

Appropriability of Innovation Results: Case of the Korean Industry

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Abstract

Innovation strengthens the company's competitiveness and moreover, it greatly contributes to the country's economic growth. Now, the importance of innovation is higher than ever before. Global enterprises innovate to survive in cutthroat competition environments, and interests in output of innovation, appropriability are increasing day by day. Appropriability refers to the degree of abilities to protect and secure profits of technical innovation exclusively. In spite of the importance of appropriability, related research is lacking in South Korea. In some industries, R and D strength approached the level of advanced countries, and they are jumping to a level on which they can be technologically competitive, so it is judged that such a study is possible. Thus, this study attempted to examine what strategies domestic enterprises take in innovation among eight appropriability mechanisms. For this purpose, a survey was carried out on the appropriability securing strategies for R and D of the domestic enterprises and the results of comparison with advanced research were proposed.

Keywords: Appropriability Mechanism, CSS, LTA, Patent, Secrecy

1. Introduction

Innovation takes place from the sense of crisis, dissatisfaction with performance and the changes intended for the production and development of new alternatives in the company environment. Changes such as globalization of the market, acceleration of changes, shortening of product life cycle and development of ICT (Information and Communication Technology) are factors that increase the importance of innovation. Enterprises have to produce differentiated products or services and provide them for consumers in order to survive competition with global enterprises under this market environment and have to innovate themselves ceaselessly to survive the competition.

Companies construct R and D (Research and Development) organizations to promote and take charge of innovation, and since much time and money

are invested in this R and D, institutions to compensate these are required. According to Cohen et al.¹ that analyzed enterprises' innovation activities, the enterprises do not consider patent an appropriate means in the plan to secure profits of research and development investment and rather, maintaining secrecy or securing lead-time advantage is much favorable for securing appropriability mechanism¹.

For instance, there are companies that secure an enormous amount of patents each year such as IBM, Microsoft and Samsung while there are companies that secure appropriability mechanism by secrecy like Coca-Cola. Coca-Cola protects the ratio of ingredients and formulation of Coke concentrate by secrecy.

This is a typical example of different applications of appropriability mechanism of innovation by company and industrial characteristics. This suggests that although patent system is most widely known among appropri-

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ability mechanisms and it seems that they utilize this, companies and industries may apply plans for innovation differently.

Enterprises come to be interested in innovation activities if it is very likely that some or all of the profits occurring from the innovation activities can be appropriated. In addition, enterprises make efforts to find an effective appropriability method to obtain some more profits, and an effective appropriability mechanism allows them to obtain profits from innovation. Yet, in spite of this importance, there are active studies on appropriability mechanisms in foreign countries, but there is almost no study on Korean enterprises that have continued rapid growths since the 2000s.

In some industries, R and D strength approached the level of advanced countries, and they are jumping to a level on which they can be technologically competitive, so it is judged that such a study is possible. Thus, this study attempted to examine what strategies domestic enterprises take in innovation among eight appropriability mechanisms. For this purpose, a survey was carried out on the appropriability securing strategies for R and D of the domestic enterprises and the results of comparison with advanced research were proposed.

2. Theoretical Background

In a changing technology competition environment, securing appropriability through R and D outcomes is a key driving force drawing the company's sustainable growth and ceaseless R and D investment. Much time and money are invested in R and D for innovation. Thus, strategies for securing appropriability mechanisms for research and development costs invested for innovation are very important.

Appropriability refers to the degree of abilities to exclusively protect and secure profits of innovation. This study classified the types of appropriability mechanism into patent, secrecy, lead-time advantage, design registered, complexity of design, learning curve effects (economies of scale), complementary sales/service and complementary manufacturing.

Most known among the appropriability mechanisms are patent, secrecy and lead-time advantage. A patent is to protect and encourage inventions, and if applied, its rights can be guaranteed for 20 years. The term of a patent is the maximum period during which it can be maintained in

force. It is usually expressed in a number of years either starting from the filing date of the patent application or from the date of grant of the patent. In most patent laws, renewal annuities or maintenance fees have to be regularly paid in order to keep the patent in force. Otherwise the patent lapses before its term¹⁰.

Since the Uruguay Round Agreements in 1994, many countries have enacted laws providing that the enforceable term of patent protection begins on the date of grant of a utility patent, and ends 20 years from the filing date of the application¹¹.

In addition, secrecy (trade secrets) is a method used for technologies not protected by intellectual property rights. Secrecy is essentially of two kinds. On the one hand, trade secrets may concern inventions or manufacturing processes that do not meet the patentability criteria and therefore can only be protected as trade secrets. This would be the case of customer lists or manufacturing processes that are not sufficiently inventive to be granted a patent. On the other hand, trade secrets may concern inventions that would fulfil the patentability criteria and could therefore be protected by patents¹².

While a lead-time advantage is a strategy to enter the market by reducing time necessary for the release of a product, which may be called the term, market preoccupation. This strategy is made up of innovation more quickly than rivals so that when a competitor manages to imitate a company's innovation, it has already released another one of the market.

This mechanism will be able to maintain are more competitive of technical superiority over his potential rivals or imitators and also to achieve a stronger brand power⁹. Also, acquire a significant market share and extend an exclusive co-operation network with technological partners, suppliers, distributors and customers. The issue raised in the literature is whether a firm can sustain that edge in the long run¹³.

Studies on appropriability mechanisms, starting from Levin et al.³ include Cohen et al.¹, Arundel⁶, Thumm⁷, Hussinger (2005) and Gonzalez-Alvarez and Nieto-Antolin⁹, and a lot of research has been made in foreign countries. In contrast, there are not active studies in South Korea.

Park et al.¹⁴ made an empirical analysis of the appropriability mechanisms for obtaining profits from R and D in Korean cellular phone industry¹⁴. Lee et al.¹⁵ derived appropriability mechanism factors from the previous

Table 1. Classification of products and services by industry types

	wyatt et al. ²	Levin et al. ³	Harabi ⁴	Konig/Licht ⁵	Arundel ⁶	Cohen et al. ¹	Thumm ⁷	Hussinger ⁸	González-Álvarez & Nieto-Antolín ⁹
Patents	2	-	-	5	4	5	2	2	4
Patents to prevent duplication	-	4	6	-	-	-	-	-	-
Patents to secure royalties	-	5	5	-	-	-	-	-	-
Design registered	-	-	-	6	5	-	-	-	-
Secrecy	4	6	4	4	2	2	1	3	3
Complexity of design	-	-	-	3	3	-	7	-	-
Long-term employment relationship	-	-	-	1	-	-	6	-	-
Lead-time advantages	-	2	2	2	1	1	3	1	1
Learning curve effects/economies of scale	5	3	3	-	-	-	-	-	-
Costs of imitation for competitors	6	-	-	-	-	-	-	-	2
Know-how advantages	1	-	-	-	-	-	-	-	-
Superior sales or service efforts	-	1	1	-	-	-	-	-	-
Brand name recognition	3	-	-	-	-	-	-	-	-
Complementary sales/service	-	-	-	-	-	4	-	-	-
Complementary manufacturing	-	-	-	-	-	3	-	-	-
Customer relations management	-	-	-	-	-	-	4	-	-
Trademarks	-	-	-	-	-	-	5	-	-
Exclusive contact with suppliers	-	-	-	-	-	-	8	-	-
Embodying intangibles in products	-	-	-	-	-	-	9	-	-

studies and prioritized 5 appropriability mechanisms by targeting ten software experts¹⁵.

Park et al. (2010) made an empirical analysis of the appropriability mechanisms for obtaining profits from R and D in Korean cellular phone industry¹⁴. Lee et al. (2013) derived appropriability mechanism factors from the previous studies and prioritized 5 appropriability mechanisms by targeting ten software experts¹⁵.

This study reviewed a total of 19 appropriability mechanisms: 6 factors (Know-how advantages, Patents, Brand name recognition, Secrecy, Learning curve effects/ economies of scale, Costs of imitation for competitors) suggested by Wyatt et al.²; 6 (Superior sales or service efforts, Lead-time advantages, Learning curve effects/economies of scale, Patents to prevent duplication, Patents to secure royalties, Secrecy) by Levin et al.³; 6 (Superior sales or service efforts, Lead-time advantages, Learning curve effects/economies of scale, Secrecy, Patents to secure royalties, Patents to prevent duplication) by Harabi⁴; 6 (Long-term employment relationship, Lead-time advantages, Complexity of design, Secrecy, Patents, Design registered) by Konig/Licht⁵; 5 (Lead-time advantages, Secrecy, Complexity of design, Patents, Design registered) by Arundel⁶; 5 (Lead-time advantages, Secrecy, Complementary manufacturing, Complementary sales/service, Patents) by Cohen et al.¹; 9 (Secrecy, Patents, Lead-time advantages, Customer relations management, Trademarks, Long-term employment relationship, Complexity of design, Exclusive contact

with suppliers, Embodying intangibles in products) by Thumm⁷; 3 (Lead-time advantages, Patents, Secrecy) by Hussinge (2005); and 4 (Lead-time advantages, Costs of imitation for competitors, Secrecy, Patents) by Gonzalez-Alvarez and Nieto-Antolin⁹.

3. Research Model and Design

3.1 Priority Resolution Method

Priority resolution methods include various methodologies such as Delphi method, scoring method, pair-wise comparison and rating/ranking method, but this study will use the Delphi method. The Delphi method is one of the techniques of predicting the future, which can be used for any purposes if expert groups are utilized. Yet, a study on prediction by a Delphi survey may be criticized as an ‘unscientific theory’ since it still takes uncertain situations as the subjects of research. This criticism may be inevitable when only its accuracy is discussed, but suppose that the ultimate goal of the Delphi method is to help make decisions in the current situation and current time, it has a sufficient significance as a method of prediction research.

3.2 Data Collection and Analysis Method

The process of the Delphi analysis for the methods of data collection and analysis has been carried out in 3 states as carried out in Schmidt et al.¹⁶. The first stage is brain-

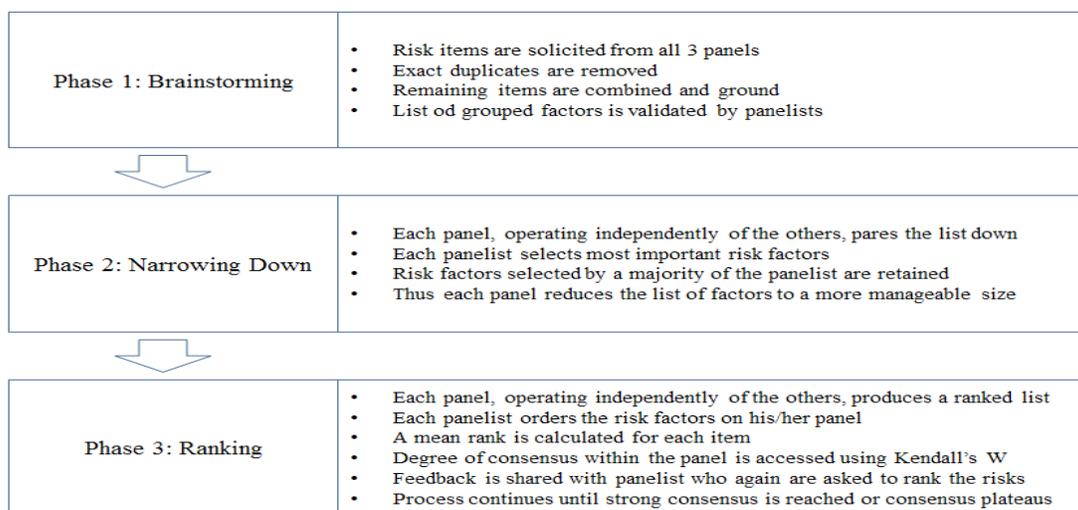


Figure 1. Description of Delphi Survey Process Used in this Study.

storming stage carried out to extract as many items as possible from panels.

The items submitted by each panel are classified and organized to use for a survey on the second stage. The second stage is one to reduce the items on the list. The third stage is one to decide the rankings of the selected factors, in which each panel decides the rankings of the items on the list made on the second stage by importance.

Each panel was asked to decide the rankings of various appropriability mechanisms, and the list filled was received to draw a list by importance according to the average rankings. In addition, this study analyzed the extent of agreement of opinions between the panels using Kendall's coefficient of concordance¹⁷.

3.3 Appropriability Mechanism Factors Derivation

This study reviewed a total of 19 appropriability mechanisms: 6 factors suggested by Wyatt et al.²; 6 by Levin et al.³; 6 by Harabi⁴; 6 by König/Lich⁵; 5 by Cohen et al.¹; 9 by Thumm⁷; 3; and 4 by González-Alvarez and Nieto-Antolin⁹.

Based on the 19 factors presented in the previous studies, in the first stage, 15 items were drawn as evaluation

items that were determined to be important by experts among the appropriability factor items. In the second stage, the integrated list made as a result of the primary survey was sent back to the experts, who were asked to describe the factors that they think were the most important among the factors in the list from at least 7 to 10 items. In the final stage, the factors selected in the second stage were ranked. In other words, experts ranked the 12 items selected in the second stage in the order of importance. The ranking of the important factors investigated across the three stages is presented in Table 3. Among the 19 items, the eight items were finally selected.

4. Research of Study

4.1 Characteristics of the Sample

Data collection was carried out on the companies with at least 50 employees having Research and Development Department. During the period of investigation from September to December 2014, questionnaires were distributed to about 200 companies, 178 companies responded to them, and 160 copies excluding insincere responses were used in the final analysis. Related industries include 160 companies: 31 in the electronic industry,

Table 2. Characteristics of the sample

		Frequency	Percent (%)
Industry	Electronics	31	19.37
	Chemical	39	24.37
	S/W	13	8.13
	Machinery	42	26.25
	Pharmaceutical	5	3.13
	Motor	16	10.0
	Electric	14	8.75
Career	~5	5	3.12
	5~10	31	19.38
	10~15	57	35.63
	15~	67	41.87
Education	BA	127	79.37
	MA	33	20.63

39 in the chemical industry, 13 in the S/W industry, 42 in the machinery industry, 5 in the pharmaceutical industry, 16 in the automotive industry and 14 in the electrical industry.

The average work experience was 13.88 years, the ratio of workers with experience less than 5 years was 3.12%; that of 5~10 years, 19.38%; that of 10~15, 35.63%; and that of more than 15 years, 41.87%.

Regarding the title, 31.7% were deputy section chief or below; 30.13%, manager or below and 38.17%, executive. Regarding education, 79.37% had a bachelor's degree while 20.63% had a master's degree or higher.

4.2 Result of Study

The results of the priority analysis are as follows: The priorities were in the order of Lead-Time Advantages (LTA) (2.83), patents (3.29), secrecy (3.71) and complementary sales/service (4.83).

Recently with the rapid development of ICT and technical innovation, the life cycle of products are getting

shorter, since enterprises want to enter the market faster than competitors by reducing lead-time advantages, LTA was drawn out to be the first place.

Lead time refers to the time consumed from product plan to commercialization or the time consumed from order of service, etc. to delivery or the preparatory period from project plan to implementation.

So if reducing the lead time consumed until the launch of product, you will have advantage over competitors in the market. If you dominate the market in advance, other enterprises are difficult to enter the existing market. In this respect, lead time is an important means to obtain opportunities to dominate the market in advance by reducing it rather than applying for patent or maintaining trade secrets, in case that the life cycle of a technology is relatively short.

Patent took second place. Patent guarantees exclusive rights for 20 years, but allows competitors to enter the same market easily. It is obvious that patent is the most well-known method to obtain appropriability of inven-

Table 3. Result of the priority analysis

	electronics	chemical	s/w	machinery	pharmaceutical	motor	electric	Ave	Var	SD	Rank
Patents	2.88	3.67	2.94	3.67	6.33	2.4	3.0	3.29	5.33	2.31	2
Design Registered	4.63	6.33	5.06	4.33	7.33	4.4	5.33	5.17	4.83	2.20	5
Secrecy	3.63	4.0	3.88	5.33	3.0	2.6	4.67	3.71	6.26	2.50	3
Complexity of Design	4.13	3.33	6.31	4.0	2.0	6.4	5.67	5.21	5.00	2.24	6
Lead-time Advantages	3.75	3.0	2.75	2.33	2.33	3.0	1.67	2.83	2.53	1.59	1
Learning Curve Effects (Economies of Scale)	5.38	7.0	6.0	5.67	4.33	5.0	6.0	5.67	3.84	1.96	8
Complementary Sales/Service	5.38	5.33	3.88	4.67	6.33	5.6	5.67	4.83	2.97	1.72	4
Complementary Manufacturing	6.25	3.33	5.38	6.0	4.33	6.6	4.0	5.36	3.75	1.94	7

tion or innovation and a means to be legally protected. It is found that recently with disputes over patents between Samsung and Apple, the importance of patents is higher than ever before, and enterprises appropriate the results of their research and development as patents. But, like in Coca-Cola as mentioned earlier, utilization of means other than patent may be useful depending on industry.

Secrecy turned out to be the third place. Patent is important as the output of research and development, but recently, it seems that they prefer secrecy. For patent, all information is opened simultaneously with its registration while secrecy is never opened in a lifetime, so it is one of the methods preferred by enterprises.

Coca-Cola, the representative enterprise related to trade secrets keeps material mix strictly a secret. The advantage of trade secrets lies in that the secrets are permanently protected unless exposed/leaked. Contrarily, patent right is limited to 20 years (utility model right: 15 years) from the date of application. In addition, it is possible to have patent right without costs or efforts consumed of obtaining it and you don't need to expose invention in detail. Therefore, if trade secrets for 20 years are favorable for you, it is good for you to be protected under trade secrets and if it is favorable to be protected under patent, it is good to be protected under patent.

Complementary sales/service took fourth. Complementary sales/services can catch up channels to the global market and possible better product placement

with retailers. Complementary ability for sales and service as well as legal appropriability mechanisms including patent and trade secrets are very important, because it is difficult to obtain profits with products holding a good technology unless they are supported (complemented) by sales and service¹⁵. Gans and Stern¹⁸ maintained that if securing such complementary assets, it would become a means to improve bargaining power for the existing enterprises¹⁸.

Registered Designs turned out to be the fifth place. Registered Designs are used primarily to protect designs for features of a shape and configuration. By registering a design, we obtain a right to ownership and prevent others from using the design without your permission. We may use it to better protect your market share and market power by barring copying by others, license it to third parties for commercial returns or sell the design for a sum of money¹⁹.

Complex designing of product makes it difficult for competitors or late movers to copy it and so design is made in a complex way as appropriability mechanism.

Even if you have a good product, but do not have a manufacturing ability (complementary manufacturing) to produce it, it is impossible to obtain profits. The importance of complementary manufacturing can be found from the case of Samsung Electronics vs. Apple which is fighting a patent war in the field of smart phone. Therefore, complementary manufacturing for competitor's product can be seen as one of the best methods to

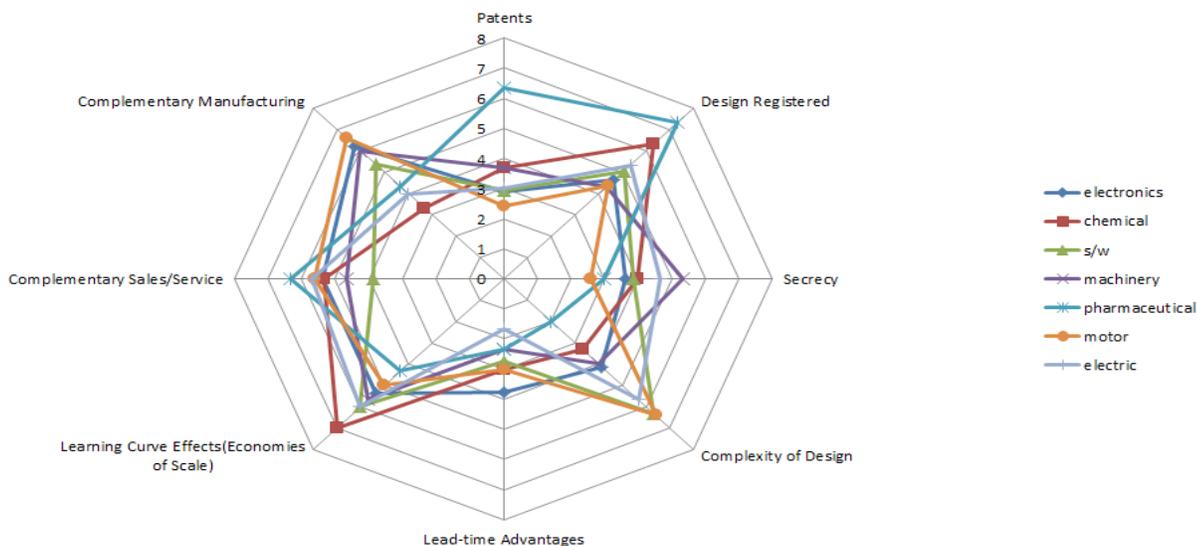


Figure 2. Priority Analysis Radial Chart.

Table 4. Interpretation of Kendall's W

W	Interpretation	Confidence in Ranks
0.1	Very weak agreement	None
0.3	Weak agreement	Low
0.5	Moderate agreement	Fair
0.7	Strong agreement	High
0.9	Unusually strong agreement	Very high

obtain appropriability by dominating the market based on the perfect understanding of competitor's manufacturing ability and product and overcoming the disadvantages as late mover. LCE appeared lower than other factors in ranking.

Complexity of Design, Complementary manufacturing and Learning Curve Effects took a relatively lower ranking than other factors.

This study used Kendall's coefficient of concordance W is a method of examining the extent to which the entire rankings set were agreed between the panels using the Delphi technique.

In the results of this study, Kendall's coefficient of concordance W was 0.42, and in the resulting rankings, the panels' opinions were consistent to some degree.

4.3 Analysis Compared to Advanced Research

The results of this study were analyzed comparing to domestic and foreign advanced research, and the results are as follows: In Cohen et al.¹, it turned out to be in the order of lead-time advantage, secrecy, patent, complementary sale and service and complementary production. In this study, the importance turned out to be in the order of lead-time advantage, patent, secrecy, complementary sale and service.

The difference from Cohen et al.¹ is that the rankings of patent and secrecy were reversed. Since there are differences in the period, target and area of research between Cohen et al.¹ and this study, a direct comparison may be difficult. Yet, the results of this study were compared to

examine the differences in the appropriability mechanisms preferred by each industry.

5. Conclusion

Enterprises innovate themselves to survive the rapidly changing competition environment and make great efforts to appropriate the output of the innovation. Since much time and money are invested in the innovation, strategies to secure appropriability are more important than ever before. This study compared the priorities of appropriability mechanisms by industry. For this, the priorities were drawn out using the Delphi method in the form of rankings for professionals in companies. The results of this study are as follows.

First, as the result of analysis on the priorities, in the entire industries, the priorities turned out to be in the order of lead-time advantages (2.83), patents (3.29), secrecy (3.71) and complementary sales/service (4.83). With the reduced life cycles of products and the development of ICT, most of the industries seem to judge that strategies of preoccupy the market are more important than patents and secrecy as a method of appropriating the output of research and development.

One of the strategies for Apple's success is lead-time advantage. Second, in spite of different research subjects, periods, number of the factors of appropriability mechanisms, the results of this study and the advanced research were similar. Such results have been drawn probably because South Korea's industrial structure becomes more similar to that of the U.S. and is modernized.

Despite these significant factors, this study has the following limitations: First, without diverse survey targets, the results of this study would be difficult to be generalized. Second, Delphi in the form of ranking was used as the priority method. It seems that more extensive analysis can be made if various methodologies such as pair-wise comparison and AHP are used.

In the future, studies extending the target industries and having differentiated analysis methods will be necessary, and studies in which a survey on experts in the related areas is conducted and the validity of the importance and weight of appropriability mechanisms will be verified through a statistical analysis should be carried out. In addition, studies on what differences in different interested parties have in their opinions about the important factors selected in the evaluation of appropriability mechanisms will be necessary.

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