Report on Technology Management Center

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Chapter 1 Introduction

1.1 Background to the Establishment of the Technology Management Centers (TMCs)

Today's global economy is changing with unprecedented speed and intensity, with the synergistic effects being realized by way of the progress of information-communication technology and the increasing globalization of the markets. The creation, protection and utilization of intellectual property, including patents is therefore vital in this increasingly globalized marketplace and knowledge-based economy. In order to coexist with "factory-of-the-world" countries that provide good quality products at low prices by introducing ready-made, low-risk technologies and improving production techniques, advanced industrial countries are creating economic policies wherein intellectual property, including patents, is regarded as a peerless resource[1].

In this society of ours centered around a knowledge-based economy and globalized markets, it is necessary to establish and manage TMCs, which further the promotion of science and technology, and protect and utilize the results thereof in the form of intellectual property.

The establishment of TMCs in the US and the UK ahead of other countries was made possible by the creation of Technology Licensing Organizations (TLOs) at universities and research institutions. With its view of universities and research institutions as leaders in the development of science and technology, Japan has also developed TMCs by way of the establishment of TLOs. This report will therefore provide information considered to be beneficial to the future development of TMCs by way of introducing Japan's experiences in the development of TLOs.

The US Bayh-Dole Act[2], enacted in 1980, invigorated TLO activities in the US. This act provided universities with incentives to create, manage and utilize intellectual property, thus enhancing industry-academia cooperation.

According to W.M. Crowell[3], a past president of the Association of University Technology Managers (AUTM), a TLO-related organization in the US, "In 2004, almost 4,000 US patents were issued to universities compared to less than 250 in 1980, the year Bayh-Dole was passed, which is an amazing statement about the effectiveness of Bayh-Dole. Licensing income of US$1.4 billion was generated, with close to 5,000 licenses signed. In addition, more than 460 companies were started based on university discoveries, that generating job creation and inward investment in the area. Now, TLOs have to develop new approaches to address the so-called "gap" of "Valley of Death." Many universities in the US are developing "translational research and gap-funding programs to take these early discoveries and do some of more applies development to see which technologies have the most potential to become the basis for a successful technology transfer deal."

When a nation pursues economic prosperity, ultimately the purpose of TMC development, it is clear that regardless of the circumstances faced by the country and its universities, a comprehensive grand design with a wide perspective is necessary in regard to the following points: (i) legislative frameworks, (ii) government policies, (iii) university missions and policies, and (iv) TLO structures and behavior. The matters considered important in regards each of the above-stated points are listed below.[4][5].

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[1] Sojo: "Information Management" 49(1)35 - 45 (2006) in Japanese

[2] Bayh-Dole Act: Unified patent policy to enable inventions made from federally funded research projects to belong to small businesses including universities and NPOs.

[3] W.M.Crowell: "Report on Int. Patent Licensing Seminar 20006" Tokyo, Jan. 23 - 25, 2006

[4] C.Garner: "Report on Int. Patent Licensing Seminar 2003," Tokyo, Jan. 27 - 29, 2003

(i) Legislative Frameworks

Improvement of legislative framework is necessary, because the purpose of this project is the nation's economic prosperity through industry-academia cooperation creating sustainable innovation utilizing the intellectual property system. The US which practiced this policy first, for example, implemented the Bayh-Dole Act (1980), Small Business Innovation Development Act (1982), and the Young Report (1985)[6] that promoted the formal adoption of a pro-patent policy, and domestic and international agreements regarding intellectual properties. Following this example, Japan, as described later, has also promoted legal reforms to date starting with the TLO Law (Law Promoting Technology Transfer from University to Industry) in 1998.

(ii) Government Policies

Multiple administrative measures that combine economic policies, such as intensive investment in R&D, and improvement and promotion of the intellectual property system by the government with a view to promoting science and technology are necessary, as is the establishment of regional clusters by way of industry-academia cooperation, support for SMEs and venture businesses, and a preferential taxation system for R&D.

As a part of characteristic support measures implemented in Japan, the National Center for Industrial Property Information and Training (INPIT), which provides comprehensive services under the JPO, supports universities' technology licensing activities, thus greatly contributing to the creation of an environment conducive to the effective use of patents obtained by universities and research institutions. The INPIT effectively promotes technology-licensing projects, with particular emphasis on universities, SMEs and venture businesses, which are not skilled in handling intellectual property. The following paragraph provides a brief summary of the INPIT's projects and the results thereof.

The INPIT, by way of governmental funds, dispatches about 110 patent-licensing advisors to local governments and university TLOs nationwide. This project has been in operation since its launch in 1997. The total number of successful patent licensing cases through these advisors has thus far totaled 9,200, with their economic effect reaching 240 billion yen, eight times as the total cost of the project. Looking at the details of successful cases, patent-licensing advisors dispatched to local governments have effectively promoted technology transfers from SME to other SME, while those dispatched to university TLOs have contributed to the transfer of technology from universities to both large-scale companies and SMEs. The survey on this project found that the number of technology transfers beyond these categories, including the local governments and universities to which advisors were dispatched, accounted for 60%, showing that networks between advisors play an important role. As described above, the use of government support organizations such as the INPIT also needs to be taken into consideration as an interim measure up until the point where university TLOs and local technology licensing projects actually are initiating such activities themselves.

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[5] T.A.Young: "Repot on Int. Patent Licensing Seminar 2002," Tokyo, Jan. 28 - 30, 2002

[6] Report compiled by President's Commission on Industrial Competitiveness: Recommendation of comprehensive policy for the revival American industries by putting priority on the promotion of technological development based on the difficulty to keep the superiority of American technology.

(iii) University Missions and Policies

It is necessary to establish and manage TLOs for universities that are the bases of innovation to positively work on industry-academia cooperation. It is important, at the same time, to position this project as "the university's contribution to the society," clarify the university's role, publicize a long-term vision based on a healthy economic model to the society, and try to make management open to public scrutiny. The content includes strengthening industry-academia cooperation, making a contribution to the regional economy, formulating rules related to conflicts of interest and duties, and providing incentives to researchers who cooperate in this project.

(iv) TLO Structures and Behavior

The basic function of university TLOs is technology transfer that is to obtain patents for university inventions and to market and license them. This project has a business nature that is different from education and research that are a university's key roles. An organization can be established within a university, but there is the alternative to entrust the business to an outside organization.

1.2 Outline of Part 1

Since initiating the development of university TLOs, Japan has been continuously working to implement the systems necessary for establishing TMCs, such as support systems for venture business and local innovation. This report includes a summary of the information provided to us by experts currently engaged in the construction of all the aforementioned systems. We hope this report will provide useful, on-the-spot information to people who will be assuming actual leading roles in the establishment and management of TMCs in the future.

Chapter 2 outlines TLO establishment and management in the US, which has served as a reference point in Japan's inauguration of TLOs. This chapter will explain the background to the development of TLOs in the US and illustrate the important points highlighted by its successful cases. Chapter 3 outlines Japan's actions with respect to the above-mentioned points: (i) legislative frameworks and (ii) government policies. This chapter will introduce Japan's grand design from a national viewpoint by way of explaining its legal and political changes. This chapter will also look at the financial aspects of TLOs in regards to point (iv) TLO structures and behavior.

Chapter 4 explains, in the form of a timeline, the role that TLOs will play in the creation of technology seeds, the introduction of new products launches onto the market and the follow-up activities thereafter. This chapter also describes the relationship between TLOs and intellectual property strategies and the importance of human resources. Chapter 5 introduces a standpoint wherein TLOs are regarded as organizations that provides services to both the inside (universities or research institutions) and the outside (companies) of the organization. This chapter includes case examples of TLO activities in Japan, in addition to activities in the US and in China.

Chapter 6 examines what preparations should be made and what should be kept in mind upon actual initiation of the development of TLOs. This chapter provides, in the form of a checklist, practical management know-how which has been obtained through TLO development in Japan, such as what should be considered in regards to the above-mentioned points with a view to establishing TLOs: (iii) university missions and policies, and (iv) TLO structures and behavior.

Chapter 2 TLO Establishment and Management in the US

As pointed out in the previous chapter, the US, which passed the Bayh-Dole Act in 1980, led the way in technology transfers and establishment of Technology Licensing Organizations (hereinafter TLOs). This policy began to bear fruit in the 1990s, at which point advanced countries in Europe as well as Japan began adopting the framework one after the other. At present, this constitutes a worldwide phenomenon, also involving developing countries. As we believe that the American experience will serve as a useful reference point for those of us aiming to establish and utilize TLOs, the following information will outline the process by which TLOs are established and managed in the US

2.1 Academia-Industry Technology Transfer and the Second Academic Revolution

As the background to the Bayh-Dole Act passed in 1980 in the US, there was a serious economic crisis involving stagflation. To overcome such a serious economic crisis, the creation of new industries with international competitiveness was essential and nationwide expansion of Silicon Valley that was developing even under the stagflation was politically pursued. This policy was termed Cloning Silicon Valley.[1] The aim of the Bayh-Dole Act was to transfer and use the results of large amounts of science research funding from the federal government to universities and to build a foundation to create competitive new industries. It is the "2nd Land Grant"[2] and the measure to promote the use of national property by private sectors. The Bayh-Dole Act suggested the establishment of organizations specializing in this use to meet the purpose and the way to carry it out. Based on the Act, each university established a TLO, and positioned the activity of industry-academia technology transfer as its "Third Mission" next to research and education.

However, realizing this Third Mission required universities to implement a large organizational transformation called a "2nd Academic Revolution."[3] The reason is that, with regard to whether research results at universities should be used for education or for industry-academia technology transfer, the "open" principle is assumed for the former and the "proprietary" principle required for the latter, which brought essential difference to universities. Therefore, universities were required to decide their policies to clarify how to balance education and industry-academia technology transfer and to realize the social benefits expected from them, namely a societal contribution, by coordinating both activities. As the place to conduct it, the University-Industry Research Center represented by NSF Center of the US was established. There, it was decided precisely by contracts what to research and to which party the results belong. In addition, as the place to do such new research, preparing of research campuses was needed in addition to the main campuses for education.

To what extent a TLO can achieve its function greatly depends on the formulation and practice of related policies at the university, establishment of research centers for industry-academia cooperation, organizational reform including campus division, and establishment of rules at the university to deal with the conflicts of interest that inevitably result from industry-academia technology transfer. With regard to industry-academia technology transfers in countries other than the US, prior to the need for university organizational transformation being fully recognized, only procedures such as the attribution of research

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[1] For details of the Cloning Silicon Valley policy, refer to A. Nishizawa "University Start-up Ventures and Clustering Strategy in Japan," R. Taplin ed. *Innovation and Business Partnering in Japan, Europe and the United States*, Routledge, forthcoming.

[2] H. Etzkowitz, *MIT and the Rise of Entrepreneurial Science*, Routledge, 2002, p. 16

[3] H. Etzkowitz, & L. Leydesdorff ed. *Universities and the Global Knowledge Economy*, Pinter, 1997, p.145

results, acquisition of intellectual property rights, and transfer to industries through TLOs were focused on, and there was the misunderstanding that industry-academia technology transfer can develop once a TLO is established. Due to this misunderstanding, unnecessary confusion and objections were caused at universities in addition to the failure to achieve the real purpose of industry-academia technology transfer. To avoid such a situation and to make TLOs function effectively, the examination and agreement on the Third Mission within universities are essential at first, and organizational transformation of universities in addition to the formulation of policies made by agreement and their implementation are necessary.

2.2 The Model and Achievement of Industry-Academia Technology Transfer in the US

TLO licensing strategies and the character of licensing companies are examined here based on the model of industry-academia technology transfer in the US. With this model, the development of technology is classified into four stages from I, Early Stage, II, Proof-of Concept, III, Reduced-to Practice, to IV, Prototype. It shows that types of licensing strategies and licensing companies differ depending on the maturity of the technology.

At stage I, the functionality of technology is not clear and legal risks for obtaining and maintaining patents are high. To enhance the functionality, a TLO emphasizes continuous research, introduction of external knowledge and acquisition of research funding through joint research with a large company, so agreement on a research contract with a large company is preferred. The large company cooperates in the research as a Window of Technology with the aim to obtain information on state-of-the-art technology. Use of the results is left to the company.

At stages II and III, the university obtains a patent and tries to license it to existing companies. Existing large companies, however, tend to avoid licensing, because they experience the “innovator’s dilemma” concerning commercialization of the product.[4] As entities intended to overcome this dilemma and commercialize the technology, venture companies are selected for technology transfer. Venture companies, however, pose business risks due to limited management resources. To reduce these risks, the university’s commitment is essential. The bonding occurs through exclusive licensing and equity acquisition.[5]

At stage IV, large companies that can immediately produce and sell the products are preferred. Additionally, a lot of the licensing at this stage is nonexclusive and designed to implement the patent as widely as possible (the abovementioned book by G. D. Markman, P. H. Phan, D. B. Balkin & P. T. Gianiodis). In fact, based on the AUTM Licensing Survey 2003, the proportion of exclusive and nonexclusive licensing was 93.7% to 6.3% for venture companies, but that for large companies was 39.1% to 60.9% (AUTM, AUTM Licensing Survey FY2003, 2004)[6]. It is clear from these percentages

[4] When Bayh-Dole Act was enacted, the avoidance of new technology introduction by existing large companies and the exclusion of SMEs by patents became controversial. At first, the article to give priority to SMEs was included (S. Ashley “The Enactment of Bayh-Dole” *Journal of Technology Transfer*, 29, Kluwer Academic Publishers, 2004). Regarding "Innovator's Dilemma", refer to "The Innovator's Dilemma - When New Technologies Cause Great Firms to Fail" written by C. Christensen, translated by Yumi Izuhara, explained by Shunpeita Tamada, Shoeisha 2000.

[5] J. Power, P. McDougall "University start-up formation and technology licensing with firms that go public: a resource-based view of academic entrepreneurship" (Journal of Business Venturing, Vol.20, No. 3, Elsevier 2005), that analyzes the growth of venture business and technology transfer by RBV theory, points out that, for the growth of venture business, academia-industry joint research, ability of researchers, number of years TLO has experienced, and closeness of VC have greater impact rather than the number of patents.

[6] Large companies' objections have increased against universities' strategy to give priority to venture companies for exclusive licensing. Large companies criticize such a technology transfer strategy as the indication of universities' profit

that the main TLO activity is licensing to existing companies. However, technology transfer to venture companies in order to use the research results is increasing, because many of the results of university research are at an early stage of development, have novelty, and have the characteristics of basic technology (AUTM, op. cit.).

Below is an outline of the achievements in the US brought about by applying the Berneman model[7], which indicates the industry-academia technology transfer as an intellectual property usage cycle, to the *AUTM Licensing Survey FY2003*.

By source, the total amount of external funding for the 165 research universities and 32 hospitals all over the US that replied was US$38.6 billion and the total number of disclosed inventions was 15,355. Among the disclosed inventions, the number of inventions examined by TLOs (triage) and which patents were applied for was 7,918. Slightly less than 50% of them were granted patents and were licensed. The proportion of licensed inventions to disclosed ones therefore was 29.1%. The number of venture company start-ups was only 2.4% of the number of disclosed inventions. This also proves how limited the number of platform technologies is, that promote the start-up of venture companies. Gross license income received from industry-academia technology transfer was US$1.28 billion, or only 3.3% of the total external research funding. The impact of income from industry-academia technology transfer is not big and cannot cover the cost of research at universities. However, the results created social benefits that cannot be judged in monetary terms, which includes the creation of venture companies, creation of regional high-technology industries, contribution to the development of infant drugs represented by the commercialization of medicine to cure respiratory distress syndrome (AUTM, op. cit.).

2.3 TLOs as Independent Organizations

The relationship between universities and TLOs in the US is classified as shown below. Internal organizations are governed by the university's management and it is difficult to treat the person in charge of technology transfer as a specialist. As a result, the person cannot employ the needed expertise and priority is given to the intention of researchers when deciding on the division of research funds. In addition, in case of a lawsuit, the university can be exposed to legal risk. External organizations, on the other hand, put priority on profit, and though the results of technology transfer may be good, these organizations' policies would not be in line with those of the university and neutrality and the public nature of the university would be sacrificed. An ideal TLO would be an interface between the two parties. With this organizational structure, the TLO has a cooperative relationship with university while holding a certain degree of independence. It has become necessary for a university, which carries out technology transfer in line with its policies, to take responsibility for the administration of the TLO which is a specialist organization practicing the work, to give it financial support to a certain extent, and, at the same time, aiming at the TLO's independence, to implement new policies such as performance-based remuneration for specialists working at the TLO. For the purpose of the establishment and management of the TLO too, universities need to transform their organizational management.

For a TLO to achieve technology transfer while closely following the university's policies, an organization different from that of a conventional university needs to be constructed. The operational

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orientation and have begun to request the amendment of the Bayh-Dole Act that brought about this situation (J. Washburn, University Inc. Basic Books, 2005).

[7] Berneman model is a model made by Dr. L. Berneman, Managing Director, Center for Technology Transfer, University of Pennsylvania (AUTM President in 1999) to clarify the entire picture of academia-industry technology transfer in the US in the 1990s based on the data from 1991 to 1999 and presented at the AUTM General Assembly in 2002.

departments of a TLO consist of 1) a technology transfer department that takes charge of screening technology seeds disclosed by the university's researchers, acquiring intellectual property rights for them, conducting marketing based on the transfer strategy depending on the nature and maturity of the technology, negotiating conditions and making agreements on licensing contracts, and of 2) a back office department that gives appropriate support to effectively promote the activities of the technology transfer department and following the situations of practices. How these two departments are organized in a TLO is to be designed depending on each country's corporate laws, but it is essential to construct flexible and horizontally-based departments so that both departments can closely cooperate and no organizational barriers or friction are created.

Furthermore, participation of specialists is important for these new business departments to function effectively. However, the work of the industry-academia technology transfer itself needs new job skills, and it is a serious issue how to employ and treat the people in charge of technology transfer and those in charge of the back office of newly established TLOs and how to nurture them in order to improve the personnel base. Though involvement of experienced people from private companies is unavoidable at the beginning, it is necessary to foster the personnel who are well acquainted both university and corporate policies, because the target and evaluation of industry-academia technology transfer by universities and companies greatly differ.

In the US, in order to obtain and enhance the necessary expertise to perform this new job, the people in charge of TLOs formed AUTM (Association of University Technology Managers) as an organization with the function of self training, and have been making individual efforts as well as conducting mutually enlightening activities. AUTM has conducted not only training in specialist skills but has also constructed a foundation to support TLO activities from the personnel aspect including the formulation of the AUTM Technology Transfer Practice Manual and intermediaries for job transfers to the new professions. When trying to introduce a new industry-academia technology transfer system and establish a TLO to shoulder the necessary duties, the area of personnel can be the biggest bottleneck. While the formation of an organization like AUTM with specialist skills is the final aim, as described in the above chapter, personnel support by the government or government-related organizations like INPIT is indispensable at the beginning.

Because academia-industry technology transfer entailed a very big system reform in the US, the time that the system to effectively implement the provisions of the Bayh-Dole Act could be firmly established was after 1987 when the rule for practice (37CFR Part401) were made. It also took a certain period of time to improve the ability of specialists to support the activities of TLOs, so that the real functioning of these activities did not start until the 1990s. Based on the figures in the AUTM Licensing Survey, the application rate that was below 30% at the beginning of the 1990s increased to over 50% in 2000.[8]

2.4 TLOs and the Formation of Innovation Clusters

For TLOs, not only the technology transfer to existing companies but also that to venture companies

[8] This increase in the number of applications caused a decline in the rate of patents granted to the number of invention disclosures. This rate peaked in 1994 at 78.2% and declined to 49.7% in 2003. However, the licensing rate increased from the low of 16.2% in 1994 to 29.1% in 2003 (AUTM, op.cit.). One reason may be that technology transfer specialists had become experienced and made patent applications that met the needs of industries rather than emphasizing academic significance. This might have resulted in a higher rejection rate for novelty and might have caused the drop in the rate of patents granted. Granted patents, on the contrary, may have caused a higher rate of licensing due to the higher possibility of use in industries and due to the phenomenon of venture companies as an alternative means starting to function. These points should be verified in more detail.

is becoming an important function. This is based on the combined demand for the characteristics of university research results as mentioned above and of the venture companies expected to shoulder the commercialization of immature technologies with unsettled functionality (D. Drake, "Creating a Start-up Climate: Ideas for Next-Generation Technology Transfer" Journal of Association of University Technology Managers, Vol. X VI, No. 2, AUTM, 2004). However, the only measure TLOs can take to deal with venture companies is the method to get paid when they succeed in the future, namely to substitute the consideration for technical transfer with stock and be paid by future profit. Also, from the viewpoint of specialist skills, support for nurturing venture companies requires different skills from industry-academia technology transfer, and mixing them up can hinder the primary duties. Nevertheless, as is clear from the above industry-academia technology transfer model, as long as one is trying to make venture companies shoulder the commercialization of the technologies at stages II and III, it is an unavoidable issue for TLOs to enhance the survival rate of ventures and to establish a foundation to enable them to grow by themselves.

Many venture companies just after establishment are likely to have very poor management resources and be unable to work independently. At initial stage, market creation through client cultivation is the most important issue. For this purpose, regarding prototype production, testing, inspection, and market creation, the company cannot help but concentrate its management resources on obtaining charter customers who purchase by evaluating new functionality.[9] The period of getting through this term to achieving profit is known as the "Valley of Death" which is said to be the most difficult and vulnerable time for venture companies at the initial stage of development. For venture companies that are immature and have insufficient independence to overcome the Valley of Death, there should be a supporting organization for business start-ups to enhance their survival rate and establish a basis for independent growth by providing an inexpensive place to perform business activities and providing support from both tangible and intangible perspectives. It is called an incubator. In this sense, establishment of an incubator can be viewed as being related to the organizational transformation of universities together with industry-academia cooperative research centers and TLOs.

Business start-up support lent by incubators to immature venture businesses at their initial stage of development in order to overcome the threat of the Valley of Death is not limited to tangible aspects of providing location and equipment. Support of intangible aspects relating to overall management is also necessary, which includes improvement in business models, support to get charter customers through Small Business Innovation Research (SBIR), planning of strategies for intellectual property, marketing, general affairs, and legal affairs. Furthermore, support measures for fund raising for business growth and employment of the best and brightest are also required. It is impossible for a university to supply all of these by itself.

Regarding the funding, a special mechanism for fund supply combined with support functions through equity investment such as business angels or incubation funds is indispensable. Regarding the personnel, an intermediary network is necessary for job transfer of specialists with good knowledge of the venture company's technology area and the product market. Regarding management information, the support for marketing, intellectual property, and legal affairs that have unique characteristics for venture companies is required. What is more, venture companies lack sufficient funds. For these support measures, just like the case of universities that receive stocks as consideration for the technology transfer, methods of payment in the future when the business is successful have to involve stocks. For

[9] J. Lerner + F.Hardymon, *Venture Capital & Private Equity: A Casebook*, Vol. 2, Wiley, 2002, p. 160

its practicability, there must be the conviction and agreement that the venture company will not only overcome the Valley of Death through this support but can also grow and achieve an IPO. A university needs to be responsible for the technology through the TLO and be prepared to entrust to the region the support for growth of the venture company that started its business based on the technology.

A regional industry-academia-government network to support the growth of venture companies by providing management resources such as technology, funds, personnel, and information with this incubator as a nodal point is called an innovation cluster[10] It has become necessary for universities to get involved in the formation of innovation clusters by having close cooperation with the surrounding region. For an innovation cluster to work effectively, it goes without saying that highly capable workers need to participate, but it has also become indispensable to build a supporting platform network of the heads of the industry-academia-government fields in the region as the basis for the workers to freely perform their activities beyond their organizational boundaries.

As stated above, TLOs alone cannot play the role. A TLO can satisfy its function based on the formulation and implementation of university policy to achieve the Third Mission, establishment of industry-academia collaborative research centers, establishment of incubators, establishment of a research campus, realization of organizational transformation to achieve these purposes, and formation of regional industry-academia cooperative organizations. Also, in order to employ and nurture specialists, the cooperation not only with universities but also with the central and local governments has become indispensable. Therefore, for the TLO's establishment and its industry-academia technology transfer, in addition to the government's policy, an industry-academia cooperative system at universities and in the region where the universities are located is the precondition and basis for success.

[10] For the details of innovation cluster, refer to Chapter 6 of "University Start-up Ventures and Cluster Strategy" written and edited by Akio Nishizawa and Michi Fukushima (Gakubunsha, 2005).

Chapter 3 Legislative Frameworks, Support Measures and Finance of TLO in Japan

Although the history of industry-academia cooperation in Japan have very long history, universities and industries functioned completely separately after World War II and industry-academia cooperation was not actively practiced for a while. However, the importance of this cooperation was pointed out in the Science and Technology Basic Plan based on the Science and Technology Basic Law of 1995, and the government since then has been promoting industry-academia cooperation including the use of university intellectual property. Here, we will describe the government promotion of industry-academia cooperation and the change in the framework to promote the use of university intellectual property, by explaining the activities to promote creation of university intellectual property and the history of industry-academia cooperation from the viewpoint of structural changes in the laws and regulations.

3.1 Changes in Japanese Laws and the Structure of Regulations

1995: The Science and Technology Basic Law was enacted.

This was enacted in 1995 as a law to promote science and technology. For Japan, the time to play catch-up had ended and the time as a frontrunner had arrived, when Japan would lead in a science and technology era. This law was enacted to promote the creation of new industries and to establish a nation built on the platform of scientific and technological creativity by producing original and creative science and technologies.

1996: The Science and Technology Basic Plan was formulated.

Based on the above Science and Technology Basic Law ("The government shall establish a basic plan for the promotion of science and technology in order to comprehensively and systematically implement policies with regard to the promotion of science and technology." etc.), a 5-year Science and Technology Basic Plan was formulated by looking about 10 years into the future. The first Basic Plan was for the 1996-2000 period and the second one for the 2001-2005 period, and Japan is now in the third period (2006-2010). In the first Basic Plan[1], "the promotion of industry-academia-government cooperation and exchange" was clearly stated and it was expressed that the promotion of industry-academia-government cooperation would play an important role in future science and technology development in Japan.

1998: Law Promoting Technology Transfer from Universities to Industry (TLO Law)[2] was enacted.

This is a law to promote transfer of the results of technological research at universities to industry and is a law supporting the establishment and work of TLOs. The enactment of this law became the driving force for a big reform in the use of university intellectual property. In this TLO Law, there are regulations for approval of TLOs by both MEXT and the Ministry of Economy, Trade and Industry (METI), and a TLO that gets approval is called an "approved TLO." However, this does not mean that a TLO cannot work without the approval. It is provided in the law that approved TLOs can get the following support from the national government when performing technology transfer work. When this

[1] From the website of the Ministry of Education, Culture, Sports, Science and Technology (MEXT) (http://www.mext.go.jp/b_menu/shingi/kagaku/kihonkei/kihonkei.htm)

[2] Its formal name is the "Law to Promote the Transfer to the Private Sector of the Results of Technological Research at Universities and Other Institutions" which, here, is shortened to the "Law Promoting Technology Transfer from Universities to Industry" or "TLO Law."

law was enacted, Japanese national universities were institutes controlled by MEXT, and TLOs were not established within the universities but rather, to make it easy to transfer research results, were established outside the universities separately as corporations, companies with limited liability, public interest corporations, etc. Therefore, obtaining the following support by being approved TLOs was a big driving force for their development.

(1) Granting of subsidies from METI for projects related to approved plans
Rate of subsidy: within 2/3, up to 30 million yen per year, period: 5 years
(2) Reduction or exemption of patent application fees, etc.
Based on this law, when an approved TLO performs a certain university technology transfer project, half of the patent fees (for 1 to 3 years) and of the fees for examination requests to be paid to the Japan Patent Office are exempted.
(3) Their charge-free use of national facilities
This law prescribes that an approved TLO can use the facilities within the national university for which it is in charge of technology transfer free of charge, which enables the TLO to have an office within the national university.
(4) Funding from national university corporation (National University Corporation Law enacted in 2004)
When national universities were incorporated, this law was enacted to authorize the universities' funding to approved TLOs. This strengthened the management system, enabling steps like making the TLO in charge a subsidiary.
(5) Project to dispatch patent distribution advisers (support for personnel cost and technology transfer cost)

The above summarizes the legal support measures for approved TLOs. The purpose of the Japanese government's support for approved TLOs is to shorten the period taken to implement the transfer of the results of technological research at universities to industries ("TLO operation"), a process that took several decades in the US, to several years in Japan.

In this law, it is prescribed that respective ministers in charge should give approval for a business entity that transfers research results from national testing and research institutes to private companies and for one that transfers research results from independent administrative institutions to private companies. These are called "approved TLOs." An approved TLO can get government support even if it is an organization independent from a testing or research institute.

The above is the brief overview of the TLO Law and related laws. As described, the TLO Law is a supporting law to promote the establishment and management of TLOs.

1999: Amendment of the Industrial Revitalization Law

Its Article 30 is the prescription commonly called the "Japanese Bayh-Dole Act." It enabled the organization entrusted with research funds from the national government to own the research results. However, the big difference is that in the case of the US Bayh-Dole Act applications for patent and licensing activity are compulsory when the organization owns the research result. The Japanese version just prescribes the ownership of the result of the entrusted research.

Furthermore, as described in the above TLO-related laws, this amendment established the system for approved TLOs to have half of the fees to pay to the Japan Patent Office for examination requests and for patents (fees to pay to the Patent Office to keep patent rights) exempted for one to three years. The

support for approved TLOs was expanded by this amendment.

2000: Amendment of the Law to Strengthen Industrial Technical Ability

As described in the above TLO-related laws, this law prescribes approved TLOs charge-free use of national facilities. In addition, this law prescribes (Article 16) that when applying in relation to a research result, half of the patent fee (for 1 to 3 years) and of the fee for examination request are exempted for university researchers and universities. It was also decided to approve for university teaching staff, which were public servants at the time, to hold an additional post at approved TLOs or to be a board member of a venture company that uses the research result. By way of the relaxation of regulations for additional posts, cooperation between approved TLOs and universities was strengthened. Also, the use of university research results by industries was promoted by university staff's additional assignment as board members of the venture companies using the research results.

2002: Amendment to the Notice of the Ministry of Finance No. 1, Amendment to the TLO Law Announcement

The Notice of the Ministry of Finance No. 1[3] is an official notice of the Ministry of Finance that prescribes "the handling standards when approving the use or the profit of national government facilities." By the amendment in 2000, it was approved for university-launched venture companies to use the facilities of the national university which launched the venture company at real market value for a certain period of time before and after the company's establishment. Based on normal rules, university-launched venture companies could not use the government facilities because they are commercial enterprises, but this amendment enabled them to get that permission.

Together with this amendment to the Notice of the Ministry of finance No. 1, the Announcement that prescribes the TLO's execution plan (the work that TLOs can perform) based on the TLO Law was amended. By this amendment, it was decided that the TLO could support a university-launched venture company (management consulting, introduction of funding, etc.).

In this way, regulations have been amended so that TLOs can perform not only technology transfers but also support for university-launched venture companies, and thus the environment has been improved in order to achieve the creation of 1,000 university-launched venture companies.

2002: Enactment of the Intellectual Property Basic Act

The purpose of this law is to intensively and systematically promote the measures concerning creation, protection, and exploitation of intellectual property, for the objective of realizing a dynamic economy and society that is based on the creation of added value through the creation of new intellectual property and effective exploitation of such intellectual property. This law prescribes a "Promotion Program on Creation, Protection, and Exploitation of Intellectual Property" (Chapter III) and annual examination of the "Intellectual Property Strategic Program." The law also prescribes an "Intellectual Property Policy Headquarters" (Chapter IV) and the establishment of the Intellectual Property Policy Headquarters (the Director-General is the Prime Minister) in the Cabinet. The purpose of the establishment of the Intellectual Property Policy Headquarters is to implement the measures for the creation, protection and exploitation of intellectual property in a focused and planned manner (Article 23). In addition, it prescribes, with regard to the responsibilities of universities concerning intellectual property, that "their

[3] Dated January 7, 1958 by the Ministry of Finance

activities are to contribute to the creation of intellectual property in the whole society" (Article 7), and makes provisions for the promotion of research and development (Article 12) and the promotion of the transfer of research and development results (Article 13). In other words, it aims to establish an intellectual-property-oriented country and strengthen international competitiveness.

2003: Establishment of the Intellectual Property Policy Headquarters (Cabinet)

The Intellectual Property Policy Headquarters was established by the Cabinet in March 2003, in light of a growing necessity to increase the international competitiveness of Japanese industry in response to the changes in social and economic conditions at home and abroad, in order to promote measures for the creation, protection and exploitation of intellectual property in a focused and planned manner.[4] In these headquarters, the program to promote the creation of intellectual property at universities has been made.

Annually from 2002: Intellectual Property Strategic Program

It is a program that the government annually formulates and announces based on the prescription in the Intellectual Property Basic Act. This program has the chapter "to promote creation of intellectual property in universities," which indicates that the government is promoting the creation of intellectual property in universities. By examining this program every year and making it fit with the times, effort is made to promote the creation of intellectual property in universities.

2003: Project of Intellectual Property in Universities (MEXT program)

This project was implemented to promote creation of departments resembling private company IP departments at the time national universities are incorporated. In order to activate intellectual property creation not only at national universities but all Japanese universities, applications from all universities including private ones were solicited, and those from 43 institutions were accepted. Those new departments are now performing their activities.

2004: Incorporation of National Universities (National University Corporation Law enacted in October 2003)

89 national universities previously under the control of MEXT were incorporated and became independent. Accordingly, the patent rights of each university became the property of each national university corporation. As a result, the characteristics of each university were clarified and a system to promote the use of university intellectual property was established.

As described, since the introduction of the Science and Technology Basic Law, Japan has conducted amendments to laws and regulations at considerable speed to promote industry-academia cooperation including the creation and use of university intellectual property. However, use of university intellectual property has only just begun and the idea of transferring university intellectual property to industry has not yet taken root in Japan as well as it has in the US It is believed that real reform cannot be promoted without effort by related people who are actually involved in industry-academia cooperation including university intellectual property related activities in addition to the government's reform of many regulations. In that sense, people in government and at the actual site need to cooperate hand in hand to bring about the needed change in society including universities.

[4] From the website of the Intellectual Property Policy Headquarters (http://www.kantei.go.jp/jp/singi/titeki2/)

3.2 Finance of TLO

One of the biggest purposes of a TLO is to transfer the results of technological research at universities to industry and return them to the community through commercialization. What indicates the contribution rate of the return to the community is royalty income. In other words, royalty income shows the result of a TLO's technology transfer best. For example, in the case of Columbia University (16 billion yen royalty income) and MIT (several billion yen) whose royalty incomes rank within the top 10 out of all American universities, royalty income occupies a large part of the TLO's entire income, and management of the TLO itself (office) is carried out using royalty income. TLOs in the US usually exist within universities, but many of them have independent systems for personnel and calculation of income and expenses. For licensing purposes, specialists (licensing associates) are employed in many cases. The application fees, however, tend to be paid by universities.[5]

Regarding the income of Japanese university TLOs, royalty income is still small compared to that of American university TLOs. The reason is that university TLOs were established for the first time in Japan in 1998, so that the time passed is short (most of them may be within five years) even in cases where the results of university research have actually been transferred and a small amount of them have been commercialized, so royalty income is small. In Japan, therefore, in order to support TLOs just after establishment, the government provides subsidies to approved TLOs. National universities have now been incorporated (national university corporations) and each national university corporation can own patent rights under this system. The trend has increased to establish intellectual property departments (resembling IP Departments at private companies) within universities, to apply for patents for many of the inventions through the headquarters, and to license them using the TLO. As stated above, however, royalty income as the result of technology (patent) transfers from university to industry is quite small. In the case of Japanese TLOs, a system exists to obtain many kinds of income to supplement a small amount of royalty income. The graph in Fig. 1 shows the breakdown in revenue of Japanese TLOs.

[5] "Research on University Technology Transfer", thesis by Osamu Tani for doctor's degree in FY2005 at Technology Society System, Graduate School of Science, Tohoku University (in Japanese)

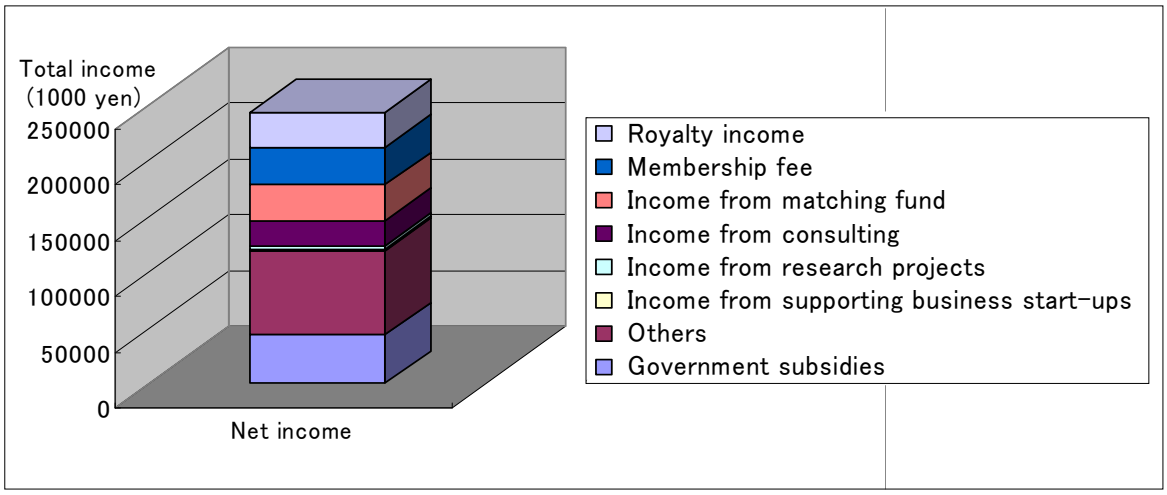


Fig. 1 Breakdown in overall business revenue of all approved TLOs in Japan
Source: Compiled by the writer from data in the METI report "How future technology transfer should be based on the incorporation of national universities"[6]

In the figure, the Government subsidies is the financial support from the government and the Income from supporting business start-ups is the income made when TLOs support university-based venture companies (business plans, introduction of funds, etc.) at their launch. Income from research projects is the income made by making research reports requested by the government or others including that made when the research is conducted by the university for the TLO about the invention's patentability (whether or not to apply for a patent). Income from consulting is the income made when giving consulting on technologies for companies and the Income from matching fund is the business income from coordinating joint research of government projects. Membership fee is the income from membership fees paid by member companies, since many Japanese TLOs have a corporate membership system. For member companies, special privileges are given such as priority in disclosing summaries of inventions. These incomes are a large part of the income source making management possible for the TLOs existing outside the universities. The primary role of TLOs, however, is to apply for patents based on the results of technological research at universities and to transfer the patents to companies, and Royalty income is therefore expected to be made. Therefore, the breakdown in royalty income and ideal development of university TLOs are explained below.

Royalty income

Royalty income can be classified into three kinds.[7] The first is running royalty income, which is created when the university licenses a patent right to a company and commercializes the invention of the patent right. The company pays several percent of the sales amount to the university when it receives sales profit. For example, in the case of Columbia University TLO and MIT TLO which are typical university TLOs in the US, this running royalty income takes up a large part of the entire royalty income.[8] Many of the TLOs with high-ranked royalty income among American university TLOs are ones where running royalties occupy a large part of their overall income.

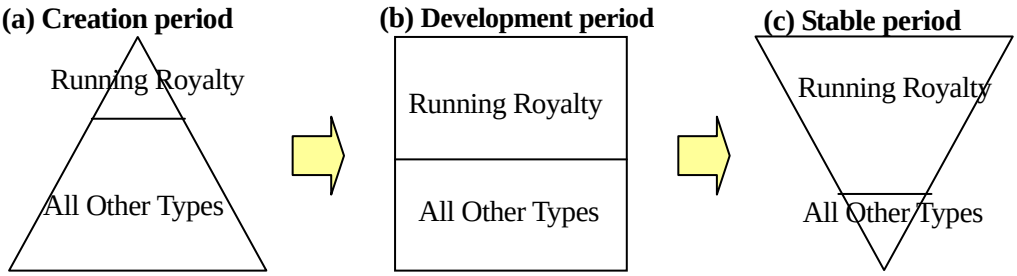
[6] Refer to the website of METI http://www.meti.go.jp/policy/innovation_corp/top-page.htm
[7] From AUTM Licensing Survey Full Report
[8] From AUTM Licensing Survey Full Report

The second is the income made by selling the stock called Cashed-in Equity. This is a case where, when licensing a patent right to a university-launched venture company, a university-launched venture company with limited cash flow gives stocks to the TLO instead of a royalty fee. This means the income is that which is gained by selling the stock when the stock price rises. It should be noted, however, that the gain on this stock sale is not the profit gained directly through the sales of commercialized inventions transferred from the university to industry. Furthermore, it is not an annual income. It is therefore unstable compared to the high running royalty income of the university TLOs in the US described above.

The third is All Other Types of income.[9] This income is, as the name shows, all income other than the running royalty income and the income obtained by selling stocks among the patent-related incomes received by TLOs from industry. In the case of American university TLOs, "Upfront Fees"[10] occupies a large part of this All Other Types of income. It also includes "Milestone Payments"[11] and "Options."[12][13] This All Other Types of income plays a very important role in the development of TLOs' income.

Among these three kinds of income, two of them (Running Royalty and All Other Types) have a basic model to indicate the development of TLO technology transfers ("Technology Transfer Development Model"). Fig. 2 shows the basic model. The creation period, development period, and stable period of the model describe the overall royalty income of individual TLOs. Furthermore, the difference in the rates for Running Royalty and All Other Types shows the difference in development in individual TLOs. This figure is the model describing the most basic idea applicable to all TLOs and the degree of development in the growth of each TLO can be estimated based on this model.

[9] This is defined as "All Other Types" in the AUTM Licensing Survey.
[10] This is the money paid to the university TLO initially when it concludes a contract with a company in licensing activity of technology transfer.
[11] Money paid to the university TLO upon completion of each stage of the research plan (such as the completion of a prototype) following an invention's transfer to industry and prior to its commercialization.
[12] Money regularly paid during the period (every month, every year, and so forth) when an invention is transferred to industry and it is being judged whether or not the invention can be commercialized by conducting development in a company for a period of several months to several years.
[13] PP..27 - 36 "A.I.P.P.I.", December 2005, Kazufumi Yaji, International Association for the Protection of Intellectual Property of Japan



* Though this is not shown in the figure, both the “Running Royalty” and “All Other Types” saw an increase from the creation period to the stable period.

Fig. 2 Technology transfer development model

A TLO is established at first, then a manager is decided, a specialist who is called licensing associate is employed, and a system for cooperation with university researchers is built. The preparation for licensing activity is thus completed. These arrangements to build the system are essential for putting university technology transfer on track. With this model, the creation period is the time after establishing the system when the licensing activity is put on track. During this period, the Upfront Fee is paid as a result of conclusion of the contract, and the Milestone Payment contract and Option contract start as activities that lead to running royalties. Therefore, entire income during this creation period is small, All Other Types income occupies more than 70% of the entire income, and the remainder is taken up by running royalty income. From among the inventions that generated All Other Types income, invention that are successfully commercialized and brings about running royalty income are born. In this way, there is a growth shift from the creation period to the development period. Furthermore, if a big commercial hit (such as the Cohen-Boyer patent of Stanford University) emerges from the inventions, a huge running royalty income is generated, overall income increases, running royalty income accounts for over 70% of overall income, and the period grows into a stable one.

Thus, for a TLO to develop through technology transfers, it is essential to establish a sound organization at first, then to implement steady activities to lead to All Other Types income. Among the inventions generating All Other Types income, that leading to running royalty income are created and a big benefit from university research results to society becomes possible.

Chapter 4 Important Points in TLO Management

TLOs are to assist in the creation of technology seeds, the launching of new products on the market and follow-up activities thereafter. By following this process in the order presented in the timeline, this chapter will outline, based on market demands, what functions and capabilities TLOs are expected to maintain and, furthermore, what TLOs should do in order to more actively promote the launching of products. This chapter will also explain development concepts in accordance with the circumstances in the countries in question and highlight the importance of human resources.

4.1 TLO Management in Consideration of the "Voice of the Market"

4.1.1 From Creation of Technological Seeds to Launch of New Products

Technological seeds may be created as a result of long years of basic research, or acquired by aggressively introducing technologies from third parties (technology scouting). It cannot be denied that some seeds are created out of almost nothing, but generally, technological seeds are created by combining several existing technologies, and such new combinations bring about unprecedented and innovative effects and applications. In other words, totally new technological seeds are born in the process of scouting useful technologies from among existing technologies for the purpose of applying them to new specific uses. In addition to pure and basic R&D, technology transfer and licensing often play a significant role in the discovery of technological seeds from which new products will be developed. TMCs should be equipped with a mechanism that can cover this area.

A typical mechanism is a business start-up using university-seeded technologies, i.e. TLOs transferring technological seeds owned by universities to the private sector, with the aim to create new industries. In this context, industry-academia collaboration can be regarded as the starting point for TMCs. Where a TLO is to be established within a university or research institute, it must be remembered that IP strategies should be formulated according to the characteristics of research results achieved by the university or institute as well as various types of industry-academia collaboration, such as IP management, joint research, dispatch of consultants, and creation of university-based venture businesses. TLOs should, irrespective of where they are established, carry out technology licensing while considering how the licensed technologies will be positioned in the market.

Since technological seeds, as they are, cannot be dealt with as objects for commercial transactions, it is necessary to transform such seeds into new products. Development of new technology intended for product launch should be carried out by the licensee's project management team under an efficient management system based on the market voice, while creating specific designs for trial models and test models of the new product. At the same time, the R&D department should develop production lines for the new product in cooperation with the manufacturing department. Until the new product yields sales, a huge investment should be made to cover the process from the basic research stage to development and launch of the new product. Both R&D and product launch require a great amount of money. TLOs must acquire basic skills in the area of financing and awareness as investors, in order to be able to support a successful product launch.

Basic technologies developed with such investment in this process will form the core of future businesses and therefore should be patented in order to monopolize the market or defend the new product from competitors. In this respect, TLOs are required to be also capable of understanding legal matters including interpretation of the technical scope of patented inventions.

4.1.2 "Market Voice" Gives Rise to Product Clusters after Launch

Even once the new product has been finally launched, the launch ifself is no guarantee of steady growth in the business. When it appears on the market, the new product might face unexpected challenges. Consumers will present high demands regarding the new product, with complaints ranging from trivial ones to those regarding substantial defects. This is the "market voice."

TLOs must be highly aware of the market voice with regard to technical aspects, and react and respond quickly to such a voice with specific solutions, working closely with the licensee. Such a response will create a "product cluster" that will satisfy diverse needs for the new product. In order to establish a strong position in the market, it is also important to develop production technology designed to achieve high-quality and low-cost production, which also requires support from TLOs. Some inventors of technological seeds, due to the perceived size of the innovation, might not consider it significant at all to create a product cluster or develop production technology in response to the market voice.

However, this stage is a critical one in the process of starting a new business. Where a new business faces difficulty in moving forward even after a venture company is established and the new product is launched, it is necessary to form a bridge between the technology and management functions so as to encourage strong growth in the business. This is the core mission of TLOs. In the new business project, the party with a technical background must also be equipped with knowledge and capability in marketing strategy, customer management, and customer satisfaction.

The lack of Management of Technology (MOT) skills is cited as a significant obstacle to business start-ups, and is commonly referred to as "Valley of Death." The essential role of TLOs has been emphasized for the aspect of promoting technology licensing and achieving business start-ups. This is indeed important, but the most critical aspect is to support creation of a market through joint efforts with the licensee in the growth process from launching a new product to creating a product cluster.

4.2 Upgrading TLOs Based on IP Strategy

As a core organization in the area of technology licensing in universities, TLOs need to develop policies and strategies with the aim to establish a market or a business domain created based on the licensed technology. In this process, IP management also plays an important role. At the R&D stage, it is necessary to develop a strategy focused on obtaining broad and strong rights based on basic patents. However, this alone is not sufficient, because technology keeps on advancing. Therefore, in order to obtain rights for improved technologies that will satisfy the "market voice" and maintain and strengthen competitive advantage in the market, it is also necessary to establish a competitive patent portfolio designed to achieve high-quality and low-cost production.

Strategic licensing based on an appropriate patent portfolio is also important. Companies should endeavor to obtain exclusive rights from the perspective not only of surviving domestic competition but also of strengthening the international competitiveness of the country's industry. In order to increase industrial competitiveness, it is also a matter of vital importance to establish products protected by exclusive rights as standard products in the international market. Countries that have huge domestic markets will aim to establish original standards. In this context, international IP strategy with an emphasis on international standardization is critical. The level of market-oriented IP strategy will greatly influence the role of TLOs.

4.3 Formulation of Policies and Strategies Based on Actual Conditions in Individual Countries

In light of the need to formulate policies and strategies based on actual conditions in individual countries, the position of TMCs varies depending on the country's stage of development as follows.

(a) Developing countries that have not yet established IP systems: These countries are introducing foreign technologies mainly with the goal to achieve economic development, and to achieve this goal, they need to establish IP systems. At the same time, these countries are implementing measures to develop universities and national research institutes under a uniform policy for education and science and technology promotion, including the establishment of TLOs.
(b) Countries at the intermediate development stage: These countries have established their status as production bases, and they are currently promoting R&D projects actively for the development of new technology. These countries are implementing IP management and strategies for universities and research institutes, focusing on the use of TLOs, joint research with foreign companies, reverse engineering at universities, venture businesses originating from universities, and industrial application of new technology.
(c) Countries making efforts to become an IP-based nation: In order to ensure coexistence with manufacturing-intensive countries or the factories of the world, these countries are formulating IP policies and strategies for national research institutes focused on creating innovative technology.

It is of great importance to establish TMCs based on each country's stage of development.

4.4 Competencies Required for TLOs

As the last point of issue, we would like to stress that whether or not TLOs will be able to play a significant role in promoting a country's industry depends entirely on the personnel who work at the centers. The majority of technical personnel have an inexhaustible interest in pursuing the truth in scientific fields in which they specialize, but are not so interested in human interactions with others or the practical need to achieve targets based on behavioral psychology. However, in order to manage a group of people and create a new market from a technological seed, activities in these areas cannot be avoided. High-level personnel at TLOs must acquire such "competencies" or the recently-termed "human power," which have been highlighted and categorized based on behavioral psychology, e.g. leadership, motivation, bargaining power, communication skills, and decision-making ability.

Chapter 5 TLOs as Service Providers

For the establishment and management of university TLOs, we were granted the opportunity to conduct a survey of actual conditions in academic-industrial cooperation projects implemented by world-famous universities and research institutions. University TLOs, as a matter of course, are bound to adapt their structures and management to the circumstances in which they find themselves. This chapter will outline a case example of a TLO in Japan whose management is focusing on information service systems. This chapter will also include successful cases in the US and the results of field surveys on TLO activities at China's major universities and research institutions.

5.1 Information Service Function of TLOs in Japan

The TLO's function to provide information externally is very important. To explain this point, let us introduce the experience of the writer and others at the Tokyo Institute of Technology (Tokyo Tech) in Japan. We had the function of a TLO at the Circle for Promotion of Science and Engineering, the TLO of Tokyo Tech, until industry-academia cooperation promotion headquarters were established at the university.

The TLO of Tokyo Tech adopted a membership system at the beginning. The services provided to members were early disclosure of its patents, provision of information through seminars, and individual services such as matching of joint research. What was surprising for us was that the early disclosure of patents was not very attractive to the member companies.

Many opinions were expressed by the member companies when annual fees were paid for membership renewal. Many of the companies quitting to be a member pointed out as the reason that early disclosure of patents was not attractive. Details of the reasons differed between SMEs and large companies.

The reason for SMEs was that the region of their activity was relatively limited compared to that of large companies and that the likelihood of the university providing the patent information exactly fitting their scope was small. The reason for large companies was that they had conducted enough surveys about university research and knew well through academic meetings and researching theses what patent would emerge from which teaching staff, so the patent information offered was not very attractive. The advantages of continuing to be a member were indicated by the members' replies as follows.

Opinions often expressed were (1) TLO seminars limited to the members given by internal teaching staff about certain topics and (2) the efforts to make a team of internal researchers in different research fields are attractive, and (3) the provision of topics for university research are desired to be continued in the future. There is an empirical rule that the possibility of quitting membership is low for companies involving in the joint research which started under TLO coordination. This may be because (4) the company is satisfied with the matching function, i.e. to find internal teaching staff to satisfy the needs of the company.

Thus, it became clear that companies surprisingly did not desire an early disclosure of patents by the TLO, and that what was attractive for them was the service to provide the information on university research by processing it into secondary information to suit to each company's need and to secure their access to the university's research resources. In other words, what Japanese large companies expect of industry-academia cooperative organizations of universities is the provision of information on university research, and the information expected is not the primary information obtainable from the ordinary sources like websites but secondary information processed to meet the needs of the individual company.

The writer and others, at a later date, after an opportunity to research the Massachusetts Institute of Technology (MIT) in the US, found out that the Industrial Liaison Program (ILP), services provided by the Office of Corporate Relations (OCR) of MIT, have similar service contents. The ILP was established in 1948 for 12 member companies and it now has nearly 200 member companies. As of February 2003, the number of members was 173, mainly large companies. Many large Asian enterprises are included in the membership including about 30 Japanese companies and 12 to 15 Taiwanese companies. The services provided by the ILP of MIT are as follows.

The services provided by the MIT ILP (in OCR)

- Maintenance and management of the research information database of MIT
- Research reports customized for each member
- Monthly MIT Report on research and development and new theses
- Bimonthly E-Note on recent research and events
- Obtaining research papers and publications on request
- Arrangement of visits to meet teaching staff and visiting of laboratories
- Arrangement for dispatch of teaching staff to companies (technology training and introduction)
- Participation in closed workshops with the teaching staff
- Participation nine times per year in ILP Research Conferences with no additional charge
- Arrangement of videoconferences linking teaching staff and a company
- Discount of tuition fees for MIT Business School
- Coordination of joint research (one to one, consortium)
- Coordination of dispatch of company researchers to MIT
- Introduction of MIT students to companies
- Dispatch of MIT students for internships
- Coordination of international inter-university agreements and of alliances with companies
- All other MIT information companies cannot obtain by themselves

The ILP services that the OCR of MIT provides are not patent-related services. Almost all the services that were popular at Tokyo Tech TLO are included in the ILP of MIT. It has become clear that, because the OCR is an internal organization of MIT, its services related to dispatching and introducing people are more welcoming.

What are the services large companies in advanced countries including the US desire from universities? Generally, companies already know that many of the research results of universities and research institutes at an early stage require a long time before commercialization. Therefore, from universities and research institutes, external companies do not seek technology that they can obtain direct licensing for and commercialize immediately. The bigger the company is, the stronger this tendency. The reason is that large companies have their own R&D function and conduct R&D for items close to commercialization by themselves.

As a result, what is requested from universities and research institutes is the information on technology seeds that will bloom in 10, 30, or more years later that companies cannot afford to research. In this sense, it is possible to say that the research contents of universities/research institutes and those of companies can coexist in society separately. The above ILP meets the expectations of industry well.

Incidentally, for the ILP alone membership income was US$8.2 million and the number of ILP staff 45. We would like to emphasize that, in order to provide information that external companies judge

worthwhile paying a large membership fee for, not only it is essential that universities and research institutes continue to achieve excellent research results but also that the organization in charge of providing information has sufficient funds and manpower.

5.2 Example of TLO in the United States

MIT has another organization called “TLO” in parallel with the above-mentioned “OCR.” In this section, we will describe MIT as a successful example of TMC management in an advanced country, and introduce the type of organizational structure MIT has built in order to realize its TMC function. The TLO function is realized by the combination of three offices, which are the OSP, TLO, and OCR. The TLO and OCR are organized in parallel with each other. The following paragraph will introduce each organization.

The functions of the OSP (Office of Sponsored Program) are to conclude contracts concerning external funding provided by companies and government organizations, to maintain and manage the contracts, and to promote and manage related projects. The management of joint research, entrusted research, and matching funds are included in the work of the OSP. The negotiations to protect the benefits of MIT and researchers are also conducted.

The functions of a TLO are to obtain rights for MIT technologies, license them to existing or start-up companies, and commercialize and make products from technologies at an early stage of development that originate from the university.

The function of an OCR (Office of Corporate Relations) is a Liaison Function, so to speak, but the scope is extensive. The OCR of MIT provides a membership information service called the Industrial Liaison Program (ILP). In addition to the ILP, they prepare the presentation materials and so on when the university's management and teaching staff give press releases or discussions are held with corporate management. The OCR is also in charge of international university affiliations and partnership formation with corporations. In other words, OCR is a contact point for external parties to obtain MIT-related information.

Many of these functions have a different nature from the conventional functions of the offices of universities or research institutes. The functions of the OSP are adaptable to some extent as an internal organization of universities or research institutes, so it may be possible to establish it as an internal organization. The functions of a TLO and OCR, however, greatly differ from the conventional functions of the offices of universities or research institutes.

There are two parties to which these functions provide services, one being the researchers within the organization and the other being outside companies. Outside companies are working on the principle to prioritize company profit and the handling of research results is basically undisclosed. On the other hand, universities and research institutes are working on the principle to give priority to public profit and research results are basically open to the public. The TLO and OCR that are interfaces between the university and companies have to understand the difference and find common ground. For this reason, it is necessary for them to be established as an interface between internal organizations and external organizations and place them in charge of coordinating the policy principles for both research organizations and external companies. The TLO and OCR of MIT are organizations within the university but retain independence in setting personnel and organizational targets and are positioned well with their status in between that of internal and external organizations.

5.3 Example of TLO in the People's Republic of China

As another example, let us look at People's Republic of China (China). Shanghai Jiao Tong University (SJTU), located in Shanghai of China and established in 1896, has 21 schools (faculties) including those for engineering, science, and agriculture and is a research university with 4,000 students and staff. What conducts the function of MIT's OCR at the SJTU is the National Technology Transfer Center (NTTC).

SJTU points out as university functions "human resource development," "science research," and "social services." The function of NTTC is in charge of is "social services." The characteristics of SJTU's NTTC is that it has the function of conducting international industry-academia cooperation to transfer the technology of overseas universities to domestic companies in addition to the function of domestic industry-academia cooperation to transfer the technology seeds of SJTU's researchers to domestic companies. In addition to this TLO function, it contributes to international industry-industry cooperation including transferring the technology of overseas companies to domestic companies, personnel exchanges between companies, and conducting outsourced research.

In China, the technology that Chinese industry wishes to obtain does not necessarily belong to universities. Rather, the technology China wants in order to become the world's production base often belongs to the industries of advanced countries. Therefore, they say the reason to work on the above international industry-industry cooperation is, placing industry-industry cooperation with overseas companies as an important factor, to try to do it as a social service of the university.

We would like to explain here about the characteristics of research at Chinese universities and companies. The writer and others visited Tsinghua University of Beijing in China in October 2005 to conduct a survey and asked the University's teaching staff who had studied in Japan to give frank opinions about industry-academia cooperation in China. Based on the survey, in industry-academia cooperation in the current China, what many industries seek is not state-of-the-art technology but generalized technology necessary for China to function as the world's production base.

Meanwhile, university researchers desire to conduct world-class basic research in general and many of their research contents are basic and far from industrialization. In China, university research is aimed at the basic technological stage and company research at the applied technological stage, making for a big gap in technological stages between universities and industry. Nevertheless, Chinese researchers have to try to satisfy the needs of industry in order to obtain research funds and there is said to currently be a trend to shift the research content to applied technologies for research fund raising.

The international industry-industry cooperation that SJTU's NTTC is attempting is in order to transfer the technologies that domestic industries seek, from foreign companies possessing the technology to domestic companies. In such industry-industry cooperation, the involvement of universities has several merits. One is to use the reputation the university has. SJTU is a famous Chinese university and has the strong trust of surrounding municipalities and companies. Its screening service is effective for foreign companies if it provides the service to find a party for a technological tie-up or joint development based on such relationships of trust. In other words, there is the merit of enhancing the possibility to meet trustworthy companies and personnel.

In addition, the university has neither a funding relationship with nor is it a company belonging to a corporate group. In comparison with private consulting companies, the university can therefore be more neutral in its compiling of survey reports on technological trends and in recommending partner companies and personnel. This is another advantage of the university.

The above industry trend is basically a stereotype. The number of Chinese companies in the same

stage as the companies in the advanced countries seeking technological seeds for the future that they cannot create by themselves is increasing. For these companies, SJTU's NTTC is trying to meet a wide variety of needs by playing the intermediary role of transferring SJTU's technological seeds or state-of-the-art technology from foreign universities.

5.4 Information Service Function of TLO

With TLO functions, especially in technology distribution and provision of information, various kinds of services to meet the needs of society are possible.

In the case of famous American universities like MIT, the expected function is to continue offering updated information to meet the demand of companies that want to make exchanges with MIT. In the case of China's SJTU, the university is using its advantages to play the role of distributing technological information that domestic companies desire regardless of whether it is from overseas or within China or whether it is from a university or industry.

When designing a TLO, it is necessary to meet the needs of industry of their own country. At the same time, the globalization perspective must be taken into consideration. The OCR in MIT is accepting as members and providing services to not only American companies but also other multinational companies and foreign companies. SJTU's NTTC understands the technological needs within China accurately and providing services in a way to meet the needs of both foreign companies and Chinese companies. Thus, it is necessary for TMC in this globalization era to provide the services necessary while taking the relationship with foreign countries into consideration.

Chapter 6 Checklist of Matters to be Verified When Establishing or Evaluating a TLO

As described up to the previous chapter, for a Technology Licensing Organization (hereinafter TLO) to function as an organization to protect and use the results of research at universities and research institutes as intellectual property, the real activities become possible only when the essential factors are prepared including various management policies for actual practice, infrastructure such as contract models and databases, and specialists, based on the ground design constituting of laws, management policies of universities and research institutes, and government support measures. The essential factors necessary for each stage of establishing a TLO and of evaluating the TLO after its activities begin are described in the following checklist.

6.1 When establishing the TLO

What is important at the time when the ground design is made is the mission the TLO should have and whether an appropriate environment to perform the mission has been prepared. The basic ideas are described from Chapter 1 to Chapter 5. To put them into practice, the following factors at least are necessary.

6.1.1 Management Policy

This is classified into two types. For one thing, from the viewpoint of TLO governance, it is necessary:

(a) to formulate regulations on the transfer of inventions from inventors belonging to the organization,
(b) to formulate regulations on the transfer from external inventors such as researchers or students,
(c) management of conflicts of interest,
(d) regulations on profit distribution, and
(e) respective responsibilities and roles of universities, inventors, and TLOs.

The other important thing is the leitmotif of the TLO's technology transfer activity, which is:

(a) an indicator to assess inventions,
(b) an indicator to determine whether or not to apply for a patent,
(c) an indicator to judge on licensing and transfer, and
(d) an indicator to determine suspension or abandonment of the application.

Transparency is important for any of these regulations and indicators.

6.1.2 Various Contract Models

These agreement models are essential for:

(a) a joint patent application agreement,
(b) a license agreement.

Depending on the scope of each TLO's duty, the models are also necessary for:

(c) a technology consulting agreement,
(d) a material transfer agreement (MTA),
(e) a non-disclosure agreement (NDA),
(f) a joint research agreement, and
(g) an entrusted research agreement.

It will be necessary to prepare various types of agreement models depending on whether the type of organization is a private company that prioritizes profit-making or a non-profit making research institute, and whether the handled IP includes an item with a physical existence, software, know-how, etc. in addition to patents. In any case, it should be based on the policy described in 6.1.1 above.

6.1.3 Cooperative Scheme Conducted with Related Organizations

The major party differs depending on the type of organization[1], but cooperation is necessary with:

(a) the researcher who is the inventor,

(b) the private company, the start-up company or the research institute to which the technology is transferred,

(c) the law office or patent agency,

(d) the administrative section for finance, personnel, and contracts of the university or research institute,

(e) venture capital, Angel Fund , Certified Public Accountants (CPAs), tax accountants, management consultants, etc. if the duties include start-up support, and

(f) the human network in the region.

At any rate, how the scheme is designed to be practical in its functionality has a big influence on the success of the TLO whose mission is "Transfer."

6.1.4 Staff

The experts who actually manage the above are the most important factor to the success of this organization, and personnel with the following skills and knowledge is essential regardless of the type of TLO:

(a) evaluation of the technology itself that is the seed,

(b) evaluation from the viewpoint of using intellectual property such as patentability,

(c) marketing based on the needs of industry,

(d) legal affairs for contracts (legal knowledge including the Patent Act, Act on Prohibition of Private Monopolization and Maintenance of Fair Trade, Unfair Competition Prevention Act and negotiation for agreements), and

(e) peripheral knowledge including related government policies and a public support system.

With the TLO that emphasizes start-up support, the personnel with:

(f) the skill to build a business model or the skill to raise funds is important.

With an internal type TLO,

(g) the manager plays an important role. From a university governance perspective, he needs to have an understanding of basic policies regarding industry-academia transfers and the 2nd university revolution, the American type industry-academia technology transfer model and its achievements[2], and the universities and research institutes that were the base for the achievements. He also needs to oversee individual technology transfer activity.

In any type of TLO,

(h) a back office that maintains and manages the organization, stores necessary data, and takes charge of general affairs and personnel is necessary as the base to support the above activities carried out by experts.

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[1] For details, refer to the respective Internal, External, and Boundary types in the above 2. Organizational models of TLO (3).

[2] For details, refer to the above 2. Organizational models of TLO (1) and (2).

6.2 Evaluating TLOs Following the Start of Their Activities

In case of problems such as a differences arising from ideas or surrounding conditions at the time of establishment, the issue of system design not matching reality following the start of operations, and any other trouble, it is necessary to examine the structure and policies of the organization by dealing with the trouble. Even if there is no clear sign of problems, examination from the following perspectives with a view to best practice is effective for maintaining and developing the organization's dynamism.

(i) Practice of management policy: Whether it is carried out according to the basic policy formulated at the beginning.

(ii) Organizational system: Whether the organizational structure is appropriate for performing the mission.

(iii) Personnel assignment and performance: Whether the minimum number of personnel appropriate for the organization's mission is secured. Whether the performance is appropriate. Whether it is well balanced without imposing an unfair burden on one part of the organization.

(iv) Target and accomplishment of activities: Whether the setting and accomplishment of the targets are appropriate. The achievement of licensing in advanced countries like the US has an impact in target value terms, but the management of terms such as "the appropriate number of days from evaluation of the invention to completion of the application" is an important achievement for a TLO that has just been established.

(v) Cooperation with related external organizations: Whether the exchange of information is smoothly carried out. Whether there is any sectionalism. Whether human networking among related people is satisfactory.

(vi) Evaluation by the customers: Whether the evaluation by the source of the seeds of "Transfer", by the organization to which the technology is transferred, and by the inventor is sincerely accepted. Whether necessary improvement is made.

(vii) Transparency of the organization: Whether the decision-making process is appropriate. Whether publication and management of information is carried out properly. Whether their checking and feedback is functioning properly.

The above are the check items common to any type of TLO at an early stage of existence, and with these basics as a foundation, there are individual issues and measures applicable for each TLO. For comments relating to building the only and best TLO model for individual universities and research institutes, please refer to the information on past examples in Chapter 5 of Part 1 and Part 2.

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