

Japanese technology policy on technology transfer

Development of technology licensing organizations and incubators

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With the emergence of a “knowledge-based economy”, governments in most OECD countries have intensified their commitment to research and development activities. In 1980, the Japanese government affirmed that its fundamental policy goal was to achieve a “nation based on science and technology”, with emphasis on “Industry-University-State cooperation.” This article focuses on technology licensing organizations, incubators and other such organizations established to facilitate the transfer of technology from university to industry.



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Introduction

The last decade of the 20th century was marked by the emergence of a “knowledge-based economy,” with technological innovation functioning as the engine of growth, and governments in most OECD countries intensifying their commitment to R&D activities. Reflecting this orientation is the convergence of economic, technological and research policies.

Japan was no exception. In its 1980 *White Paper on science and technology*, the Japanese government affirmed as its fundamental policy goal the achievement of a “nation based on Science and Technology”. Since then it has implemented several laws and policy packages in the fields of science, technology, industry and higher educa-

tion. This policy orientation has been consolidated by the *Science and Technology Basic Law*, introduced in 1995, which gave the government legal competence in promoting the advancement of science and technology. The R&D expenditure financed by the government is expected to attain one per cent of GDP during the second term *Science and Technology Basic Plan* (2001-2005).

It is worth noting that behind this policy lie hope and speculation that the creation of spin-off and start-up companies, as well as new industries induced by technology transfer from universities and research institutes, will finally defeat the prolonged economic stagnation that Japan has been facing for the last decade.

Under the 1998 *Law for promotion of university-industry technology transfer*, technology licensing organizations (TLOs) were set up inside Japanese universities to facilitate technological innovation and the creation of new businesses. This has created a new path for technology transfer, which had hitherto been dependent on relationships between individual faculty members and industry.

To transform technological “seeds” into new products and industries, it is essential to provide supporting infrastructure, technology and business know-how. Incubators providing these services first appeared in Japan in the 1980s, and at present, more than 300 such facilities have been established.

This article focuses on the role of TLOs and incubators in supporting intermediaries in the process of commercializing new technologies, and provides an assessment of the current situation and relevant issues.

Technology policy

To understand the emergence of TLOs and incubators it would be helpful to have a brief description of the technology policy adopted by the Japanese government during the last decade.

Basic law and plan

The 1990's were often called “the lost decade”, a reference to the prolonged economic recession Japan faced. It was in this context that the Science and Technology Basic Law was promulgated in 1995, to equip the government with a legal basis to pursue its objective of a “nation based on the creation of science and technology”, which would clearly call for a costly and long-term engagement of the government.

In accordance with this law, the state becomes “responsible for formulating and implementing comprehensive policies with regard to the promotion of S&T”. The state is thus expected to take necessary measures, especially budgetary ones.

The law emphasizes cooperation between national research laboratories, universities and the private sector, the right balance between basic research, applied research and development, and the training of research-

ers. Particular attention is paid to preserving the autonomy of researchers and specifying research activities within the university sector. The law envisages the establishment of a basic plan to promote S&T, which will contain operational policies.

The first Basic Plan, covering the 1996-2000 period, mainly focused on the improvement of R&D conditions. The Basic Plan recognized the need to increase government investment in R&D to the level of Western countries, to create a competitive R&D environment, to improve R&D capability in the private sector, and especially, to reinforce industry-university cooperation.

In keeping with the spirit of the Basic Plan, a certain number of laws and measures were implemented, reinforcing the tie between industry and universities. Indeed, universities were expected to become major players, as knowledge-creating and training institutions, leaving behind their ivory tower image.

Promoting university-industry technology transfer

Recognizing that inventions made within universities are under-exploited and that giving value to these dormant technologies in terms of new products or creation of frontier industries is of social value, a law for promoting university-industry technology transfer, called the *Law on Technology Licensing Organizations* (TLOs), was promulgated in 1998. This law, prepared jointly by the Ministry of International Trade and Industry (MITI) and the Ministry of Education, Science, Sports, and Culture (*Monbu-sho*), aimed at facilitating technology transfers from universities to industry.

Given the number of non-finalized research projects within universities, the right to patent an invention, for the most part, now falls into the hands of the faculty. In general, technology transfer takes place on the basis of a case-by-case contract or of an informal agreement between a faculty member and a private company, which results in a limited return to the inventor and his affiliate institution.

Thus, the law on TLOs was implemented to create a “virtuous cycle of technology transfer” by facilitating the patenting and licensing of privately patentable inventions (Regarding na-

tional universities, they consist of faculty-owned inventions, and regarding private and public universities, they also cover those owned by the university), which would generate a financial return, which in turn would be reinvested in research activities within the university.

The TLO charged with executing the technology transfer business, may be organized as a stock corporation, a limited corporation, or incorporated foundation, according to the Commercial Code in the case of national universities, and also as a division of a school corporation in the case of private universities.

The TLOs, once approved (*shonin*) by the Minister of Monbu-sho or Minister of MITI on the basis of the execution plan they present, become eligible to receive subsidies, (Limited to an annual subsidy of 20 million yen per TLO during the first five years.) debt guarantees and support for information gathering provided by the Industrial Structure Improvement Fund.

Besides the conditions guaranteed by the law, the TLOs may benefit from the services of the “patent distribution adviser” dispatched by the Patent Office and managed by the Japan Technomart Foundation without charge to reinforce their competence in legal issues.

Regarding patents generated within national universities and owned by the State, the Law defines another category of TLOs – those said to be “accredited” (*ninte*) by the competent Ministers. They are allowed to file and to keep the patent free of charge, and to exploit these patents. (The article on this issue went into effect in 1999.)

As for the licensee, the law introduced a modification to the Law for Facilitating the Creation of New Business, allowing an SME to remain the beneficiary of the investment provided by the SME Investing and Promoting Company, even beyond the capital limit of ¥ 100 million.

After the first period of application, some supplementary measures were taken to improve the operation of the TLOs. The *Industrial Revitalization Law*, (Another important issue of this law concerns commissioned research funded by the State, including special corporations. Hence the right to intel-

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Table 1: Review of the first Basic Plan

Items	Effects	Remaining problems
Competitive environment	Research funds allocated on a competitive basis were doubled between 1995 and 2000. Research funds targeted to young researchers were more than doubled during the same period.	Limited total amount
Mobility	The objective "10,000 post-docs" was attained in 1999.	Problem of follow-up after the post-doc period due to lack of a competitive market of researchers
	Time limited positions were increased within national research laboratories (129 positions in a total of 9,791 in 1999). Timid introduction in national universities (75 in 59,557 in 1998).	National universities not enthusiastic
Research environment	Investment in physical infrastructure was insufficient (total amount of budget has decreased between the period 1991-1995 and 1996-2000). The number of research support staffs by researcher remained low (0.84 at national labs and 0.24 at national universities in 1999).	To be improved
Evaluation	Assessment system on R&D themes and research institutions was introduced.	Absence of feedback
	National universities have obligation to proceed to a self-assessment	Lack of transparency
Tripartite cooperation	Certain number of measures facilitating technology transfer were implemented.	Limited effect

Source: "Follow-up of the Science and Technology Basic Plan" (January 2000)

lectual property rights belongs to the commissioned research institution. This law is called "Japanese Bayh-Dole Act" for this reason.) enacted in 1999, allowed the TLOs to benefit from a reduction in the filing and patent fees during the first three years of their operation. The *Law for Reinforcing Industrial Technology*, enacted in 2000, allowed the approved TLOs to use facilities located on national university campuses for their operation free of charge.

Basic Plan II

The Science and Technology Basic Plan II has been prepared according to the following schedule: presentation

of the draft by the end of 2000; discussion and presentation of the final version by the General Council for Science and Technology, newly founded within the framework of the administrative reforms of the Central Government, and adoption by the government by the end of March 2001.

The Preparatory Office of the Science and Technology Basic Plan started to review Basic Plan I in 1999. Its aims were to assess the effects of Basic Plan I, to identify inherent problems and to take them into consideration when preparing Basic Plan II. Their conclusion is summarized in Table 1.

The result is that the expectation of the Basic Plan I was not fully realized although the quality of the R&D environment was improved to a certain extent. Basic Plan I remained inertly tied to a linear model of innovation and was focused on "science" and "research activities," so that Japan still encounters difficulties when translating inventions in terms of innovative products. In other words, the "interface with society" is not yet wholly established. To overcome this problem, Basic Plan II launches its concept of science and technology as follows: science and technology within the society, serving the society, and receiving feedback from the society. Accordingly, it defines three general objectives that Japan has to pursue, which are:

- To become a centre of knowledge creation and exploitation;
- To build a secure society;
- To ensure international competitiveness and sustainable development: and
- To specify how science and technology may contribute to reach these objectives.

The major change with regard to Basic Plan I is that the government clearly affirms its intention to build a technological innovation system that will serve society as a whole, and its preference for a "strategic" and "targeted" approach.

Besides the traditional support for basic research, research funds will be allocated giving priority to the fields of life sciences, information technology, environment, nano-technology and materials, energy, manufacturing technology, social infrastructure, and new frontiers likely to bring solutions to the major problems that will face society in the future. This choice reflects the guidelines of the National Strategies for Industrial Technology, though the argument to develop new markets is attenuated.

Regarding the innovation system, Basic Plan II indicates the way the reform must be pursued (Table 2).

In summary, Basic Plan II presents a vision of an innovation system functioning in a competitive environment, and is based on close ties between industry, universities and national research laboratories, and on the dynamics gener-

ated by the exchange of people and ideas across these three sectors.

Technology Licensing Organizations (TLOs)

The Law on TLOs defines the technology transfer business as follows:

- Information gathering on inventions with a potential for commercialization generated within associated universities;
- Acquisition of the right to patent and patent filing of selected inventions among the latter, or assignment of a patent, and acquisition of an exclusive license of already patented inventions;
- Licensing (exclusive and non-exclusive licence) or assignment of the above patents to private companies; and
- Passing on to researchers and to their affiliate institutions a part of the licensing and other revenues.

TLOs today

From the passing of the law on TLOs in 1998 to the end of April 2003, Japan has seen 32 approved operating TLOs, and one accredited operating TLO, which is engaged in the licensing of government-owned patents. Among these approved operating TLOs, some had been operating at universities before the passage of this law. It is worth noting that there is a limited number of TLOs operating without formal approval. In the rest of this section, we will focus on approved operating TLOs.

Regarding organizational types, up to the end of April 2003, there have been 16 TLOs in the form of stock corporations, two of limited corporations, eight of incorporated foundations, and six of school corporations. (In the case of private universities). As for the relationship of TLOs with universities, the above 32 TLOs can be divided into two groups: six internal subordinate offices and 26 external entities. While all six internal subordinate TLOs are related to private universities, external TLOs can be further classified into eight single-client TLOs and 18 regional (multi-client) TLOs. All eight single-client TLOs are related to national universities, six of which are in the form of stock or limited corporations, and the

Table 2: Innovation system according to the Basic Plan II

Targets	Means
Competitive environment	To increase competitive research funds following the US model. To introduce the system of overhead.
Mobility and autonomy of young researchers	To increase non-tenured and public offering positions. To redefine the status of assistant professor and assistant.
Evaluation system	To increase equity and transparency. To reflect the results of evaluation on resource allocation. To invest in staff training and in research on the evaluation system.
Supporting system	To allow carrying over of research funds. To increase autonomy and flexibility of public research institutions.
R&D management	To enlarge the competency and the responsibility of the head of a research institution. To make organization of R&D flexible.
Tripartite cooperation	To inform the private sector on the public sector's R&D activities. To reinforce matching between the private sector's needs and public sector's seeds. To make the use of existing research cooperation systems more transparent and simpler.
Technology transfer to the private sector	To reinforce support to technology transfer organizations. To set the incentive mechanism to license privately-owned patents. To open the way to transfer the right to patent or patents, and to grant exclusive license to the private partner within the framework of commissioned or joint research projects. To open the way to transfer nationally owned patents to technology licensing organizations. To set up an incentive mechanism for the creation of high-tech venture companies.
Training of researchers and engineers	To improve the practice of evaluation carried out within universities. To implement an internationally recognized accreditation system. To make researchers and engineers aware of their social responsibilities.
Science and technology infrastructure	To improve physical infrastructure. To increase the ratio of support staffs to researchers. To consolidate the intellectual infrastructure. To become a participant at the international meetings on the intellectual property rights and standardization.
Internationalization	To reinforce international R&D cooperation. To become an information emitter. To facilitate the international exchange of researchers.

Source: Basic Plan II (March 2000)

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remaining two in the form of incorporated foundations. Regional TLOs have been gradually increasing in number since 2000.

By regions, there is a concentration of 15 TLOs in the highly university-populated Kanto area, in sharp contrast to just one TLO each in Hokkaido area, Shikoku area, Tohoku area, and Chugoku area.

Since the four newly established TLOs in 1998, not only has the number of university patent applications been increasing along with that of the TLOs, but also university licensing income, such as royalties and income accrued from option contracting. This implies that more and more intellectual properties (IP) owned by university faculty have started to rely on the patenting and licensing services by TLOs. Moreover, under the policy direction of "IP as national foundation," IP creation and protection have become an important element of innovation system and national development strategies, leading also to a raised social recognition of TLOs' importance.

From the perspective of transforming university technology seeds into practical uses, TLOs undertaking the patenting and licensing of academic research results have to devote time also to such extended activities as industrial liaison, negotiating and contracting of industry-university collaborative researches. Moreover, while the importance of TLOs has been widely recognized, the deepening and rooting of industry-university partnership are still in their early stage of development and require persistent efforts. Therefore, the involvement of TLOs has been extended into businesses from basic patenting and licensing, to faculty education on IP issues, to industry liaison, and to more comprehensive supporting activities for technology transfer.

In 2002 the meeting of the Industry-University Cooperation Committee of Employment and Industrial Structure Reform transformed TLOs into Technology Management Organizations (TMOs). Moreover, in promoting university faculty start-ups, the government modified the related rules and measures in June 2002 to broaden the definitional scope of university TLOs' ac-

tivities for supporting technology commercialization. However, while it encounters considerable difficulty in securing financial and human resources to expand TLOs' service range, such expansion also creates coordination issues between the TLOs and the university research support divisions, raising the demand for setting clear guidelines.

For external TLOs, governmental subsidy is the major financial source. Until the end of Fiscal Year (FY) 2001, under the subsidization of "Industry Structure Improvement Funds," once a subsidy application was approved, up to two thirds, of TLO operational expenditure, not exceeding ¥ 30 million would be granted annually for the subsequent five years. Since FY 2002, the Ministry of Economy, Trade and Industry (Since January 2001, MITI became METI.) (METI) started administrating the TLO subsidization, and reduced the subsidization to some extent. However, given the time lag from licensing to realized return and the high uncertainty, it is difficult at present to further reduce the rate of subsidy even when the number of patent applications is in a notable increase.

More than half of all TLOs adopt a membership system and collect membership fees. For TLOs without a membership system, local governments provide some subsidies to ensure the financial stability of TLOs.

As for TLO expenditure, costs related to personnel and patent applications constitute the major component. It is worth noting that such personnel costs as those for applied consultants for patenting and supporting staffs from enterprises or local governments are excluded from the calculation of TLO expenditures. Costs of patent application, while regarded as a part of TLO expenditures in the accounting system, are treated by the tax system as durable assets, thus affecting the financial basis of TLO operation.

The major financial issue for the TLO operation is how to overcome possible financial deficiency once government subsidization stops. Some probable counter-measures include enlarging the membership size, increasing royalty income, and diversifying related services. However, it remains questionable how to enhance

marketing, industrial liaison, service diversification without significantly increasing the personal costs. It is also challenging to obtain the right balance between the stable membership fee income and uncertain royalties.

As for human resources, security of adequate manpower supply is another common issue in TLO operations. Manpower for TLOs comes from a variety of sources: some TLOs use as their full-time personnel those assigned by related enterprises or local governments; others hire experienced personnel (old bird, OB) from large enterprises, some rely on the "patent distribution adviser" or the beneficiaries of internship programmes of the New Energy and Industrial Technology Development Organization (NEDO). Among the above sources of manpower for TLOs, "patent distribution advisers" are highly rated for their professional skills.

For such professionals as patent attorneys, lawyers, accountants, and the like, TLOs almost always outsource the related services. Also, it is observed that some TLOs outsource the related services from university' alumni. TLOs place human resource development at top of priority list, due to the fact that licensing officers is an emerging profession. In the short-run, it is an option to leverage such manpower from the IP departments in large enterprises, while in the long-run, it is expected that management of technology programmes will contribute to train such manpower.

Incubators

While TLOs work on transforming the technology seeds from universities or research institutes into IPs, and transferring these IPs by licensing to the technology users, the social value for technology cannot be realized without the incubation process, in which specialized incubators play an important part. After the incubation stage, science parks enter into the scene as an important facilitator for those research-intensive start-ups to advance. As mentioned previously, a trend has been observed of expanding the TLO into a TMO. In this context, the boundaries between TLOs and incubators, and those between incubators and science parks turn less clear-cut. Therefore, this section will start with a brief explica-

tion for the essence of incubators, followed by a review of their development in Japan.

Firstly, distinction should be made between pre-incubators, which mainly foster innovative ideas into product prototypes, and incubators, which further develop those preliminary results into commercial and marketable products. Since the latter provides various sorts of commercial supports, it is accordingly also called "business incubators." In Japan, pre-incubators are rarely seen, and often universities or research institutes contribute to overcome this stage by allocation of their space and leveraging external resources.

Incubators could be classified as the general type of business incubators and special type such as those for multimedia, software, environment, biotechnology, and so on. Alternatively, incubators could be categorized into non-profits and for-profits.

While there might be some difference between the incubator definition proposed by National Business Incubation Association (NBIA) and by Japan Association of New Business Incubation Organization (JANBO), the core functions of an incubator are nonetheless in agreement. That is, an incubator should provide supporting services such as: providing information and professional consulting, introducing seed funds, leveraging resources from universities or research institutes and training; as well as facilities like office space, experimental or manufacturing equipment, conference rooms, and information technology facilities.

During the 1980's, the Japanese government started to implement a series of measures for promoting regional industries, including the wide establishment of industry-supporting institutions and science parks, although the concept of incubators was still not common. The first non-profit incubator was promoted based on the *Private Participation Promotion Law*, and the number of non-profit incubators has been increasing since the beginning of the 1990s. Additionally, since the passage of New Business Promotion Law in 1998, it has become the responsibility of the Japan Regional Development Corporation (JRDC) to facili-

tate the development of incubators. By April 2002, as many as 30 incubators had been established by JRDC. Also, in 2002, an additional budget of JRDC was approved to finance the establishment of university incubators. Beside JRDC's efforts, the Ministry of Education, Culture, Sports, Science and Technology (MEXT). (Since January 2001 Monbu-sho became MEXT). financed the establishment of incubators at Tohoku University, Tokyo Institute of Technology, and Nagoya University, followed later by 10 more university incubators, by the 2000 additional budget of MEXT. The above shows the government's recognition of the physical proximity of universities during the incubation process of technology seeds. Institutional adjustment was also underway; from June 2002 onwards, university faculty start-ups could move into the university incubators despite the national ownership of national universities' facilities.

The growth of for-profit incubators has been taking-off since 2000 in metropolitan areas. Compared with non-profit incubators, for-profit incubators aim at existing enterprises, operating principally in the fields of investment, consulting, real estate, for their diversification.

According to the survey by JANBO (FY 2001 survey), up to the end of February 2002, among 234 surveyed structures, which regarded themselves as incubators, there were 113 providing software-type supports, including information services, conferences, technical development supports, financial support, and so on, and 80 per cent of these were organized as non-profits.

"The 2003 Overview of Business Incubation", based on the JANBO survey of November 2002, reported 266 incubators providing software-type support, half of them with diversified services and supports. On the other hand, there were only 10 per cent of these incubators providing a limited range of services - no more than information service, conferences, and the like.

As for human resources, there were about 40 per cent without regular incubation managers, who are expected to play an important catalytic role in business incubation. Clearly,

face-to-face communication channels are in short supply.

In April 2000, the government's *Business Incubator Subsidization* was formally established, and since then incubation facilities have been increasing significantly. However, whether such subsidization provides incentive for the improvement of software type services requires further investigation.

In the FY 2001 JANBO survey as mentioned above, 113 incubators, providing software-type services, hosted 1,723 tenant companies, and computer-software companies constituted the major portion - 44 per cent for the non-profit incubators and 40 per cent for the for-profit incubators. The next major industrial group, if any, could be precise instrument manufacturing firms for non-profit incubators (about 5.3 per cent), and consulting service companies for for-profit incubators (7.8 per cent).

The so-called "graduated companies" refers to those still in autonomous existence after finishing their use of incubation facilities. According to the 2003 Overview of Business Incubation as mentioned above, there were 1,471 graduated enterprises among the 266 surveyed incubators. Regionally, Osaka, Kanagawa, and Gifu were among the most outstanding areas. As many as 96 graduated firms from the Business Innovation Centre, Osaka, 127 from the Kanagawa Science Park, and 84 from the SoftJapan Dream Core, specialized in IT.

If the main mission of incubators is to incubate start-up companies, then the number of graduated companies could serve as a useful proxy for the measurement of incubation performance or efficiency. However, given the orientation of rental space for most of the existing incubators, this number does not reflect correctly the performance of incubators.

In recent years, governmental supports have been increasing for the development of incubators, aiming at reviving regional economies by start-ups and emergence of new high-tech industries. The promotion of such activities as technology-intensive SMEs, university faculty start-ups, and regional clusters has been among the foci of economic policies, since business incubation could be placed at the heart of

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policies of SME development, regional industrial and economic development, and industry-university partnership.

Regarding infrastructure, it follows that in 2003 the related annual budget amounted to ¥ 2.3 billion for the establishment of business incubators and ¥ 7.3 billion for university incubators.

With respect to soft-type supports, although the importance of incubation managers has been widely recognized, government involvement did not start in the education and training of incubation managers until 2002. At the present moment, incubation managers come mainly from OBs of private enterprises or transferred personnel of the local government through on-the-job training. It is now in the government's priority list to improve this human deficiency.

Improving Incubators

While incubators continue to increase in number, improvement in the quality of their services remains the most crucial issue, and the improvement of related software-type supports is still at a slow and passive pace.

As the range of incubation-supporting services expands, constraints of human and financial resources become much more binding, leading to the necessity for business outsourcing and outside expertise. Essentially the incubator manager's capability and interpersonal networking constitute the key determinant to the quality and performance of an incubator.

In order to improve the supporting services of incubators quantitatively

and qualitatively, a better strategy is to concentrate on the quantitative and qualitative upgrade of incubation managers, an emerging professional field. This is why METI has started to subsidize incubators' expenditure on the training of incubation managers, with the hope of forming an incubator managers' network in future.

One responsibility of incubators is to provide start-ups with space and opportunities. Besides such formal educational activities as lectures, conferences, and studies, it is also important to facilitate informal exchange among tenant companies. For start-ups, such informal exchange in an incubator allows for the opportunities to share experiences of other companies of different developmental stages and industries. The composition of tenant companies should be examined strategically and some space should be preserved to facilitate such learning among them.

Daily contact is necessary between incubation managers and tenant companies. In helping shape the tenant companies' business plan, incubation managers should be able to understand upcoming problems, and provide useful suggestions, supporting services, and interpersonal connections. Moreover, such interaction would be largely facilitated if trust could be built between incubation managers and tenant companies. Also each company has its own specifics, which means that the type of supports differs from one company to another. Thus it is necessary for incubation managers to

pay close attention to the daily operation of tenants.

For technological supports, it is important for an incubator to retain contact with universities and research institutes, and enhance access to information. For commercial supports, an incubator should work on integrating such specialists as experienced entrepreneurs, patent attorneys and lawyers, accountants, and other supporting service providers, groups, and networks.

Conclusion

Japanese technology policy entered a new era by the end of the 1990s, with university-industry partnership as a feature. Recognizing that technology transfer from university to industry is a complex process, the government acted as an initiator, promoter and supporter in this process. To facilitate the transformation of a new idea into a product with commercial value, bridging intermediaries such as TLOs and incubators came into the scene through a series of policy measures promoting industry-university partnership, creating new industries, SMEs supports, and revitalizing regional economic development. Their importance has been widely recognized in Japan.

Today the situation is that all players are at the table. The remaining task is to continue upgrading the functioning of all related institutions and developing human resources, in order to induce innovation dynamics. Japan is in the incubation process of its innovation system. □

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