Final Report

Measures to Promote Intellectual Property Commercialization: Japan Experiences and Implication for Thailand

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Executive Summary

In order to drive the country towards knowledge-based economy, Thailand needs to build innovative capabilities of the nation. Thailand needs to develop intellectual property policy that could tackle the issue in IP cycle; creation protection and especially IP commercialization. As Thailand government has already announced the target of increasing R&D expenditure. However, the investment in R&D alone could not create economic value. The intellectual property is not yet creates economic value until the results are transferred and commercialized. This research explored government policy that support the commercialization of university-based and small business-based research. For university-based research, this research explored the policies formulated during 1990’s in Japan. The policy promote the linkage between university-industry through the establishment of TLO within universities and remove the limitation of technology transfer by changing the ownership system of government funded research result from government to university and industry. The corporation of university helps implement the previous policy by giving university legal status and management ability of its intellectual property and support to TLO. There are tangible impacts after the implementation of policies; the university-industry collaborations were increased. For small business-based research commercialization, Japanese government formulated policy to increase innovative capability of small firm named after U.S. SBIR. The program provides support in form of grant and extensive supporting measures to support company to achieve commercialization process.

For Thailand, as we are considering adopting the same approach such as ownership system, there are further considerations such as scope of IP rights to cover or small business preferential. The political leadership is of important to implement cross-cutting issue as IP. However, from Japanese experience, the increase of licensing activities to industry does not always equal successful commercialization. The emphasis might be the collaboration on joint research which take into account the needs of industry from the start and could lead to a successful commercialization. The support to small business not only funding but also a technical and business advisory will be needed. The policy support that ties with financial institution would serve small business as a bridge from pilot scale to commercial production.
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Chapter 1: Introduction

1.1 Research Rationale

Thailand is a country situated geographically in a central of South East Asia. The country has been blessed with natural resources. However, in knowledge-based economy whereby a resource is limited, a capacity to develop and innovate new products is considered a key factor for economic growth. In order to achieve economic development presently involving the development of technological capabilities and the eco-system that encourages the capacity to innovate and to commercialize is needed.

Recently, Thailand has been upgraded from middle income country to upper middle income country which is a result of constant foreign direct investment (FDI). However, in order to keep a sustainable growth and to be able to move away from middle income trap, Thailand needs to focus on improving productivity by promoting domestic development of technology by using Science Technology and Innovation. Thailand recently launched Thailand’s first Science, Technology and Innovation Policy and Plan for 2012-2021. This STI Plan is designed to assist the country in moving towards knowledge-based economy as well as to improve country’s competitiveness and enhance socio-economic sustainability.

However, in knowledge based economy where intellectual property is considered an important factor to help increase country’s competitiveness, Thailand still facing some specific hurdles regarding intellectual property cycle; creation, protection and utilization.

In creation, Thailand still has limited resource with average R&D expenditure of 0.24%. In IP protection, Department of Intellectual Property of Thailand is facing a backlog because of the shortage of patent examiner and limited budget to improve IT infrastructure. And regarding IP commercialization, it is ineffective because of several factors. For example, the lack of uniform policy on IP ownership of government sponsored research creates an unsupportive environment for technology transfer between public funding agency and university and industry. The Missing link between government support and incentives for private sectors to develop a lab prototype to the market and the limited experience on technology transfer in University/research center technology transfer office makes the commercialization rate relatively very low.
Therefore, in order to drive the country towards knowledge-based economy, Thailand needs to build innovative capabilities of the nation. A well-designed intellectual property strategic measure is an integral part of the process to incentivize innovation. Thailand needs to develop intellectual property strategies that could cover the entire issue of IP cycle, IP creation, protection and commercialization, in order to promote technology transfer activities and thereby to improve the country’s competitiveness.

However, this research will mainly focus on government policy and mechanism to support the utilization or commercialization of IP, as Thailand government has already announced the target of increasing R&D expenditure from present at 0.24% to 1% by 2016. The investment in R&D will resulted in the creation of intellectual property which will also increase the rank of country’s competitiveness in the world context. However, besides the investment in R&D one of the crucial issues is a diffusion and exploitation of research. The intellectual property is not yet creates economic value until the results are transferred and commercialized. The emphasis on the exploitation or commercialization of R&D will have an impact on the growth of economy.

This research will cover an intellectual property commercialization in the public sector, which means the IP developed by government funded research, then transferred and commercialized by university start-up/spin-off or private sector especially by SMEs. This research will explore on the support policy and mechanism to bridge the so called “valley of death” during the commercialization process. In commercializing the IP, the path between developing basic research into commercial product, researcher or entrepreneur often face an obstacle so called “valley of death”. This valley of death implies to the insufficiency of funding or other infrastructures during intermediate stage of commercialization process. Therefore, this research will also look at the mechanism to bridge the valley of death in order to maximize the government supported R&D effort. And in order to generate economic value out of government funded- intellectual property, apart from developing technology itself, such intellectual property needs to be developed into products or services. Therefore, intellectual property commercialization policy is needed.

Japan, has a long experience of the implementation of government intellectual property and innovation policy regarding the promotion of technology transfer and technology
commercialization more than 10 years. Therefore, with this research, I hope that I can derive the best practice policies of Japan and the mechanism to support the transfer of research results from university, public research institutions and public funding agency to industry and in the end successfully commercialize into product. And in the successful commercialization process, it will also result in socio-economic benefit such as job creation and return of tax payment.
1.2 Research objectives:

- To explore the Japanese government policies and regulations to promote the intellectual property commercialization of government funded research.
- To explore policies and measures to promote IP commercialization of government funded research in SMEs, especially a financial funding mechanism.
- To find out the best practice from Japan’s experience in formulating and implementing intellectual property commercialization policy.
- To develop a policy options and recommendation for Thailand in promoting IP commercialization.

1.3 Research Methodology

- Study and analysis of a government policies and mechanism to promote IP commercialization eco-system especially a policy to transfer the research result from University to Industry in Japan.
- Study and analysis of government policy and measure to promote IP commercialization for SMEs focusing on funding mechanism, this study can be done by means of interviewing government funding agencies and academia.
- Investigate a challenge of Japan’s experience for the past 10 years of implementing its policies in technology transfer and technology commercialization, this investigation can be conducted by means of literature review and interview of government officials and academia.
- Analysis of Japanese’s experience and to develop a policy options and recommendation to support IP commercialization of government funded research for Thailand.

1.4 Expected Benefits

This research is expected to be the source of information and a policy options for government policy makers who are interested in developing the policy regarding the technology transfer and commercialization of government funded research. The detailed study on the development of Japanese policy about the promotion of technology transfer and commercialization during the 1990’s adapting from the U.S. experience in 1980’s and its implementation of the policy will provide the lesson learned for Thailand.
considering to adopt the similar approach to foster technology transfer and commercialization. And hopefully this research will be an input for the formulation of Thailand intellectual property commercialization strategy, which will lead to an increase of a capability on science, technology and innovation and overall competitiveness of Thailand.
Chapter 2: A study on Japanese government Intellectual Property policy and mechanism to support IP commercialization for university based-research

After the catch-up period of industrial technology development was over and is suffered from the poor performance of economy in the early 1990’s, Japan was facing a challenge in maintaining and improving its industrial competitiveness. The Japanese government considered science and technology is a key factor in revitalizing the economy. There was a significant development of Japanese policies influenced by the U.S. model policy to promote science based and R&D intensive innovation, and measures to strengthen the collaboration between university-industry, despite the fiscal constraint during that time. Japanese government plays a critical role in developing Japanese innovation system by formulating a set of policies to support the technology transfer environment\(^1\), in order to utilize the seed of government funded research into market. At present, Japan is still one of the biggest economies in the world driven by its capacity of research and innovation. One of the key success factors might come from its strong policy regarding the technology transfer and utilization, in which the appropriate technology transfer strategies will result in technology commercialization. Therefore, in this chapter I will explore the development and the role of Japanese intellectual and innovation policies and its impact on the development of economy through technology transfer and commercialization.

2.1 Science and Technology plays a greater role

Starting with the enactment of S&T Basic Law in 1995, government policy stresses its emphasis on science and technology. Based on this law, the government is required to formulate a basic plan for S&T in every 5 year-period. The Science and Technology Basic plan is drawn up based on the Science and Technology Basic Law every five years in Japan. There are two steps to draw up the basic plan. First, Council for Science and Technology Policy (CSTP) deliberates the basic policy about science and technology. Second, based on

\(^1\)Technology transfer, it is a transferring of research results, technical expertise or know-how developed by an individual, enterprise, university or organization to another individual, enterprise, university or organization. And effective technology transfer can results in a commercialization of a new product or service.
that, the government formulates and decides a basic plan. The plan put emphasis on structuring R&D system, realizing the importance of R&D bases.

The first S&T basic law covered the main issues of

- Cooperation between industry, university and government research organization
- Promotion of the establishment of new ventures based on technological seeds or ideas from universities or research institutes
- Increase support for young researchers by increasing the number of post-doctoral fellowships
- Increased mobility of researchers
- More emphasis on competitive research fund
- Increase funding for R&D

Under this first plan, government influences the R&D funding as a driving force with its science and technology policies. Government spent 17 trillion yen on S&T during the first plan period. The second plan from 2001-2005, government spent 24 trillion yen and for the third plan from 2006-2010 government spent approximately 25 trillion. As for the 4th plan from 2011-2015, the R&D expenditure expected is approximately 25 trillion yen. The increase of funding from government support resulted in the increase ratio of government-funded research to GDP from 0.67% during early 1990’s to 0.69% in the late 1990’s which account for over 10 percent\(^2\). The budget went to 4 priority areas; life science, information and communication, environment and nanotechnology/materials.

\(^2\)21st Century Innovation Systems for Japan and The United States, Lessons from a decade of Change, National Research Council
The second and third basic plan also stress the importance of the commercialization of R&D by means of technology transfer of the research results to private company, activating high-technological ventures, fostering entrepreneurship in universities, improving a system for small business innovation and allocating research funds for small companies.

The Basic Law on Science and Technology set a new framework for S&T policy making, it received unanimous support from all political parties in its enactment.

2.2 The nation built on Intellectual property: Political leadership took place

A topic related to science and technology which also has received high political attention is the matter of intellectual property. During the time that Prime Minister Koizumi took his office in 2002, strong leadership on intellectual property was put in place. At the time of giving his policy statement speech, making Japan an “Intellectual property-based nation” was a national policy. The Basic Law on Intellectual Property law was enacted in 2002, with the aim to promote IP cycle concerning the creation; the protection and the utilization of intellectual property. The ultimate goal is to increase national wealth through the effective use of intellectual property, therefore, it is necessary to promote the creation of high-
quality IP, with strong protection of IP and eventually commercialize such creation for economic value.

It was followed by the establishment of Intellectual Property Headquarters within the cabinet based on the Basic IP law, chaired by the Prime Minister with the role to plan developing and implementing the Japanese IP strategy. The first strategic program for the creation, protection and exploitation of intellectual property was launched in 2003.

![Diagram of Japan's Intellectual Property Promotion System]

**FIGURE 2 JAPAN’S INTELLECTUAL PROPERTY PROMOTION SYSTEM**

Source: Formulation and Implementation of National IP Strategy in Japan, Japan Patent Office (JPO)

IP Strategic Policy Outline points out the need to enhance gross domestic product and exports by increasing enterprise revenues on IP-based exports; to enforce IPRs so as to comply with international obligations; to enhance regional and international trade opportunities by harmonizing laws so as to reduce trade impediments; to stimulate human capital development and retention in key industries; and to turn information/knowledge into a significant source of national wealth.

The strategic program is planned according to the IP cycle, creation, protection and utilization. Various measures to implement the strategic program have been taken. In terms
of creation, university Intellectual Property Headquarters and Technology Licensing Organizations were established nationwide to serve as the technology transfer mechanism. For protection, the system improvement in order to reduce the time for patent examination was developed by appoints a large number of fixed-term examiners. In terms of exploitation, the amendment of the trust business Law made Intellectual property available as trust property.3

2.3 Legislative framework: The U.S. Model technology transfer laws adaptation

In United States, during 1980’s, the questions from society arose, regarding the “sitting on shelf- intellectual property” generated under government funding as its investment effectiveness was low. Many key pieces of legislation that improve the technology transfer environment were passed by Congress. Before 1980, the concept of R&D was proliferated in the U.S. as it believed that this would increase technology development and innovation. But after 1980, the new concept has brought to the table; technology commercialization is a value adding to basic R&D.4 National policy regarding technology transfer and technology commercialization was then emerged.

Government emphasized on the needs to promote exploitation of technologies developed by universities and research institutions. A set of legislative measures were passed in the 1980’s to facilitate the technology transfer and the exploitation of government funded research.

One of the important pieces of legislations is the Bayh-Dole Act which emphasis on the role of university and national laboratory in the creation of intellectual property and passes on the result to the society. Prior to the Bayh-Dole act, the government retained right to the government funded invention. And few inventions were licensed or commercialized. After the enactment of Bayh-Dole Act, the university is allowed to gain title to its invention resulting from public funded research. The act motivated the university patenting and licensing activities. Several studies indicated that after the enactment of Bayh-Dole Act, there is a significant increase in the number of patent held by

4Technology transfer principle and strategy, APCTT, See http://www.technology4sme.net/tech_handbook.htm
universities.

Back in 1999 when Japan faced a deep economic recession, Japan was looking for a measure to revive its economy. At the time, Ministry of International Trade and Industry (MITI, presently METI) reviewed a set of United States technology transfer legislation during the 80’s and early 90’s.

Technology transfer environment in Japanese universities before the formulation of technology transfer policy was limited in terms of scale. The invention made by faculty member was owned by either government or faculty members; the ownership was determined by the source of funding. If the intellectual property was a result of joint research, commission research or funded by government; IP would belong to government or jointly owned between government and enterprise. For another source of funding, such as cumulative fund and scholarship fund, would belong to faculty member. As for technology transfer environment IP that owned by government will be treated as national property, therefore the assignment of right or grant of exclusive right was almost impossible. And IP that owned by faculty member, the transfer can be done through the help of JST which help university faculty conducts licensing activities during that time. Another way of technology transfer was done through a private manner between faculty member and industry. The transfer through personal relationship made on a one-to-one
basis that can only might lead to one company. And the opportunity of transfer for university faculty who did not have personal relationship with industry is very limited.

In 1998 “Act on the Promotion of Technology Transfer from Universities to Private Business Operators” or TLO Law was enacted followed by the Act on Special Measures for Industrial Revitalization including the Japanese Bayh-Dole Act in 1999. These 2 pieces of legislations play a vital role in changing the Japanese technology transfer environment between university and industry. The TLO law set up the system of establishment technology transfer licensing office (TLO) inside universities in Japan. The Japanese Bayh Dole is aiming to promote the utilization of inventions arising from R&D supported by the Japanese government, by means of giving IP ownership to universities and research institutions and to promote technology transfer of their research results to industry for commercialization. It allows universities and research institutions to retain ownership arising from government contracted research. However, the Japanese Bayh-Dole was not fully effective due to the legal status of national university.

The institutional reform in 2004 was important to complement the TLO and Japanese Bayh Dole. It was also a turning point for the management of intellectual property in universities. The enforcement of National University Corporation Act was enacted, in order to give a legal status to national universities. Before 2004, Japanese university belonged to national government and they were unable to receive or manage the IP ownership. Before TLO law, university technology transfer did not take place in university. The funding agencies such as JST have extended their support to university for the help of commercialization of research result. The detail of Japanese Bayh-Dole Act, the TLO law and National university corporation law will be discussed further.

In addition to these 3 important legislations that enabled the technology transfer climate in Japan, there were other laws and policies which helped constitute innovation system in Japan as follows;
Act on the Promotion of Technology Transfer from Universities to Private Business Operators (TLO Law)

According to the TLO law, METI and MEXT developed guidelines to encourage the technology transfer between university and industry by providing the direction and conditions to set up a technology transfer office within a university. TLO needs to submit their implementation plan to MEXT and METI to be accredited or approved TLO. The TLO that is approved by MEXT and METI is entitled to receive government subsidy for up to 30 million JPY for the period of 5 years. There are other benefit of being approved TLO under this law, the law facilitate the operation of TLO by providing guarantee.
allow TLO to obtain a bank loans. Approved TLO can also use facilities of national universities free of charge when they work in relation with university technology transfer activities.

Other laws also revised to promote the TLO activities, The Japanese patent law allowed a discount of patent annual fees and fees for requesting examinations for approved TLO. The following are various supports for approved TLO:

- Grants from METI to carry out TLO operations
- Debt guarantee by Organization for Small and Medium Enterprises (SMRJ)
- Investment by a government-affiliated (Small & Medium Business Investment & Consultation CO., LTD. A stock corporation founded in accordance with the Small Business Investment Company Limited Law) investment company in SMEs that receive technology transfer from TLOs
- Reduction or exemption of patent fees for the application filed by approved TLOs; as a result of Act on Special Measures for Industrial Revitalization 1999
- Investment by national university corporations in approved TLOs; as a result of National University Corporation Act, 2003
- Dispatch of patent licensing advisors from INPIT to TLOs

The TLO law was enacted to introduce technology management activities to universities; at the same time policy makers also developed supporting measures which could strengthen the operation of TLOs.

**Act on Special Measures for Industrial Revitalization: The Japanese Bayh-Dole**

The Japanese version of Bayh-Dole act is incorporated in the law hereinafter “The Industry Revitalization Law or Act on special measures for Industrial revitalization of 1999” This act was enacted separately from the patent law. The essential part of U.S. Bayh-Dole which aims to promote the utilization of inventions arising from the effort of the government was only one part of the law. There are some differences from the U.S. version; the differences are resulted from the different goal. The U.S. Bayh-Dole was aimed to promote the

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5 Experience in TMCs in Japan, KITAMI Junichi
6 Law No. 131 of 1999
participation of small business firms in federal supported R&D. But Industrial Revitalization law has broader goal which aims to maximize business resources in Japan in order to recover Japan’s economy from recession.

The transfer of ownership in Japanese version is beyond patent right, it includes other subject matters; utility model, design, copyrights for computer programs, databases, and plant variety (Takenaka, 2005). In United States, after the enactment of the law, it created the uniform patent policy among federal funding agencies, in enabling small businesses and non-profit organizations, including university to retain the right to invention. But in Japan, since the development of this law was an initiative by METI and MEXT, there were still different practices among government agencies that are not under umbrella of METI and MEXT.

The U.S version expected the universities to file patents on inventions they elect to own but in the case of Japan, the filing of patent is not mandatory. Another major difference is in the transferee of license, in the U.S law, university is expected to transfer technology to local small business. However, Japanese law does not provide any small business preference. The act allows large corporations to retain IP rights, and the grantee is able to license government funded technologies to both domestic and foreign company. But the main purpose of transferring ownership to universities is similar to promote transfer of their technology for commercialization is similar. However, in Japanese case, the government remains the right to refuse the transfer of rights, which is different from the U.S. that universities have the right to choose to retain the right (Watanabe, 2012).

The Industry Revitalization law also imposes duty to the Ministry of Economy, Trade and Industry (METI) and Ministry of Education, Culture, Sports, Science and Technology (MEXT), to implement measures to promote technology transfer of universities research results to private industry. And also the Law of small and medium-size business innovation research system or Japanese SBIR was enacted in December 1998, which will later be discussed in the next chapter.

**National University Corporation Act, 2003**

Despite the enactment of Japanese Bayh-Dole set the new framework regarding the retaining of IP ownership rights resulted from government sponsored research and it
allowed university to hold patent and other rights, it was meaningless for national universities because they did not have independent legal status, then the National University Corporation Act was enacted in 2003. Originally, the purpose of this law was aimed to reduce the total number of national civil servants by the end of 2003; however, the law is a complementary to previous TLO law and Industrial Revitalization Law. National universities were able to obtain and manage the IP resulted from government sponsored research through TLO system. Prior to 2004, when university still does not have legal status, IP ownership belonged to inventors, the technology transfer climate was happen in a more private relationship between university professor and a company (Kitami). But after the existence of TLO system, university ownership system and the legal status of university, the collaboration between university and industry was done in formal manners.

To improve administrative efficiency of universities, some portions of budget appropriation from MEXT are to be reduced year by year. This also affects the need to find new source of budget for example from government research funding and also a funding from companies.

2.4 Impact of Japanese policies on technology transfer climate

2.4.1 The increase of university-industry collaboration: joint research

The collaboration between university and industry for an effective transfer of technology and commercialization is one of the important jigsaws for a successful intellectual property commercialization. The promotion of U-I collaboration is essential for converting the public R&D investment into industrial innovations. In the past, the relationship between university, government institutions and industry was rather limited. University researcher were concentrating on their own basic research with little interest in the utilization of research results, while industry focused on developing products by themselves rather than research cooperation. One of the reasons that hinder the cooperation between university and industry is a legal prohibition. University professors in national universities were considered civil servants; therefore, they should purely serve the benefit of society rather than private sector. However, through a joint research with industry, the research agenda can serve the need or problem which industry is currently facing. Instead of the seed-driven research from
university, the demand-driven research can happen according to the specific need of industry, market and society.

Basically, there are 2 main types of research collaboration between university and industry. First, in joint research project, the collaboration from industrial firms will be both in kind and in cash. Company finances a research project and dispatches its researcher to university. Researchers from university and industry work together.

Research can either take place at university or firm. If it takes place in university, the university will provide required facilities and equipment. For the IP management in joint research, the patent is usually a co-filing by both parties.

Second, Commission research or contract research, in this case the firm contracted university to conduct a research which is normally a regular service of university. In the case of commission research the research result will belong to the university. In some cases the contractors are given the priority for obtaining licensing of research results.

Sets of Policies were introduced for promoting industry-academia-government cooperation; including a joint research system, which was created in 1983, and a system for commissioned research in 1987. The centers for joint research were established at national universities for promoting joint research; from fig there is a steady support in an establishment of joint research center each year; from 3 centers in 1987 to 58 centers in 2003. And a variety of policies for industry-academia-government cooperation were implemented in the form of TLO and intellectual property headquarters.
The annual budget for collaborative research was also increased. The budgets for national university joint research projects with industry & commissioned research from industry at the end of pre-1st S&T plan period were ¥3.6 billion in FY1995. And it rose to ¥5.8 billion under the 1st Plan, and increased by more than 100% under the 2nd Plan to ¥12.3 billion. And due to the fact that the system of ownership has changed, this is also one of the factors contributing to the change in form of collaboration. In the former system in which government or university researcher owns the IP ownership, the relationship was a one-to-one basis between university professor and company; industry did not have much interest in a formal joint research project with university because university did not own an IP right which would affect the transfer of research results. Also as previous mentioned, universities received fewer budgets from MEXT and were required to find new source of budget including funding from industries. Therefore, with the improvement of overall environment resulted in the increased number of joint research projects. The amount of funds received from the private sector increased over 5 years from year 2005-2010 from 50,123 Million Yen to 57,988 Million Yen (Satomi, 2012)

The numbers of joint research projects were increased, but the fund of project was remaining the same at around 2.5 Million yen. Most of the joint research over 50% is collaboration w
2.4.2 The increase of licensing activities

Similarly to the effect of U.S Bayh-Dole Act, after the enactment of TLO law and Japanese Bayh-Dole, there were an increase number of licensing activities.

There was some criticism regarding the relationship between university professor and Industry in the U.S when Bayh-dole act was enacting, that even before the BD act, university professor tend to have personal relationship and they can conduct the technology transfer activity even without the help of TLO.

However, for Japan situation after the enactment of TLO law and the Japanese Bayh-Dole, it help increasing more opportunity for other professors without personal relationship with industry to transfer their technology through university TLO. And by having TLO, instead of using personal relationship of professor that can only lead to one company, but through TLO it created more opportunity to introduce the research result to more companies (Kitami). In addition, this contractual approach can be done in a larger scale than one-to-one relationship between professor and industry. The number of domestic patent applications by universities and approved TLO has increased dramatically, from 641 in 2001 to 8,527 in 2005. However, the amount of licensing income received was not so much in contrast to the
amount of patent number. The small amount of revenue might came from several factors such as the value of university inventions, the experience in licensing activities (Nagaoka, Flamm, 2006) or even the mindset of university that is willing to contribute its invention to society with small return of revenue.

FIGURE 6 NUMBER OF LICENSING CASE CATEGORIZED BY TYPE OF UNIVERSITY FROM 2004-2010

Source: JST university-industry collaboration report 2011-2012
FIGURE 7 LICENSING INCOME CATEGORIZED BY TYPE OF UNIVERSITY FROM 2003-2010

Source: JST university-industry collaboration report 2011-2012
2.4.3 The impact of policies on start-up and spin-off of universities

Before 2004, IP ownership system was a major factor inhibiting IP ownership (Kneller, 2007), government ownership and non-exclusive licensing make undesirable situation for companies and faculty inventors. The formal TLO system also legitimizes the negotiated transfer of IP rights to university start-ups. In addition, the enactment of Development of Industrial Technology Enhancement Act allows university researchers to consult and hold management position of start-ups.

The infrastructure was established; venture business laboratories were set up. National universities can also lend facilities for universities-based start-ups. In addition in 2001, government recognized the important of creating new ventures to help stimulating economy. Japanese government had issued the 3-year plan to create 1,000 start-up companies from 2001 to 2004. At the end of 2004, over 1,000 companies were created. As shown in the graph, there were 562 companies in 2001 and rose to 1,235 companies in 2004.

FIGURE 8 NUMBER OF UNIVERSITY-START-UPS ESTABLISHMENT
However, the question remained, is whether the company can continue and grow into a company to stimulate the economy of the country as it should or whether there was a continuity of support program. However, despite the plan was achieved, in year 2006 the government has reduced the policy to support start-up ventures and university start-ups and the number of start-up were decreased significantly. At the same time the bankruptcy rate in Japan was increased. One of the reason dedicated to the failure of start-ups company in Japan might come from the structure of management, when university start-ups was created, the CEO of the company usually came from faculty members. Basically, faculty member was a person with academic knowledge but lack of business management skills, some of the success case of start-up in Japan, was the case that the company was able to invite the business/industry side person to be a CEO and work together with university professor. Start-up Company should be run by people who understand business, in order to succeed (Nishizawa, by interview). Even though, the main macro-policies of government fully supported the creation of the start-ups, in order for the company to survive they might need other factors such as risk taking fund or management skills from private sector.

2.5 The role of government research institutions and government funding agencies in supporting IP commercialization

In addition to the knowledge created in university, government research institutions are also the source of important invention. Therefore, this part will explore the role of some research institutions and their program which impact the transfer of technology to industry, such as RIKEN and JST. These implementing agencies are one of the key players in knowledge flow from government sector to industry. Even, the institutions which mainly focus on basic research also sees the importance of collaboration with industry and commercialization as shown below.

2.5.1 RIKEN

RIKEN has a long history of collaboration between RIKEN and industry, RIKEN is a comprehensive research institute in science and technology; research and development covers various areas including physics, chemistry, medical science, biology, and engineering. RIKEN was established in 1917, first as a private research foundation and reorganized in
2003 as an independent administrative institution under MEXT. Besides focusing on basic research RIKEN also provide a platform for collaboration with industry, focusing on problem solving research to contribute its “social wisdom” to society. One of the program that emphasis on technology transfer from RIKEN to Industry called “Baton zone”

**RIKEN: Baton Zone**

Baton zone program is a program that aims to create technology transfer mechanism between University and Industry collaboration. The objective is to develop technology transfer from RIKEN to industry. In this program, it aims that science and business can work together. The collaboration can take place either with large enterprise or small enterprise.

There is some uniqueness about Baton zone program the project leader of baton zone project must come from the industry side. The sub-leader of project will come from RIKEN side. Industry side will bring the industrial problem or demand to research institute and together will develop a joint research proposal. Project leader is entitled to decide when professor can publish the research result. Having business oriented leader together with experience of RIKEN researcher is considered the key success factor for Baton zone project. Therefore, the merit of the project would be well time-managed, market-orientation together with research experience of RIKEN researcher.

Another point to consider which might be a key success factor for U-I collaboration is, researcher from each side has a senior position which has a decision making power. Researcher who works in this project will get paid both from RIKEN and Industry.

The other advantage of RIKEN in the collaboration project is the ability to work across laboratories, which is different from the culture of Japanese universities. RIKEN system can be quite flexible and work in a multi-disciplinary way.

But at present, there still no clear incentive system to attract researcher. And the primary concern of RIKEN researchers is their research activities. Although they are interested in the commercialization of their research outcomes, most researchers are not interested in developing their careers in the business world. The direct benefit for researcher in this project is to get paid from both RIKEN and industry and to earn royalties for the relevant patent rights. An indirect benefit is through the collaboration project they can better
understand the actual needs of industry, which may provide them with ideas for their own research themes. Vice versa, the engineer from industry also benefit from collaboration with research institutes such as the human resources networking with researcher and to catch up with global technological trends and scientific and technological matters. But the actual incentive for government researcher might be a success story of the project which might attract researcher to join U-I collaboration.

2.5.2 Japan Science and Technology Agency (JST)

JST is an independent administrative institution under the umbrella of MEXT. It is in one of the core institutions responsible for the implementation of science and technology policy in Japan. Their programs have covered most of the IP cycle in order to promote creation to utilization of intellectual property. JST has programs to facilitate the cooperation between University-Industry, in order to maximize the research results.

JST provides infrastructure mostly in terms of funding and other infrastructure supportive program such as human resources support and information support programs are also provided. Many of its program focus on utilizing research result of university.

The interview was focusing on intellectual property management activities and the gap funding program of JST which is called “A-STEP”. In this chapter will mention only the activities of center for intellectual property strategies (CIPS), regarding their support in enhancing value for university IP and the acceleration of university IP utilization. The A-Step program will be discussed further in the next chapter.

First program I mentioned is the program that can help university to add more value to university patent portfolio, the program offer supporting system by providing patent expert called “patent investigator” which will help universities across Japan in developing its patent portfolios. At present, there are 23 patent investigators, who are experts in different field of technology. The patent surveyors are those with experience in research and development at private companies over long period of time. The objective of strategic assistance for creating patent portfolios is to increase the potential for patent utilization. The approach is to create related patent around core patent. JST will select university core patent and appoint senior patent investigator to assist in giving advice on patent application strategies for overall patent portfolios.
Another program is to accelerate university IP utilization. This system is cooperate with investment institutions in utilizing unused patents held by universities, the program consists of 4 activities

1) Provisions of patent maps & portfolio information – over 100 patent maps have been developed so far. JST also develop software for patent mapping.

2) Cooperation with investment institutions

3) Support for increasing the value of university patents

   3.1) JST will provide financial support for experiment and research in an amount of 2-3 million yen, for the expense required for examining the practicality of patents and acquiring additional data to raise the motivation of companies to achieve practical application.

   3.2) Financial aid for technology transfer: This is a grant for IP departments or TLOs at universities approx. 0.5 million yen. The funding will cover these activities, technological enhancement, creation of applied invention, test products, market surveys. What is interesting about this financial support program is that, there is a support for market surveys, which consider important criteria for IP commercialization.

4) Utilization of J-Store and the science and technology commons

J-Store is an online database that comprises of both unpublished patent and patent from universities across Japan. For unpublished patent, university can use J-Store as a market testing bed, if there is an interest from industry side, then university can decide to pursue patent registration and license agreement. Any university in Japan can publish its inventions on J-Store. At present there are 20,000 research results on J-Store website.
Conclusion

This chapter has explored the development of Japanese innovation policy, which covers the area of intellectual property creation to intellectual property transfer and utilization. Started with the enactment of S&T basic law which provides a policy framework in realizing innovation as a source of economic growth, the major point is the increase of public spending on R&D expenditure, despite the deep economic recession at that time. And in order to maximize the benefit of government spending on R&D, there is a need to exploit the research result generated by the University. Therefore the policy to strengthen university-industry collaboration was the key components of Japanese innovation policy as a mean to transfer and utilize research result of universities. Japanese policy makers had studied the example of United States case during 1980’s when the U.S was faced similar situation of economic down time. In 1990’s Japanese government adopted a U.S. model of technology transfer policy and tried to adapt it to its own context. The TLO law which first introduced created the TLO system within universities to serve as an intermediary for the technology transfer between university and industry. As a complementary to the TLO law, the Japanese Bayh-Dole law was enacted which changed the system of intellectual property ownerships; it allows university to retain IP ownership resulting from government funded research. And to solve the problem of national university as state organization and unable to receive the ownership, in 2004, national universities were incorporated which was a turning point for national universities in intellectual property management and transfer. The impact of abovementioned policies resulted in an increased number of patent application, licensing cases, collaborative research and a number of start-ups of universities across the country.

Another key point which had an effect on intellectual property policy development of Japan was when Prime Minister Koizumi took his office. The political leadership was in place and the role of intellectual property was emphasized as a tool to generate wealth of the country. The political commitment resulted in a policy and institution reform; IP headquarters and the first IP strategic plan were established.

At the implementation level, since the introduction of U-I collaboration policy, each public agency had incorporated the U-I concept into their activities. For example RIKEN,
despite the core activities focusing on basic research, Baton Zone program was designed as a platform for company and researcher to work together, in developing research which could lead to commercialization.

In a next chapter I will examine the policy and mechanism which focuses specifically in bridging the gap between basic research and commercialization.
Chapter 3: A study on Japanese government Intellectual Property policy and mechanism to support IP commercialization for small business based-research

To borrow the term of RIKEN baton zone program, once the baton has passed from university/research institutions to the industry, industry will need to carry the baton to the finish line. However to carry baton to the finish line, industry might run through the “valley of death”; or “Funding Gap” which is a gap at an intermediate stage between scientific invention to commercialization of a new product. This funding gap may have a significant impact on the productivity of government supported R&D efforts. If intermediate stage financing is not available to individual or firms that allow them to transform research results into a commercial product, then society could not get a return on the public support for R&D. As mention in a previous chapter, Japanese policies has already supported the transfer of technology from university to industry, however, to develop the research results further into product or the pre-commercialized phase often involves high risk and high expense. As for large enterprise they might not face financial constraint obstacle but for small business and venture this could be a major hindrance. This chapter will explore the supporting mechanism for small business to improve their innovative capabilities. In addition to technology transfer policy which Japanese government adopts the U.S. model, they also implement the Small Business Innovation Research (SBIR) program that believes to be very successful program in helping small firms’ to move up the technology ladder and to bridge the valley of death in United States. This chapter will also explore the program of Independent Administrative Agency; JST and AIST which contribute to the utilization of government funded research result; for JST I will explore the gap-funding program of Japan Science Agency (JST) that try to utilize the research result of universities and AIST. I will explore their research activities which aimed at commercialization.

3.1 Japanese SMEs: an innovation and economic growth driver

In Japan, SMEs are accountable for 99% of all enterprises and account for approximately 70% of all jobs. During the crisis, especially the recent great earthquake has emphasis the role of SMEs as key players to stimulate economic growth. When a large enterprise faced
bankruptcy and closure, startups and SMEs are expected to be promoted in the process of economic renewal and job creation.

FIGURE 9 NUMBER OF ENTERPRISES

FIGURE 10 NUMBER OF EMPLOYEES

FIGURE 11 MANUFACTURING VALUE ADDED
SMEs are now believed to be the driver of an innovation and introduce breakthrough innovations to the market. From the figure below shows that, despite the economic recession perceived from the ratio of ordinary profit to sales and ratio of capital investment to sales, the ratio of research and development cost to sales remain steady. It suggests that SMEs place an importance on R&D even during the downtime of economy. SMEs use R&D as a means to develop and improve the product and service in order to raise their competitiveness. However, there is significant obstacle for SMEs compared with large firms, when it comes to access to financial resource in order to develop R&D into products. The challenge of SMEs to attract investors when a developing technology seems promising but it is still too new to validate its commercial potential and often find obstacle in attracting capital. Therefore, the Japanese government also formulates a policy and mechanism that try to support the innovation development of SMEs and to bridge the valley of death that will be discussed further.

FIGURE 12 THE RATIO OF RESEARCH AND DEVELOPMENT COSTS OF SMES

Source: 2009 White paper on Small and Medium Enterprises in Japan

Regional Bureaus of Economy, Trade and Industry held interviews with local SMEs from December 2008 through January 2009 and some of the SMEs reported that, although the economic climate is down, they want to change business direction and work on the development of new technologies and products. See SMEs White Paper 2010
3.2 Relating legislations to support innovative capabilities of SMEs

3.2.1 The new Small and Medium Enterprise Basic Law

The new SME Basic Law that was amended in 1999\(^9\) sets the new framework from protection of SMEs; by trying to adjust gap between large enterprises and SMEs to the promotion of SMEs activities by foster innovation and promote self-help efforts of independent SMEs.

The law defines SMEs as companies with capital not exceeding 300 million yen or have employee at the maximum of 300 or less. And “Small enterprises” are defined as enterprises with 20 employees or less but they are defined as enterprise with 5 or fewer employees\(^{10}\).

<table>
<thead>
<tr>
<th>Industries</th>
<th>Capital Size (in million)</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing and Others</td>
<td>300 or less</td>
<td>300 or less</td>
</tr>
<tr>
<td>Wholesale</td>
<td>100 or less</td>
<td>100 or less</td>
</tr>
<tr>
<td>Retail</td>
<td>50 or less</td>
<td>50 or less</td>
</tr>
<tr>
<td>Services</td>
<td>50 or less</td>
<td>50 or less</td>
</tr>
</tbody>
</table>

The principal of the law is to promote the diverse and dynamic growth and the development of independent SMEs. It focus on 3 main points

1) Reinforcement of the business foundations of SMEs
2) Support for the self-help efforts of SME entrepreneurs embarking on startups and business innovation and
3) Development of a safety net.

\(^9\)The SMEs basic law was originally enacted in 1963
\(^{10}\)2004 White paper on Small and Medium Enterprises in Japan
The law emphasis on promoting innovative capabilities of SMEs and start-ups of SMEs as stated in Article 12-14 as shown below;

(Promotion of Business Innovation)

“Article 12: In order to promote business innovation at SMEs, the State shall promote research and development related to technologies for developing new products and services; promote the introduction of plants and equipment to substantially improve the efficiency of production and sale of products; promote the introduction of new methods of business management for integrated control of product development, production, transportation and sale; and take any other necessary measures.”

(Promotion of Start-Ups)

“Article 13: In order to promote start-ups of SMEs, the State shall provide information on and improve training for start-ups, facilitate the financing of start-up expenses, and take any other necessary measures, and shall also endeavor to increase public interest in and understanding of the importance and need for start-ups.”

(Promotion of Creative Business Activity)

“Article 14: In order to promote the creative business activities of SMEs, the State shall promote research and development concerning remarkably original techniques related to the production or sale of products or provision of services, develop systems to facilitate the acquisition of the necessary human resources and financing through such means as shares and corporate bonds, and take any other necessary measures.”

This law is a turning point that changed SMEs from being object of protection into the driving force of the economy. This new policy framework treats SMEs as the source of entrepreneurship, innovation and job creation. SMEs can develop new technology through exchange programs with different businesses and partnerships among industry, academia and government.

3.2.2 Law on Supporting Business Innovation of Small and Medium Enterprises 1999

The purpose of this law is to support business innovation by existing SMEs. The support provided to SMEs such as subsidies and low-interest loans, to enter
plan had been approved. The plan is to raise value added by annual average of 3\% over three to five years through business innovation. In 2004, according to the “SME Agency’s Survey of Enterprises with completed business innovation plans” around 30-40\% achieved 3\% value added figure\textsuperscript{11}.

### 3.2.3 The Law for Facilitating the Creation of New Business 1999

The law is designed to encourage the creation of new business through, for example, startups. The emphasis is on assisting access to human resources and providing financial support to startups. The law authorized government loan guarantees to startups without requiring them to provide collateral or guarantors when borrowing through the Credit Guarantee Association. This law also constitutes the SME Technical Innovation Plan or “Japanese SBIR program”. The law requires the government and special corporations to draw up expenditure targets for the government and special corporations, including subsidies for research & development in new technology for medium/small companies.

The abovementioned SMEs support laws were created based on different requirement of SMEs according to the size and stage of growth of SMEs. However, the law has overlapping support in some areas. The system has been criticized of being complex. There are the demand for support not only for development of technologies but also other kind of support which leads to the actual commercialization of product; or to help bringing product to the market such as market research, evaluation of business viability and development of market.

In 2002, the Law for Facilitating the Creation of New Business was amended under the Law for the Support of Small and Medium Enterprise Challenges to allow exemptions from the minimum capital requirements for corporations, in order to provide support for startups and new business ventures by SMEs.

### 3.3 SBIR program the U.S model and the adoption of Japanese SBIR

#### 3.3.1 U.S. SBIR system

During 1980’s U.S. realized that they had fallen behind the technological capabilities of competitor like Japan in semiconductor and automobile industry. While they had a pile of

\textsuperscript{11}2005 White paper on Small and Medium Enterprises in Japan, Japan Small Bus
stock of academic research results which had never been commercialized, federal government then changed the research direction by giving importance to the research and development conducted by small businesses which would create impacts in terms of innovation and economy. The SBIR awards were started as experimental program in National Science Foundation (NSF) in 1976 by Roland Tibbets. The principal of the program was to utilize small high tech firms to increase the economic return on investment from NSF research. The program design means to lower the risk for small business, to attract large amount of investment from follow-on private investors to small business. There was a success example such as Symantec Corporation; one of the biggest IT solution provider today, which helped persuade the Congress to approve SBIR.

The small business innovation research program or SBIR was established under the Small Business Innovation Development Act of 1982. The program encourages small businesses to engage in Federal Research that has potential for commercialization. The program is designed to support the funding during critical startup and development stages before commercialization. It tries to support the need of small businesses in developing innovation while there is a high risk and expense beyond their means. There is often economic failure in seeking financing at the idea stage for potentially breakthrough technology.

![FIGURE 13TO BRIDGE THE VALLEY OF DEATH]
In the U.S. small businesses are a leading source of employment growth, generating 60-80 percent of new jobs annually. One of the reasons to invest in small firm rather than large firms is because high-risk investment also requires a high payoff through stock price and stock split appreciation. The stock of small firms can multiply and value up in a few years, unlike large firms whose stock price is often too stable and too large to multiply in value.

The implementation of SBIR is carried out by 11 federal agencies. Each year, federal agencies will set aside 2.5% of their extramural R&D budget that exceeds 100 million USD for SBIR program. Each agency administers its own program and designates its own R&D topic, but the structure of the program is under the guideline established by Congress.

SBIR program consists of 3 phases

- Phase I: feasibility study: This phase is to establish the technical merit, feasibility study and commercial potential. Phase I award normally not exceed 150,000 USD for 6 months
- Phase II: To continue the R&D efforts initiated in Phase I. Only Phase I awardee are eligible for Phase II
- Phase III: At this phase small business should pursue commercialization from results obtained in Phase II. The funding comes from federal government sources outside the 2.5% SBIR budget for follow on development or commercialization and private investors.

Each year SBIR makes over 4,000 awards and provide 100% funding to small businesses. The awards comes in the form of “grants” and “contracts”, agencies that has a precise requirement and set a very specific theme tend to define awards as “contracts” and agencies that require research or demand for new technology which the research topic will be broad, tend to describe awards as “grants”.12 The company eligible for SBIR must be a U.S. company that has not more than 500 employees. The intellectual property derived from this project will belong to the company. Another mechanism, which is a complementary to SBIR awards in the U.S., is the set aside policy of “Government Procurement “. All federal agencies are given annual goals for the percentage of overall

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12 How the United States Government uses its SBIR programme and procurement budget to support small technology firms, David Connell, Centre for Business Research, University of Can
procurement expenditure to be spent with small businesses. The procurement expenditure of each agency is different. The procurement can be categorized into direct procurement and indirect procurement for small businesses. The direct procurement is that agency directly contract or purchase from small business. The indirect one is that government contracts to prime contractors which are often large enterprises and indicate in the contract that large enterprise must agree to sub-contract with small business. With government procurement set aside program, it can be a test bed of new product and help small business to cross over valley of death to actual marketplace. The collaboration with university is also a success factor of SBIR. SBIR provides a bridge between universities and the marketplace; an important percentage of SBIR awards involve university researchers.  

However, the main criticism to U.S. SBIR awards is regarding the post-SBIR support. The readiness level of technology requires further research and funding support in order to achieve commercialization and only half of the company is able to seek for investment in phase III.

3.3.2 Japanese SBIR System

The Japanese small business innovation research program was first introduced in 1999; during the time of economic recession, the agency that is responsible for SBIR system is Small and Medium Enterprise Agency (SMEA), which is under METI. SMEA will select existing government funding project that can be used for SMEs and appoint it as SBIR supporting project. Seven government ministries implement the program namely;

- Ministry of Internal Affairs and Communications
- Ministry of Education, Culture, Sports Science and Technology
- Ministry of Health, Labor and Welfare
- Ministry of Agriculture, Forestry and Fisheries
- Ministry of Economy Trade and Industry
- Ministry of Land, Infrastructure, Transport and Tourism

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13PUBLIC PROCUREMENT PROGRAMMES FOR SMALL FIRMS – SBIR-TYPE PROC
The cabinet sets the budget annually. Budget allocations under the program have gradually increased from 26.1 billion yen in 2003 to 37.1 billion yen in 2007 and 45.1 billion yen in 2011. Each ministry voluntarily register technology development subsidy and decide the target amount of expenditure for SMEs. Prior to the setting of SBIR research theme of each ministry, METI will ask the need of each ministry in order to find the highest probability of research that match the need of society and eventually resulted in commercialization.

There are 17 programs through which SBIR is implemented provided by government funding agency such as the Japan Science and Technology Agency (JST) and New Energy and Industrial Technology Development Organization (NEDO). Two types of support are offered; 1) research and development support through subsidies or contract grants and 2) support for technological application development, such as patent fee reductions, loan guarantees, capital investment loans, and loans for facilities. Small businesses which receive SBIR funding will be eligible for the following special measures;

<table>
<thead>
<tr>
<th>SBIR Package</th>
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<tbody>
<tr>
<td>Entitled to the low-interest rate loan from the Japan Finance Corporation Company, which is funded by SBIR Program, has a better opportunity for government procurement.</td>
</tr>
<tr>
<td>Publicize R&amp;D success at the SBIR special site Patent fees are waived, for those who apply patent within 2 years after SBIR project is completed. Maintenance fees for 1-3 year are reduced by half</td>
</tr>
<tr>
<td>Company can receive special measure of Insurance law for SMEs. Insurance limits will be extended from 200 Million yen to 300 million yen. They can receive special measure for Limited partnership act for investment</td>
</tr>
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14 SMEs Entrepreneurship and Innovation, OECD Studies on SMEs and Entrepreneurship, OECD, 2010
They can receive special measure of the law to support facility of SMEs. (Funding support facility for SMEs.) Company can borrow up to 2/3 of the total equipment installation cost, rather than the usual ½.

The supporting measure is a complementary to the main program, for example the low-interest loan provides benefit for company after finishing SBIR project in scaling up the production.

The majority of schemes target venture companies and SMEs. Funding recipient should have less than 300 employers or capital below JPY 300 million. Individual researcher who does not own business can also apply for SBIR.

Japan established its own SBIR based on many years’ careful study of America’s SBIR. Japan historically implemented many policies to support small businesses, which treated small businesses only simply as subjects to be protected as previously mentioned.

The purpose of Japanese SBIR is to encourage business activities of SMEs and to increase opportunity of SMEs in order to join research and development under Japanese government project. The SBIR system, however, places the major emphasis upon their capacity of technical innovation. The SBIR system divides the innovation process into three stages: (I) feasibility study, (II) development and (III) commercialization.

Specifically, SBIR has increased opportunities for government to spend directly to small business owners. The program subsidizes and outsourcing costs for SMEs aimed at research and development relating to new technologies that may create new industries.

In 2010, Small and Medium Enterprise Agency conducted a survey to SBIR awarded companies for follow up result of the program. Questionnaires were distributed to 1000 companies and 491 replied. Following are some results regarding the SBIR awarded company
From the pie chart, the success rate of commercialization accumulated is approximately 56.8%; however, companies that couldn't have achieved commercialization account for more than 40%, and so-called “Death Valley” still can be seen in this result numerically. If we break it down, the company that succeeded in commercialization phase, but did not pursue marketing or gave up on marketing is approximately 33%. This result shows that the success rate for SBIR awarded companies couldn't exceed Darwinian Sea.

Therefore, the SBIR program that aims to support small business can help the company over 50% to cross the valley of death. However, after crossing Death Valley, in order for product to make economic returns; the products need to make sales. And the marketing strategy of the product such as writing business plan is an important component of successful commercialization. And from the survey, over 30% still stuck in marketing phase.
According to the graph, the issue that most companies faced during commercialization phase was the issue of finding financial support to secure fund, follow is the marketing issue in terms of developing market strategy and market development, and to scale up production also an critical issue for the company.

Following are the reason that contributed to success of the commercialization, the top tree reason respectively are; 1) technological strength, 2) technical tie-up and exchange and 3) R&D management skills. And the top reasons for failure in commercialization respectively are; 1) Technological strength 2) Funding ability and 3) market information. The reason for
both success and failure are the same, which is technological strength. But for the failure factor, the second reason is still about the funding for the small businesses. And the third reason for success case is R&D management skills. But for failure case is depend on ability to gather market information.

In addition, from the SBIR survey document, it concluded some interesting factors which could result in a commercialization failure as follows; 1) lack of technology marketing and info which means lack of grasping market needs and have difficulty of obtaining info of market and technology 2) lack of funds 3) lack of sales & advertising which means company
has insufficient advertisement ability 4) lack of management strategy and project management ability.

From the survey, it can imply that the financial issue is still a major issue for small businesses in pursuing commercialization. Another interesting issue listed from the survey is marketing issue such as drawing up marketing strategy or ability to gather market information, which from the survey is one failure factor for commercialization. This can suggest that small businesses might not have sufficient resource or need certain support besides financial support in order to achieve commercialization.

Some of Japanese SBIR subsidy also provides support for technical management and legal support by dispatching expert to the company. This support is called “Hands-On” support, which is not a main scheme of SBIR but it is being implemented by some subsidies under SBIR system. The Hand-on support is basically to dispatch an expert to help SMEs on-site, the expert can support in the area of scaling up-production, management, product design, marketing and strategy plan. From the survey also suggest that, since issue that company are facing sometimes beyond financial issue, therefore, the hand-on support should incorporate into SBIR program as a common scheme.

Although, the main objective is similar to the U.S. SBIR aiming at encouraging innovative capabilities of small businesses, there are some differences in the program, which could lead to a different result.47% of the small firms that used United States SBIR program said that the program helped them to achieve commercialization. In the U.S. SBIR program, the common scheme is set, such as a control phase, whereas it is up to each agency’s management of the details, while the common scheme is not provided in Japanese SBIR. In Japanese system, the program design and research topic is based on the purpose of each specific agency rather than the purpose of main SBIR program

While in the 3-phase program, the third phase of U.S. SBIR requires the complementary manner of private and venture capital but this structure does not exist in Japanese system. As previously mentioned, the research topic and program design can be vary based on each specific subsidy rather than the purpose of main SBIR, which is different from U.S system in which each agency design the program and research theme base on SBIR purpose.
Therefore, some specific subsidy may not focus their support on SMEs very well compared to the U.S.

However, in Japanese SBIR version it claimed that, they not only provide the support for small and medium size company but also extend its support to large enterprise, they broaden the support so that they can promote more kind of R&D to commercialization.

The program has been found to be administratively difficult to implement, In particular the methods of application are too complex.\textsuperscript{15} From the survey of Small and Medium Enterprise Agency, the outcome of the program is not yet satisfactory but the performance is increasing steadily.\textsuperscript{16}

### 3.3.3 Implementation of SBIR program by NEDO

New Energy and Industrial Technology Development Organization (NEDO) is an incorporated administrative agency. The role is to promote research and development regarding energy, environmental and industrial technologies and acquisition of emission reduction credits through the Kyoto mechanism. NEDO is one of the largest funding agencies, to combine the efforts among industry, government and academia. The funding programs are separated into 3 types; Technology seed development activities (1.6 billion yen), National Projects (109.3 billion yen) and practical application and commercialization promotion activities (3.2 billion yen). The Technology Innovation Program for Small Business Innovation Research (SBIR) is under the third program. The program was started in 2008 Research theme is using a top-down approach, in which the research area that SMEs can receive support will be announced annually by government, and a part of the program is implemented by NEDO. This year NEDO announce 35 designated areas of funding. The company selection will be chosen by a group of external experts in each technology area.

The design structure of NEDO SBIR divided into 2 phases; first phase is a feasibility study, the time period is 6 month with 100% funding from NEDO up to 10 million yen. The second phase is R&D phase, the time period is 1 year with 100% funding up to 50 million yen. However NEDO using the stage gate control system, before the applicant can receive the

\textsuperscript{15} Ibid
\textsuperscript{16} SBIR survey 2010, Small and Medium Enterprise Agency
phase 2 support, the company need to pass the stage gate evaluation. Approximately 50% of the applicants can pass the stage gate evaluation. The budget for 2012 is 400 million yen.

From the interview, I have asked about the 2 phases of NEDO which is different from the U.S. SBIR system, NEDO provided the reason that, there are also other mechanism especially financial mechanism of government related institute that can provide financial help to SMEs, and there is other specific agency which is responsible of supporting SMEs such as SBIC.

The NEDO SBIR program requires that the applicant need to collaborate with academia in order to apply to the program, the collaboration can be in a form of external advisor to the project. Each project take a time period of 1.5 year, after that within 3 years company needs to commercialize the research result.

Intellectual Property ownership management is in line with the concept of Japanese Bayh-Dole Act, IP ownership will belong to the company 100%.\(^{17}\) In case that the project is not successful, NEDO does not have to explain about the failure of the program to METI.

The following are successful cases, which receives the funding under SBIR program and exploits the benefit from supporting package of SBIR.

**IPOCA**— used the SBIR scheme to expand customer base of the company, which require money to scaling up technology. The company wants to change its card system platform into mobile phone using RFID based technology; company received 5 million yen from METI.

*IPOCA has tried to develop system which could reduce the several “point card” that store use to attract customer. Starting with the problem of stores in his neighborhood that would like to campaign for more customer by offer point cards, however, customer doesn’t seem to appreciate carry several cards in his/her wallets. President of IPOCA and his study group came up with IPOCA; a system which could reduce several point cards to 1 card.*

\(^{17}\) In case of other type of research of NEDO such as consortium between University-industry-government, the agreement regarding IP ownership must be made in advance during the application time.
Since IPOCA is only a venture company, then the company looking for support from
government; company received first subsidy from Tokyo Metropolitan Government,
which is a subsidy for small business. Then the company uses this subsidy to develop
technology and use it in a trial area of small business district “Aomonoyokosho” After
trial phase company needs money for further development of technology from using
magnetic card into mobile phone using RFID technology. The company finally
received SBIR subsidy after several try of submitting application. Company received 5
million yen; the subsidy cover 50% of the whole developing cost of 10 million. The
subsidy came in a form of reimbursement; the company needs to pay in advance and
reimburse afterwards. However the President of the company is a certified public
accountant, with his position gave him credibility, and he was able to passed difficult
period. In addition to the main funding program, the company also received experts
support under SBIR program. The program provided the dispatch of expert to IPOCA
to assist in marketing issue. The company also utilized SBIR supporting package such
as patent fee to apply for company new technology and reduction and low-interest
rate loan to scaling up and expand its customer base. From example of IPOCA in
utilizing SBIR system, shows that SBIR can help company to shift from pilot scale to
commercialization scale and gave support during high risk period. The way IPOCA
utilize supporting measure; also shows the complementary of supporting measure
and main funding program. However there are some suggestions about the program
design, the SBIR is implemented by 7 ministries and each has its own criteria and
different documentation, therefore, it is timely and difficult for SMEs to exploit SBIR
program.

“Kawamura Sangyo Kabushikigaisha”\(^{18}\) used the SBIR scheme to undertake project
to develop production technology for H-type insulation material for next generation
hybrid vehicles. The firm obtained funding from “Assistance of Production of
Innovations” which is part of SBIR scheme. The firm was then able to get a low
interest loan from Japan Finance Corporation which enabled it to expand production
scale.

\(^{18}\)The content is excerpted from The 4th Science and Technology Basic Plan: A national Innovation
System for New Challenges –Role of East Asia and Small & Medium Businesses, Reiko
Kawamura Sangyo has been fabricating insulation material for motors and transformers since it was founded in 1967. The firm has been an innovative leader in this field and is now focusing on insulations for motors of hybrid vehicles (HV), electric vehicles (EV), railroad carriages and industrial machineries. SBIR enable the firm to develop, produce and start sale of “Namil”, a innovative new high performance insulation for motors. Traditional motor insulations typically made from layers of aramid paper and PEN film is 0.26 mm thick and can withstand temperatures up to 155C degrees. The new product “Namil” uses PPS as insulation material covered by aramid paper. As result, total thickness is 0.2mm and it can withstand heat up to 180C degrees. The 23% reduction in thickness allows it to release heat more efficiently and is also lighter. These properties make Namil ideal for EV and HV which require small and efficient parts. The company was able to bond PPS and aramid sheet together, a feat previously considered not possible, by employing plasma equipment and rolling press.

The company got a 90 million yen subsidy from the SBIR FY 2008 Innovation Adoption Subsidy scheme of New Energy and Industrial Technology Development Organization (NEDO) to develop the new insulation. The money was used for introduction of plasma surface treatment equipment, wages and cost of materials.

After the successful development of the product, it was necessary to implement large scale production. The company took advantage of the SBIR scheme and obtained a loan of 300 million yen from Japan Financing Corporation under its New Enterprise Assistance Fund scheme. The term of the loan was for two years at rate of 0.3% (the rate after Special Provisions of the Act on Equipment Installation Support). 250 million yen from the loan covered the cost of a custom made laminator for fusing PPS and aramid sheet together. The remaining 50 million yen was use d to convert the factory into a “clean room” environment. The favorable rate of the loan, not available from a bank, allows the firm to persevere the first few years of low revenue immediately after the introduction of new product, until new demand is materialized. The company is in the process of building up new demand at home and abroad.”
From this successful case, it shows the complementarily between the SBIR funding scheme and supporting package especially the low-interest loan program. Generally, the access to financial source for small business is difficult and the amount of loan they receive can be small and insignificant, compared to the need of the company. To scale up from product to large scale production is also an obstacle for small company, while large amount of loan with low-interest rate provided from the bank allow the company to put product into a market place and stand the low revenue during the first few years after the launch of new product.

3.4. JST: A-STEP Gap funding program

Here I describe A-STEP Program (Adaptable and Seamless Technology Program through Target-driven R&D), In order to utilize the research results, JST has the scaling up program for commercial operation called “A-STEP” Feature of A-STEP mostly is collaboration between university, which is an inventor, and private sector jointly submits the application. The aim is to bridge the gap between research development and production.

The funding area covers all fields of science and technology, the A-STEP program is considered a bottom-up funding program for a wide range of R&D from early phase to mass production.

Annual budget is 208 million USD. A-STEP consists of 7 sub-funding programs to support the utilization and collaboration between university-industry and also to support SMEs and private sector in high-risk project. Since A-STEP has several funding programs, it has provided mechanism to select the program, which is suitable for applicants, which is called “a reception section”. And then it will pass through the “peer review” process and then the committee will decide which program is suiting the applicant’s need.

Peer review panel

The peer review panel consists of members from both academic and industry. The peer review panel has 7 sub-committee separated by fields of technology, namely, IT, organic chemistry, medical technology, equipment/device, inorganic chemistry, agricultural biotechnology and drug discovery. Every technology field has program director, which came from industry side, usually was a former director of research and department of a company.
The criteria to assess the project are from

1) originality, novelty, competitive edge (Feasibility Study)
2) validity of target setting (Feasibility Study)
3) Possibility of making innovation (Feasibility Study)
4) Execution possibility of proposed action plan (Feasibility Study)
5) Commercialization possibility (Full-Scale R&D)
6) Risk in development (Full-Scale R&D)

The approval process normally takes about 6 months from submitting application to approval. The following are the details regarding each program of A-STEP

1. Exploratory research and Seeds Validation
   These 2 programs are grant program for a feasibility study phase. The objective of the program is to examine the possibility of commercial viability of research results obtained in academia. The Seeds validation requires joint submission between university and company.

2. High-Risk challenge program – The objective is to help companies pursue high-risk R&D that has high impact but might be too novel for the companies. And it's too risky to invest private funding in the technology. This program is also requiring the joint application between university and company.

3. Ventures Program – This program will support the start-up company from university. The main characteristic of this program is that, the applicants consist of 3 parties; R&D representative, which is university professor, entrepreneur from company and development supporter which mean TLO. This program expects an entrepreneur to be a chief of a start-ups company. The evaluation of application will evaluate people as well.

4. Promoting R&D Program – This program is to help companies promote high-risk, long-term R&D. Funding type is matching grant at 1:1 basis but if a company is considered an SMEs the ratio will change to 2:1 between JST and company. This program will also require joint application between university and company. The project leader can either be university-led or industrial-led on case-by-case basis.
5. Promoting R&D program for small business – This program aims to help small and medium sized companies carry out development for commercialization. This scheme is a grant and royalty scheme, in which a company receives grants from JST, and makes a royalty payment to JST, once the company makes a product sales; royalty payment is based on product sales. SMEs can apply for this program by itself, but SMEs need to develop the product based on university research results. In this scheme, SMEs can commission universities to carry out a part of the development.

6. Drug Development Program (Full-Scale R&D)
This program focuses on drug development and offers a support for full scale R&D (pilot production). It aims to help pharmaceutical company carry out drug discovery development. Target is to complete phase IIA clinical trial. Development results are expected to move on to phase II-b clinical trial by applicant, licensing out or alliances with another pharmaceutical company. The project period is 5 years.

This program can consider as a soft loan because if the project is successful the company have to pay back 100% to JST but if the program is failed, company will have to pay back only 10% of the granted amount. The aim is to support the companies challenging the commercialization and JST will take the potential risk of developing new technology.

The funding programs mentioned try to bridge the gap from lab discovery to product innovation. The program designs are various based on the risk of the project and the grantee. The grantee can be either university or industry; both SMEs and large enterprises. The program is carefully designed to use variety of approaches to utilize university research results. But what every program has in common is the requirement for university and industry to collaborate in the project. Most of the projects require joint application between university-industry.

Besides funding program, JST also provide several support programs in order to match the “seeds” with “needs” JST has a weekly event, “new technology presentation meetings which is a venue for university researchers to introduce their research results to industry people. JST claims matching ratio as 22%. Annual event JST held the exhibition to introduce
universities’ technology seeds to the public called “Innovation Japan” with a matching ratio of 10-30%

Vice versa, in order to provide venue for industry that needs help from university, JST held a seminar, which is a presentation of problem or needs of industry to academia, with the matching ration of 23%. This forum can help the company that does not have its own research section or SMEs.

J-Store is a database that collects research results from academia that can be licensed, This database information came from the weekly event of university presentation, which is a smart way to manage information without doing survey and JST can receive up-to-date information from university.

JST claim that the success rate of A-Step program is approximately 25%. During the interview, I have asked about the sentiment of society and government towards the failure case. JST replied that, being failed actually not trigger the question from government. On the contrary, if JST shows the high success rate of its programs, some questions may arise, as they might not perform their function to support the risk-taking project, because it is supposed to be JST’s mandate to support high-risk project with a potential of commercialization.

3.5 AIST: Commercial research

National Institute of Advanced Industrial Science and Technology (AIST) is a public research institution which has network throughout Japan, the research fields cover large 6 area of (1) environmental and energy, (2) life science and biotechnology, (3) information technology and electronics, (4) nanotechnology, material and manufacturing, (5) metrology and (6) measurement science and geological survey and applied geosciences. The research conducted under AIST is aimed for practical use. And one of the missions is to put national R&D based on the need of local community. AIST places an emphasis on the collaboration research or joint research with industry as a mean of effective technology transfer. In order to link AIST to company, AIST uses “Innovation Coordinator” as intermediary to support the connection between univeristy and industry, each R&D unit has their own innovation coordinator and in innovation promotion headquarter. Innovation coordinator builds his
connection with industry to find out the needs of the corporation, which could lead to collaborative research.

In order to maximize the research result of AIST, AIST has a mechanism called “patent application preview”, the objective is to choose the best manner to utilize research result. After researcher made an invention disclosure, the examination of application strategy will be conducted by innovation coordinator, 2 months later innovation coordinator will make a pitch presentation giving brief information about invention, how to utilize and how to develop into the next step to related division to decide what the most effective way to utilize is; joint research, licensing, start-up venture or continue action as new research.

I requested information regarding the successful commercialization case of AIST. For example of success case is a collaborative research between SMEs and AIST, a small company was a manufacturer of AMPHLET which is a material used for connection between pipes in chemical plants but was prohibited to use by law. The company resorted to AIST to find the new material. AIST and the company conducted collaborative research under funding by NEDO and the collaboration received an award from METI. And the new product was commercialized and placed on a market.

Another successful case is cooperation with large company. AIST license its technology regarding humidity control material to large company, and after licensing both parties conducts a collaborative research, which lead to a successful commercialization.

One interesting aspect of AIST technology transfer activities I received from the interview is that patent solely owned by AIST; as a result of research and development by AIST researcher only, has small number of licensee compared to those jointly owned. It is also interesting that to license patent to companies is considered more difficult than to propose a joint research, which tends to show more prospect of commercialization for the company. This is because after licensing, the company still needs to conduct further research and development and also require substantial amount of fund to succeed commercialization.
3.6 Conclusion

This chapter examines policy and mechanism which focuses specifically to bridge the gap between basic research and commercialization. First I explore the small business innovative research or SBIR originated in the U.S., the program received a good feedback from the society in supporting the growth of small science and Technology Company; which account for generate revenue and job creation. SBIR program is believed to bridge the valley of death when government provides funding support at an intermediate stage between basic research and commercialization to SMEs.

Japanese government has a long history of providing policy support for SMEs but the old SMEs supporting policy was treated SMEs as “weak entity”. After the revision of SMEs basic law, the policy gave a new outlook of SMEs as the source of entrepreneurship, innovation and job creation. One of the innovation support policies is Japanese SBIR; modeled after U.S. SBIR. The program’s main objective is similar to the U.S. SBIR, whereas in the program details there are some differences. In Japanese SBIR each agency that implemented the program are free to design their SBIR which sometime resulted in losing focus of the main SBIR program. But the feature of supporting package of Japanese SBIR is especially valuable to the post-SBIR phase such as an extension of debt guarantee limits and special interest loan, for business activities.

At the implementation level, this chapter explore JST “gap funding” program. The aim is to utilize university research result and achieve commercialization. The program offer various kind of support; from feasibility study to pilot production; grantee can be university, start-ups company, small business or large firms. But most of the programs place an importance on U-I collaboration by requiring a joint application between university and industry.

As another implementation body I have explored AIST activities as it claimed to be research institution which focuses on conducting near-commercialization R&D. It appears that technology transfer of AIST prefer the collaboration between AIST and industry which has more potential to achieve commercialization. The examples of successful commercialization were derived from the joint research from the beginning.
Chapter 4: Conclusion and Policy Implication

This research is try to derive policy implication and best practice of Japanese government policy that support utilization or commercialization of IP resulted from university based-research and small business-based research.

The university based-research; focus on Japanese government policies developed during 1990’s; regarding technology transfer, university-industry collaboration, the information and data was obtained by means of literature review and in-depth interview. With regard to small business-based research, this research focus on Japanese SBIR policy that supports the commercialization of research result by SMEs, data was obtained by both literature review and in-depth interview.

The selected interviewee is an expert in a field of Innovation policy, technology transfer, university-industry collaboration; working as a policy maker or academia. Researcher tries to explore all related policy and implementation mechanism, which supports the transfer and commercialization of knowledge, resulted from government support. Researcher also interviewed government research institutions and funding agency to derives recommendation at both policy level and implementation level. The following are conclusion and policy recommendation;

4.1 University-based research

Researcher has explored the evolution of Japanese government policies, which support the university-industry linkage to improve technology transfer climate from university or government research institute to private industry.

From the study shows that Japanese government plays an important role in introducing various policies with an effort to improve university-industry linkage, a number of policies came from different agencies across Japanese government, but the key players are Council for Science and Technology Policy (CSTP), IP Headquarter, METI and MEXT.
Japanese government had shown the interrelation between intellectual property and S&T as a driver for economic growth by promote the creation of knowledge that stated in the first S&T Basic plan. The main focus was to increase the government support on R&D expenditure despite the economic recession in 1990’s, by having university as a key player in R&D.

Moreover, In order to maximize the research results came out from university; the S&T basic plan also emphasis on strengthening the collaboration among university-industry-government to improve efficiency for the exploitation of intellectual property, which could lead to national economic growth.

According to the S&T basic plan, in order to achieve the objective of technology transfer among parties, Japanese policy makers formulated series of policies which was very much concentrated on building a formal relationship between university and industry. It was focus on removing the obstacle that hinders the transfer of knowledge from university/research
institution to industry. For example, the change of IP ownership system from government-owned to university-owned, which allow university to manage their research result and transfer result to industry. The government support for collaboration between university and industry is necessary so as to return the public investment on R&D back to society. After the enactment of regulations, it significantly changed customary technology transfer manners between universities to industry. The customary technology transfer manner was conducted in an informal approach through personal relationship between professor and industry; through joint research or licensing activities, instead of conducting via university.

The university-industry cooperation can divided into 3 categories; 1) “technology transfer” approach which means to transfer research result created by universities to specific corporations 2) an approach based on university-industry cooperation which took the form of joint-research which research topic could come from industry side 3) an approached based on “start-ups led by academics” this approach use research result of university to form a startups company. The regulations have covered the promotion of all 3 categories of university-industry cooperation.

- The TLO law resulted in establishing a system which has technology licensing office within national university as intermediary to transfer the seed of university to corporation; with the TLO system it significantly changed the technology transfer manners from private relationships between researcher and company to a formal relationship. The formal technology transfer relationship conduct through TLO resulted in a significantly increase in number of patents and licensing cases; however from the study shows that the licensing revenue was not significantly increased as the number of licensing cases.

- The Industrial revitalization law was resulted in reforming a system of IP ownership; allowing university to own the result of government-funded research. Ability to own research result also attracts industry to conduct more joint research project with university. However the law only applies to private university but it was not applied to national university prior to the incorporation of national university.

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19 How should universities approach intellectual property, Koichi Sumikura, 200
National University Corporation is given to be the most important legislation; it gave legal status to national universities, which helps complete the objective of the previous law in exploitation of research result. With regard to the intellectual property ownership now national university have the right to own and utilize the IP at its own discretion through the operation of TLO. And national university within its authority can support the operation of TLO by providing facility and other support.

It is also been proved by the interview that, government policies has impact on a changing of U-I relationship. From the interview; one policy maker gave his opinion that without the enactment of these set of legislations would produce a different result in technology transfer situation in Japan, there would be fewer opportunity for technology transfer between university and industry. To carry out technology management through TLO provides more opportunity for university and society to introduce the research result to more companies and also create more opportunity for Professor who lack of personal connection with industry, on the contrary before technology transfer laws the technology transfer was conducted through private relationship from university professor and industry or only through one to one relationship but not in a large scale. And the term university-industry collaboration became a common terms for person working in research and development field.

It should be noted that the adoption of U.S. model law regarding technology transfer of Japanese government; was not a “copy and paste” approach. There are several differences in details which were customized to specific needs of Japanese society at the time. For example, the Bayh-Dole act of U.S. provides licensing preference to small businesses because it aimed to promote the participation of small business firms in federal supported R&D. But in Japanese Bayh-Dole does not contain such preference, because the main objective of the Industry revitalization law aimed to maximize business resources in Japan in order to recover Japan’s economy. Therefore, the policy was not specify the size of industry and because of large enterprises play an important role in Japanese society which would also help reviving economy as a whole.

At implementation level, the cooperation between METI and MEXT in structuring university-industry partnerships policy represents the tie between knowledge creation and utilization
of knowledge in real sector. Since the two ministries has a different area of responsibility, MEXT is mainly responsible for country’s education and METI is responsible for Industrial related issue, but when it comes to university-industry relationship; which is an overlapping issue; the ability to cooperate across ministry was carried out under Japanese government.

One of the most important factors contribute to the success in the collaboration among ministries in propose IP related policies and IP policy execution is because of strong leadership lead by Prime Minister Koizumi during 2002 under slogan “IP- based nation”. The enactment of IP basic law and the establishment of IP headquarters resulted in a comprehensive IP system and an execution of uniform IP policy.

From the study, it can be conclude that prior to the formulation of policy regarding U-I collaboration, Japanese university has several limitations in terms of legal framework to cooperate with industry. But after the enactment of government regulations, specific obstacles were removed which resulted in an increase of U-I collaborations in various forms.

4.2 Small business-based research

In addition to the broad government policies which support the transfer of knowledge from public sector to industry aim at commercialization, Japanese government also put an emphasis on the role of small businesses as an innovation driver; although large companies employ a large proportion of R&D contribute to the growth of Japanese economy. But the current corporate innovation strength which rested within the traditional Keiretsu structure might not be able to adapt rapidly to the future trend as the university-based research or small business research. There is a need to improve Japan’s innovation system by supporting small businesses to bring on new ideas to the market, so as to remain Japan’s competitiveness among emerging countries such as China or South Korea.

Japanese government revised related SMEs supporting policy by introducing public policy that reduce the structural and financial obstacle that small businesses are facing, one of the policy introduces was Japanese SBIR program. The program was designed after the U.S. SBIR model by targeting innovative small firms. It allows government direct support to SMEs in conducting R&D relating to the potential technology which may create new industries.

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20 21st Century Innovation Systems For Japan And the United States : Lesson from a Decade of Change, National Research Council, p.80
From SBIR survey conducted by Small and Medium Enterprise Agency in 2011, the results of survey revealed success and failure factor of IP commercialization that small businesses have faced. Around 43% of the surveyed company couldn’t pass R&D phase to commercialization; the failure factor came from the lack of technological strength; to elaborate the exact problem is company facing difficulty to develop prototype into product and the lack of funding. Once the company achieve commercialization phase; which from the survey accounted for 35%, the obstacle that SMEs face next are insufficient information about market needs or have difficulty obtaining marketing information or sales channel and the access to financial resource.

From interview with IPOCA; Venture Company that developed an accumulated point card system, the company has experience using many government subsidies. When the company applies for SBIR sponsored by METI, the product was in a trial phase, company distributed its “1-point card system” in small business district area. But the company needs funding in order to upgrade its “tatchang”; a receiver technology from using card to mobile phone to scaling up company’s business, then company applied for SBIR program.

The president told interesting story that when he first received subsidy from Tokyo Metropolitan government, the company started to received media attention which also resulted in attracting investors. However when investors came to his company, most of them look for stability which venture company could not achieved at that time, so there is no investment from investor during early stage development. Therefore, SBIR program offer a financial assistance for his company when investor was still reluctant. The program also provides management and marketing expert to the company. IPOCA also utilize the extended support package of SBIR such as low interest-rate loan and patent reduction fee.

However, there are some criticisms about the administrative issue of the program. For example the hand on support to the company, program will send expert to venture for 10 times and each times take 2 hours. But for Venture Company the working culture and time might not fit with availability of experts, then the appreciation of helps is less than that expecting by the program. The vertical design program of SBIR is also cause some difficulty for SMEs in searching for subsidy that match their own needs, SBIR contains many subsidies offered by various agencies. The interdependent of the program has some negative effect.
for small company in application process because each agency has different requirement, conditions and documentation. IPOCA received several rejections during application process when they tried to apply for SBIR program, but the President of the company has his own networking which could helps him to succeed in applying and was selected by SBIR program.

Furthermore, from the study it shows that, even though the program shares the same name “SBIR” but in practice, there are several differences. One major difference is that each ministry that employed SBIR program can freely determine the program structure, which also resulted in different practice in each subsidy. The original idea of SBIR support is to provide small firms with financial support during intermediate stage between basic research and commercialization. But in Japanese subsidy program also contains a mix of support between basic research and near-commercialization support. The support in some subsidy also extends to large company, in which is out of original scope of SBIR program.

Therefore, it can be concluded from information derived from survey and interview that the critical issues for SMEs or Venture Company are 1) Funding problem 2) marketing and management strategy 3) technical problem. Japanese SBIR program offer early stage support for SMEs and venture business by providing money, management support and supporting package which could help company to access funding at a difficult stage. But the program is still not been utilized by most of Japanese SMEs, which might came from the reason of administrative process. From the program survey, the result of the program is not yet satisfactory; it might be concluded that one of the reason is because the program design which allow each agency to freely determine its own subsidy; some subsidy does not focus on commercialization phase and resulted in fewer successful commercialization case.

4.3 Policy Implication

From literature review study and from interview, researchers derived some policy implication and implementation mechanism, which could apply to support the intellectual property commercialization for Thailand in order to assist country in strengthening its innovation capabilities and eventually resulted in the increase of country competitiveness. However, Japan and Thailand has many differences, in terms of country’s context; different level of technological development, government administrative system and culture, therefore, some recommendation will be specific for Thailand context. I will separate
recommendation into policy and implementation level for both university-based research and small business-based research.

4.3.1 Policy implication for Thailand to support the commercialization of University-based research

- To formulate a clear policy regarding IP ownership system of government funded research: IP ownership should transfer from government agency to university and industry

At present, the Bayh-Dole act style of law is still not exists in Thailand.

Thailand situation regarding ownership system is various among funding agencies, each agency exercise its own rules. The research results, which are a result of government-funded mostly, belong to government funding agency, jointly owned between government agency and university or case-by-case basis. The capacity of government funding agency to manage intellectual property is also various among agency; most of funding agency does not possess technology transfer function which limit the exploitation of intellectual property and resulted in a bulk of “sitting on shelf” intellectual property. This current situation brings about difficulty and constraint for university to be able to manage intellectual property and transfer to industry.

According to Thailand government target to increase R&D expenditure from approximately 0.24% to 1% by 2016, in which will resulted in the increase of intellectual property and also this accentuate the role of university in conducting research and transfer its result to society. Therefore, the policy which allow university and industry to be able to own Intellectual Property right arise from government funded research would remove a current limitation, increase overall environment of university-industry collaboration and support the utilization of intellectual property.

Learning from Japanese experience, the Bayh-Dole act law is adapted to be suitable to the country context. Thailand needs to consider the same tailor-made approach. Following are some considering point for Thailand if the country will adopt the Bayh-Dole act policy;
What type of intellectual property Thai Bayh-Dole would cover; patent, computer software (copyright), plants variety that would maximize the use of government funded IP and creates economic value.

Small business and local firms preference regarding licensing activity from university TLO

Learning from Japanese context; at the time when Japan developed the technology transfer policy; the country was in deep economic regression, the intention is to recover by means of technology transfer to industry; and the industry which plays a great role in developing R&D in Japanese society is a large firms. Japan Bayh-Dole also does not contain preference for local business so as to maximize the most of research result and to create revenue out of research results; therefore Japanese TLO can license to foreign company.

In Thailand context, large firms and multi-national company such as SCG, PTT, conduct most of R&D but for SMEs there is also a sign of increase in R&D activity. Therefore, Thailand should consider technology transfer style, which would mostly benefit for Thailand.

It should be note that, at present Thailand University possesses legal entity and are able to retain ownership.

- To formulate policy that provide continuous support for operation of TLO systematically; in both financial, human resources support and extensive supporting measure that enable TLO to be financially dependable

At present, Technology Licensing Office already exists in Thai universities. There are 10 TLOs, which was an initiative by project of office of Higher Education under the umbrella of Ministry of Education and 53 university business incubators which some of them also contain TLO function. TLOs are mostly established within university; only Chulalongkorn university which has outside-TLO as a separate legal entity but operating for Chulalongkorn university. The operation performance of Thai university TLO is quite various among universities which came from several factors; university industry relationship, human resources, insufficient budget, quality of university invention. Human resources problem in Thailand also came from “not put the right man for the right job”, many university mistaken the function of TLO as legal function since it is related to making licensing agreement with

21 University Business Incubator is also an initiative supported project under Office of Higher Education. And some of UBI also contains TLO functions. And there is still no official numbe
industry, therefore, some university entrust law professor to be in charge of TLO; in which nature of TLO personnel should possess technological background, business-oriented and legal expertise. And since the TLO system has just started in Thailand, therefore university/research center technology transfer/licensing offices are in early stage of development. Technology transfer personnel still have limited experiences.

Based on Japanese policy to support TLO, the government provide subsidy for approved TLO for 5 years with extending support regarding human resources support by providing “on-site” patent licensing expert from the National Center for Industrial Property Information and Training (INPIT) However, as for Thailand context the time period of support should depend upon the capability of Thai TLOs; in which further study can be conducted regarding the performance of Thai TLOs. And for the model of human resources support, Thailand might need different model since Thailand still have limited number of IP experts, therefore the dispatch of expert might not be enough to all TLOs. The possible model might be the exchange of experience and knowledge sharing among TLO, with the present of experts periodically.

- To develop incentive system which promote the collaboration between university/researcher and industry

Based on the literature review regarding the relation between internal management and an effectiveness of TLO operations, that conduct a study of 4 TLOs; TODAI TLO, Keio TLO, TUAT and Tokyo Tech. TLO, the result revealed that one of important factor is to have intellectual property management policy; with a clear rules on benefit sharing.

However, according to Baton Zone program of RIKEN, researcher will receive money from both RIKEN and industry in a collaboration project. However from the interview, money is still not enough incentive for researcher; their primary concern is still their research activities. Therefore, reward system, which would attract researcher to work in collaboration with industry, is still an issue that needs to be developed.

- The strong political leadership and work integration among agencies must put in place
The main driver of public policy is no surprise a politician, despite how useful policy is to the country but if it cannot grasp the political attention; the execution of policy can be challenging. As for Japan, the strong leadership led by Prime Minister Koizumi and his cabinet in 2002; help in the execution of uniform IP policy across related ministries led by IP headquarters. The IP headquarters is not an implementation body but rather make a clear action plan of which agency or ministries to be undertaken. IP headquarters dispatch liaison officer to related agencies so that policies and legislation developed by the Headquarters are executed effectively and uniformly throughout the government.

For Thailand, this research is not suggested an establishment of another agency to supersede IP related matters agencies. But rather suggest the work integration among agencies. Intellectual property is a across the board issue, the perception of intellectual property as one of the key economic driver should be emphasis among related ministry. Take the example Japanese government of the work integration between METI and MEXT, which sometimes perceived as policy competitor because of overlapping jurisdiction; but with the strong leadership by Prime Minister and strong working ethic help them to achieve the work across ministries and action plan.

At the implementation level; to achieve successful commercialization; there are some suggestions based on interview with related government funding agencies and research organizations ie: RIKEN, JST, NEDO and AIST. Every agencies share one common goal; even research institute, which focuses on basic research, that is their research result should be utilized further by industry. I have derived some lesson learned which contribute to a success of commercialization base on the interview are as follows;

1) Built-in commercialization process should be promoted by supporting early collaboration between university and industry. Instead of having university to develop research result and license to industry, the university-industry collaboration through joint research might show more potential for commercialization. Licensing does not always guarantee the success of commercialization.

Commercialization process can be categorized into3 main types; licensing, conducting joint research and start-ups using university/research institution IP. Based on the interview with AIST, which concentrates on conducting translational research R&D,
however, the result of utilizing research result solely owned by AIST was fewer compare to the joint- ownership, which resulted from the cooperation between AIST and industry. Therefore, only licensing to industry does not mean that it can lead to a successful commercialization. After licensing, the follow-up of technology transfer activities between researcher and industry must be taken. AIST IP personnel also told about his work experience that in many cases the collaboration take place in a form of joint research more than licensing because it guarantee the possibility of commercialization more than licensing agreement.

2) In Funding program which support the joint research between research institutions or between university and industry, the research theme often came from a “bottom-up approach” which means the research topic will be based on the problem or the needs of researchers; not the funding agency. The “bottom up” research topic that came from the needs of industry tend to shows more possibility of commercialization.

Based on the interview with RIKEN, in Baton Zone program, which is a collaboration research between industry and RIKEN, both parties will conduct a pre- session to work together before the actual project commence. During the pre-session, Industry and RIKEN will jointly develop research proposal and them submit to RIKEN.

According to JST A-STEP funding program, the research theme also set using bottom-up approach, based on the needs of industry. The theme should come from the demand-side or jointly develops.

3) The intermediary position in university or government research institute which help bridging the gap between university and industry. Based on AIST innovation coordinator mechanism, the innovation coordinator help bonding U-I relationship by go out and find the needs of industry to pursue the collaborative project.
4.3.2 Policy implication for Thailand to support the commercialization of Small business-based research

1) Policy to support research and development for SMEs especially during early stage development; cover the commercialization process from feasibility study, prototype development, pilot production to scaling up

SMEs in Thailand are also accounted for a large percentage over 95% and contributing to Thailand economy as Japan. At present, the law and mechanism to support SMEs in Thailand are existing, but Thailand is still lack of specific policy, which support the innovative capacity building for SMEs. The specific financial mechanism offered by government to support industry especially SMEs to commercialize intellectual property is limited. National Innovation Agency (NIA) of Thailand offer supporting scheme in the form of grant, loan and equity finance to help industry achieve innovation development for industry but is still insufficient. Another supporting scheme in Thailand offer to build innovative capabilities to industry is ITAP

Thailand needs a general policy, which allows all government agencies to be able to provide direct technological funding support for SMEs. Researcher put an emphasis on having general law, which allows government related agencies to promote SMEs in conducting research and development for new products or services. Researcher use the term general law is because; at present each agency that can give the support to private sector; support is made pursuant to specific law of each agency. In addition, Thailand has a unique notion regarding spending government money on private sector; government money should be able to retrieve back when spending to private sector. This notion is opposite to the principal of government support for SMEs during the high-risk time in developing idea into products; which SMEs face a challenge of finding private financial source. Therefore, the general law, which allows the R&D support to private sector, would remove limitation of government agencies in providing support to SMEs.

National system and support measures from government plays an important role to national innovation capabilities.

At the implementation level, the SBIR model originates in a U.S.; adopted worldwide including Japan could be considered as a model. Base on the interview and from literature review; I have derived some best practice model, which could be adapted to Thailand context as follows;
2) **A support provided to SMEs should include both financial support and technological and business advisory support**

From the study it shows that issues arise when company tries to achieve commercialization not only often involves source of funding but also involves technological issue and marketing issue. The main support in both U.S SBIR and Japanese SBIR is financial support, but Japanese SBIR has offered a unique “hand on” support by sending expert to guide company with technical and management aspect such as to establish, sale & marketing, legal issues. Although the hand-on support is not a common scheme for all subsidies under SBIR but from the SBIR survey in 2010, shows that companies receive hand-on support have a high degree of satisfaction for this support. The financial support from government is important for the company during prototyping phase and pilot scale phase when investors or V.C can’t yet absorb the risk. At the same time, company need to prepare marketing strategy to increase its competitive advantage and succeed in placing product to the market.

3) **A “set aside” support which continue support to SMEs after funding is finish in order to succeed commercialization.**

The purpose of set aside support is to help company after the company finish the R&D phase. In U.S. SBIR during Phase III, there is some criticism for phase III support because not all company that can attract angel investors to support the company in scaling up production, therefore this implies that SMEs still need support in the phase after R&D in order to achieve commercialization. Based on the study of Japanese SBIR program, which provides the supporting package for SBIR, awarded company, some of the support can help company to cross the valley of death, especially the financial support in the form of low-interest rate loan from government affiliated financial institutions. The case study of Kawamura Sangyo and IPOCA, shows the complementary of supporting package to a main program, after the subsidy of SBIR scheme, both company utilize the available subsidy of government in the form of low-interest rate loan to implement large scale production.

However, from the study of Japanese SBIR program and U.S. SBIR program also show some lesson learned for Thailand if we consider adopting the program;

   a. The original U.S. SBIR program, the structure of the program is under the guideline established by Congress unlike Japanese SBIR
determine its own program. Some resulted in the nonconformity of the objective which originally to support small business to succeed in develop idea into products but some subsidy is more focus on basic research rather than commercialization. The nonconformity of the program can result in a poor performance rate of the program.

b. The “vertical design” of implement bodies under SBIR program

In Japan there are 7 ministries as an implementing bodies, each ministries offer specific subsidies and has different requirement, conditions and documentation. From the user point of view, the interdependent of each subsidy can be an obstacle for SMEs to apply for SBIR. Company need to do research to find out which ministry offers the subsidy that match the needs of company. And the requirement of different conditions and documentation is also a hassle for small businesses to invest amount of time for application. This administrative process can also limit the number of application.

From the example of JST, JST provide a various funding scheme, but JST has provided mechanism to select the program, which is suitable for applicants, which is called “a reception section”. The well design of the program can also attract more users.

c. Based on the interview the amount of money received for SBIR program is still not cover the needs during commercialization phase. However the benefit of being SBIR Award Company can attract media attention and also provide creditability, which also draw investor attentions. However, investor is still reluctant to take risk with Venture Company during intermediate stage, which involves high risk. Further study could explore the incentive policy, which could attract investor to invest in SBIR awarded company such as tax policy.
4.4 Concluding Remarks

From Japan experience for a past decade on developing technology transfer and technology commercialization, it removed limitation that hinder the transfer of research result made under government sponsor and helps create a formal linkage between university research institutions and industry. Policies resulted in an increase of university-industry collaboration activities; the data shows the direct impact on technology transfer policy and increase in University-Industry activities which could lead to commercialization such as, licensing cases and increase of joint research.

However, based on the interview; licensing case does not always guarantee the success of commercialization. Instead of having university to develop research result and license to industry, policy might need to concentrate on building the university-industry collaboration through joint research which might show more potential for commercialization. The consistency of government support is of important to nurture new setting up entity such as in the case of TLO.

Beside the main policy, the supportive policy which support and ensure the continuity of the program by collaborate with other government affiliated agency is also needed. In the case of SBIR system, the support program help ensure the success of commercialization. And last but not least, despite influence by U.S Policies, It was not a copy and paste approach but rather a Tailor-made approach to suit Japan’s country context. Similarly, Thailand needs to carefully observe the problem and craft it to suit our country context.
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