Pathologies of Technology Transfer and Commercialization in South Korea
- A Social Interdependence Theory Interpretation

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논문 요약

The paper tests the above socio-cognitive model with four empirical case studies of leading Korean science and technology research and technology transfer organizations. The case studies demonstrate clear differences in individuals' frames about the technology transfer process and arising conflicts. As a result, technology transfer process is not fully controllable and is highly contextual. We argue, whereas public policy in countries approaching technology frontier provides essential support for defining and exploiting best practices (routines/pathways) for technology transfer at organizational level, they have not matured enough to support the timely identification and resolution of conflicts between individual actors, hence the inefficiencies. Therefore, among others, public policy for technology transfer could consider allowing an inclusive approach to recognition of best practices for technology transfer and innovation processes, increased social interactions between technology transfer actors, and their training on resolution of individual level cognitive conflicts.

Keyword : Technology Transfer, Socio-cognitive View, Technology Commercialization, Case Study, South Korea

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1. Introduction

This study attempts to examine each firm's decision-makings of CoPS innovation strategy so that it tries to unlock the nature and role of CoPS innovation strategy by approaching an innovation process as a strategic decision-making process. It deals with CoPS innovation different from other-typed innovation (Hobday, 1998; Hobday et al., 2000; Hardstone, 2004; Davies et al., 2006; 2011). While those studies of CoPS innovation have much dealt with a business-to-business industry, this study tries to locate each firm's decision-makings of CoPS innovation strategy in a business-to-consumer service industry. And, it considers market power as one of strong influential factors offering an explanatory power of why and how system integration firms (hereafter firm) come up with or decide different CoPS innovation strategies. This study constructs each firm's market power as its market share by the installed base of technology - through network effect - and switching cost. Many studies explored innovation strategies on the competition (Clark, 1985; Khazan and Mowery, 1994; Anderson and Tushman, 1990; Utterback and Suarez, 1993; Suarez and Utterback, 1995; Suarez, 2004; Schilling, 2003; Murmann and Frenken, 2006; Narayanan and Chen, 2012). Even though those studies have much contributed to understanding unique characteristics of innovation strategies - such as network effect, dominant design etc., there are still the lacks of understanding of how each firms come up with or decide their innovation strategies - specifically decision-making processes of innovation strategy. So far, a decision-making process of innovation strategy has been regarded as a kind of the black-box, veiled so that it may negatively works out to understand a full-picture of innovation strategy. And, because of unique characteristics of CoPS industry and innovation, market share, network effects, switching cost and dominant design, etc., have been relatively ignored in the studies of CoPS innovation. Those things have limited theoretical developments of CoPS innovation. By empirically unlocking the black-box of deciding CoPS innovation strategies, this study can contribute to empirical and theoretical development of innovation management and CoPS.

This study adopted a comparative case study of each firm's decision-makings of CoPS innovation strategy in an industry. It had SKT and KTF in South Korea. On the introduction of MP3 player mobile phone, the three mobile operators initiated new digital music services, which were the convergent music service in

South Korea digital music service industry. And, they adopted the digital rights management (hereafter, DRM) technologies as a control unit of each convergent service. This study empirically looked into two mobile operators' decision-makings of DRM innovation strategy. Through literature reviews, it formulated three research propositions and empirically examined those propositions. And then, this presented empirical results.

2. Decision-Making of CoPS Innovation Strategy and Market Power

2.1. Strategic Decision-making as Analytical Negotiation Process in CoPS Innovation

This study considers an innovation process as a strategic decision-making process (Schilling, 2010; Tidd, et al., 2005). It deals with CoPS innovation. There have been many studies of CoPS innovation (Hobday, 1998; Hobday et al., 2000; Hardstone, 2004; Davies et al., 2006; 2011). Those studies identified unique characteristics of CoPS innovation - technology intensity and complexity, business-to-business industry, and multiple economic actor involvements, which are different from innovations in mass-production good. This study approaches a CoPS innovation process as a strategic decision-making process taking place in a business-to-consumer service industry.

Many studies have examined various theoretical perspectives of a strategic decision-making process (Archer, 1981; Bear, Dirks, and Nikerson, 2013; Bourgeois and Eisenhardt,1988; Cyert and March, 1963; Drucker 2001; Elbana, 2006; Mintzberg, Raisinghani, and Theoret, 1976; Mintzberg, Ahlstrand, and Lampel, 1998; Mark and Peteraf, 2006; Shoemaker, 1993). Drucker (2001) suggested that decision-making is a process from problem recognition to decisions of alternatives to solve problems, while Archer (1981) recognized decision-making as a composite of specific processes. Bear, Dirks and Nickerson (2013) put an emphasis of problem definition and formulation in a strategic-decision making process. They argued that the boundary of problem defined by each firm can limit or constrain alternative of strategic options, while it can expand strategic options or generate various alternatives. However, the process in strategic decision-making would not have linear flows but iterative processes (Mintzberg, et al., 1976). Mintzberg, et al. (1976) examined the structure of a strategic decision-making. They identified several inter-related decision-makings. Therefore, this study attempts to define a

strategic decision-making as the process subdividing into a series of inter-related decision-makings from problem recognition.

This study adopted a power perspective, based on Porter (1980; 1991; 1994; 2001). While a decision-making can be thought as a political negotiation process as Bourgeois and Eisenhardt (1988; Elbana, 2006) argued, Porter maintained a striking balance between political maneuvering and competitive economics (Mintzberg, et al., 1998 p. 113). A firm's strategic decision-making necessarily accompanies the alignment between a firm's strategy and the environment. Porter (1980; 1994) argued that one of important environments where firms are competing is about an industry structure. He suggested the influential framework of analyzing an industry structure by using the five force model. He identified five forces as rival, competitor, supplier, customer and entrant. However, recently, Brandenburger and Nalebuff (1996) noticed a new emerging force in an industry as a complementor. Porter (1980) argued that introduction of new technology opens new negotiation process of new technology among economic actors in a given industry structure. Some studies on introduction of new technology or innovation articulates power struggles in competition as well as negotiations among various economic actors (Shapiro and Varian, 1999; Suarez, 2004; Narayanan and Chen, 2012). Each firm's power can be understood through interactions between a firm and economic actors. Hobday (1998, p.689) also argued that a firm in a CoPS innovation is engaged into negotiating new product design, methods of production etc., with suppliers, competitors, customers, and regulators and other economic actors. It means that a strategic decision-making of CoPS innovation strategy requires multiple economic actors to be involved (Hobday, 1998; Davies and Brady, 2000). Braybrooke and Lindlom (1968) argued that many economic actors in the political process are hardly coordinated by any central authorities, due to distributed powers of economic actors. However, Quinn (1980) refuted Braybrook and Lindbloom's argument by saying that a firm take a role of a central economic actor, which coordinates diverse economic actors and guides all to compromise in the production of optimal favorite output. In other words, a firm can decide decisions in a competitive power landscape, where diverse economic actors' powers are located in an industry. In a CoPS innovation, a system integration firm's strategic decision-making is a negotiation process through interaction between a firm and economic actors. In relationships with each economic actors in an industry, each firms analytically understand discrepant powers through interactions with economic actors when they are engaged in their decision-making processes. It means that each firm's problem recognitions or decisions of

alternatives regarding new technologies are outputs of analytical negotiation processes in an industry.

2.2. Market Power: Market Share, Network Externalities and Switching Cost

This study constructs the market power originated from each firm's market share from its installed base through network effect, as well as from its switching cost. Many studies indicate that each firm's market share is one of important factors to understand or measure its market power against economic actors in an industry (Porter, 1980; 2001). Many studies identified that the higher market share possessed by a firm enables it to directly increase its profitability through economies of scale, learning effects and power exercises against economic actors in an industry (Boulding and Staelin, 1990 p. 1160; Martin, 1988; Porter, 1980; 2001). Each firm's market shares in an industry structure give them discrepant market power, even though different industry structures such as monopoly or oligopoly indicate that monopoly or oligopoly firms have stronger market powers than in competitive industries. In a network-based industry, a firm's market share of technology indicates its installed base of technology or product through network effects (Katz and Shapiro, 1985; Schilling, 2003; Suarez, 2003). A dominant firm could have its larger installed base of technology. In other sense, as discussed, in a product category, a dominant design of a technology indicates that a specific technology occupies more than 50 percent market share, regardless of quality or properties of technology such as superiorities of technology (Farrell and Saloner, 1985; Schilling, 2010 p. 71). It indicates that a firm, successfully achieving its technology as a dominant design in an industry, could have the better chance to achieve its higher market share against competitors, even though some studies also empirically indicate opposite evidences (Utterback and Suarez, 1993; Suarez and Utterback, 1995; Schilling, 2003; Suarez, 2004; Narayanan and Chen, 2012). In this study, each firm's market share of a technology is a source of market power.

In a network-based industry, the size of the installed base is arisen from network effect or externalities. Network externalities arise when the value of a good to a user increases with the number of other users of the same or similar good (Katz and Shapiro, 1985; Arthur, 1989; 1996; Unruh, 2000; Suarez, 2004; Rouvinen, 2006; Narayanan and Chen, 2012). Network effect or externalities can be identified in network-based industries (Katz and Shapiro, 1986; Arthur, 1994;

Schilling, 1998; 2003). However, Schilling (2003) also argued that network effect can be founded in other industries beyond a network-based industry. Also network effect can arias when complementary goods are important (Suarez, 2004). The value of network externalities can be determined by the degree of the installed base and availability of complement goods for a focal firm's product or service.

Otherwise the installed base arise customer's switching cost (David, 1985; Schilling, 2003; Suarez, 2004). Customer's familiarity or usage of technology could elect switching cost, so that inferior technology can be selected (David, 1985). Through adoption process of a specific technology, customers or other economic players are adapted into usage or systems of a specific technology (Arthur, 1989; 1996). Switching cost is a source of market power. Switching cost is the cost to incur customers when customers switch current product into a competitor's products (Farrell and Shapiro, 1988; Klemperer, 1995). Because the degree of relationship between a firm and customers through switching costs indicates how much firms are able to retain or obtain their customers, Porter (1979; 1980; Suarez, 2004) pointed out that customer switching costs give firms a degree of market power over their customers or competitors. Once strong switching cost of product or technology is elected, superior technology or new other products can't easily break down existing switching cost. A firm's installed base of a technology indicate customer's familiarity of a specific technology. If a firm's technology becomes a dominant technology, customers become lock-in of a specific technology. Otherwise, As Suarez (2004) argued that the existence of switching costs can have an effect on a firm's ability to attract customers and build or retain its installed base.

2.3. Research Propositions

This study deals with strategic decision-makings of CoPS innovation strategy by approaching a CoPS innovation process as a strategic decision-making process. It is concerned with the nature and role of CoPS innovation strategy. Many studies have looked into various innovation strategies on competition (Suarez, 2004; Schilling, 2003; Murmann and Frenken, 2006; Narayanan and Chen, 2012). However, there are still insufficient understandings of how each firms come up with or decide their innovation strategies – specifically decision-making processes of CoPS innovation strategy in a business-to-consumer service industry.

Many studies have examined various theoretical perspectives of a strategic decision-making process (Mintzberg, et al., 1998). Many studies of decision-making

suggested that a decision-making is a process from problem recognition to decisions of alternatives to solve problems (Archer, 1981; Bear, et al., 2013; Drucker 2001; Lyles and Mitroff, 1990). And, as Mintzberg, et al., (1976) argued, decision-making process can be identified in a series of sub-decision-makings from problem recognitions. This study define a strategic decision-making as the process composing a series of inter-related decision-making from problem recognition. And it adopted a power perspective by Porter (Mintzberg, et al., 1998). Porter (1981) argued that new introduction of technology often opens new negotiation process. It implies power struggles and bargaining among economic actors in a given industry. In relationships with each economic actors in an industry, each firms analytically understand discrepant power through interactions with economic actors, when they are engaged in their decision-making processes. It means that each firm's problem recognitions or decisions of alternatives regarding new technologies are outcomes of analytical negotiation process among economic actors in an industry. Therefore, this study formulated the following research proposition.

[P1] Each system integration firm's decision-makings of CoPS innovation strategy are related to analytical negotiation processes between a system integration firm and economic actors in an industry.

This study considers each firm's market power as an influential factor in decision-making processes of CoPS innovation strategy. It constructs each firm's market power as a composite of market share and switching cost. In a network-based industry, a firm's market share could indicate its installed base of its product or technology (Schilling, 2003). A dominant firm of technology in an industry has the larger market share of a specific technology or product, against rivals or competitors. Otherwise, a dominant design of a technology indicates that a specific technology occupies more than 50 percent market share, regardless of quality or properties of technology such as superiorities of technology (Schilling, 2010). The size of the installed base can be arisen through network effect or externalities. Switching cost of technology is arisen when each economic actor adapts into usage or learnings of a specific technology. Switching cost give firms discrepant powers against other economic actors in an industry. Each firm's market power come from its market share and switching cost. This study argues that each firm's market power against economic actors influence their decisions of CoPS innovation strategies. And it led them to decide different CoPS innovation strategies. Therefore, this study formulates its research proposition.

[P2] Each firm's market power against other economic actors are related to its decision-making of different CoPS innovation strategies.

Each firms have their own intentions to achieve through their strategies (Prahalad and Hamel, 2006). Schilling (2003) argued that each firm's innovation strategies attempt to achieve its dominant position by exploiting its installed base – market power or switching cost (Adner and Zemsky, 2005; Christensen and Rosenbloom, 1995; Christensen, 1997; Markides, 2006; Schilling, 2003). It indicates that each firm's innovation strategies consider network effects and switching cost of technologies. Schilling (2003) articulate various cases of each firm's innovation strategy utilizing network effects and switching casts on its installed bases. As Christensen and Rosenbloom (1995; Adner and Zemsky, 2005) pointed out, each firms intend to achieve its dominant position of a technology by obsoleting competitor's technology or breaking down competitor's installed bases. In decision-making processes of CoPS innovation strategy, this study argues that each firm's decisions of CoPS innovation strategies has its intention to achieve its better market power of a specific technology or product, consequently a dominant design. Therefore, it formulates the second research position [P3]

[P3] Each firm's decision-makings of different CoPS innovation strategies are related to its intensions of achieving its better market power, consequently a dominant design.

3. Research Design and Methodology

3.1. Research Strategy of Design and Methodology

In order to examine research propositions and questions, this study considered an intensive research design on critical realism. It adopted a comparative and qualitative case study of CoPS innovation strategy decisions in an industry structure. This study designed a comparative case study in a single setting, in order to examine decision-makings of different CoPS innovation strategies. By comparing two cases, it can understand the reasons of how and why system integrators decide different CoPS innovation strategies – in relation of market power. Miles (1979) pointed out that multiple case studies can increase theoretical confidence of research findings; further more strengthen the precision, the validity, and stability of the research findings. However, in order to control limitations of a multiple case study, this study considered a single setting. It chose a digital music service industry in South Korea. Therefore, this study can control environmental variables by having a single competitive setting.

Secondly, a qualitative method is suitable for researching ‘process’ (Miles and Huberman, 1994; Sayer, 1992). Decision-making processes in CoPS innovation take place in multiple relationships with various economic actors in a given industry. And, this study considered market power as one of important influencers to decision-making process in innovation. Relative assessments or exercises of market power against economic actors can be appropriately captured through qualitative data.

Thirdly, in order to deal with threats of causal validity and explanation in qualitative research, this research adopted and developed two approaches: triangulation and member checks. Denzin (1983) distinguished four types of triangulations: data, investigator, methodology, and theory. This study effectively used those triangulations. However, regarding investigator triangulation, it used member checks. Maxwell (2004) addressed that soliciting feedback from others is an extremely useful approach for identifying validity threats of the research. Because this study used the concept of system integrator and CoPS, which Hobday (2000; 2005) proposed, this study obtained feedbacks from Hobday.

3.2. Research Site and Target

Because this study intended to deal with two decision-makings of CoPS innovation strategy, it selected the two cases of the open mobile alliance (hereafter OMA)-DRM innovation, which SKT and KTF respectively conducted in South Korea. DRM was regarded as one of CoPSs (Hobday, 2005; OECD, 2005). And by selecting SKT and KTF’s DRM innovation, this study can compare each mobile operator’s decision-makings of DRM innovation strategies. It can systematically offer qualitative data of two decision processes of CoPS innovation strategy by SKT and KTF in DRM innovations.

3.3. Data Collection and Tactics

Two-type data: interviews and secondary data, were collected. This study rigorously used an interview method with triangulations of interviews, in order to increase validity and reliability of this study. In the field study, 52 interviews were conducted from 24 June to 16 September 2007. Otherwise, this study collected secondary data such as research reports, books, magazines, and presentation files to supplement interview data, until 2010.

At the first stage of the interview process, along with preliminary knowledge

from desk-top research and informative interviews of DRM and digital music service industry, interviews with industrial experts from South Korea research institutes were conducted. Secondly, detailed information and documents of DRM and digital music services were obtained through interviews with managers and engineers in the mobile operators: Korea Telecom Federation (KTF), SK Telecom (SKT), and LG Telecom (LGT). 18 interviews were collected from the three mobile operators ranged from chief executive officers to managers and engineers, who were directly related to digital music service and DRM. Lastly, interviews and information of internet music service providers, license holders, technology solution providers, etc., were collected. This study attempted to get interviews from internet music service providers, which were leading companies occupying higher market shares. In respect of confidentiality, the name of companies can't be specified here. They considered interviews in various dimensions. Through telephone and e-mail contacts, they expressed their concerns and sensitivities. Their information was useful to confirm (or verify) the mobile operator's decisions of DRM innovation. Also the interviews with managers such as team chief or senior managers in technology providers and license holders such as recording company and collective society were conducted. An executive member in one of complementors refused interviews. It indicated market power relationships, as managers in the mobile operators and other experts addressed. Therefore, this part of the research involved 12 interviews. Eventually by looking into empirical data, this study understood that the empirical data are useful to understand SKT and KTF decisions of DRM innovation strategies.

3.4. Empirical Data Analysis

Empirical data analysis followed guidelines from Eisenhardt (1989) and Miles and Huberman (1994). The first step was to gain familiarity with the data. Write-ups of detailed case studies for each case were initiated. These write-ups were simply the pure descriptions of cases and translations. In order to produce 'first-order interpretation' based on pure descriptions, this study initially constructed the two mobile operators' decision-making processes in DRM innovation, by deploying innovation process on the time frame from initial event (introduction of MP3 player mobile handset by mobile manufactures such as Samsung Electronics etc.,) ended into launching new digital music services along with new DRM.

In order to systematically examine decision-makings of different CoPS innovation strategies, this study constructed the template driven from theoretical and

empirical studies (please see <Table1>). The template is helpful to systematically analyze empirical data of multiple cases (Miles and Huberman, 1994). By using the template, this study conducted coding of empirical data. However, because it required dealing with two cases, this study adopted a replication strategy of empirical data analysis, which Miles and Huberman (1994) suggested. However, it was iterative processes.

The empirical data were coded by using the template. This study coded empirical data on problem recognition to decisions of alternatives. However, because of technological characteristics of DRM, three inter-related decision-makings were identified in each DRM innovation. And, by using Porter's framework, this study identified relevant economic actors in a digital music service industry: competitors (mobile operators and internet music service providers), suppliers (technology solution providers, license holders), compliment companies (MP3 player mobile handsets and mobile phone manufacturers), and customers (customers in internet music service market and mobile telecom service market). This study grouped and coded empirical data of relevant economic actors. And then, it also coded empirical data on sources of market power – market share as the installed base, network effect and switching cost. Because of power relationships with each mobile operators and economic actors, as well as market power as an influencer in decision-making processes, this study coded empirical data: for example, a mobile operator understood that because MP3 player mobile handsets already adopted DRMs for internet music service providers, it would be hard for them to switch. In a short term, MP3 player manufacturer did not have any intension to switch. Those things coded as sources of market power and indication of each power relationship. And empirical data was coded in the dimension of 'process,' and 'interaction between economic actors'.

This study was able to examine research propositions. However, in order to increase validity and reliable of this study, I considered triangulations of empirical data analysis (Miles and Huberman, 1994). I tested my empirical data on different theoretical lenses in order to avoid problems of subjectivism originated from a qualitative study, as well as problems of insufficient comparisons commonly identified in a comparative study. Finally, this study presents the empirical result of two decision-making processes of DMR innovation strategy in relation of SKT and KTF's market powers. And, two mobile operators' decisions of DRM innovation strategy in S. Korea were presented in <Table 2>.

4. Empirical Results

This study empirically examined three research propositions. Empirical evidence demonstrated that the two mobile operators decided different DRM innovation strategies on different power relationships. I summarized decisions of different DRM innovations strategies in the <Table 2>. In this study, the three mobile operators in South Korea occupied different market shares, respectively around 50: 35: 15 percent in South Korea mobile service industry, while those market shares have been almost constant over more than a decade in a mobile telecom service market and a wireless internet market (please see <Pic. 1>). Two companies were dominant but did not have equal market shares. Otherwise, a company has its smallest market share compared to other two companies. It indicated duopoly dominance (Brown and McDonald, 1994 p. 38). The two mobile operators established and exercised different market power against other economic actors in a digital music service industry.

4.1. Common Problem of Requirements of DRM technology

On news of MP3 player mobile phone from mobile phone manufacturers such as Samsung Electronics, LG Electronics etc., the three mobile operators asked them to postpone the launching of MP3 player mobile handsets. They temporarily stopped proceeding the introduction of MP3 player mobile phone. Sales of mobile phone in S. Korea relied much on mobile operators. Particularly, SKT and KTF had respectively higher market shares in the mobile telecom service market. Otherwise, music license holders were concerned about impingement of their music license rights through MP3 player mobile phone, so that they insisted proper technical requirements such as DRM technology, even though they did not have particular preferences and requirements of DRM technology. Music license holders wanted to increase their profits by making mobile operators to adopt DRM technology into their services, so that customers would use DRM adopted services. During the meetings with mobile operators, mobile phone manufacturers, and music license holders mediated by the Ministry of Information and Communication as well as Ministry of Culture and Tourism, LGT disrupted its participation in the meeting, as well as decided to firstly retail MP3 player mobile phones on market

DRM, because LGT had an intention to increase its market share in mobile telecom service market. License holders spontaneously exercised their market power on music licenses through collective actions and hold-up of music license provision. The three mobile operators noticed a necessity of DRM on the relationship with license holders in a digital music service industry. LGT commercial success of retailing MP3 player mobile phone made managers in the mobile operators to re-confirm that customers were interested in purchasing MP3 player mobile phone instead of buying MP3 digital plyer or changing their mobile phones to MP3 player mobile phone, like sales of camera-equipped mobile phone.

4.2. SKT Decision-Making Process of DRM Innovation Strategy

4.2.1. Decision-Making of DRM Technology

In order to respond to LGT as well as deal with the introduction of MP3 player mobile phone, managers in SKT were concerned that SKT might lose its controllability of mobile handsets in terms of digital content business (digital music services and also voice service), which would be sources of SKT growth. Customers can easily use or customize their mobile phones through other internet music services - for example, ringtone etc. It would hamper down SKT revenue streaming from digital content services. It could make to deteriorate SKT installed base of digital content service. And, one of important concerns was about consumer behaviors regarding digital music service. Because there were two competing technological systems: mobile music service and internet music service, managers in SKT wanted to make customers to stay in SKT mobile music service. It led SKT to consider DRM technology. Otherwise, SKT decided to get into the internet music service market. SKT started to plan a new convergent music service-Mellon-, offering its digital music service through wireless network and internet. SKT considered DRM as an essential technology to enable Mellon service to offer two different networks as well as protecting music licenses from illegal usage or impingements. Because Mellon had a rental service model, application of DRM can function to authorize music licenses through both network services.

SKT asked a technological feasibility of DRM for the Mellon service to DigiCap, which was a solution provider. DigiCap supported technological helps to SKT, in order to confirm technological feasibility of DRM innovation. And, through discussions with Microsoft, SKT noticed that powerful DRM vendors like Microsoft, who had higher market shares of operating system (hereafter O/S) and internet

browsing, as well as that customers were familiar with usage of MS window for the internet service. It could constrain SKT's decision of DRM innovation strategy, because SKT would have to use MS-Mobile O/S and MS-Windows Media Players etc., as undesirable constraints. It implied that SKT needed to adjust its technological systems for MS or change SKT operating systems or others in SKT mobile phone. Because SKT customized operating systems in mobile phones for its mobile service, it increased the switching cost. Also engineers realized that MS-DRM or market DRMs could occupy much physical and memory spaces in mobile phones. Even though decisions of MS-DRM could cut down the cost of DRM development and marketing, SKT decided Open Mobile Alliance (hereafter OMA)-based technologies, which were technologically suitable for mobile telecom services, as an engineer in SKT told. And, SKT decided to develop SKT-own exclusive DRM technology on OMA technology. SKT wanted to stay their customers into its services - voice and digital music service. And, SKT considered technological independence and dominance from Microsoft' - in a digital music industry and mobile phones. Otherwise, SKT appointed DigiCap, as a developer, because DigiCap was willing to help and follow SKT decision of DRM innovation, compared to Microsoft and others. SKT's market share were positive incentives for DigiCap to commit more on DRM development.

4.2.2. Decisions of DRM Sub-Systems: Device and Packaging

Because SKT decided to develop its owned and exclusive DRM technology on OMA technology. It raised another problem of DRM. Engineers in SKT noticed that OMA 2.0 based DRM was too heavy for diverse digital devices, even though OMA 1.0 was not capable to protect the 'right object' on PC, PMP, or MP3 players, even though it demonstrated enough capability of protecting 'right object' in mobile phones. And, SKT needed to make SKT OMA-DRM to be compatible and inter-operated in diverse digital players, when its device system would be imported into diverse digital players. But, because some leading internet music service providers had enough market shares in internet music service market, many manufacturers of MP3 digital players were based on their unique technologies or DRMs used by internet music service providers. It would be hard for SKT to ask MP3 digital player manufacturers to change or improve their production systems or their products. Otherwise, potential current customers in SKT Mellon service would be expected to encounter technological difficulties of installing SKT device system into their MP3 Players and other digital players. SKT decided technological flexibility of SKT-OMA DRM, which indicated that its OMA-DRM device system can

be inter-operated or compatible with a variety of MP3 players and desktop's operating systems etc. It required SKT to conduct surveys of MP3 digital players - technological requirements - and their innovation trends of digital player. Engineers in SKT incorporated those technological properties into DRM innovation, in order to make SKT DRM device system to be compatible with various digital players along with DigiCap.

The other problem was about a packaging system. SKT decided flexibility of a packing system as DRM innovation strategy. Engineers in SKT considered at least a minimum 10 slots of devices in a packaging system. There would be various circumstances of DRM packaging and services. Managers and engineers noticed that there would be various demands from license holders in terms of music license contracts and new emerging devices. SKT OMA-DRM should be capable to control its service of digital music files. An engineer told that it would be hard to change DRM system - a packaging system after installing into SKT service system. Mellon was a composite of array of systems - system architecture and technological differences between networks. DRM system should govern those technological systems. Otherwise, DRM system should be inter-connected with various platforms and systems on the convergent network. However, at the stag of testing, the real difficulty of testing was the device side. SKT-DRM should be imported into external digital players, manufactured by various electronics companies. If there were systematic errors of DRM, it might be very hard to know which part would be the problem.

4.3. KTF Decision-Making Process of DRM Innovation Strategy

4.3.1. Decision-Making of DRM Technology

After LGT and SKT successfully got into digital music service market, KTF was under pressures to move into a digital music service industry. Executive-level officers in KTF were concerned with the loss of controllability of mobile phone and current or potential customers of KTF service. There was an obvious movement of KTF customers into SKT and LGT services. Many KTF customers expressed their interests of purchasing MP3 player mobile phone or changing their mobile phones into MP3 player mobile phone. Through the executive meeting in KT group, KTF decided a plan to develop its new digital music service - Dosirak. Like SKT, KTF intended to offer its Dosirak - through a convergent network - wireless network and internet. KTF was able to authorize customer's usage of

Dosirak by a convergent network through DRM technology. It was able to protect Dosirak business, as well as needs for a technological requirement of DRM from license holders in a digital music service industry. However, KTF noticed importance of DRM technology on KTF's future digital content business. KTF created its DRM team to coordinate or evaluate all activities of DRM innovation in KTF. An executive-level officer in KTF expressed 'increasing return' and profit in a network business. As he told, it would not be easy for KTF to catch up the network effect, which a winner established like a network-based market. KTF wanted to increase controllability of its customers, in order to retain current KTF customers from the other mobile operators and internet music service providers.

KTF decided to have exclusive DRM technology on OMA technology. OMA technology is a technological standard of mobile telecommunication service suitable for KTF technological properties. Because SKT already successfully adopted OMA-based DRM into its convergent music service, it was proven. KTF carefully considered how and which the DRM technology would meet the characteristics of its music and other content service. KTF carefully reviewed the market and technical standards and trends of DRM technologies. Each digital content has unique technical characteristics, requiring different DRM technologies. In South Korea, MS-DRM by Microsoft and two local DRM vendors dominated the internet music service market in a digital music service industry. Many internet music service providers preferred using MS-DRM. Because of the advantage being that many digital players adopted MS-DRM, using MS-DRM could be very convenient. On a necessity of DRM technology, by discussing with market solution vendors like Microsoft, KTF reached a similar conclusion like SKT. And, engineers in KTF noticed that market DRMs did not give KTF any technical flexibility for KTF content services. KTF considered its technological independence and its future business. It decided to have OMA-DRM for Dosirak service. Eventually, KTF appointed NETS as a DRM solution provider. NETS had much knowledge of DRM and had worked on the issues of DRM standards.

4.3.2. Decisions of DRM Sub-Systems: Device and Packaging

By deciding KTF owned OMA-DRM, the OMA-DRM technology had to interconnect with MP3 players and many other systems or legacy systems, while KTF needed to make customers to use KTF DRM on their digital players. However, an engineer in KTF noticed that OMA-DRM device system should be operated with WIPI (Wireless Internet Platform for Interoperability) operating system, which were common operating systems in mobile phone. And, OMA-DRM

device should work out in KTF unique operating systems – BREW, and MP3 players or other digital devices – Desktop or notebook. Engineers in KTF looked into the market share of digital players. Because manufacturers of MP3 players already worked for internet music service providers, it was hard to request manufacturers to switch for KTF OMA-DRM. Engineers in KTF expressed that KTF incorporated various technological requirements – mechanism and operating systems – of diverse digital devices such as MP3 players, etc. They entered into discussions with manufacturers of digital players. It would be critical for KTF to fit KTF DRM into diverse digital devices to expand its market share in a digital music service industry. Otherwise, in KTF, DRM technology was regarded as one of core technologies for its digital content services. Different digital content services in turn required different DRM technologies, intrinsically having different technological requirements. Managers and engineers considered extensible flexibility of DRM technology. It would be critical for KTF to make DRM device system to fit into diverse digital players in order to expand its market share or retain customers in KTF service.

KTF packaging system needed to be flexibly compatible with its legacy systems. There was much difficulty to fit technical interfaces of DRM into other KTF systems, because of previously many different technical system developments. Even though digitalization could make those systems relatively interoperated better, different developers developed different systems. Once new DRM system would be developed, it would be hard and difficult to change or modify. But in a consideration of future digital content business, and current systems, engineers in KTF considered flexibility of DRM packaging system and technologies.

4.4. Dominant Design: OMA-DRM and Mobile Operators' Service.

The three mobile operators together noticed a necessity of DRM for their digital music services. SKT and KTF consequently decided OMA-DRM technologies for their convergent music services, even though two mobile operators had similar but different DRM innovation strategies. Eventually, later, LGT decided to adopt DRM on OMA technology for its music service, while it maintained market DRMs such as Microsoft. OMA-DRM and service through both networks – wire and wireless internet became a dominant design of an internet music service. DRM took an important role of making mobile operator's services as a dominant design.

5. Conclusions

This study empirically identified two decision-making processes of DRM innovation strategy by SKT and KTF in relation of their market powers against other economic actors in South Korea digital music service industry. The empirical evidences identified that each firm's decision-making of DRM innovation strategy is an analytical negotiation process between each firm and other economic actors. And, this study demonstrated that each firm's market power against other economic actors was one of influential factors in its decision-making process of DRM innovation strategy. It found that each firm's market power led to similar and different DRM innovation strategies.

Regarding the nature of CoPS innovation strategy, through empirical evidences, this study understood that each firm's DRM innovation strategy is a reflection of diverse economic actors' powers in a competitive power landscape in terms of each firm's market power. However, alternative competing theories can be discussed.

This study constructs the market power as a composite of market share and switching cost. Interestingly, the empirical evidences are in contrast with Teece *et al.*, (1997) argument of that innovator's market share is not an influential factor of innovation longer. However, this study empirically argue that socially constructed market power through network effect and switching cost can be an influential factor of innovation.

Regarding the role of CoPS innovation strategy, the empirical evidences clearly indicate that each firms have their intensions to achieve better market power, by considering network effects and switching cost of economic actors. Furthermore, this study empirically demonstrated the emergence of a dominant design – a convergent service and OMA-DRM technology – in South Korea's digital music service industry. Those things help to overcome theoretical limitations of CoPS innovation.

Finally, this study needs to have further discussions on the nature and role of CoPS innovation strategy in terms of market power, network effect, switching cost and dominant design.

[References]

Abernathy, W. J., and James M. Utterback (1978) "Patterns of Industrial Innovation," *Technology Review*, Vol. 80 No. 7 p. 40-47.

Abernathy, W., and Kim B. Clark (1985) "Innovation: Mapping the Winds of Creative Destruction," *Research Policy*, 14 p.3-22.

Adner, Ron and Peter Zemsky (2005) "Disruptive Technologies and the Emergence of Competition," *the Rand Journal of Economics*, 36(2) p.229-254.

Anderson, Phillip and Micheal L. Tushman (1990) "Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change," *Administrative Science Quarterly*, Vol. 35. No. 4 p.604-633.

Arthur, Brian W. (1989) "Competing Technologies, Increasing Returns, and Lock-In By Historical Events," *Economic Journal*Vol. 99, No.394. p.116-131.

Beggs, Alan (1989) "A Note on Switching Costs and Technology Choice," *The Journal of Industrial Economics*Vol.37, No.4 p.437-440.

Baer, M., Dirks, K. T. and Nickerson, J. A. (2013), Microfoundations of strategic problem formulation. Strat. Mgmt. J., 34: 197-214.

Boulding, William and Richard Staelin (1990) "Environment, Market Share, and Market Power," *Management Science*Vol. 36, No. 10. October 1990 p. 1160-1177.

Bourgeois III, L. Jay and Kathleen M. Eisenhardt (1988), "Strategic Decision Processes in High

VelocityEnvironments:FourCasesintheMicrocomputerIndustry,"*Management Science*, Vol. 34,

No.7p.816835.

Christensen, Clayton M. and Richard S. Rosenbloom (1995) 'Explaining the Attacker's Advantage: Technological Paradigms, Organizational Dynamics, and the Value Network, *Research Policy*, 24(2) p.233-257.

Clark, Kim B (1985) "The Interaction of Design Hierarchies and Market Concepts in Technological Evolution," *Research Policy*14 p.235-251.

Cyert, Richard M. and James G. March (1963), *A Behavioral Theory of the Firm*. New York: Prentice

Hall.

David, Paul A. (1985) "Clio and the Economics of QWERTY," *American Economic Review*Vol. 75 No.2 Papers and Proceedings of the

Ninety-Seventh Annual Meeting of the American Economic Association p.332-337.

Denzin, Norman K. (1983) "Interpretive Interactionism," in Morgan, Gareth. ed. *Beyond Method: Strategies for Social Research*London: Sage Publications

Denzin, Norman K. and Yvonna S. Lincolin eds. (2000) *Handbook of Qualitative Research*Thousand Oaks: Sage Publications

Drucker, Peter F. (2001) Effective Decision in Drucker, Peter F., Ralph L. Keeney, and John S.

Hammondeds.,*Harvard Business Review on Decision Marketing* Boston: Harvard Business School

Press.

Eisenhardt, Kathleen M. (1989) Building Theories from Case Study Research. *Academy of Management*

Review, Vol. 14, No. 4 p.532-550.

Elbanna, S. (2006), Strategic decision-making: Process perspectives. International Journal of

ManagementReviews,8p.1-20.

Farrell, Joseph and Carl Shapiro (1988) "Dynamic Competition with Switching Costs," *The RAND Journal of Economics*Vol. 19, No. 1, pp. 123-137.

Hobday, Mike (1998) "Product Complexity, Innovation and Industrial Organization," *Research Policy*Vol. 26 No.6 p. 689-710.

Hobday, Mike, Andrew Davies and Andrea Prencipe (2005) "Systems integration: a core capability of the modern corporation," *Industrial and Corporate Change*Vol.14 No.6 p. 1109-1143.

Hobday, Mike, Howard Rush, and Joe Tidd (2000) "Editorial: Innovation in Complex products and System," *Research Policy*Vol. 29 No. 7/8 p. 793-804.

Itami, Hiroyuki and Tsuyoshi Numagami (1992) "Dynamic Interaction between Strategy and Technology," *Strategic Management Journal*13 Special Issue: Fundamental Themes in Strategy Process Research p.119-135.

Gomes-Casseres, Benjamin (1994) "Group Versus Group: How Alliance Network Compete," *Harvard Business Review*, 72(4) p.62-66.

Katz, Michael L. and Carl Shapiro (1986) "Technology Adoption in the Presence of Network Externalities," *Journal of Political Economy*Vol. 94, No. 4. P.822-841.

Klemperer, Paul (1995) "Competition when Consumers have Switching Costs: An Overview with Applications to Industrial Organization, Macroeconomics, and

International Trade," *Review of Economic Studies* Vol. 4 p.

Maanen, John Van (1979) "Reclaiming Qualitative Methods for Organizational Research: a Preface," *Administrative Science Quarterly*Vol. 24 No. 4 p.20-526.

Markids, Constantinos C. and Paul A. Geroski (2005) *Fast Second: How Smart Companies Bypass Radical Innovation to Enter and Dominate New Markets*, San Francisco: Jossey-Bass.

Martin, Stephen (1988) "Market Power and/or Efficiency," *Review of Economics and Statistics*Vol.70 No.2 p.331-335.

Maxwell, Joseph A. (2004) "Using Qualitative Methods for Causal Explanation," *Field Methods*Vol.16 No.3 p.243-264.

Maxwell, Joseph A. (2005) *Qualitative Research Design: An Interactive Approach*, London: Sage Publications.

Miles, Matthew B. (1979) "Qualitative Data as an Attractive Nuisance: The Problem of Analysis," *Administrative Science Quarterly*Vol.24 No.4 Qualitative Methodology p.590-601.

Miles, Matthew B. and Michael A. Huberman (1994) *Qualitative Data Analysis: An Expanded Sourcebook*, Beverly Hills: Sage Publications.

Mintzberg, Henry, Bruce Ahlstrand, and Joseph Lampel (1998) *STRATEGY SAFARI: A guide tour*

through the wilds of strategic management, London: Prentice Hall.

Mintzberg, Henry, Duru Raisinghani, and Andre Theoret (1976) "The structure of "unstructured"

decisionprocesses."*Administrative Science Quarterly* Vol. 21, No. 2 p. 246-275.

Murmann, Johann Peter and Koen Frenken (2006) "Toward a Systematic Framework for Research on Dominant Designs, Technological Innovations, and Industrial Change," *Research Policy*35 ( ) p.925-952.

Nalebuff, Barry J. and Adam Brandenburger (1996) *Co-opetition*, New York: Currency Doubleday.

Narayanan, V. K. and Tianxu Chen (2012) "Research on Technology Standards: Accomplishment and Challenges," *Research Policy*41( ) p.1375-1406

OECD (2005) *Digital Broadband Content: Mobile Content New Content for New Platforms*. Paris: OECD.

Phil, Firsts K. and Susan K. Cohen (2006) Implications for Imitation, Innovation, and Sustained Advantage, *Academy of Management Review*31(4) p.995-1011.

Porter, Michael E. (1979) "How Competitive Forces Shape Strategy" *Harvard Business Review*Vol. 57 March p.137-145.

Porter, Michael E. (1980) *Competitive Strategy: Technique for Analyzing Industries and Competitors*. New York: The Free Press.

Porter, Michael E. (2001) "Strategy and the Internet," *Harvard Business Review*Vol.79. No. 3 p. 62-79.

Schilling, Melissa A. (2003) "Technological Leapfrogging: Lessons From the U.S. Video Game Console Industry," *California Management Review*Vol.45 No.3 p.6-32.

Schilling, Melissa A. (2010) *Strategic Management of Technological Innovation*, New York: McGraw-Hill.

Shanley, Mark and Margaret Peteraf (2006) The Centrality of Process. *International Journal of*

Strategic Change Management, Vol. 1, No. 1 p. 4-19.

Suarez, Fernando F. (2004) "Battles for Technological Dominance: An Integrative Framework," *Research Policy*33 p.271-286.

Suarez Fernando, F. and James M. Utterback (1995) "Dominant Designs and the Survival of Firms," *Strategic Management Journal*16(6) p.415-430.

Tidd, Joe, John Bessant, and Keith Pavitt (2005) Managing Innovation: Integrating Technological, Market, and Organizational Change, Wiley, NJ: USA.

Tushman, Michael and Philip Anderson (1986) "Technological Discontinuities and Organizational Environments," *Administrative Science Quarterly*, 31(3) p.439-465.

Utterback, James. M. and Fernando F. Suarez (1993) "Innovation, Competition, and Industry Structure," *Research Policy*, Vol. 22 No. 1 p.1-21.

Utterback, James. M. and William J. Abernathy (1975) "A Dynamic Model of Process and Product Innovation," *OMEGA*, Vol.3 Issue 6 p.639-656.

Utterback, J. M. (1996) *Mastering the Dynamics of Innovation*, Boston: Harvard Business School Press.

Appendix

〈Table 1〉 Template for Empirical Data Analysis

Section	Factors	Sources
DRM Technology	Packaging Component Device Component	Industrial Experts
Decision-Making	Decision-Making Process Problem Recognition Decisions of Alternative Power Relationships with Economic Actors	Drucker (2001), Mintzberg et al (1976)
Industry Structure	Five Forces and Complementary Force	Porter (1979; 1980; 2001) Brandenburger and Nalebuff (1996)
Market Power	Market Share :Existinginstalledbases Network Effects : Complementary Good Switching Cost	Schilling (2003) Kat and Shapiro (1986); Arthur (1994)

〈Table 2〉 Two Mobile Operators' Decisions of DRM Innovation Strategy in S. Korea

Section	SKT	KTF
Technology	OMA-Based DRM	OMA-Based DRM
Strategy1	Exclusive and Owned DRM on OMA Technology	Exclusive and Owned DRM on OMA Technology
Strategy2	Flexibility	Extensional Flexibility

Note: LGT decided to have market DRMs - Opened DRM on market DRMs technology and Efficiency