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# Questionnaire Survey at Universities on Utilization of Patent Information for Academic Science and Technology Researches

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**Abstract--** It seems that, currently, patent information is not fully utilized for academic research at university. What kind of consciousness do university researchers have about patent information? In response to this question, we designed a questionnaire aimed at clarifying its actual condition and consciousness based on preliminary hearing to university researchers. This questionnaire was sent totally to 319 laboratories of the top 35 Japanese universities, where their number of patent applications are positioned as top ranking. In addition to clarifying the situation of utilization of patent information for their own science and technology research, we visualized the consciousness of university researchers concerning basic research and commercial research, also extracted the issues in patent information utilization, finally we suggested important factors to utilize patent information for science and technology researches. Also, we suggested the transition of basic research to commercial researches along with the processes of research progress. This paper aims to derive hints for science and technology researches at universities to be able to more efficiently contribute to society launching a startup company or a venture company utilizing patent information in the future. We expect to be an important message in the field of managing technological entrepreneurship.

## I. INTRODUCTION

Patent information is not fully utilized for science and technology research in university laboratories. In this research, we will examine whether patents information will be useful for research activities in science and technology at university, what kinds of science and technology research areas will be useful, what kind of usage forms will be useful, it aims to clarify the possibility and significance of information. By effectively utilizing the enormous amount of patent information for scientific research, we clarify the aspects of academic roles of patent information and contribute to the development of science and technology research by effectively utilizing it. Also, linking IP education for

university researchers at university, we can expect to grow human resources having the talent of innovation and patent protection. The university's research results should be patented, securing earnings through licensing, and further improving university rankings.

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 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 supplement 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 research activities. But, in some cases they find similar technical findings in the patent publication after their academic research activities, and we can say it's too late to insist their research originality. Some researchers say that patent information has time delay of publication with one year and six months from the date of filing, and they do not use patent information because of its delay. But, it's not proper idea, because in some cases, it takes also similar long period for peer review process of academic publication. Also, as long as we investigated so far, it does not exist 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, how far it has been put to practical use in society, in helping you understand the progress of research and development for practical use, and determine the theme of their own science and technology research, it is necessary to identify the research to be transformed as a target or not.

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 talked about the characteristics of patent data and also its database which shall be structured as they can be utilized by science 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]

In Japan, the ratio by university patent applications 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 for patent in universities, etc. However, this real situation with very low patent applications by universities shall be improved in the future. [4]

## II. PURPOSE OF THIS RESEARCH

Therefore, in this study, first we try to check and clarify the researchers' thinking on the value of patent information. In 2016, 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. According to the preliminary interviews, university researchers in the field of science and engineering do not utilize patent information for their 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. We tried to grasp the researchers' needs what kind of patent information is requested at universities, depending on the research processes in the field of science and engineering, such as overviewing social needs on research, defining research theme, outlining of research framework, designing experimental devices, analyzing experiment data, observation and concluding, filing patent applications, licensing, etc. Then, depending on the researchers' needs, we tried to propose how they can utilize patent information to proceed with their research activities, together with providing patent information searching systems. 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. As a conclusion, those research universities will be expected to make further contributions on the growth of industry based on their academic researches. In 2016, as a first step, we tried to extract indispensable factors in order to proceed with this research through limited interviews, and we tried to understand the academic researcher's thinking in the field of science and engineering at university, and designed our questionnaires. By making such questionnaires, we tried to clarify the possible use and significance of patent information for academic research in universities. In 2017, since we designed a questionnaire survey and carried out its survey for university researchers, we would like to report the results of the questionnaires, at the conference of PICMET 2018.

### III. RESEARCH METHODOLOGY

#### *A. Summary of Interviews in 2016*

In 2016, we carried out interview survey to university researchers, in order to find concrete needs from researchers how patent information can be utilized for academic research at universities. [5] Let us 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 other cases.
- ✓ For the basic research, academic publication is enough to find prior research results, not necessary to check patent publication.
- ✓ 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.
- ✓ 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 on the positioning in the industry of their research activities.
- ✓ 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 students' graduation thesis.
- ✓ Understandings on patent information of companies will be very helpful for students for having their future career.

In 2017, we made questionnaire survey to extract how university researchers can utilize patent publications depending on each research process. For designing the questionnaires, we can use the model we extracted during this 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 hope we can provide how efficiently utilize patent publications for academic research at universities.

### *B. Design of questionnaire survey*

Based on the interview results for the recognition research on the utilization of patent information by the university researcher conducted in 2016, we designed questionnaire surveys, and carried out delivered to university researchers. This questionnaire was sent totally to 319 laboratories of the top 35 Japanese universities, where their number of patent applications are positioned as top ranking. By doing this, we tried to extract important factors for utilizing patent information in university science and technology research, and summarized the recommendation to university researchers.

We defined our basic idea for the questionnaires to researchers as described in the following figure Fig.1 and Figure.2.

We understand that university researchers tried to make patent searches or they asked to IP related unit in their organization when they filed patent applications on their research results. However, during their research activities, most of researchers put importance on academic publications and not so much attentions on patent publications. And, it seems that they do not understand the value of patent information. Through this questionnaires, we tried to grasp researcher's recognitions on the utilization of patent information, and tried to extract some suggestions and recommendations.

## Questionnaires to university researchers

Selected top 35 universities for patent applications.  
Number of universities: 35  
 Selected top researchers in the above universities.  
Number of researchers: 319

- We understand that patent search is necessary for patent applications.
- But, patent information can be valuable for academic research itself?
- How university researchers thinking on the utilization of patent information?
- Researchers' recognition?
- From fact findings to suggestions!

Figure 1: Basic idea for the questionnaires

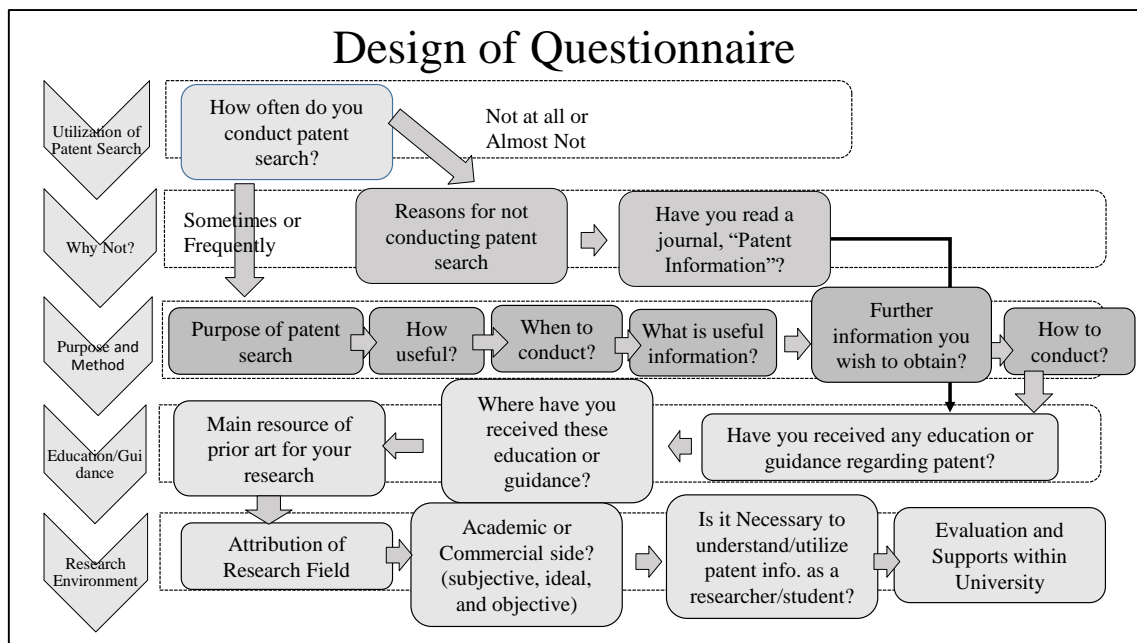


Figure.2: Design of Questionnaires

#### IV. RESULTS OF QUESTIONNAIRES

In this paper, because of limited pages, we cannot report all the answers of questionnaires. So, we tried to pick up the important questions to extract researchers' recognition, also extract critical factors when we talk on how we should use patent information for university research. Hope you understand our deductive approaches have been derived from all results of questionnaires.

##### A. Attribute of questionnaires

Let us show the attribute of respondents to questionnaires in the figure Fig.2. Basically, most of the respondents are working in the field of engineering. Since we selected the respondents focusing on the researchers who have made and positive on patent acquisition in order to derive the positive suggestions how to utilize patent information, and many patent applications have been filed in the field of engineering. Therefore, we understand we received the researchers in the field of engineering.

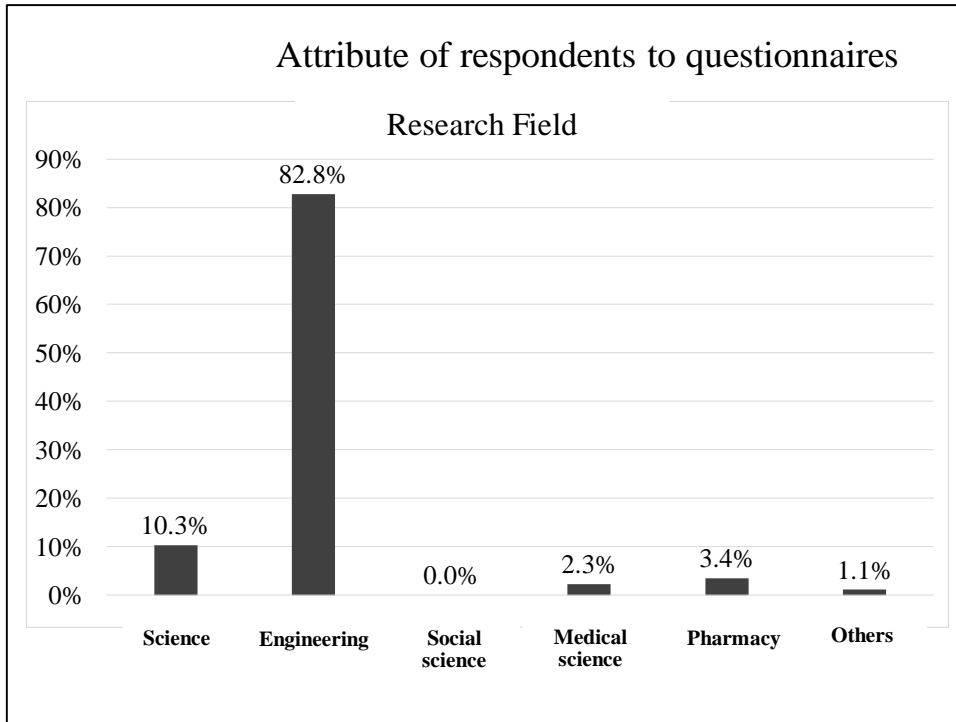


Figure 3: Attribute of respondents

## B. Question & Answer

### Question 1: How often do you make patent search at university?

Regarding this question, totally 73.5% researchers answered positive responses “sometimes make it” or “make it frequently”. So, from this responses, over 70 % researchers use patent data base and involved patent searching in their research activities. On the other hand, 25.3% researchers do not make patent search for their research activities.

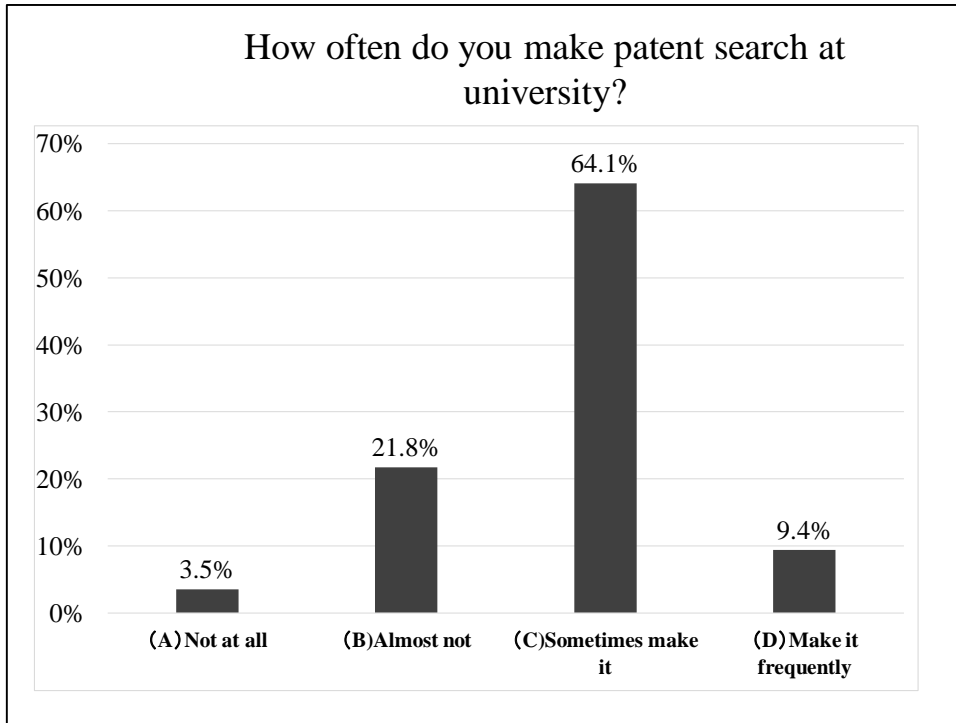


Figure 4: Frequency of use of patent search

### Questions 2: What is the purpose of patent searches?

Biggest purpose is for filing patent applications. This means that they make evaluation on their invention whether it has novelty and inventive step or not, when they file patent applications on their research results. And, as long as they make patent search for patent applications, they do not get technical information from patent publications in order to apply the technical information into their research activities, only for evaluation of novelty and inventive step. However, their response does not fall into patent applications, but they have clear purpose to promote university-industry

collaboration including fund acquisition, commercialization, and utilization of patent information for their own research activities in the university, which is good signs for future role of university research making social contributions.

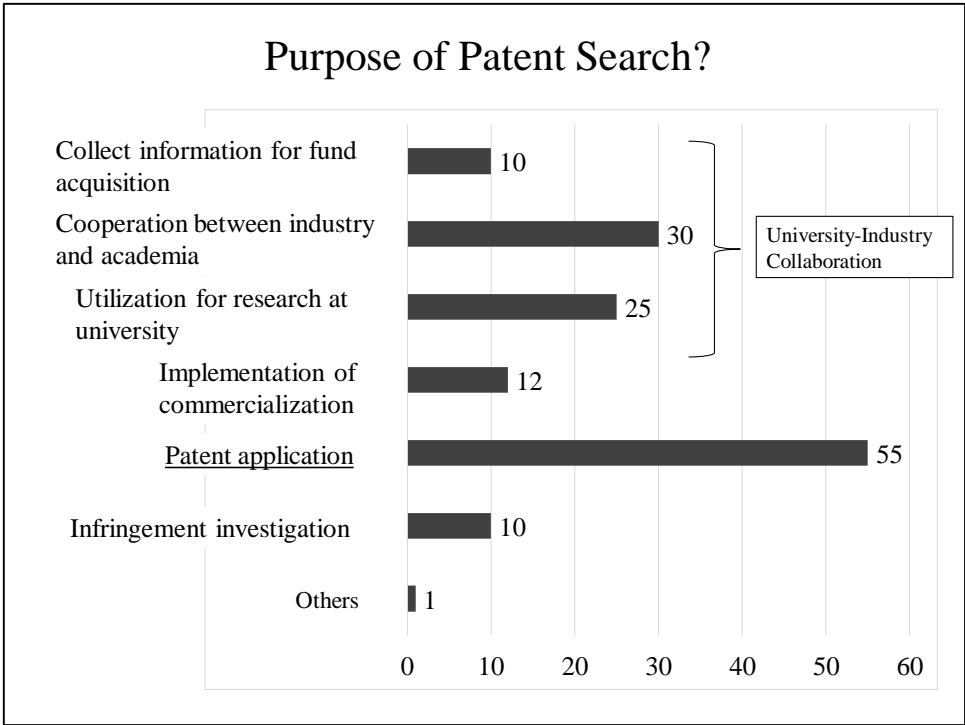


Figure 5: Purpose of patent search

*Q3: How does the patent information help when applying for research funding?*

This question has been asked to the researchers who have the purpose of patent search for fund acquisition. Their answers are to get the information of industry field having higher possibility of commercialization of university research results, also to get know the technology commercialized based on industry needs. In order to get research funding, first, we have to know social needs especially industry and consumers' needs, to respond by the research results using outside research funding. If we cannot contribute to the industry and consumers, it will not easy to get research funding.

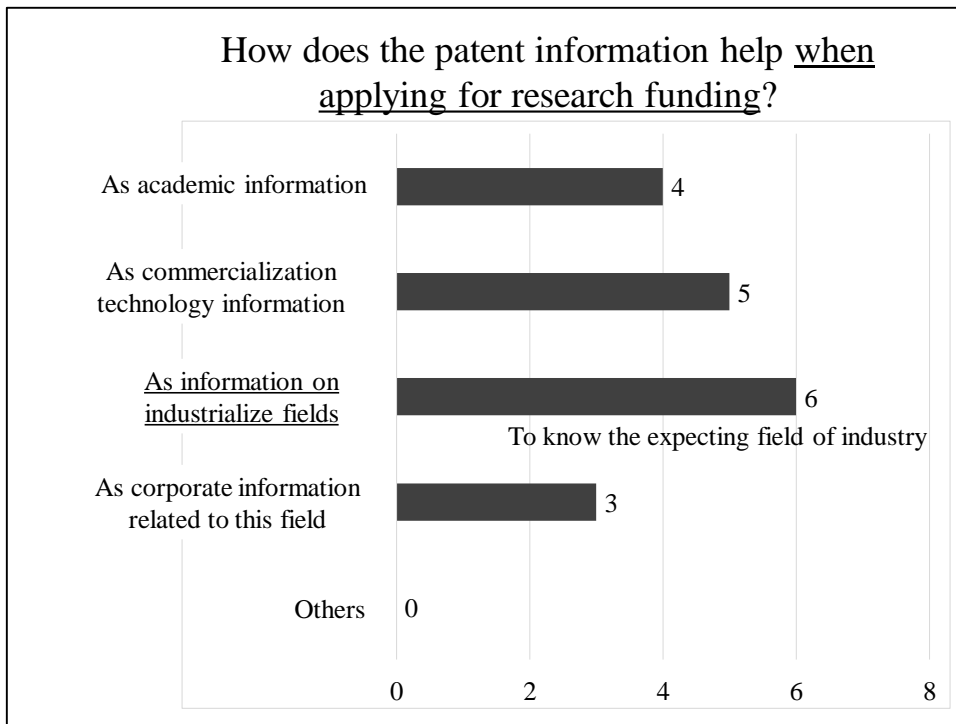


Figure 6: Role of patent search for research funding

*Q4: What kind of information should I obtain further when applying for research funding?*

We asked this questions for the same researchers who have the purpose of patent search for fund acquisition. The best answer is the information on patent technology trends in research fields. From this answer, the researchers would like to have a certain information of technical trend of patents how the applicants have competed together to get exclusive rights in the research fields. To get research funding, we have to know the academic publications, but it's not enough, and to make contribution by university research with outside research funding we have to know the market situation not only academic situation by checking the patent information in details.

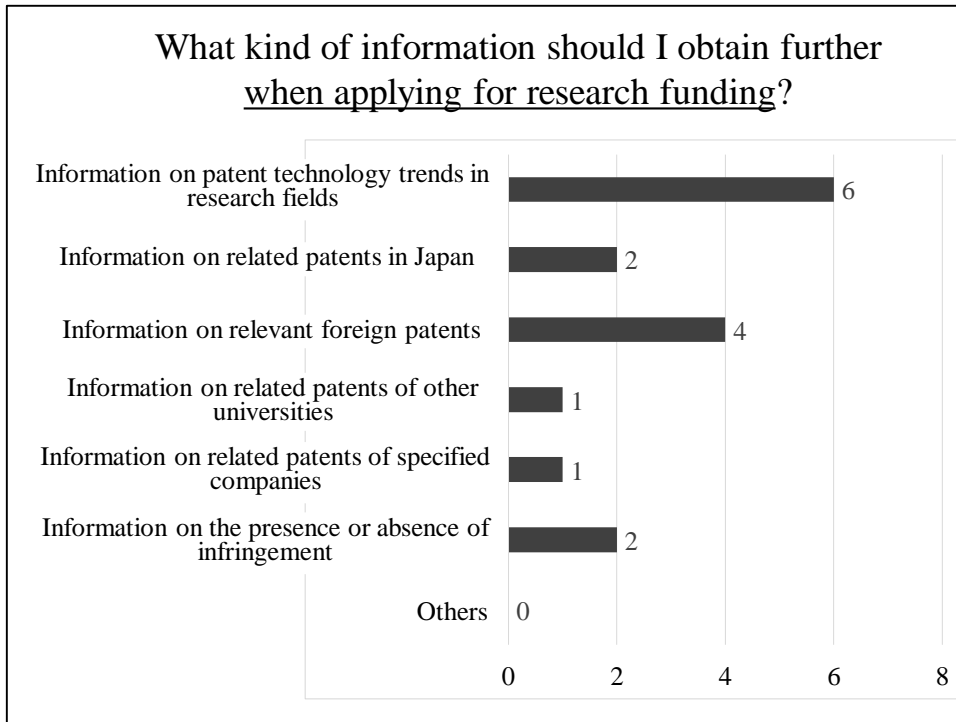


Figure 7: Patent information for research funding

*Q5: How can patent information be useful in promoting industry-university collaboration?*

Majority of this answers is patent information is useful to promote university-industry collaboration. From patent information, we can extract market needs by making analysis of the description in patent specification “subjects which shall be solved”, which is the reflection of market needs. Basically, the industry file patent applications to make their customers and consumers satisfied by producing new technology and technical improvement. University researchers also can recognize where the market needs exist by making patent information analysis. If the researchers understand the market needs and industry needs, the researchers can well define their research theme as it will be accepted by the investors of research funding.

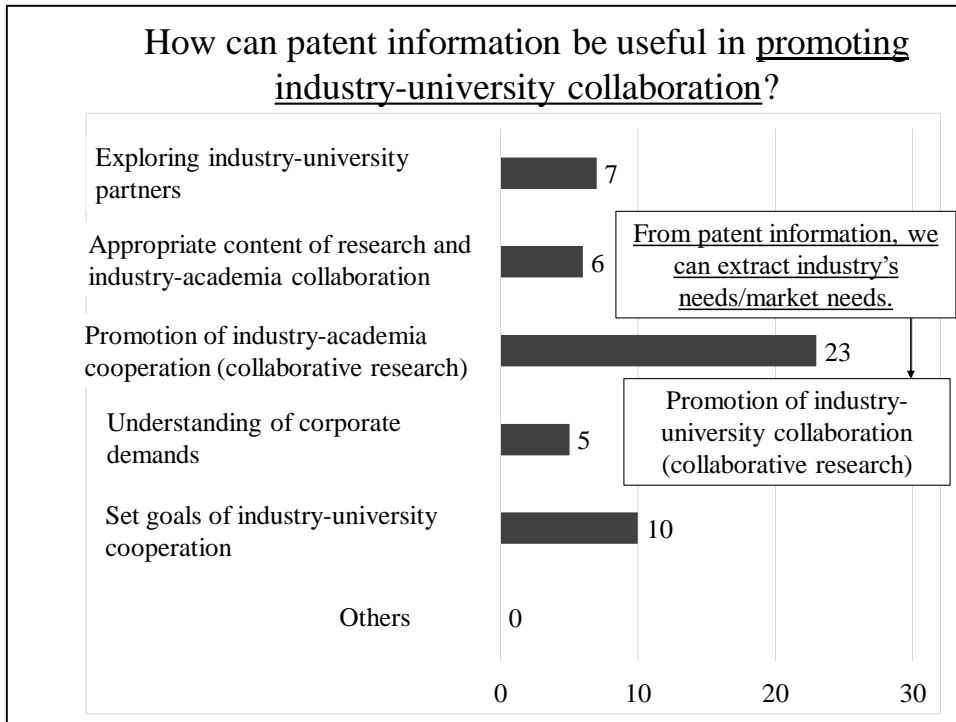


Figure 8: Role of patent information in promoting university-industry collaboration

**Q6: How can patent information help in promoting research at university?**

How can patent information promote university research? In general, it will not easy to respond to this question. Because, when we say university research, we have to consider many variation and research characteristics, such as a basic research to an applied research. If the university research is positioned really in a basic research, it will be difficult for patent information to become helpful for promoting research. However, if the research is positioned in applied or commercial side, patent information is definitely important and helpful for promoting such researches. It will become case by case.

Majority of answer is patent information serves as prior information for research. From this answer, we have a belief that patent information will be helpful to promote university research. We can use patent information applied into our university research activities. Some researchers answered it helps to promote basic, research, commercialization of research, setting research theme, experimental conditions, etc. We should find the effective way how to utilize patent information to university research activities.

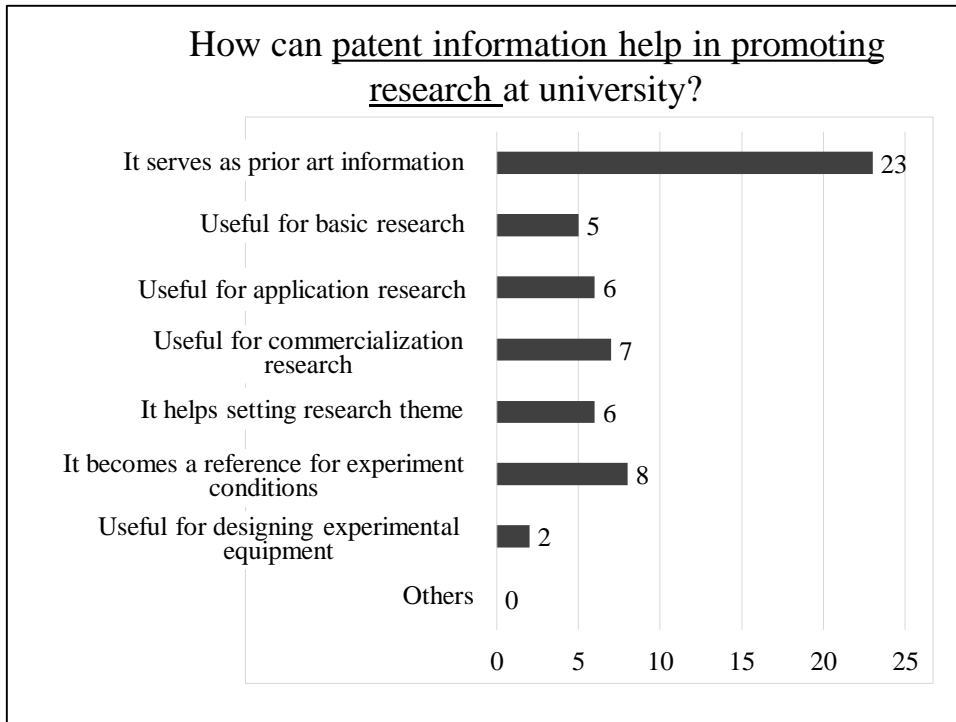


Figure 9: Role of patent information in promoting research at university

**Q7: How is patent information useful for promoting commercialization based on research results?**

Patent publications are generated as results of patent applications. Why the applicant file patent applications and get patent granting? Because patent granting gives its owner an exclusive right to use the patented invention. The applicants decide patent applications when the inventions are the important subject for customers' and consumers' satisfaction. If we obtain patent granting in the area of high market needs, including customers' and consumers' needs.

The highest answer is to get business information for commercialization through patent information, also to find an expecting field of commercialization.

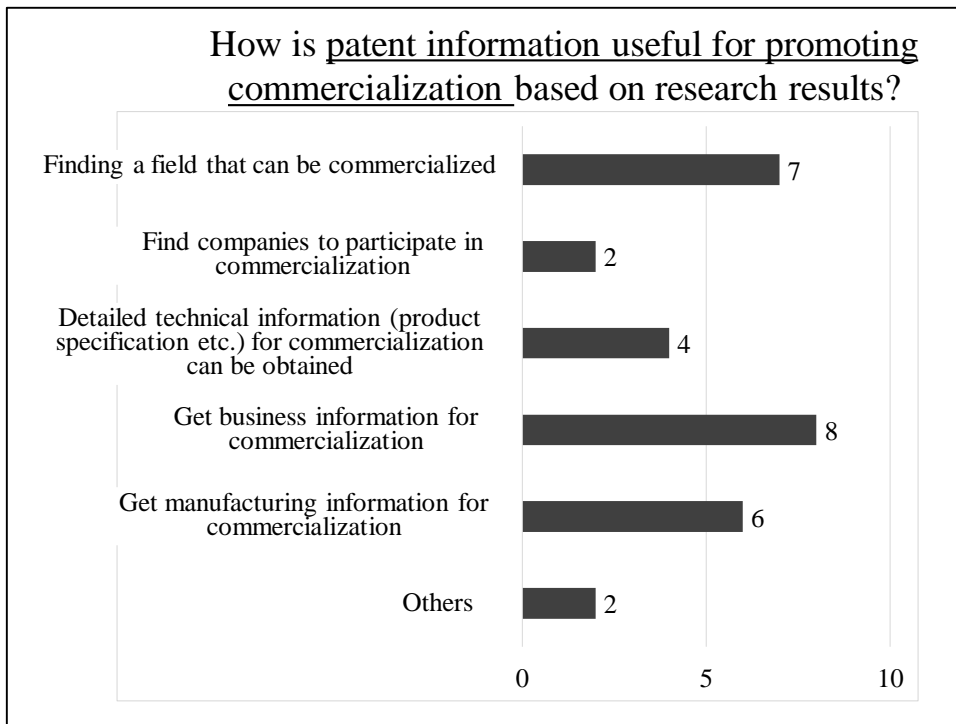


Figure 10: Role of patent information in promoting commercialization

**Q8: How do you conduct patent information survey?**

Basically, most of researchers use patent DB provided by Patent Office. Nowadays, WIPO provides patent searching services including worldwide patent information, EPO, USPTO, JPO, major IP organization provide patent information with free of charge. Of course, many commercial DB services are provided by different private enterprises as business basis. If we do not need higher additional analytical functions, we can use WIPO or the other government data bases for patent searching.

In case that university has the responsible organization on IP or technology transfer, the researchers can ask to the internal organization, or, in case of existing university-industry collaboration projects, they can ask to the industry side to take care of patent searching.

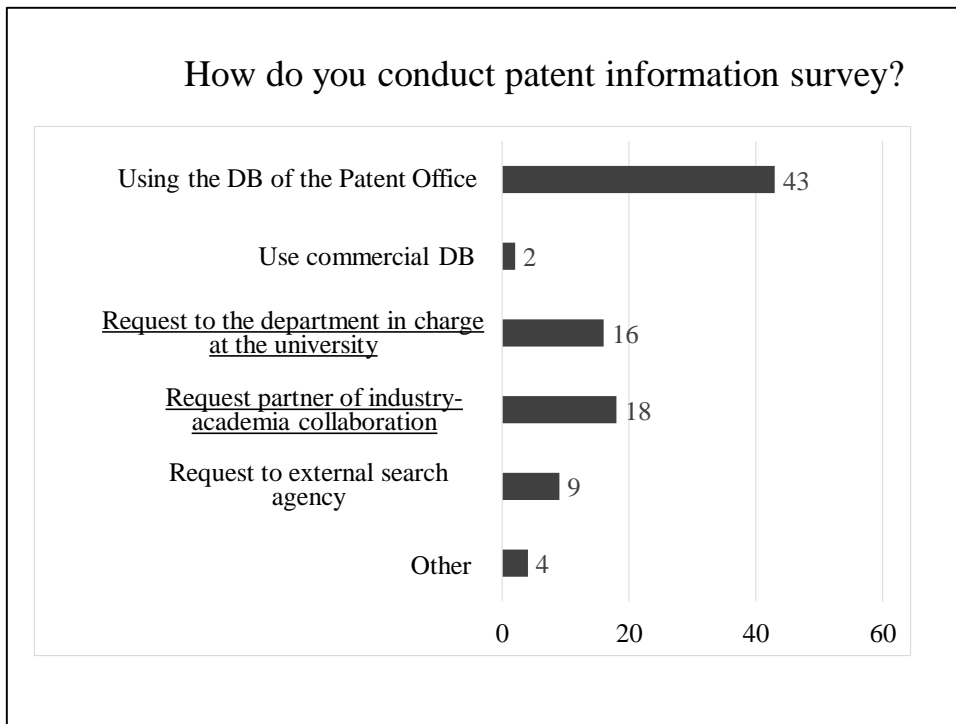


Figure 11: Resource for patent information survey

*Q9: In your research field, how do you obtain the prior art? What is its information source?*

It seems the university researchers are positive to use patent information from the previous questions and answers. However, from this question directly asking the information source of prior art for research, most of researchers answered academic paper, academic meeting, and academic journal paper. Not so many responses putting on the importance on patent information. Academic information is must for academic research, that is everybody agreed, but in addition to academic information, if we expand our sight involving patent information we can understand the market and industry needs, which can be useful for applied and commercialized research. If university research is an applied or commercialized, we can say that patent information is getting important together with academic information.

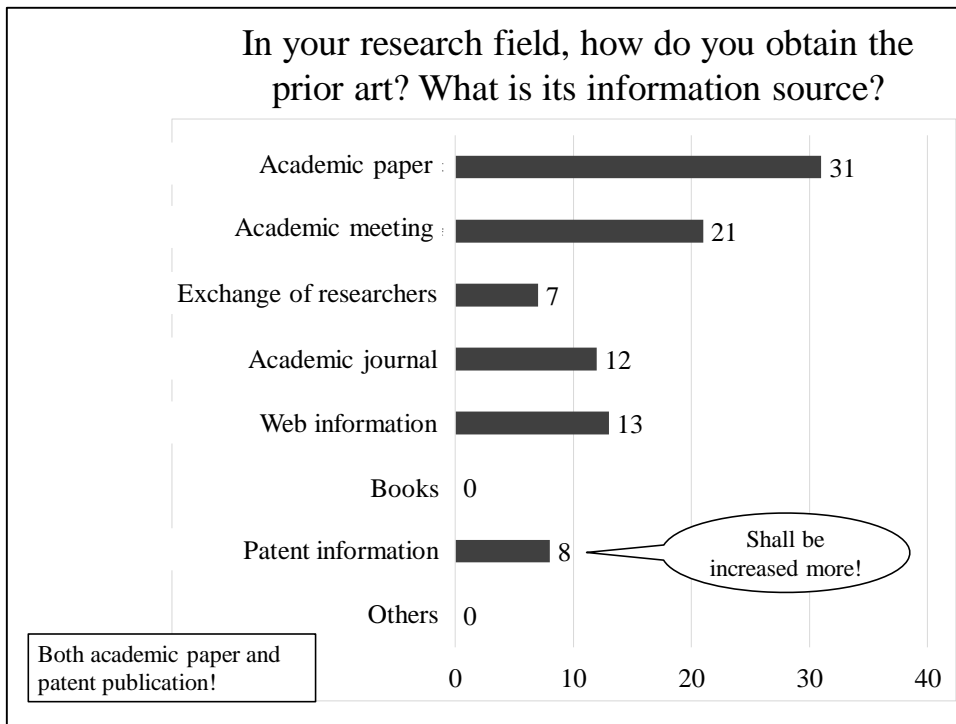


Figure 12: Resource for prior arts for your research

*Q10: If students were to receive education on patent system and patent information search, when would be appropriate?*

In the other question which is not described in this paper, we found that most of current university researchers did not have training and education of patent system and patent searching. And, most of researchers suggest the importance of such training and education in the future. Especially, they suggest the necessity of education at undergraduate or master course at university before joining individual laboratory. Then, the students can utilize patent searching and patent information for their own research activities, also involving the patent searching results into their thesis or academic paper submissions.

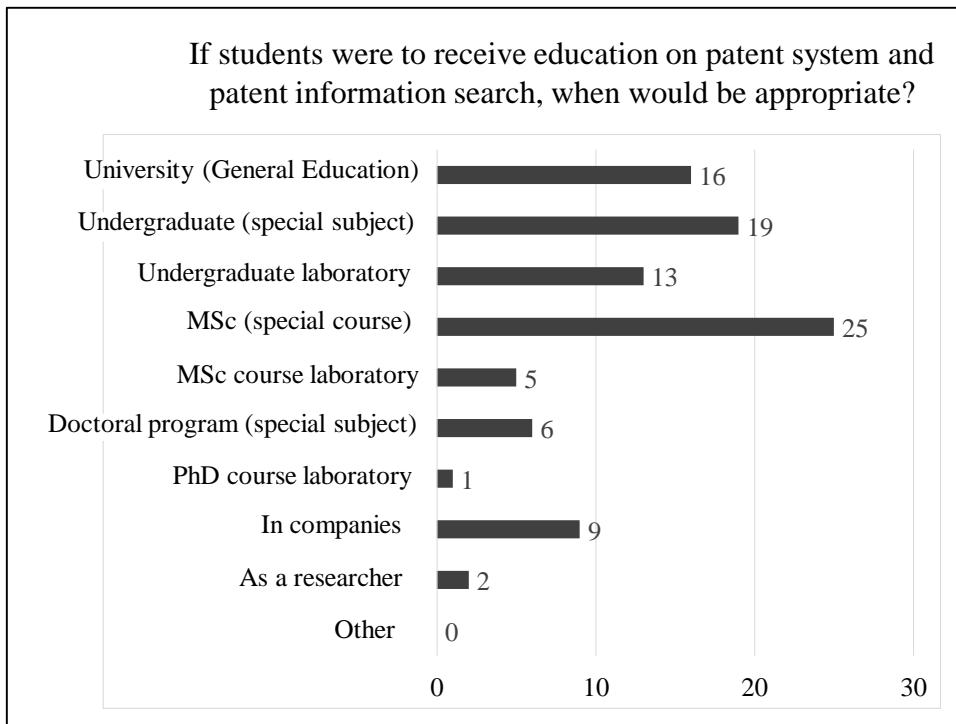


Figure 13: Education for patent system and patent search

**Q11: At your university, is the patent application be evaluated as your achievement?**

As achievements of researchers at university, patent applications shall be more evaluated and appreciated as long as the university's third mission which is the contribution to the society by utilizing research results. According to the answers, a little appreciated; 72.9%, appropriately evaluated; 12.7%. When the research results are properly protected by patents, technology transfer from university to industry will be more smooth and efficient because the research results are protected and could not copied by the others. As

Also, when the licensed technologies are commercialized and generate much profits, the royalty based on the licensing will be returned back to university as research fund from industry. It is strongly expected to appreciate patent activities by university researchers.

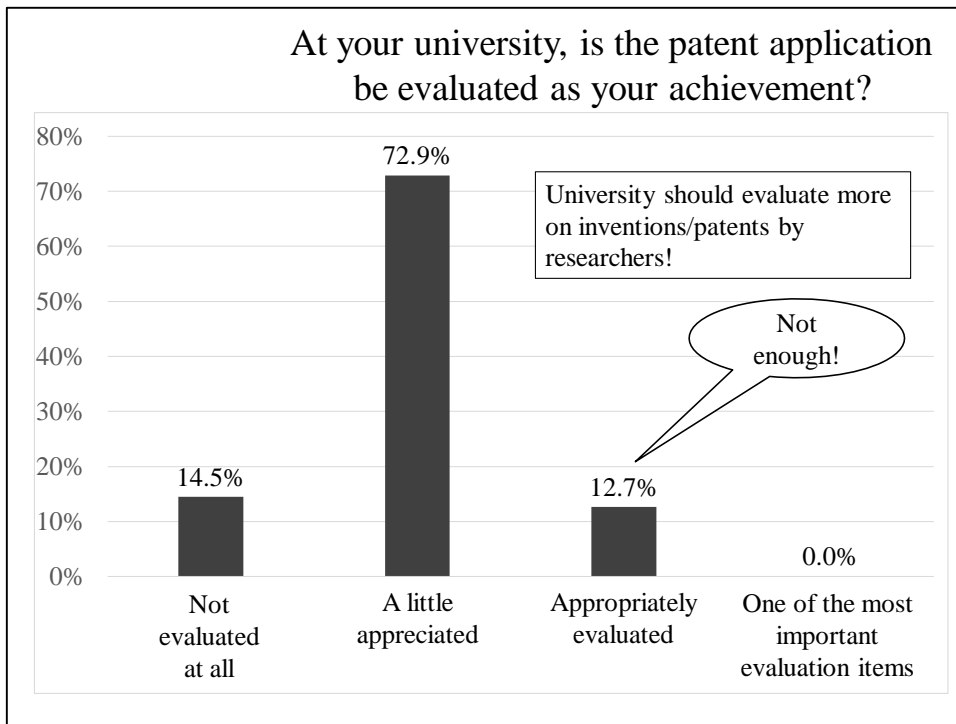


Figure 14: Evaluation on patent applications

*Q12: At your university, is industry-academia collaboration considered as your achievement?*

When it comes to the university-industry collaboration, it seems universities put the importance on such activities more with appreciations for researchers. Over 90 % researchers feel such collaborations are well appreciated and evaluated by university. In this case, we have to understand that the university-industry collaboration is strictly connected with patent activities. Industry requests patent protection and licensed when university-industry collaboration, giving proper licensing protected by patents to the industry is critically important.

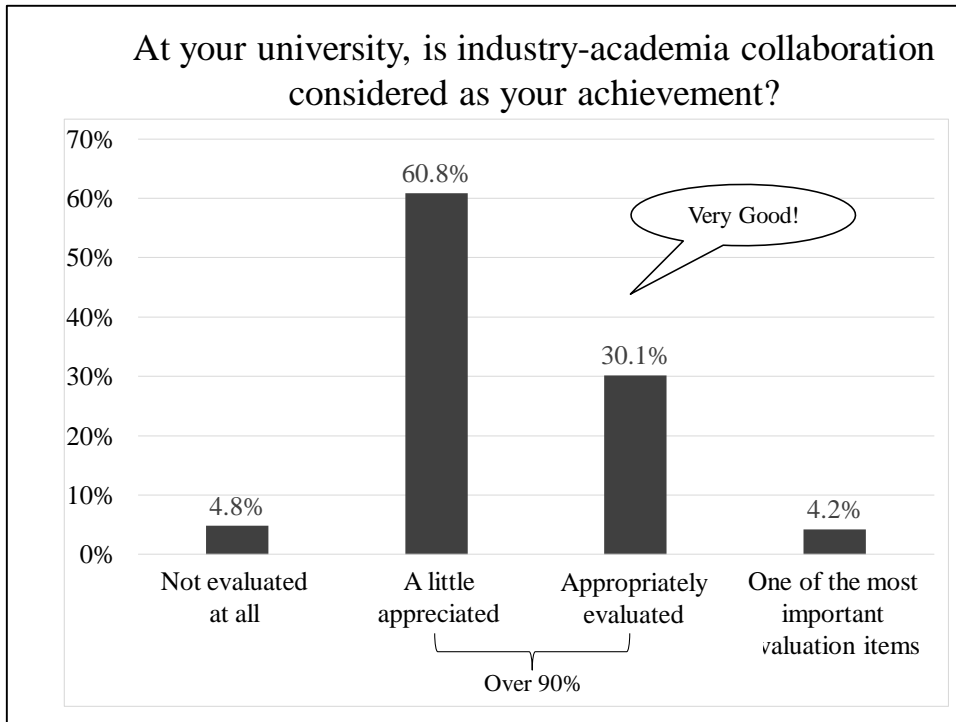


Figure 15: Evaluation on university-industry collaboration

**Q13: Recognition of their standing position - Academic side or Commercial side?**

Finally, we asked to the researchers about their positioning whether in basic research side or commercial research side? It seems they like to be more academic side, and university researchers should stand on more academic side. However, in the real situation, they stand on commercial side. We have to reconsider where we should be, based on the social needs together with 3 important roles of university, education, research and social contributions.

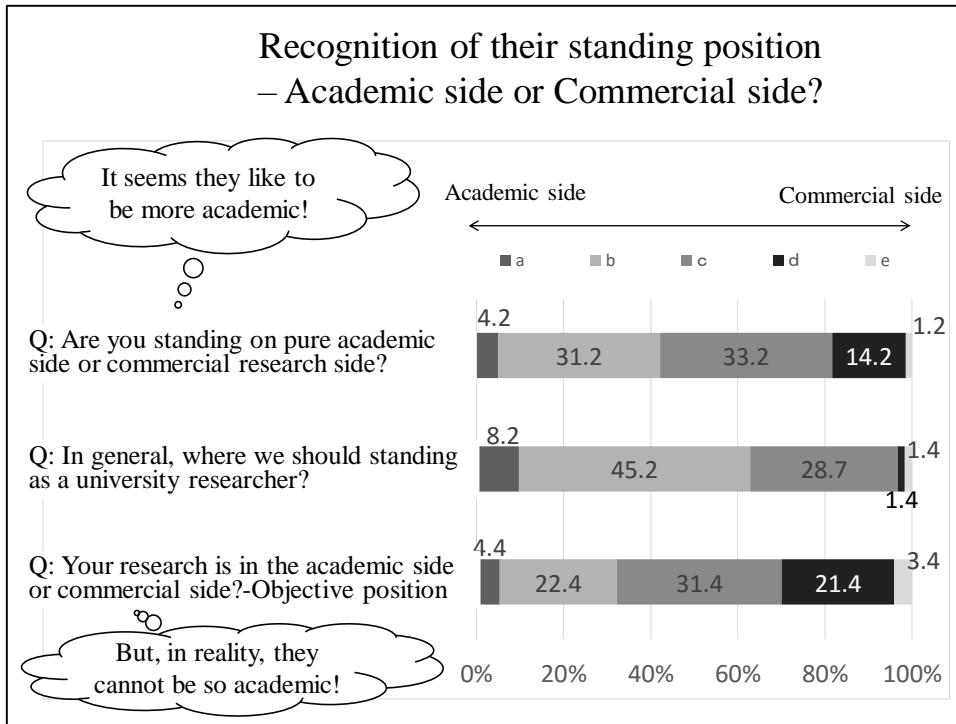


Figure 16: Positioning of researcher on basic research or applied research

#### V. OBSERVATIONS ON QUESTIONNAIRES - Deductive approaches to define hypothesis from the results of questionnaire surveys:

Based on the results of the questionnaires, we tried to make observations and reached and defined some hypothesis, by making the deductive approaches. This has not been done with inductive approaches because of the design and characteristics of our questionnaires. They have not yet verified still shall be considered as hypothesis. Therefore, the structure of this research can be said as “Hypothesis Extraction Type Research”. We extracted hypothesis in this chapter, and the conclusions as “Extracted suggestions and Expected merits when we use patent information for academic research at universities” in the next chapter. Needless to say, as our next step, we have to introduce our suggestions into our real academic research activities, and verify whether we can get the expected merits by using patent information for academic research at university.

##### A. What kind of merits we can expect when we use patent information?

We drafted a model to extract market needs from patent information in the figure 16. In the document of patent application, it is requested to described “technical subjects

which shall be solved” in the patent specification. Based on this request, all patent publications include this description. Therefore, the people understand the technical subjects which shall be solved by invention, when they read patent publication. What does it mean by “technical subjects which shall be solved”? We can understand the subject to be solved is the reflection of market needs. Since market request to solve it, the research and development have been done by companies, institutes, universities, etc. Therefore, if we make detailed analysis on the patent information, we can extract market needs, which cannot be easily extracted from academic information. From patent information, we can confirm the historical trend of concerned technology, and make estimate the future road mapping on the future market.

Based on introducing such process, university research theme can be defined along with market needs, making a bridge between university and industry, university researchers’ and students’ sights will be broadened and linked with industry and market. And, as a results, it will promote commercialization of university research results, receiving royalty income in the future.

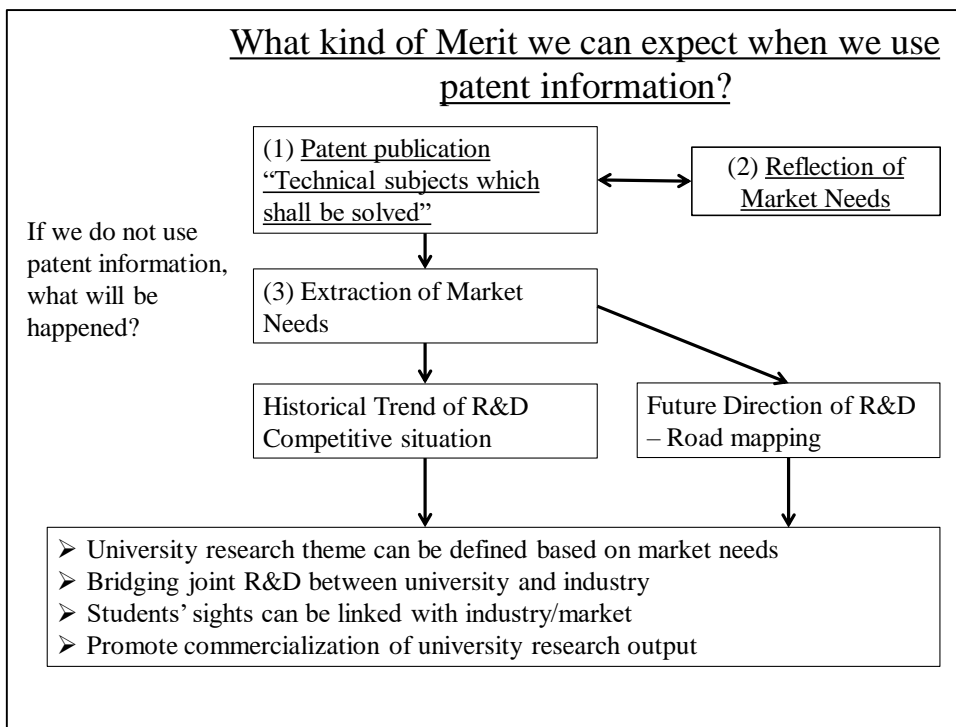


Figure 17: Merits of patent search

*B. When patent information can be used as valuable information?*

When the university research is really positioned in the basic side, we can say it is not invention, rather than that, we can say it a finding or discovery. In this case, there

are no patent information corresponding to such basic research. Because, the subject for patent applications are the inventions, not findings or discoveries. Therefore, university researchers working in such basic research field do not necessary to make patent searching.

On the other hand, even if we say basic research, but still it is a new combinations of the existing technical elements, in that case, it is not findings or discoveries, we call it technological creation, which can be the subject for patent application; called “invention”. Most of researchers are working on this technological creation fields. In these fields, there have been many patent applications filed and exist as prior technologies. We definitely need to check patent information by making detailed patent searching. Otherwise, our research results go into lack of originality. And, a basic research generates applied area after making more concrete technological improvement. We can say finally goes into applied research or commercial research. Therefore, even if we carry out a basic research, we have to shift into commercial side in the future. As a result, we should understand that patent information is valuable and necessary for most of all university researches except new findings or discoveries.

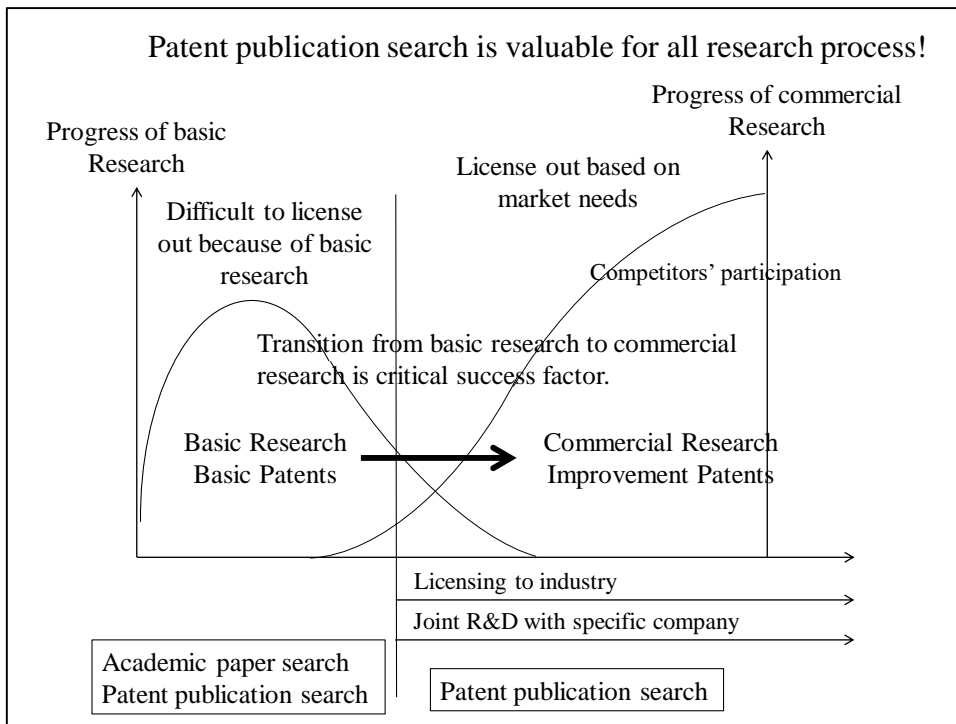


Figure 18: Positioning of patent search on research progress

*C. University tries to get basic patent or also improvement patents?*

Now, we understand most of university researches need patent information search

and the subject for patent applications. However, the university is not the stakeholders to make business operation, more focusing on basic side of research, not pure basic researches. In the initial stage of new research and development, we come across the basic inventions, and along with further progress of research and development we create many improvement technologies which shall be considered as improvement patents. Since the improvement technologies are positioned close to the final commercial products, its main players shall be the business enterprises producing such final products. Therefore, university should start joint R&D at a certain timing after going into commercial side researches, applying joint patent applications with shared ownership, depending on the joint research contract. [6]

As a results, the university should try to focus on getting basic patents, and let the business partners to get improvement patents, this direction shall be planned. [7]

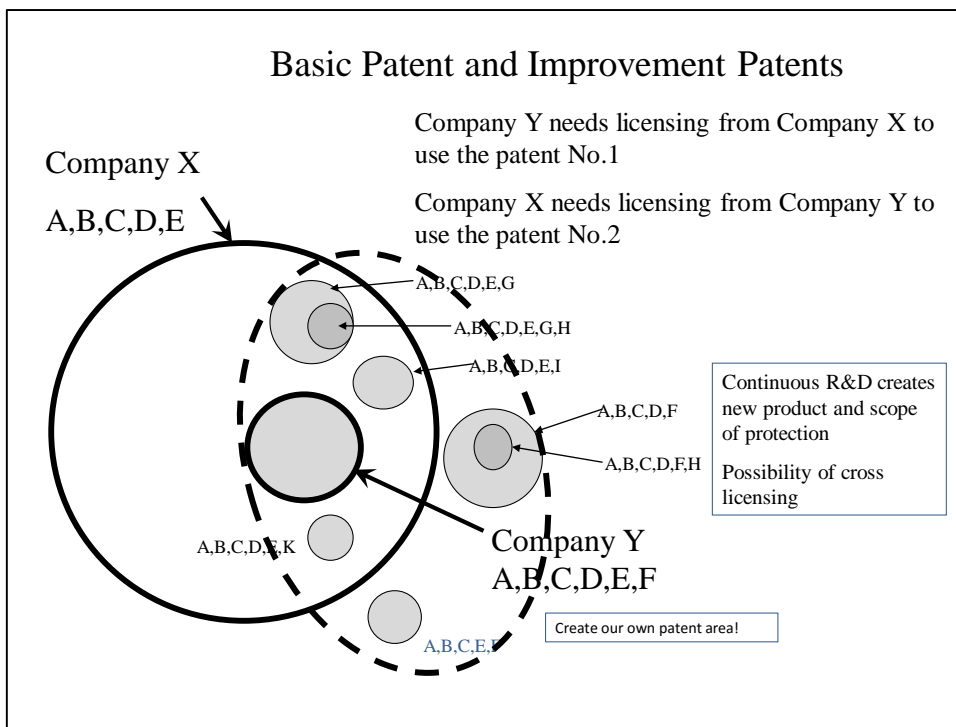


Figure 19: Basic patent or Improvement patent?

#### D. Dominant market share is realized by patent protection?

Needless to say, patent is an exclusive right, and when the technology is protected by patent, no other people cannot copy it and cannot enter into this market. If we can obtain patent protection at the area of high market needs, customer and consumer's needs, the legal power of patent makes strong effect.

In the enterprises, they are focusing on the high market are for research and development, university also should more strongly pay attention to the market needs. [8] In general, university does not see the market and do not aware on the market needs. However, in the future, since the university is expected to make more contributions on society, we have to broaden our sights to see the market needs. If not easy by ourselves, we can work together with industry and utilize industry's resources, generating university-industry collaboration more in the future. [9]

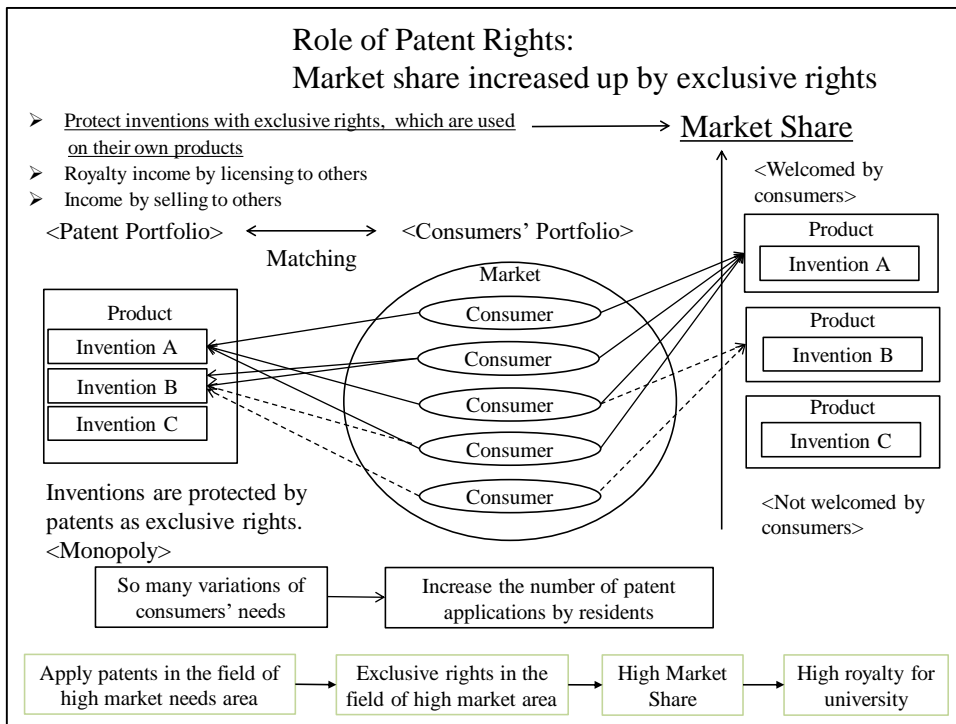


Figure 20: Patent protection and market needs

## VI. CONCLUSION - Extracted suggestions and Expected merits when we use patent information for academic research at universities

Let me summarize the merits of patent information for academic researches, as follows. We hope these ideas will be well understood and shared by all concerned not only at universities but also at industry side to create our future efficient collaborations.

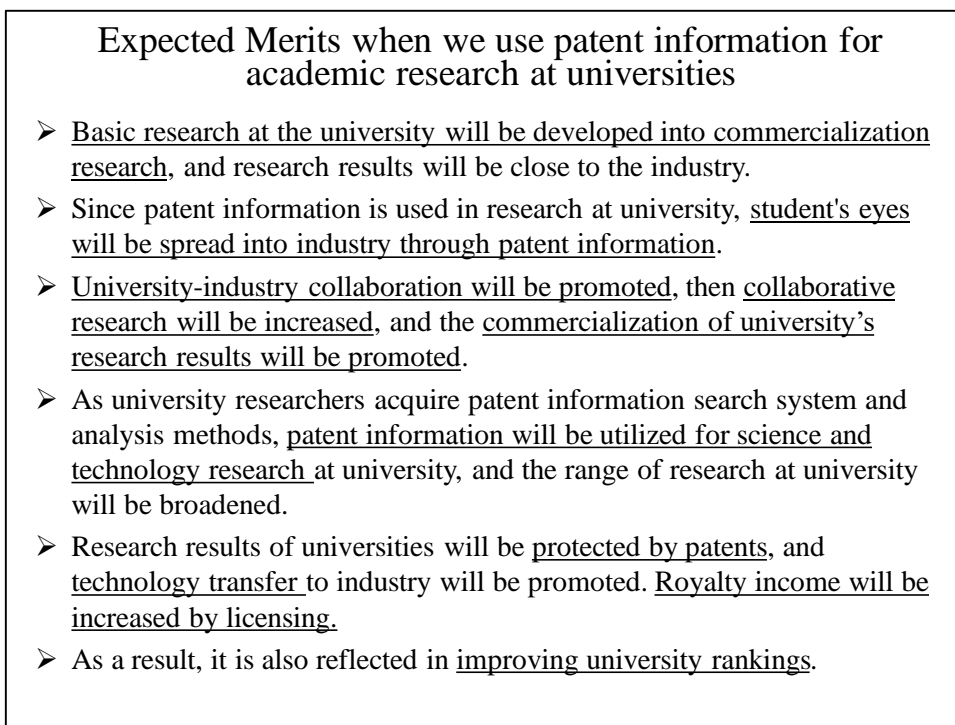


Figure 21: Expectation for future role of patent information

## VII. FUTURE RESEARCH - Implementation of our suggestions

As a future research, we are planning to involve all research laboratory of our university on the education of patent system, patent searching, and patent mapping. And, introduce patent searching activities in the laboratories, involving master and PhD students, as the patent information can be integrated with lab research activities. We can make monitoring of the progress of introduction of patent search, also evaluate the research activities getting more concrete positioning of basic research or commercial research, checking the collaboration level with industry, watching the outcome of research results patented. We hope these future researches promote university-industry collaboration together with realizing the merits summarized in the conclusions of this paper.

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