The Policy of Promoting University-Industry Collaboration in Japan

-The Impact and Issues of University's Technology Licensing Organization in Japan-

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Abstract

University industry collaboration is at a crossroad in Japan. Since the 1990s, lack of interaction between University and Industry and under-exploitation of University research have been cited as the key factors that caused Japan to lose its international competitiveness. National Innovation System that promotes university-industry collaboration is particularly essential in today's information technology and knowledge-based society. As a way to promote innovation and to reconstruct its innovation system to regain International competitiveness, Japan's Science and Technology Policies is undertaking a great challenge in linking university research to industry. The related legislations have been changed over the last couple of years to promote this initiative. One of this is "The Law Promoting Technology Transfer of Universities" which was enacted in August 1998 to pave the wave for the establishment of University's Technology Licensing Organization (TLO). The aim of TLO is to encourage the patenting of university research and channel the University's intellectual property into the industrial sector. As of today, 26 TLO have been established. These TLO are expected to provide monetary incentives and other feedback, and breathe new life into the university system in Japan by improving the applied dimension of research and serving society more directly

The object of this study is to dig into policies, law and model for University transfer technology in Japan. The purpose of this paper is to study the impact of the establishment of TLO particularly to examine its effectiveness for the promotion of high-tech innovation and entrepreneurships in Japan. This paper also presents problems and issues encountered by TLO based on a questionnaire survey sent to the 20 approved TLO in Japan in July 2001. Finally, the importance of cross-sector interaction between university researchers, private companies, venture capital and entrepreneurs will be explored.

1. Introduction

What role does university play in transferring or exploiting its science and technology knowledge? This issue has drawn great interest among policy makers, academics and industry (Manfield 1991, Nelson 1993, Rosenberg & Nelson 1994, Yong 1995, OECD 1997, 1999). Although many people particularly academics considered that university-industry collaboration will be a threat to the integrity of academic research, but the major consensus in Japan now is that university can and should contribute to technological innovation of industry and increase competitiveness of the economy. The motives for the university-industry collaboration vary and depend on the needs of respective party. Table 1 provides the summary for some of the major motives spurring the collaboration between industry and university (Wu 2001).

Since the 1990s, lack of interaction between University and Industry and under-exploitation of University research have been cited as the key factors that caused Japan to lose its international competitiveness. National Innovation System that promotes university-industry collaboration is particularly essential in today's information technology and knowledge-based society (OECD 1997, 1999). As a way to promote innovation and to reconstruct its innovation system to regain International competitiveness, Japan's Science and Technology Policies is undertaking a great challenge in linking university research to industry. This policy is largely influenced by the success of America experience that university can help restore competitiveness by promoting university-industry collaboration such as licensing of the

patents in the university.

Table 1: Major motives for the industry and university collaboration

For the industry	For the university
1. Obtain knowledge of basic research and emerging technology 2. Obtain direct technical support 3. Increase interactions with other organizations or technical staff 4. Reduce costs and risks 5. Shorten learning curves 6. Obtain access to expensive facilities 7. Gain vital knowledge about competitors 8. Stipulate creativity for R&D 9. Recruit promising students as future employees	1. Increase source of research fund 2. Provide opportunities to learn about new industrial practices 3. Seek Opportunity to use facilities of private enterprises 4. Enhance understanding of business value and stimulate innovation 5. Provide students with opportunities for jobs 6. Gain access to industry funds with less red-tapes

Source: Wu (2001)

In the middle of 90s, the policy makers have initiated some drastic institutional transformation in its policy for promoting university-industry collaboration in Japan. Some related legislations have been changed over the last couple of years to promote this initiative. One of this is "The Law Promoting Technology Transfer of Universities" which was being enacted in August 1998 to pave the wave for the establishment of University's Technology Licensing Organization (TLO). The aim of TLO is to encourage the patenting of university research and channel the University's intellectual property into the industrial sector. As of today, 26 approved TLO have been established[1]. These TLO are expected to provide monetary incentives, feedback and breathe new life into the university system in Japan by improving the applied dimension of research and serving society more directly.

The object of this study is to dig into policies, law and model of technology transfer of the university in Japan. The purpose of this paper is to study the impact of the establishment of university's TLO particularly to examine its effectiveness for the promotion of high-tech innovation and entrepreneurships in Japan. However, before we go into the detail of this, we will glance through some brief history of the university-industry collaboration system in Japan. This paper also presents a framework based on the concept of National Innovation System (NIS) for analyzing the significant and impact of the TLO. The problems and issues encountered by TLO will be discussed based on a questionnaire survey sent to the 20 approved TLO in Japan in July 2001[2]. Finally, the importance of cross-sector interaction between university researchers, industries, venture capital and entrepreneurs will be explored.

2. How does TLO fit into the NIS framework

The concept of National Innovation System (NIS) has been used as a tool for policy analysis and served as a guide for science and technology policy formulation now. As opposed to the "linear model of innovation, the concept of NIS provides systemic approaches for us to understand the nature of innovation in a country. This concept helps the policy makers to identify leverage points for enhancing the performance of innovation and overall competitiveness.

Ironically, Freeman (1988) is the first to use this concept trying to explain the prowess of Japanese economy during 70s to 80s. Japanese government, especially Ministry of Trade of Industry (MITI), 'Keiretsu' firm, social and institutional changes in the innovation system of Japan were cited as the key factors contributed to the competitiveness of the Japanese economy during that period. Since then, with better understanding of the innovation processes and recognizing the economic importance of knowledge, we have seen some theoretical advances of this concept . It highlighted the significant role of knowledge creation in university and emphasized the importance of interaction

[1] The TLO, once approved by the Ministry, will be eligible to receive incentive such as subsidies. Please note that here are also a number of universities which have set up their TLO but did not submitted for approval due to their own reasons. However, the scope of this paper basically only deals with issues of approved TLO.

[2] When the survey was conducted on July 2001, there were only 20 approved TLO exist.

between university and industry (Lundvall 1992, Nelson 1993, Edquist 1997, OECD 1997, 1999, 2001, Liu & White 2001).

NIS is consists of a set of organizations or actors and institutions that determine the innovation processes in a country. Here, the organizations are referred to government, industry, research institutions and universities. While the institution are the set of practices, routine, rules and laws that influence the actors[3]. Innovation is the results of the interaction of the actors and institutions. Basically, this paper follows the general framework proposed by Liu & White (2001) that focus on the five interdependent fundamental activities for analyzing innovation systems. These five fundamental activities are (1) research & development, (2) implementation, (3) end-use, (4) education and (5) linkage. Rather than just describing the individual role of organizations and institutions, the framework focuses on the performance of a system's structure and it studies the dynamic in the systems that explains the significant of the arise of new institutions and new organizations (Liu & White 2001).

In the context of this paper, we consider university-industry collaboration as a key component and as an importance sub-system in NIS. TLO is considered as a new set of organization or player created to improve the "linkage" activity in the NIS. Thus, overall NIS performance could be improved by enhancing the linkage of university-industry collaboration.

3. Brief history of the university-industry collaboration in Japan

In 2000, the R&D expenditure of Japan for research and development (R&D) stood at 16 trillion Yen, which was the second largest R&D expenditure country in the world. In terms of the amount of R&D spending against GDP, Japan has increased its ratio from 1.96% in 1975 to 3.14% in 1999, which is the highest percentage in the world today. Industry sector is the largest contributors and it has increased its R&D spending from 1,589 billion Yen in 1975 to 10,630 billion Yen in 2000. Industry's R&D spending accounts for 58.5% of total R&D spending in 1975, it increased to 69.7% in 1990 but dropped a few percentage to 66.4% in 2000. On the other hand, the R&D expenditure of university sector accounts for 26.4% in 1975 but decreased to 18.0% in 1990. Since then, university sector R&D spending remains at around 20% of total R&D spending. It is interesting to note that the funds channel from industry sector to university sector was low and it only channeled around 2% of university's R&D spending for last ten years. This may imply that the state of industry-university collaboration in Japan was less than satisfactory (Table 2).

Table 2: Research activities of science and technology in Japan (1975--2000)

	Expenditure on research and development (disbursement) (in billions of yen)					
Year	Total	Industry (%)	Research institutions (%)	Universities (%)	Universities R&D Funding from Industry (%)	Total R&D/ GDP(%)
1975	2,716	1,589 (58.5%)	409 (15.1%)	718 (26.4%)	-	1.96
1980	4,584	2,665 (58.1%)	660 (14.4%)	1,258 (27.5%)	-	2.04
1985	7,894	5,137 (65.1%)	1,033 (13.1%)	1,724 (21.8%)	-	2.55
1990	11,815	8,234 (69.7%)	1,451 (12.3%)	2,129 (18.0%)	38 (1.7%)	2.83
1995	13,596	8,980 (66.1%)	1,863 (13.7%)	2,753 (20.2%)	53 (1.9%)	2.76
1998	15,741	10,658 (67.7%)	2,024 (12.9%)	3,059 (19.4%)	60 (2.0%)	3.03
1999	16,140	10,800 (66.9%)	2,117 (13.1%)	3,223 (20.0%)	59 (1.8%)	3.14
2000	16,011	10,630 (66.4%)	2,171 (13.6%)	3,209 (20.0%)	-	3.12

Sources: Science and Technology Indicators 2000, Science and Technology White Book 2001

In Japan, there are two types of universities. One is public university that consists of national and local government universities and the other is private university. As of end of 2000, Japan has total number of 649 universities. It consists of 99 national universities, 72 local goverment universities and 478 private universities. Historically, except for a few private universities, national universities are the main actors in the research activities in Japan. The resources also highly concentrated in a number of old imperial universities such as University of Tokyo, Kyoto, Tohoku, Nagoya,

3 The "institutions" here refers to the concept defined by North (1990).

Kyushu, Hokkaido.

How does the structure of R&D activities evolved in the context of university-industry? We begin by examining the brief history of the role played by each actor in the innovation systems in Japan After the second world war, the main concern of the university is to help industry in improving existing technology and introducing oversea technology to the industry. Although universities in Japan have played an important role in developing industry technology, their main contributions are mainly to act as gatekeeper in introducing, assimilating and implementing advance technology through training of postgraduate researchers and engineer to the industry.

The government has been playing an important role in promoting technology development in Japan. In the context of promoting university-industry policy, Ministry of Trade & Industry (MITI), Ministry of Education (MOE) and Science and Technology Agency (STA) are the three main actors. In 1961, the "Law on Industrial Technology Research Association" was promulgated and from 1963, MITI has initiated to promote R&D collaboration between industry-public research institution- university which the research associations have been formed to carry out targeted research project. One of such project is "the VLSI Technology Research Association" which is well known for its contributions to the development of Japanese semiconductor industry[4]. On the other hand, MOE was not active in promoting collaboration between university-industry until 1980. With pressure from both oversea and domestic that called to search for its own indigenous technology and carry out more basic research, MOE has also established various systems in promoting collaboration between university and industry. For example, a program called "Joint research with private sector" was created in 1983 to encourage researchers of national university to conduct joint research with industry's researchers. This joint research is carry out by the university and industry's individual laboratory. Center for co-operative research were being set up in various national universities to promote full scale co-operation with the private sector. Other program includes "commission research" which allows industry to sponsor the researchers of the university to carry out R&D activities for them. The university is allowed to receive grants and endowments from private sector for doing scientific research and educational activities[5].

Since 1960s most of the private companies have started to set up their own "Central Research Laboratories" to carrying out in-house R&D activities. Apparently, these companies have recognized the importance of the technology development and devoted its efforts in improving existing or imported technologies. In early 1980s Japanese companies started to invest heavily in R&D activities by themselves. As a result, some of the private companies have built up and improved their research capability significantly and some of them have higher research capability than national university. In 1980s, in spite of the government called to promote collaboration of R&D inside Japan, some companies choose to search for the source of technological innovation from overseas universities due to the lack of mechanism in providing linkage between universities and industries.

4. Factors contributed to the establishment of university's TLO

In the middle of 90s, the need for technology transfer from university to industry has become a major policy agenda in Japan. Admittedly, researchers inventions in universities are not fully exploited in Japan in spite of above mentioned programs that called for more university-industry collaboration. Policy makers in Japan have studied the problems of their policy from institutional perspective. The following institutions factors in the university's technology transfer systems have been identified.

First of all, the patent system was considered as one of the fundamental problems that caused the low technology transfer rate from university. National universities in Japan are directly under the jurisdiction of MOE and considered as a division of MOE. As such, the faculty members are employed as public servants and subject to the law governing public servants. Thus, the national universities in Japan do not have legal personality. Besides, the law and rule concerning the right to own the patent in national university is very ambiguous and complicated. Generally, the rule and law concerning the right to own the patent in national universities are as follows. If the invention made was the result from the funding of government and the nature of research itself is applied research, then the inventor shall report this to the university invention committee. If the university invention committee considered this as a national invention, then the inventor must assign their right of the invention to the government. In fiscal year of 1999, there were in total 1,725 inventions reported to the university invention committee and only 281 inventions have been judged as national inventions. The right for the remaining 1,444 inventions have been passed back to the inventors. As such, we can say that most of the investor retains the right to own the patent in Japanese national university. Nonetheless, most of the

[4] For the history of technology policy in Japan and the role played by MITI , see Harayama (2001)

[5] For the examination of the policy initiated by MOE in encouraging joint research of university-industry see Wen and Kobayashi (2001)

faculty members were not keen in patenting their invention due to the high cost in filling and maintaining the patent. On the other hand, most of the professors maintain informal relationship with the private companies from industry through recommending their students to work in the companies after their graduation. Additionally, the professors in national universities is willing to pass their inventions to the companies without proper contract based on this kind of informal and long-term relationship. Beside patent systems, there are other regulations such as the law prohibited faculty members in national universities to provide consulting service or serve as a board member of a private companies have dampened the motivation of faculty member to actively promote and commercialize their research.

The second factor that constrained the development of university-industry collaboration is the lack of policy coordination between the MITI, MOE and STA. As mentioned above, "research association" program initiated by MIT and "joint research" program initiated by MOE have been carrying out separately without coordination of both parties Even though STA is the planner overseeing the whole Science & Technology Policy development, MITI and MOE have been the key players in implementing the overall policy. The different between MITI and MOE is that MITI has emphasized more on industrial technology while MOE has overly stressed on the academic science. This has reduced the effectiveness as most of the program did not address the patent issues concerning national university. So far, we can say that most of their programs were largely based on the linear model of innovation that considered innovation starts from the seed of technology and therefore neglected the importance in providing linkage and interaction in university-industry collaboration.

Furthermore, the research collaboration implemented by the MITI and MOE have been driven by large established companies and neglected the importance of entrepreneur who is willing to undertake risk to commercialize university's technology. From the America experience, high-tech start up entrepreneurs from university is playing important role in the development of the economy. Thus it is also important to nurture venture capital industry to support the entrepreneurs from university and also to provide sufficient infrastructure such as incubators and science parks closed to university.

Beside this, low personnel mobility in the labor market among the researchers of universities and the staffs of private companies, the red tape of the university for receiving grant or endowment from the private sector and the mindset of the industry sector toward the research capability of the universities are some of the institutions factors that has limited the role played by university in the innovation system of Japan.

5. Institutional changes in university-industry collaboration

After identifying above problems, policy makers in Japan have implemented a new policy to encourage university to establish TLO to facilitate technology transfer through licensing of their inventions. In the middle of 90s, Japan has initiated some drastic institutional change to accelerate technology transfer from university and has implemented new policy for the establishment of university's TLO. This TLO model was based on the America experience and similar to the Bayh-Dole system in the U.S that allows university to exploit its intellectual property right. The related legislations have been changed since then to promote and enhance the effectiveness of this initiative. Some of the major legislations are "Science and Technology Basic Law" in 1995, "the Law Promoting Technology Transfer of Universities" in August 1998, "Industrial Revitalization Plan" in 1999, "The Law on Reinforcing Industrial Technology " in April 2000 and other related legislations. Some of the key points of the particular legislations were shown in Table 3. With this, it allows university to establish the Technology Licensing Organization (TLO) to manage its patent and carry out of technology transfer activities through licensing of their patents to private companies.

6. The mechanism of TLO in Japan

Basically, there are three types of university's TLO in Japan. TLO can be formed as a "stock holding company" (kabushiki-kaisha), "a foundation corporation" (zaidan-houjin) or just as an "organization inside university" (gakunai-soshiki). However, the national university in Japan does not have legal personality and it cannot carry out business activities. Thus, it has to set up its TLO as either "stock holding company" or "foundation corporation" to carry out technology transfer business. As for private university, most of them have set up TLO as "an organization inside university". In fact, most of the "stock holding" TLO were founded and managed by the faculty members of the respective universities. The main objective of TLO is to transfer research achievement of universities to private sector through the licensing of the patent and receiving the income such as royalty from the private sector in return. This income will be distributed to universities and faculty members that owned the patents. The university and faculty members can use the fund to improve the research infrastructure. Below are the main functions of the TLO as illustrated in figure 1.

Table 3: Related legislation for promoting industry-university collaboration

Related legislation	Key Points
The Science and Technology Basic Law	● R&D system reforms (example: to increase research fund from government to 1% of GDP) ● Reinforcement of competitiveness in industrial technology and enhancement of industry-academia- government collaboration ● Human resource development and educational reform in Science and Technology ● Education of researchers, engineers and reform of universities ● To improve R&D infrastructure
Law for Promoting Technology Transfer of University (enacted May 1998)	● Universities are encouraged to set up TLO and promote technology transfer of university's technology. ● Approve TLO is eligible to an annual subsidy of 20 million Yen per TLO for the first 5 years. ● Approved TLO can apply for debt guarantee to carry out activity of technology transfer and received support for information collection from Industrial Structure Improvement Fund.
Law for Promoting Research Cooperation (amended July 1998)	● To allow private company to set up its research facilities in national universities campus with a discounted price
Special Law on Public Servants in Education (enacted April 1997)	● Faculties member in national university are allow to conduct research and consultant for the private company
Industrial Revitalization Plan (enacted August 1999)	● To allow private companies to own 100% of the intellectual property rights gained through government funded research
The Law on Reinforcing Industrial Technology (enacted in April 2000)	● To allow approved TLO to use facilities located on national university campuses free of charge ● The faculties member of national universities are allowed to become member of the board of director and the auditor of the private companies such as TLO
Other measures	● To allow national university to employ faculties member on fix-term basis ● To allow faculty member to take unpaid leave to concentrate on the research without jeopardizing their pension contribution ● To promote entrepreneurship and technology management education in universities ● To send patent advisors to TLO

(1) TLO is to gather information and seek cooperative from the faculty members to disclose their invention.
(2) The technology evaluation specialist of the TLO will work closely with the inventor and perform evaluation of the invention to judge its potential for commercialization.
(3) If there is potential, the inventor will transfer the right to TLO and the patent specialist in TLO will do all the application of the patent.
(4) The TLO will do the marketing and searching for the interesting companies. TLO will disclosed its invention to interested companies through various channels and activities such as seminar, newsletter.
(5) If the private company appeared TLO will then negotiate for the conditions of the technology transfer. The licensing contract will be signed.
(6) Finally, if the transfer were successful, the interested company will pay TLO licensing fees or royalty.
(7) This income will then be appropriated between TLO, university, researcher faculty and researcher who have contributed the patent.
(8) TLO will do all the patents management such as execution of patent right.

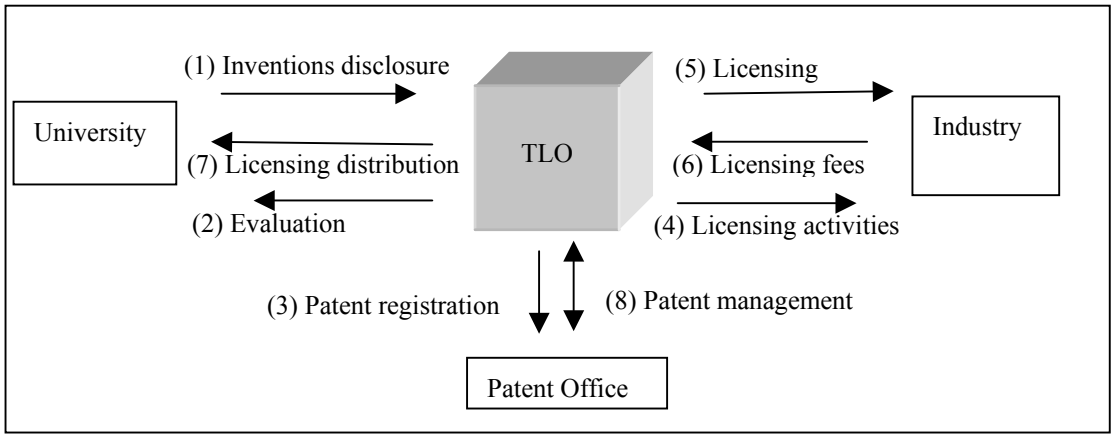

Fig. 1 Function of TLO

6. The impact and issues of the TLO in Japan

As at end of March 2002, 26 approved universities TLO have been established (see Table 6). Among them, 14 are "stock holding", 7 are "foundation corporation" and the remaining 5 are "organization inside university" type of TLO. The purpose of the TLO is to exploit the research achievement of the universities through technology transfer to private sector and university is also encouraged to give support for the creation of new venture or start-up companies from university. Since the first TLO being approved in the end of 1998, we can see significant improvement in the technology transfer from university to industry in Japan. Since the establishment of TLO, 1,306 patents from universities have been submitted through approved TLO for application, 24 patents have been granted registration and 223 of the patents have been successfully licensed to the private sector as at end of September 2001(see table 6). If we breakdown by the type of TLO, "stock holding company" have submitted 620 patents which accounts for 47.5% of total number of patent registered, "Organization inside university" accounts for 32.1% and "foundation corporation" type of TLO accounts for the remaining 20.2%. As for the number of patents registered, "stock holding company", "organization inside university" and "foundation corporation" TLO accounts for 29.2%. 33.3% and 37.5% respectively. Out of 223 of the patents that have been successfully licensed to industry, "stock holding company" is the largest contributors which have transferred 131 patents since the establishment of TLO and it follows by "organization inside university" and "foundation corporation" TLO that have transfer 46 patents so far.

At the same time, we can see a big jump in the number of the university's new start-up company. For the past five years, 87 new companies have been created from the commercialization of university technology (see table 4). The numbers of new companies established have been increased substantially after TLO law was enacted in 1998, of which 26 new companies in 1999 and 34 new companies in 2000, the number has increased five times compared to the year 1996. The government wants to achieve 1000 new start-up companies by year 2005.

Table 4 New university's venture companies established in the past 5 years

Year	1996	1997	1998	1999	2000*
No of new university's venture companies	6	11	10	26	34

Source: The survey of the current status and issues of university's venture companies
*: The number in Year 2000 is for the period of January to September only.

To further enhance the effectiveness of technology transfer system, it is important to find out current state and problems faced by TLO. The author has conducted a postal questionnaires survey in July 2001 to find out this. The questionnaires were mailed to all the 20 TLO, each recipient was asked to answer 23 questions comprised of six sections. Out of 20 questionnaires sent out, 14 were returned. The respond rate is 70%. Among the TLO who has responded, 4 are "organization inside university", 7 are "stock holding companies" and 3 are "foundation corporation" type of TLO. All the TLO were asked to indicate the level of importance of the problems currently faced by them based on the 5 scale of "not important at all", "not so important", "important", "rather important" and " very important". Table 6 shows the percentage that TLO responding to "rather important", "very important" of the problems. The result is that 78.6% of the TLO considered "insufficient specialists of technology evaluation", 71.4 % considered "low practical usage of the technology from university", "insufficient marketing capabilities" and "low awareness toward university's technology" are the major problems. 63.4% have indicated that they are facing the problems of "Low awareness among faculty members", "insufficient specialist of intellectual property" and "government regulations". Lastly, 57.1% are concerned of the problem of "insufficient funding" (see table 5).

However, if we look at the responded answer by the type of TLO, we can see some difference on the percentage between "organization inside university", "stock holding companies" and "foundation corporation". Basically, private university's "organization inside university" has a higher percentage compared with the other two types of TLO on the problems faced by them. It can be interpreted that the level and human resources in private university is far behind of national universities as historically R&D resources are highly concentrated in the national universities. However, as concerning on the problem of "government regulations", only half of the "organization inside universities" considered it a problem whilst "stock holding companies" and "foundation corporation" TLO show a higher percentage. This implies that the rule and law governing the national university is facing more problem than private university in dealing with the government regulations.

Table 5 The main problems face by TLO

		Type of TLO		
Major problems faced by TLO	Overall	Organization inside university	Stock holding companies	Foundation corporation
Insufficient specialists of technology evaluation	78.6%	100.0%	71.4%	66.7%
Low practical usage of technology from university	71.4%	75.0%	71.4%	66.7%
Insufficient marketing capabilities	71.4%	100.0%	57.1%	66.7%
Low awareness among faculties member	64.3%	100.0%	42.9%	66.7%
Insufficient specialists of intellectual property	64.3%	100.0%	57.1%	33.3%
Insufficient Funding	57.1%	75.0%	42.9%	66.7%
Low awareness toward university's technology	71.4%	100.0%	71.4%	33.3%
Government Regulations	64.3%	50.0%	71.4%	66.7%

Source: Lau (2002)
Note: Percentage of TLO who responded to "rather important" and "very important

Table 6 The performance of the approved University's TLO in Japan as of 31 September 2001

	Name of TLO	University (U) involved	Approved Date	No. of Patents Under application	No. of Patent registered	No. of executed licensing contract
1	Center for Advanced Science and Technology	U. of Tokyo	4-Dec-98	142	0	22
2	Kansai TLO	Principally Kyoto U, Ritsumeikann U	4-Dec-98	172	2	25
3	Tohoku Technoarch	Tohoku U.	4-Dec-98	63	3	44
4	Institute of Tsukuba Liaison Co	U. of Tsukuba	16-Apr-99	20	0	3
5	Yamaguchi Technology Licensing Organization, Ltd.	Yamaguchi U.	9-Dec-99	57	1	18
6	Hokkaido TLO	Principally Hokkaido U.	24-Dec-99	42	1	9
7	Kitakyushu Techno Center	Principally Kyushu Technical U.	19-Apr-00	25	0	4
8	Kyushu Liaison Office	Principally Kyushu U.	19-Apr-00	50	0	4
9	Yamanashi TLO Co. Ltd	Yamanashi U., Yamanashi Medical U.	21-Sep-00	6	0	1
10	Tama-TLO Co. Ltd	U. in Metropolitan Area	4-Dec-00	21	0	1
11	Yokohama TLO Co. Ltd	Principally Yokohama National U., Yokohama City U.	25-Apr-01	10	0	0
12	Techno Network Shikoku Co. Ltd	U. in Shikoku area	25-Apr-01	12	0	0
13	Tokyo University of Agriculture and Technology TLO Co., Ltd	Tokyo University of Agriculture &Technology	10-Dec-01	0	0	0
14	Niigata TLO Co. Ltd	Principally Niigata U.	25-Dec-01	0	0	0
	(A) Subtotal of "Stock-holding company" TLO			**620**	**7**	**131**
15	Nihon University Business Incubation Center	Nihon U.	4-Dec-98	147	1	16
16	Waseda Technology Licensing Organization	Waseda U.	16-Apr-99	92	3	10
17	Keio Intellectual Property Center (1999, established 1998)	Keio U.	26-Aug-99	152	3	16
18	Tokyo Denki University	Tokyo Denki U.	14-Jun-00	18	1	2
19	Meiji University Intellectual Property Centre	Meiji U.	25-Apr-01	13	0	2
	(B) Subtotal of "Organization inside University" TLO			**422**	**8**	**46**
20	Center for the Promotion of Science and Engineering (1999)	Tokyo Institute of Technology	26-Aug-99	152	9	27
21	New Industry Research Organization	Kobe U. and others U. in the Kobe region	19-Apr-00	37	0	8
22	Nagoya Industrial Science Research Institute	Nagoya U. and Nagoya Technical U.	19-Apr-00	58	0	4
23	The Foundation for the Promotion of Industrial Science	Institute of Industrial Science, U. of Tokyo	30-Aug-01	17	0	7
24	Osaka TLO	Principally Osaka U.	30-Aug-01	0	0	0
25	Kumamoto Technology and Industry Foundation	Kumamoto U.	30-Aug-01	0	0	0
26	The Foundation of Hamamatsu Science & Technology Research Centre	Principally Shitsuoka U.	17-Jan-02	0	0	0
	(C) Subtotal of "Foundation Corporation" TLO			**264**	**9**	**46**
	Total (A)+(B)+(C)			**1306**	**24**	**223**

Sources: Compiled from http://www.jpo.go.jp/link/tlo.htm (some of the TLO names are translated directly from Japanese names), Ministry of Economy, Trade & Industry (http://www.meti.go.jp/policy/innovation_policy/index.html)

7. Conclusion

The establishment of TLO in Japan has been the result of the institutional change and creation of new actor in the innovation systems of Japan. The decision making process of the policy makers, such as METI and MOE have yielded positive results. In January, 2001, Japanese government has streamlined its administrative structure which MOE and STA have been combined under Ministry of Education, Culture, Sport, Science & Technology (Monbukagaku-sho) and the name of MITI was change to Ministry of Economy, Trade and Industry (METI). It is worthy to note most of the legislations that have changed for the promotion of university-industry collaboration were prepared jointly by MOE and METI. This coordination of policy between different government agencies is very important.

From the above assessment of the TLO performance, it has clearly shown that the introduction of TLO has brought changes to university-industry collaboration systems in Japan. Recently, the MOE of Japan has called for transforming national universities into independent administrative entities, which will give legal personality for them to have greater autonomy as well as more responsibility regarding their management. This would allow university to own patent right and could further enhance the effectiveness of TLO as national university could set up and manage the TLO internally.

However this is just a beginning stage in technology transfer system in Japan to exploit the science and technology knowledge of university. What is more important is that there are still some problems remained in the systems such as the issues concerning lack of sufficient specialists for technology evaluation and intellectual property, legal personality problems concerning national university and the change of the mindset of the professors. For university-industry collaboration to succeed, TLO needs more support from newly start-up entrepreneurs to undertake risk for commercialize the university's technology. So far, development such the establishment of Japan Nasdaq and Mothers, the stock-exchange market enables new venture company to list its share without profit track-record, as an complementary factor in the development of TLO. The cross-sector interaction among university researchers, private companies, venture capital and entrepreneurs should be further encouraged through setting up of incubation center or science park near to the university.

We believe that this is time to call for the rethinking on the role of university not only in developed countries like United America and Japan but also for the developing countries. How to link university's research systems to industry and the society as a whole has become an important macro policy issues which entitled serious attention from us.

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