

## University-industry collaboration

Effect of patenting and licensing by university on collaboration research

Toshiya Watanabe

**This article contains an overview of collaboration or joint research between the university and the industry in Japan, with a focus on the patenting and licensing management by university technology managers. An analytical study based on statistics indicates that collaboration research is greatly affected by the university technology manager's patent management. Patenting and licensing have a favourable effect when the joint research involves SMEs, but it has little effect when it involves large firms. Two case studies of the University of Tokyo indicate that collaboration involving venture start-ups or joint marketing with the industry partner is effective in fostering commercialization.**



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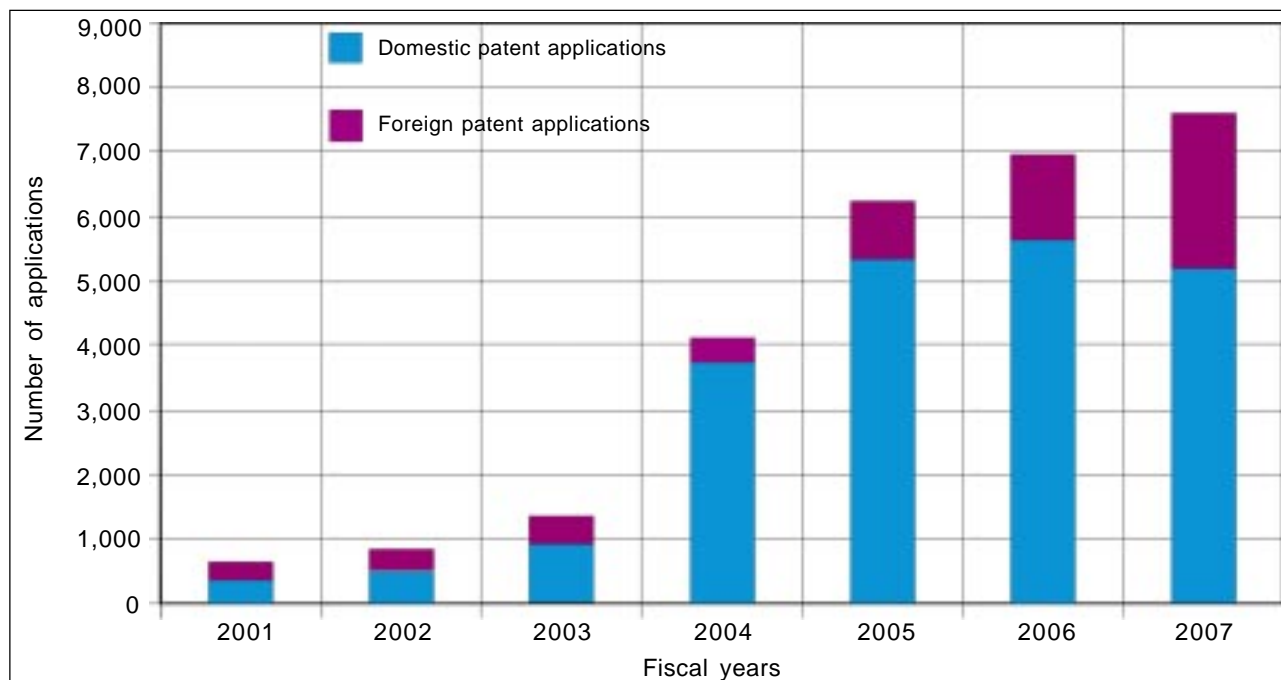
### Introduction

**T**he collaboration between university and industry employs a variety of channels, such as publications, workshops or conferences, hiring of people and personal exchange of information. Most of these routes are through public domain. However, more recently, university-industry collaboration has started utilizing more private routes. Although these are private transactions meant to incentivize the industry, they need to be transparent because university research mostly consumes public funds. Universities can transfer knowl-

edge to private parties under the intellectual property (IP) regime, utilizing patent system, design law, copy right law, etc. Licensing, venture start-ups, joint ventures and contract research are typical schemes that use IP systems. Universities should undertake such transactions to foster commercialization of technologies from universities through a fair and transparent process that is accountable to the tax payer (Watanabe, 2003).

In Japan, industry-university collaboration can be traced to pre-World War II. Although it has continued over the years, a recent change has come

Figure 1: Patent applications from Japanese universities



about by the introduction of the patenting and licensing system. Prior to the 1990s, the collaborative research agreements did not incorporate any rules related to inventions. The results of research were disseminated in the public domain through publications or presentations in academic conferences. In the process, sometimes, university inventors transferred their inventions to industrial firms which funded their research. In return, the inventors received more funding or donation as compensation for the knowledge transfer. They might have also received cash payments in some cases. Despite the lack of transparency, this kind of collaboration worked well for many years.

Since 1998, when the Technology Transfer Law came into effect, industry-university collaboration has developed through patenting and licensing. The number of patent applications has increased dramatically in the last ten years. In the fiscal year (FY) 2005, the total number of patent applications from Japanese university had reached 8,527, as shown in the Figure 1.

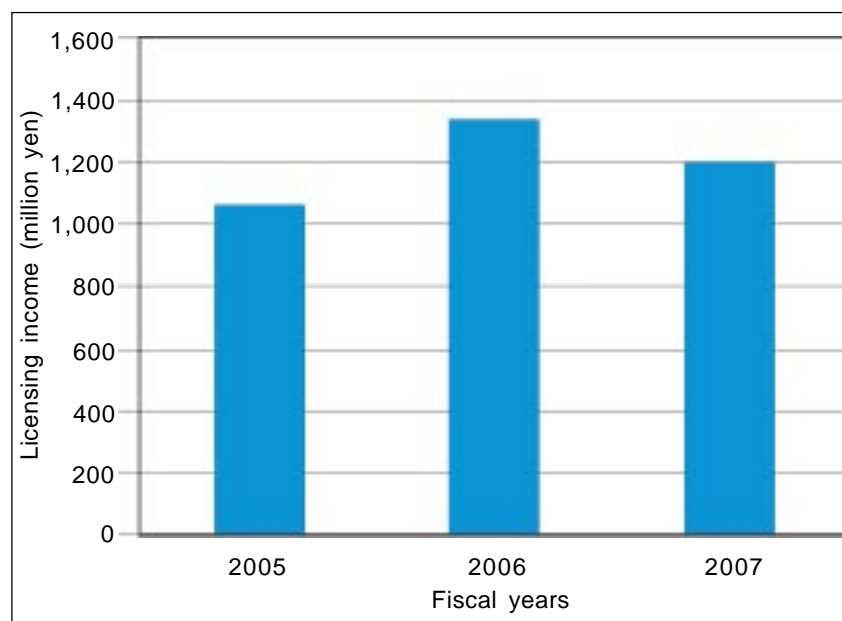
Despite the increasing presence of patenting in the industry-university collaboration, income from licensing has remained relatively low in Japan

as compared with that in the United States (Figure 2). Patents may not be just a tool for income but also an opportunity to attract industrial firms and new collaborations. Indeed, it is well known that patents are utilized strategically for trading technologies and for facilitating research and development (R&D) between firms (Penin,

2005). Similarly, a university can use patents strategically for collaborating with firms rather than obtaining just the licensing income.

The patent policies of universities have affected contract research significantly. Some examples of this from among the recent collaboration research schemes are provided in this

Figure 2: Licensing income of national universities: FY 2005-2007



article. Based on statistical data and several case studies relating technology transfer from the University of Tokyo, the article evaluates the pros and cons of these schemes.

## Current system of collaboration between university and industry in Japan<sup>1</sup>

### Overview

As mentioned earlier, collaboration between university and industry takes many paths. Some of these are official ones under the administration of universities, while others are informal, conducted between researchers or laboratories and industrial firms. The IP rights in the latter case are unclear. Sometimes, instead of paying for IP rights, a donation is made to the laboratory or the faculty member (usually a professor) is provided remuneration. Usually there would be no formal contract regarding the IP rights of the research result, and the professor decides which firm would procure the technology without any involvement of the university administration.

Theoretically, as taxpayer's money is invested in technology development, the licensee should be the firm that is most suited for commercializing the technology. Furthermore, it is unfair to remunerate a private party for a research result that has utilized university resources. In order to rectify these issues, the Japanese government has changed the system by introducing an IP system. University administration can employ the system to deal with transfer of IP of a faculty member.

The following section describes the key aspects of university-industry collaboration activities under the administration of universities.

<sup>1</sup> Statistical analysis in this article is based on the master's thesis entitled "The Influence of University's IP Management on Industry-funded Collaborative Research after Privatization of Japanese National University: FY2005-2007" by Peng Jiao of Department of Technology Management for Innovation, the University of Tokyo, under the supervision of Prof. Toshiya Watanabe (2009).

### Licensing

University can transfer its IP right on a patent to an industrial firm by way of an exclusive or a non-exclusive licence in exchange of a licence fee. An exclusive licence means no one except one licensee can utilize the licensed patent, while a non-exclusive licence allows more than one party to benefit from the licensed patent. The licensing business of universities is usually handled by Technology Licensing Offices (TLOs).

The licensing income has been stagnant as shown in Figure 2, when compared with the increasing number of patent applications (Figure 1). In FY 2007, the licensing income of national universities was approximately 1 billion yen (US\$11.3 million<sup>2</sup>) – around 100 times smaller than the licensing income of universities in the United States.

### Joint research

National universities' joint research system started in 1983, with the aim of setting up Joint Research Centres in national universities by 1987. These Centres work as a bridge between universities and enterprises, and contribute to promote joint research and other university-industry collaboration by providing technology consulting, information, etc.

In a joint research project, industrial firms finance the research, as well as send co-researchers to work with the university researchers. Depending on the contract, joint research can be conducted at universities, or at industrial firms that have the facilities. When the research is conducted at the university, the university supplies and maintains the necessary facilities and equipment. Therefore, besides the direct research expenses, enterprises also have to pay the university for indirect research expenses such as for daily management and support systems. Enterprises enjoy a certain degree of tax deduction for such joint research expenditure.

For initiating a joint research, an application needs to be first sub-

<sup>2</sup> All currency conversions are at current rate US\$1 = 88.50 yen

mitted by the industrial firm to the university. Then both parties begin to negotiate details of the contract such as expense, period and researchers. This usually takes a few months. After the negotiations that finally lead to an agreement, the joint research project begins. At the end of the project, both parties confirm the research results. The ownership of research results is specified in the contract. In most occasions, a joint patent application will be filed by both parties, though often co-researchers from enterprises do not actually join or contribute little to the research project. Consequently, and because of the wide prevalence of collaborative research between university and industry, the number of jointly owned patents is significantly higher than that in the United States. This is considered a unique feature of industry-university collaboration in Japan.

In FY 2007, the total amount of joint research for national universities was 28.8 billion yen (US\$325.42 million). In this, industry-funded joint research totalled 22.2 billion yen (US\$250.85 million) – 77.2 per cent of the total. Figure 3 shows that joint research experienced a rapid growth after the Technology Transfer Law took effect in 1998. Figure 4, which depicts the research fields of patent applications from joint research work, shows that nano and material technology and life sciences are major fields of joint research between university and industry.

Figure 5, on the number of single and joint patent applications from the national universities in Japan, clearly indicates that the ratio of joint patent applications is increasing and more than 60 per cent of patent applications are joint applications with the industry. In contrast, only about 5 per cent of total applications from United States universities are joint patent applications. In other words, management of joint patents is very important for the commercialization of technologies from Japanese universities.

Japan's patent law regime is considered the cause for the higher ratio of joint patent filings. In university-industry collaborations, large firms

Figure 3: Joint research at Japan's national universities: FY 1992-2007

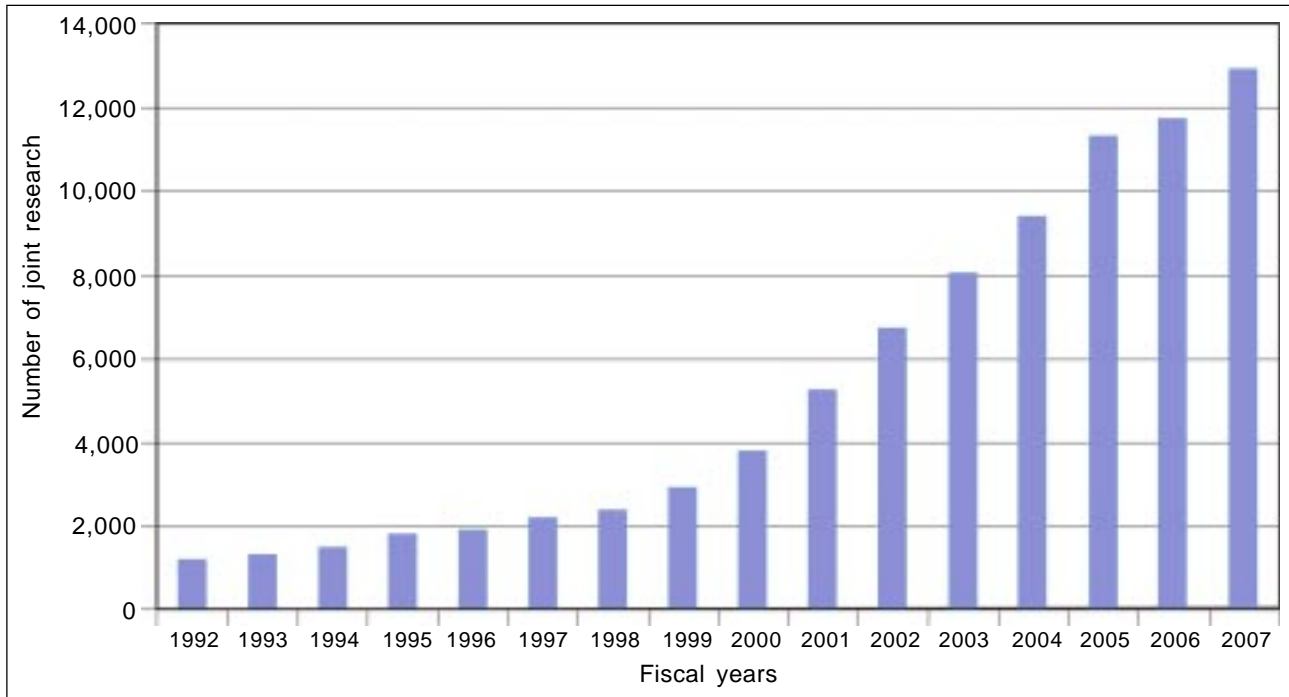
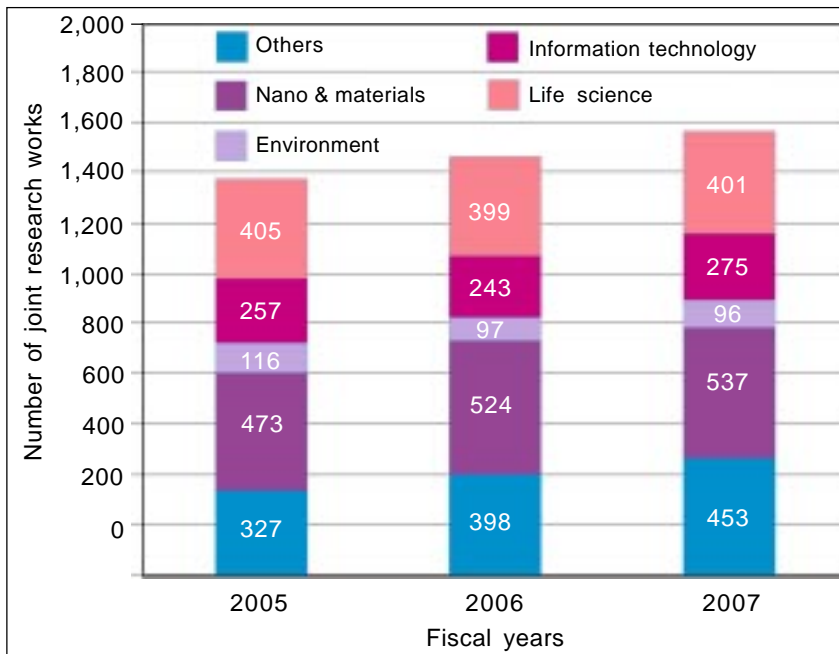


Figure 4: Patent applications from joint research in different research fields: FY2005-FY2007



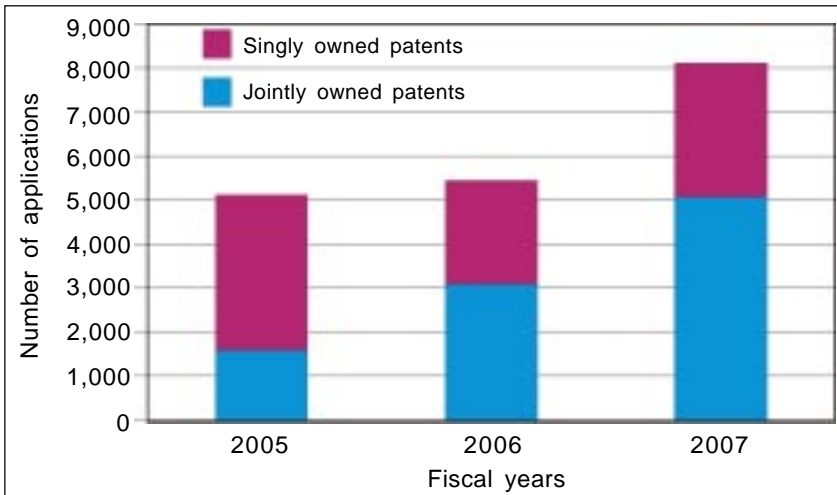
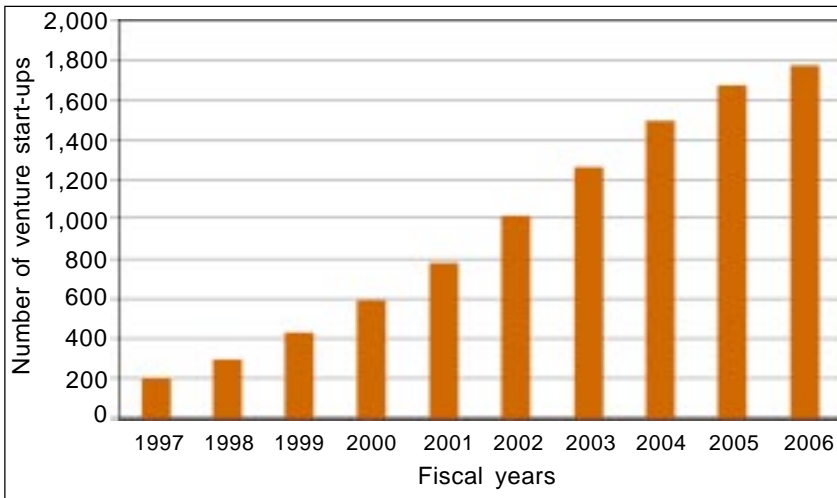
can have pre-emption on university's patent resources and researchers' time and energy (Kneller and others, 2009). Under Article 73 of Japan's Patent Law, each co-owner has a *de facto* perpetual, royalty-free, exclusive licence that cannot be transferred

unless all other co-owners agree. It is an advantage for large firms to co-own joint research inventions, but a disadvantage to universities because they cannot exploit the invention by themselves. Therefore, an additional clause is usually incorporated in joint

research contract to ensure that the universities will receive monetary compensation from the patented invention. Such compensation usually consists of an initial payment and a running royalty. However, as most large firms are royalty-averse, this clause often becomes a barrier for joint research.

### Contract research

Contract research, also named commission research, means research projects that universities conduct on contract with industrial enterprises. A regular service of university, contract research is simpler than joint research. When the project finishes, the result of the research belongs to the university, but should be reported to the contractor. In some cases, the contractor is given priority in licence. Like in many countries, most such research projects in Japan too are contracted by government and public sector organizations. In FY 2007, the total contract amount of commission research for national universities was worth 104 billion yen (US\$1.17 billion). In this, commission research financed by the industry was about 3.4 billion yen (US\$38.42 million), or only 3.3 per cent of the total contract research funds received.

**Figure 5: Comparison between single and joint patent applications from Japanese national universities****Figure 6: Annual total number of university start-ups: FY1997-2006**

### Venture start-ups

After the deregulation of faculty's part-time jobs in industrial firms, university researchers and some students are enthusiastic about commercializing university technologies through venture businesses. In Japan, some universities provide incubation facilities to support such venture start-ups. The University of Tokyo has a fund named UTEC to provide financial support for start-ups aiming at commercializing the university's research results. The 1,000 Start-ups Plan during FY 2002-2004 achieved its goal by creating 1,000 university start-ups in three years.

While the number of start-ups is impressive (Figure 6), according to

a survey conducted by the Ministry of Economy, Trade and Industry (METI), start-ups in Japan face many difficulties. The top three difficulties are lack of skilled personnel, inadequate funds and poor marketing.

### Effect of patent management on joint research between university and industry

The author has studied the effect of patent management (such as patenting and licensing) on joint research with large firms as well as small and medium enterprises (SMEs), using statistical multiple regression for analysis (Watanabe and others, 2009).

The results of three year's multiple regression analysis, summarized

in Figure 7, shows that the effect of patent management on joint research differs with the size of the counterpart firm. In the figure, value of correlation coefficient represents the degree of positive effect of patent management on joint research activity. For joint research with large firms, the effect of patent management turns out to be negative in all three years, while for joint research with SMEs, the effect of patent management is significantly positive.

Some earlier studies (for instance, Acs and others, 1994) have suggested the possibility of a collaborating firm's size having an effect on the collaboration. The conflict in IP policies between universities and industrial firms lies in two aspects. The first one is that large firms and SMEs have different policies on the payment related to joint research and usually, large firms' policy in this respect conflicts with that of universities. Our previous study suggests that the acceptance of patent management by university is higher with SMEs than with large firms. A previous interview with Hiroshima University officials indicated that the University's patent manager tries to initiate contracts with industry on the basis of university-owned patents (Watanabe and others, 2008). It is not easy for a university patent manager to exploit jointly owned patents because those can't be licensed without the counterparts' permission. The situation of having a lot of jointly owned patents is like having many off-limit areas. Large firms can retain the right to access patent resources of universities to strategically use the jointly owned patents. Because SMEs usually do not conduct such strategic management to produce jointly owned patents, they have less opportunity to access the patent resource of universities. The number of singly owned patents is also not significant in joint research with SMEs.

At the same time, because large firms have relatively clear IP policies related to such strategic alliances, they try to apply them not only in industry-industry collaborations but also in industry-university collaborations. Even though large firms have to spend more money for joint research

Figure 7: Correlation coefficients between IP policies and joint research with large firms and SMEs: FY 2005-2007

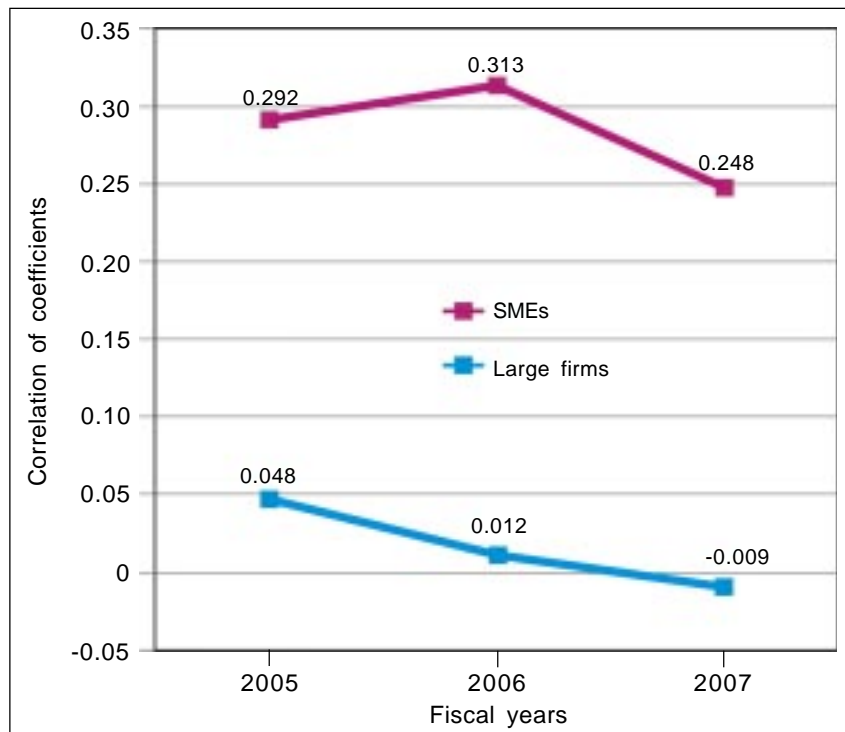
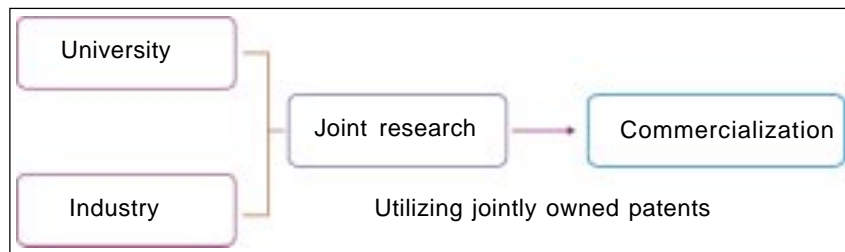


Figure 8: Typical scheme of commercialization of joint research results



contract, they stick to their policy because they place greater emphasis on avoiding future risk and associated costs. For instance, large firms prefer advance cash payment to avoid having to pay a running royalty in the future. However, a patent manager of a university tries to preserve the right to obtain licensing fee in the future. These conflicting interests usually have a negative effect on joint research contracts with large firms.

On the other hand, as SMEs usually do not have a healthy cash flow, universities are reluctant to collaborate with them. However, future royalty payments could be expected if SMEs agree to pay such royalties on successful commercialization of the result from joint research work. SMEs gen-

erally prefer taking the risk of paying running royalties instead of investing large amounts of cash for a joint research. Thus, for universities, it is a trade-off between getting large lump sum payments and retaining a hold on patents in the future.

### Case studies

#### Commercialization of contract research results

As shown previously, collaboration research between university and industry is closely associated to patent licensing by university, and contract research often generates jointly owned patents. Such joint patents should result in commercialization, as shown in Figure 8. However, it is not clear

whether they really lead to commercialization or not, mainly because the firms have no obligation to report on such commercialization, even when utilizing jointly owned patents under Article 73 of Japan's Patent Law.

While there are many cases that demonstrate the success of cooperation between university and industry, the mode of cooperation employed in such cases is usually more complicated than a simple contract research. Venture start-up by universities often plays a prominent role. Although, the exact nature of their relations varies widely, start-ups can be categorized broadly into two groups: one group involves licensing of a joint patent by the start-up, while the other also involves contract research by the venture start-up that licenses the patent from university/industry. Contract research is required because the technology developed by the university is often not complete or mature and further development is necessary before it can be commercialized. This often requires the close involvement of the university/industry with the application industry/start-up.

#### Development of antivirus mask<sup>3</sup>

Calcium hydroxyapatite –  $\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$  or CaHAP – is a naturally occurring mineral form of calcium apatite. As CaHAP is a component of teeth and bones, it finds application in medical treatment materials such as artificial bones and dental implants. It is also used in a wide variety of adsorbents, chemical sensors as well as catalyst materials.

A group of researchers from Fujitsu Laboratory and the University of Tokyo (including this author) studied the addition of titanium (Ti) ion to CaHAP and accidentally found that the combination has photo-induced oxidation capability. On exposure to ultraviolet rays, the combination generates hydroxyl radical with a strong oxidation capacity. The hydroxyl radical facilitates complete oxidation and decomposi-

<sup>3</sup> Information of the products is available in the following web site (Japanese) <http://www.tamagawa-eizai.co.jp/product/fitty/kyuuchaku/index.html>

tion of organic substances into water and carbon dioxide. It was also found that TiHAP, the newly developed photocatalyst, has stronger adsorptive power than conventional titanium dioxide (TiO<sub>2</sub>) photocatalyst. TiHAP was expected to have application in air cleaner filters and antimicrobial textile.

The Technology Licensing Organization (TLO) of Tokyo University and Fujitsu Laboratory have applied for several patents jointly on the basis of results from this research. As at present, seven technology licensing contracts have been issued in various application fields.

One of the most successful projects is the development of an antiviral mask. An intensive study had shown that a mask made of non-woven fabric with TiHAP has an antiviral effect on influenza A (H1N1) virus. Kurashiki Textiles Company started to develop non-woven textiles added with TiHAP. Manufacture of sanitary masks also started, utilizing TiHAP non-woven textiles. The conceptual scheme is shown in Figure 9 and the detailed scheme in Figure 10.

This year (2009), H1N1 virus has become also known as "swine flu" and "swine influenza A". As the germs broadcast through the air, wearing a mask is recommended as protective measure, especially for those who have health problems that compromise immune systems. Such people would be greatly helped by the commercialization of the TiHAP mask.

In this case, the licensee of the patent continues collaborating with Fujitsu Laboratory and the University of Tokyo to improve the performance of the anti-virus effect. In the initial stage of joint research between the University of Tokyo and Fujitsu, even though TiHAP has been proved to have photocatalytic activity, there was no evidence to support its use for a specific purpose. It was not clear whether the application of the new material is competitive in relation to other technologies. To address this issue and improve the performance of the material, the collaboration has continued between the University researchers and their counterparts in several industries even after the licen-

Figure 9: Joint licensing of joint research results

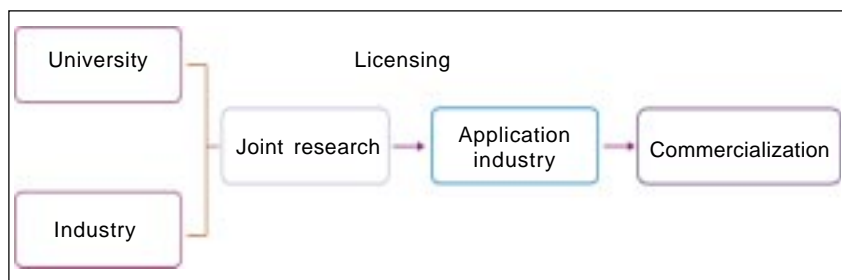
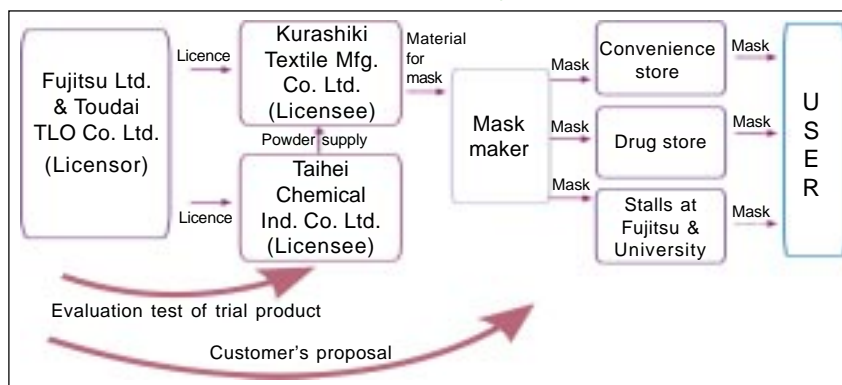


Figure 10: Technology transfer of TiHAP technology to commercialize non-woven sanitary mask



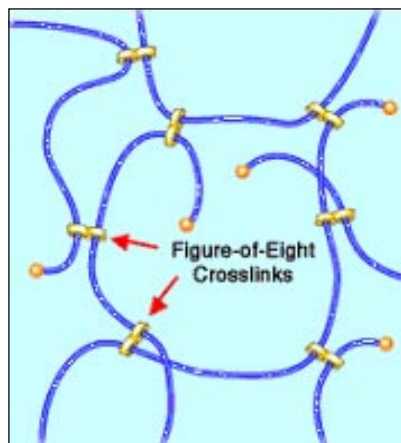
sing contract. Patenting and licensing out the technology have thus played an important role to attract the attention of the industry, and resulted in the building up of a team for further technology development. In this sense, it can be said that patenting and licensing were used as strategic measures to build up a desirable development team with members drawn from many industries.

Fujitsu Ltd. adopted an open innovation strategy utilizing their IP rights for innovative development. This strategy worked well in this case, and the company is encouraging licensing the technology to various industries. Thus, the case of TiHAP technology is a successful example of open innovation activities.

**Advanced Softmaterials Inc.<sup>4</sup>**

In 1999, Prof. Kohzo Ito's group at the University of Tokyo developed a novel concept in polymeric materials, sliding crosslinks along the polymer chains, with distinctive and wide-ranging pro-

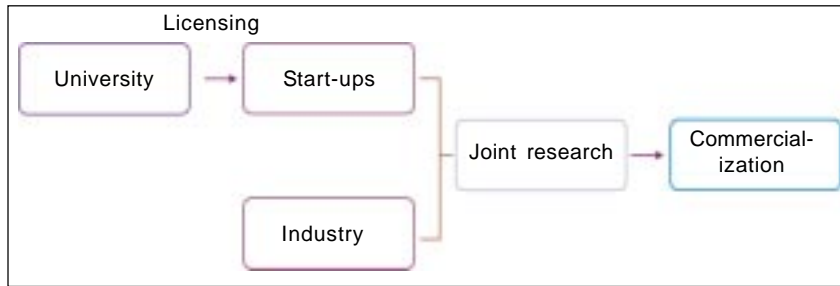
Figure 11: Structure of slide ring gels



perties (Figure 11). In March 2005, Advanced Softmaterials Inc. (ASI) was founded to commercialize this new sliding crosslink material, as it had high potential for many practical applications. The unique features of this material include mechanical properties similar to human soft tissue, large elongation under tensile stress, ability to contain different kinds of liquids including water, and biocompatibility and adaptability of design for specific applications. TLO of the University of

<sup>4</sup> Information of the venture company is available in the following web site <http://www.asmi.jp/e/index.shtml>

**Figure 12: Joint research between venture start-ups and application industries**



Tokyo patented related technologies and licensed them to ASI to incubate them for practical applications.

ASI soon began contract R&D with industries in various application fields. Many projects are presently under way. One example is a contract research work between ASI and Nakaden Keori, which manufactures woollen textiles. The research aims to utilize the new sliding crosslink material to develop woollen textile with ultra stretching property.

In this case, a start-up has initiated joint research with an industrial firm, and the university is supporting the collaboration. As the technologies that were transferred to the start-up were not complete or mature, collaboration with application manufacturers was necessary to commercialize the technologies. Start-up companies design the scheme of alliance with application industries, and the university technology managers have supported such alliances. These efforts help decrease the uncertainty associated with an immature technology and are effective in facilitating commercialization. Figure 12 illustrates the scheme.

The development of products by university-industry collaboration can be fostered by choosing the appropriate licensing terms by university technology managers. For example, licensees sometimes could be asked to pay an upfront fee or prepay royalty according to the licensing agreement. In this case, the licensee invests in the potential technology by paying for it in advance, and hence makes the maximum effort to get return on the investment as early as possible. This incentivizes early commercialization of the transferred technology. On the contrary, industries that have jointly

owned patents with university have no such incentive to commercialize the technology early. They may even preempt early commercialization of advanced technology to discourage their competitors from commercializing more advanced products.

Although management of jointly owned patent is thus difficult for technology managers, patenting and licensing management itself is effective in fostering commercialization of technology under joint research. However, university technology managers are advised to avoid joint filing for patents and try for single patents as much as possible, particularly at the first stage of research. Such singly owned patents could be utilized to attract industry partners to build an effective team for further development of the technology. Such an approach would lead to fruitful results from the collaboration.

### Conclusion

Joint research between university and industry is a powerful tool to foster commercialization of an unproved technology emanating from a university. However, such collaboration cannot be expected to yield positive results without appropriate patent management by university technology managers. Under Japan's Patent Law (Article 73), large industrial units that hold joint patents tend to pre-empt the potential technology to impede the advancement of technology by their competitors. Evidently, in terms of designing a national innovation system, a mechanism that prevents acceleration of technology development is not desirable.

Technologies emanating from universities are usually immature and incomplete, and normally the industry

would consider investment in such technologies as too risky. Moreover, a transfer of explicit knowledge from university to industry is not enough to ameliorate the uncertainties associated with that technology; transfer of tacit knowledge relating to it is inevitable. Collaboration with universities and public sector units that know the fundamentals of the technology mitigates the risk. Collaborative research and venture start-ups are schemes that efficiently bring about smooth and complete knowledge transfer and technology commercialization, as are patenting and licensing.

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