

Preliminary Study on Why University Researchers Do Not Utilize Patent Information for Their Academic Research in the Field of Science and Engineering in Japan

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Abstract—Generally speaking, university researchers in the field of science and engineering do not utilize patent information for their academic research activities, and mostly they depend on academic research publications to insist on their research originality. On the other hand, there is much volume of technical information in the patent publications along with the rapid increase and the absolute big number of patent applications in the world. As a first step of this research, we tried to grasp the researchers' needs what kind of patent information is requested for their academic research at universities, depending on the research processes in the field of science and engineering. We made preliminary interviews to the limited number of researchers to extract indispensable factors together with providing patent information searching systems, and we tried to understand the academic researcher's thinking in the field of science and engineering at university, for the purpose to design our future questionnaires as a next step. We positioned this research as a preliminary study before designing the challenging research framework which will be started based on the discussions in this paper. We started this research as a qualitative research to find out academic researcher's thinking, before entering a quantitative research approaches in the future.

I. INTRODUCTION

Globalization has made rapid changes of the world economical framework. During such period of changes, a lot of activities to strengthen the power of our human resource have been carried out in many fields, in order to maintain our international competitiveness and also to contribute more to the global society. In the higher education such as universities, we have been focusing on the development of human resources who create future innovation with improving the research capabilities. In particular, many of the students who have completed higher education in the fields of science and engineering get jobs in industry, mainly in the manufacturing industry, having committed to the development of the industry taking advantage of their expertise accumulated in higher education. And, through the hands-on experience in the industry, they strengthen their expertise, and expand their professional domain, contributing as a member of the economical growth.

In the higher education of science and technology, the students in the faculty, master's program, in the doctoral course devote themselves into the research in a specific area. It is true that we need to make detailed investigation and analysis on the past research results, collecting and making evaluations on academic research publications. In order to confirm their originality, we have to check all the past academic research publications, however at the same time we

have to check not only academic publications but also all the other technical publications such as patent publications, in order to get necessary information on materials, facilities, experimental devices, laboratory equipment, etc., which have been used in the real manufacturing business world. To design and make necessary experimental facilities, we at universities normally contact some limited suppliers to purchase some materials, and sometimes we face on the situation that it is not enough to get the best experimental facilities. We need to have more practical and commercial information to promote our scientific and technical research activities. Here, patent information plays an important role to get more practical and commercial knowledge and information which has already been defused in the industry. In other words, we can obtain a lot of information from patent information, especially practical and commercial information such as on the raw materials, facilities, experimental devices, etc., which have not been disclosed in academic publications.

In general, in the science and technology research activities in universities, the researchers do not adopt the process to use patent information to support academic research activities. In many laboratories at universities, they do not use patent information to strengthen their academic research activities themselves, they only make patent search when they have reached to the timing of patent application to check the novelty and inventive step. They do not utilize patent information for their own research activities. But, in some cases they find similar technical findings in the patent publication after completing their academic research activities, and we can say it's too late to insist their research originality. Also, some researchers say that patent information has time delay of publication with one year and six months from the date of filing. Therefore they cannot use patent information because of its delay of publication. But, it's not proper idea, because in some cases, it also takes similar longer period for peer review process on academic publication and waiting for actual publication. Also, there is lack of research in the past, from the perspective of whether or not the patent information is useful to the academic research at the university. In order to place the research results that enable commercialization in society and contribute to the social development, the university researchers have to properly understand the social needs, especially from industry, and define their research theme of their own science and technology research.

Therefore, in this study, first we tried to check and clarify the researchers' thinking on the value of patent information, discussing on the difference of basic research and

improvement research from some examples of patent application statistics. Also, we made interviews to some academic researchers to extract a model of their research processes, asking them what kind of patent information is useful for which process of academic research, resulting its modeling for our future research. Final goal of our research in the future is to clarify the possible use and significance of patent information for academic research in universities. This time, we will make intermediate research report with this paper by finding the researchers' thinking on the validity of patent information.

II. PURPOSE OF THIS RESEARCH AND LITERATURE REVIEW

In this paper, we will summarize the facts that university researchers in Japan are not conscious on patent publications to carry their own research activities. They are not well trained to use patent publications, and they do not have searching tools in their laboratories, also do not use patent information in their daily research life. Some of the researchers have strong interests in basic research, and the others have strong interest in commercial research, which is depending on the researcher. For both basic research and commercial research, they do not utilize patent information for their research activities. However, even if university researchers do not utilize patent information for their academic research, they or their patent agents make patent search to describe prior technologies in the patent specifications at the timing of patent applications. If they make patent search to utilize patent information for their academic research, they will get more practical and commercial technical information through patent information for the sake of improving their academic research.

Through this research, we may face on the necessity to define basic research and applied research. If we can make leveling the basicness and applied level with a specific measurable scale, then we will be able to evaluate the characteristics of academic research at universities. In case the applied level is bigger, we can recommend using patent information more on their research in the field of science and engineering at universities.

This time, we tried to extract indispensable factors in order to proceed with this research through limited interviews. We do not intend to extract a certain theory with inductive approach through interviews, but we tried to understand the academic researcher's thinking in the field of science and engineering at university with deductive approach, for the purpose to design our future questionnaires with reasonable number of researchers in the different technical fields. We positioned this research as a preliminary study before designing the challenging research framework which will be started based on the discussions in this paper.

We could not find past research literatures describing whether or not patent information have been utilized for

academic research in the fields of science and engineering. There are many research papers using backward and forward citations of patents, but they do not talk about utilization of patent information for their academic research itself. When we check the patent specifications on the inventions created by academic research at universities, we can understand that the researchers or their patent agents made patent search and described in the specification as the prior arts at the timing of patent applications, but we cannot confirm that they utilized patent information for their academic research activities. From our limited interviews, we recognized some researchers are not aware on patent information and have not utilized patent information.

There are several past literatures having the same recognition that patent information has not been utilized for innovation at universities. In these literatures, based on the situation that university researchers do not know how to access and utilize patent information, they have been introducing patent searching skills and system for effective utilization of patent information. But, they have not yet analyzed how university researchers think about patent information.[1] Also, in the other literature, they surveyed patent data bases currently available in Japan, including the IIP patent data base, and showed some of the preliminary results using the data base. They talked about the characteristics of patent data and also its database which shall be structured as they can be utilized by academic researchers for further innovation. But, it does not analyze the researcher's mind and thinking also the relations between science research activities and patent publications.[2] Also, Licensing Promotion Department, National Center for Industrial Property Information and Training introduced the background and the utilization of Research Tool Patent Database towards promotion of research and development in the field of life science at universities, but it's limited within introducing the current patent information services, not involving university researchers.[3]

III. THE DIFFERENCE IN THE PATENT PUBLICATION AND ACADEMIC PUBLICATION

The invention subject to a patent application is defined as "a highly advanced creation of technical ideas utilizing natural laws", such as new substance, material, device, method, etc. And, the industrial applicability is required to be patented. On the other hand, the academic research results in science and technology should have a new scientific and technical knowledge, but the industrial applicability is not required as an academic research result. So, the invention is different from an academic research result in characteristics of the artifacts of interest.

Table 1 shows the difference of characteristics between academic publications and patent publications in terms of major factors.

TABLE 1: ACADEMIC PUBLICATIONS VS PATENT PUBLICATIONS
Academic publications vs. Patent publications

	Academic publications	Patent publications
Purpose	Based on previous research, describes the new knowledge obtained by the research activities, and to publicly transmit it	It describes the technical ideas utilizing a law of nature to solve technical problems and to claim an exclusive right
Paper structure	Introduction Research methods Research results Consideration Conclusion	Scope of claims Detailed description of the invention (Prior art, solve problems, solving means, examples, operational effect) Brief description of the drawings
Evaluation method	Originality by researchers in the field, the logical resistance, and peer review on the academic value	Examination of the patent with respect to novelty and etc. by the Patent Office examiner
Relations with prior arts	No originality if it is described in previous studies. Originality is observed if the new knowledge it is created	Can be patented if there is novelty and inventive step in relation to the prior arts
Citation by following paper	High value enough to be cited in subsequent research and development	High value cited with subsequent patent applications Exclusive rights constructed as portfolio

In addition, the invention is intended to be published after one year and six months from the patent filing date, the idea exists that the time lag of publication prevents the use of patent publication for academic research. Therefore, it has not yet been researched whether or not the patent information is useful for a cutting-edge research of science and technology. However, in the industry, the relations between strategic patent application, patent portfolio construction, and the growth of company have been emphasizing as relevant factors, and the case studies using patent information for strategic R&D or commercialization have already come up

with research results. In other words, for decision-making in corporate management, or for business activities, patent information has been effectively utilized, however not effectively utilized in academic research in reality. In this study, if it is confirmed that patent information is one of useful information in helping to advance the science and technology academic research, patent information can contribute to further improvement of academic research, which is considered to be a big contribution to future progress of academic research.

TABLE 2: NO. OF ACADEMIC PUBLICATIONS VS NO. OF PATENT PUBLICATIONS
No. of academic publications vs. No. of patent publications

	SCOPUS		Web of Science		Patent Applications	
	No. of academic publications	Share %	No. of academic publications	Share %	No. of patent publications	patent publication share%
Japan	89,607	7.1	67,805	7.4	328,436	12.8
US	320,698	25.5	235,243	25.7	571,612	22.3
China	136,559	10.9	62,160	6.8	825,136	32.1
World	1,255,477	100.0	916,534	100.0	2,568,000	100.0

No. of academic publications: average of 2004-2006 National Institute of Science and Technology Policy "Third Science and Technology Basic Plan follow-up to such research in Japan and major countries of the input and output comparative analysis"

Patent applications: WIPO IP Statistics Data Center

	SCOPUS	Web of Science	Patent Applications
	Academic paper ratio	No of paper=1.00	Patent publication ratio
Japan	1.32	1.00	4.84
US	1.36	1.00	2.42
China	2.20	1.00	13.3
World	1.37	1.00	2.80

Patent application number ratio in the case of the 1 Web of Science paper number, about 2.8 times the world average

Scopus (Scopus), the world's largest abstract & citation database of Elsevier provides. All fields (science, technology, medicine, and social science and humanities), the world 5,000 companies or more publishers of 21,000 magazines or more of the journal, recorded the literature of more than 52 million reviews.

Well, we can review the volume of information in the patent publication and academic papers. In Table 2, it was an overview of the amount of information. Although there are some differences according to the country, the amount of patent publications is bigger than the amount of academic papers, it can be said that a big volume of information is involved in patent publications from the number of publications. In other words, it would be said that scale as an information source of patent documents is excellent enough.[4][5]

IV. RESEARCH METHODOLOGY

A. Preliminary research

First, in the selected laboratories at a university in the field of science and engineering, we tried to extract researchers' needs on patent information depending on each process of scientific and technological research. Then, organize the patent information required for the decision-making in each research process analyzed, and identify the source of necessary information. For example, in the process of the research plan, it is necessary to have the information for organizing the social and academic background required to define the research theme. In the process of designing the research methodology, it is necessary to have the information to identify the data to be studied, and the information on the data analysis technique and for data processing. In addition, in the process of planning an experimental apparatus, it is necessary to have the information to design the experimental apparatus, the necessary materials, and the information about the procurement of raw materials, etc. We can find that patent information is getting very helpful depending on the type of the research process. In addition, depending on the progress of science and technology research, we will carry out the patent information retrieval in each process, and we will evaluate how patent information helps the science and technology research, and will propose the evaluation methods.

In the series of this study, taking into account the particularities of the research process, it is presumed that customized evaluation techniques are required for each research process. Also, it is considered that the advantage of the patent information is different depending on each research field. Therefore, we will perform the experiment consists of the evaluation of patent information search and its results in each different field, such as the material field, chemistry field, machinery field, electric field. In the experiment, first, in each laboratory, we will introduce the patent information retrieval system in order to allow easy access to the patent information. And, we nominate graduate students to participate in the experiment of patent searching in each research field. Then, we will support them to perform patent information searching for each research process. As a result of experiment, we will analyze the validity of the patent information.

In order to increase the validity of the patent information, we have to provide educational programs on the basis of patent search and the characteristics of the patent information, which lead strengthening of intellectual property education for science and engineering human resources. The majority of students engaged in science and technology research in the laboratory of universities, get jobs in the industry. It becomes useful in the future for these students to have practical experiences of patent information searching. It is important to understand how the science and technology research in the laboratory of university can be positioned in the industry. For this purpose, patent information is really useful, because it contains much commercial and applied technology. In addition, in order to produce research results that can be returned much to society, these students should be familiar with the use of patent information which is actually used in corporate management and business activities.

The present study, did not plan to reach all of the conclusions in a single year, it is positioned as a project to be completed in about three years. This report describes the first step of our whole project to achieve the effective utilization of patent information in university laboratories in the future.

First, we considered the differences between the invention to be the subject of patent application and academic research achievements in university. It is said generally speaking that academic research at universities is a basic research, while the R&D in the enterprise is the applied research, or practical research. What is the characteristic of a basic research, and what is the characteristic of an applied research? So far, enough analysis has not yet been made. In this study, from the analysis of the reasons for refusal notification originating from responsible authorities for the patent application, it implies that it is the evaluation of basic research or applied research. It sets as a hypothesis for the performance of future research.

Next, in order to explore whether the patent information can be used for academic research at university or not, we made preliminary interviews to the limited number of researchers to extract indispensable factors together with providing patent information searching systems, and we tried to understand the academic researcher's thinking in the field of science and engineering at university, for the purpose to design our future questionnaires as a next step. Also, the preliminary interviews told us how we can help providing patent information for their academic research, listening to the idea how they distinguish basic research and applied research. As a result of this interview, we will be able to define a model of the research process of science and technology academic research at universities. This model can be used to design our future questionnaire as one of our research hypothesis.

B. Expectations for the significance and future of the series of this research

By taking advantage of the patent information in science and technology research at universities, research at the

TABLE 3 PATENT APPLICATIONS FROM UNIVERSITIES IN JAPAN

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total patent applications	413,008	423,017	426,974	408,569	396,160	390,879	348,429	344,397	342,312	342,589	328,138	325,688
Patent applications by universities	2,775	4,604	7,352	7,569	7,859	7,601	7,151	6,909	6,756	6,962	6,561	6,899
Ratio by universities	0.67	1.09	1.72	1.85	1.98	1.94	2.05	2.01	1.97	2.03	2.00	2.12

university will be close to commercialization. The use of patent information is positioned in science and technology research at university, and also the eyes of the students are expanded into the industry. In addition, it is expected that the commercialization of basic research at universities is promoted. During this study, university researchers are able to acquire the search and analysis methods of patent information. In addition, by linking the use of patent information in science and technology research activities at the university, further improvement of the quality of science and technology research at universities will be expected. In addition, it will be promoted patenting of research results of the university, getting revenue from license secured, further, a series of these results may be also reflected in the improvement of university rankings.

V. RESULTS AND OBSERVATION

A. Basic patents and improvement patents

Table 3 shows the situation of patent applications by universities in Japan. In Japan, the ratio of patent applications by university is really low with about only 2% out of total patent applications. There are several reasons why so low in Japan; university’s researchers do not have interests in patents, they do not understand the relations between research results and patents, university research results are basic and are not qualified as inventions for patenting, there is lack of infrastructure and budget for patent in universities, etc. However, this real situation with very low patent applications by universities shall be improved in the future.[6] Against such situation, Japan Patent Office has been supporting universities with a series of programs, but not remarkable results on patenting by universities.[7]

Also, there is a big problem of the existence of unutilized patents. The majority of patent applications over 300,000 every year are filed by the Japanese industry, but many of granted patents are not utilized on the market. There are many reasons why so many unutilized patents.[8] But, these unutilized patents cannot be used by university researches. In the big industry, it is investigated that the lack of collaboration between IP department and the other functional department generates such unutilized situation.[9] Also, the other investigation regarding company’s competitive situation creates flooding number of patent applications. In the electrical manufacturing field, we can see the serious competing situation to produce new unique functions to

increase their market share.[10]

As an example of research field in university which can be considered as a research close to commercialization, we checked the patent application situation in the field of ultrasonic diagnosis engineering. Table 4 shows the number of patent applications in that field. From total number of patent applications, the ratio of university patent application is 2.81%, and still low ratio, which shall be improved in the future.

TABLE 4 PATENT APPLICATIONS IN THE FIELD OF ULTRASONIC DIAGNOSIS

Ultrasonic Diagnosis (1993-2012)	
Total patent applications	2,098
National universities	36
Private universities	10
National Institutes	13
Universities total	59
Universities %	2.81

We focused on the patent applications filed by national universities; 36 patent applications, and we could find that 17 patent applications have been granted as patents and currently existing as patent rights dated January 7, 2016. This means 47% of patent applications are granted, which is quite high from general ratio for patenting. About these 17 patents, we checked the prior arts described in the patent specifications and found the situation in Table 5. From this table, 6 patents refer academic publications as prior arts, while all 17 patent specifications refer patent publications as their prior arts. This means, even if university researchers do not utilize patent publications for their own research, we can say that these academic research have prior arts of patent publications close to their research results. Regarding those 6 patents having academic research publications, we can say the research results are close to basic research side, but at the same time, they had the characteristics as applied researches because they also had patent publications in the specifications as their prior arts in the field of ultrasonic diagnosis, which is quite different findings from the interview results, described later. We can say that the situation to utilize patent publications for academic research depends on the research field, also individual of researcher. This shall be considered to continue this research in the future.

2016 Proceedings of PICMET '16: Technology Management for Social Innovation

TABLE 5 PATENT SITUATION OWNED BY NATIONAL UNIVERSITIES IN THE FIELD OF ULTRASONIC DIAGNOSIS

	Patent publication No	Prior Arts	
		Patent publications	Academic publications
1	2007-185242	1	0
2	2008-237670	2	0
3	2009-148395	1	5
4	2009-148396	1	2
5	2009-66268	1	4
6	2009-183416	6	0
7	2009-183417	6	0
8	2010-75616	4	0
9	2011-177338	1	0
10	2011-104079	2	0
11	2014-33816	2	0
12	2007-167414	3	0
13	2007-75382	1	3
14	2008-136863	2	0
15	2010-233921	2	0
16	2007-159920	2	2
17	2011-62358	1	1

TABLE 6 ASSUMPTION OF CHARACTERISTICS OF ACADEMIC PUBLICATION AND PATENT PUBLICATION

		Publication after	
		Academic publication	Patent publication
Publication before	Academic publication	90%	5-10%
	Patent publication	5%	95%

The result of investigation in the field of ultrasonic diagnosis was really surprising for the author, because of the big difference between the author's assumptions based on practical experiences. The assumption based on author's practical experience was described in the Table 6. It says that academic publications refer mostly academic publications and less patent publications, while patent publications refer mostly patent publications and less academic publications. We found that, in the ultrasonic diagnosis field, university researchers utilize more patent publications than assumed. Most of university researchers insist on the idea that patent information is not helpful for academic research. In order to deny this general idea, we showed one case of ultrasonic engineering, and it is sufficient to introduce one example to deny the idea. In such case, there is no need to say why we picked up the specific field.

Considering basic research or applied research, we can define the basic research corresponds to a basic patent, and the applied research corresponds to an improvement patent, based on the idea that basic research consists new combination of technical elements, and applied research consists partial improvement of existing technical combination. Figure 1 shows the concept of basic patent and improvement patents.[11]

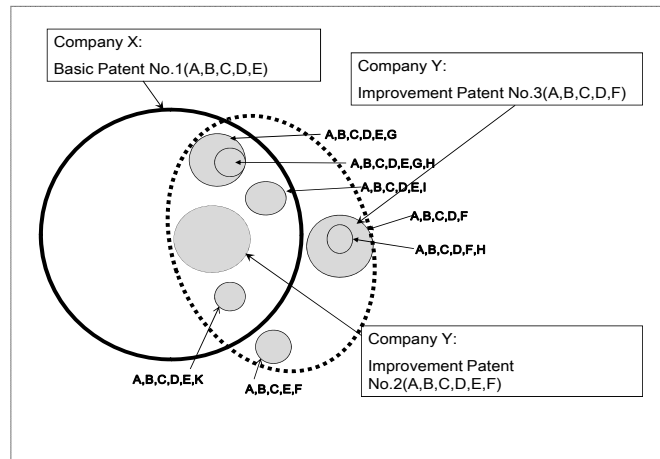


Figure 1 Basic patents and Improvement patents

From the findings in the field of ultrasonic diagnosis, we cannot say that universities' patents are basic patents. All 17 patents had patent publications as their prior arts. We can say that most of universities' patents are improvement patents in this field.

Table 7 and table 8 show patent situation in terms of the existence of prior arts in the field of Japanese automobile companies and electrical companies. We checked the number of patent applications which the patent examiners sent the existence of prior arts in the office actions of notice of refusal.

From this statistics, we found that 83-85 % of patent applications are improvement patents and 15-17% of patent applications are basic patents in average. Since 15-17% patent applications are related with basic patents, we can say patent publications contain basic research results, and worth to be utilized by university researchers. This means we cannot say patent publication cannot be utilized in university research.[11]

TABLE 7 PATENT SITUATION IN TERMS OF THE EXISTENCE OF PRIOR ARTS IN THE FIELD OF JAPANESE AUTOMOBILE COMPANIES AND ELECTRICAL COMPANIES

	Office actions with prior arts	Office actions without prior arts	Ratio having Prior Arts
TOYOTA	47	3	94%
HONDA	46	4	92%
NISSAN	40	10	80%
SUZUKI	44	6	88%
MITSUBISHI Motor	43	7	86%
MAZDA	41	9	82%
ISUZU	36	14	72%
HITACHI	47	3	94%
PANASONIC	42	8	84%
SONY	38	12	76%
TOSHIBA	43	7	86%
FUJITSU	38	12	76%
NEC	39	11	78%
CANON	40	10	80%
MTSUBISHI Electric	35	5	88%
SHARP	41	9	82%
SANYO	42	8	84%

TABLE 8 RATIO OF PATENTS HAVING PRIOR ARTS IN THE FIELD OF JAPANESE AUTOMOBILE COMPANIES AND ELECTRICAL COMPANIES

Enterprises/ Japanese/ European/ Automobile/ Electric/	Ratio Patents having Prior Arts
Average of Japanese Automobile Enterprises	85%
Average of Japanese Electric Enterprises	83%
Average of Japanese Enterprises	84%

In the period of industry’s growth in 1970-90’s, Japanese industry tried to file a lot of improvement patents to catch up the western countries, and the patent system and its practices are well organized to protect those improvement patents. However, we have to reorganize more advanced patent system and its practices to protect more basic patents in the future.^[12] These kinds of modernization give benefit to university research, as long as basic research is done by universities.

From the above two examples, one in the field of

ultrasonic diagnosis and the other in the concept of ratio of basic research from citation percentage by patent examiners, we can conclude that academic research at universities have possibility to utilize patent publications because patent publications include not only applied research but also basic research results, of course depending on the technical fields. We can deny the opinions that university research does not need to investigate patent publications

B. Interview results in selected laboratories

This time, we tried to extract indispensable factors in order to proceed with this research through limited interviews. But, we do not intend to extract a certain theory with inductive approach through interviews, but we tried to understand the academic researcher’s thinking in the field of science and engineering at university with deductive approach, for the purpose to design our future questionnaires with reasonable number of researchers in the different technical fields. We positioned this research as a preliminary study before designing the challenging research framework which will be started based on the discussions in this paper.

1. Professor N, Department of Energy Sciences

Research experience at university: Over 30 years
 Research field: Heat transfer

First, we explained the purpose of this research in details, and we made an interview to him, spending about 2 hours. The following shows the discussions of the interview, including comments from Prof. N.

“I have the following 3 aspects of my research activities.

1. Clarification of the mechanism of heat transfer with heat pipe (Academic research field)
2. Proposal of method to estimate the function of heat pipe, based on the said mechanism clarified (Between academic research field and commercialized research field)
3. New proposal to improve the function for commercialization (Commercialized research field)

The reason why I have been making research on heat pipe is that heat pipe is very important technology for the research of air-liquid 2 phase stream flow phenomena. In that sense, I may say that I am one of researchers to try to clarify the mechanism emphasizing the academic research.

Regarding the questions like “Do you have expectation that the heat pipe is welcomed by industry and contribute to improve competence of enterprises?”, “Or, just concentrated on the clarification of mechanism to find new knowledge as purely academic research field?”, I expect that my research results contribute to the society with economical benefits. However, in the real situation, my research results are not easily licensed out to the industry. As a result, I understand that I have been trying to concentrate on finding new knowledge with the progress of academic research.

Regarding the question “How we define our research theme? Have we been watched social needs on R&D?”, I

understand that we have been watching and understanding the social needs through academic activities, academic research papers, researchers' collaboration, etc. We do not think we need to check patent information. Generally speaking, 99% of patent information has the subjects on small improvement technologies for commercialization, and they are not indispensable information in the field of my academic research. And, the rest 1 % of patent information may be related with academic research, however such contents are included in the academic research paper or researchers' close discussions with human network.

We do not want to say that we never check patent information. It depends on the situation and research theme. In some cases, we check patent information in detail together with patent searching. We had discussions on the research project of micro-gas turbine long time ago. It was an international research forum by turbine experts, and according to the patent searches on the data base of US Patent, we found a patent application on the micro turbine filed by MIT professor. In the US, patent activities are also very efficient in addition to academic research papers. In this case, we concluded and finally terminated this project after patent searching.

Regarding the question on "Is it necessary to check patent information to confirm the novelty and creativity on the science and technology paper?", I think it enough to check academic research papers. Most of academic researchers check academic research papers, and not necessary to check patent information which is the results of commercial research. In order to define our research theme, there is possibility that we can utilize patent information, which is up to the situation.

The research theme in the field of academic research is strongly related with the government policy of Ministry of Education, while the commercial researches made by NEDO or AIST are related with the government policy of Ministry of Industry. For these commercial researches, we have to check patent information since they represent the progress of commercialization.

The required information depends on basic research or commercial research. For the basic research, it is enough to check the academic papers, however it is required to check patent information in addition to academic papers for the commercial research. In some case, it will be beneficial to provide patent information to the academic researchers who have proceeded with basic research. In the case of joint research with industry, my role will be academic fields, and the R&D targeting commercialization with products shall be done by industry side.

Training and education of patent searching for the students will be very important and significant from the educational purpose point of view thinking future contribution to the industry after graduation."

2. Professor A, Department of Industrial Management and Engineering

Research experience at university: Over 15 years

Research fields: Human behavior and cognitive, ergonomic analysis of advertising visual information processing, awareness of intellectual creative tasks engineering analysis.

First, we explained the purpose of this research in details, then we made an interview to him, spending about 1 hour and 20 minutes.

The following shows the discussions of the interview, including comments from Prof. A.

Prof A explained his new research project just started recently with restaurant chain. The overview of this joint research is to propose a new operation of restaurant by checking customer's eye movement using eye tracking device, and analyze customer's behavior. At this newly developing unique restaurant, the customer receives a basic food on the dish and he/she make toppings on the basic dish from the topping corner picking up their preference toppings.

Consumer enters the store, when he/she are going to put the toppings on the basic dish, first, overlooking the whole of topping corner, and finds the ingredients what to put. We check this process to check eye movement as the first step. Under these circumstances, what kind of factors makes the human eyes? There are so many complicated factors making influences on eye movement, such as physical saliency factors, semantic saliency factors, sensibility factors of the people, etc. Consequently, it is very difficult to explain the eye movements and people's actions. However, if we can clarify these factors, then we can propose a new operation and arrangement of the restaurant based on these analyses. Here, let's think about why and how we reached to this kind of research theme? In our case, we did not listen to the industry's voice, and we did not check patent information. We reached to this idea from our intuitional thinking. So, it is not necessary to check patent publications to define our research theme at universities, more intuitional idea generation will contribute our research activities. Of course, it is worth to check patent publications in order to confirm our originality having novelty or not.

I have my mind that the new findings at universities shall be distributed for free use to public. Therefore, I have a doubt we should obtain patent right. However, I also agree the idea that the university research is sponsored by the government using national budget, we should protect our new technologies as patents to keep our competence. In general, university students have not received enough education on intellectual property rights. I have a strong belief and request to organize intellectual property education for science and engineering students in the future.

3. Professor I, Department of Mechanical and Control System Engineering

Research experience at university: About 7 years

First, we explained the purpose of this research in details,

and we provided patent searching practical training to the graduate students. Then, we made an interview to him to receive his comments.

The following shows the discussions of the interview, including comments from Prof. I.

To graduate students belonging to the laboratory, we provided a practical description of patent information retrieval and its basic search method. We provided a patent searching system where they can search for patent information in the laboratory. In addition, we explained how to use patent information for their research.

There is high demand and consciousness on the positioning in the industry of their research activities. We may expect that patent information survey will be helpful to understand the value in the industry by checking the prior art, problems to be solved, etc. which have been described in patent publications. The understanding of positioning together with prior arts will be helpful to draft research papers, especially draft the part of background of research. Also, it is very helpful to draft research fund application paper to persuade the importance of the research.

Prof. I instructed to students to reflect the patent information in the background part of their graduation thesis. This also leads to understand how their research is positioned in the industry. Furthermore, Prof. I thought that the understandings on patent information of targeting companies will be very helpful for students for job hunting. He confirmed that along with the timing for job hunting students will be requested to investigate of patent publication of targeting companies before going to interviews.

C. Summary of Interviews

As reported in the above, we carried out interview survey to 3 different fields, in order to find concrete needs from researchers how patent information can be utilized for academic research at universities. In this paper at present, we concluded qualitative research cases as the first step of our research. And, we can summarize the researchers' needs on patent information as follows.

- ✓ The researchers have their consciousness on their research activities as basic research in some cases, also as commercial research in the other cases.
- ✓ One researcher has a pride on his work positioned in the basic research side. The other researcher put the importance on its commercial value.
- ✓ The researchers think that, for the basic research, academic publication is enough to find prior research results, not necessary to check patent publication.
- ✓ The researchers think that, for the commercial research, they understand the necessity to check patent publications.
- ✓ Whether they need to check patent publications or not depends on the characteristics of the research basic side or commercial side.
- ✓ Patent search will be beneficial for the students as educational aspect.
- ✓ In some cases, it is not necessary to check patent

publications to define our research theme at universities

- ✓ It is worth to check patent publications in order to confirm our originality having novelty or not.
- ✓ We need to organize intellectual property education for science and engineering students in the future.
- ✓ There is high demand and consciousness by researchers and students how to position their researches in the industry.
- ✓ The understanding of positioning together with prior arts using patent publications will be helpful to draft research papers
- ✓ Patent information shall be described in the background part of his graduation thesis.
- ✓ Understandings on patent information of companies will be very helpful for students for job hunting.

VI. CONCLUSIONS AND FUTURE PLAN

In this paper, we will summarize the facts that university researchers in Japan are not conscious on patent publications to carry their own research activities. They are not well trained to use patent publications, and they do not have searching tools in their laboratories, also do not use patent information in their daily research life. Some of the researchers have strong interests in basic research, and the others have strong interest in commercial research, which is depending on the researcher. For both basic research and commercial research, they do not utilize patent information for their research activities. University's researchers do not have interests in patents, they do not understand the relations between research results and patents, university research results are basic and are not qualified as inventions for patenting, and there is lack of infrastructure for patenting in universities. In one specific field of technology, we can say that most of universities' patents are improvement patents, we can deny the opinions that university research does not need to investigate patent publications. We received various opinions through selected interviews, such as the researchers' consciousness of characteristics on basic research or commercial research, the value of academic publication and patent publication, patent search as educational value, intellectual property education for science and engineering students, etc.

Based on these results, as the next step, we will design a questionnaire survey which will be widely distributed to the laboratories of faculty and students. This time, we extracted the above findings. Based on the findings, we will continue our researches and will make progress reports at the next conference.

VII. FUTURE RESEARCH

We will make questionnaire survey to extract how university researchers can utilize patent publications depending on each research process. For designing the questionnaires, we can use the conclusion we extracted

during this preliminary research result. We will make evaluation of patent publications, along with the process such as, analysis and information gathering of the research field, research theme settings, research activities framework design, design and manufacture of laboratory equipment, collection of experimental data and analysis, clarification of new knowledge obtained, thesis writing a patent application, technology transfer by license, etc. We will propose how they can utilize patent information for their academic research activities. If they can utilize patent information for their academic research in the field of science and engineering, we can expect the quality up of their research results, also high contributions on industrial applications, resulting patent protection on their research results.

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