Chapter 2
Does Technology Transfer from Universities to Industry Contribute to Innovation?

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Abstract Japan's industry-academia collaborations started against the backdrop of economic stagnation. A variety of legislation was passed, leading to the birth of technology licensing offices and head offices of intellectual property. However, industry-academia collaborations really started to take off in 2004. That is why it is too soon now to determine whether technology transfer contributes to innovation in Japan. However, the prospects for the future look bright if we take into consideration the fact that the number of licenses from universities has now reached the level that the United States was at 20 years ago and is continuing to grow steadily. Furthermore, promising university-based startup companies (university spin-offs) are continuing to form, and technology transfer intermediaries are continuing to learn and grow. Thus, technology transfer from universities to industry is likely to contribute to innovation.

1 The Background of Industry-Academia Collaborations in Japan

The growth of industry-academia collaborations in Japan occurred against the backdrop of Japan's sustained economic recession. The technology licensing organization (TLO) bill was passed in 1998, approximately 5 years after the collapse of Japan's bubble economy. At around that time in the United States, Google was born in Stanford University, Netscape was born at the University of Illinois, and Sun Microsystems and Cisco Systems, companies that had been formed more than 10 years earlier, were already growing rapidly. For Japan, the success stories of

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industry-academia collaborations in the United States had a powerful impact. In every era, people look for a silver bullet when faced with sustained economic stagnation. The Japanese government was also keenly interested in finding a way to escape from the era that would later be referred to as Japan's Lost Decade. It appears they put their hope in industry-academia collaborations. The TLO bill of 1998 led to the formation of numerous technology transfer institutions known as technology licensing organizations (TLOs) around universities. At that time, inventions made in universities generally belonged to the inventor. Thus, if the university professor who made an invention had no interest in patents, no patent application would be made, and the research results would merely be presented to academic conferences and published in technical journals. The advantageous aspect of this situation was that anyone could use published research results. However, no special advantages could accrue for Japanese companies. According to an independent survey by a large European pharmaceutical company, approximately 15% of the world's medicines were first discovered in Japanese universities. Unfortunately, the majority of these medicines were not made into products and sold by Japanese companies. Foreign pharmaceutical companies further developed the research results of Japanese universities to come up with marketable therapeutic and diagnostic medications. Because neither the university nor the researchers applied for patents in the early stages of the pharmaceutical development process, neither received royalties from the medications. Some university researchers may have been aware of the possibility of applying for patents before they released their findings to the public. However, for researchers who believe that having their research results recognized is everything, applying for patents and forming licensing contracts seemed like extraneous labor. That is why the majority of research results were provided to industry free of charge.

To change this situation, it was necessary to make the technological findings of universities into intellectual property before transferring them to industry. TLOs were established as specialized organizations for carrying out this conversion and transfer of technology. Also, in 1999, the year after the TLO bill was passed, the Japanese version of the Bayh–Dole Act was passed. This law stipulated that the results (primarily patents) of research funds from the government belong not to the government but to the university to which the researchers belong. The passing of this law in 1980 in the United States had a significant impact on the state of industry-academia collaborations. However, the impact of the Japanese version of the Bayh–Dole Act was not actually felt until 2004. This is because until 2004 national universities did not have corporate status; just as the universities did not have their own land (at the time, the land of a national university belonged to the government of Japan), they also did not have their own patents. The legal framework truly came to resemble that of the United States when national universities gained corporate status in 2004. Thus, industry-academia collaboration activities in Japan became fully functional in 2004. It is thus still too early to argue about the effects of industry-academia collaborations in Japan. This is because at Stanford University, for example, licensing started to earn the university money about 15 years after the foundation of the Office of Technology Licensing (OTL). Also, after the founding of Stanford's OTL, Niels Reimers was dispatched to the Massachusetts Institute of Technology (MIT) and

used his experience to create a TLO there. It took about 10 years for licensing to start earning MIT money. Given these examples, it seem that the effects of industry-academia collaborations in Japan will start to appear sometime after 2015.

2 The Position of Industry-Academia Collaborations and Innovation in Japan

Currently, Japan needs to develop a system to take advantage of highly advanced technology. The concern is spreading that even though Japan has the necessary technology, it may become a country that loses in business. The essential question for Japan is how to develop a system within the country that takes advantage of technology. I would like to avoid imposing a strict definition of innovation here. Whether we are talking about Schumpeter's "new combinations" or the more common concept of technological innovation, there is a limit to how perfectly we can define innovation. However, as a long-time participant in industry-academia collaborations, I sense that in universities there are clearly many potential seeds of new high-level technologies that could have a tremendous impact on future generations. There is no way for Japan to commercialize highly advanced technologies without commercializing university technologies. Thus, if we examine how technology transfer from universities to industry is progressing, we will see whether industry-academia collaboration activities have the potential to trigger innovation.

2.1 Comparing the Number of Licenses in Japan and the United States

It is worth noting that according to the 2011 University Technology Transfer Survey (Daigaku Gijutsu Iten Survey)—the most recent survey of the University Network for Innovation & Technology Transfer (UNITT) [1], which could be considered to be the Japanese version of the Association of University Technology Managers (AUTM)—the total number of new licensing contracts made by Japanese universities, TLOs, and research corporations in 2010 was 1,673. According to a survey by the AUTM of the United States, the number of licenses in 1991, when the AUTM started taking surveys, was 1,229. Thus, Japan is at the same level the United States was at 19 years ago (Fig. 2.1). In the United States, the number of licenses in 2009 increased fourfold compared with 1991, to 5,328. Thus, the question of whether Japan can catch up to the United States is important. The number of active licenses (contracts whose licenses are continuing) in Japan in 2010 was 5,770. This is the same level that the United States was at 19 years ago (Fig. 2.2). In the United States, 33,523 active licenses existed in 2009. Looking at these figures we can thus see that the state of industry-academia collaborations in Japan is the same as it was in the

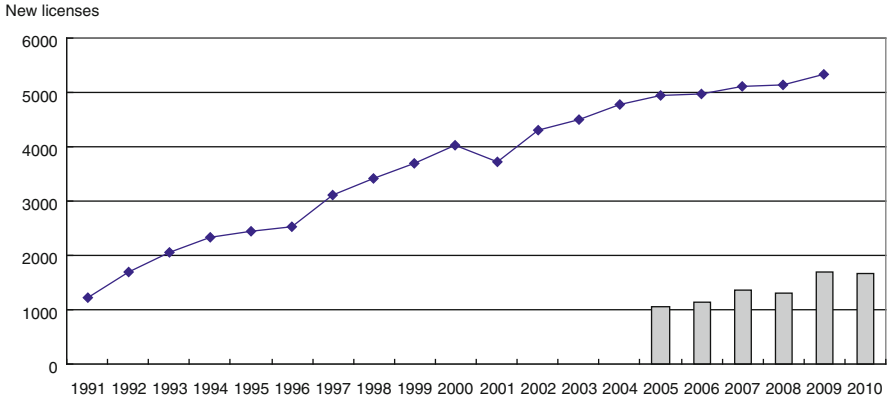

Fig. 2.1 The *line graph* shows the number of new licenses at United States universities, and the *bar graph* shows the number of new licenses at Japanese universities

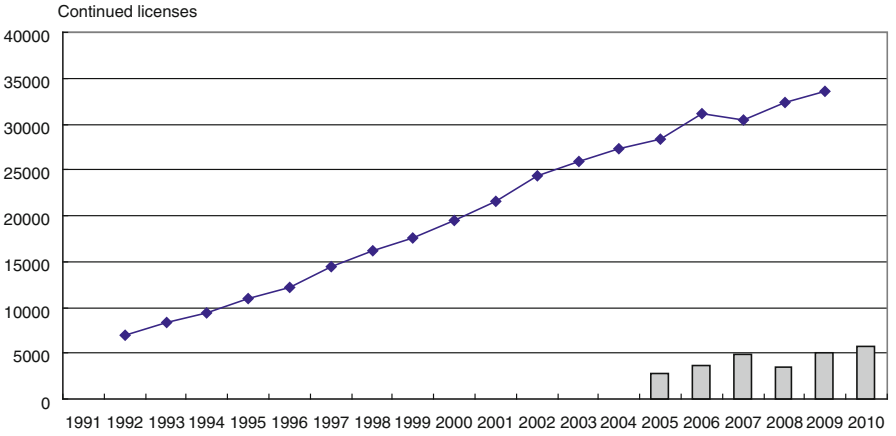

Fig. 2.2 Trend diagram of continued licenses in Japan and the United States. The *line graph* shows the trend in the United States, and the *bar graph* shows the trend in Japan

United States about 20 years ago. Of course, it would be incorrect to interpret this as meaning that Japan is a full 20 years behind the United States in this regard. However, as mentioned above, the Japanese legal framework for innovation was in a development phase until the acquisition of corporate rights by national universities in 2004. Before then there was almost no technology transfer. I believe a more constructive interpretation of the above data is that Japan has finally caught up to the United States of 20 years ago. Over the past 20 years in the United States the promotion of industry-academia collaborations has led to the stimulation of innovation. This means that the issue facing Japan is how to sustain and grow industry-academia collaborations.

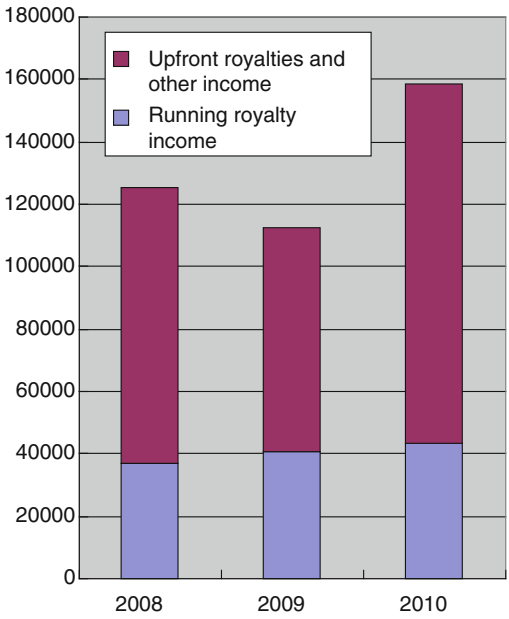

Fig. 2.3 Breakdown of income from licensing by Japanese universities to industry

2.2 Royalty Breakdown

When considering future prospects for industry-academia collaborations, looking at a breakdown of licensing income is informative. In the United States, approximately 20% of the income that universities receive from licenses is paid in the form of upfront royalties, which are paid when a licensing contract is made. Approximately 80% of the income is paid in the form of royalties that correspond to product sales (running royalties). Figure 2.3 shows that in Japan upfront royalties account for an overwhelming majority of licensing income. This is not a result of any unique feature of the licensing system in Japan but rather stems from the fact that most of the technology that is licensed in Japan is still in the development phase and has not been commercialized. Thus, considering the numbers of licenses discussed previously, we can expect that running royalties will increase in the future. In fact, The University of Tokyo is in such a situation. At The University of Tokyo, running royalties are expected to increase, and royalties are expected to increase sometime around 2015. Other universities have made similar announcements. It is too early to take a pessimistic view of the situation. Licensing to foreign companies has also been increasing recently. If Japanese universities produce quality technology, we can expect to see the same trend in Japan as has been observed in the United States.

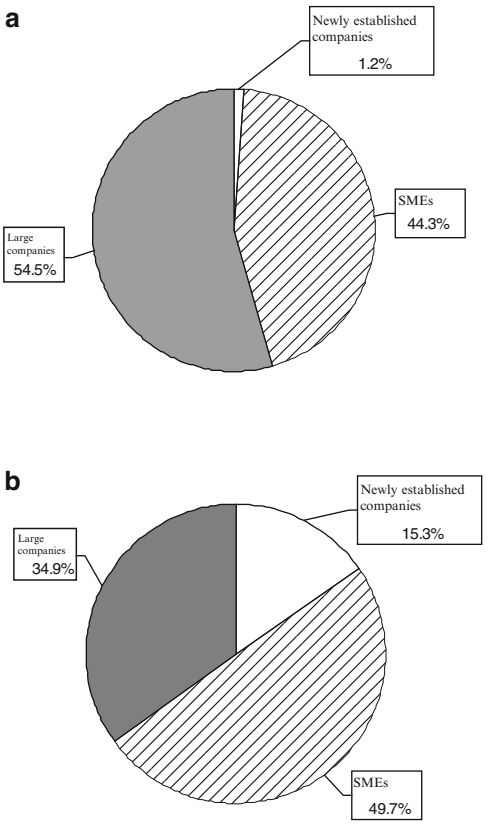

Fig. 2.4 Comparison of licensee company sizes in Japan and the United States. Sizes of companies that universities license to in Japan (**a**), the United States (**b**)

3 New Developments for University-Based Startup Companies (Spin-Offs)

Significant differences between Japanese and United States industry-academia collaborations can be found in various areas. For example, as shown in Fig. 2.4, the scales of the companies that universities license their technology to are very different in Japan and the United States.

In the United States, the percentages in this figure have changed very little in the past 10 years. Universities transfer approximately 15% of their technology to startup companies and about half to small and medium-sized enterprises (SMEs). Large companies are the recipients of about one third of the transferred technology. Meanwhile, in Japan, the amount of licenses that go to startup companies is very small. Even when we look at past data, in the year when the most licenses went to startup companies these licenses still only accounted for 5% of the total number of licenses. Any baseball or soccer team whose young players do not actively participate loses vigor. In this sense, there is a problem with the strategies for supporting startup companies in Japan.

It is certainly the case that there was a phenomenon that could be called a boom in university-based startup companies that took place around the time of the initial public offerings (IPOs) of AnGes MG in 2002 and OncoTherapy Science in 2003, when university-based startup companies went public one after the other. However, the economic stagnation and collapse of Lehman Brothers that followed sent the boom into hiding.

Not all the news has been bad. If we look at the IPOs that have taken place over the past few years, we can see that they have included a number of university-based startup companies, also known as spin-offs. Examples of spin-offs that have had successful IPOs over the past few years include the 2009 IPO of Tella, a spin-off from The University of Tokyo; the 2011 IPO of Morpho, another spin-off from The University of Tokyo; and the 2011 IPO of Chiome Bioscience, a spin-off from RIKEN (The Institute of Physical and Chemical Research). Of course, IPOs are not the only sign of a successful spin-off. For example, The University of Tokyo spin-off PeptiDream has not yet had an IPO, although it has been producing good results since its founding in 2006 and is forming alliances with various large pharmaceutical companies in Europe and the United States. Thus, while there might not be as many startup companies in Japan as there are in the United States, startup companies that have commercialized university technology and are growing steadily are continuing to form, and there is a strong possibility that promising enterprises will arise from these companies.

Looking at the past, Teijin started as a spin-off from Yamagata University, TDK started as a spin-off from the Tokyo Institute of Technology, and Ajinomoto and Ebara started as spin-offs from The University of Tokyo. These companies were formed and grew in an era when there were no head offices of intellectual property or TLOs. When discussing startup companies, many people emphasize the differences between the economic and cultural environments of Japan and the United States. Nevertheless, it is clear that Japan has successfully brought forth innovation in the past.

4 Training Industry-Academia Collaboration Intermediaries

As has been set forth thus far, Japanese research seeds are being steadily patented and transferred to industry. Sometimes this has led to the formation of promising university spin-offs. Focusing on the present, it may appear that Japan's industry-academia collaborations are lagging behind, but that is not necessarily the case when we look at the issue on a larger time scale. There is a professor at the University of Texas whose analysis of industry-academia collaborations in Japan concludes that it is amazing and proceeding at a breathtaking pace. As someone who is involved in industry-academia collaborations, there are in fact times when I feel a sense of sluggishness, although I can still see that this field is growing steadily.

To solidify this trend and bring about even greater development, it will be important to train workers in the field of industry-academia collaborations. For a new sport from a foreign country to be established in a new country, it is important for new players of the sport to be trained. For industry-academia collaborations, the question can be asked whether technology transfer intermediaries are being trained.

The answer is both yes and no. When it comes to this issue, differences between universities are extremely pronounced. There are a variety of reasons for this. One reason is that at many universities, technology transfer intermediaries are hired for limited terms. It is difficult to attract talented workers to a profession that requires a person to change his or her job every 3 or 5 years. Whether a university has a leader who can manage licensing and marketing and guide his/her younger associates is also a significant issue that sets universities apart. When national universities gained corporate status, many universities not only did not understand technology transfer, they also did not understand the step before technology transfer of applying for patents. That is why many national universities hired people from the intellectual property and patent divisions of private sector companies. While there is a great deal of individual variation, most people from intellectual property divisions are professionals in applying for patents but have little experience when it comes to licensing and marketing. Universities do not commercialize technology on their own, so rather than the ability to patent technologies, what industry-academia collaboration intermediaries really need is intimate knowledge of licensing and the ability to market technologies. This type of hiring mismatch can be seen in various universities.

Overall, however, the training of industry-academia collaboration intermediaries is proceeding. It is impossible to quantitatively measure how the skills of industry-academia collaboration intermediaries are growing. Thus there are no data that clearly show this growth. However, the UNITT holds an annual conference similar to the annual meeting held in the United States by the AUTM. The 9th conference will be held in 2012. Each year, about 500 people associated with universities gather at the conference and discuss a variety of themes for 2 days. The content of these discussions has been increasingly advanced each year. Also, UNITT holds a number of fundamental and applied licensing training seminars each year. These seminars teach participants what they need to know about licensing. At these seminars, I have spent about 10 years teaching a variety of people associated with universities how to license university technology. I have seen how the participants in these seminars have become more capable over the past few years. In that sense, I think the overall level of technology transfer intermediaries is rising.

Human potential is incredible. Only 66 years after the first flight of the Wright brothers, humankind made it to the moon. In the field of industry-academia collaborations in Japan, we are probably at the point where we have finally managed to get an airplane to fly. However, I believe that this single step is sure to pave the way to new innovations, and I am looking forward to the future.

Reference

1. University Network for Innovation & Technology Transfer (2012) UNITT Survey 2011. University Network for Innovation & Technology Transfer, Tokyo, Japan