Patent Survey to Japanese R&D-Directed Firms

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Abstract—**The patent systems in the world have been standardized. The patent laws including Japanese one have been revised in accordance with this standardization. We investigated how Japanese firms utilize the patent systems and how they have changed their behavior for patent protection between the last decade and the next decade by use of a questionnaire. The survey was conducted to 60 R&D-directed Japanese firms in the second half of 2011 (response rate was 35%). The firms as a sample were selected on the basis of the ranking of R&D expenditure and the number of patent applications. The results show, a) No big differences are found between activities for obtaining patents between the last decade and the next decade, b) The patentability of services inventions provide an incentive for patenting these inventions to the firms with higher R&D expenditures, c) It seems that the extra period of a patent protection affect on R&D expenditures of firms with lower number of patent applications, and d) As international activity for patent protection, the firms seem to put emphasis of their patent protection on those in China and India.**

I. INTRODUCTION

The importance of intangible assets, primarily in the form of intellectual property (IP) and intellectual property rights (IPR) is increasing in the business world, and firms should manage their IP and IPR appropriately in order to optimize the value of their assets (e.g., [4],[5]). Among these, patents are the most important for technology related IP and IPR.

With regard to strategies about patenting, there are the four following main decisions to be taken: Step 1: Decide whether to file a patent, publish it or keep it a secret; Step 2: Determine what, specially, to be patented; Step 3: Choose when it is best to patent; Step 4: Decide where to patent? [17]. The efficiency and effectiveness of a patent system to protect inventions would have an impact on these firms' decisions, especially those for Step 1.

World patent systems have been standardized and strengthened by measures such as including the duration limit for patent rights [12]. The patent laws, including that in Japan, have been revised in accordance with this standardization. An invention for which a patent application is filed is allowed as a patent right through examination by patent offices. The examination practices of these offices including the Japan Patent Office, have been changed. For example, a business model invention, which previously was not allowable as a patent, is now patentable [9].

The purpose of this study is to investigate how Japanese firms utilize patent systems and how they evaluate these systems for their protection of technology or business, and how they are changing their behaviors for patent protection from the past decade into the next decade, by use of a questionnaire.

II. BACKGROUND AND LITERATURE REVIEW

A. Revision of Patent Laws and Practices

Japan's Patent Law has been revised many times up to now. The developing countries have established their own patent systems in accordance with the World Trade Organization's Agreement on Trade-Related Aspects of Intellectual Property Rights [6]. Also, patent examination practices have been changed in accordance with changing circumstances. In Japan, business model inventions have become patentable. The business model patent is demonstrated to be useful for firms in the information and communication technology (ICT) industry [16]. The technology scope of patent protection becomes much broader than before, including business model inventions.

Firms should learn the revised or newly introduced patent laws and practices and manage changing their patent protection behaviors in order to effectively develop or introduce their technologies or businesses to the world.

It is meaningful to investigate how the patent protection activities of firms have changed in correspondence with the revised patent laws and practices.

B. Patent Propensity

Firms file patent applications and use the patents for protection of their key products, freedom to produce their goods and operate their businesses, and so on (e.g., [7][18]). The number of patent applications filed with the Japan Patent Office was the largest in 2005 and it is gradually decreasing from 2006 to 2011. Recession and strict selection of patent applications by firms are suggested as the reasons for this decrease of the number [10].

Protection by patents is not the only means for appropriation of their innovations or inventions. Empirical evidence from a previous study showed that the Japanese patent reforms of 1988 had no significant effect on R&D spending [15]. While it was shown that more IP protection is not always the best path to capturing from innovation [13][14], firms can choose to protect their innovations by other means including, through secrecy and lead time.

The propensity of firms to use patents has been studied by a number of researchers (e.g., [2][3][11]). Although it has been shown that patents are the most important channel in Japan by the survey of R&D labs across the manufacturing sectors in the US and Japan [2], it has also been shown that patents are not as central to the protection of inventions as other mechanisms, with the exception of a few, select industries [3].

A recent literature review of selected studies on patent propensity revealed that patent propensity varies across industries, innovation types, time, countries, and firm sizes [8].

In this study, a survey was conducted with Japanese R&D-directed firms that have their own IP management departments, excluding small- and medium-sized firms.

This study investigates how they utilize patent systems, evaluate patent protection systems and how they would change their patent protection activities.

III. METHODOLOGY

A. Samples of R&D-directed Firms

We selected 60 sample firms from Japanese R&D-oriented firms, which rank as the top 60 manufacturers with regard to the number of patent applications filed with the Japan Patent Office and R&D expenditures in 2008, the period for which the data is available.

B. Questionnaire

The questionnaire was delivered to these 60 firms by mail in August 2011. Twenty-one viable responses (from October 2011 to January 2012) were obtained (response rate: 35%), The questionnaire was addressed to IP management department managers. Table 1 shows the respondent characteristics, revealing that manufacturers of varied industries are included.

TABLE 1. CHARACTERISTICS OF RESPONDENTS

Industry	Number of firms
Pharmaceuticals	4
Transportation machinery	2
Electric machinery	5
Information and communication technology	1
Oil, coal, plastic and ceramics	1
Chemicals	1
Steel, nonferrous metal	1
Business machinery and instruments	1
Plural industries	2
Others	3
Total	21

We constructed a questionnaire from the viewpoints of the following activities:

1) Patenting patentable inventions grouped as products, processes and services/business processes
2) Developing or introducing patentable inventions without patent protection
3) Increasing research or development budget for longer patent protection
4) Decreasing research or development budget for shorter patent protection
5) Patenting patentable inventions in different counties or areas of the world.

The questionnaire is composed of 12 inquiries. The answers to 10 of the questions are obtained as numerals of percentages; the answers to the other two questions are obtained as 'Yes' or 'No'.

IV. RESULTS AND DISCUSSIONS

A. Comparison of Patent Behavior between the Last and Next Decade

The previous studies demonstrated patents seem more important for the firms in the industries of discrete products such as pharmaceuticals and chemicals, and patents seem less important for the other firms in the industries of complex products such as primary metals, motor vehicles (e.g., [1][11]). We divided the respondents into two parts. One is consisting of firms in the industries of pharmaceuticals, food, chemicals, chemicals/other manufacturing, pharmaceuticals/ chemicals/electric machinery, steel/nonferrousmetal and Oil/coal/plastic/gum (Group A) and the other is consisting of firms in the industries of transportation machinery, electric machinery, machine/instrument for business-use, electric machinery/other manufacturing, ICT (Group B). Table 2 demonstrates the results of firms' behaviours with regard to patenting patentable inventions, grouped into three categories: products, processes and service/business processes. No significant differences were found (with a significance level below 5%) between the values for inventions in all three categories from the last decade to the next decade (Wilcoxon rank sum test). Ten of 21 firms estimate an increase of the values at least in one of the three categories from the last decade to the next decade. There is only one firm, which does not estimate an increase of the values in the three categories. Other two firms estimate an increase in one category and a decrease in another category.

As for service/business processes inventions, seven firms answered that they had patented 0% of their inventions in the last decade and would patent 0% of them in the next decade. Although four firms answered that they expect an increase in patents for the category of service/business processes over the next decade, as compared with the last decade, there is also one firm, which conversely expects a decrease. This firm belongs to the ICT industry.

We grouped the respondents into either lower-ranking (a ranking of 30 or below) or higher-ranking (a ranking above 30) by the number of patent applications and R&D expenditures (hereinafter, lower-ranking or higher-ranking by patents or R&D). The firms of lower-ranking by patents include six firms of Group A and five firms of Group B, and the firms of higher-ranking by patents include three Group A firms and seven Group B firms. The lower-ranking firms by R&D include four Group A firms and four Group B firms, and the firms of higher-ranking by R&D include five Group A firms and eight Group B firms. The results of questionnaire study showed that four of 13 higher-ranked respondents expected an increase in those patents in the next decade,

although none of eight lower-ranked respondents by R&D expected an increase in patents for the category of services/business processes. Two of these four higher-ranked firms by R&D belong to the lower-ranking category by patents and the other two belong to the higher-ranking category by patents. This suggests that the patentability of those inventions provide an incentive for patenting the category of services/business processes to the higher-ranking firms by R&D compared with the lower-ranking firms by R&D.

It is shown that a firm in the ICT industry appear not to place as much importance on patents for the category of service/business processes in the next decade as they did in the last decade, and the firms with higher R&D expenditures would be expected to pay more attention to service/business process-related inventions when obtaining their patents in the next decade than they did in the last decade. This means the firms with higher R&D expenditures would utilize the patent system for more diverse categories of inventions.

TABLE2. THE RESULTS OF BEHAVIOURS REGARDING PATENTING PATENTABLE INVENTIONS (2-A, 2-B AND 2-C)

TABLE2-A. COMPARISON OF EACH CATEGORY FROM THE LAST DECADE TO THE NEXT DECADE (ALL FIRMS)

Category of invention	Last decade Median(%)	Next decade Median(%)	Z value (p value)
.Products (N=21)	60	70	0.899 (0.368)
Processes (N=21)	50	50	0.547 (0.585)
Service/Business Processes (N=19)	5	12.5	0.559 (0.576)

TABLE2-B. COMPARISON OF EACH CATEGORY FROM THE LAST DECADE TO THE NEXT DECADE
(Group A: firms of pharmaceuticals, food, chemicals, chemicals/other manufacturing, pharmaceuticals/chemicals/electric machinery, steel/nonferrousmetal and Oil/coal/plastic/gum)

Category of invention	Last decade Median(%)	Next decade Median(%)
.Products (N=9)	50	50
Processes (N=9)	34	50
Service/Business Processes (N=7)	0	5

TABLE2-C. COMPARISON OF EACH CATEGORY FROM THE LAST DECADE TO THE NEXT DECADE
(Group B: firms of transportation machinery, electric machinery, machine/instrument for business-use, electric machinery/other manufacturing, ICT)

Category of invention	Last decade Median(%)	Next decade Median(%)
.Products (N=12)	80	82.5
Processes (N=12)	50	50
Service/Business Processes (N=12)	20	20

B. Evaluation of Patent Protection in Development and Introduction of Inventions

Half of the respondent firms (10 of 20) estimated that there is no influence (0%) on the development of patentable inventions, regardless of whether patent protection is available or not. Three firms estimated that they would not have developed 50% or more of those inventions without patent protection. These firms belong to the pharmaceutical or food industries. Eight of 20 respondent firms estimated that there is no influence (0%) on the introductions of patentable inventions regardless of whether patent protection is available or not. Seven firms estimated that they would not have introduced 50% or more of patentable inventions if patent protection was not available. Four of them belong to the pharmaceutical or food industries. The ratio of respondent firms which estimated that there is no influence on the development and introductions of patentable inventions regardless of whether patent protection is available or not is larger in firms of Group B than in firms of Group A.

It is shown that firms evaluate patent protection to be more important for the introductions of inventions than for the development of inventions. It is also shown that firms, which belong to the industries such as the pharmaceutical or food industries, where patents specifically and clearly correspond to their products, estimate an influence on the development or introductions of patentable inventions by patent protection.

The ratio of respondent firms which estimated that there is no influence on the development and introductions of patentable inventions regardless of whether patent protection is available or not is larger in lower-ranking respondent firms than in those of higher rank for both patents and R&D. It is shown that the lower-ranking respondent firms by patents and R&D place less importance on patent protection in the development and introductions of inventions or technologies. This suggests that their lower evaluation of patent protection may be caused by their lower ranking for patents and R&D, and vice versa.

C. Research and Development Expenditure with the Length of Patent Protection

Only four of 20 respondent firms answered they would spend more money on research if patent protection lasted longer. As for development expenditures, five of 20 firms answered they would spend more money on development if patent protection lasted longer. Even in cases of such firms, they would increase research or development expenditures by no more than 10% with an extra every year that patent protection lasted. Regarding the inquiry into the shortened patent protection, the answers are almost identical. Only four firms answered they would decrease spending on research or development if patent protection was shortened. The amount by which they would decrease spending is less than 10%.

It seems that an extra period of patent protection does not largely affect on R&D expenditures for the respondents as a whole. Systems for patent protection have been standardized

around the world and the patent duration is limited (20 years after the filing date of a patent application). This limitation term has been established and it appears to be hard for firms to imagine the shortening or lengthening of patent protection by a year.

The ratio of respondent firms which answered they would spend more money on both research and development if patent protection lasted longer is larger in firms of Group A than in firms of Group B. The ratio of respondent firms which answered they would spend more money on both research and development if patent protection lasted longer is larger in respondent firms of lower-ranking by patents than in those of higher-ranking by patents. This suggests that the length of patent protection affects R&D expenditure of lower-ranking firms by patents. It is shown that the respondent firms with lower number of patent applications evaluate the length of patent protection to be important and the protection of an individual patent to be much important.

D. International Activity for Patent Protection

The results of patent protection behaviors (patenting patentable inventions) in the world are shown in Table 3. It suggests that firms expect to obtain patents mainly in the home country, namely, in Japan, and in Europe, North America, and China. There are differences in the rates of likelihood among these areas or counties. The likelihood of patent protection in India, Russia, and Brazil follow.

TABLE 3. PATENT PROTECTION BEHAVIORS IN THE WORLD

Country/ Area	The rate of patent protection Median (%)
Japan	100
North America	40
China	30
Europe	25
India	9
Brazil	3.5
Russia	3.5
South America	1
Africa	0
Others	10

Taking the market size into consideration using each GDP distribution rate of these countries or areas in the world as a proxy for the size of its market, the firms seem to put emphasis of their patent protection on those in China and India. The results of this study suggest that the standardization of patent systems to protect patentable invention in the world has affected their activities and they can take their businesses or domains into consideration with little worry about great differences in developing countries in comparison with developed countries.

The median of the rate for patent protection in India of lower-ranking firms by patents is about ten times larger than that of higher-ranking firms by patents. This result is different from the results in other countries or areas, which had values that were 0.2-5 times. The lower-ranking firms by patents are found to place more importance on patent protection in India, even though their patent propensity is rather low among the top 60 R&D-directed firms. Three of the lower-ranking firms by patents estimated the rate for patent protection in India to be 50% or more and they belong to the pharmaceutical industry. It is shown that firms of the pharmaceutical industry place so much importance on patent protection for business in India.

E. Explanations and Discussions

Japanese firms file a greater number of patent applications in the world and they are one of the firms, which most utilize patent systems in the world. They are expected to manage their patent propensity in accordance with the changing circumstances of IP. The results of this survey show no significant differences of patent protection activities for three categories inventions, namely, products, processes and service/business processes between the last decade and the next decade for the respondents as a whole. This suggests that, even though the number of patent applications filed with the Japan Patent Office is decreasing, R&D-directed firms in Japan would patent their patentable inventions in the future as much as they patented in the last decade. Also, the results of this survey suggest that Japanese firms have established their own methods of patent management and they would prefer not to move or change their style of management largely, even if patent laws or practices are revised.

As for inventions of service/business processes, the patentability of a business model invention was discussed in 2000 [9]. Then, in the last decade, firms in the ICT industry have patented their inventions of service/business processes and appear not to place as much importance on these patents in the next decade as they did in the last decade. We grouped the respondents into either lower-ranking or higher-ranking by patents and R&D expenditures. It is shown that the patentability of services/business processes inventions would provide an incentive for patenting inventions of this category in the next decade to the higher-ranking firms by R&D compared with the lower-ranking firms by R&D. The patentability of service/business process inventions should be discussed from the viewpoint of IP management for patent applicants with higher R&D expenditures.

In the queries, we used category grouping by inventions. Firms usually put an emphasis on patents of product inventions because product patents provide the most enforceable and strongest rights as patents. Using this type of query, the survey could reveal the patent behaviors of firms for different categories of inventions, especially those relating to service innovation, as a different aspect of patent propensity.

As for evaluation of patent protection in the development and introductions of inventions, the ratio of respondent firms which estimated that there is no influence regardless of whether patent protection is available or not is larger in lower-ranking respondent firms than in those of higher rank for both patents and R&D. The lower-ranking respondent firms by patents and R&D were found to place less importance

on patent protection in the development and introductions of inventions or technologies. Introductions of technologies or patents are essential for open innovation. Firms should place more importance on patent protection in order to activate introductions or transfer of technologies, especially in the case of those into higher-ranking firms by patents and R&D.

As for the length of patent protection, the results by grouping into either lower-ranking or higher-ranking by patents suggest that the length of patent protection affects R&D expenditure of lower-ranking firms by patents. It is shown that lower-ranking firms by patents evaluate the length of patent protection to be important. The timing when a patent application is filed and the way in which an applicant proceeds with the examination of a patent can affect the duration of patent rights. Firms of lower-ranking by patents may substantially prolong the duration of their patent rights through strategic patent application management. Further studies by interviews would reveal how they manage this issue.

As for global patent protection activities, it is found that lower-ranking firms by patents, especially firms of the pharmaceutical industry, place more importance on patent protection for business in India than higher-ranking firms by patents. The international patent protection activities of Japanese firms will be discussed by comparison with those of other countries' firms.

This questionnaire was delivered to IP management department managers. The questionnaire included the queries about their visions for the next decade. It appears that their answers reflect the patent strategy constructed by the IP management department. Patent awareness is an inherent driver of patent strategies in firms. Such a questionnaire could reveal the patent behaviors of firms in the form of patent strategies constructed by IP management departments.

V. CONCLUDING REMARKS

This study investigated patent protection activities for patenting patentable inventions of Japanese R&D-directed firms between the last decade and the next decade. Japanese firms file a large number of patent applications with the Japan Patent Office and other patent offices around the world. The results of this study suggest that Japanese R&D-directed firms have evaluated patent protection as important for appropriation in the last decade and would continue to develop inventions and to patent their patentable inventions over the next decade.

In the queries of this study, we used category grouping by inventions. Using this type of query, the survey could reveal the patent behaviors of firms for different categories of inventions, especially those relating to service innovation, as a different aspect of patent propensity. The questionnaire of this study was delivered to IP management department managers. Such a questionnaire could reveal the patent behaviors of firms in the form of patent strategies constructed by IP management departments. This study was conducted in Japan and is, we believe, of particular importance in Japan, where the number of patent applications is large. But a survey of a small number of firms in different industries, all of which are based in the same country, cannot be definitive. Looking ahead, we see ample opportunities to expand the scope of this survey. The real test will come when we include firms outside of Japan.

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