How public research institutes can create new startups?
A case study on Innovation center for startups; National Institute of Advanced Industrial Science and Technology in Japan

Emiko Tsuyuki[1]

In recent years, there has been an emphasis on the importance of technology transfer and commercialization by using the outcomes of research conducted by universities and public research institutes. This paper examines a case study of creating high-tech startups within an intentionally designed incubation system at Innovation center for startups (INCS), National Institute of Advanced Industrial Science and Technology(AIST) in Japan.

Introduction

In recent years, there has been an emphasis on the importance of technology transfer and commercialization by using outcomes of research conducted by universities and public research institutes. This is not a new issue. Many studies have done on industry-government-academia collaborations and technology transfer over the years. However, it is only in the last several years that the importance of technology transfer has been re-advocated because of the following reasons.

Firstly, industries are becoming increasingly dependent on science. Science linkage between academic papers and patents were found in each technical field. Especially, that linkage is strongly related in growing industries, such as biotechnology, nanotechnology and ICT fields.

Secondly, the expectancy and role of universities and public research institutes has been changing. There is a need for industries to strengthen their competitiveness on the international market through the commercialization of inventions provided by universities and public research institutes. There are two routes for transferring technology. The first is to spill over technologies through collaborative research with companies or licensing patents, and the second is to create startups..

As to returning publicly funded technology assets to society in the form of startups, establishing small enterprises is seen to make a small impact on industries. Commercialization of technology seeds is deemed not very significant unless the business scale reaches a reasonable volume. Therefore, the new companies, which employ technology seeds from advanced technology fields and aims for growth-oriented in scale and scope, are called “high-tech startups (HS)” to differentiate it from typical

[1] Emiko Tsuyuki is associate professor of Department of Management at Meisei University. Address correspondence to: Emiko Tsuyuki, Department of Management, Meisei University, Hodokubo1-1, Hino Tokyo Japan. 191-8506. Tel: +81-42-591-6460. E-mail: tsuyuki@mi.meisei-u.ac.jp.

family businesses(Shane 2004). The features of HS is that it has a mission to systematically follow, from the start, a growth strategy which would enable it to go public (IPO), or be acquired (M&A) to a major enterprise at least within ten years.

As is widely known, HS have been performing successfully in the U.S. If that is the case, can all the countries and all the regions in the world create something akin to Silicon Valley if they boosted R&D and supported the creation of HS in a similar fashion? If not, how universities or public research institutes can "intentionally" create HS? This paper provides a case study for incubating HS, which conducted in a public research institute in Japan.

A Model of Incubation

Hackett and Dilts (2004) claimed that the study about incubators themselves was limited. A comparative study over incubators conducted by Clarysse et al. (2005), they clarified three categories of incubators, such as Low selective model, Supportive Model and Incubator model. They described that "the Incubator model results in fewer spin-outs, but the businesses supported will typically be likely to be VC-backed growth-oriented businesses, achieving higher levers of innovative activity at the leading edge of technology and operating in global markets".

Roberts et al（1996）studied the U.S. and British universities which created HS and came to the following conclusion: The infrastructure required for establishing businesses, such as human resources and venture capital (VC), is in place in areas such as the Silicon Valley or Greater Boston where there is an abundance of entrepreneurial spirit. So, even if universities and other organizations had no special mechanisms, successful case examples can come about simply through the use of the usual Technology License Organization (TLO). Other areas, meanwhile, can produce successful results by selecting highly promising technology suited for HS and providing strong support in terms of funds and people. In other words, whereas an incubation infrastructure functions in these two U.S. regions without having to implement special policies thanks to the function of market mechanism, it is difficult to establish HS in other regions unless some sort of mechanism is adopted policy-wise. In a word, there is a need for a political mechanism for technology selection and support.

Overall both Clarysse et al and Roberts et al discussions, it would be intentionally necessary to design an appropriate functional incubator in order to create HS, if the incubation social infrastructure is immature.

As I introduce in the following pages, INCS is an incubation-organization designed for creating HS through a mechanism of strong selection and support. I will focus mainly on the phase after a new invention has been made in which 1) it is recognized as a technology seed; 2) R&D and market survey are conducted; 3) funds and human resources are acquired; and the time 4) after a start-up is established and 5) until some degree of progress is made so as to lead it onto the growth track.

Verification of AIST Model

Outline of AIST

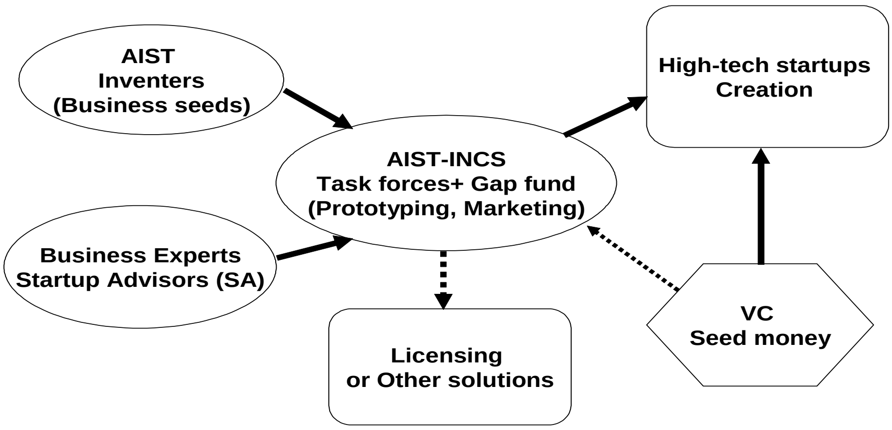
AIST[2] (National Institute of Advanced Industrial Science and Technology) was established on April 1, 2001. It is a newly formed research organization that is the result of an amalgamation of the 15 research institutes previously under the former Agency of Industrial Science and Technology (the former AIST) in the Ministry of International Trade and Industry and the Weights and Measures Training Institute. The new AIST is the largest public research organization in Japan. Headquarters of AIST are located in Tsukuba and Tokyo. AIST has over 50 autonomous research units in various innovative research fields such as life science and technology(18%), Information technology and electronics(16%), Nanotechnology, materials and manufacturing(16%), Environment and energy(24%), geological survey and applied geosciences(10%) and Metrology and measurement technology(15%).

The research units are located at nine research bases and several sites (smaller than research bases) of AIST all over Japan. About 2500 research scientists (about 2000 with tenure) and well over 3000 visiting scientists, post doctoral fellows and students are working in AIST.

About 700 permanent administrative personnel and many temporary staff supports research works of AIST.

Figure 1

AIST- INCS Model



An Incubation *Model in AIST*[3]

AIST set up Innovation Center for Start-ups (INCS)[4] in 2002 as a super COE(center of excellence) project, co-sponsored by The Ministry of Economy, Trade and Industry and The Ministry of Education, Culture, Sports, Science and Technology . INCS is not only a research center, as is named, for

2 Detail information about AIST is http://www.aist.go.jp/index_en.html

3 The case study of AIST-INCS model is mainly quoted from chapter six in “A study report” of INCS-AIST (2007).

4 An official leaflet about INCS is http://unit.aist.go.jp/incs/ci/publication/panflet/panflet_e.pdf

entrepreneurship but also a practical unit in order to create new startups. INCS subsequently started a task force in 2003 for creating future HS, using the schemes of the AIST-INCS model (Figure 1).

A task force is a research and development team comprised of technology investors, startup advisers, post-doctoral researchers and technical staff. 44 task forces were formed between 2003 and 2006. The research and development operations carried out within the task forces are POC (Proof of Concept) as a preliminary stage for the firm creation of the HS. INCS provided the gap fund for those task forces from about US $ 200,000 to US $ 300,000 per team per year for maximum two years.

A unique characteristic of the AIST-INCS model is that business experts (external entrepreneurs) are temporarily employed as startup advisers (SA), and these SAs are expected to launch HS. The SAs also become HS executives such as CEO, CFO and COO when the HS is launched, and soon after formulating a management team through investing from VCs, SAs leave AIST. The SAs are also expected to search inventions as business seeds. If the inventors (mainly researchers in ASIT) are motivated to be involved in a startup creation, SAs perform consulting work related to the business planning and submit applications to the task force adoption committee. Typically, the SAs work for two or three task forces. As a general rule, a task force is required to come to the conclusion either setting up a startup or finishing the project in two years operation. If the members of task force decide to set up a startup, they become shareholders and/or executives of the new HS.

The flow and strategy of the entire HS creation process of INCS is as follows.

1) AIST researchers, who have idea or invented new technology and wish to commercialize them, submit an application to the INCS task force adoption committee.
2) After being selected as a task force, the task force members are required to submit the research and development and business plan. At this stage, the SAs carry out marketing activities such as communicating directly with the future clients, soliciting joint research, investigating the market conditions, and making presentations at international conventions, and reflect any needs in the development process.
3) A company creation is highly depending upon the timing. Members of the task force decide to set up a startup at the optimal timing for them. As is the case of biotechnology, if the development span were long, the HS would be set up after finishing the task force. If the HS are set up without investment by VCs, the HS need to apply for public grant in order to increase the efficacy of the technology, and promote partnerships with major corporations.
4) It is usual that the inventors and SAs become stockholders of the new startup. In addition, some researchers who move to the company from the task force team (such as post-doc researchers) also become stockholders as founding members.
5) A task force can start contacting with VCs before setting a company. It is ideal to set up a startup approximately half a year before the task force ends. Therefore, the startup is able to receive investments from the VCs soon after launching.

The important question is who would be suitable for a SA. Ideally, they should be business experts who conducted a successful HS in a certain technological field (such as serial entrepreneurs), but the number of successful HS cases is limited, it is impossible to find such serial entrepreneurs in Japan. Therefore, INCS recruits business experts under considering the following elements.

· Capability of carrying all kinds of managing tasks
· Self-independence
· International working experiences
· Connections and networks
· Technological background to communicate with the inventors

INCS recruited 17 SAs from October 2002 to March2007. Those SAs worked from one to five days per week. 11 out of 17 worked at least 4 days per week. At least 10 SAs met the all requirement above.

Case Studies of Startups from AIST-INCS Model

1) Company A(Bio technology field)

Company A’s technology is based on a new DNA microarray that can transfect nucleic acid such as plasmid DNA and siRNA. Approximately 1500 types of genetic biological effects can be analyzed with a mere 10mL cell culture scale. As a result, extensive gene function analysis using primary cells in culture is made possible, the correct target genes can be identified at a high speed and with high accuracy, phenotypic changes commonly seen in multiple cell types can be indexed, and the essential genes that influence objective phenotypic changes can be reasonably identified. In the past, problems with screening when using phenotypic reporter genes resulted in the obtained genes not necessarily being phenotypic.

Company A’s business concept is to carry out joint research with pharmaceutical companies and increase the value of the startup by sharing the results. The activities of the task force proceeded through the following steps.

1) Mr. B, an AIST inventor (he used to work in an American research laboratory), pursued the commercialization of the invented technology, but he gave up because he had no competent of marketing skills and business experiences.
2) He consulted with Mr. C., a SA in INCS. Mr. C recommended applying for a task force, while at the same time discussing the whole concept of the business model.
3) Because Mr. C has no background in biotechnology, he searched through his network for an adviser, and recruited Mr. D.
4) Mr. D. had experience as a researcher for an international pharmaceutical company, and provided advice to several bio-ventures.
5) Their task force was given a positive assessment from the many pharmaceutical companies within Mr. D’s network, and the member of task force decided to set up a startup. Mr. D became the CEO, Mr. C the CFO, and Mr. B the CSO. The startup began contract negotiations for joint research with other companies.
6) They concurrently began negotiating with VCs, and raising fund from a VC. Company A was also succeeded in second round financing.

Without the meeting between Mr. B and Mr. C and the participation of Mr. D, they would not have been able to set up a growth-oriented startup. In the case of Company A, Mr. C, as the SA, has a financial background and also MBA in the US. He has also experience in the management team of an international incorporation and after that, he started a software development company by himself and served as the CEO.

The combination of members of this task force was not realized by chance, but intentionally conducted in incubation process The activities of the SA is the critical point in the steps above, and the foundation of his activities is provided by the AIST-INCS model.

2) Company E (Micro electronics field)

EEPROM and flash memory (Semiconductor Design Nonvolatile memory) have developed as industrial use. However, due to reasons of cost and security, it is seldom used at LSI process. PermSRAM (trademark) developed by Company E is a type of nonvolatile SRAM. It can use at the standard CMOS processes, and without increasing the wafer cost by removing the necessity for any additional processes, an LSI design for nonvolatile memory is made possible as an F/F (flip-flop) or a buffer-like circuit component.

Company E's business concept is to use nonvolatile memory technology as its core competence and provide design IP in semiconductor integrated circuits that realize a nonvolatile memory function in a standard CMOS platform.

Company E proceeded through the following steps to set up.

1) Mr. F, a SA, was dissatisfied with the fact that there were few successful examples with LSI design in Japan.
2) Mr.F stumbled upon Mr. G, who planed to start a LSI design HS. Mr. G quit working for a major electronics corporation and worked for an overseas venture company. Mr.G had an interest in HS because of his experience at UC Berkeley, and wanted to eventually start his own business.
3) Mr. G's plan envisioned commercializing the circuits invented by Mr. H, who was affiliated with the same company and was an associate professor at a technical university in Japan.
4) Mr. F, Mr. G, and Mr.H refined a business plan and filed an application for an AIST task force. A task force was adopted, and the plan was started as an AIST project.
5) Due to the limit of the AIST gap fund, they decided to set up a startup suddenly after starting the task force, and the chip prototype shuttle fee for Taiwan was covered with funding from a VC.
6) They formulated a management team of the startup as; Mr. G became the CEO. Mr.G recruited Mr.I as the CTO from the same electronics corporation. Mr. H became the CSO. Mr.F became CMO(chief marketing officer).
7) They had succeeded in second round financing from a few VSs.

If Mr. G and Mr. H, both of them would have only been researchers and engineers, started the startup without helping by Mr.F, they might encounter some difficulties with respect to patent strategies ,marketing and communicating with VCs. Although their starting point was successfully achieved, their next stage was to acquire a primary user and sophisticate their technology.

In the case of Company E, Mr. F's background was Ph.D. of Engineering with technical expertise in liquid crystal development. After leaving the major electronics company, he became a consultant and worked with international corporations involved in semiconductor development.

Results of Incubation

There were 44 task forces started in AIST-INCS from 2003 to 2006. The results of incubation in AIST-INCS model were below (at the point of February 2007).

1) Project ended by 2007: 27 task forces
   - 8 task forces set up a startup and invested by either VCs or business partners
   - 12 task forces set up a startup but not yet invested by VCs
   - 7 task forces did not set up a startup

2) Project continued in 2007: 17 task forces
   - 5 task forces set up a startup and invested by VCs
   - 3 task forces set up a startup but not yet invested by VCs
   - 9 task forces continuously precede the project

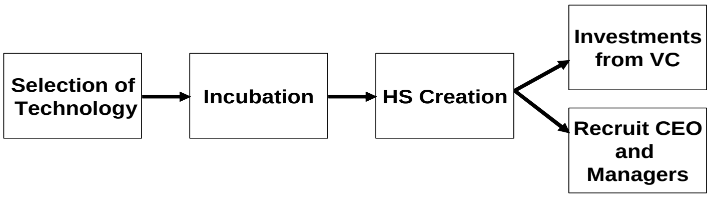
Even among the task forces which did not set up startups, the SAs were continuously working at bringing the technology into commercialization. There were four task forces progressing in the following ways;

1) Although they could not set up a startup because of the research group not having reached a consensus, the research continued as a joint research with the existing company. At the same time, they selected multiple existing companies for further joint research.
2) Commercialization of the product was difficult due to the lack of complementary technology, and the HS has not yet set up. However, the task force selected a company that had complementary technology and met their needs, gave this case into the negotiations with TLO through licensing.
3) Although the level of technology improved and modifications to the application were made during the period of the task force, business partners were necessary to receive investments from a VC. The member of the task force tried to obtain other public research funds for further technology development, and restarted to operations for setting up a startup.
4) Although they could not reach the practical level of technology, the possibility of commercialization was in sight due to the joint research with other companies. The member of the task force planned by means of merging with another startup, and came to complete of the technology.

Although startups could not have been set up with the task forces, the road towards commercialization was accessible in some cases. This phenomenon would also be a result of SA’s activities toward the technology exploitation.

Figure 2

HS Creation Process



Implication from the Case Study

A region such as Silicon Valley that sees a cluster of high-tech entrepreneurs and VCs that have a wealth of experience and which correspond to an early stage, as well as the existence of law firms that are involved in the process right up until creating a business plan, cannot be formed in a short period of time. Even in other industrially advanced countries, startups from universities and research institutes increased at volume-wise, but the establishment of rapid-growth and scale-expansion high-tech startups is still limited.

AIST-INCS model suggests that the following conditions are necessary within the mechanism of incubation of HS.

1) Technological screening for a seed of HS should be conducted not by inventors or scientists but by business experts
2) Recruit business experts from outside the organization (external entrepreneurs) for the leadership roles in a startup project, and develop the selected seeds so that they can be commercialized.
3) A strong management team with high-tech entrepreneurs is necessary at least when setting up a startup and starting business
4) In order to sharing the interest and retrieving the expense for research and development and additional supports, the incubating organization hold shares of startups
5) An institutional framework of public technology development funding such as gap fund is necessary to complement for investment at pre-seed stage or early stage startups

A characteristic of the Japanese business environment is that successful examples of high-tech startups are extremely limited, including spin-offs from existing companies. Therefore, the important issue in Japan is to determine how high-tech entrepreneurs should be involved in an HS creation process, or how to construct a system in which they can be involved.

Professor Morishita from the Medical Department of Osaka University, the founder of AnGes MG, Inc., Japan's first startup from university to go public (IPO) in the new market of Tokyo stock exchange, stated the following in a lecture:

“It is important to have awareness of the importance of business experts in a company, and treat them as such. Business experts have great pride in their careers, and implementing a system that shows respect for them, including reflecting this through their salary, is important.”

It is often that the HS creation process is shown generally in Figure 2. However, if the business plan has already been made, is there anyone who would take risks of the business plan? It may be possible to recruit management professionals after achieving a certain degree of success and planning to go public, or having already gone public. However, during the stages before a VC has invested, it is difficult to recruit appropriate CEO.

On the other hand, if a business plan were created together with the inventors and the business experts involved, they would have a certain degree of confidence in business development. As such, there is no hesitation over their becoming members of the executive team. Through discussions with the inventor group during the prototype development stage, the whole concept can be understood. Regarding the fund raising from VC investment as well, there is also the possibility that they will declare their intention to assume management responsibilities and proactively negotiate the details, which increases the level of persuasion for potential investors.

During the trial of the AIST-INCS model, the role of the SA was assessed as being effective to create HS and their growth. This results in that many VCs take part in a meeting with the task forces.

It is sometimes, however, claimed that it would be appropriate to spend public money to recruit a business expert and to create a startup which is totally private company. However, if the research results were not realized as innovations and commercialization into the market, would this imply that the research and development project had used public money effectively? If policy makers dealing with public money do not understand the importance of high-tech entrepreneurs, this model will not become popular. That is to say, it is crucial for policy makers and the managers of universities and public research organizations to be aware of the importance of gap funding under the appropriate conditions in order to create startups.

Discussion; An Integrated Model of TLOs and Incubators

Until now, only incubation strategies for the creating HS have been focused on in this paper. In terms of organizational framework, however, it is optimal for the function of transferring technology to the existing company and the incubation of the HS to be implemented within the same organization.

At Cambridge in England, the organization that manages the invention, the organization that carries out licensing to existing corporations, the organization that aims to establish the high-tech startup, were all originally handled without cooperation. Therefore, they established Cambridge Enterprise in order to integrate the functions of all of these organizations.

At Imperial College London, a subsidiary named Imperial Innovations Ltd. [5] was established in 1986 which is fully owned by the college, and in 1997, the three activities (intellectual property applications, licensing (TLO function), and spin-outs (business/development) were merged into one organization. Imperial Innovations Ltd. is comprised of thirty employee altogether, including the former venture capitalists employed externally. Business specialists are assigned to each department:

[5] Detail information about Imperial innovations is http://www.imperialinnovations.co.uk/

two employees are in charge of joint contracts, three are in charge of life sciences and medicine, three are in charge of physics and engineering, and three are in charge of spin-outs and business development.

The following two benefits are given as reasons for why an integration model is ideal.

1) After the high-tech startup is established, the HS need to negotiate with TLO for the patent licensing contracts, if the patent is owned by universities or research institutes. In that case, if TLO can own HS's stock, it is not necessary to require patent licensing fee for the HS, because TLO expects to have capital gain by IPO or M&A of the HS. If the licensing organization and the HS incubator are separated and have different ways to maximize their profits, a conflict of interests would happen. This conflict sometimes prevents startups from incubation.
2) As introduced in AIST case examples, licensing becomes possible under several conditions when the company has been incubated as a high-tech startup. If HS incubation and licensing are handled by the same organization, a foundation exists in which this orientation can be further intensified through cooperation with a unified purpose.

We need to collect and investigate more cases of incubators in order to find an ideal model of organization for technology exploitation and commercialization.

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