product, delivered service characteristics to customers. That is, the final service characteristics (S) are materialized by the combination of technical characteristics (T) and service providers' competences (C). This framework is supplemented by the 'co-production', interaction between the user and the provider in generating service outputs. In particular, there are important interactions at the user-provider interface in which technical characteristics intervene. Both the technical characteristics and the competences of the provider interact to affect the ability to deliver the service, as well as communicate to the consumer his role in facilitating use of the product. Note that these interactions are denoted by arrowed lines among [C'], [C], [T] and [Y] in the figure.

In their framework, innovations can be defined as any change affecting one or more elements of one or more characteristics vectors. The utility of this framework is that it provides a systematic way of distinguishing different types of innovation, such as radical or non-radical innovation.

[42] This definition is adopted from [5, p. 224].

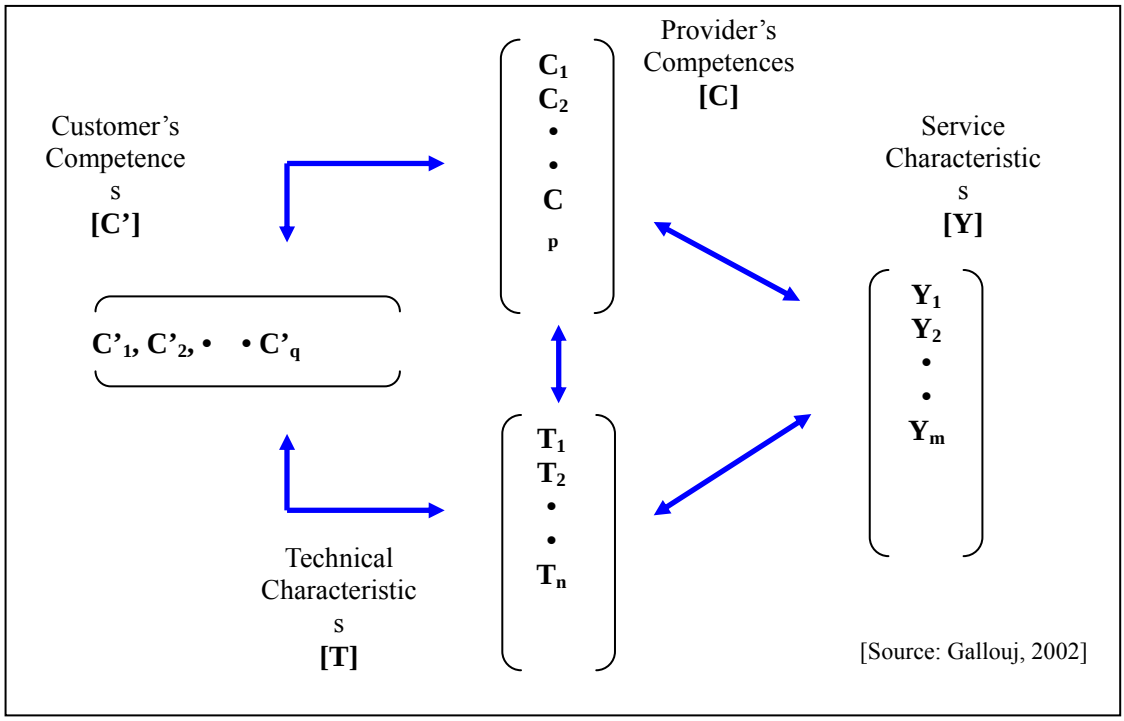

Figure 1 Characteristics in the Service Innovation Model

2.2 Modification for the DC industry

Having discussed the framework of Gallouj-Weinstein (G-W) which explained a general framework for knowledge-intensive business service industries, I now present a framework appropriate to the DC industry. Any framework for the DC industry should contain several idiosyncratic features that are not found in other knowledge-intensive service industries.

First, the G-W framework assumes that [C] and [T] are possessed by the same entity, service providers. For example, they took ATM's owned by banks as an instance of [T] in the banking industry (p. 543). In the DC industry, entities which determine technical characteristics are typically several, not single, industries including contents developers, platform holders and network providers that are both functionally and legally different entities from service providers or publishers.

Secondly, for the DC industry, the legal separation of [C]'s and [T]'s ownership has some important implications for any adequate innovation model. Users' reactions or requirements can be transferred to entities in charge of [T] through entities in charge of [C]. That is, there is no formal interaction between [C'] and [T]. Second, interaction of [C] and [T] takes a form of organic development. Since [T] is governed by several industries, cooperation, coordination, competition and even conflict are involved at their interaction. These interactions cannot be planned. Instead, they emerge. In the G-W framework, technical characteristics are of static nature and do not come into play as parameters that eventually determined service characteristics. For instance, in the banking industry, once ATM facilities are introduced, the service qualities are decided by service providers and customers' competences. Once in place, there is no further development.

Thirdly, [T] is determined not only by DC producers but also by several industrial parties including platform holders and network providers. The DC producers incessantly coordinate or collect information about the other players in the field to stay at the cutting edge of technical possibility. The technical characteristics of DC products are final representations of technical specifications selected by DC producers on the basis of this information.

Fourthly, in the DC industry, network providers are important players that decide the level of service qualities. DC producers strive to maximize the efficient use of network potential. The direct roles of network providers in the service innovation system are various. First, they work as a hygiene factor in a way, limiting the domain of technical characteristics. Without broadband wired network, for example, it is not possible to provide contents with video streams at sufficiently realistic frame rates. Second, network externalities depend on the network access rate. Network potential can accelerate innovation diffusion and make the system enter a virtuous cycle, or stifle a child industry. It can also

increase the cognitive level of service characteristics and provide more 'fun' elements to end-users. Third, the network access rate decides the level of the co-production or user-provider interaction. The user-service provider interaction ([C'] x [C]) has little interruption if the network provider's technical capability is high.

Finally, in addition to the co-production, interaction among users is very important. End users' mutual interaction is important in the DC service innovation system, since it is regarded as important sources of innovation. In summary, service characteristics in the DC industry are outcomes of three players; DC producers who configure technical characteristics, publishers who package and deliver them, and network providers who facilitate or limit both their dissemination and use characteristics.

3 A Case of Korean Online Game Industry

3.1 Background

3.1.1 Features of Online Games

In Korea among various genres of online games, a massively multiplayer online game (MMOG) has drawn game users' greatest attention. Beginning in 1998 and the number of MMOG users had increased dramatically until 2004. Hundreds of games of this genre were developed and published in Korea. Below is described the general features of MMOG's [6], [7].

First, MMOG's differs from other online games in that thousands of users, so called "massively multiple" users, concurrently access to game servers through the Internet and play the game together. Individual players choose their own playing characters, or "Avatars," which have pre-designed 'roles,' and play their roles in a cyber game world. From a production standpoint, development of PC games and online games are similar in a sense that they require designers, programmers and graphic artists. However, MMOG developers need to have additional capability in server technology and network system design to provide services as hundreds of thousands of users access game servers concurrently. Popular games such as *Mir 2* in China or *Lineage II* in Korea have been accessed by more than a quarter million users concurrently [8].

Second, a cyber game world needs to be operational 24 hours a day and seven days a week without interruption as a so-called 'persistent world.' If bugs or errors are found in game software, service providers or publishers in cooperation with game developers must quickly fix them by adding program patches. In addition, portions of the game world must be updated or upgraded in a timely manner. Therefore, unlike in PC or video games, close cooperation between game developers and publishers is more critical after publication. Publishers of online games cannot succeed without service-oriented mind, while those of PC games suffer no such constraint. The latter simply manufactures a CD ROM, distributes it and provides customer service only if necessary.

Third, most MMOG users are hard-core users who play games at least 1-2 hours a day, every day. They are very loyal to their favorite games and do not easily switch to another game once they become steady members. Thus, a handful of successful publishers have run extremely profitable businesses for a considerable period while the rest have barely survived from the beginning. At the same time, since users need to register at log-in servers to access the game servers, there is little possibility of software piracy. Thus, business can be profitable even in a country where the rate of software piracy is high, a crippling factor for conventional game publishers.

3.1.2 Online game in the framework

Figure 2 shows the characteristics of online games according to the proposed framework. As shown in the figure, online games' characteristics are listed in the vector format and the arrows indicate interaction between the characteristic vectors. The major differences between this framework and the G-W framework are that there is no interaction between [T] and [C'], and it includes the filtering function of network externalities as explained at the previous section.

Service providers' competence (C) is closely related to scope and quality of game publishers, whereas technical characteristics (T) are decided by capability of game developers. Most elements in [C] show publication activities of game publishers. They typically distribute client packages, provide download services, manage game-play and user communities, the so-called "Guild," administer servers at the IDC (Internet Data Center) and various databases and set up user-payment systems. The technical characteristic vector ([T]) contains scenario, graphic design, client software and server software as well as PC specification and network speed requirements.

Elements in the user's competence vector ([C']) are the interactive game playing capability and

role playing ability. In the process of playing games, players interact with other players. Then, they deliver their opinions regarding playability, including both individual and community level concerns, to publishers. At the same time, the GM's (game masters) of publishers receive users' requests, monitor playing behaviors and patrol the game cyber world to ensure that the game remains fun enough to retain membership.

When the value of a product depends on how many other users there are, it is said that this product exhibits network externalities [9]. Network externalities may increase or decrease the impact of online game services (the combination of [T] and [C]) on the user's final characteristic vector ([Y]). Schilling [10], [11] listed two positive factors which intensify network externalities; a large installed base and complementary goods. He also mentioned incumbent dominant designs as a negative factor to network externalities eventually resulting in the lockout of late-comers. In the online game industry, thus, three types of network externalities - the size of a broadband Internet installed base, complementary products and substitution products - have influence on the model. The first two function as positive factors and the last functions as a negative factor.

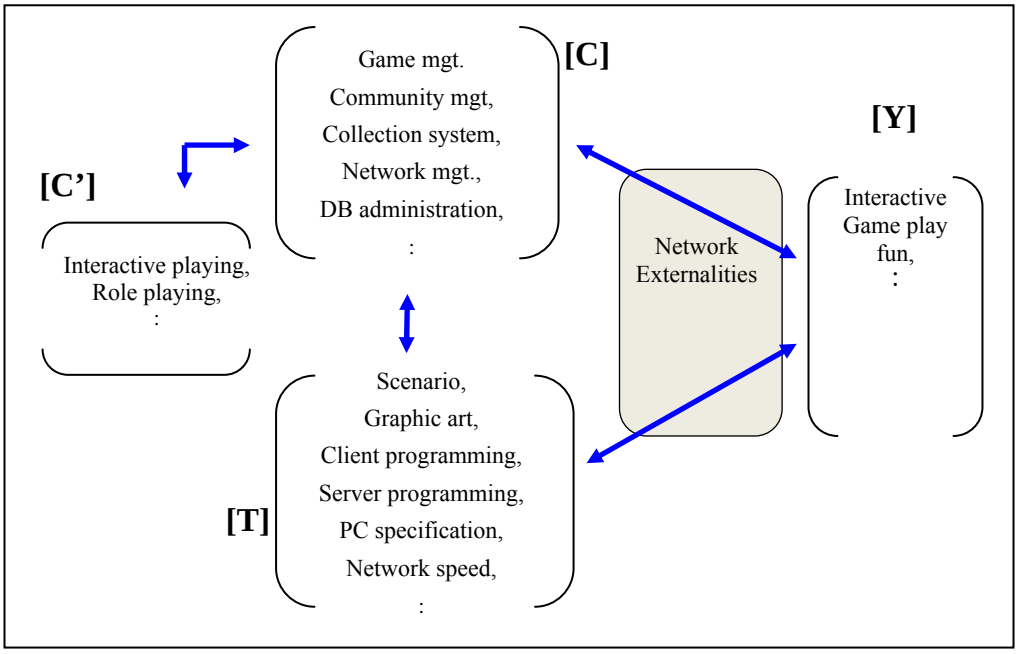

Figure 2 Online Games Characteristics in the Service Innovation Model

3.2 Early Stage (1996-1999)

3.2.1 Genesis: How it initiated and exploded

In the mid 90s, because of the high rate of software piracy which once peaked at an incredible 70%, the size of Korean video or PC game industry was very small.[43] [44] Ironically, Korea, which had little path dependency on the PC game industry, proved to be fertile soil for the growing online game industry when a network-based MUD (multi-user dimension) game was introduced in the mid 90s. By 1996, some game companies developed text-based MUD games and continuously MUG (multi-user graphic) games. These immediately earned high popularity from low-speed telephone-modem users. As broadband Internet users increased, the MUD game developers were transformed into online game developers of the sort working in the industry, today.[45] Finally, in 1996 **Nexon** developed *the Kingdom of the Wind* which was, arguably, the first truly online game in the world, exhibiting as it did all the

[43] According to BSA, in 1996 the software piracy rate was 71%; in 2005 it dropped to 46%.

[44] PC game distributors did not make money until 1997 when **Hanbitsoft** distributed *Starcraft*, a network game. Even in 1999, an estimation of Korean PC game market was 86 billion Korean Won (around $ 86 million) among which total sales amounts of 7 major distributors were 60 billion Korean Won [12].

[45] The number of the broadband Internet subscribers reached to around 4 million in 2000, ten times higher than in 1999 [13].

factors characteristic of today's online games.

Technologically, the MUD developers already had basic capabilities of storytelling, game programming, database administration and network coordination. Though the MUD games lacked graphics and server programming, the essential capabilities to develop and operate primitive online games were accumulated by learning-by-doing over the course of several years. This technological capability was the basis for game developers to transform their basic businesses into online games using the Internet.[46]

In 1998, *Starcraft,* a local area network game produced by **Blizzard Entertainment**, set an unprecedented record in Korean game industry.[47] As of October 1999, around one million copies of *Starcraft* had been sold in Korea, which was one third of the world sales volume (Korean Economy Daily, 1999). It drew great attention from youngsters, especially from college students. A thriving gaming community emerged, with many students gathering at PC Bangs (Internet cafés) to contest each other.

Through playing network games, players understood interactive game playing mechanisms and appreciated the fun from the interactive game format. Since the quality of the game was so advanced in terms of storytelling and game design, Korean players' quality requirements for domestic games were set very high. It also produced many skilled interactive game players who had high quality demand.[48] In addition, it influenced game developers itself. In effort of capitalizing on *Starcraft* fever, MUG (multi-user graphic) game developers quickly transformed themselves into broadband Internet-based online game developers.

After the financial crisis in 1997, Korean Government announced the Venture Registration Rule to promote the setup of new technology-based venture firms. According to this rule, many new small hi-tech firms were registered as "venture firms" and received special favors such as tax reductions or favorite interest rates of bank loans. Also, venture capital funds invested capital into entrepreneurial ventures. The number of the venture firms registered increased very rapidly and reached 11,392 in 2001.

In early 1990s, only a few institutes, such as KAIST and Seoul National University (SNU), could gain access to the Internet through the National Academic Internet Test-bed Program. At research labs at KAIST and SNU, some graduate students experimented with online game technology using the early-stage broadband Internet. When the dotcom boom came, they quickly capitalized on their technological capabilities and successfully set up their own online game companies. As shown at Table 1, **Nexon**, **NCsoft** and **Hangame**, which are the largest and most successful online game companies in Korea, were established by graduates from KAIST and SNU around this time.[49]

Table 1 Major Developers and Their Graduate Schools

Company	Founding Year	Sales * ($ M)	Name	Position	Age**	Graduate School
NCsoft	1997	154	Kim, Taek-Jin	CEO	39	Seoul N. U.
			Song, Jae-Kyung	Core Engr.	41	KAIST
Nexon	1994	51	Kim, J	CEO	39	KAIST
			Lee, M.	Core Engr.	40	Seoul N. U.
Hangame	1999	33	Kim Bum-Su	CEO	41	Seoul N. U.
Taewool	1994	-	Cho, Hyun-Tae	CEO	36	KAIST

* As of 2006
** As of 2007

3.2.2 Radical innovation[50]

[46] Mr. Song who was a Nexon's core engineer recollected that when he applied client-server systems to Korean first graphic-based MUD games, *the Kingdom of the Wind,* many were suspicious of the technical success [7, p. 53]

[47] The game is not an Internet-based online game but a local area network (LAN)-based multi-person real time simulation (RTS) game. Maximum 16 persons can play together through the LAN.

[48] Still *Starcraft* is the most popular e-sports item and there are 316 professional gamers registered at KeSPA, Korean e-sports association in 2007 (http://www.e-sports.or.kr/progamer/p_2_2.asp).

[49] At an interview with author, Mr. Cho, president of Taewool Entertainment recalled that when he was at KAIST, he paid attention to the *Kingdom of the Wind* that had been produced by his school senior, J Kim at Nexon, and continuously checked technical direction of his colleague's game development.

[50] The strictest definition of radical innovations is used. Thus, the structure of competences of users and providers are destroyed and these are completely new technical characteristics and user characteristics.

Three events are closely related to the window of opportunity for innovations in the online game industry. First, MUD technology was a basis when the game companies developed the Internet-based online games with better graphics and new client-server technology. Second, a local area network game, *Starcraft,* attracted many young players. It quickly produced many skilled players. It also made them appreciate the new type of game fun from interactive plays. Third, the dotcom boom brought many positive impacts to the game industry indirectly.

Events during the genesis of the online game industry can be seen as changes in the elements of the vectors in the framework modeled above. The MUD technology induced a change in [T]; S*tarcraft* fever boiled down to changes in [C'] and [Y]; and the dotcom boom produced new entrepreneurs ([T]) and new business models ([C]). All the changes to these vectors can be regarded as radical innovations, since there had been no similar elements in these vectors before the changes. In addition, service innovation, changes in [C] and [C'], and manufacturing innovation, changes in [T], occurred at the same time, creating new forms of [Y] and thereby completing the radical innovation. Interestingly, there had been no innovations initiated by the Government policies, except for the Academic Internet Test-bed Program which was are not intended to create an online game industry.

3.3 Subsequent Development (2000-)

3.3.1 Growth stage

In 2000, at the peak time of the dotcom boom, many dotcom firms needed network engineers. Many engineers applied to this technical field. Since the technology was new to Korea, most of applicants did not have chance to learn it at school, but instead they learned it through on-the-job training and in the trial-and-error way.

The dotcom boom in 1999 and 2000 created many Internet-based firms that developed new business models, testing their profitability as well as their capacities to overcome unforeseen difficulties. Electronic commerce models - or simply e-business models - created new services for front and back offices such as electronic billing and payment services. Online game companies could choose their own business models from various e-business models.[51].

In 1999, the number of PC Bangs (Internet cafés) increased suddenly, in 2001 reaching the highest number, 22,548 PC Bangs in the small country of Korea. It has been argued that the popularity of *Starcraft* resulted in the rapid increase of PC Bangs.[52] Since the broadband Internet line supply to homes was not enough, many players played *Starcraft* at PC Bangs. The rise of PC Bangs influenced the growth of the online game industry in various ways.

First, there was a large demand of high speed Internet lines from PC Bangs. Consequently, increasing installation of broadband Internet lines eventually lowered monthly connection fees, which induced more users and in turn sped up broadband network installation. Second, PC Bangs served as learning centers for game beginners. Players gathered physically at the same places and exchanged information and tutored others in the special skills necessary for gaming success [14]. Third, PC Bangs and online game firms created a new business model for online game sales. PC Bangs in advance bought IP addresses dedicated to popular online games, and players only paid to PC Bangs for access to any of the games available there. At one time, for example, **NCsoft** relied on PC Bangs for 80% of their revenues [13]. The IP sales to PC Bangs also intensified advertisement effects for a new game especially when it was introduced through PC Bang chain-stores. Table 2 shows the growth trend in PC Bang operations in Korea over a seven-year period.

Table 2 Number of PC Bangs in Korea

	'98	'99	'00	'01	'02	'03	'04
Number of PC Bangs	3,000	15,150	21,460	22,548	21.123	20,846	20,893
Growth rate	-	405%	41.7%	5.1%	-6.3%	-1.3%	0.2%

Source: KGDI (2005)

NCsoft's *Lineage: the Bloodpledge* has been the principal propellant of the company's rapid expansion. In 1999, the average number of its concurrent users was over 10,000, while in 2000 and 2001 the numbers expanded to over 100,000 and 300,000, respectively. In 2002, **NCsoft** accounted for about 40% of the domestic online game market [17].

The advent of the killer application, *Lineage*, influenced the Korean game industry in many ways.

[51] A business model depicts the design of transaction content, structure and governance so as to create value through the exploitation of business opportunities [15]

[52] Seventy to eighty percent of total sales volume of *Starcraft* was sold to PC Bangs[16].

Among them, there are two aspects worth mentioning. First, server programming technique improved as the number of concurrent users soared. Many load balancing techniques which allow online game companies to economize server resources were developed and implemented. As shown in Table 3, more than 120 Korean patents regarding server technology were applied for by the end of 2002.

Second, the importance of user communities of lasting success came to the forefront of game development and implementation. For instance, *Lineage* was notable for its enormous number of cyber-communities. User community ("Guild") membership stood at 1.5 million, while the average number of concurrent users were around .3 million at that time [17]. From the lesson of *Lineage*'s great success, it was proven that the crucial element for the success of an online game business in Korea was to construct 'social bonds' among the game players in the cyberspace. The community building became the *de facto* standard of the successful operation of online game services.

Table 3 Comparison of Number of Server Technology Patent Applications

	1998	1999	2000	2001	2002	Total
Korea	3	10	51	29	33	128
U.S.	2	2	4	6	8	22
Japan	3	2	15	14	2	42

Source: Websites of Korea Patent Office, 2004

3.3.2 International expansion

As the growth in the number of domestic users slowed down, Korean game companies looked at the international market. Until 2004, China was the main target market for Korean game companies, but later Japan and Southeast Asia were included in their international market list. As shown in Table 4, 160 online games were published abroad in 2006. Through the course of internationalization, Korean developers learn to improve localization techniques, adapting their games to network conditions and cultural settings of importing countries. In addition, as Korean game developers targeted increasingly diverse cultural settings, the contents of their game worlds also diversified. In the early 2000s, most Korean MMOG's were fantasy games with European Middle Age themes, imitating the *Dungeon & Dragons*[53]. These days, some developers produced MMOG's with a Kungfu storyline or oriental background for the purpose of oversea publication.

Table 4 Number of Korean Games and Firms Published Offshore

	China	Taiwan	Japan	SE Asia	USA	Europe	Total
Number of games	44	31	49	19	12	5	160
Number of firms	32	23	38	17	9	5	124

Source: revised from KGDI [17]

3.3.3 Genre expansion

It was found that one way to overcome the oversupply of MMOG's was to expand on existing game genre categories. In 2003, several online companies, targeting non hard-core users such as women and young office workers, developed mid-size casual games such as *KartRider*, *Freestyle, FIFAOnline* or *Audition.* Players could spend as little as an occasional 10 minutes to participate in this new genre, whereas most MMOG users invested at least 1-2 hours almost every day. One of difficulties in publishing these so-called casual games was how to charge fees, however. Since the users did not play casual games regularly, they in general disliked paying fixed monthly fees and new payment schemes had to be developed. In order to reduce users' resistance to signing up and to enlarge the online user base, a payment system in which game items with special functions were sold with no fixed fee was introduced. This new charging system for casual online games was welcomed immediately and became the *de facto* standard.

3.3.4 Analysis of innovation pattern

[53] The original *Dungeons & Dragons*, designed by Gary Gygax and Dave Arneson, was first published in 1974 by Gygax's Tactical Studies Rules (TSR). Originally derived from miniature wargames (particularly *Chainmail*), *D&D*'s publication is widely regarded as the beginning of modern role-playing games (http://en.wikipedia.org/wiki/Dungeons_&_Dragons).

The history of *Lineage* offers a convenient insight into the role of PC Bangs as well as the importance of the killer application to online games. The phenomena of the killer application resulted in improvement of server programming capabilities in [T] and service operation abilities in [C]. PC Bangs induced the changes in users' competence in [C'] as well as the change in providers' business models in [C]. They also functioned as a multiplier of network externalities. These change vectors can be regarded as non-radical innovations in the online game industry. The role of PC Bangs and the new revenue model are the additional elements in the vectors so that they are regarded the incremental innovations; the other two innovations, improved capabilities on server technology and service operation can be regarded as improvement or ameliorated innovations.

Since 2003, the Korean game market became saturated, two major trends appeared. Game companies searched for opportunities in the international market more aggressively and casual games genre opened new markets, even in Korea, attracting mid-core players to the industry. The globalization trend induced the improvement of abilities to develop content specific to different cultural tastes (T), while the advent of casual games changed the competences of users (C') and service providers (C) together. The innovations in the mature stage are regarded as a recombinative innovation. The recombinative innovations occur when the service characteristics are unbundled or combined with other services in order to create a new service structure [2]. This is an extremely common form of service innovation.

4 Innovation Model of the Digital Contents Industry

4.1 Two systems in the model

Innovations of the DC industry are created by two players who operate under different innovation systems. Innovations in publishers' operations fall within the category of the service innovation system, whereas game developers' technical changes fall under the manufacturing innovation system. Two innovation systems are different in terms of innovation players, innovation directions, effective government policies, etc. Table 5 shows their differences.

First of all, manufacturing innovation follows the technology trajectory [19]. As in the Korean game industry, the development of Internet-based online games followed the technology trajectory, preceded as they were by the MUD games and the MUG games. However, service innovation of game publication did not follow this trajectory. It only accommodated users' explicit or implicit requests. For instance, no one expected that casual games would receive popularity in 2004 under new business models and user payment systems. In fact, technically, casual games are easier to produce than MMOG's. Thus their development is actually seen as moving backward on the technological trajectory.

The second major difference is the region of initiation and diffusion. Service innovation is initiated and diffused within a region of cultural homogeneity or at least national boundary where users of common culture and language can communicate with each other. On the other hand, manufacturing innovation requires a hub of technological networks, a so-called innovation cluster [20, p. 365]. At the cluster, knowledge is gathered and the collected knowledge both produces innovation and allows for technical standards to be established. In Korea, KAIST and Seoul National University played a role in the innovation cluster as the government installed Internet test-beds in these schools and they became centers for development and consensus over standards going forward.

Third, in the manufacturing innovation system, it is very important to protect private technology. Every country has its own legal and social institutions to support private use of technical innovation. On the other hand, in the service innovation system, no explicit legal system exists to prevent from copying innovation, and it is difficult to protect from being copied. Once a company creates innovative and superior services, other companies in similar industries immediately try to copy them. However, it is not easy to copy them because of ambiguity. These innovations are often rather unspectacular, and hard for outside interests to successfully implement since they do not have explicit development plans or prototypes. In addition, if the change results from improvement or recombinative innovations, it is even more difficult to copy. In case of recombinative innovation, where they mix and match several changes in their system, others notice some changes in the system but often cannot see all changes, and even then have difficulty evaluating which might be effective or appropriate to them.

Table 5 Characteristics of innovation in DC industry

	Service Innovation	Manufacturing Innovation
Major Players	publisher and users	Game producers, HW manufacturers, Network providers

Direction of Innovation	Following user's request	Following technology trajectory
Region of Innovation	Cultural homogeneity	Innovation cluster
Piracy Protection	Hard to copy due to ambiguity of innovations	Legal institution under national innovation system
Government policy	No block for diffusion, Provision of network externalities	Goal-directed strategies

Fourth, the government can utilize goal-directed technology-push strategies in order to promote innovation for manufacturing sectors. Typical innovations in Korean ICT industries are those resulting from catching-up strategies. That is, core technologies in the form of hi-tech products such as TFT-LCD, semiconductors, etc. were imported and then domestically developed with supervision or with support from Korean government (e.g. [21]). On the other hand, as far as the DC industry is concerned, the roles of the government are to build infrastructure for network externalities and to promote effective cooperation or interaction among value-chain players.[54] In the concluding section, this point will be elaborated on.

4.2 Necessary conditions for successful innovation

4.2.1 Cooperative environment

Service characteristics of online games are determined by three conditions: competence of publishers and technical capability of game producers as well as network accessibility. In the DC industry, innovation can happen only when both service and manufacturing innovations occur simultaneously or interactively. For example, in 2000 when *Lineage* received explosive welcome by users, **NCsoft** had publishing capabilities to manage a huge number of users, while game producers wrote server software programs with effective load balancing ability, and network providers also managed huge traffic. This means that in order to add new features to game services, service providers, game producers hardware manufacturers and network providers should cooperate and have frequent interactions. Without cooperation one cannot have successful innovations of service characteristics (Y).

4.2.2 Network externalities

The DC industry is a typical industry where network externalities influence industrial success and failure. In the late 1990s, high software piracy rates gave the chance for radical innovations occurring at the game industry in Korea. Perhaps if there were any incumbent game industry that provided substitution products, the impact of network externalities on online game would be much less and the fast radical innovation would not be possible.

As shown at Figure 3, the installation of the broadband Internet users increased very sharply from 1999, and the increase of online game users followed. The Korean Government set a direction for the knowledge-based society with the "Cyber Korea 21" program in 1999 (MIC, 1999). As a result, the ICT industry grew from 8.6% of GDP in 1997 to 13% in 2000 (KISDI, 2002). Around 2000, the Korean Government finished the national and public broadband Internet network, and then the telecommunication industry took over non-public Internet networks [22].

[54] At the beginning of the online industry Korea Government did not exercise any direct policy tools for the industry. For example, White Paper 2000 [22] does not contain any mention about game industry or game technology. In 2001, the government began to publish the Korea Game White Paper [23].

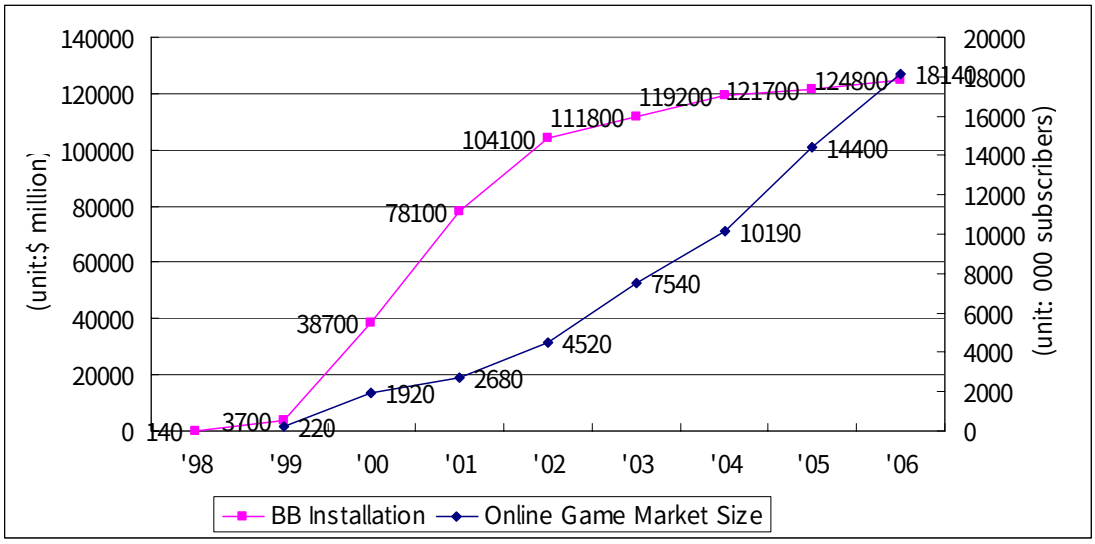

Figure 3 Number of Broadband Internet Subscribers and Online Game Market Size

4.2.3 Killer application and virtuous cycle

At every stage, killer applications played important roles in driving the game industry into leapfrogging development. *Starcraft* introduced fun from an interactive game to many youngsters. It also trained future game designers through learning-by-playing. At the growth stage, *Lineage* had an enormous impact on the PC Bang industry as well as the whole game industry. Its impact pertained to technological characteristics ([T]) as well as publishers' competence ([C]). At the mature stage, *KartRider* and other casual games set up a standard of a new business model and it expanded the population of game players.

The contributions of *Starcraft* and *Lineage* are not limited to the game industry. The killer applications initially increased the number of the PC Bangs. The boom of the PC Bang industry required more high-speed Internet lines, which in turn promoted the telecommunication industry [14]. This induced a virtuous cycle for the online games as shown Figure 4. The more online game users, the more PC Bangs and the more demand for broadband Internet lines. Thanks to the ubiquitous broadband Internet, game users easily downloaded large memory games within relatively short times.

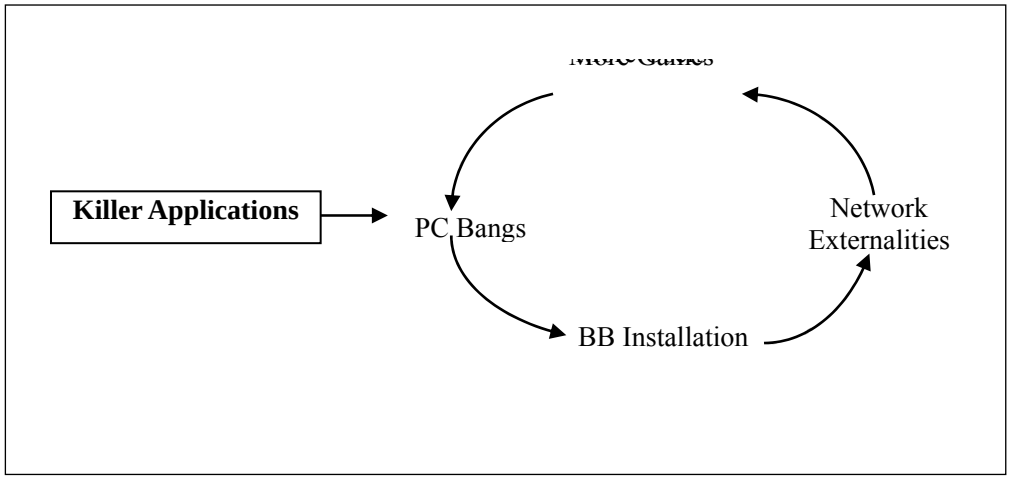

Figure 4 Virtuous Cycle of Online Game Industry

5 Conclusions: Government Policy Implication

Since the DC industry has characteristics of both service and manufacturing innovation systems, government innovation policy applied to the DC industry requires both service and manufacturing

considerations. The government policy for manufacturing innovation is well known and researched in many ways. Typically, there are push and pull policies for inducing more innovations in the industry. However, for service innovation, it is not easy to find the place of origin and direction of innovation so that the government might decide policy based on other perspectives such as network externalities or human resources building. Some points in regards to promotion of service innovations are worthwhile mentioning.

First, it is asserted that recombinative or ameliorated innovations are important to make the DC industry reach sustainable development stages. Actually, core competences of a firm, a city or a nation in service industries reside in many trivial non-radical innovations that others often do not imitate or adopt. For instance, world centers of special services such as London and New York of finance services, or R&D in Silicon Valley simply cannot be imitated by other nations or cities.

In this regard, the role of the government is to get rid of hurdles for rapid diffusion. For example, learning their lessons from *Lineage*, game companies understood the key success factors in the Korean market. They immediately followed the leader. In 2000, around 100 games were developed and most of them were 'me-too' products developed along *Lineage* lines. PC Bangs also worked as an intermediary for the diffusion of innovation, making game developers understand users' tastes and playing behaviors. In the DC industry, the rapid diffusion of innovation is important in the sense that many service providers can adopt the best practice temporarily and improve it in the future.

Secondly, the service industry does not have a discretely identifiable product life cycle such as that found in the manufacturing industry. In the product life cycle theory, once the industry enters into the mature stage, eventually it slides into the declining stage, and after some time passes, a new innovative industry springs out from ashes of the old one. However, one might conjecture that the mature stage of the DC industry can be followed by the growth stage immediately, with some non-radical innovations. In the case highlighted above, casual online games rejuvenated the Korean online game industry in 2004. For instance, if users could play online games over mobile equipment as well as wired terminals interchangeably, the market size of online games could increase drastically and the industry could change into the growth stage again. In this instance, the government policy should responds by putting more weight on improvement of the industrial situation than on preparing and implementing some new grand-scale master plans.

Thirdly, the government's role in initiating innovations in service industries is limited. This is partly because there are many factors required for service innovations and it is not easy for the government to boost these factors all at once, and partly because the users' capabilities in [C'] are not easily improved by policy tools. However, the Korean case indicates that there are some indirect roles the Government should play for service innovation. For example, as the Korean Government did in the 1990s, the government needs to prepare the master plans for human resources development as well as for network infrastructures in advance. According to the plans, the private sectors prepare their activities and capitalize on the opportunities that present themselves in time. In the end, however, it is up to the government to foresee these needs, and to help to finance their solutions.

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