Measurement of input resources for standardization activities in basic research and applied and development research, and the difference of the measuring results between the research types

— Case studies of universities and technology licensing organizations, and the electric machinery industry —

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This study explores the methods for measuring standardization activities in basic research and applied and development research. Such methods are supposed to enable more sophisticated management of innovation in organizations. This paper focuses on standardization activities relating to intellectual property, because such activities are thought to be strongly linked to innovation. Universities and technology licensing organizations were chosen as examples of basic research institutions. Companies in the electric machinery industry and information and communication industry were selected as examples of the applied and development research institutions. First, the stability of data over multiple years and the validity of the definition of standardization activities are discussed. Then, the difference in measurement results between basic research, and applied and development research is described. A hypothesis is proposed that the ratio of standardization activities in basic research is as high as that in applied and development research.

Keywords : Basic research, applied research, development research, standardization activities, university

1 Outline

The objective of this research is to clarify whether the measurement method for quantitative data pertaining to the standardization activities in basic research and applied and development research is appropriate or not, and to set the clarified method as a foundation to advance innovation management. In addition, to construct an evaluation method for standardization policy, the elemental activities of standardization activity and the re-synthesis of various elements are investigated through the quantification of outcomes and invested resources in the standardization activity. Until now, while the quantification of outcome was possible to some extent through statistics such as ISO, there was no sufficient quantification of the invested resources.

In this paper, the usability of the definitions pertaining to the standardization activity in research analysis (hereinafter, will be called efficacy), and whether the data measured over several fiscal years stay roughly within a certain range will be investigated (note: the situation in which the data collected over several fiscal years fall roughly in a certain range will be described as being “stable”). Based on the data obtained, the difference of the standardization activity between the universities that engage in basic research and the companies that engage in applied and development research will be evaluated. Also, the management of the standardization activity in basic research institutions will be discussed. In addition, the social foundation where the standardization activities for innovation are quantitatively managed is established as a long-term outcome goal, and proposals will be made for research processes necessary for its achievement, and the point of achievement at the time this research paper was written is described.

Although the importance of standardization strategy is emphasized in recent years, surprisingly, the method for measuring the quantitative data pertaining to standardization activities in companies and organizations is still in the research stage. The *Monbu Kagaku Tokei Benran* (Statistical Abstract for Education, Culture, Sports, Science and Technology) carries data pertaining to patents, but there are no data for standardization activities.[1] The quantitative data for standardization activities collected officially focus heavily on the results, and are limited to the number of de jure standards offered by ISO or IEC, and the number of staff in the office.[2]

In such a situation, the Japan Patent Office (JPO) added the survey items pertaining to the standardization activities in intellectual property (IP) activities in the *Chiteki Zaisan Katsudo Chosa Hokokusho* (Results of the Survey of Intellectual Property-Related Activities) that is conducted for all industries in Japan.[3]-[6] Compared to the whole

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standardization activities, the standardization activity in IP activity has recently gained attention, because there are many patents related to standards and its importance in policymaking has increased.[7] By narrowing down the range to IP activities, the possibility of unintentionally including the activities unrelated to standardization planning, such as resource investment for the verification activity pertaining to ISO 14000 series, will be reduced. The data thus obtained will accurately represent the effect of the amount of resource investment for the standardization activities in IP activities.

In case of Japan, about 60 % of the research funds are spent on basic research in the research institutions such as universities. On the other hand, nearly 90 % of the research funds are used for applied and development research in companies.[1] Considering this point, the data in the category, "education, Technology Licensing Organization (TLO), public research institutions, and public service," will be used to evaluate the standardization activities in basic research. This category includes basic research institutions such as universities. The data in the category of "electric machinery industry" and "information communication industry" will be used to evaluate the standardization activities in applied and development research. Focusing on these standardization activity data, investigation will be done on whether the collected data are adequate and stable, and whether they are adequate enough to be used in future policy analysis. In addition, the collection and use of data pertaining to the standardization activities that may contribute to an evaluation method for innovation activities in both research fields will be discussed. The differences and the reasons will be considered for the standardization activities by different research objectives. Moreover, based on the results obtained, the management of standardization activities in basic research institutions such as universities will be considered.

Comparing the data for the standardization activities in IP activities for the four years between 2008 and 2011, we obtained results that indicated that the data had certain reliability and stability in terms of continuity. The number of people in standardization activities was higher in the IP activities for education, TLO, and others that represent basic research. In the aspect of policy, it was pointed out that the universities had insufficient management of standardization activities in the IP activities.

In this paper, chapter 2 explains the previous researches. chapter 3 describes the hypotheses and their background. Explanation of the method and data are provided in chapter 4, results in chapter 5, discussion including the scenario for realization in chapter 6, future issues in chapter 7, and conclusion in chapter 8.

2 Previous researches

Since there are very few previous researches in this discipline, I shall describe the literature necessary for understanding the framework of this research.

2.1 Collection method for the number of standardization activity personnel and the definitions

2.1.1 Collection method

For the collection of the number of researchers and personnel, the full-time equivalent (FTE) method is recommended in the OECD's Frascati Manual.[8] FTE is a counterpart to the method based on per capita count. The per capita counting method counts the actual number of people. On the other hand, FTE is a method of counting the number of people by the percentage of working hours. Therefore, if one works half a day on a certain job, the count will be 0.5 person. The FTE is a method appropriate for understanding the amount of labor invested in cases where people engage in both education and research, as in the case of university faculty members. This is because this method prevents overvaluation of the actual research activity that may occur by counting the actual number of people. In the *Chiteki Zaisan Katsudo Chosa Hokokusho* (Results of the Survey of Intellectual Property-Related Activities), the Japan Patent Office has conventionally used the FTE method to count the number of people engaging in IP activities. Therefore, the FTE method was employed in this research to count the number of standardization activity personnel in the overall IP activities.

2.1.2 Definition

The definitions of the standardization activity often use the keyword "specialization" by focusing on technology.[9] However, this is a definition for products, and is not intended for use in the collection of quantitative data for standardization activities. In the OECD Frascati Manual that sets out the evaluation method for innovation activities around the world, there is no definition of the standardization activity.

However, some clues have been offered recently in considering the definitions for the standardization activities in companies. In this paper, the following definitions were used in the JPO's IP activity survey.[3]-[6]

Standardization activity personnel:
Standardization is the process of establishing or revising the rules (standard) such as the evaluation method for technical specs and tests, unification of terms and symbols, or simplification in certain technological field, through deliberation by several people.

Intellectual property (IP) activity personnel:
This is a person who engages in the work including exploration of industrial property rights, obtainment of rights, and maintenance of rights. It also includes people engaging in the work pertaining to the management, assessment, transaction,

licensing, and dispute of IP activities, as well as people engaging in the planning, research, education, accounting, clerics, and other work necessary to support the IP activities.

Standardization activity personnel of IP activity personnel: This is a person who engages in research of patents for standardization, assessment of essential patent and license negotiations, writing and submission of patent statements for standardization, response to patent violations of technology in standardization, and other works to manage the intellectual properties related to standardization. It also includes persons engaging in planning, proposals, and deliberations, as well as people engaging in education, diffusion, accounting, clerics, and other works necessary to support the standardization activities of the IP personnel.

2.2 International comparison of the existing data

Internationally, there is hardly any attempt to collect data for standardization activities. One of the main reasons is because there is the lack of effort to collect data by the related international institutions. In the annual reports of the ISO and IEC that are organizations that set the international standards, there are data on the number of people at the government organizations of various countries and the number of standards established, but there is no report of the number of standardization activity personnel in each country.[12] It is indicated that the objective of ISO and IEC is to create international standards in document form, and the collection of statistical data pertaining to the actual state of standardization activities around the world is not considered their organizational goal. On the other hand, the international intellectual property organizations such as the World Intellectual Property Organization (WIPO) collect economic data pertaining to patents, but do not have the function to collect statistical data for standardization activities. The lack of institutions that conduct data collection systematically for standardization activities results in the lack of data that allows international comparison.

Another reason is that the amount of resource invested in standardization activities is not recognized as part of science and technology data. Frequent discussions are conducted in OECD and UNESCO on how to set the range of science and technology activities. However, the activities for technological standards have been positioned as “related activities” to R&D, and are not considered as science and technology activities. They are positioned merely as activities related (or pertaining) to science and technology. Therefore, even to this day, they are not included in the official statistical data for science and technology.[10]

As a result, the question of which quantity should be considered as policy variable in order to evaluate standardization activities remains unsolved.

As another practical reason, it is difficult to collect such data. In many cases, the standardization activities are not established as independent work, and they are often conducted as additional work adjunct to the main work of R&D or IP activities. Therefore, they are less likely to be recognized within the organization.

2.3 Relationship between basic research, applied and development research, and standardization activities

For the number of standardization activities in universities that primarily engage in basic research disciplines, real data cannot be found internationally, as mentioned above. A similar situation can be seen for the real data of companies that mainly engage in applied and development research.

2.4 Effect of standardization activities on technological innovation

It is reported that in electric machinery manufacturing in the US, there is a clear positive correlation between the number of people involved in the standard development organization and the number of patents obtained by the companies. The results indicate that the standardization activities of the standard setting organizations may have a cause-and-effect relationship with the IP activities as represented by the corporate patents.[9]

3 Hypotheses

In this paper, the following hypotheses will be investigated.

3.1 Hypothesis 1a

There is no internationally established method for collecting data on the number of people engaging in standardization activities within an organization, and it is currently under investigation. First, it is necessary, as an assumption for utilizing the data, to check the collection method and to see whether the data can actually be collected stably.

Hypothesis 1a: The collected data of the number of standardization activity personnel is stable in terms of recovery rate, etc.

3.2 Hypothesis 1b

In collecting the number of standardization activity personnel in IP activities, the collection is based on the definition for standardization activities that spread out within the organization, rather than on the definition considering only the work of standardization negotiation. Since whether the collection of data based on this definition is actually possible has never been verified in the previous researches, the verification of this hypothesis will be conducted.

Hypothesis 1b: The definition is effective in the data collection of the number of standardization activity personnel.

Figure 1 shows the hypotheses and the relationship to the research synthesis of research.

4 Method

Using the data from the JPO *Chiteki Zaisan Katsudo Chosa Hokokusho* (Results of the Survey of Intellectual Property-Related Activities), observations were made from 2008 to 2011 on the number of IP activity personnel by industrial field, and the number of standardization activity personnel in IP activities. The comparisons were made among research fields to see the percentage of the standardization activities in IP activities.

4.1 Outline of the Chiteki Zaisan Katsudo Chosa Hokokusho

4.1.1 Objective of the survey

The objective of the survey was: "To understand the situation of the IP activities of individuals, corporate bodies, research institutions such as universities in Japan, to organize basic materials for planning and proposing the IP policy of Japan." This statistical survey was started in FY 2002.

4.1.2 Subject year

The subject years of the survey for standardization activities are FY 2008 and after.

4.1.3 Survey subject

The subjects are the companies and others with five or more patent applications, utility model applications, design registrations, or trademark registrations in the previous fiscal year. Specifically, this includes companies, corporate laboratories, universities, and public research institutions. The data collection for IP activity survey was started in 2002. Since it is conducted as a general statistical survey based on the Statistics Act of Japan, the subjects are required to respond honestly, unlike regular questionnaire surveys, and it is believed that highly reliable results are obtained for the standardization activities in companies.

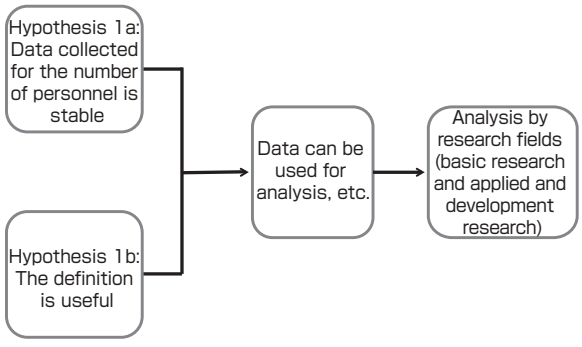

Fig. 1 Flow of the hypothesis to the composition of research

Table 1. Number of standardization personnel in IP activity and number of IP personnel that serves as parameter

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Number of standardization personnel in IP activity (persons)	Non-surveyed	Non-surveyed	Non-surveyed	Non-surveyed	Non-surveyed	Non-surveyed	2,296	2,298	2,336	1,826
Number of IP personnel that serves as parameter (persons)	17,679 (Reference value)	9,234 (Reference value)	17,569 (Reference value)	17,700	18,658	19,589	18,458	19,227	17,106	18,583
Percentage (%)	—	—	—	—	—	—	12.4 %	12.0 %	13.7 %	9.9 %

Source: Data of the JPO *Chiteki Zaisan Katsudo Chosa Hokokusho* (Results of the Survey of Intellectual Property-Related Activities). The numbers of IP personnel for 2002, 2003, and 2004 are reference values, because they were measured using measurement method that was different from the current method.

5 Results

5.1 Number of IP activity personnel and the number of standardization activity personnel in IP activities

The recovery rate of the JPO survey over the years has been about 50 %, and the responses are obtained from the majority of those surveyed. Of the companies and others that responded, about 90 % entered information about the standardization activities for IP activities. It is thought that there is a low possibility of sampling bias due to response or no response.

The data collection for the number of IP personnel has been done since 2002 (Table 1). The numbers fall in the range of 17,000 to 19,000 persons. For 2003, the number dropped to half of about 9,000 persons, due to the changes in collection method, and this figure is considered as reference value. In contrast, the number of standardization activity personnel in IP activities that is used as the alternative index of the standardization activities remained around 2,000 persons between 2008 and 2011. The percentage of standardization activities was approximately 10 %. For 2011, the percentage was 9.9 %, and the percentage of standardization activities was lowest in the past four years.

5.2 Comparison of data over the years by industrial category

The changes in the figures by industrial category are shown (Table 2, Fig. 2). At one glance, one can see that the fields of "electrical machinery manufacturing" and "education, TLO, public research institution, and public service" have the highest number of personnel. However, because this number may be affected by the number of companies and the number of working people that serve as the parameter, the high-low of numbers cannot be simply compared. Yet, it is appropriate to overview the level of activities in each industry. Also, by looking at the variation of numbers for each year, it can be used to determine the appropriateness of the collection method and data reliability.

Table 2. Number of standardization personnel among IP personnel and the percentage (total by industry)

	Number of samples				Number of IP personnel				Number of in-company patent attorney in IP personnel			
	2011	2010	2009	2008	2011	2010	2009	2008	2011	2010	2009	2008
Total	3,030	4,805	3,663	3,231	18,538	17,106	19,227	18,457	1,352	1,055	1,202	998
Education, TLO, public research institute, public service	256	515	252	251	1,246	1,549	1,412	1,524	46	54	62	47
Electric machinery industry	328	425	378	389	6,600	4,806	6,711	5,953	563	336	491	337
Information & communication industry	108	254	170	149	431	653	687	568	39	42	38	21
Construction	107	190	110	126	286	360	242	345	15	12	5	10
Food manufacturing	164	200	228	161	465	501	531	493	47	30	39	41
Textile, pulp, papermaking	53	98	66	72	238	260	244	263	23	22	22	24
Drug manufacturing	88	82	86	85	626	565	610	551	106	94	101	89
Chemical industry	211	261	227	227	1,743	1,844	1,912	1,725	128	132	125	109
Oil & coal, plastic, rubber, ceramics	192	262	224	208	990	1,039	944	955	76	76	65	51
Iron & steel, non-iron metal manufacturing	75	79	82	84	667	603	697	633	52	50	41	33
Metal product manufacturing	109	190	149	133	271	335	320	329	4	10	6	7
Machinery manufacturing	215	266	219	294	905	872	1,156	865	58	40	59	39
Transportation machine manufacturing	137	166	139	145	1,581	1,207	1,272	1,468	71	46	47	53
Commercial machinery & equipment manufacturing	104	108	90	100	1,023	667	852	845	61	37	50	48
Other manufacturing	209	291	236	229	699	804	703	1,133	33	35	25	66
Wholesale, retail, etc.	323	594	528	296	329	380	389	314	10	15	4	6
Other non-manufacturing	226	446	317	281	337	512	385	472	15	18	15	18
Individual, others	125	378	162	91	147	149	161	19	6	6	7	-

	Number of IP personnel				Number of standardization personnel in IP personnel				(Number of standardization personnel)/(IP personnel)			
	2011	2010	2009	2008	2011	2010	2009	2008	2011	2010	2009	2008
Total	18,538	17,106	19,227	18,457	1,826	2,336	2,298	2,296	9.9%	13.7%	12.0%	12.4%
Education, TLO, public research institute, public service	1,246	1,549	1,412	1,524	161	402	386	390	12.9%	26.0%	27.3%	25.6%
Electric machinery industry	6,600	4,806	6,711	5,953	421	465	461	484	6.4%	9.7%	6.9%	8.1%
Information & communication industry	431	653	687	568	34	63	73	35	7.9%	9.6%	10.6%	6.2%
Construction	286	360	242	345	40	62	36	41	14.0%	17.2%	14.9%	11.9%
Food manufacturing	465	501	531	493	115	120	80	85	24.7%	24.0%	15.1%	17.2%
Textile, pulp, papermaking	238	260	244	263	20	31	21	19	8.4%	11.9%	8.6%	7.2%
Drug manufacturing	626	565	610	551	129	133	127	65	20.6%	23.5%	20.8%	11.8%
Chemical industry	1,743	1,844	1,912	1,725	98	161	204	180	5.6%	8.7%	10.7%	10.4%
Oil & coal, plastic, rubber, ceramics	990	1,039	944	955	109	103	149	173	11.0%	9.9%	15.8%	18.1%
Iron & steel, non-iron metal manufacturing	667	603	697	633	44	37	35	26	6.6%	6.1%	5.0%	4.1%
Metal product manufacturing	271	335	320	329	63	66	73	84	23.2%	19.7%	22.8%	25.5%
Machinery manufacturing	905	872	1,156	865	159	220	153	192	17.6%	25.2%	13.2%	22.2%
Transportation machine manufacturing	1,581	1,207	1,272	1,468	113	106	123	164	7.1%	8.8%	9.7%	11.2%
Commercial machinery & equipment manufacturing	1,023	667	852	845	63	50	66	77	6.2%	7.5%	7.7%	9.1%
Other manufacturing	699	804	703	1,133	122	154	143	148	17.5%	19.2%	20.3%	13.1%
Wholesale, retail, etc.	329	380	389	314	82	88	85	66	24.9%	23.2%	21.9%	21.0%
Other non-manufacturing	337	512	385	472	32	54	55	63	9.5%	10.5%	14.3%	13.3%
Individual, others	147	149	161	19	21	23	28	6	14.3%	15.4%	17.4%	31.6%

Source: Modified data of the JPO *Chiteki Zaisan Katsudo Chosa Hokokusho* (Results of the Survey of Intellectual Property-Related Activities) for 2011, 2010, 2009, and 2008.

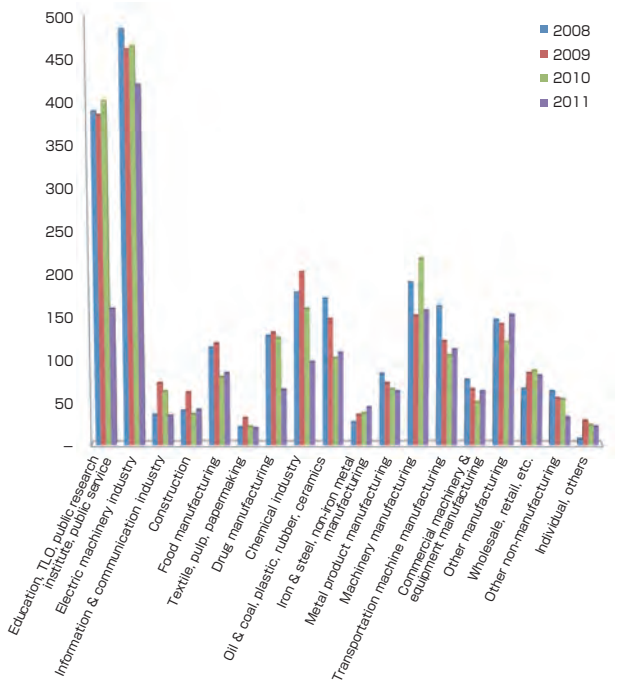

Fig. 2 Number of personnel involved in standardization among the IP personnel by industrial category (2008-2011)

5.2.1 Education, TLO, public research institution, and public service

This category includes the advanced research institutions such as universities. Therefore, the data can be used to understand the trend of basic research. Looking at the data by category, the number of personnel involved in standardization activities is second after the electric machinery industry. In 2010, the number was highest at 402 persons, and lowest with 161 persons in 2011. The percentage of the standardization activities among IP activities was lowest at 12.9 % in 2011. In other years, the percentage was about 26 % to 27 %. The reason for the shift in the data, other than the decrease in the actual number of personnel, was because the amount of standardization activities decreased in work. Other factors include the fact that this data was not panel data but targeted the companies with five or more patent applications in the previous year, and the sample companies might have been replaced.

5.2.2 Electric machinery industry

The highest number was 484 persons in 2008, and the lowest number was 421 persons in 2011. While the percentage of the

number of standardization activity personnel in IP activities was lowest at 6.4 % in 2011, the percentage was highest at 9.7 % in 2010.

5.2.3 Information and communication industry

The lowest number was 34 persons in 2011, and highest number was 73 persons in 2009. For the percentage in IP activity personnel, it was lowest at 6.2 % in 2008, and highest at 10.6 % in 2009.

6 Discussion

6.1 Verification of the hypotheses

From the above results, the Hypotheses 1a and 1b were evaluated. In verifying the hypotheses, we looked at: 1) the recovery rate of the questionnaire, 2) the response rate to the number under investigation among the recovered data, and 3) the changes observed when the data were compared by year. Currently, since the statistical index that may serve as precedent data is not internationally available for the number of standardization activity personnel, adequacy cannot be verified by international comparison. Therefore, the investigation of the data usability was based on the stability of collection.

For Hypothesis 1a, it was observed that the number of standardization personnel among IP activities fell in a certain range each year. Also, the recovery rate of the questionnaire for each year was approximately 50 %. Of the recovered questionnaires, it was found that there was about 90 % response for the item under investigation, and it was determined that the data collection was stable and could be used for secondary analysis. For Hypothesis 1b, based on the results of Hypothesis 1a, it was indicated as possible to collect data that captured the wide range of standardization activities that included back office work and planning, as well as the negotiation for establishing the standard. Combining the results of Hypotheses 1a and 1b, it could be determined that there was low probability for the collected data to be subject to sampling bias, and the data could be used for various analyses (Fig. 1).

Considering both the inside and outside of an organization, there was ambiguity in how to understand the range of the standardization activities related to the innovation activities. The reason is because in establishing the international standard, the involvement in the committee that is the ultimate place for decision-making and vote execution was considered most important. Therefore, the standardization activities meant the activities in the standardization bodies that actually drafted the standards outside the organization. The concept was formed where the standardization activities represented the number of people who participated in the committee for standard establishment, and as a reflection, there was a recognition that it was difficult to survey and count the standardization activities in places other than in the negotiation activities such as participation in the committees. On the other hand, the standardization activities within the organization assumed the developmental strategy of new products accompanying the development of the new technological standards, in addition to the negotiations. The definition of the survey pertaining to the patent activities that may serve as the subject of comparison is not limited to the conventional negotiations including those of patent disputes and licensing, but includes a wide range of activities as in the expanded definition for standardization activities in this research.[3]-[6]

The standardization activities that were the subject of this study was the standardization activities related to the IP activities within the organizations, but it could be construed as the general trend of the data for standardization activities. Therefore, the obtained data are expected to be a meaningful finding in the discussion of whether to position the data for resource investments related to the standardization activities as part of science and technology data. Also, it may allow evaluation of the effect of the expanded standardization activities including the negotiation work on the innovation activities.

6.2 Comparison among research fields

The hypothesis was formed that the standardization activities in IP activities for basic research activities may be conducted at the same percentage as the applied and development research. The category, “education, TLO, public research institution, and public service,” was set as a representative field of basic research, and “electric machinery industry” and others were set as representatives of applied and development research. When the two were compared to see which was higher in degree of standardization activities in IP activities, the result showed that the basic research disciplines were higher. On the other hand, in total, both fields were higher than average, and showed approximately the same figures.

Figure 3 shows the changes of the average percentage of standardization activities related to IP activities during the four years from 2008 to 2011 in basic research of “education, TLO, public research institution, and public service” and in applied and development research of “electric machinery industry” and “information and communication industry” to see the trend of standardization activities by types of research.

Looking at the ratio of basic and applied and development researches, the average percentage was higher for basic research, at approximately 20 %. On the other hand, the results showed that applied and development research was around 10 %. One reason for the higher percentage of basic research than applied and development research can be that the percentage shifted due to the change in the number of

IP activity personnel, because the data was collected for the standardization activities of IP activity personnel. Looking at the "electric machinery industry" that represents the applied and development research, the number of IP personnel was approximately 5,000 persons. In the category "education, TLO, public research institution, and public service" that represents basic research, it was about 1,500 persons (Table 2). This can be considered as one reason the percentage of standardization activities increased in "education, TLO, public research institution, and public service" that represent basic research. The reason the number of IP activity personal was higher in "electric machinery industry" than in "education, TLO, public research institution, and public service" was because the number of patents filed was higher compared to the basic research institutions such as universities, and there were more work related to patent application. For example, in NEC Corporation, Fujitsu Ltd., and Hitachi Ltd., which are major Japanese companies, there are 100 to 300 persons assigned to the intellectual property division, and this matches the result of this study.[11] In basic research institutions, there was also the reason that the percentage of personnel belonging to the IP division engaging in both the IP and standardization activities increased since the researchers contributed less to the IP or standardization activities.

In Japan, the activities to establish the international technological standards to utilize the developed technologies are done at AIST and the National Institute of Information and Communications Technology (NICT) that engage mainly in basic research. AIST actively publishes papers on international standardization. Also, development of standards is done by university researchers, and the researches on communication protocol are done at the science and engineering departments of universities. It is thought that the activities related to the establishment of the technological standards are included in this category. The public service category is thought to include the public or governmental institutions that function as the secretariat for establishing the de jure standard. The above activities are thought to represent the standardization activities in basic research disciplines.

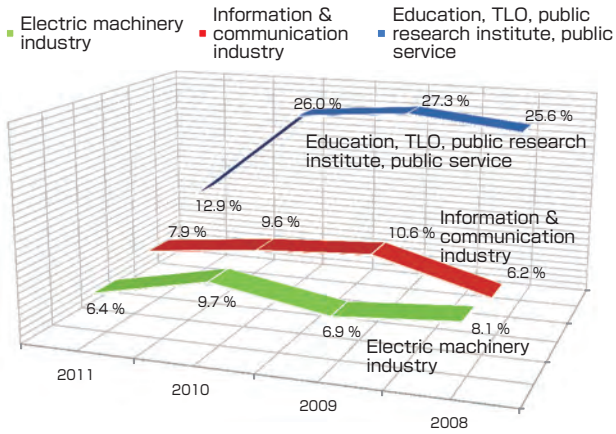

Fig. 3 Change over the years of the percentage of personnel involved in standardization among the IP personnel

The "electric machinery industry" and "information and communication industry" are thought to represent the applied and development research. It is essential to standardize the interface to commercialize technologies and to create development strategies of products. Therefore, the research disciplines in the applied and development fields include the activities related to technological standards, because they are extremely important in product innovations for today's electrical machinery manufacturing industry.

The above results lead to the hypothesis that there is a possibility that the standardization activities related to IP activities in basic research discipline may be conducted at the same level as the applied and development research of the companies.

6.3 Problems in the standardization activities in basic research

The universities file a number of patent applications, and it is necessary to confirm whether the technological standards born from the standardization activities by universities are related to the patent groups that they possess. Looking at the handling of the technological standards in the IP policies of the universities that ranked top for the number of patents published in Japan (Tohoku University, the University of Tokyo, Tokyo Institute of Technology, and Osaka University), it was found that no universities had any rules.[12]-[15] This means that a clearance system within the organization for patents and standards that exists in Japanese companies, does not exists in the divisions that handle intellectual properties at universities. The reason is because the basic research institutions such as universities have no production facility, and therefore do not execute patents themselves. Unlike the companies that engage in applied and development research, the universities do not have to pay attention to the presence of the patented technologies in the technological standards.

The comparison of the standard management and patent management by different research objectives is shown in Table 3. In the private companies of the information and communication industry, the system for collaboration between patent management and standard establishment is established, as the execution of IP strategies is integrated and the framework is solid. NEC Corporation, Fujitsu Ltd., and Hitachi Ltd. have standard committees that integrate standard strategies and standardization activities of the companies. In the applied and development research, the effort to integrate patents and standardization activities is in progress.[11] Considering the result of this paper, in the future, similar effort to manage the effect of patents owned by research institutions in establishing the technological standards will become necessary in basic research institutions such as universities.

Table 3. Differences in the standardization activities related to IP activities in basic research and applied and development research

Research objective	Percentage	Number of people	Degree of integrated management of standardization activities and patent management activities (Drafting of internal guideline, etc.)	Remarks: Representative industrial categories, etc.
Basic research	High	Higher than average	Hardly any cases (No description in IP policy)	Education, TLO, public research institute, public service
Applied and development research	Low	Higher than average	Some companies with advanced policies	Electric machinery industry

6.4 Goal to be achieved: viewpoint of synthesiology

Figure 4 shows the scenario of the flow and introduction of research from the synthesiology viewpoint. To establish the management method for the standardization activities in innovation activities that may serve as the index of long-term outcome, it is necessary to establish the method for data collection and usage in basic research as well as applied and development research. To do so, it is necessary to establish ways to collect data in companies and universities as well as evaluation methods for the effect of standardization activities in universities that are basic research institutions and in company organizations that are applied and development research institutions. In this research, some accomplishment was made to establish the foundation of data collection for companies and universities. On the other hand, for the evaluation of the situation that may occur between basic research and applied and development research, this paper only introduced the hypotheses. Further research will be necessary in the future.

7 Future research topics

For the commercialization of technology for information and communication device, or product innovation, addressing interface standards is essential today to obtain network externality. The collection and evaluation methods for statistical data pertaining to IP activities centering on patents are described in the OECD Frascati Manual[8] and the Oslo Manual,[16] but there is no description of the standardization activities. Therefore, it is difficult to conduct the check of adequacy through international comparison at this point. The precision will increase if comparison of international data becomes possible through data collection in various countries. The advancement in international research is desired in the future.

To verify the hypotheses for the degree of standardization activities in IP activities for basic research and applied and development research as developed in this paper, the understanding of actual situations of the standardization activities of basic research discipline is awaited.

8 Conclusion

It was confirmed that it was possible to stably collect data for the standardization activities in the IP activity survey, and that the data are reproducible. From the investigations of the rate of data recovery and others, it was concluded that the adequacy was supported. While it is necessary to continue investigation on whether the data can be stably collected and that they are reproducible from 2012 onward, from the result of the investigation in this paper, the reliability as primary data was mostly confirmed. This result is expected to advance innovation management through the visualization of

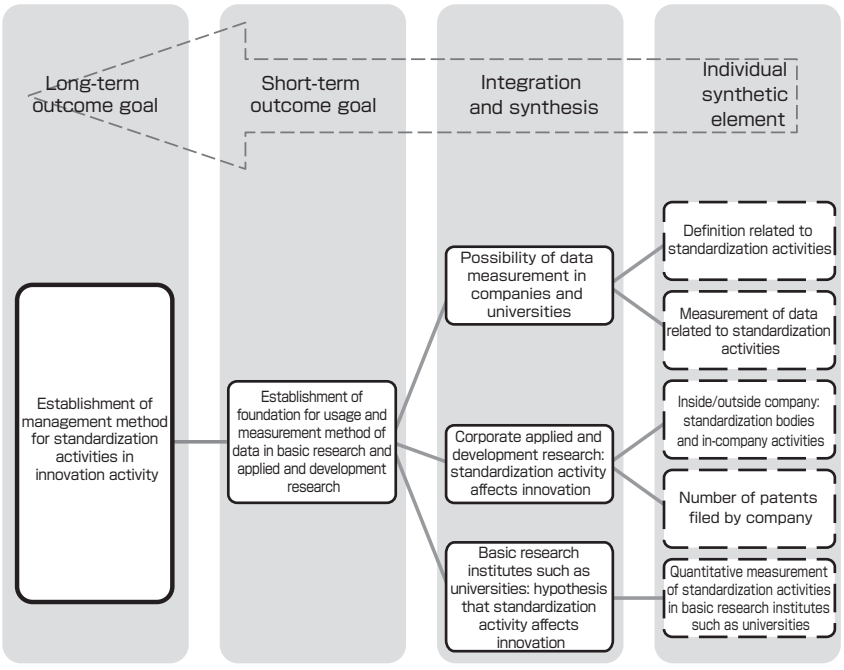

Fig. 4 Scenario for the development and introduction of the methods for standardization acidities to improve innovation activity management

standardization activities in organizations. In addition, from the analysis of the total data, the hypothesis was established that there is a possibility that standardization activities related to IP activities are being conducted in basic research institutions at the same level as the applied and development research. Aside from the precision, at least, the presence of standardization activities in basic research was confirmed from the quantitative data.

As an implication on policy, although an equivalent or higher percentage was observed compared to applied and development research of companies for standardization activities, the management of the standardization activities is not sufficiently organized in IP management at universities, and the standardization and patent activities are not sufficiently coordinated. The universities need the integrated management of standards and patents as in the electric machinery industry, and it is necessary for the divisions for industry-academia collaboration promotion at universities that currently handle patent information to play the role of transmitting information on standardization. Also, standardization activities must be considered when universities set IP policies as internal rules.

As an implication on research, in short-terms, the results indicate the usability of the number of people involved in technological standard activities to the quantitative analysis of evaluation of the innovation activities in basic and applied and development research. In long-terms, using the findings of this paper, the establishment of the system to collect similar data internationally is expected.

For establishing the evaluation method for innovation activities, considering the qualitative changes that the standardization activities confer on the IP activities, further advancement in the measurement method of the quantitative data for standardization activities will be demanded. Assuming the evolving network society, the standardization activities will become a factor that cannot be ignored in evaluating the innovation activities in the future.

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This paper was written under the responsibility of the author, and the contents including the mistakes are the responsibility of the author.

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Discussions with Reviewers

1 Point that the measurement was not done for the whole standardization activities, but was limited to the standardization activities within IP activities

Comment (Hiroo Matsuda, International Standards Promotion Division, AIST)

You mention as your research goal is "to consider the method for measuring standardization activities." However, you only considered the numerical fluctuation (stability?) of the standardization activity survey in the "Results of the Survey of Intellectual Property-Related Activities" conducted by the Japan Patent Office (JPO), and concluded that the hypothesis is adequate. Since the result of this JPO survey is an important "element" for the synthesis of this paper, I think you need deeper consideration for adequacy. Looking at the details, in the basic research that was the subject of this paper, the percentage of the standardization personnel in FY 2011 was reduced to half compared to the past fiscal years. You mention this in subchapter 5.1 but do not offer consideration of the fluctuation in the survey method.

Answer (Suguru Tamura)

I described that the reason for the reduction in 2011 was due to the replacement of companies that were subjects of the survey, as this was not a panel survey. For the reliability of data, I added the reasons that the recovery of the questionnaire data was about 50 % and the response on standardization was provided in 90 % of the recovered questionnaires. These two points were given as reasons that the sampling bias could be eliminated and the data could be considered reliable. (5 Result; 5.1 Number of IP activity personnel and the number of standardization activity personnel in IP activities; 5.2 Comparison of data over the years by industrial category)

2 Reliability of data

Comment (Mitsuru Tanaka, AIST)

Your discussion relies greatly on an evaluation index based on the fact it uses the basic data from the statistics of the Japanese IP activities. In particular, you address the comprehensible nature of the data based solely on the fact that the data is public data. For the readers who are not familiar with data reliability, they will be skeptical of how to view the changes from 2008 to 2011, or have trouble in understanding the comparison of basic and applied and development researches. I recommend you to supplement the explanations for such readers.

Answer (Suguru Tamura)

I explained that because the rate of response to the questionnaire was about 50 %, and because the percentage of response to the question related to this research was 90 % among the recovered questionnaire, it was possible to eliminate the bias in response. It can be concluded that the reliability of data is high. In ordinary questionnaire survey, though it depends on the situation, the reliability of a data source is thought to be high if there is 20 % to 30 % response. For the conclusion, I added the point that we cannot deny that a certain level of standardization activities related to IP activities is present in the basic research field. (5 Result; 5.1 Number of IP activity personnel and the number of standardization activity personnel in IP activity; 6 Discussion; 6.1 Verification of the hypothesis; 6.2 Comparison among the research fields; 8 Conclusion)

3 Description of the importance of definition for standardization

Question (Mitsuru Tanaka)

In relation to your description, "the verification method of the hypothesis that the new definition for standardization is adequate," I wonder if the fact, "…It was possible to collect data that captured the wide range of standardization activities that included back office work and planning, as well as the negotiation for establishing the standard" is critically essential for the new definition. It looks quite obvious that "taking up a wide range of items for standardization activity provides" makes the definition clear with "more accurate index." Instead of picking up specific examples for broader items, you should provide a simple discussion on the support of the scope of items for standardization. Or, is the main point of this paper, "one can obtain data" because there is stability? I recommend you to clarify this point.

Answer (Suguru Tamura)

I have added that the definition was matched to the patent activities for which surveys have already been done, and that the count of the standardization activity personnel was almost the same as the count of the negotiator. Also, I added the description on the reflective disadvantage such counting method may bring forth. No quantification of the standardization activities has ever been done using the expanded definition, so I indicated that, the fact that data can be collected is meaningful. In a sociological survey, unlike the measurements using measuring devices as done in natural sciences, there are many cases where responses may not be obtained in a questionnaire survey. (6 Discussion; 6.1 Verification of the hypothesis; and 6.2 Comparison among research fields)

4 Verification of the hypothesis on the standardization trend in basic research

Question (Mitsuru Tanaka)

Quantitative study is presented on the contribution of basic research to standardization compared with that of applied and development research. However, the reliability of the process of the study has to be explained taking into account the applied evaluation index and the definition of standardization. Since the evaluation index will be no more than one of the consequences of assumed contributions of basic research, the author will be allowed to explain his own speculation explaining the difference in the contributions of the two different research fields, which is of great interest to the readers.

Answer (Suguru Tamura)

I revised the text to state that there is a possibility that the standardization activities related to IP activities may be done at similar levels in the basic and applied and development researches. (6 Discussion; 6.2 Comparison among research fields; and 8 Conclusion)

Question (Hiroo Matsuda)

In the abstract you write that you "obtained the conclusion that the percentage of standardization activities is higher in basic research compared to applied and development research." The reviewer feels this conclusion is extremely dangerous as it can mislead the readers. The JPO survey used in this paper merely uses the personnel engaging in IP activities as a parameter, and the standardization activity personnel is counted as an included number. In subchapter 2.4 you mention the positive correlation between the participation to standardization organization and the number of patents, and it can be estimated that there are many of the standardization activity personnel who do not belong to the IP division in the applied and development research. On the other hand, the researchers contribute little to IP or standardization in basic research institutions such as universities. As a result, the personnel who belong to the IP division must cover both fields, and therefore, the percentage of the standardization activity personnel included in the IP activity personnel increased. Isn't this the case?

Answer (Suguru Tamura)

The handling of the conclusion was changed to an introduction of the hypothesis. Also, I changed the description to there is a possibility that about the same level of standardization activities may be done in basic research as in applied and development research. (6.2 Comparison among the research fields)

I added a discussion on the factors in the basic field. (6.2 Comparison among the research fields)