Chapter 2 To Accelerate Open Innovation

Section 1 Issues and Future Direction Concerning Open Innovation

Chapter 1 explained that there is a growing need for the diversification of collaborative forms, ranging from conventional small-scale collaboration among individuals to large-scale collaboration among organizations. It was also pointed out that further creation and expansion of startups and collaboration involving them are needed.

However, in Japan, collaborations are still mostly small-scale industry-academia-government collaborations among individuals. It is considered that universities, research and development (R&D) agencies, and companies are still not ready for full-scale industry-academia-government collaboration among organizations. The creation and development of startups are still sluggish, despite various efforts to date. In addition, in order to overcome these problems, it is necessary to enrich human resources that support each area, including entrepreneurial talent.

As such, we will explain issues behind the following three problems in the present situation where Japan's open innovation has not yet come into full swing.

- Industry-academia-government collaboration among organizations has not gone into full swing
- Startup creation and development is sluggish.
- There is a shortage of human resources to advance open innovation.

As mentioned in the beginning of Chapter 1, we will focus on universities and R&D agencies and clarify issues and direction for each problem.

1 Promoting cooperation of full-scale industry-academia-government collaboration among organizations

Why is industry-academia-government collaboration not going to be full-scale in Japan and staying on a small scale? We will analyze issues concerning the following three aspects based on what has been discussed at the Industry-academia-government Dialogue for the Promotion of Innovation[1] and the Open Innovation Co-Creation Congress[2], as well as matters pointed out in the White Paper on Open Innovation[3] and others.

(1) From a corporate perspective, universities and R&D agencies in Japan have room for improvement in organization management, making it difficult to make large investments.

(2) There is no effective incentive[4] for collaboration on the university and R&D agencies side, making it difficult to shift to full-fledged collaboration.

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1 A meeting held by the Ministry of Education, Culture, Sports, Science and Technology and Ministry of Economy, Trade and Industry since FY2016 with the aim of discussing the respective roles of industry, academia and government and specific measures for promoting innovation under industry-academia-government collaboration, in accordance with the Japan Revitalization Strategy 2016.

2 A meeting held by Minister of Education, Culture, Sports, Science and Technology Matsuno with experts since FY2016 to examine concrete reform measures for universities and R&D agencies towards full-scale open innovation.

3 Japan Open Innovation Council, White Paper on Open Innovation (initial edition), 2016

4 Incentives are factors that change human decision-making and behavior. Here, incentives refer to motives for individual researchers and organizations for participation in industry-academia-government collaboration.

(3) Most companies are still sticking to closed innovation, and are reluctant and not ready to engage in full-fledged collaboration.

(1) Organizational Management Issues and Directions

Today, industry is becoming ever more knowledge-intensive and cross-sectoral solutions are required. In order for industry, academia and government to collaborate and create innovation in such a situation, full-scale interorganizational collaboration needs to take over the place of conventional individual collaboration based on social reasons. Full-fledged organizational collaboration among industry, academia and government means that the tops of organizations collaborate with each other, making the most of their human and intellectual resources across departments, fusing knowledge and creating new value. To do so, it is unquestionable that organization management led by the headquarters[1] is needed.

However, there are currently some problems concerning the management of large-scale collaborative research, etc. One such problem is that universities and R&D agencies have difficulty developing attractive R&D plans and proposals led by the headquarters and managing progress and outcomes due to insufficient cross-departmental cooperation.[2]

Interviews with several domestic private enterprises experienced in collaborative research with overseas universities conducted by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) contained many insights into differences related to joint research between Japanese universities and universities in the US, which are more active in academic-industrial collaboration (Table 1-2-1).

First of all, we will clarify the issues behind each item of Table 1-2-1.

1 Many universities and R&D agencies have "industry-academia collaboration headquarters" etc. as departments responsible for industry-academia-government collaboration. Since their form, name and scope of responsibility vary, the departments in charge of industry-academia-government collaboration will be simply referred to as "headquarters" in this Chapter.

2 Council of Industry-Academia-Government Dialogues for the Promotion of Innovation, Guidelines on the Strengthening of Joint Research under Industry-Academia-Government Collaboration, November 2016

■Table 1-2-1 / Comparison of practices in industry-academic collaborative research between Japanese and US universities

	US universities	Japanese universities
Planning / proposal	○ Planning and system development that guarantee appealing results for the involved organizations (grasp and analyze corporate needs and build teams by gathering teachers from different fields according to the task). There are many examples of forming a collaborative research consortium with a large number of companies led by leader researchers.	○ Since there are no incentives such as linking research results to business, there are few proposals that clearly present outcome targets.
	○ A specialized organization for external fund acquisition is set up under the research staff to carry out marketing and proposal activities at home and abroad.	○ Even through universities have personnel to support external funds acquisition, such personnel are in short supply and their scope of activities is limited.
	○ Joint research proposals often contain some parts that require the full-time engagement of postdoctoral fellows and students.	○ Such proposals are very few, as universities lack a mechanism or supportive system to encourage engagement of postdoctoral fellows and students.
	○ Joint research expenses are clearly stated. Indirect expenses are also fully recovered.	○ Estimation of collaborative research expenses is often ambiguous. Indirect expenses are estimated lower.
Negotiation / adjustment	○ A negotiation and coordination system is established with companies.	○ The negotiation and coordination system with companies has not been fully established.
Progress management	○ Universities usually strictly implement collaborative research contracts. Based on the companies' technology strategies, universities promote projects with speed.	○ Responsibility to fulfill collaborative research contracts tends to be ambiguous.

Source: Excerpts from the handout titled "Sorting of Review Items" provided at the first meeting of the Open Innovation Co-Creation Congress (January 19, 2017).

①Planning and proposal for joint research, etc.

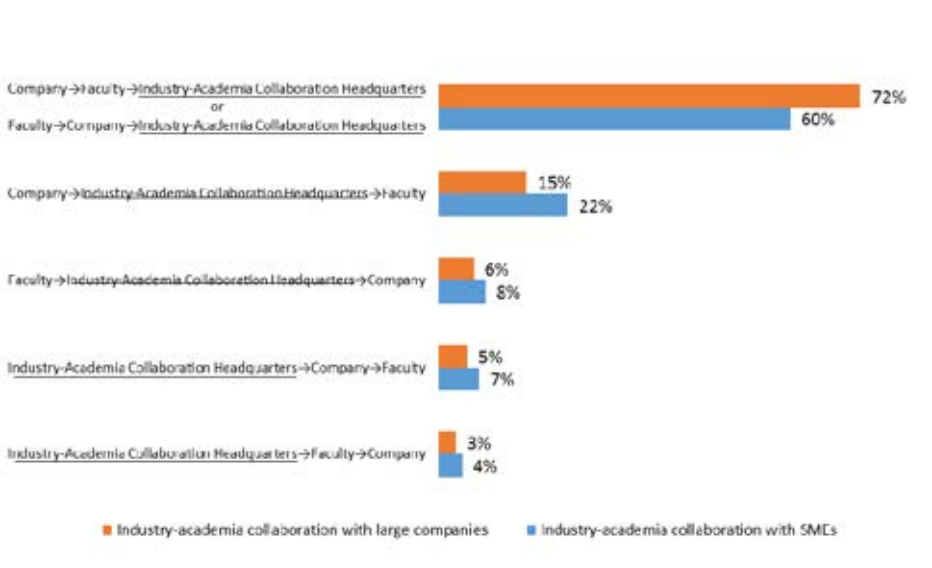
(Cross-departmental planning and proposals)

Universities and R&D agencies in Japan have pointed out the problem that there are few proposals to clearly present the result targets due to the lack of an incentive to link the research outcome to a business. In order to disseminate the results of R&D projects conducted by faculty and researchers of universities and R&D agencies to society by putting them into practical use, it is necessary to promote research and development with the sense that they are able to talk and collaborate with companies, while acquiring the ability to do so. As stated later in Subsection 3 of this Section in relation to the problems concerning training and securing of personnel, there is a need for doctoral human resources who are active not only in the field of academia but also in various areas such as industry.

Meanwhile, as universities and R&D agencies are not commercial organizations in the first place, and due to the low liquidity of human resources, faculty and researchers of universities and R&D agencies often do not have experience in companies. Efforts are needed to improve the mobility of human resources, but it is not realistic to impart business sense to all current researchers in the present situation. In addition, it would be totally meaningless if their research ability is deteriorated in exchange for such efforts. For this

reason, it is necessary for the headquarters personnel with business sense to coordinate industry, academia and government collaboration to lead planning and proposals while accurately grasping the needs of society and companies. However, at present, it is considered that there are not so many cases where the headquarters is leading planning and proposals from the beginning (Figure 1-2-2).

■Figure 1-2-2 / Flow of planning of industry-academia collaboration projects



Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on the Industrial Technology Research Project "Survey Report on the Actual State and Promotion of Industry-Academia Cooperation with Small and Medium Enterprises" by the Ministry of Economy, Trade and Industry (February 2014).

In addition, it has been pointed out that it is rare to make proposals as a team across fields according to the task. In order to do this, it is also necessary for the headquarters to lead and involve relevant departments. As a prerequisite, it is necessary for the headquarters to grasp what kinds of research projects and seeds exist within the organization, including information concerning postdoctoral fellows and students. Even at companies, open innovation is considered to be "primarily an issue of the optimization of internal corporate resources," because "it is impossible for the management to make decisions on those to be prompted as open projects and those to be promoted as closed projects without firstly analyzing their internal management resources."[1] For universities and R&D agencies, too, it would be inefficient to collaborate with an external organization without knowing what internal resources and strengths they have. For this reason, it is also a task to create a system that allows the headquarters to gather information.

As a premise for attractive projects and proposals, attractive research and seeds are important. Although research and development projects that lead to innovation require long-term support, research funds are basically allocated as a single-year budget. In addition, it is also considered to be essential to incorporate industry opinions when deciding a research theme, as is seen in the "Public & Private Investment Expansion Initiatives for STI" published by the Committee for the Activation of STI and Economy and Society in December 2008, which stressed the importance of deciding R&D fields based on industry opinions to

1 Edited by Seiichiro Yonekura and Hiroshi Shimizu, "Open Innovation Management : Challenges for Japanese Firms" Yuhikaku, 2015

attract private investment.

Case Study 1 Enhancing planning and proposal capabilities by collaborating with other universities, etc.: Efforts of the Union of the Four Universities in the Northern Tokyo Metropolitan Area (4u)

Cross-sectional collaboration and search for various seeds of new technologies to meet public demand have been promoted as it may be difficult for individual universities to discover such seeds by themselves. In this example case, this problem is overcome by cooperating with other universities, etc. in promoting industry-academia-government collaboration. Ibaraki University, Utsunomiya University, Gunma University and Saitama University, which are four national university corporations located in the northern part of the Kanto region, launched the "Union of the Four Universities in the Northern Tokyo Metropolitan Area (4u[1])" in FY 2008 to carry out multifaceted industry-academic-government cooperation activities, making use of the scale merit obtained through mutual cooperation. In addition, each university collaborates with local public and private universities, etc. in each area to expand the network. Gunma University, serving as the secretariat of 4u, said that "even small and medium-sized universities can become comprehensive department stores rather than retail stores, if they collaborate and accumulate to a certain degree."

4u publishes a collection of technical seeds that covers the laboratories of the four universities, including a new technology briefing "*hizazume* (intensive) meeting" by traveling around local cities in cooperation with local financial institutions and the Japan Science and Technology Agency. In addition, 4u has a system to introduce researchers from one university to another when one of the universities receives technical consultation from a company but is incapable of dealing with it, even if the consultation involves confidentiality obligations.

In addition, the content of the seeds collection, etc. is listed and actively sent to companies, which lead to the implementation of joint research projects. For example, in FY2015, 4u launched ten joint research projects with Fuji Heavy Industries Ltd. (manufacturer name changed to SUBARU Co., Ltd. in April, 2017), a major automobile and aerospace equipment manufacturer with many bases in Gunma prefecture. Even universities that have only a limited range of faculties can plan attractive cross-sectoral joint research projects, etc. and propose them to companies by strategically cooperating with other universities.

Union of the Four Universities in the Northern Tokyo Metropolitan Area (4u)
Source: Gunma University

1 Pronounced as "for you." Abbreviation of "4 Universality for you."

(Posting expenses required for the system for implementing joint research projects, etc. with responsibility)

One of the reasons that projects and proposals are not seen as attractive is the lack of a system that defines the responsibilities of faculty and researchers involved at universities and R&D agencies. This creates a situation where companies are not able to make large investments with confidence. When a university in the U.S. conducts joint research, etc. with a company, participation of teachers, postdoctoral fellows and students, etc. is clarified by contract, and necessary personnel expenses are often paid by contract.

On the other hand, in Japan, labor costs of teachers and researchers are not recorded as joint research expenses in most cases, due to such reasons as the difficulty of effort management[1] with education and research activities that are conducted as the original duty. In particular, it is considered that some national university corporations thought that personnel expenses of full-time teachers could not be recorded as joint research expenses.[2] According to the report by the Board of Audit of Japan[3], there are many corporations that do not include personnel expenses of full-time staff, such as research staff, in the calculation of joint research expenses (Table 1-2-3). This report pointed out that "the reasons behind this practice are that the consigned research projects and their content are based on the themes of research projects conducted by researchers, etc. at each corporation and thus the research outcomes will also contribute to other research projects carried out at the corporation, and that labor costs of researchers and other full-time staff are covered by the government subsidies for national university corporations, etc." The report also states that "corporations should consider asking the private companies that are contractors to pay for [...] labor costs of researchers and other full-time staff." Meanwhile, it was not common in Japanese universities to allow students to participate in projects as researchers that receive salary. It is considered that the lack of such a system or approach resulted in the current situation where students' participation is inactive (for example, 1 (1) ⑤ also shows that rules concerning students are underdeveloped). If the personnel expenses of full-time faculty members, researchers, postdoctoral fellows and students are posted as expenses, the scale of joint research expenses would be naturally larger than the current average.

One of the issues related to administrative procedures for full-time faculty members and researchers is the difficulty of effort management. The Guidelines on the Strengthening of Joint Research under Industry-Academia-Government Collaboration (hereinafter referred to as the "Industry-Academia-Government Collaboration Guidelines") formulated at the Industry-Academia-Government Dialogue Conference to Promote Innovation in November 2016 presents measures and precedent cases, etc. concerning the inclusion of personnel expenses in joint research expenses, including those for the abovementioned issue. Corporations are required to take ingenious measures based on these Guidelines.

1 Effort is the allocation rate (%) of the time required for the implementation of research, calculated deeming a researcher's total work time as 100%. Effort management refers to organizational understanding and management of this rate.
2 Council of Industry-Academia-Government Dialogues for the Promotion of Innovation, Guidelines on the Strengthening of Joint Research under Industry-Academia-Government Collaboration, November 2016
3 Board of Audit of Japan, Report Based on Article 30-2 of the Board of Audit Act: 'Regarding the Status of Efforts toward Securing of Self-income etc. at Incorporated Administrative Agencies and National University Corporations' (December 2015)

■Table 1-2-3 / Inclusion of personnel expenses of researchers and other full-time staff in the amount charged to entrustors (private companies) of entrusted research projects, etc.

(Unit: corporations)

Category	Included		Not included		Total	
	Contracted research	Contracted project	Contracted research	Contracted project	Contracted research	Contracted project
Incorporated Administrative Agency	11	5	23	12	34	17
National university corporation, etc.	-	-	87	65	87	65

Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on the "Report based on Article 30-2 of the Board of Audit Act 'Regarding the Status of Efforts toward Securing of Self-income, etc. at Incorporated Administrative Agencies and National University Corporations'" (December 2015) by the Board of Audit of Japan.

In addition, the appropriate procurement of expenses necessary for fulfilling contracts is an issue that is inseparable from the system for fulfilling the contracts with responsibility. There is also a problem of the ambiguity of grounds for the calculation of direct expenses, such as labor costs, and indirect expenses in estimating joint research expenses at Japanese universities and R&D agencies. These two problems are two sides of the same coin. While direct expenses refer to expenses that are apparently and directly necessary for and solely used for research projects themselves, indirect expenses refer to expenses required for the management of research institutions (universities and R&D agencies) in relation to the implementation of research projects.[1] To be more specific, indirect expenses include maintenance and operation expenses of facilities, expenses for supplies and rental fees for shared equipment, utilities costs, etc. However, it is difficult to distinguish these expenses from those for other research projects. In the current situation, indirect expenses are mostly calculated by multiplying direct expenses by a fixed rate (indirect expense rate).[2] As there are no particular grounds for the calculation of this indirect expense ratio, companies paying research expenses are reluctant to pay such indirect expenses as their use and grounds seem unclear.

One of the factors that make universities and R&D agencies incapable of presenting grounds for indirect expense ratios is that they themselves are not fully aware of the amount of indirect expenses required for one joint research project.[3] On the other hand, there is a report that, as a result of meticulous calculation of indirect expenses required of a university when carrying out a joint research project, it turned out that it exceeded the amount that is estimated using the current indirect expense ratio.[4] In any case, it is an issue that universities and R&D agencies have failed to carefully consider or externally present how to distribute the burden of expenses for shared equipment and facilities and expenses concerning administrative work related to industry, academia and government collaboration, to departments across the whole organization.

As seen above, it is thought that the ambiguity of the content of necessary expenses presented by universities and R&D agencies is one of the major factors behind why full-fledged industry-academia-

1 Agreement among relevant ministries on competitive funds "Common Guidelines for the Execution of Indirect Expenses of Competitive Funds" (Revised on May 29, 2014)
2 Review Committee on Diverse Financial Resources for Innovation, Report on Approaches to Cost Sharing for Expanding Joint Research Based on Full-Fledged Industry-Academia Collaboration, December 2015
3 Review Committee on Diverse Financial Resources for Innovation, Report on Approaches to Cost Sharing for Expanding Joint Research Based on Full-Fledged Industry-Academia Collaboration, December 2015
4 Review Committee on Diverse Financial Resources for Innovation, Report on Approaches to Cost Sharing for Expanding Joint Research Based on Full-Fledged Industry-Academia Collaboration, December 2015

government collaboration is yet to be seen. From the perspective of companies, it is obviously difficult for them to make large investment for joint research projects, etc. where the grounds of expense estimation are ambiguous and it is unclear whether the results will be secured.

In addition, the shortage of funds causes a problem concerning structural improvement at universities and R&D agencies that their aged and deteriorated facilities are left unrestored, inhibiting research activities.[1] From the viewpoint of companies, maintenance and improvement of facilities are also considered to be an important aspect in order for universities and R&D agencies to be attractive joint research partners.

②Negotiation, coordination and progress management related to joint research, etc.

The lack of an established negotiation and coordination system has been pointed out as a problem of Japanese universities / R&D agencies.

According to a questionnaire survey[2] on companies conducted by a contractor of the Ministry of Economy, Trade and Industry (METI), most common issues concerning universities' contact points for industry-academia collaboration were that companies are "not sure which universities to consult with" and "not sure who at the university is in charge of consultation" (Figure 1-2-4). Also, for example, in the case of a problem relating to intellectual property relations, staff specialized in intellectual property should deal with it; but in the case of conventional individual-to-individual collaboration among industry, academia and government, it was researchers who had to handle such problem, making it impossible to deal with it in a unified manner. In order to promote interorganizational collaboration in the future, it is necessary for the headquarters to take the initiative, clarify the contact points, and positively communicate their existence.

According to a survey conducted by the National Institute of Science and Technology Policy, matters concerning negotiation, coordination and progress management that are seen as problematic by companies when considering collaboration with universities included "difficulty in concluding a contract" and "slow progress of research."[3] When a university or R&D agency intends to start joint research with a company, arrangements are made on various matters, such as research content, research implementation systems, expenses, handling of deliverables (intellectual property). In particular, it is considered to be common that negotiation and adjustment take place concerning the attribution of patents and other deliverables that are deeply related to commercialization and monetization.

In addition, if external collaboration is promoted proactively, the number of contracts can increase greatly. However, there would be no time to carefully consider the content of individual contracts. On the other hand, universities should not change their cautious stance on contracts. As a result, universities may fall into a situation where they rely on heavily used contract templates and ask the other party to agree on the terms contained therein without any change.[4] In 2002, before the corporatization of national

1 Study Group on Comprehensive Management of Facilities of National University Corporations, etc., Facility Strategy Required for University Management: Facility Management Strengthens Education and Research Infrastructure, March 2015
2 METI-commissioned Industrial Technology Research Project in the FY2013 "Survey Report on the Actual State and Promotion of Industry-University Cooperation with Small and Medium Enterprises" (February 2014)
3 National Institute of Science and Technology Policy, Research Report on Research Activities of Private Companies 2014, NISTEP REPORT No. 163, 2015
4 Japan Intellectual Property Association, The First Subcommittee, The First License Committee, Collaborative Research Agreements between Industry and Academia – Contact practices for supporting diversified and sophisticated collaborations -, Intellectual Property Management Vol.64, No .8, 2014

universities, the Ministry of Education, Culture, Sports, Science and Technology presented a template for joint research contracts as a reference. Some of the contract negotiations using this temperate were conducted in a rigid manner.[1] Such persistency on a sole template may have had adverse effects in the field of joint research. In response to this, in March 2017, the Ministry of Education, Culture, Sports, Science and Technology started the provision of "Sakura Tool" as a result of survey research on the handling of joint research outcomes, etc. in the case of intellectual property management at universities, etc. Sakura Tool provides contract templates that allow universities to smoothly carry out negotiation on research contracts, while emphasizing the utilization of results. It is hoped that this tool will be used fully in the future.

In traditional individual-to-individual collaboration between industry and academia, negotiations, adjustments and related administrative work have not been systematically implemented. Many researchers have argued the need for a support system for industry, academia and government collaboration procedures.[2] Therefore, it is necessary to strengthen the headquarters functions, including the above.

■Figure 1-2-4 / Problems of university contacts from the companies' perspective

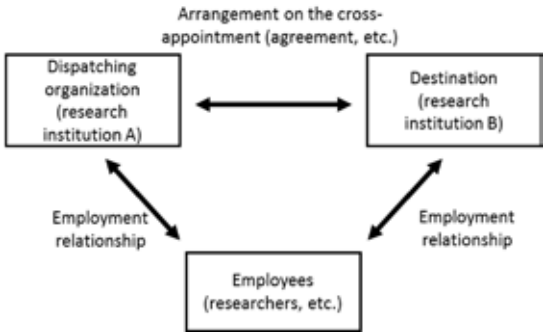
Source: FY2013 Industrial Technology Research Project "Survey Report on the Actual State and Promotion of Industry-Academia Cooperation among Small and Medium Enterprises" (February 2014) (Ministry of Economy, Trade and Industry)

③Securing liquidity of human resources to deepen interorganizational collaboration

In ① and ②, we mentioned the necessity of raising the liquidity of human resources and the necessity to make personnel participate in joint research projects, etc. among universities, R&D corporations and companies in joint research, etc. with a clear awareness of their responsibility. As stated in the fifth basic plan, it is effective to increase the liquidity of human resources among organizations to promote full-fledged collaboration among industry, academia and government. One of the means to realize this is the cross-appointment system.

1 MEXT-commissioned Project for Supporting Industry-Academia-Government Cooperation in the FY2016 "Study Report on Approaches to the Handling of Results of Joint Research based on the Analysis of Intellectual Management Practices at Universities, etc." (March 2017)

2 Japan Science and Technology Agency, Center for Research and Development Strategy, Report on Questionnaire Survey on the Research Expense System in Japan, March 2013



Outline of the cross-appointment system
Source: "Basic Framework of the Cross-appointment System and Points to Keep in Mind" (December 2014) (Ministry of Economy, Trade and Industry and Ministry of Education, Culture, Sports, Science and Technology)

The cross-appointment system is a system in which researchers and others are employed by two or more institutions among universities. It allows researchers, etc. to engage in R&D and educational activities according to their roles at each institution, under a certain effort management. The dispatching and receiving parties conclude an agreement, etc., based on which researchers establish employment relationships with both organizations. This allows the world's top-class researchers and other outstanding human resources to exert their talent across sectors at multiple institutions. For this reason, it is necessary to promote the use of the cross-appointment system as part of organization management in promoting full-scale interorganizational collaboration among industry, academia, and government. The implementation of the cross-appointment system will allow universities and companies to utilize each other's knowledge and resources and mutually stimulate each other's research activities. Also, in a mere joint research project, there is a limit to the involvement of university researchers, etc. in companies' research activities; however, concurrent employment on the company side makes it possible for the researchers to directly access companies' research teams and their facilities and equipment. Another advantage is that this system will make it possible for university researchers to participate in a stage that is close to practical use, which is difficult to be seen in research activities at universities, etc. In addition, this system will reduce the burden on researchers, because the amount of work they have conventionally carried out can be reduced to an extent equivalent to the amount of time spent engaging in work at the destination to which they are dispatched[1].

However, as seen in Table 1-2-5 which shows the status of use of the cross-appointment system by universities, etc. in FY2015, it is hard to say that the system is fully utilized, although it has been used to a certain extent. In particular, the number of researchers dispatched from universities to companies under the cross-appointment system is 0 for FY2015. This is considered to be a significant issue (in April 2017, researchers of Ritsumeikan University were dispatched to Panasonic Corporation under the cross-appointment system, which will be covered in a case study later).

1 For example, if the destination workforce is set at 20%, the dispatched worker's effort will be 80% and the work will be reduced by 20% from the original 100% effort. In the case of a concurrent assignment, the work burden of the main work does not decrease because it is to be carried out in addition to the work of the original work.

■Table 1-2-5 / Number of faculty and staff at universities, etc. who used the cross-appointment system (FY2015)

Acceptance

Institution category	Number of people
Domestic universities, etc.	16
Domestic Incorporated Administrative Agencies, etc.	9
Domestic companies	19
Foreign universities, etc.	39
Foreign companies	2
Total	85

Dispatch

Institution category	Number of people
Domestic universities, etc.	10
Domestic Incorporated Administrative Agencies, etc.	38
Domestic companies	0
Foreign universities, etc.	4
Foreign companies	0
Total	52

Source: "Status of Industry-Academia Collaboration, etc. at Universities, etc. in FY2015" (Ministry of Education, Culture, Sports, Science and Technology)

According to the results of an entrusted survey of MEXT in FY2016[1] and what has been discussed at the Open Innovation Co-creation Congress, factors behind the inactive use of the cross-appointment system can be summarized as shown in Table 1-2-6. However, issues in implementing the system are still not clear particularly with regard to cross-appointments from universities to companies.

■Table 1-2-6 / Challenges related to the use of the cross-appointment system

	Challenges
Role of the system	✓ Merits of the cross-appointment system and differences from other systems (concurrent duties, etc.) are not necessarily clear, making it difficult to find the meaning of utilizing the system. ✓ Universities are required to establish a strict approval process. ✓ Low awareness of the system
Personnel system	✓ Review of employment management and employment rules, etc. and improvement of the mechanism of researchers' effort management are insufficient. ✓ Sometimes allocation of travel expenses and other burdens is unclear. ✓ Unlike concurrent duties, individual researchers are not able to obtain additional income.
Intellectual property	✓ It is difficult to decide the attribution of research outcomes and accompanying intellectual properties.
Conflict of interest	✓ There may be restrictions on joint research projects with companies other than companies to which researchers are dispatched. ✓ Personal interests may be affected by decisions on the attribution of research outcomes, possibly causing conflicts of interest with duties.
Information management	✓ Increased opportunities to contact confidential information of both sides. ✓ Increased risks of mutual information leakage through researchers.

Source: Created by the Ministry of Education, Culture, Sports, Science and Technology, Ministry of Education, Culture, Sports, Science and Technology based on the FY2016 Industry-academia-government Collaboration Support Project "Basic Study on the Promotion of Full-fledged Industry-academia Collaboration Activities" (March 2017) and Reference Material 4 provided at the third meeting of the Open Innovation Co-creation Congress (March 16, 2017).

As the basic part of the cross-appointment system has already been established, the biggest factor for the underuse of the system can be attributed to its complicated procedures and low recognition of its advantages. For this reason, we will review the role of the cross-appointment system in promoting full-

1 MEXT-commissioned Project for Supporting Industry-Academia-Government Cooperation in the FY2016 "Basic Study on the Promotion of Full-fledged Industry-academia Collaboration Activities" (March 2017)

scale interorganizational collaboration between the industry and academia, and then promote the utilization of the system at each organization based on the Industry, Academia and Government Collaboration Guidelines, etc. In addition, it is also necessary to promote the sharing of best practices while promoting the utilization of the cross-appointment system.

Case Study 2 Cross-appointment from Ritsumeikan University to Panasonic Corporation

The number of cross-appointments from universities to companies was zero for FY2015, but then Professor Tadahiro Taniguchi was dispatched to Panasonic Corporation (hereinafter referred to as "Panasonic") under the system on April 1, 2017. Taniguchi is a researcher of artificial intelligence and Panasonic decided to accept him to gear up their efforts in the artificial intelligence field, which is a growth field. Taniguchi will work at Panasonic's Business Innovation Headquarters as a visiting general manager at an effort rate of 20%.

Tadahiro Taniguchi, Professor, Ritsumeikan University
Source: Ritsumeikan University

Prior to this, Ritsumeikan University established relevant regulations for the utilization of the system and set up relevant procedures, such as consultation with the Conflicts of Interest Committee for the approval of the system. As for salary, the university decided to return part of the funds received from the company to relevant persons as cross-appointment allowance.

Ritsumeikan University expects that joint research will be further deepened and expanded with the use of the system. In addition, the researcher said that having a position in a company and the right to access the company's unique facilities and data, etc. are also one of the merits of cross-appointments. Meanwhile, Panasonic said that the cross-appointment was beneficial in that they could obtain a researcher in the technical field of its focus. The company also believes that the cross-appointment system is a clear and reliable system as a contract is concluded with a university, rather than an individual.

It is hoped that universities, etc. and companies will promote the utilization of the cross-appointment system from universities to companies, which has just begun, with reference to precedent cases like this.

Above, we have clarified the issues for the respective aspects of ① planning and proposal for joint research, etc. ② negotiation, adjustment and progress management related to joint research, etc., and ③ securing liquidity of human resources to deepen interorganizational collaboration. If the scale of joint research will be further expanded in the future, the volume of research outcomes will also increase. In addition, if relationships among many stakeholders become more complicated, intellectual property management and risk management will naturally be more complicated.

As it is expected that much intellectual property will be created with research and development becoming active, and as the number of R&D projects targeting a stage that is closer than ever to the commercialization stage will increase through full-scale industry-academic-government collaboration, universities, etc. need to make sophisticated decisions on the organizational management of intellectual property, while taking into account the relationships with their partners. Also, if the amount of funds received from the outside becomes large and universities, etc. are involved in a stage that is close to the commercialization stage in relation to multiple commercial companies, the risks of organizations and researchers will be larger. It is not easy for a researcher to deal with such risks as an individual, nor is it appropriate. Such risks must be managed by the whole organization. Below, we will discuss issues concerning intellectual property management and risk management in detail.

④Intellectual property management

A report titled "Approaches to University Intellectual Property Management That Will Contribute to the Growth of Universities and Creation of Innovation" published in March 2016 by the Review Committee on University IP management in the Era of Open & Close Strategies listed the following as major issues in intellectual property management at Japanese universities.

- The management teams of universities are not aware of the significance and necessity of intellectual property management.
- Intellectual property budgets and intellectual property related personnel are not adequately allocated.
- Due to budget constraints, applications in foreign countries are not properly filed.
- From the viewpoint of promoting the creation of university-originated startups, the number of patents owned by a university alone is limited.
- To promote the use of intellectual property, intellectual property management from a commercialization perspective is needed.
- Companies are not making enough efforts for open & close strategies.

This report states that, although many universities have already established intellectual property policies, they also need to develop intellectual property strategies from the following viewpoints, in order to advance full-scale industry-academia-government collaboration, grow as an organization, and contribute to society. R&D agencies are also required to have these kinds of strategies.

<Example of intellectual property strategies for universities>

- Positioning of intellectual property in university management
- Establishment of intellectual property management budget according to research area
- Construction of an intellectual property management system with an eye to IP utilization
- Setting of technical fields focusing on patent acquisition

At universities, intellectual property is often managed by the industry-academia collaboration headquarters and TLOs (technology licensing organizations). As shown in Figure 1-2-7, on average, expenditures of the industry-academia collaboration headquarters, including labor costs, cannot be fully covered by income from intellectual property.[1] It is assumed that adequate budgetary measures on intellectual property cannot be taken under such circumstances.

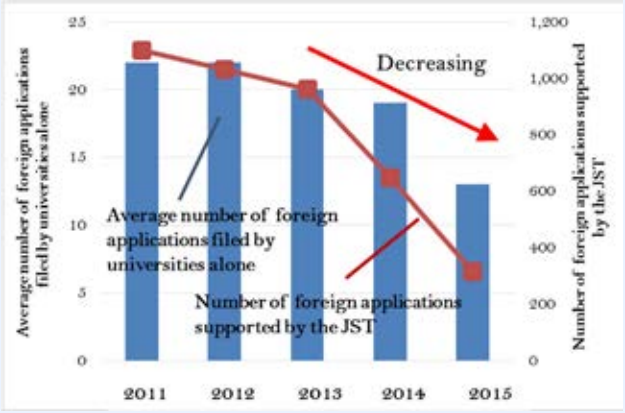
1 In Figure 1-2-7, if payment (intellectual property-related activity cost) of 40.54 million yen is subtracted from income of 105.35 million yen, the remainder will be 64.79 million yen. However, if the average annual salary of 5,766,000 yen (according to the Ministry of Education, Culture, Sports, Science and Technology, Salary Level etc. of Officials and Employees of National University Corporations, etc. (FY2015)) is multiplied by 16.4 persons, the amount will be about 94.56 million yen, greatly exceeding the abovementioned amount.

■Figure 1-2-7 / Average income and expenditure of universities' industry-academia collaboration headquarters and TLOs (FY2014)

Source: "University Technology Transfer Survey: University Intellectual Property Annual Report FY2015" (2016) (edited by the University Network for Innovation and Technology Transfer)

Also, patent applications to foreign countries will be important in growing seeds of universities and R&D agencies into innovation amid economic globalization. However, the cost of filing a patent application to a foreign country is generally much higher than the fee for a domestic application. For this reason, the Japan Science and Technology Agency (JST) has supported expenses of universities' foreign applications through its Promotion of the Use of Intellectual Property, but the amount is decreasing year by year. As the amount of support is decreasing, many universities are forced to give up on foreign applications due to incapability to afford high cost burdens on their own (Figure 1-2-8).

■Figure 1-2-8 / Average number of foreign applications filed by universities alone and number of foreign applications supported by the Japan Science and Technology Agency (JST)



Note: Results of a survey on the top 20 universities that most frequently use support by the Japan Science and Technology Agency (October, 2016; survey by the Japan Science and Technology Agency).
Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on Reference 4-4 provided at the third meeting of the Working Group on the Deepening of Academia-Government Collaboration under the Industry-Academia-Government Dialogue Conference to Promote Innovation (November 2, 2016).

Companies are sophisticating their open and close strategies and other intellectual property strategies even amid the abovementioned issues. Universities and R&D agencies seeking collaboration with such

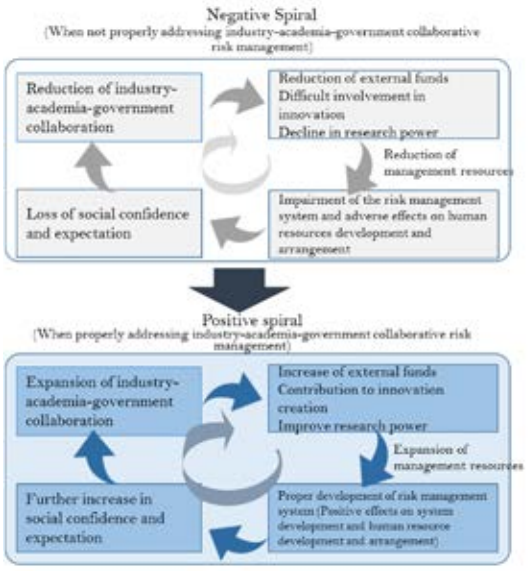
companies are also required to prepare a system capable of performing advanced intellectual property management. To that end, it is necessary to secure personnel capable of performing advanced intellectual property management from a commercialization perspective. In addition, it is important to cooperate with human resources etc. coordinating industry, academia and government collaboration as mentioned above. In order to do so, cross-sectorial management led by the headquarters is required.

The issues from the viewpoint of intellectual property management to promote the creation of university-originated startups will be described in detail in the next section.

⑤Risk management

There are various risks related to industry-academia-government collaboration, such as conflicts of interest and technical leakage.

Note that conflicts of interest covered here refer to conflicts between personal interests of teachers/researchers and their duties in their organizations, or conflicts between organizations' interests and organizations' social responsibilities. Conflicts of interests occur on a daily basis in relation to industry-academia-government collaborative activities, and neglect of appropriate response can result in a loss of social confidence in universities and R&D agencies.



Source: Excerpt from "Policy for the Review of Approaches to Risk Management Associated with the Promotion of Industry-Academia-Government Collaborative Activities at Universities" (Review Committee on Industry-Academia-Government Collaborative Risk Management at Universities, Industrial Collaboration and Regional Support Group, Council for Science and Technology)

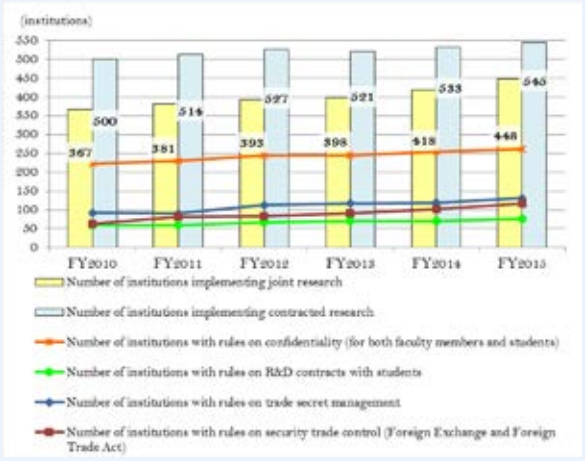
Toward full-fledged collaboration in the future, organizations are required to clarify their attitude toward possible risks and establish a system that can appropriately respond to individual cases. It is important for people concerned to be aware that industry-academia-government collaborative risk management in this context is not intended to suppress industry-academia-government collaborative activities; rather, it is intended to prevent such activities from shrinking by linking risks to actual damage, fostering an environment that allows universities, R&D agencies and researchers to smoothly such activities[1].

As mentioned in Chapter 1, industry-academia-government collaboration has been addressed from before the First Basic Plan. While it is considered that risk management pertaining to such collaboration has penetrated to a certain extent at universities and R&D agencies, the number of institutions that already have established related rules and policies is still small compared to the number of institutions implementing joint research and contracted research (Figures 1-2-9 and 1-2-10). In particular, the number of institutions that have established regulations concerning trade secrets and regulations concerning security trade control are remarkably low. In addition, there are not many universities that have regulations

1 Council for Science and Technology, Industrial Collaboration and Regional Support Group, Review Committee on Industry-Academia-Government Collaborative Risk Management at Universities, Policy for the Review of Approaches to Risk Management Associated with the Promotion of Industry-Academia-Government Collaborative Activities at Universities, March 2015

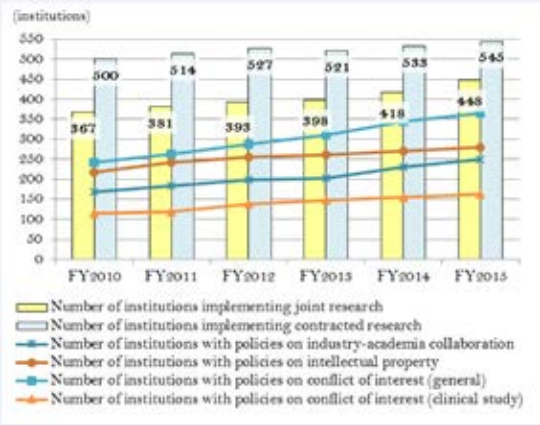
concerning student participation. This also suggests that a system for student participation has not yet been established, as also mentioned in 1 (1) ① of this section.

■Figure 1-2-9 / Changes in the number of institutions implementing joint research and contracted research and number of institutions that have already established related rules



Source: "Status of the Implementation of Industry-Academia Collaboration, etc. at Universities in FY2015" (Ministry of Education, Culture, Sports, Science and Technology)

■Figure 1-2-10 / Changes in the number of institutions implementing joint research and contracted research and number of institutions that have already established related policies

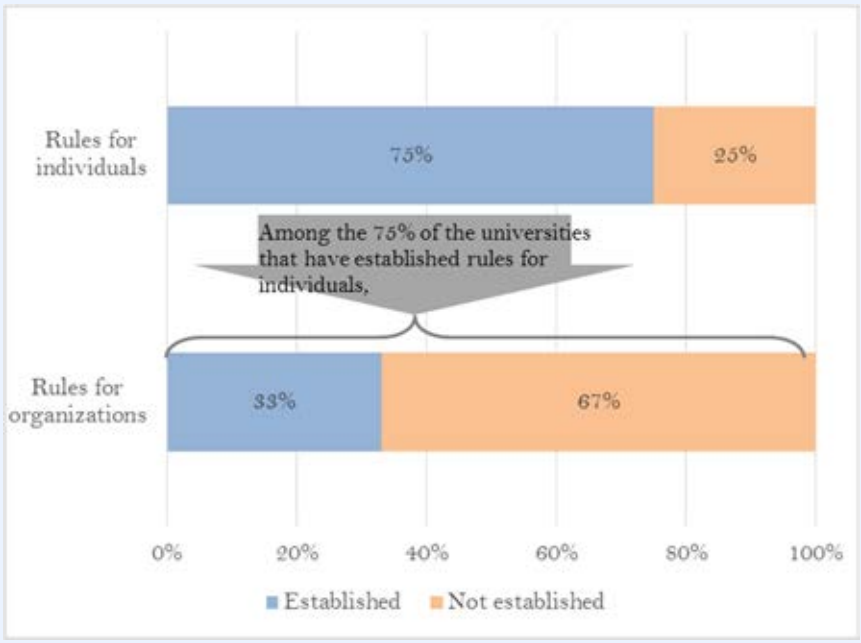


Source: "Status of the Implementation of Industry-Academia Collaboration, etc. at Universities in FY2015" (Ministry of Education, Culture, Sports, Science and Technology)

As seen in Figure 1-2-10, many institutions have already developed a conflict of interest policy, suggesting that the past efforts have taken root to some extent. On the other hand, in promoting interorganizational collaboration in the future, the focus of conflict of interest management will be conflicts of interest among organizations, rather than among individuals. However, at present, it is estimated that many of the universities' rules on conflict of interest management etc. are focused on individuals. In a survey on the development status of conflict of interest rules at universities conducted in 2012, only 33% of the universities had established conflict of interest rules for organizations, while 75%

of the universities already had conflict of interest rules for individuals (Figure 1-2-11). Furthermore, even at universities that established rules for organizations, their conflict of interest rules were largely were largely many universities merely defined the term "conflict of interest for universities (organizations)" in their rules for individuals.[1]

■Figure 1-2-11 / Introduction of the conflict of interest management system for organizations at universities (establishment of rules, etc.) (survey in 2012)



Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on "Conflicts in Interest in Theory and Practice: How to Rebuild Public Trust in Scientific Research" (Yukiko Shinya) (University of Tsukuba Press)

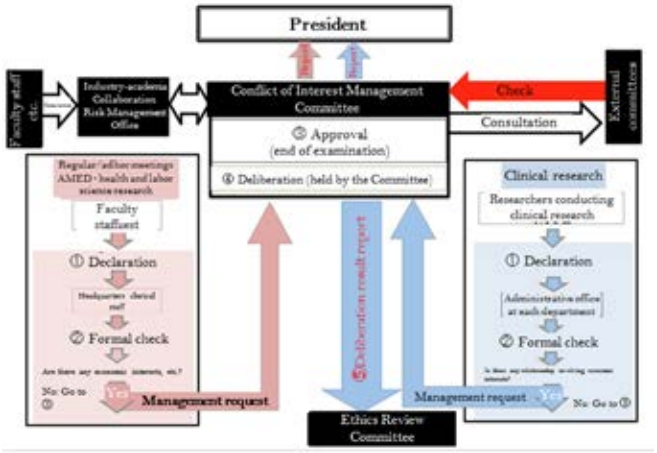
As mentioned earlier, if large-scale interorganizational collaboration is to be promoted while actively engaging students in joint research, the lack of organizational risk management rules and system at universities and R&D agencies will affect trust from companies. This will eventually push companies away from taking risks and making large investment in collaborative projects.

Each organization needs to establish not only a risk management system for individuals but also a system for organizational risk management with reference to Industry-academia-government Collaboration Guidelines and precedent cases. MEXT has been working on the industry-academia-government risk management model project since FY2015 to establish model industry-academia-government collaboration risk management systems to help universities develop their own systems and to expand such efforts nationwide. The model system for conflict of interest management is implemented at four universities and the system for technology outflow management are implemented at three universities. It is hoped that the results of this project will be disseminated across the nation.

1 Yukiko Shinya, Conflicts in Interest in Theory and Practice: How to Rebuild Public Trust in Scientific Research, University of Tsukuba Press, 2015

Case Study 3 Efforts for organizational conflict of interest management at Tokyo Medical and Dental University

As a medical university, Tokyo Medical and Dental University is working on the strengthening of conflict of interest management concerning medical research. The university has established the Industry-academia Collaborative Risk Management Office under the Research Center for Industry Alliance, which is in charge of industry-academia-government collaboration-related affairs. In FY2015, in order to strengthen the structure of conflict of interest management, administrative staff specialized in conflict of interest management is assigned to the said Office. In addition, the university has established a simple and easy-to-understand system that reduces burden on faculty members and researchers concerning voluntary report of the status of industry-academia-government collaboration projects.

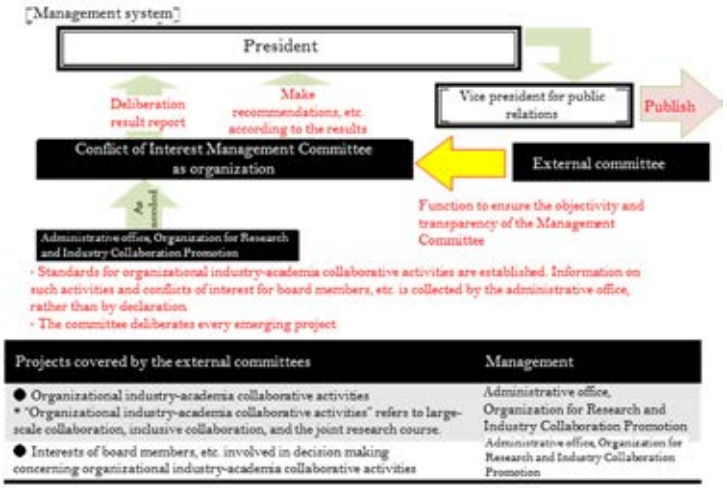


Conflict of Interest Management System

Source: Industry-Academia-Government Dialogue Conference for the Promotion of Innovation, Guidelines on the Strengthening of Joint Research under Industry-Academia-Government Collaboration

Furthermore, as it geared up for the full-fledged industry-academia-government collaboration, the university also strengthened its organizational conflict of interest management system. The university has a framework for consultation with external committees composed of external experts on such matters as industry-academia-government collaborative activities that result in income, donations, stockholding etc. over a certain amount, and income and stockholding etc. obtained by the board members (President, directors, auditors, etc.) from industry-academia-government collaborative activities.

These activities are implemented utilizing the Industry-Academia-Government Collaborative Risk Management Model Project (conflict of interest management) commissioned by the Ministry of Education, Culture, Sports, Science and Technology. It is hoped that the model systems established by Tokyo Medical and Dental University will be disseminated across the nation.



Conflict of Interest Management as organization

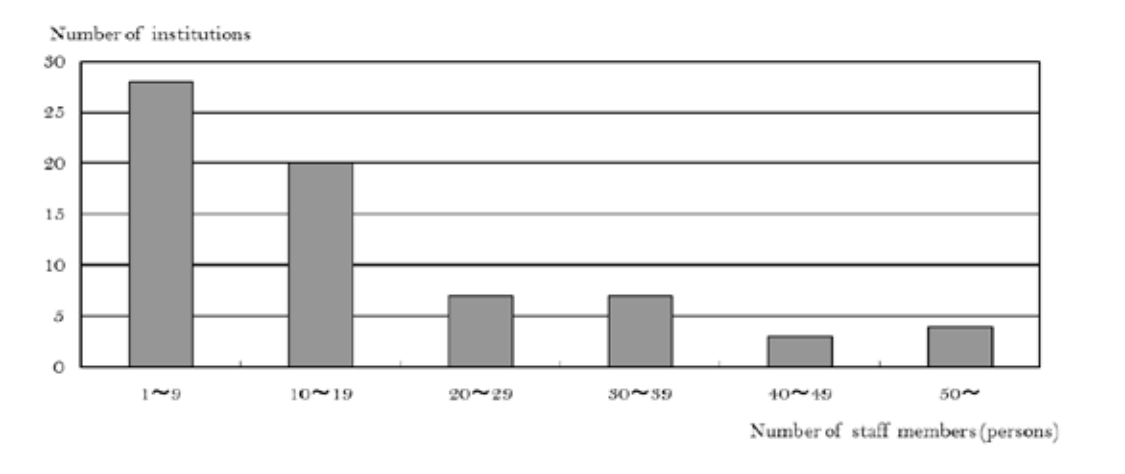
Source: Industry-Academia-Government Dialogue Conference for the Promotion of Innovation, Guidelines on the Strengthening of Joint Research under Industry-Academia-Government Collaboration

⑥ Headquarters function

Above, we analyzed various issues from ① to ⑤, and it has been proved that it is necessary to strengthen the headquarters function in order to overcome these issues. It has been pointed out that open innovation at companies requires decision making by top management and the establishment of a special department for promoting open innovation.[1] This also applies to universities and R&D agencies.

In fact, the status of allocation of personnel to industry-academia collaboration departments of universities in Japan (as of May 20, 2015) is as shown in Figure 1-2-12.

■Figure 1-2-12 / Distribution of the number of staff members in universities' industry-academia collaboration departments (as of May 1, 2015)



Source: "University Technology Transfer Survey: University Intellectual Property Annual Report FY2015" (2016) (edited by the University Network for Innovation and Technology Transfer)

Meanwhile, research universities in the United States, where industry-academia collaboration is active, have rich human resources to support such collaboration. For example, Stanford University mentioned in Chapter 1 has a large specialized staff of about 70 people (Figure 1-2-13). It is hoped that Japan will also strengthen the structure for promoting full-scale industry-academia-government collaboration in the future.

■Figure 1-2-13 / Case examples of deployment of personnel in charge of industry-academia collaboration at universities in the United States

(Persons)

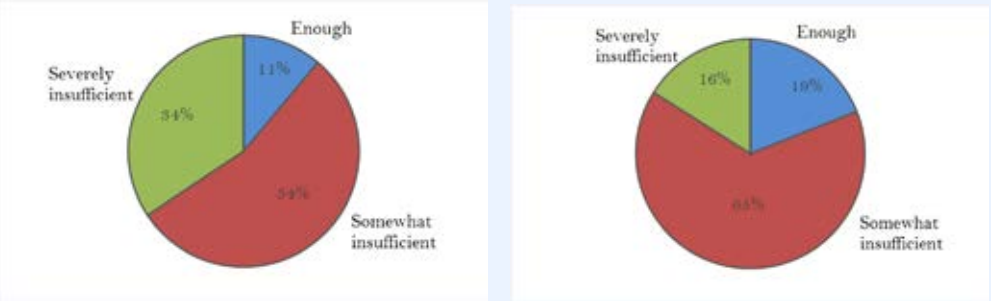
	Contract/negotiation	Technology transfer	Relationship building with companies
Stanford University	9	50	6
Massachusetts Institute of Technology	52	37	50

Source: Excerpt from "Status of the Sorting of Review Items," which was provided at the first meeting of the Open Innovation Co-Creation Congress (January 19th, 2017)

1 Edited by Seiichiro Yonekura and Hiroshi Shimizu, "Open Innovation Management : Challenges for Japanese Firms" Yuhikaku, 2015

Particularly at universities in our country, URAs, which are research management human resources at universities etc., are expected to promote collaboration among industry, academia and government and strengthen the functions of headquarters for the development of university management through such collaboration. At R&D agencies, such a role will be taken by RAs (Research Administrators) etc. As of FY2015, 830 URAs are working at 93 organizations.[1] However, according to the questionnaire[2] on university staff conducted in FY2005, quantitative and qualitative shortages of URAs have been pointed out (Figure 1-2-14). Further enhancement of such human resources is desired.

■Figure 1-2-14 / Quantitative (left) and qualitative (right) sufficiency of URAs



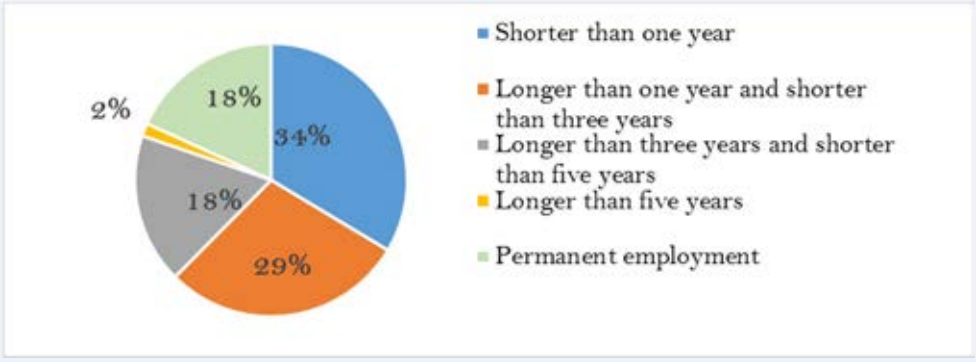
Source: Created by the Ministry of Education, Culture, Sports, Science and Technology, based on the FY2015 Industry-academia-government Collaboration Support Project commissioned by the Ministry, "Survey and Analysis for Autonomous Management of Research and Administrator Work" (March 2016)

One of the major causes of the quantitative and qualitative shortage of URAs is considered to be the lack of a system to secure the stable supply of URAs. Looking at the form of employment of URAs in FY2015, more than 60% are employed for a short period of 3 years or shorter, and the form of employment for which there is no fixed period is low at 20% or less (Figure 1-2-15). This is because the employment period is often decided according to the period of the provision of individual external funds, which account for a significant portion of the current resources for URA employment (Figure 1-2-16). Furthermore, future financial resources for the employment of URAs have not been figured out yet (Figure 1-2-17). If universities were to employ these fixed-term URAs as regular employees, procurement of stable financial resources would be an issue.

1 Ministry of Education, Culture, Sports, Science and Technology, Status of the Implementation of Industry-Academia Collaboration, etc. at Universities, etc. in FY2015

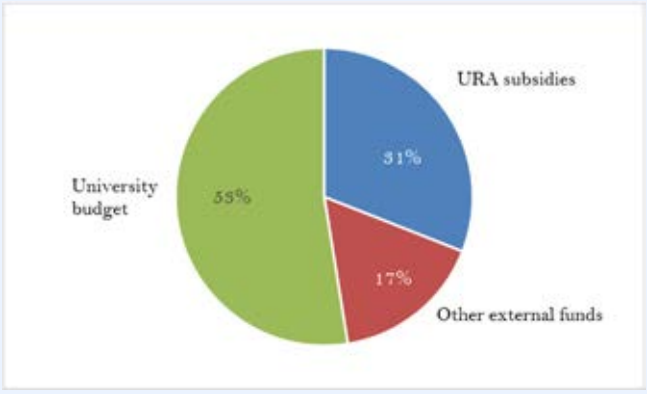
2 MEXT-commissioned Project for Supporting Industry-Academia-Government Cooperation in FY2015 "Research and Analysis toward the Independent Operation of Research Administrator Works" (March 2016)

■Figure 1-2-15 / Number of URAs by employment period



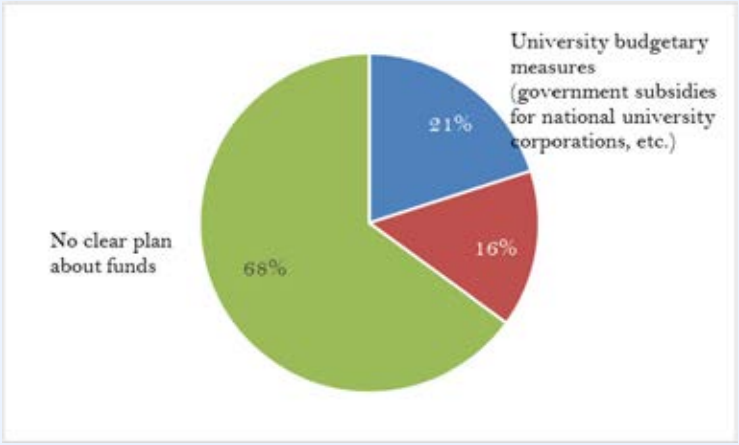
Source: Created by the Ministry of Education, Culture, Sports, Science and Technology, based on the FY2015 Industry-academia-government Collaboration Support Project commissioned by the Ministry: "Survey and Analysis for Autonomous Management of Research and Administrator Work" (March 2016)

■Figure 1-2-16 / Current composition of financial resources for the employment of URAs



Source: "Status of the Implementation of Industry-Academia Collaboration, etc. at Universities, etc. in FY2015" (Ministry of Education, Culture, Sports, Science and Technology)

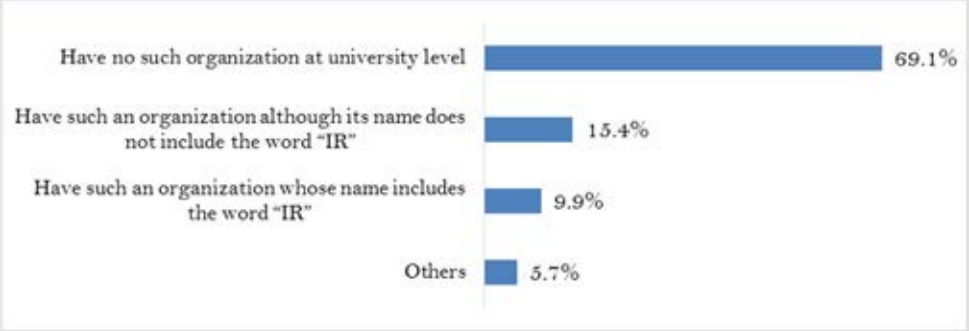
■Figure 1-2-17 / Expected future funds for URAs



Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on the FY2015 Industry-Academia-Government Collaboration Project Support Project commissioned by the Ministry of Education, Culture, Sports, Science and Technology, "Research and Analysis toward the Independent Operation of Research Administrator Works" (March 2016)

Also, in order for the headquarters at universities to take the lead in the active promotion of external collaboration, the development and implementation of management strategies based on objective information will be needed. For example, institutional research (IR) activities can contribute to such efforts. In Japan, IR is commonly defined as "studies carried out by higher education institutions to provide information to support organization planning, policy formation, and decision making."[1] IR can be used for financial analysis and determination of strengths and weaknesses and is expected to play an important role in university management in the future. Some universities have dedicated IR organizations and utilize information gathered and analyzed for their university management strategies. However, there are few universities that have such organizations across Japan (Figure 1-2-18).

■Figure 1-2-18 / Presence/absence of an IR organization at universities



Source: FY2012-2013 Pioneering University Reform Promotion Project commissioned by the Ministry of Education, Culture, Sports, Science and Technology "Survey and Research on the Current Status of and Approaches to IR (Institutional Research) at Universities" (March 2014)

Moreover, as we have seen so far, in order to strengthen the functions of the headquarters, diverse professionals, including those for intellectual property management, risk management, legal affairs, and accounting, will be necessary. At the same time, it is necessary to foster and secure personnel with a high level of expertise who are capable of conducting planning, proposal formulation, and management across the fields, departments, and sectors.

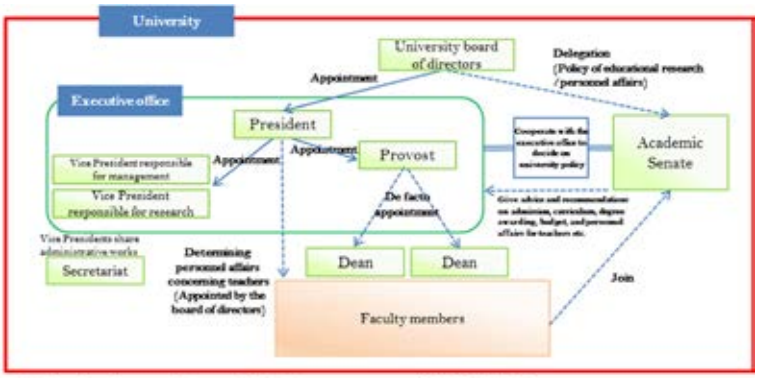
In order to effectively promote countermeasures regarding these issues, it is necessary that the management capabilities of the presidents, chairpersons and other top management that lead the organizations are demonstrated. However, especially at universities, there are some issues in this regard, including the following: [1] although the School Education Act[2] provides that presidents are to make final decision, there are also cases where de facto decision making is done at the faculty level or at faculty meetings; [2] executives involved in university management, such as the president, vice president, and dean, are often appointed from inside universities, and thus it is sometimes difficult to appoint a person with proper experience and management ability; [3] the role of vice president is narrowly defined to

1 Hirosuke Honda, Shigeru Asano, Toshiyuki Shimada, Four-Quadrant Framework for Analyzing Institutional Research Projects in the United States: Through the Scope of Accountability, Improvement, Routine, and Ad-hoc Basis Work, Research on Academic Degrees and University Evaluation, No. 16, 2014

2 Act No. 26 of 1947

certain segments, making it difficult to conduct cross-sectorial management.[1]

The full demonstration of the management ability of presidents and chairpersons cannot be achieved solely through their personal efforts; rather, it requires the establishment of a structure with a cross-sectorial authority to support them. For example, universities in the United States often have personnel called "Provosts" who have cross-departmental authority and work to support the presidents. Such personnel take the lead in arranging research and educational budget and personnel affairs. Universities in Japan are also encouraged to study systems to help presidents and chairpersons fully demonstrate their management abilities, including those for budget and personnel allocation, while taking into account the actual circumstances of the organizations.



Positioning of provost at universities in the United States (typical case)
Source: Material 5 provided at the seventh meeting of the Organizational Management Group , Subdivision on Universities, Central Council for Education Subcommittee Organizational Management Subcommittee (7th) Reference Material 5

(2) Increase incentives for collaboration

Designing incentives for researchers at each organization is important in creating a system to promote active participation of excellent researchers in industry-academia-government collaboration. At the same time, incentives for the organization as a whole are also needed. Incentives are factors that change decision making and behavior. In this context, an incentive refers to the motivation of individual researchers and organizations for participation in industry-academia-government collaboration.

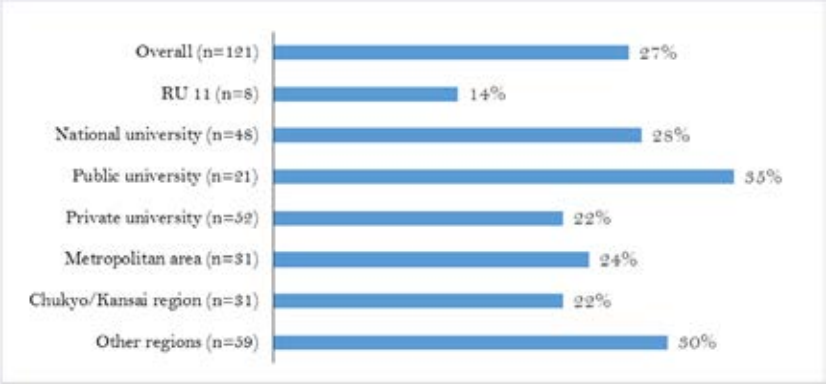
①Incentives for researchers

What is the current level of involvement of researchers in industry-academia-government collaboration? According to the results of a questionnaire survey[2], less than 30% of teachers at universities are involved in industry-academia-government collaboration (Figure 1-2-19). In particular, the ratio at the member universities of the Research University 11 (RU11) is lower than the average. In order to promote further participation, it is necessary to design appropriate incentives at each university and R&D agency.

1 Central Council for Education, University Working Group, Report on the Promotion of University Governance Reform (Discussion Summary), February 2014

2 METI-commissioned Industrial Technology Research Project in FY2013 "Survey Report on the Actual State and Promotion of Industry-University Cooperation with Small and Medium Enterprises" (February 2014)

■Figure 1-2-19 / Percentage of faculty members engaged in industry-university collaboration

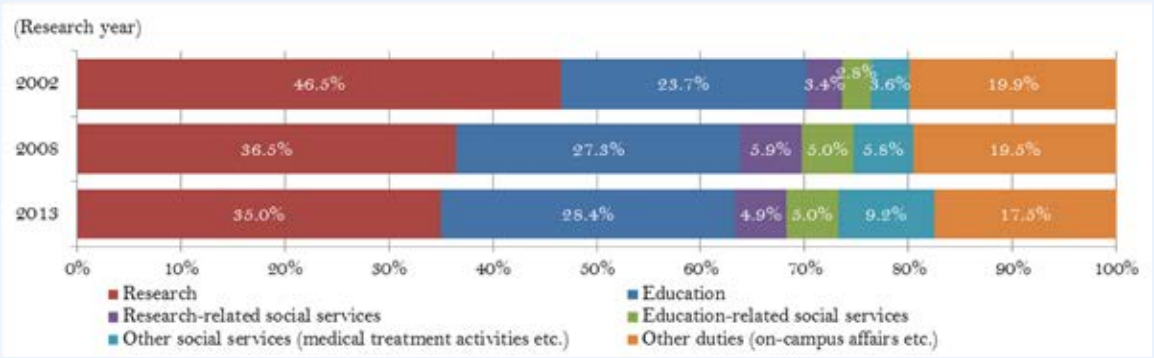


Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on the FY2013 Industrial Technology Research Project by the Ministry of Economy, Trade and Industry, "Survey Report on the Actual State and Promotion of Industry-University Cooperation among Small and Medium Enterprises" (February 2014)

(Reduction of burden related to research time etc.)

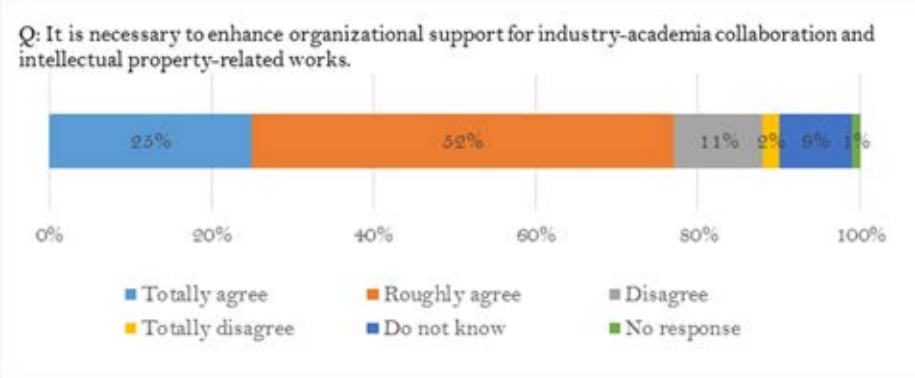
At present, especially at universities, the decrease in the time researchers spend on research is becoming a problem. According to the Survey on Full Time Equivalent (FTE) data for Research Staff members in Higher Education Organization (national FTE survey) (Figure 1-2-20), the percentage of time faculty members spent on research was significantly reduced from 46.5% in 2002 to 35.0%. It is estimated that this will make it more difficult to spend time on new collaborative research projects. In addition, when engaging in new industry-academia-government collaborative activities, researchers will also have to spend time on additional clerical work in addition to research activities. According to a questionnaire survey of researchers, many of the respondents wished for the strengthening of organizational support for industry-academia collaboration and intellectual property-related works (Figure 1-2-21).

■Figure 1-2-20 / Change in the composition of job hours of teachers at universities, etc.



Source: RESEARCH MATERIAL No.236 Changes in the Ratio of Time Spent on Work Activities by University & College Faculty Members— A Comparison of results of the "Survey of Full-time Equivalent Data at Universities and Colleges" of 2002, 2008 and 2013 (National Institute of Science and Technology Policy) (April 2015)

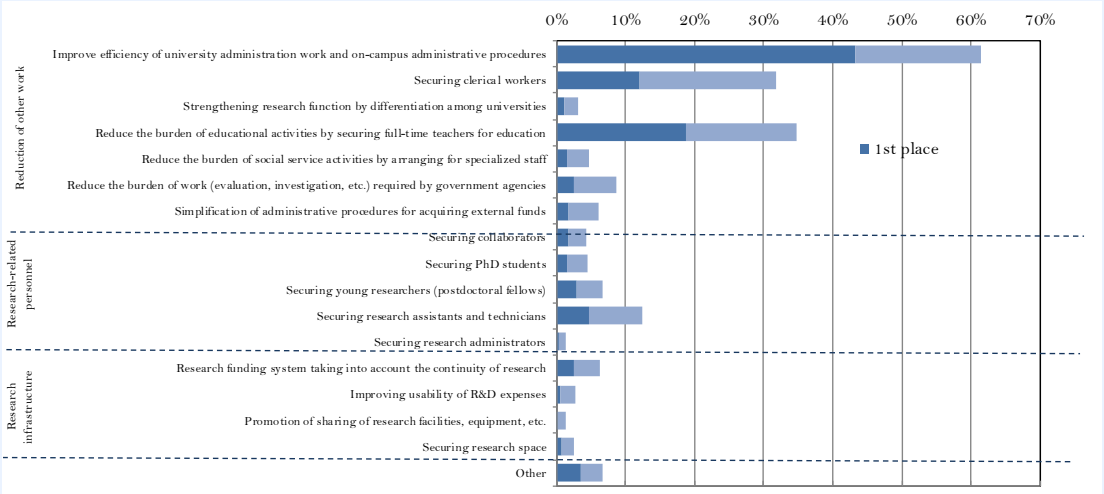
■Figure 1-2-21 / Necessity of organizational support for industry-academia collaboration and intellectual property-related works



Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on the investigation report titled "Questionnaire Survey on the Research Expense System in Japan" (March 2013) by the Center for Research and Development Strategy

According to the results of the national FTE survey, simplification of universities' administrative procedures is mentioned as the most effective means for increasing research time (Figure 1-2-22). The first thing universities are required to do as organizations is to reduce the burden on researchers and create time for researchers to be able to participate in industry-academia-government collaboration projects.

■Figure 1-2-22 / Effective means to increase research time



Source: RESEARCH MATERIAL No.236 Changes in the Ratio of Time Spent on Work Activities by University & College Faculty Members— A Comparison of results of the "Survey of Full-time Equivalent Data at Universities and Colleges" of 2002, 2008 and 2013 (National Institute of Science and Technology Policy) (April 2015)

In addition, when a faculty member of a university makes an effort to conduct joint research with a company, another faculty member must carry out the work which the first faculty member was responsible for. However, unless there is an organizational support system, such as employment of new support personnel, other faculty members may not be able to cover others' work as their time spent on research is

also decreasing. The same applies to R&D agencies. Needless to say, financial resources for the employment of such personnel will be necessary.

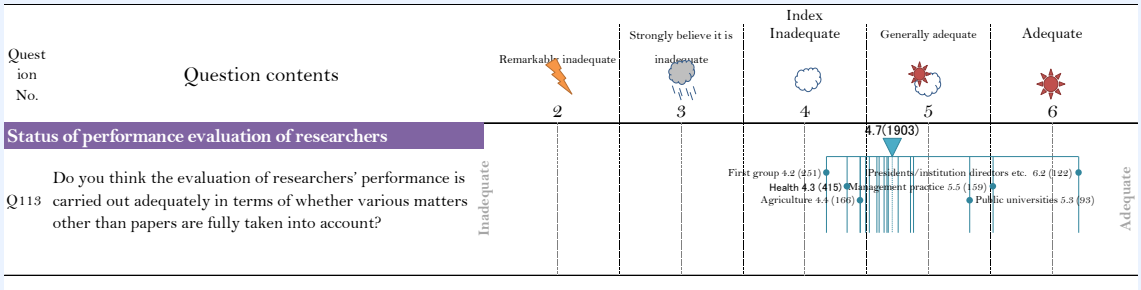
(Personnel evaluation etc.)

Unless industry-academia-government collaboration efforts are taken into consideration in personnel evaluations and reflected in salary, it can be a big obstacle in incentive design. It is assumed that evaluation of the performance of university faculty is mainly focused on papers and academic presentations, in principle. According to the Expert Survey on Japanese S&T and Innovation System (NISTEP TEITEN survey) conducted by the National Institute of Science and Technology Policy, in response to the question "do you think the evaluation of researchers' performance is carried out adequately in terms of whether various matters other than papers are fully taken into account?" presidents, institution directors, and other management practitioners answered "adequate" or "generally adequate," while the portion of researchers answering "insufficient" was relatively high, showing that groups with different attributes have different views regarding this issue (Figure 1-2-23).

However, especially with respect to personnel evaluation at universities, it should be noted that it is difficult to uniformly evaluate faculty members who are engaged in various works, including education, research, organization management, and social contribution. In addition, the degree of difficulty of participation in industry-academia-government collaboration depends on the characteristics of research fields. It is important for universities and R&D agencies to establish consensus on the approach to personnel evaluation through thorough discussion at each level of the organization.

Some universities in the United States pay remunerations for their faculty members for only nine months of the year. In such case, faculty members cover the amount equivalent to the remunerations for the other three months by acquiring external funds. This could also be one of the big incentives. Although such a system cannot be readily introduced in Japan as it would drastically change the calculation method for salaries at universities and R&D agencies, each organization can consider revising their approach to the payment of remunerations, including bonuses.

■Figure 1-2-23 / Status of performance evaluation of researchers (NISTEP regular survey)



Note: The blue inverted triangle shows the index of the university/public research institution group as a whole. Each line indicates the index of each attribute. Attribute names, indices, and the number of respondents are shown for the three highest and lowest indices. Attributes of groups of 50 or more respondents are indicated. The index is a value obtained by converting the result of the six-point scale question into a scale of 0 to 10 points.

Source: "Analytical Report for 2016 NISTEP Expert Survey on Japanese S&T and Innovation System," NISTEP REPORT, No.171, (National Institute of Science and Technology Policy) (May 2017)

The heavy focus on research papers in evaluating researchers' performance is also problematic in that it is hard to publish results of joint research projects as papers. This is because joint research projects themselves must be kept confidential in some cases.

There is a view that researchers' motives for research are not limited to monetary remuneration, but also include establishing preferences over their discoveries, communicating intellectual progress, earning the recognition from the scientific community that they were the first ones that achieved the results, and the satisfaction of solving a mystery.[1] For these purposes, they put high priority on the early publishing of research results at academic conferences and as papers. In order to avoid rushed decisions on the timing of and approaches to patent applications and paper publication when the project is about to yield results, which may cause dissatisfaction to all concerned parties, organizations are required to establish a system that enables them to carry out intellectual property management as described above from an early stage, while also considering ways of publishing papers, etc. that do not interfere with patent application. In addition, companies also need to understand the motives of university researchers as stated above and pay appropriate consideration.

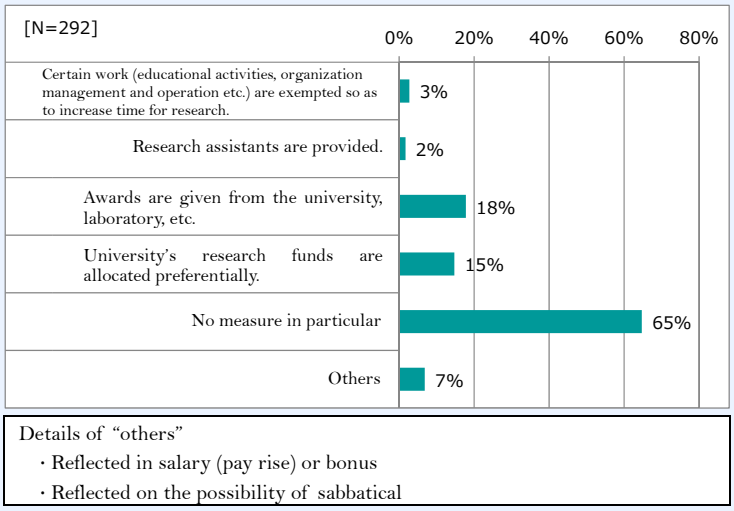
(Distribution of resources)

It has also been pointed out that funds and environments that allow for free research activities are also part of incentives for researchers.[2] However, at present, researchers are not seeing improvement of the situations surrounding their research activities even when their activities are highly evaluated. According to a questionnaire survey conducted with universities in FY2014, most universities do not provide any special treatment for researchers who have made significant achievements. There were very few universities that offer such researchers preferential measures, such as the allocation of research assistants and exemption from certain duties to increase time spent on the research project (Figure 1-2-24).

In order to promote academic-academic-government collaborative activities and faculty members' and researchers' research activities, it is required to give incentives related to the research environment. However, this would require funds as well as evaluation and top-down management to distribute the resources.

1 Paula E. Stephan, translation and commentary by Yasuo Goto, The Economics of Science, Nippon Hyoron Sha, 2016
2 Material 1 provided by President Hashimoto of the National Institute for Materials Science at the third meeting of the Open Innovation Co-creation Congress (March 16, 2017)

■Figure 1-2-24 / Special measures based on research achievements at universities



* Note that "research activities" are not limited to joint research projects carried out under industry-academia-government collaboration.

Source: FY2014 R&D Promotion Research Project commissioned by the Ministry of Education, Culture, Sports, Science and Technology, "Research and Analysis Report on Evaluation of Researchers' Achievements" (March 2015)

Case Study 4 Personnel evaluation and provision of incentives with an eye to industry-academia-government collaboration: Okayama University

At Okayama University, activities of faculty members are classified into four areas: education, research, social contribution, management and operation. The university uses the weighted sum of scores for these four areas as the total evaluation score. In addition, each faculty member is given a certain weight which he/she can add to any of the four categories based on consultation with the department manager. Furthermore, "industry-academia-government collaboration activities" are included as an evaluation item for research activities. This allows the university to systematically evaluate its faculty members' collaborative activities over a long term, including possible expansion of such activities in the future. In addition, "acquisition of inventions and industrial property rights" and "international joint research" are also included as evaluation items concerning industry-academia-government collaboration. The evaluation results are to be reflected in salary and other treatment, providing incentives for collaborative activities.

Area	Professor	Associate professor	Lecturer	Assistant teacher	Vice dean, etc.
Education	0.30	0.25	0.25	0.25	0.25
Research	0.25	0.40	0.40	0.50	0.10
Social contribution	0.10	0.10	0.10	0.10	0.10
Management and operation	0.25	0.15	0.15	0.05	0.45
Discretion	0.10	0.10	0.10	0.10	0.10

Weighting by area and official title on the personnel evaluation at Okayama University

Source: Okayama University

In addition, Okayama University asks the faculty members to enter the status of their activities on the database system in order to organizationally collect objective data. The data is disclosed on the university's website and used for third party evaluation, etc.

②Incentive for organizations

(Expenses for collaborative research etc.)

In order to full scale promote interorganizational collaboration, it is important to provide incentives for

organizations, in addition to those for individual researchers. However, the "Report on Approaches to Cost Sharing for Expanding Joint Research Based on Full-Fledged Industry-Academia Collaboration" published in December 2015 by the Review Committee on Diverse Financial Resources for Innovation stated that costs required for actual joint research projects carried out by the universities are estimated to be higher than the percentages they prescribed. In other words, on top of the lack of incentives for organizations, there is even a possibility that the more industry-academia collaboration is promoted, the more universities' financial bases are eroded, causing negative effects on university management. The same situation is also applicable to R&D agencies.

According to a report[1] by the Board of Audit of Japan, many independent administrative agencies and national university corporations use their own subsidies to cover expenses that exceeded the contract amount incurred as a result of fulfilling the contracts entrusted by private companies (Table 1-2-25).

In order to avoid such a situation, universities and R&D agencies need to prepare for negotiation with companies through such means as increasing the visibility of costs for their own understanding and including a settlement clause in the contract if there are any items for which expenses cannot be confirmed at the time of concluding the contract, as mentioned in 1 (1) ① of this section.

■Table 1-2-25 / How corporations handle expenses exceeding the amount agreed under entrusted research contracts

(Unit: corporations)

Category	Charge the entruster (note 1)	Paid by the corporation (note 2)	Total
Independent administrative agencies (38 corporations)	16 (42.1%)	22 (57.8%)	38 (100%)
National university corporations (88 corporations)	28 (31.8%)	60 (68.1%)	88 (100%)
Total (126 corporations)	44 (34.9%)	82 (65.0%)	126 (100%)

Note 1: Corporations in the "charge the entruster" column include those that responded that they would negotiate changes to the contract if the expenses exceeded the estimated amount.
Note 2: Corporations in the "paid by the corporation" column include those that responded that they may pay the exceeding expenses as a result of consultation.

Source: "Report based on Article 30-2 of the Board of Audit Act 'Regarding the Status of Efforts toward Securing of Self-income, etc. at Incorporated Administrative Agencies and National University Corporations'" (December 2015) by the Board of Audit of Japan

Meanwhile, the aforementioned "Report on Approaches to Cost Sharing for Expanding Joint Research Based on Full-Fledged Industry-Academia Collaboration" refers to approaches to expenses other than indirect expenses used for the implementation of joint research, etc. with a view to the development of industry-academia collaboration in the future. In other words, in order to promote large-scale collaborative research etc., investment for the future toward the development of industry-academia-government collaboration and risk management expenses for such activities are needed, in addition to substantial expenses to support research projects. By applying such approaches to expenses to indirect expenses for joint research projects, the establishment of a new framework for industry-academia-government

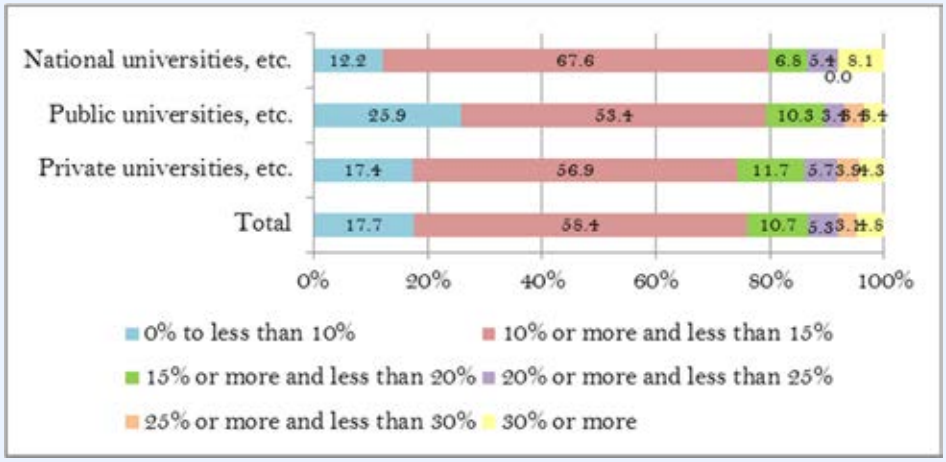
1 Board of Audit of Japan, Report Based on Article 30-2 of the Board of Audit Act: 'Regarding the Status of Efforts toward Securing of Self-income etc. at Incorporated Administrative Agencies and National University Corporations' (December 2015)

collaboration will be promoted. The Industry-Academia-Government Collaboration Guidelines refer to this concept under the title of "strategic industry-academia collaboration expenses" and it has already been introduced by some universities.

The state of introduction of indirect expenses for joint research projects conducted by Japanese universities is as shown in Figure 1-2-26. Compared to US universities, the figures are relatively small. For example, the figure is 55% at the University of Michigan, 57% at the University of California, 69% at Harvard University and 58% at Stanford University.[1]

US universities charge funds that they can use for educational and research activities at their discretion, in addition to indirect expenses necessary for the joint research project subject to the contract. Such additional funds are distributed strategically within the university. It is pointed out that this helps the development of academic areas for which procurement of funds is relatively difficult.[2]

■Figure 1-2-26 / Status of introduction of indirect expenses for joint research projects at Japanese universities



Source: "Status of Implementation of Industry-Academia Collaboration at Universities in FY2015" (Ministry of Education, Culture, Sports, Science and Technology)

Keidanren referred to this situation in its recommendation[3], stating that investment from industry to academia through joint research, etc. should be "promoted with a view to the strengthening of investment in (contribution to) educational and research infrastructure." It is necessary to encourage industry to make active investment for strengthening the infrastructure of universities and R&D agencies, including their academic aspects. At the same time, universities and R&D agencies are required to clarify their approaches to expense estimation and actively acquire investment based on such approaches.

If industry-academia-government collaboration can bring funds that contribute to organizational development, unlike conventional collaborative projects that were squeezing organizational financial status, this can be a great incentive for organizations.

1 Research by the Ministry of Education, Culture, Sports, Science and Technology based on the universities' websites
2 Material 5-1 provided at the first meeting of the University IP Management Review Committee for the Enhancement of Competitiveness, Council for Science and Technology, Industrial Collaboration and Regional Support Group (May 14, 2015)
3 Japan Business Foundation (Keidanren), Fortifying Joint Research through Industry-Academia-Government Collaboration: Expectations for Universities and R&D Corporations Leading Innovation, February 2016

(Startups launched by universities and R&D agencies)

As mentioned in Chapter 1, startups play an important role in promoting open innovation. However, there are still some areas that need to be improved with regard to incentives for universities and R&D agencies to create startups.

Under the current system, when a startup receives a license for a patent held by a national university corporation, payment for the license can be made with stocks or stock acquisition rights.[1] However, the national university corporation must sell the stock received from the startup as the payment for the license (including shares acquired through the exercise of the stock acquisition rights), as soon as it becomes possible to cash the stock, in accordance with Notices[2,3] of MEXT. Therefore, even if the startup was later listed on the stock market and the stock price rose sharply after period of time has passed, the university would already have sold the stock by then.

Moreover, as for R&D agencies, it is not clearly stipulated that they are to acquire stocks and stock acquisition rights as a consideration for licenses in the first place.

As seen above, universities and R&D agencies have yet to see a virtuous circle of obtaining enough revenue from their startups and utilizing it for strengthening the foundation for the creation of next new knowledge and development of human resources.

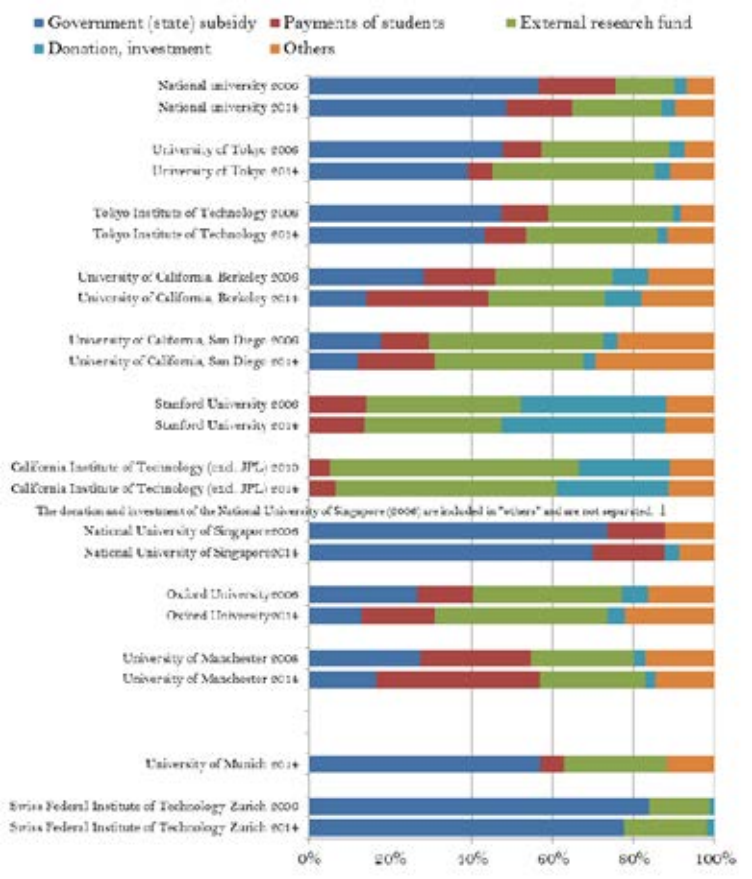
Currently, the revision of the notices regulating the current operation is discussed at the Open Innovation Co-Creation Congress held by MEXT, etc. This will increase incentives for universities and R&D agencies to create startups, which in turn is expected to lead to the development of universities and R&D agencies.

(Other Issues related to financial bases)

Besides the above, diversification of financial resources can be cited as an issue related to the financial base. For example, the composition of financial resources for the operation of US universities is as shown in Figure 1-2-27, which shows that the proportions of external funds and donations are higher than those of Japanese universities.

1 Stock acquisition rights are rights to be exercised against a stock company to receive the delivery of shares of the stock company.
2 2004 Notice of MEXT on Higher Education No. 1012 dated March 29, 2005, Notice from Director-General, Higher Education Bureau and Director-General, Research Promotion Bureau "Treatments in the case where national university corporations and Inter-University Research Institute Corporations acquire stocks as contribution or consideration for licenses (Notice)"
3 2008 Notice of MEXT on Higher Education No. 260 dated July 8, 2008, Notice from Director-General, Higher Education Bureau and Director-General, Research Promotion Bureau "Treatments in the case where national university corporations, etc. acquire stock acquisition rights as contribution or consideration for licenses (Notice)"

■Figure 1-2-27 / Composition of financial resources of universities in Japan, the United States, and Europe



Note: "JPL" stands for NASA's Jet Propulsion Laboratory.
Source: Created by the Ministry of Education, Culture, Sports, Science and Technology based on the Ministry's FY2015 Industry-Academia-Government Collaboration Support Project titled "Basic Survey on Domestic and Overseas Trends for the Establishment of a Research Management System for Japanese Universities" (March 2016)

Some universities in the United States have many fundraisers, staff dedicated to the acquisition of donations, in order to gather donations systematically. Even though some universities in Japan are working on such a measure, this activity is still on a small scale.

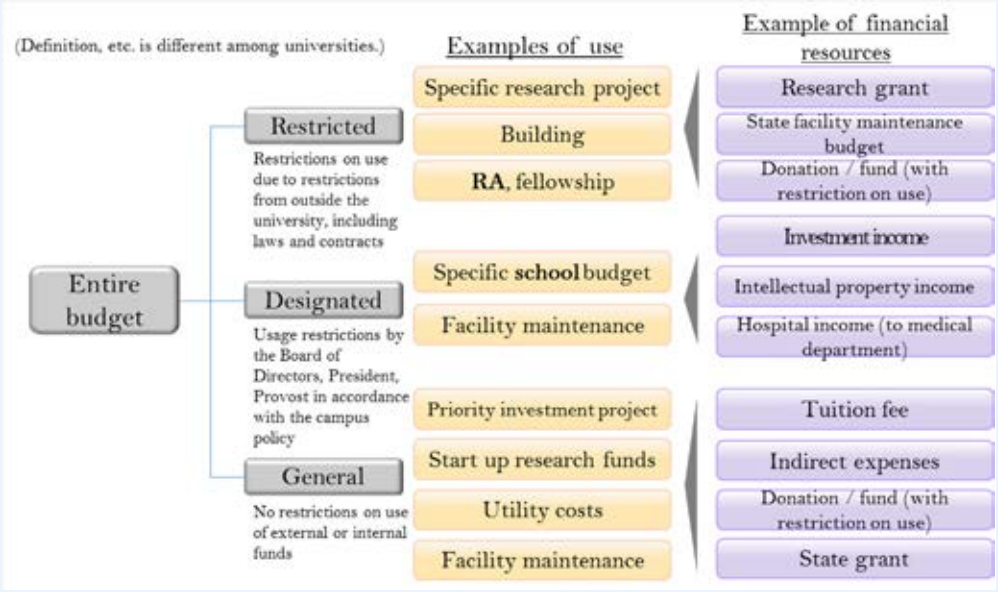
In the "Public & Private Investment Expansion Initiatives for STI" compiled by the Committee for the Activation of STI and Economy and Society in December 2016, it was pointed out that there is a need to revise the system to make it easier to donate real estate and other assets that require evaluation, create a donation culture, improve the environment, and consider approaches to the tax system and other relevant systems. It also stated that it is necessary to utilize more inherited assets and other personal assets to support scientific research through charitable trusts. Moreover, it was also pointed out that the active utilization of the home tax donation system for corporations should be promoted from the perspective of regional revitalization.

Meanwhile, fund management practices are also very different between Japan and the United States. Some universities in the United States have asset management experts to manage a large amount of funds collected and utilize various financial resources including the investment gain as resources for strategic fund allocation within the university (Figure 1-2-28). National universities and R&D agencies in Japan have

been restricted from aggressive fund management under laws and regulations, as these organizations were established for the purpose of the public interest. After the enforcement of the amended National University Corporation Act in April 2017, national university corporations are allowed to expand their scope of management of self-income, such as donations which do not fall under the category of public funds, to more profitable financial products, upon the approval of the Minister of Education, Culture, Sports, Science and Technology. It is hoped that this system will be used more often in the future. In addition, national university corporations are also allowed to lend their land etc. to a third party, upon the approval of the Minister of Education, Culture, Sports, Science and Technology, as long as it does not interfere with education and research activities.

It is considered that Japanese universities will need to develop an asset management system, while also accumulating know-how on asset management.

■Figure 1-2-28 / Example of fund classification at US universities



Note: The above chart is created based on the classification at Stanford University. The definition, use, and financial resources of each category are not always the same among the universities and may be divided into the two categories of "restricted" and "unrestricted." In this case, a budget item falling under the "designated" category may be included in the "unrestricted" category.

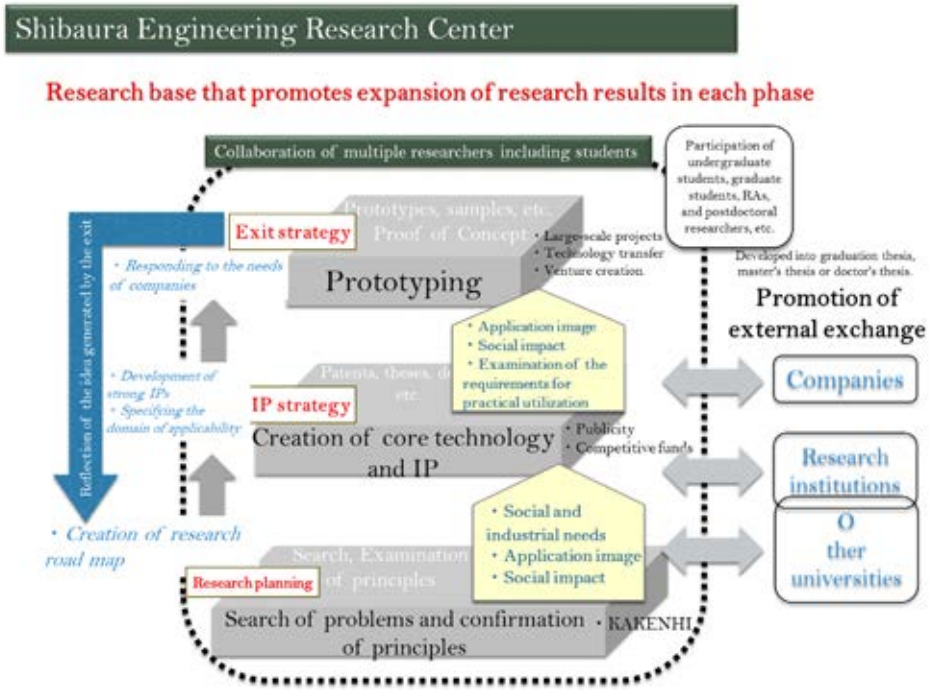
Source: Ministry of Education, Culture, Sports, Science and Technology FY2015 Industry-Academia-Government Collaboration Support Project "Basic Survey on Domestic and Overseas Trends for the Establishment of a Research Management System for Japanese Universities" (March 2016)

Case Study 5 Initiatives for full-scale interorganizational industry-academia-government collaboration – Shibaura Institute of Technology

Shibaura Institute of Technology started an initiative called the "Shibaura ERC (Engineering Research Center)" in 2016. Shibaura ERC is an initiative developed with reference to the ERC of the U.S., wherein consistent research and development activities are carried out from research planning (road map creation) to intellectual property and exit strategy as a hybrid research base carrying out both "social implementation" and "human research development." In particular, it is characterized in that the exit to be jointly followed can be searched by having numerous conversations on the social and industrial needs from the planning stage.

Shibaura ERC sets three themes, i.e. "Improvement of QOL[1]," "Realization of Super Smart Society (Society 5.0)" and Creation of Green Innovation" as the problems to be solved on a global basis. For each theme, 10 to 20 research laboratories are expected to participate in the joint research of industry-academia-government collaboration in a cross-sectoral manner. In addition, human resources are developed simultaneously with the promotion of joint research by having excellent graduate students participate in joint research and engage in research activities.

Admit the situation where it is necessary to consider what to do in addition to considering how to do it regarding the appropriate way of promoting open innovation, this initiative could serve as one of the reference cases.



Shibaura ERC
Provided by Shibaura Institute of Technology

1 Quality of life

Case Study 6 Initiatives for full-scale interorganizational industry-academia-government collaboration – Nagoya University

Nagoya University started to operate the "designated joint research system" since 2016 in addition to existing joint research activities, as an initiative for full-scale interorganizational industry-academia-government collaboration. The Academic Research & Industry-Academia-Government Collaboration which leads such system is an organization launched in FY2013 by unifying several organizations including the research and promotion office, headquarters for promoting industry-academia-government collaboration and research administration office that were divided into different organizations and is unifying URAs in charge of research assistance, industry-academia collaboration and creation of intellectual properties. Establishment of this headquarters enabled planning of large-scale research projects in which different fields are collaborating or in which humanities and sciences are combined beyond departments and agencies, from a university-wide perspective as well as consistent research management from basic research to industry-academia-government collaboration and creation of university-launched startups.

Under the system, the university designates research activities for which the cross-sectional system including the headquarters of the university carries out research planning and operational management of the utilization of the research results, as the "designated joint research." While the risk of delay is reduced by establishing a "promotion council" for each designated joint research and managing the progress of research, attention is paid so as to avoid any excessive control of numerical targets from being made.

By adopting an hour rate method[1] for labor costs related to joint research, the university can include in the expenses an amount equivalent to labor costs of full-time faculty members that was not included in the total amount of joint research costs in the past and can employ on a full-time basis students as researchers. In addition, the university is recording expenses related to the enhancement of the function of industry-academia-government collaboration and planning and implementation of intellectual property strategy in the future as "strategic industry-academia-government collaboration expenses."

The university has also taken other measures such as the improvement of IR functions and establishment of a system for risk management that are expected to serve as precedents for promoting full-scale interorganizational industry-academia-government collaboration.

Outline of the designated joint research system
Provided by Nagoya University

1 An hour rate method is one which calculates the hourly unit price based on the past results by adding up the labor costs of faculty members and additional extra costs (i.e. costs for research space or administrative and clerical support) involved in the implementation of joint research and dividing such costs by the time taken for the joint research. It is a method to calculate indirect costs by multiplying the set unit price by the research period of each designated joint research.

Case Study 7 Initiatives of R&D Agencies - Designated National Research and Development Agencies -

In FY 2016, the "Designated National R&D Agencies System" was established for the purpose of creating world-class R&D achievements while enhancing the international competitiveness of industries in response to the changes in social and economic situations by reforming the innovation system of Japan. Three corporations, i.e. the National Institute for Materials Science (NIMS), RIKEN and the National Institute of Advanced Industrial Science and Technology (AIST), are designated as the Designated National Research and Development Agencies. These corporations are expected to lead the formation of a "platform" for concentration of personnel, knowledge and funds, etc. of industry-academia-government under the swift, flexible and voluntary and autonomous management by the presidents.

In order to fulfill the mission required of the Designated National Research and Development Agencies, NIMS is promoting an initiative called M3 (M-cube). The three Ms stand for the "Materials Open Platform (MOP)," which is a platform to promote open innovation by advertising the function as the fundamental research laboratory of private corporations, the "Materials Global Center (MGC)," which aims to become an international research center in which personnel, materials and funds gather from around the world, and the "Materials Research Bank (MRB)," which is a world-class research base accepting excellent researchers and students from across Japan based on each research group. Through these activities, NIMS is leading "horizontal" open innovation where different companies in the same industry jointly conduct basic research by serving as the hub of materials science.

AIST is seamlessly implementing the process from basic research to development and verification by establishing a basis to carry out integrated research in college campuses, etc. as an Open Innovation Laboratory (OIL) and utilizing the cross-appointment system where faculty members concurrently serve as the research member of AIST or employing graduate students as research assistants. In addition, as the "Kan Labo; Laboratory bearing the company's name," AIST is implementing R&D focused on corporate needs by establishing an integrated laboratory bearing the company's name and gathering research funds and researchers from the companies and researchers, research equipment and research environment including intellectual properties from AIST.

RIKEN is also promoting industry-academia-government collaboration utilizing high-level basic research abilities and proposing interorganizational full-scale joint research where creation of themes is discussed with companies while implementing "interdisciplinary integrated research" by a "baton zone" which is a platform for companies and RIKEN to integrally promote R&D from basic research to research for commercialization. Furthermore, RIKEN is promoting initiatives of innovation design to draw the proper future social image for innovation creation and building a hub for science and technology for multilateral cooperation among different fields and industries.

Every designated research and development agency is implementing initiatives under the strong management of the presidents with a strong sense of linking their R&D abilities with the industry. These corporations are expected to lead the open innovation of Japan in the future.

Joint press conference by the presidents of the three agencies held in connection with the designation as Designated Research and Development Agencies
Source: RIKEN

(3) Challenges and Direction for Improvement of the System by Companies

In order to promote interorganizational industry-academia-government collaboration on a full scale, companies must naturally take organizational measures under the management of the head. Yet, under the present circumstances, companies have yet to launch active external cooperation on a full scale as a whole nor have they made sufficient amounts of investment in universities and R&D agencies.

The challenges faced by companies in taking measures for open innovation are explained in detail in

Chapter 3, Section 3.1 of the "White Paper on Open Innovation" published by the Japan Open Innovation Council in FY2016 and summarized in Table 1-2-29 based on the analysis, etc. of the results of a survey covering large companies.

■Table 1-2-29 / Challenges and constrains for promotion of open innovation by companies (summary made in the White Paper on Open Innovation)

		Characteristic features of companies in which measures for open innovation are becoming more active in comparison to 10 years ago	Challenges and constraints for promoting open innovation that are suggested from the circumstances mentioned in the left column
1	Entity proposing new themes	● Many proposals on new themes are made by the business division.	● The business division is not involved in the establishment of themes.
2	Approval of new themes	● The actual person who approves the new themes differs based on the budget size. ● The authority for decision-making for external cooperation is delegated to the division head or laboratory chief while that for acquisition of startups is delegated to the chief executive of each division.	● The authority for approval of new themes or external cooperation or acquisition of companies is not delegated.
3	Standard for determining whether or not to carry out external cooperation	● Determination is made by placing great emphasis on every aspect such as the technical advantage, speed and cost for R&D in comparison to the case where the company carries out R&D independently, role-sharing after commercialization and treatment of intellectual properties. ● Emphasis is placed on the senior management's attitude towards open innovation and advice from organizations promoting open innovation.	● The standard for determination has not been clarified or is clarified but has not been thoroughly disseminated. ● External cooperation has not become one of the company-wide measures.
4	Support for spin-off	● Supportive measures such as employment maintenance, investment of capital, favorable treatment of intellectual property licenses and hands-on support are implemented in relation to spin-off.	● Support for spin-off is not implemented in a sufficient manner.
5	External transmission of information	● Clear statements in management plans, etc. and external transmission by the top executives, etc. are made.	● Commitment of the top executive is insufficient.
6	Professional structure	● Improvement of mechanisms such as the establishment of a professional structure or arrangement of personnel for promoting open innovation is promoted and such mechanisms are working well.	● A professional structure is not established or is established but not functioning.
7	Problems and challenges of the mechanisms for promoting open innovation	● Sense of challenge in terms of personnel and budget is relatively low in comparison to companies in which measures for open innovation have not become more active in comparison to 10 years ago. ● Meanwhile, these companies are feeling a sense of challenge in gaining the understanding of the persons engaged in R&D and organizations or in seeking partners for external cooperation as is the case of companies in which measures for open innovation have not become active.	● Personnel and budget are the first challenges. ● Even if such challenges are overcome, it is difficult to obtain the understanding of the R&D division or to seek partners for external cooperation.
8	Search of partners for external cooperation	● More weight is attached to measures such as "needs announcement meeting," "business contests," "Hackathon/Ideathon," "acceleration program" and "CVC" rather than conventional means such as "exhibitions, etc." and "thesis and information on academic conferences."	● Companies are relying on conventional means and have not been able to utilize new mechanisms (business contests, Hackathon/Ideathon and CVC, etc.)

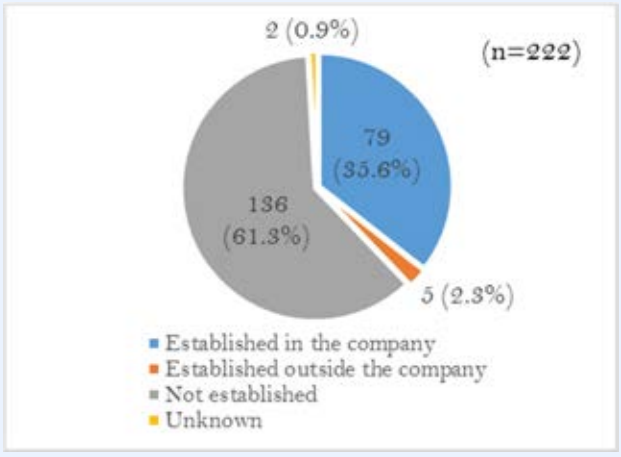
9	Challenges in carrying out external cooperation with domestic organizations	● Similar to companies whose measures have hardly changed from 10 years ago, they are facing challenges in finding appropriate partners. ● Major challenges are the difficulty in reaching an agreement on cost sharing and treatment of IPs, as well as the mismatch in the objective or speed for collaboration in the case of cooperating with universities or public research institutions.	● Appropriate partners cannot be found. ● Agreements cannot be reached in cost sharing or treatment of IPs. ● There is a mismatch in the objective or speed for cooperation (especially in the case of universities and public institutions).
10	Challenges in carrying out external cooperation with foreign organizations	● Similar to companies whose measures have hardly changed from 10 years ago, they are facing challenges in finding appropriate partners and in the differences in business practice and cultures. ● Many companies have raised the mismatch in the objective and speed for collaboration as challenges (the more actively they take measures, the more differences they face in the speed with foreign organizations).	● Appropriate partners cannot be found. ● Business practice and cultures differ. ● There is a mismatch in the objective or speed for cooperation.
11	Constraints in promoting open innovation	● Not a high ratio of companies felt constraints in terms of sentiments such that the topnotch mangers or CTO do not have sufficient understanding on the necessity or purpose of open innovation, motivation is not improved in the overall company or the relative personnel have a strong desire to implement open innovation independently by the company group in comparison to companies in which measures have hardly changed since 10 years ago. ● A high ratio of companies raised constraints in practical aspects such that "it is difficult to receive necessary budget," "the speed of decision-making for external cooperation has not reached the level necessary for smooth cooperation," "external utilization of technology which is not utilized in the company has not been achieved" and "there is a shortfall in the personnel capable of carrying out coordination."	● The first challenge is faced in terms of sentiments (top executives have insufficient understanding of the necessity or purpose of open innovation, the relative personnel have a strong aspiration for implementing open innovation independently by the company, momentum has not been increased in the company) ● In addition, challenges are faced in the process and resources (budget securing, decision-making speed, external utilization of company technology and insufficient personnel for coordination).

Source: Japan Open Innovation Council "White Paper on Open Innovation (first edition)" FY2016

The challenges summarized in the above table suggest that companies have not yet established a concrete structure to institutionally engage in external cooperation. While it has been pointed out that it is important to organize an appropriate specialized department in promoting open innovation,[1] according to the survey conducted by METI,[2] which has also been dealt with in the White Paper on Open Innovation, less than 40% of the companies have established an organization to promote external cooperation (Figure 1-2-30).

1 Edited by Seiichiro Yonekura and Hiroshi Shimizu, "Open Innovation Management : Challenges for Japanese Firms" Yuhikaku, 2015
2 METI FY2015 Industrial technology survey "Survey on the appropriate research and development activities and verification and evaluation research of Japanese companies" (February 2016)

■Figure 1-2-30 / Establishment of organizations for promoting external cooperation



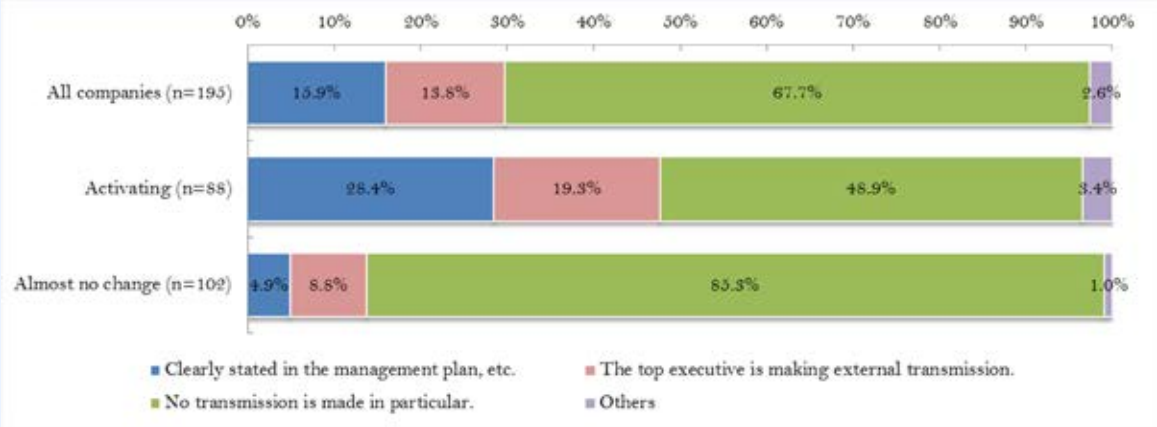
Source: METI FY2015 Industrial Technology Survey "Survey on the appropriate support for research and development activities and verification and evaluation studies of Japanese companies" (February 2016)

In addition, insufficient efforts of the top executives to clearly present the vision on open innovation inside and outside the organization and to penetrate such vision in the organization can be one of the factors that are preventing the promotion of organizational measures. According to the survey carried out by METI,[1] companies making external transmission on promotion of open innovation are limited to approximately 30% of all companies (Figure 1-2-31).

1 METI "Questionnaire survey on the decision-making process and awareness of companies in relation to open innovation, etc."

■Figure 1-2-31 / State of external transmission for promotion of open innovation

Question: Is you company making external transmission on the promotion of open innovation?

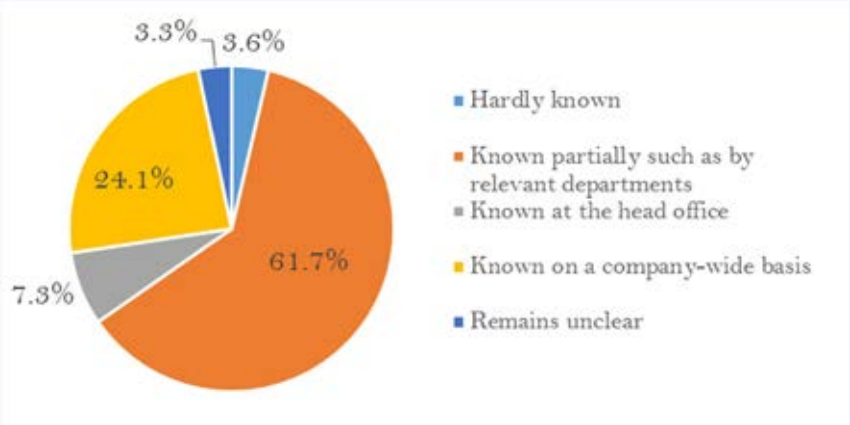


Note: "Activating" represents companies that answered that their measures for open innovation have "become active" in response to the question "Have your company's measures for open innovation become more active in comparison to 10 years ago?" and "Almost no change" represents companies that answered that there was "almost no change" to the same question.

Source: METI "Questionnaire survey on the decision-making process and awareness of companies in relation to open innovation, etc."

On the other hand, according to the results of a survey carried out covering companies implementing open innovation by the 21st Century Public Policy Institute[1] regarding the penetration of open innovation within the organization, not more than one-fourth of the respondent companies answered that open innovation is known on a company-wide basis (Figure 1-2-32). This result also suggests that there are many companies in which open innovation has not become one of the company-wide measures. In addition, it is pointed out in the report that it is important to develop company-wide strategies, establish departments for promoting open innovation, have the senior management involved in open innovation and establish a position of director in charge of open innovation, in relation to such result.

■Figure 1-2-32 / Degree of recognition of open innovation in companies



Source: The 21st Public Policy Institute "Research on Japanese open innovation" (June 2015)

1 The 21st Century Public Policy Institute "Research on Japanese Open Innovation" (June 2015)

As described above, industry-academia-government collaboration is remaining at a small scale due to the fact that many companies have yet to institutionally engage in open innovation. As shown in Figure 1-2-33, in companies, persons in the position to decide on the conclusion of agreements for joint research, etc. differ based on the amount of such agreements. In other words, if agreements for joint research, etc. are to be concluded only by the R&D department or each division of such department or research institute, it becomes difficult to expand the scale of the project. This leads to an implication that past industry-academia-government collaboration has been promoted mainly between researchers without the involvement of the top executives of companies. Companies are required to focus on the necessity to engage in open innovation in an interorganizational manner and to share the awareness of importance of open innovation in the company including the top executives and the persons at site in order to shift industry-academia-government collaboration into full swing.

■Figure 1-2-33 / Amount of the agreement for joint research, etc. based on the person who holds the authority for approval (Classification)

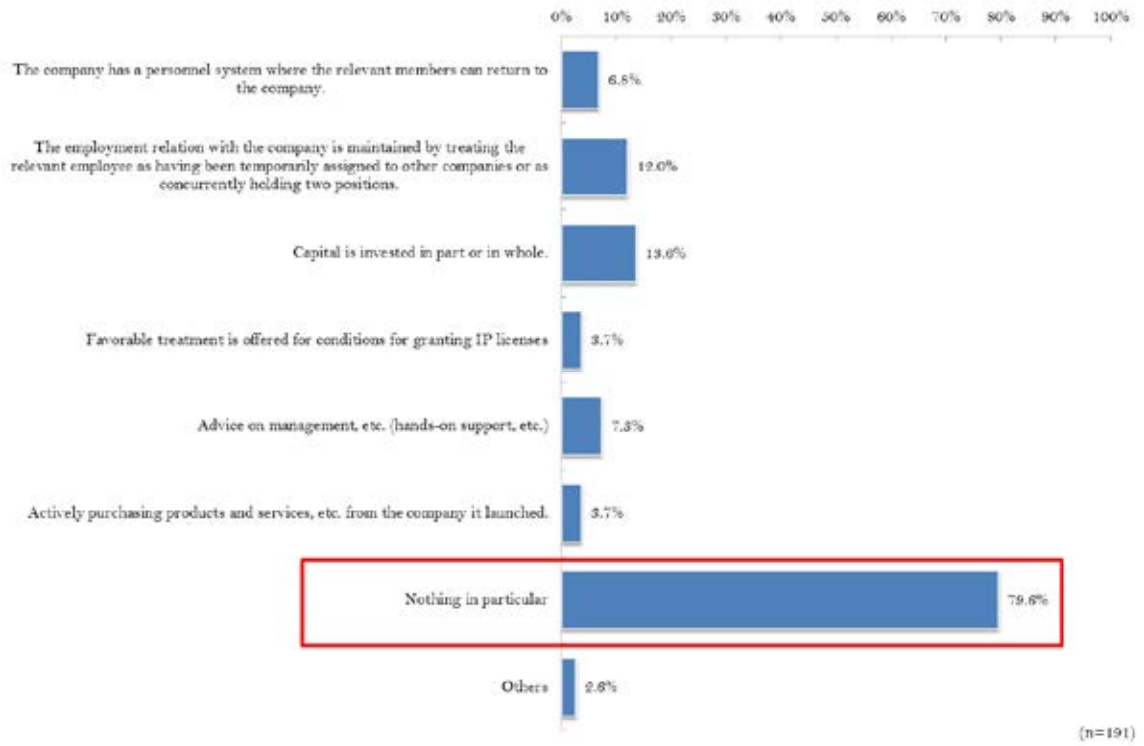
Note 1: CTO refers to chief technology officer.
Note 2: CEO refers to chief executive officer.
Source: METI "Questionnaire survey on the decision-making process and awareness of companies in relation to open innovation, etc."

In addition, as stated in Chapter 1, startups play important roles in promoting open innovation. It has also been explained in a book written by Henry Chesbrough that open innovation has been promoted by the circumstances where startups were established based on the research results produced by research institutes of companies.[1] Meanwhile, hardly any of the large companies of Japan are giving support for their members or spin-off of the organization (Figure 1-2-34). This kind of support is considered

1 Henry Chesbrough, translated by Keiichiro Omae "OPEN INNOVATION The New Imperative for Creating and Profiting from Technology" Publishing department of Sanno Institute of Management, 2004

necessary to utilize the research results obtained at research institutes and to incorporate them in future growth.

■Figure 1-2-34 / Support for Members or Spin-off of the Organization in Large Companies



Note: Multiple answers are allowed.
Source: METI "Questionnaire survey on the decision-making process and awareness of companies in relation to open innovation, etc."

As described above, companies are required to take measures such as the development of strategy by the top executive of the organization, establishment of departments or positions for promoting open innovation and support for startups. SMEs may particularly face difficulty in establishing specialized departments but the existence of professional business operators for intermediating open innovation and cases of active promotion of cooperation between parties including local universities, R&S corporations and local governments suggest that they should consider various means according to the actual circumstances of the organization.

Case Study 8 Universities and University-launched Startups Play a Pivotal Role in Cooperation between SMEs- Muroran Institute of Technology-

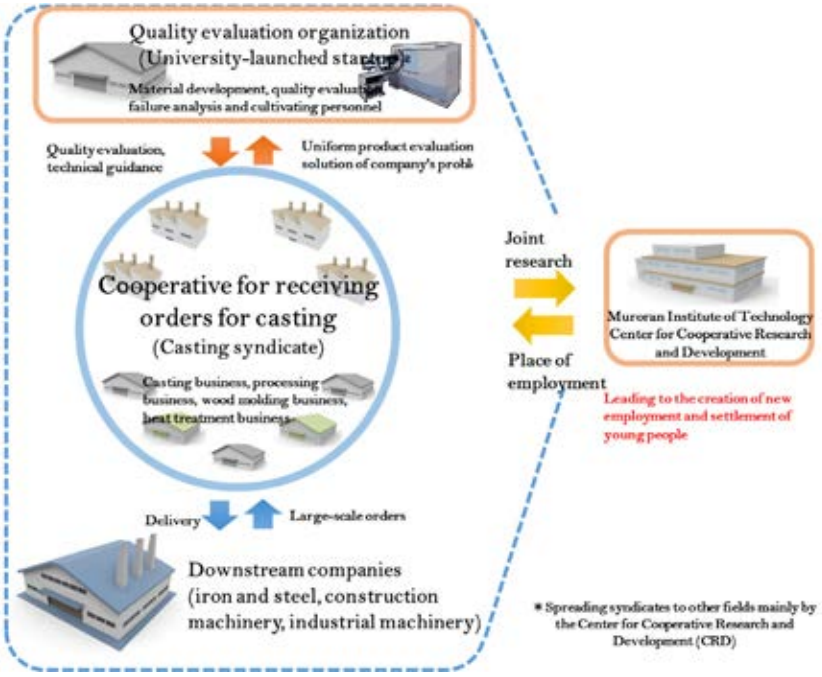
One of the major cases where universities or university-launched startups play an important role for cooperation between SMEs is the project of "casting syndicate" led by Muroran Institute of Technology. Casting syndicate is a project wherein Muroran Institute of Technology leads the formation of a network consisting of small and medium-sized casting companies with high technology to receive orders for heat and abrasion-resistant parts which are high-value added products from large companies. While Muroran Institute of Technology supports research and development, the startup which is slated to be launched by said Institute this autumn is expected to take charge of quality control such as evaluation of products. About 30 SMEs located in Hokkaido are planning to participate in the network which is further expanding across the country. Muroran Institute of Technology has purchased high-performance devices for quality inspection by utilizing the subsidies from METI and is guaranteeing quality control.

This project has the advantage that participating companies can receive large-scale orders, which could not have been received by individual companies, by cooperating with other companies while incorporating high technology or receiving quality guarantee as a result of cooperation with universities or university-launched startups.

Kazumichi Shimizu professor of Muroran Institute of Technology, who planned this project and launched a startup, advocates that universities should assume the role of supporting the solution of challenges faced by SMEs and states that the aim of the project is to enable companies participating in the syndicate to turn into a company with corporate strength.

Muroran Institute of Technology is also implementing a number of industry-academia-government collaborative activities such as a search for antidementia substances in cooperation with local companies and is supporting cooperation and development of local companies by aiming to improve the rate of employment at local companies. The project of casting syndicate introduced in this column is expected to become a model case showing that intermediation of universities or R&D agencies is effective in promoting open innovation between companies.

(University-launched startup)



Casting syndicate

Source: Created by MEXT based on the materials provided by Muroran Institute of Technology

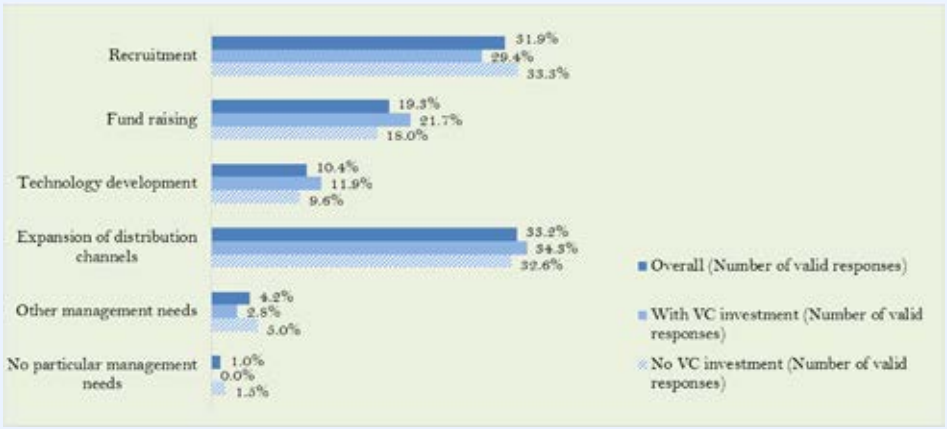
The government is strongly promoting research and development challenges which are nationally focused and should be comprehensively promoted based on industry-academia-government collaboration in anticipation of practical utilization and commercialization which is the exit from basic research. In the Cross-ministerial Strategic Innovation Promotion Program (SIP) promoted by the Cabinet Office, while several companies and universities or R&D agencies are cooperating and universities and R&D agencies are promoting research and development by incorporating the needs of the companies that are the users of the research results, the industry is promoting research and development by incorporating systematic

and basic knowledge, thereby seeking solutions to specific issues faced in the process from basics to practical utilization and commercialization by the industry-academia-government as a whole. The program is promoting industry-academia-government collaboration on a full scale including horizontal open innovation where companies in the same trade cooperate, as explained in Chapter 1.

2 Promoting creation and development of startups

As stated in Chapter 1, the low number of persons opening up businesses in Japan is the first challenge regarding the problem of slumping creation of startups by universities or R&D agencies and non-development of startups that have been created. In addition, according to a questionnaire survey conducted covering the managers of startups, they raised the difficulty in fund raising and development of distribution channels, etc. after the launch of the company (Figure 1-2-35). In the following parts, such challenges shall be explained in detail separately from the aspect of personnel and the aspect of environment for startups to be created or to develop such as fund raising and development of distribution channels.

Figure 1-2-35 / Current of Near Future Management Needs of Startups



Source: Venture Enterprise Center "VEC YEARBOOK 2016 / Annual Report on Japanese Startup Businesses" (November 2016)

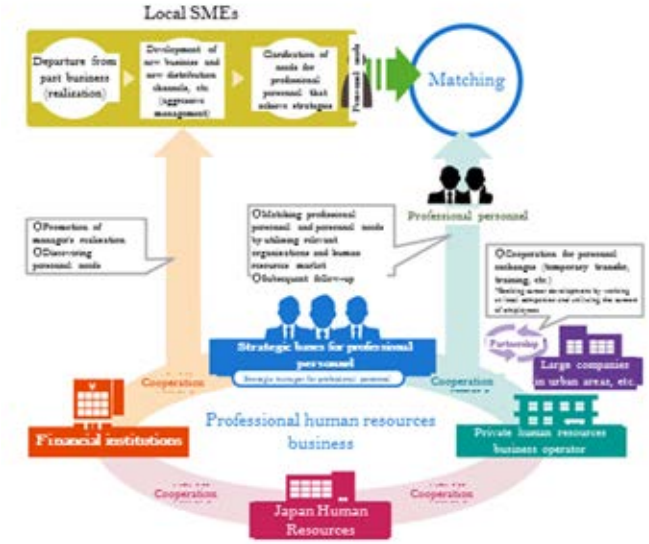
(1) Challenges and direction for personnel for startups

In Japan, there is only a small number of persons who open up a business in the first place. While measures to cultivate or secure such persons shall be explained in detail in Section 3, various personnel other than the person who opens up a business must be involved for the startup to be successful. However, generally, it is possible for startups that have just been established and thus have almost no achievements or profile, etc. to face difficulty in recruiting excellent personnel.

Startups launched by universities or R&D agencies also require various personnel such as persons that take charge of business and affairs such as management, legal work and accounting. It is unrealistic for one person to take charge of everything and team building would be important. In addition, persons who take charge of such aspects should be searched by also considering the possibility of recruiting external managerial talents. In fact, according to the results of an analysis on the influence of the structure of the top management teams of university-launched startups of Japan on the business performance of startups,

it has been clarified that better business performance was achieved when outside persons with more knowledge on business were recruited instead of the case where many of the members were recruited from the campus.[1]

Although support for recruitment of startups has become active in the human resources industry, human resources tend to be short especially in local areas. The Cabinet Office is implementing a professional human resource project in cooperation with the strategic base for professional human resources established in each prefecture, and this project is expected to the utilized in securing human resources of startups.



Professional human resources business
Source: Cabinet Office

In addition, it is also necessary to develop a system to support startups including dispatch of personnel who give advice on management, etc. In the past, support for new business including team building consisting of a variety of professional personnel has been implemented such as in the Program for Creating Start-ups from Advanced Research and Technology (START) led by the JST. However, the problem of lack of possible candidates for manager in the company despite its promising technology has been revealed in the project and further improvement of support is expected.

(2) Challenges and direction for the environment to create and develop startups

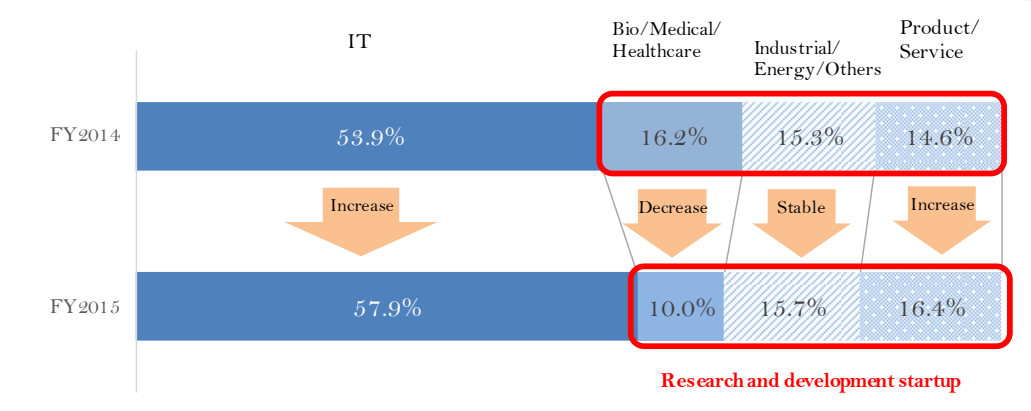
(Fund raising, etc.)

While difficulty in fund raising is particularly faced by research and development startups that are launched by universities in addition to startups in general, a slight decline has been seen in the ratio of investment amount for the period from FY2014 to FY2015 (Figure 1-2-36). In addition, although they face difficulty in fund raising, research and development startups, especially non-IT research and development startups, would require a huge amount of funds and time for implementation of research and development and subsequent capital investment, etc.

1 Yuri Hirai, Toshiya Watanabe, Atsushi Inuzuka "Empirical Analysis of the Effect of Japanese University Spinoffs' Top Management Teams on Their performance" The Journal of Science Policy and Research Management Vol. 27 No. 3/4 2012

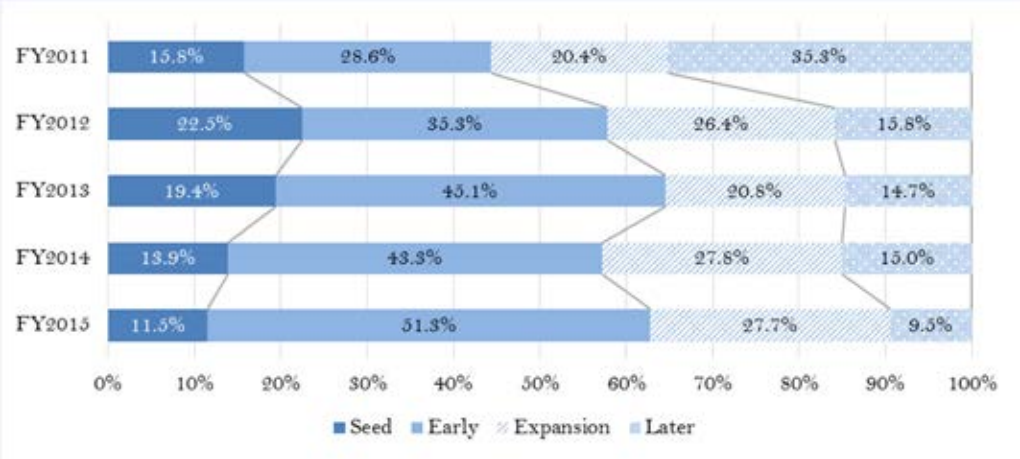
Investments in startups by venture capitals during the period from FY2011 to FY2015 are as shown in Figure 1-2-37 based on the stage of the business[1], and the ratio of investment in the seed stage is declining.

■Figure 1-2-36 / Investment Ratio According to the Type of Business (limited to Domestic investments)



Source: Created by MEXT based on the "VEC YEARBOOK 2016 / Annual Report on Japanese Startup Businesses" of Venture Enterprise Center (November 2016)

■Figure 1-2-37 / Changes in the stages of investment destination (amount ratio)



Source: Created by MEXT based on the "VEC YEARBOOK 2016 / Annual Report on Japanese Startup Businesses" of Venture Enterprise Center (November 2016)

Normally, venture capitals form funds by externally raising funds and make investments in startups using the fund. External funds injected by the fund are sometimes refunded to the investors together with profits after a certain period of time has passed and such period is generally set to be 10 years for funds.[2]

1 In Figure 1-2-37, companies are categorized into the following four classifications based on the definition used in the survey carried out by Venture Enterprise Center.
Seed: Companies whose commercial business is yet to be established in whole and is continuously working on the research and development of products.
Early: Companies directed toward the development of products, initial marketing, manufacture and sales activities.
Expansion: Companies that have started to conduct production and shipment with increased stock and sales
Later: Companies with continuous cash flows and are almost ready to conduct IPO.

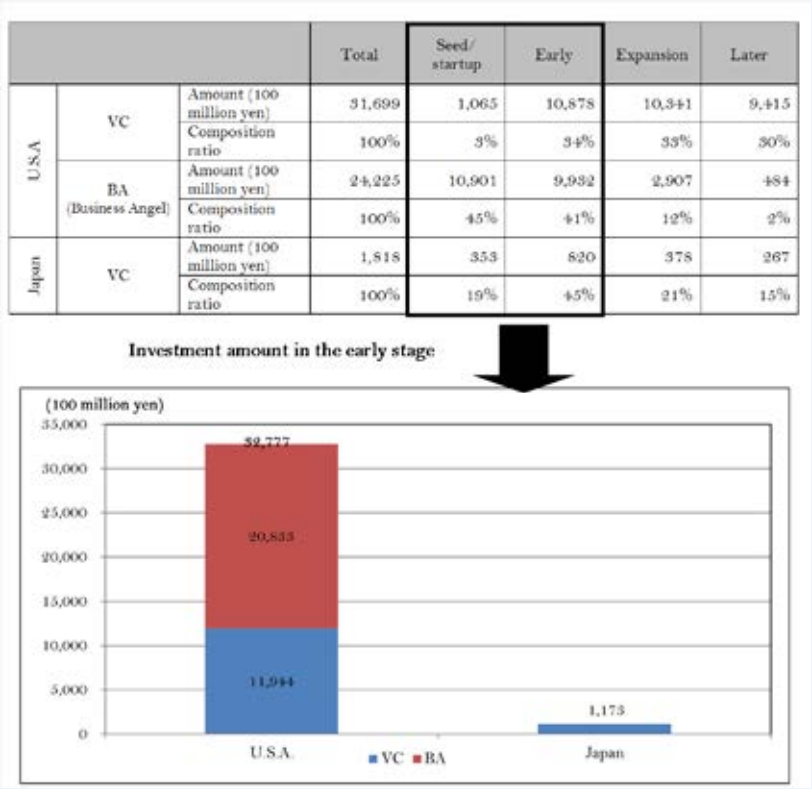
2 For example, in Shuichi Matsuda "Startups" 4th edition (Nikkei Publishing Inc., 2014), it is stated that "In many cases, the payout time of investment partnerships is 10 years. In general patterns, investment is completed in the first two to five years, […] and then investment is recovered the most in

On the other hand, many of the research and development projects promoted by research and development startups are considered to require a relatively long time, resulting in less investment due to the duration of the fund.[1] Moreover, the relatively high risk in the seed stage of research and development startups that require a long road for commercialization is also considered as one of the factors for less investments.

This trend is not only seen in Japan but also in the startups of the U.S.A. Meanwhile, in the U.S.A., many angel investors are injecting funds into companies in the seed stage. Angel investors refer to wealthy individuals who supply funds to startups, etc. In the U.S.A., there is a cycle wherein persons who built a fortune by staring up a business invest in new entrepreneurs. In 2013, angel investors invested approximately 2.4 trillion yen, 45% of which was investment in companies in the seed stage (Figure 1-2-38). While angel investors are also active in Japan, the overall scale is assumed to be smaller than that in the U.S.A.

■Figure 1-2-38 / Comparison of Investment Scale in the Early Stage between Japan and the U.S.A. (FY2011)

			Total	Seed/ startup	Early	Expansion	Later
U.S.A	VC	Amount (100 million yen)	31,699	1,065	10,878	10,341	9,415
		Composition ratio	100%	3%	34%	33%	30%
	BA (Business Angel)	Amount (100 million yen)	24,225	10,901	9,932	2,907	484
		Composition ratio	100%	45%	41%	12%	2%
Japan	VC	Amount (100 million yen)	1,818	353	820	378	267
		Composition ratio	100%	19%	45%	21%	15%

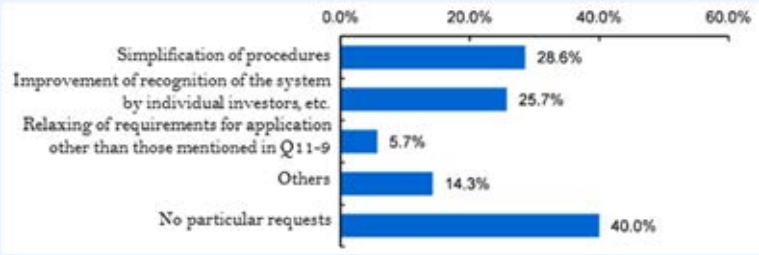


Notes: Calculated by using the annual average exchange rate of 2012, 1$=105.79 yen. The numerical figures of Japan and the U.S.A. are those of FY2013 and 2013, respectively.
The ratios for the stages of Japan are the values calculated by the Venture Enterprise Center based on the questionnaire survey conducted with 69 venture capitals. The investment amount for each stage of the startups, etc. in FY2011 is estimated by multiplying the abovementioned ratio by the investment amount made in venture capitals, etc. in FY2011.
(Source) Venture Enterprise Center "VEC YEARBOOK 2014 / Annual Report on Japanese Startup Businesses"
Data: FY2014 JPO-commissioned research study report on the issues related to the industrial property rights system "Research Study Report on the Investment Decision of Research and Development Startups" (February 2015)

1 the subsequent five to eight years and the last two years will be the period during which stocks that have not failed but cannot be listed will be treated." Minutes of the annual autumn public verification "autumn review" regarding the promotion of growth strategy (ii) (startup support) (third day) (November 12, 2016)

In Japan, there is an angel tax system to systematically support the activities of angel investors. In FY2015, about 2.5 billion yen was subject to the angel tax system. According to a survey commissioned by METI in 2014,[1] various problems for operation were suggested including the simplification of procedures and dissemination of the system[2] (Figure 1-2-39).

■Figure 1-2-39 / Requests concerning the angel tax system



Source: METI, Survey on Support of New Business and Startups in FY2014 "Regarding the Startup Ecosystem Focused on Angel Investors, etc." (March 2015)

In addition, there are many cases where universities in Europe or the U.S.A. independently establish gap funds to lead the seeds of universities to commercialization. Gap funds refer to funds that fill in the gaps that exist between basic research and commercialization in universities and prompt technology transfer from inside to outside the university.[3] According to a survey commissioned by MEXT,[4] it has been reported that researchers are carrying out proof of concept (POC[5]) and creation of prototypes based on the research results by receiving funds from gap funds; this flow is assumed to be effective in leading the research results to practical utilization. In Japan, creation and development of startups are also expected to be promoted by having the universities or R&D agencies themselves invest in the startups launched by them or utilizing public support projects for stating up a business based on the seeds of universities and R&D agencies that often face difficulty in fund raising. In the past, various measures have been taken such as the fund support equivalent to gap funds by some of the universities, support by the JST and support of research and development startups by the New Energy and Industrial Technology Development Organization (NEDO), but the scale of these measures is considered to be small in comparison to those made in the U.S.A. and European countries.

Furthermore, with respect to R&D agencies, only three corporations, namely the JST, NEDO and the National Institute of Advanced Industrial Science and Technology (AIST), can invest in startups based on the Research and Development Capacity Improvement Act.

Meanwhile, startups facing difficulty in fund raising sometimes make payments by stock or stock options. Under the current system, university-launched startups that start up a business by receiving a license for a patent held by a university are allowed to pay the university the consideration for the license by stock

1 Growth Strategy Council –Investing for the Future, Council for Advancing Structural Reform, Council on "Company-related Institutional Reform and Industrial Restructuring –Promotion of Long-term Investment and Bold Restructuring" (Startups) (first meeting) (December 12, 2016), Material 3 "Startup policies of METI"
2 METI, Survey on New Business and Startups in FY2014 "Regarding the startup eco system focused on angel investors, etc." (March 2015)
3 Intellectual Property Office of Kanazawa University, Kanazawa University TLO, Hokuriku Branch of Development Bank of Japan "Survey on the Significance of Gap Funds and Possibility of Introducing Them" (October 2004)
4 MEXT-commissioned Project for Supporting Industry-Academia-Government Collaboration in FY2011 "Survey on the Utilization of Gap Funds in Japan, the U.S. and Europe" (March 2012)
5 Proof of concept

options. However, they are not allowed to make other payments, for example, usage fees of facilities, to universities by stock or stock options,[1] which is presumably a burden on startups. The same problem is seen for R&D agencies.

The Open Innovation Co-creation Congress is discussing these problems by examining the possibility of expanding the scope of R&D agencies that can make investments, expanding the scope for state-owned universities to acquire stocks or stock options and treatment of stocks, etc. of R&D agencies.

Case Study 9 Startup launched by the University of Tokyo that Believed in the Growth of Kyushu University-launched Startup -Kyulux and Euglena-

Kyulux is a startup launched by Kyushu University in 2015 with an aim to put the technology of organic EL into practical use which had been promoted by Chihaya Adachi, Professor and Head of the Center for Organic Photonics and Electronics Research of Kyushu University.

Organic EL (Electro-Luminescence) refers to the phenomenon where a specific organic substance shines by electric voltage. Organic EL displays utilizing organic ELs have already been used in many goods including the displays of TVs, personal computers and smartphones. However, organic ELs which have been used in the past required iridium which is a scarce metal, resulting in expensive production cost. The research team led by Professor Adachi promoted the development of organic EL without using scarce metal to substantially reduce the production cost in comparison to conventional ones by receiving assistance from programs including the Cabinet Office's Funding Program for World-Leading Innovative R&D on Science and Technology and established a startup to accelerate the practical utilization thereof.

Nowadays, its advanced technology and potential are gaining wide attention and Kyulux is raising funds in a total of 1.5 billion yen from QB Capital, which is a venture capital in which Kyushu University's TLO is investing, the Japan Science and Technology Agency, and display manufacturers in and outside Japan. However, at the time of its start-up, Kyulux faced difficulty in fund raising and could not find any willing partners although they explained their technology hundreds of times to business companies and venture capitals, etc. Kyulux which aimed to develop new organic ELs is considered to have faced difficulty in fund raising due to the facts that research and development startups dealing with materials require much time and money for research and development and the Japanese display-related industry per se was having a hard time in global competition.

On such an occasion, Real Tech Fund operated by euglena SMBCNikko Leave-a Nest Capital L.L.C., display manufacturers in Japan and overseas and others provided funds. Euglena is a startup with a market capitalization of more than 10 billion yen which has been launched by the University of Tokyo and its success has partially supported the growth of Kyulux. Real Tech Fund is Japan's largest technology-focused fund consisting of business companies, which aims to nurture startups which are the investment destination together with the shareholding companies and to have the technology socially implemented. While this kind of formation of a virtuous cycle and practical utilization of remarkable research and development results of Japanese universities and R&D agencies are expected to further accelerate in the future, the society as a whole must recognize again the importance of supporting the research and development startups of Japan over a long period of time.

(Transfer of technology of universities, etc.)

Patents held by startups are an issue straddling fund raising and exit strategy. While the technological strength of the research and development startup is important until the startup succeeds, unless the patents used by the startup can be autonomously, strategically and freely used, they could hinder the attracting of investment or determination on M&A.

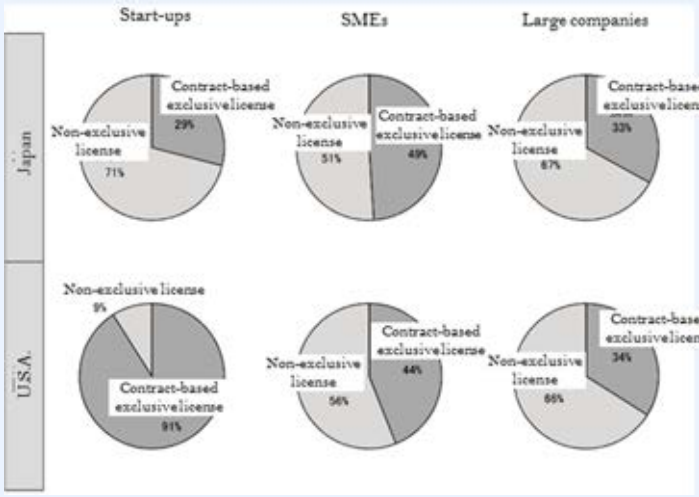
However, the case where the patents held by Japanese universities are licensed to startups in the form of a contract-based exclusive license is limited to less than 30% of all cases, and they are licensed in the form

1 Based on the 2004 Notice of METI on Higher Education No. 1012 dated March 29, 2005, Notice from Director-General, Higher Education Bureau and Director-General, Research Promotion Bureau "Treatments in the case where national university corporations and Inter-University Research Institute Corporations acquire stocks as contribution or consideration for licenses (Notice)"

of a non-exclusive license in more than 70% of all cases. This is a contrasting situation in comparison to that of the U.S.A. where patents are licensed to startups in the form of a contract-based exclusive license in more than 90% of all cases (Figure 1-2-40).

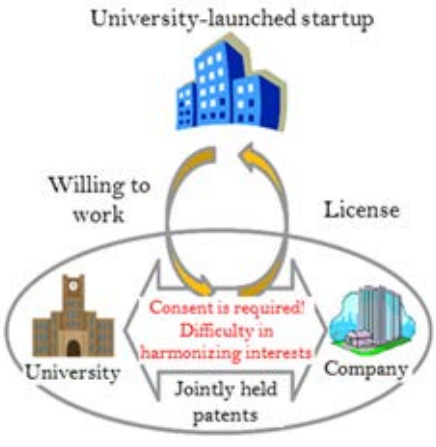
The competing risk is feared to increase for startups which intend to develop a business by using the patents held by universities if such patents are not exclusively licensed to startups. This could further cause difficulty in fund raising.

■Figure 1-2-40 / Comparison of the Form of License based on the Scale of the Licensee (Companies) of University Patents between Japan and the U.S.A.



Note 1: Data of FY2013 is used for Japan while that of FY2006 is used for the U.S.A.
Note 2: In this Figure, startups are mentioned as "Start-ups"
Material: FY2015 JPO-commissioned research study report on the issues related to the industrial property rights system "Research Study Report on the Treatment of Patent Rights for the Promotion of Utilization of Research Results of Industry-Academia-Government Collaboration" (February 2016)

One of the possible causes for universities to license patents to startups only in the form of a non-exclusive license is the sharing of patents. Normally, when universities and companies file a patent application by jointly conducting research, they often share the ownership of the patent. When the university or R&D agency intends to exclusively license this jointly-held patent to other startups, it must obtain consent from the company which is the other co-owner, based on the provision of Article 73 of the Patent Act[1]. In this case, the company which jointly holds the patent may intend not to give consent since giving such consent would hinder it from licensing other companies.



Source: MEXT

Many university patents are jointly held due to the issue of arrangement on the attribution of the outcome of the joint research performed with companies and the

1 Act No. 121 of 1959

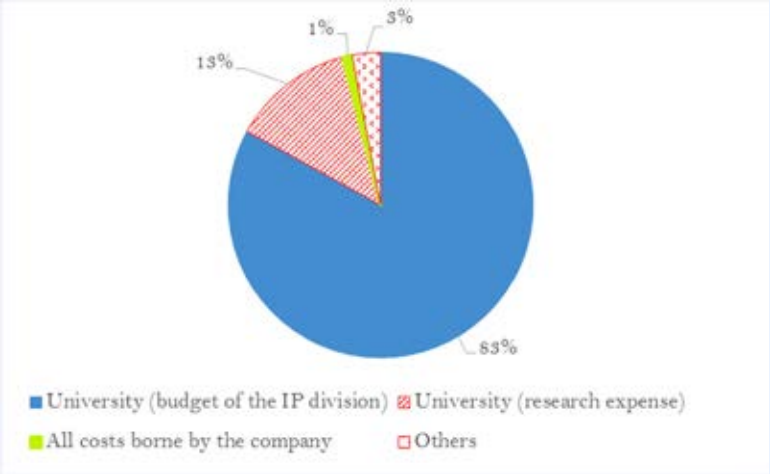
issue of costs. With respect to the former issue, when universities and companies intend to start joint research, they often start the research ahead while postponing decisions due to the difficulty in reaching an agreement on the holding and working of intellectual properties. In fact, according to a survey conducted by the JPO, many universities and companies of Japan raised opinions that they preferred keeping the patent jointly held as stated in the boilerplate contract and bringing a conclusion at the time of negotiation for considering the working of patents since much time is required to file the patent application independently.[1] In addition, with respect to the later issue, when a university intends to independently hold the patent obtained as a result of a joint research, in most cases, the university bears all of the costs (Figure 1-2-41). In contrast, when the university requires the company to bear costs, patents are jointly held[2] (Figure 1-2-42).

In the U.S.A., many patents whose right holder is the university are independently held by universities (Figure 1-2-43) and this is one of the possible factors enabling universities to exclusively license their patents to startups. Yet, differences in patent law are also considered to be behind this situation. Unlike the Japanese Patent Act, under the U.S. Patent Law, granting of a non-exclusive license or assignment of rights can be made without obtaining the consent of the co-owner even in the case of jointly-held patents. For this reason, when the relevant patent is jointly held, companies would face higher risks since they will not be aware of the specific party to which the university will grant a license or assign the rights. To avoid such a situation from occurring, companies include the negotiation rights to receive an exclusive license on a priority basis in the agreement while allowing the university to independently hold the patent, thereby leading to the situation where many patents are independently held by universities.

Whatever the case, in order to create and develop startups launched by universities or R&D agencies in Japan, the autonomous management of intellectual properties by universities and R&D agencies is required. As stated in 1(1) above, there are cases where universities or R&D agencies in Japan are jointly holding patents without looking ahead to the commercialization thereof due to the rigid operation by the "form principle" of contracts. In the "Sakura Tool" introduced in Subsection 1(1) of this Section, several forms of joint research contracts are presented including the option of attributing the outcome of joint research independently to universities, etc. or private companies. Universities and R&D agencies are required to implement strategic intellectual property management by utilizing such forms. In addition, upon such implementation, they will also face the challenge of coping with the costs required for intellectual property management.

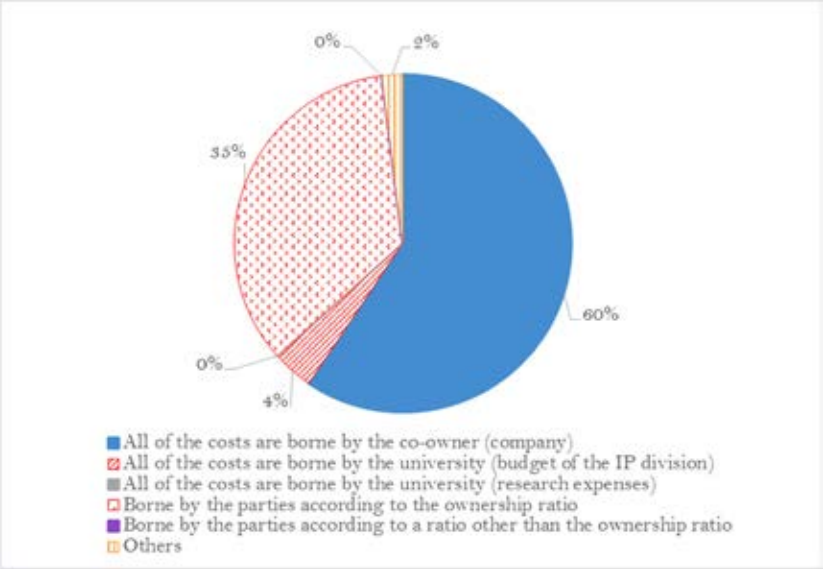
1 FY2015, JPO-commissioned research study report on the issues related to the industrial property rights system, "Research Study Report on the Treatment of Patent Rights for the Promotion of Utilization of Research Results of Industry-Academia-Government Collaboration" (February 2016)
2 In this case, patents could independently be held by companies.

■Figure 1-2-41 / Ratio of Cost Burden in the Case where Universities Independently Hold the Outcome of Joint Researches (Intellectual Property Rights)



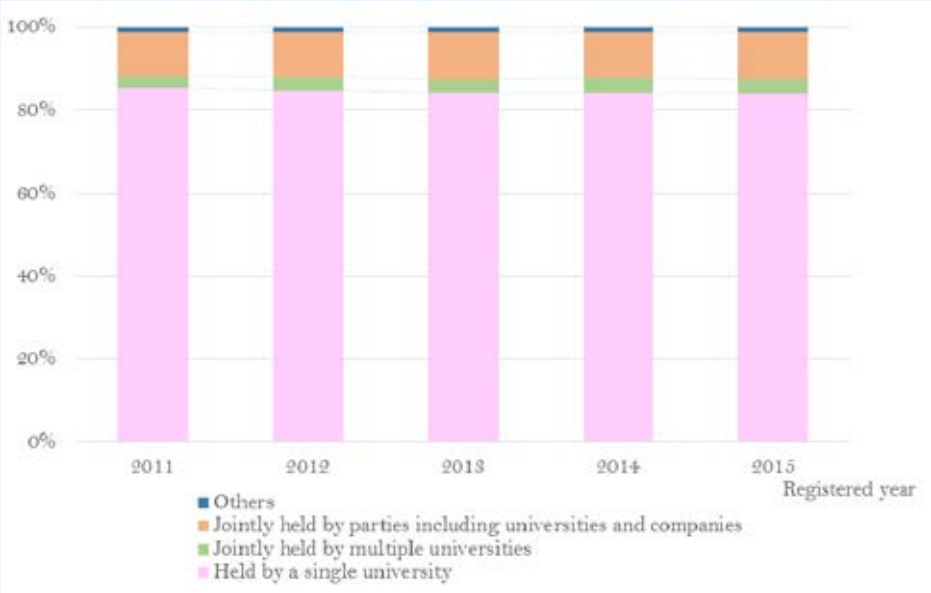
Source: FY2013 University IP Promotion Project of JPO "Study Report on the Organized Measures of Universities that Contribute to the Utilization of Intellectual Properties" (February 2014)

■Figure 1-2-42 / Ratio of Cost Burden in the Case where the Outcome of the Joint Research (Intellectual Property Rights) is Jointly Held



Source: FY2013 University IP Promotion Project of JPO "Study Report on the Organized Measures of Universities that Contribute to the Utilization of Intellectual Properties" (February 2014)

■Figure 1-2-43 / Ratio Based on the Composition of the Assignee of a U.S. Patent for which U.S. Universities Hold the Rights



Note 1: Universities that were included in the list of names of the assignees as the U.S. universities covered by the survey on the number of patents which was contained in the report created by USPTO ("U.S. Colleges and Universities - Utility Patent Grants, Calendar Year 1969-2012") were covered in this figure.

Note 2 Under the patent system of the U.S.A., traditionally, only inventors are expected to file patent applications and companies, etc. to which the inventor belongs can receive the right to obtain a patent from the inventor and. further, it has become possible for assignees to file patent applications as a result of the amendment of the U.S. patent law in 2011. From this viewpoint, the assignee of a U.S. patent can be recognized to be equivalent to the applicant of a Japanese Patent.

Note 3: "Jointly held by parties including universities and companies" includes joint holding by the university and company, joint holding by the university, company and individual and joint holding by the university, company and governmental organization.

Note 4: "Others" includes joint holding by the university and individual and joint holding by the university, state government or federal government.

Source: Created by NISTEP using the bulk data downloaded from the database supported by USPTO ("Patentsview (http://www.patentsview.org)").

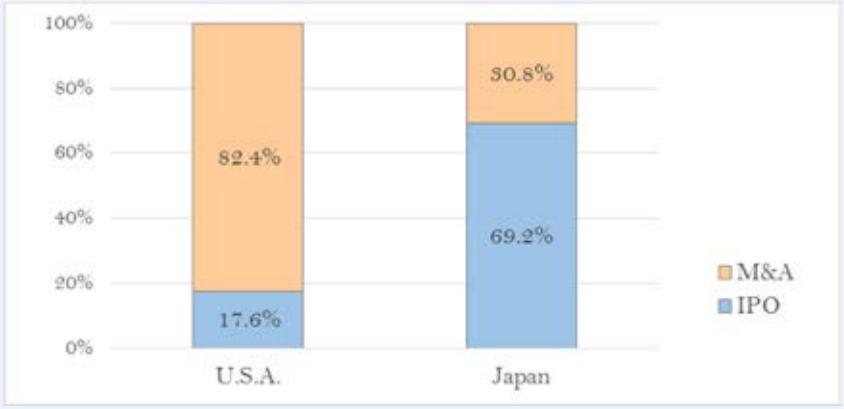
(Development of distribution channels)

In many cases, startups do not have an existing network because they are start-ups. In addition, if the product created by the startup is innovative, the market for such product may not have been formed in a sufficient manner. Thus, expansion of the distribution channel could be one of the major problems for startups.

When the exit of Japanese startups and that of U.S. startups are compared, many of the former are using IPO[1] as the exit, while the latter are mainly using M&A (Figure 1-2-44). Specifically, in the U.S.A., the startups themselves are not actually engaged in the sales, etc. but they are assumed to be utilizing their own technology and products in the existing management of company.

1 Initial Public Offerings

■Figure 1-2-44 / Difference in the Exit of Japanese Startups and U.S. Startups (2015)



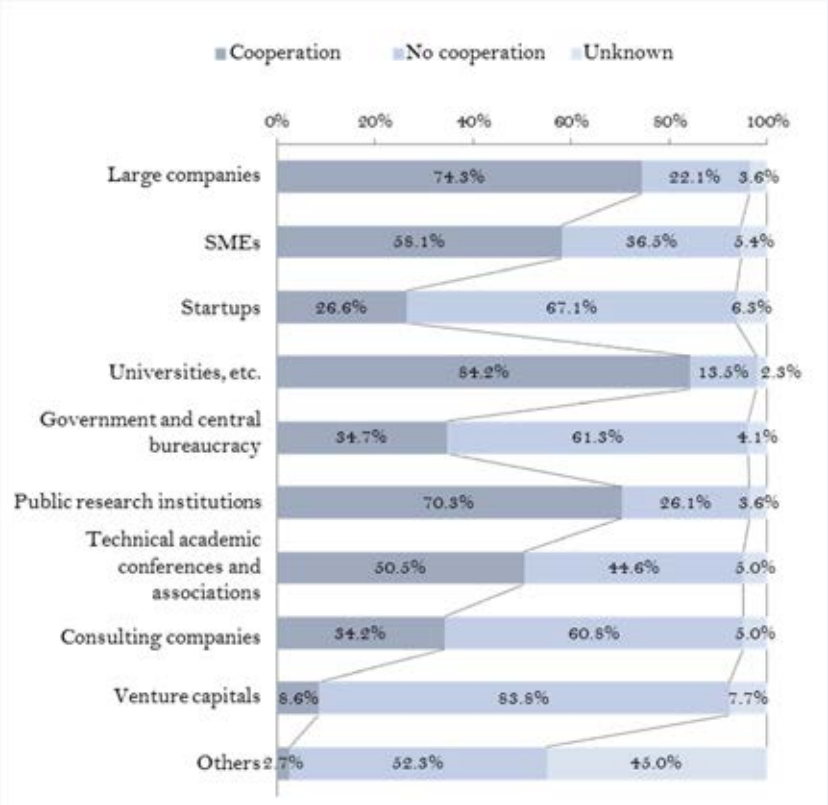
Source: Created by MEXT based on the "VEC YEARBOOK 2016 / Annual Report on Japanese Startup Businesses" of Venture Enterprise Center (November 2016)

Startups may expect to secure distribution channels by cooperating with existing private companies and further cooperation with private companies is required. However, under the current situation, the ratio of startups cooperating with large companies is relatively low in comparison to that of large companies, universities and R&D agencies (Figure 1-2-45). It is also important for existing private companies to cooperate with startups to promote open innovation, and relationship-building wherein both parties can mutually create interest must be promoted.

With respect to the cooperation between large companies and startups, as KEIDANREN (Japan Business Federation) has stated in its proposal that large companies shall regard startups as an equal partner for the creation of new business or future business and for management strategy, promote cooperation and take measures such as building a system to create an environment which allows active involvement of the management or failures and to expand the range of cooperation;[1] the industry is expected to take further measures.

1 KEIDANREN (Japan Business Federation) "Towards the creation and development of startups that contribute to the 'development of new key industries' –To build a Japanese 'startup ecosystem'" (December 2015)

■Figure 1-2-45 / External Cooperation Partners of Large Companies (Records of FY2014 (Domestic))



Source: METI, FY2015 Industrial Technology Survey Project "Survey on the Appropriate Support for Research and Development Activities and Verification and Evaluation Research of Japanese Companies" (February 2016)

As described above, there is a problem that innovative products and services of startups are poorly acknowledged in existing markets. With respect to this problem, the U.S. government has been implementing supports by purchasing the products of startups based on the SBIR[1] system from the 1980s and this support is found to be effective for securing distribution channels for startups and serving as an appeal to the market.[2] In Japan, a public procurement system such as a trial ordering system is created mainly in local governments, but this movement has not shifted into full swing especially in government procurement by the State.

In light of such a situation, currently, the Cabinet Office is holding discussions for developing or enhancing SMEs and startups by utilizing the system of public procurement, etc.

3 Personnel for promoting open innovation

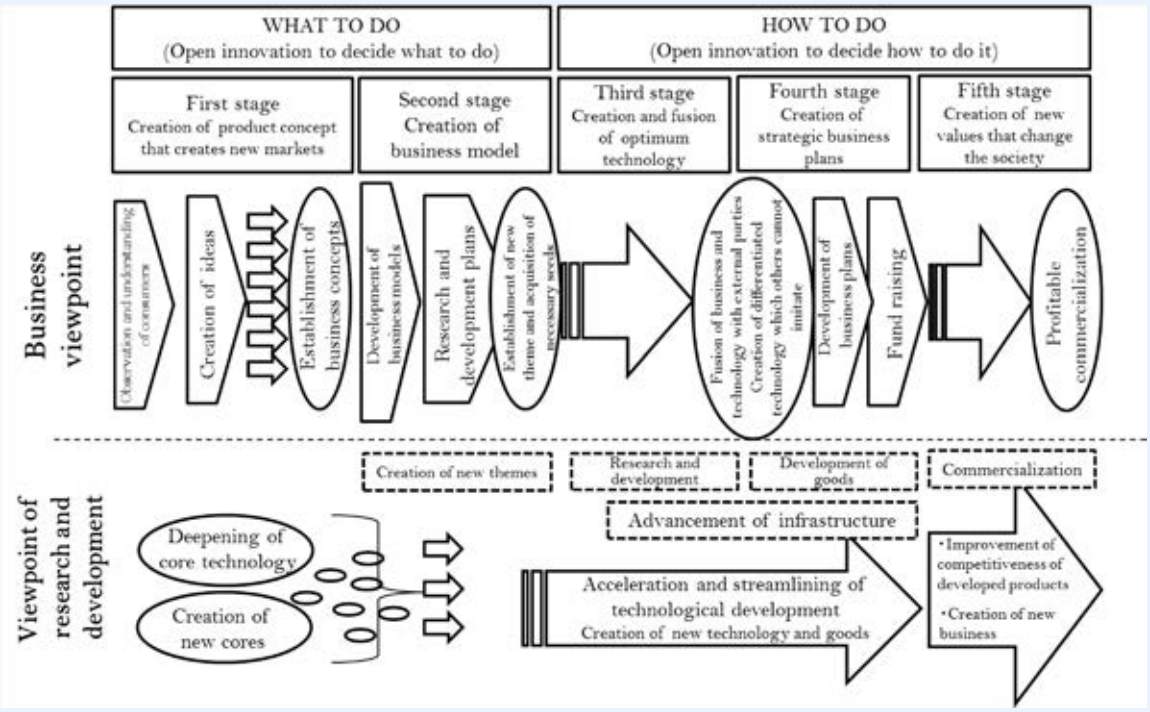
In Chapter 1 to the previous Chapter, the shortfall in various personnel that are necessary for open innovation has been dealt with. In this Subsection, the current situation and challenges of such shortfall in personnel shall be summarized and the direction for securing and cultivating such personnel shall be presented.

1 Small Business Innovation Research Program
2 MEXT 2014 "Survey analysis on the policy issue of promotion of Science for RE- designing Science, Technology and Innovation Policy, part (2) of the report, survey analysis on 'public procurement' that promotes innovation" (March 2015)

(1) Personnel necessary for open innovation

First of all, this Subsection will summarize the specific human resources involved, the way they exercise their abilities and the various roles they play in the promotion of open innovation while looking down on the overall flow. It should be noted that this summary is a schematic presentation of the overall flow based on relevant data and does not apply to every case. The overall flow of open innovation has two major flows, i.e., open innovation to decide what to do and open innovation to decide how to do it. Recently, the acceleration of the changes in the industrial structure has increased the opportunities where the importance of what to do comes into question instead of how to do at which Japanese companies. In deciding what to do, first of all, the product concept which creates a new market must be created by creating ideas based on the observation and understanding of consumers and establishing business concepts. Secondly, the business model shall be developed and establishment and planning of new themes of research and development that are necessary for realizing such business model shall be carried out by acquiring seeds from external parties. Thirdly, in order to achieve the objective, research and development of optimal technology shall be promoted based on the fusion with external business and technology with an aim to accelerate and streamline technology development and then fourthly, a strategic business plan in the market shall be drawn by developing specific business plans and raising funds for putting such plan into practice and promoting development of goods by using differentiated technology which has been created by research and development and which cannot be imitated by others. In the final stage, new values that change the society will be created by improving the competitiveness of the developed product, thereby leading to the creation of new business and profits (Figure 1-2-46).

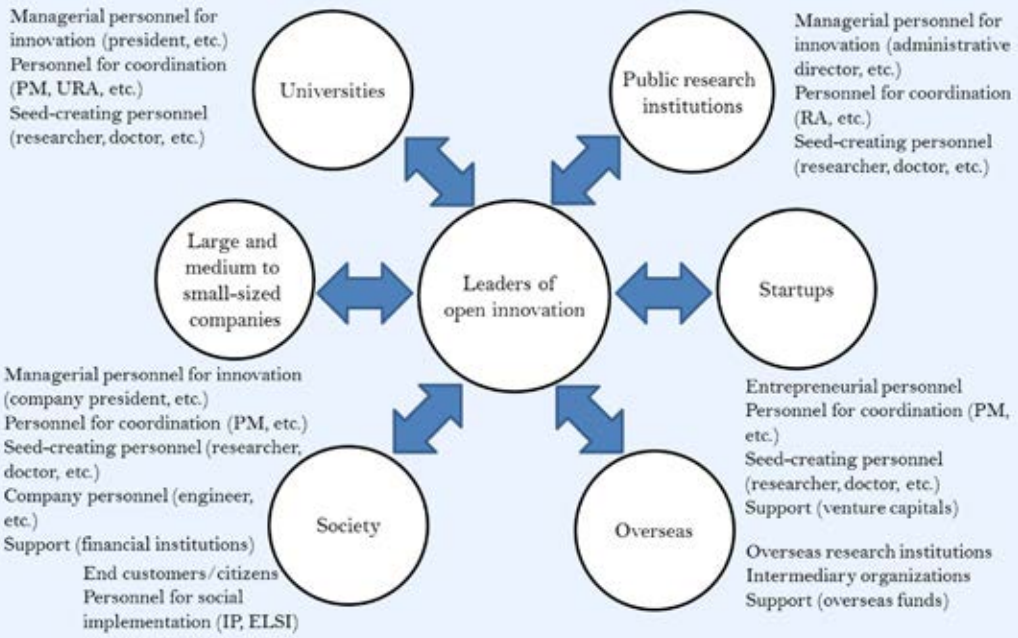
■Figure 1-2-46 / Overall flow of open innovation



Source: Created by MEXT based on Ninesigma Japan's "Materials of the Lecture Given by Mr. Takeshi Matsumoto at the Open Innovation Seminar Tokyo" (March 15, 2017)

Representative relevant organizations involved in open innovation consist of universities, public research institutions, large and medium to small-sized private companies, startups, society consisting of many citizens and overseas research institutions. It is important to create an environment where the personnel that belong to these relevant organization can recognize their roles and utilize their strengths or abilities to a maximum extent (Figure 1-2-47).

■Figure 1-2-47 / Personnel and various organizations involved in open innovation



Source: Created by MEXT based on Ninesigma Japan's "Materials of the Lecture Given by Mr. Takeshi Matsumoto at the Open Innovation Seminar Tokyo" March 15, 2017)

Taking into account the overall flow and relevant organizations shown above, we have attempted to summarize the abilities and roles of the personnel that produce open innovation based on the following seven types of personnel (Table 1-2-48).

① End customers and citizens

End customers and citizens widely involved in the society ranging from big cities to local areas are indispensable to clarify social needs through dialogues at the final stage of open innovation. They are also important parties in the fourth stage to state their valuable opinions on the prototypes created through innovation activities and reflect such opinions in the final product.

■Table 1-2-48 / Personnel map that produces open innovation

No.	Personnel	Flow of open innovation	First stage		Second stage	Third stage	Fourth stage		Fifth stage
			Creation of a product concept that creates new markets		Creation of business models	Creation and fusion of optimum technology	Development of strategic plan for commercialization		Creation of new values that change the society
1	End customers, citizens		Clarify social needs	-	-	-	Test the prototype and give opinions	-	-
2	Managerial personnel for innovation	Manager (innovation designer)	Develop the overall strategy		Develop the strategy for open innovation and create a business model	Adjust the seeds and demands and create new market opportunities	Create differentiated technology which others cannot imitate and develop a business plan	Confirm financial affairs and collect necessary resources	Implementation of business commercialization
3	Personnel for social implementation	Personnel for IP and ELSI	Share IP strategies, ethics and laws, etc.		Share the business model based on IP strategy, ethics and laws	-	Examine the IP strategy, ethics and laws	-	-
4	Entrepreneurial personnel		Develop the overall strategy		Develop the strategy for open innovation, create a business model and develop a research and development plan	Adjust the seeds and demands and create new market opportunities	Create differentiated technology which others cannot imitate and manage the business plan	Confirm financial affairs and collect necessary resources	Start up a business and implement business commercialization
5	Personnel for coordination	Program manager (PM)	Share the overall strategy		Share the business model and develop a research and development plan	Adjust the seeds and demands and create new market opportunities	Create differentiated technology which others cannot imitate and manage the research and development plan	Confirm financial affairs and collect necessary resources	Support productization
		URA			Develop plans and manage research plans	Implement analysis that is helpful for adjusting seeds and demands	Create differentiated technology which others cannot imitate and support the business plan	Manage financial affairs	-
6	Seed-creating personnel	Researchers (doctors, etc.)	Search and propose seeds based on demands	-	Share the business model and research and development plan	Create and realize creative ideas and differentiated technology which others cannot imitate by exercising advanced expertise		-	Support productization
7	Personnel of private companies	Engineering	-		-	Share new market opportunities by adjusting the seeds and demands	Establish the manufacturing technology and enhance the perfection level of the prototype	-	Put manufacture and sale on track and complete productization
		Marketing	Search seeds based on demands	Share the strategy	Share the business model and research and development plan	Share new market opportunities by adjusting the seeds and demands	Collect and reflect customer opinions	Share financial affairs	Collect customers opinions and reflect them in business commercialization

Source: Created by MEXT based on Ninesigma Japan's "Materials of the Lecture Given by Mr. Takeshi Matsumoto at the Open Innovation Seminar Tokyo" March 15, 2017)

② Managerial personnel for innovation

In coordinating the overall innovation, the role of the managers of relevant organizations including universities, public research institutions and private companies who have a viewpoint as an innovation designer is required. These personnel assume the role of developing the strategy of the overall innovation while looking at the final objective in the first stage. In the second stage, they assume the role of developing a strategy for open innovation and creating a business model which are necessary in producing new seeds such as open & closed strategy, management of intellectual property and social implementation. In the third stage, they share the method of creating new market opportunities while seeking consistency between seeds and demands. In the fourth stage, they assume the role of creating differentiated technologies which others cannot imitate through new cooperation or business plans, confirming the state of accounting and finance of the research and development system and collecting necessary resources. In particular, managers of private companies assume the role of seeking monetization of business with responsibility in the final fifth stage. In addition, an innovation designer refers to personnel who create innovation based on design thinking which creates new values.

③ Specialized personnel for putting innovation into application in society

In creating new innovations and examining the possibility of putting them into application in society, the roles of personnel who can make determination on the management of intellectual property that is indispensable for promoting cooperation with different organizations based on specialized knowledge and those of ELSI (Ethical, Legal and Social Issues) personnel who can make determinations from an ethical, legal and social perspective would be necessary. These personnel participate in the process of open innovation at its early stages such as the first and second stages and are expected to cooperate with the personnel who develop the strategy of overall innovation and business models from the standpoint of putting innovation into application in society. They are also assuming an important role in creating a commercialization strategy in the fourth stage.

④ Entrepreneurial personnel

As referred to in Chapter 1, the role of entrepreneurs who promote creation of swift and agile startups is necessary to respond to the rapid change in the industrial structure. These personnel are required to lead the monetization of business with responsibility after starting up a business while concurrently serving as the personnel who coordinate the managerial personnel and relevant organizations.

⑤ Coordinating personnel

In order to bring multiple relevant organizations together and fuse different knowledge, the role of a program manager (PM) who develops a research and development plan, promotes cooperation and leads the implementation of the plan beyond the walls of an organization is required. PM may assume the role as an industry-academia-government coordinator, and in universities, URA is expected to undertake such role. The major duties of URA are to support the activation of research activities of researchers and enhancement of research and development management by planning and managing research activities with researchers and utilizing and promoting the research results. Yet, they are also expected to assume the role of comprehensively managing research activities such as planning of research and development plans and

management of intellectual property by grasping the seeds within the university.

These personnel share the strategy of the overall innovation with the managerial personnel in the first stage and the business model in the second stage. They also assume the role of planning research and development plans through the coordination activities for promoting cooperation between the managerial personnel and researchers. In the third state, they create new market opportunities by matching the seeds and demands and then, in the fourth stage, they manage the research and development plan while creating differentiated technology which others cannot imitate and create business plans by promoting new cooperation through their coordination activities with external organizations. In the final fifth stage, they support product development through improvement of prototypes by incorporating the opinions of end customers. In particular, they are assuming an important role in seeking cooperation between relevant organizations and personnel in accordance with the research and development plan in the second to fourth stages.

Source: Japan Science and Technology Agency 2016 Application Guidelines for the "Program for Promotion of the Development and Active Participation of Program Managers (PMs)"

⑥ Seed-creating personnel

In creating seeds, especially doctors with advanced research abilities and rich knowledge among researchers are expected to play a big role. They are expected to search seeds and propose them after clarifying the demands in the first stage. In the second stage, they will share the business model and research and development plan with the PM. In the third stage, they are required to exercise their advanced expertise that would lead to the creation and realization of creative ideas and differentiated technology which others cannot imitate. In particular, they are required to actively promote fusion between different fields through exchanges with other fields in which they do not specialize with a wider perspective in the era of open innovation.

⑦ Company personnel

In finally developing business, company personnel who assume an important role in business such as engineering, marketing and accounting are essential. In terms of engineering, they assume the role of establishing the manufacturing technology, creating prototypes and ultimately finishing the product by improving the prototype based on the opinions and demands from end customers regarding the prototype. In the final fifth stage, they assume the role of completing the process of productization by putting the manufacture and quantity-production on track. In terms of marketing, they are required to clarify the demands in the first stage, then search for seeds and summarize and reflect the opinions and demands of the customers in the monetization of the business in the final fifth stage.

(2) Direction for securing and cultivating personnel that are necessary for open innovation

In this Subsection, the current challenges and direction of cultivating mainly the four types of personnel (i.e. managerial personal for innovation who coordinate the innovation as a whole, in addition to the coordinating personnel that would serve as a key person in interogranizational cooperation, entrepreneurial personnel indispensable for starting startups and personnel who creates seeds of innovation), who have been dealt with as scarce personnel in open innovation in the aforementioned parts, will be marshalled.

① Managerial personnel for innovation

(i) Managerial personnel for innovation of universities

According to the "Survey on the Current Situation and Future Prospects of Senior Executives of Universities" which was carried out to clarify the current situation of senior executives of universities (from February to March 2015, covering 3,996 senior executives of universities across the country, response rate: 24.4%), 26.0% of the respondents "highly agreed" and 52.2% of the respondents "rather agreed" to the opinion that senior executives should have "university management experts" who receive advanced and specialized training and development on the overall management of universities and can put it into practice as the perception of the future of university management. In addition, 49.6% of the respondents "highly agreed" and 41.5% of the respondents "rather agreed" to the opinion that the president (or administrative director) should exercise his/her leadership ability and arrange any conflict of opinions within the senior executives. Meanwhile, in terms of the training experience of senior executives, 3.1% of the respondents had the experience of receiving education or training for managers at the graduate school level (MBA (Master of Business Administration) and MPA (Master of Public Administration)) while 47.0% of the respondents had no special experience of receiving education or training on administration, operation and management (Figure 1-2-49).

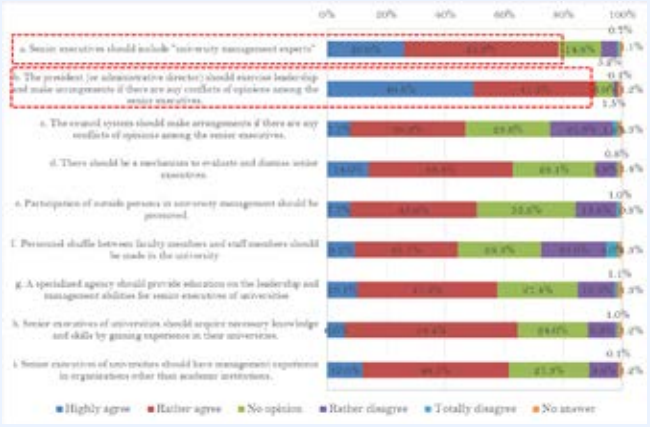
Amid the acceleration of the changes to the industrial structure, university management experts that have further advanced expertise and diversity are required as the managerial personnel of universities. Not to mention the cultivation of new managerial personnel but also recruitment of managerial personnel who also have achievements is effective for solving urgent problems. For example, managerial personnel who have achievements in private companies or non-governmental organizations outside the university could be valuable candidates.

As described above, in universities, the shortfall in the managerial personnel who have sufficient knowledge and know-how for operation of the organization and facilities, etc. for creating innovation is raised as one of the challenges.[1] According to a survey carried out by the MEXT, it is suggested that an innovation management system which is necessary for effectively utilizing the enormous research and management resources held by universities has not been sufficiently established, resulting in valuable research and management resources being buried and difficulty in creating innovations.

1 MEXT "Primary Recommendations on Approaches to the Management of University Intellectual Property for Innovation" (August 5, 2015)

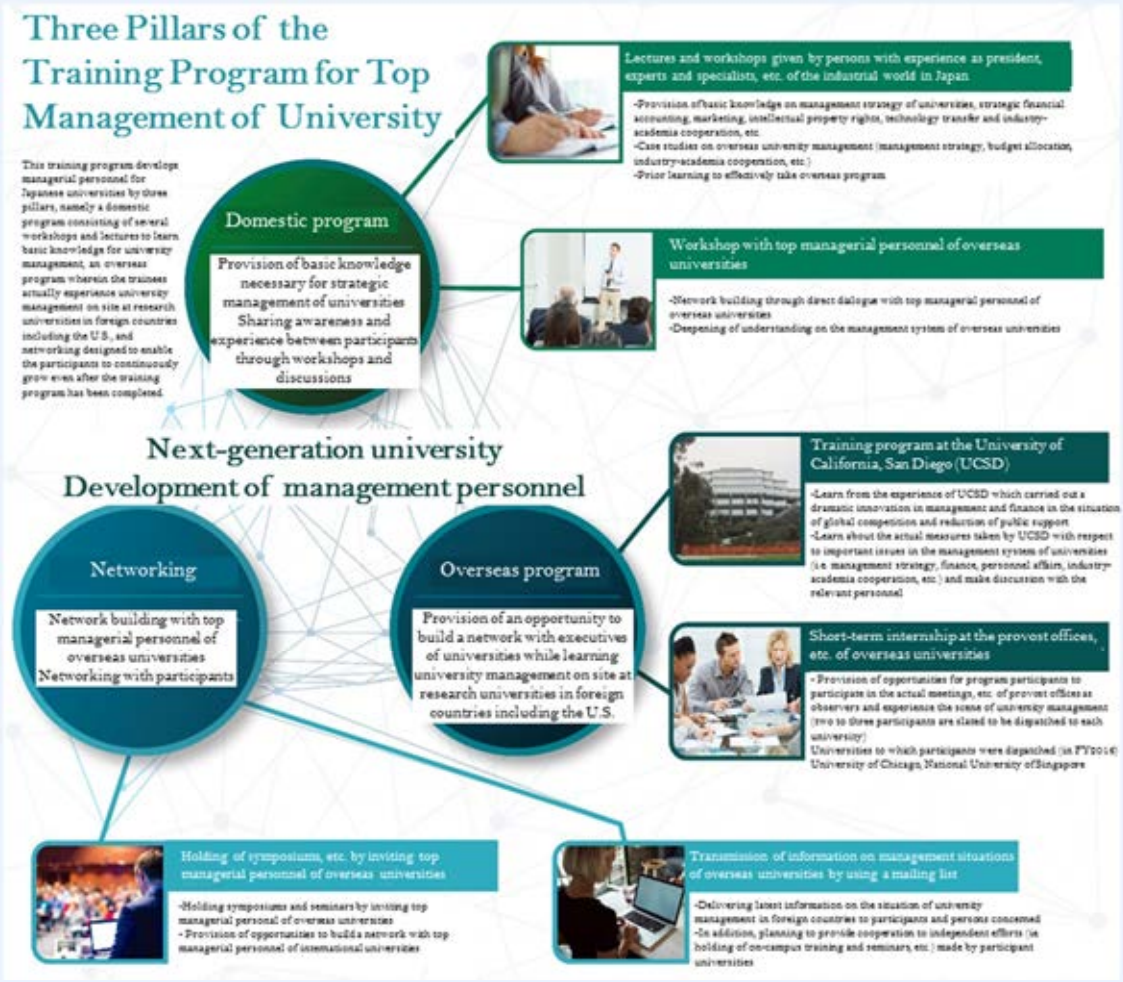
As such, MEXT is offering the "Training Program for Top Management of University" at GRIPS under the "Project for Building a System for Cultivating Managerial Personnel for Innovation." The training program offers a domestic program wherein future executive candidates of universities gain knowledge required of the top management of universities and an overseas training opportunity where the trainees learn on site about the university management system of the U.S. which is under a substantial change under global competition. In addition, MEXT is also building a network which enables the participants to continuously exchange information even after the training program has ended. As of September FY2016, a total of 24 persons including the current and next executives attended this program. This kind of program focused on university management is valuable and could be an effective measure for cultivating managerial personnel for the university in the future (Figure 1-2-50).

■Figure 1-2-49 / Perception the Future of University Management and Training Experience of Senior Executives



Source: The University of Tokyo "Survey on the Current Situation and Future Perspective of Senior Executives of Universities" (March 2016)

■Figure 1-2-50 / Training Program for Top Management of University



Material: Provided by GRIPS (March 22, 2017)

(ii) Managerial personnel for innovation in companies

The industrial field is requiring managerial personnel who can probe the changing times, point the direction for the company with boldness and determination and take the initiative and act in the environmental changes of rapid digitization, advancement of globalization, rise of emerging countries, emergence of competing companies from other industries and diversified customer needs.

To explode the accepted myth that "No innovations spring up from large companies," METI established the "Innovation 100 Committee" consisting of the managers of large companies of Japan who are involved in pioneering measures in relation to innovation and has compiled a report on the appropriate way of managing large companies, etc. Up to now, the Committee has presented a common understanding of the sponsors such that "Active commitment of managers is indispensable for springing up innovation" and has compiled a course of action required of managerial personnel for global companies to continuously create innovation, through interviews with 17 managers (members) who intend to promote innovation and achieve innovative changes[1] (Table 1-2-51).

1 Japan Innovation Network, METI, WiL LLC "Innovation 100 Committee" (February 26, 2017)

■Table 1-2-51 / Course of action for managerial personnel of companies to spring up innovation

No.	Challenges that hinder innovation	Course of action
1	Stuck in the past model for success.	Ascertain the change and transmit and push through the vision of innovative changes.
2	Too much focus on short-term performances of existing business.	Realize two-layered management based on efficiency and creativeness.
3	Incapable of grasping the essential needs of customers.	Build a mechanism to create business based on values.
4	Every local idea is denied.	Establish an environment where members can fully conduct trial and error processes.
5	Too much persistence regarding internal resources.	Promote cooperation beyond the walls in and outside the organization.

Source: Japan Innovation Network, METI, WiL LLC "Innovation 100 Committee" (February 26, 2017)

② Entrepreneurial personal

As stated in Chapter 1, currently, the ratio of entrepreneurs and expected entrepreneurs of Japan is hovering around the lowest position among developed countries and is slumping in comparison to other countries. On the other hand, the number of startups listed in Japan is increasing little by little, and, in fact, some startups have created products that lead to the solution of global social challenges using research results of universities and are expanding their sales through cooperation with large companies. It is necessary to clarify the direction of challenges and responses and continuously work without overemphasizing the negative side of the current situation.

(i) Exploration and Development of Global Entrepreneurship for NEXT generation

In order to cultivate entrepreneurial personnel of Japan, MEXT is implementing the Enhancing Development of Global Entrepreneur Program (EDGE Program) to assist the initiatives of 13 universities across the country with an aim to establish startups based on the research and development results of universities, cultivate personnel that create new business at existing companies and build a startup ecosystem. In fact, an entrepreneur cultivation program utilizing Project Based Learning (PBL) has been introduced to a certain degree and has received certain evaluations from industrial associations (Table 1-2-52).

■Table 1-2-52 / Operation and outcome of the EDGE Program

Operation and outcome of the EDGE Program

○MEXT established a council consisting of external experts in operating the EDGE Program. The progress of the program is managed by frequently paying site visits to each university and exchanging opinions, every year.
○The number of entrepreneurial personnel is increasing thanks to the EDGE Program. Students with strong interest in starting up a business are taking interest in the program and are increasing their interests in taking actions.
○Companies and student entrepreneurs, etc. have collected capital in an amount of more than 100 million yen though only two years have passed from the commencement of the program.
○Increase in the ratio of participants with no clear interest in starting up a business and increase in the number of startup activities by persons who actually intend to make a startup are the major challenges.

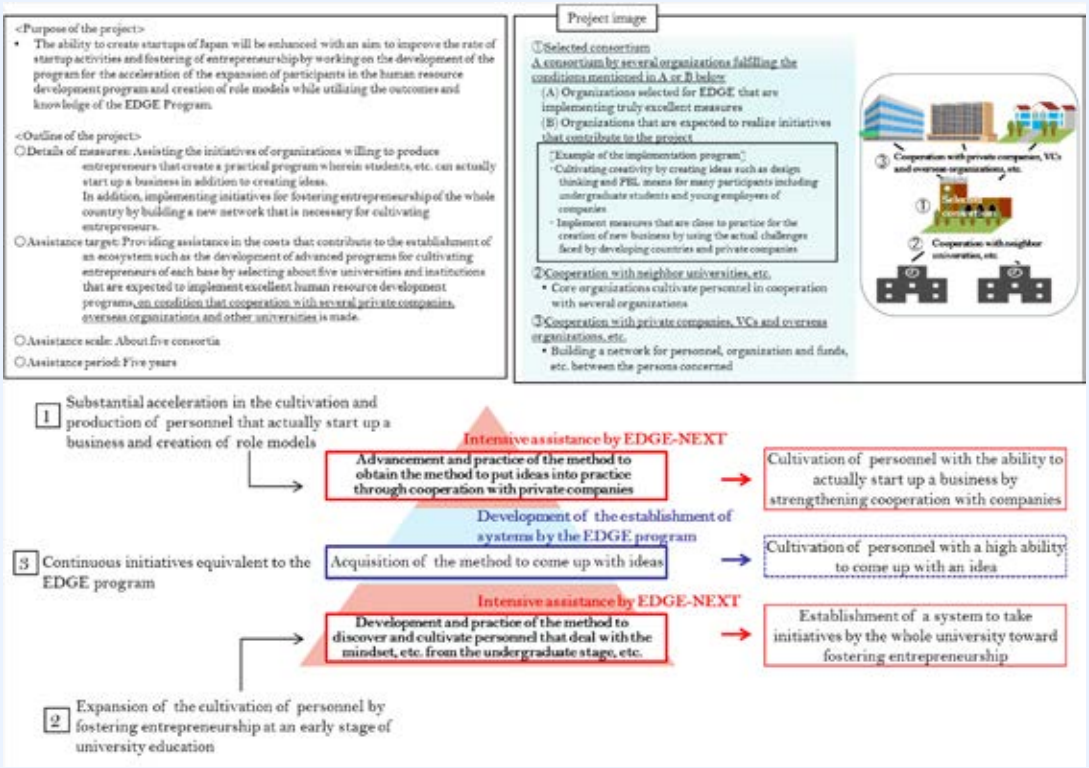
Indicator	FY2015 [FY2014]
Total number of participants	2,899 [1,315]
External participants	818 [444]
Amount of external funds	41,630,000 yen [11,920,00 yen]
Number of startups created	28*
Number of participations in business contests, etc.	More than 100*

*Cumulative total from FY2014

Source: MEXT "Exploration and Development of Global Entrepreneurship for NEXT generation -Promotion of Growth Strategy" (November 12, 2016)

However, the actual number of startups is hovering in comparison to other countries and thus the Exploration and Development of Global Entrepreneurship for NEXT generation (EDGE-NEXT) is promoted to seek significant acceleration in the cultivation and production of entrepreneurial personnel and creation of role models and cultivation of personnel by fostering entrepreneurs from an early stage in university education. Specifically, it is assisting programs with more practical contents that increase the participants' willingness towards startups by implementing a program focused on the creation of new ideas for undergraduate students, graduate students with expertise and young researchers and development of business models. Especially, through cooperation with organizations related to startups, overseas organizations and private companies, cultivation of personnel that leads to the building of a role model in the cultivation of entrepreneurs and enhancement of the ability to create startups in Japan is promoted by building a personnel and organizational network and focusing on the efforts that lead to the global network (Figure 1-2-53).

■Figure 1-2-53 / Exploration and Development of Global Entrepreneurship for NEXT generation (EDGE-NEXT)



Source: Created by MEXT (February 27, 2017)

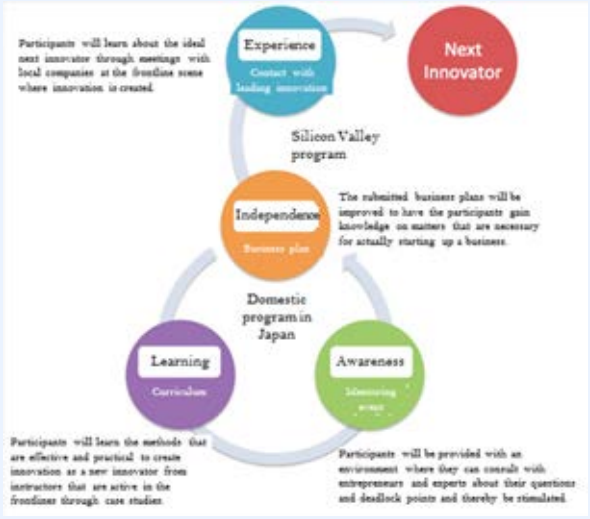
(ii) Sido Next Innovator 2016 (Program for cultivating global entrepreneurs, etc.)

METI is dispatching 20 persons including entrepreneurs or persons in charge of new projects in large companies that have been selected from across the country for the purpose of cultivating personnel that create innovations in the next generation and to create a connection with Silicon Valley as one of the projects of the "Project for a Bridge of Innovation between Silicon Valley and Japan" which was announced by Prime Minister Shinzo Abe at Silicon Valley, U.S. on April 30, 2015. In fact, METI is implementing a

program wherein participants are dispatched to Silicon Valley and cultivated as key persons of innovation through exchange with local investors.

232 applications were filed from across the country for "Sido Next Innovator 2016," and 126 persons including entrepreneurs and persons in charge of new projects in large companies that passed the first selection participated in the domestic program for six months. In the domestic program, participants improved their business plans through mentoring by experts while gaining knowledge through practical lectures and work on actions and the mindset that would be an important key for future innovators that are essential for creating new business. Then, the 20 members to be dispatched to Silicon Valley were decided in the second selection by a review board consisting of the lecturers and mentors of the domestic program, the executive secretariat and METI which reviewed, in a strict sense, factors including the innovativeness of the business plan and social impact. In January 2017, they stayed in Silicon Valley for about two weeks and gained the mindset and skills necessary for creating innovation of the next generation through practice at a frontline site by giving presentations on their business plans in front of local investors and entrepreneurs, etc.[1] (Figure 1-2-54).

■Figure 1-2-54 / Sido Next Innovator 2016



Source: Secretariat of Sido Next Innovator 2016

(iii) Support through public and private cooperation for entrepreneurial personnel who travel to gain skills

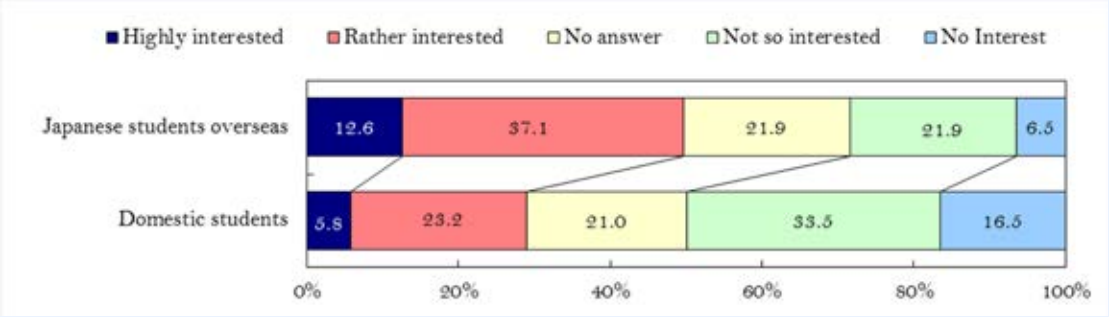
According to the results of a survey on the career consciousness and job-hunting situation of student overseas, when both student overseas and domestic students were asked about their intention of finding a job in a startup, nearly half of the student overseas were interested in being employed by a startup (12.6% of them were "highly interested" and 37.1% of them were "rather interested). Meanwhile, domestic students had low interests (only 5.8% of them were "highly interested" and 23.3% of them were "rather interested"), showing that the group of interested students is limited. There is a trend that the experience of studying abroad has some influence on the intention for starting up business. (Figure 1-2-55).

It is considered effective to thoroughly support students and young researchers in the process from studying at overseas universities, etc. to the challenge of starting up a business after being dispatched through cooperation between private organizations and Japanese core universities for cultivating entrepreneurs (universities participating in EDGE-NEXT), in the future. MEXT is examining the possibility of establishing a system for providing support. Such support is to be made by providing the opportunity to participate in the program for cultivating entrepreneurs offered by overseas leading universities through dispatch based on the assistance of private companies and organizations, prior training

1 METI "Sido Next Innovator 2016 (Program for cultivating global entrepreneurs, etc.)" (January 13, 2017)

programs at national universities, etc. and assistance for starting up a business after returning to Japan. MEXT is also examining the possibility of developing a system that continuously produces personnel with high willingness to start up business across the country based on students that have travelled and improved their skills or supporting companies or organizations.[1]

■Figure 1-2-55 / Degree of interests in being employed by startups



Source: DISCO Inc. "Survey on the career consciousness and job-hunting situation of student overseas" (published in April 2017)

③ Coordinating personnel

Open innovation requires personnel who can coordinate research and development so that researchers can carry out joint research beyond the walls of organizations to fuse knowledge in different fields. The role of research coordinator who analyzes the competitiveness of the relevant persons and constantly considers strategy based on the weighting of patents, personnel to be gathered and technologies to be combined based on an understanding of the characteristics of each expert is considered important.[2]

At the Council for Industrial Competitiveness, the necessity to enhance open innovation consisting of industry-academia-government collaboration through enhanced creativity of innovative technical seeds and the function of "bridging" that leads these technical seeds to prompt commercialization by private companies has been pointed out. Cultivation of PM necessary for realizing innovation and formation of career tracks are raised as urgent challenges for enhancing this role of bridging. In addition, promotion of measures to cultivate and secure various personnel such as PMs that plan and manage research and development projects is included in the fifth basic plan.[3]

In addition, at the Council on Industrial Competitiveness-Nippon, challenges in the initiatives for mid-to-long term internships were found and it was suggested that the following measures be taken by universities to enforce the function linking industry and academia to solve such challenges: establishment of an environment where companies, students and faculty members can participate in mid-to-long term internship programs with security by enhancing the coordination function of the industry-academia collaborative organization and the cooperation between the teaching advisor and the secretariat. It has also suggested the necessity to promote the cultivation of personnel for industry-academia collaborative organizations, assistance organizations such as URA and research supporters in addition to researchers as

1 MEXT, Open Innovation Co-creation Congress (third meeting) "Summary of the past examination items" (March 16, 2017)
2 MEXT, Open Innovation Co-creation Congress (second meeting) "Challenges in accelerating the growing of the size of joint researches from the industrial world" (February 24, 2017)
3 Japan Science and Technology Agency "Program for promoting cultivation and active participation of program managers (PM)" (2016 application guidelines)

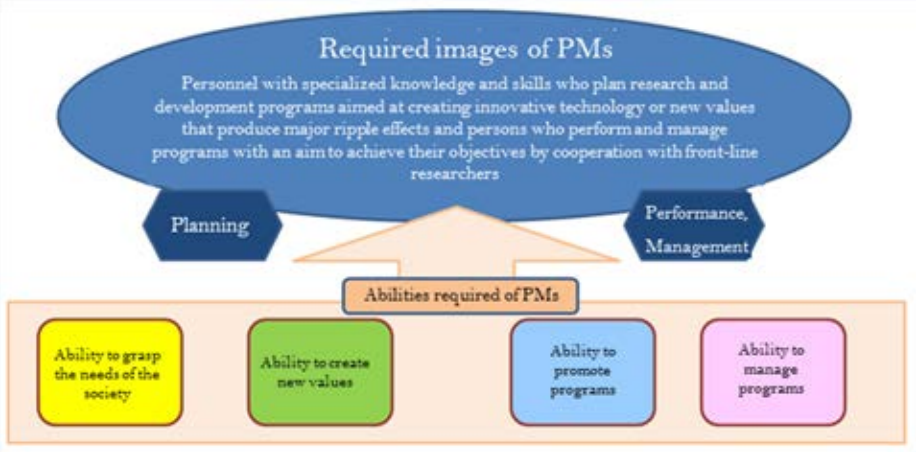
a result of placing focus on the establishment of an environment where the best researchers of universities or public research institutions can concentrate on research activities and summarizing the preceding measures taken by organizations.[1] The current situation of quantitative and qualitative shortfall in URA is as shown in Subsection 1(1), Section 1 of this Chapter.

(i) Measures for securing and cultivating PMs

JST has established a "Program for Promoting Cultivation and Active Participation of PMs" to cultivate PMs in FY2015 and is promoting their cultivation. While there is no established image of PMs, their main activities, target, required image and abilities expected in the PM cultivation program are as stated below (Figure 1-2-56).

■Figure 1-2-56 / Activities, targets, required image and abilities expected in the PM cultivation program

Activities	・Discovery of innovative technology seeds ・Shaping and planning the method to realize an outcome that produces a major ripple effect ・Growing technology seeds for solving challenges ・Mobilizing appropriate personnel with specialized knowledge and skills necessary for implementing programs and performance and management of plans
Targets	・Companies: Persons with the experience of planning new products or business or engaging in research and development ・Universities/research institutions, etc.: Persons with the experience of URA or engaging in a business equivalent to URA or research and development activities ・Domestic funding organizations, etc.: Persons with the experience of taking charge of research and development programs



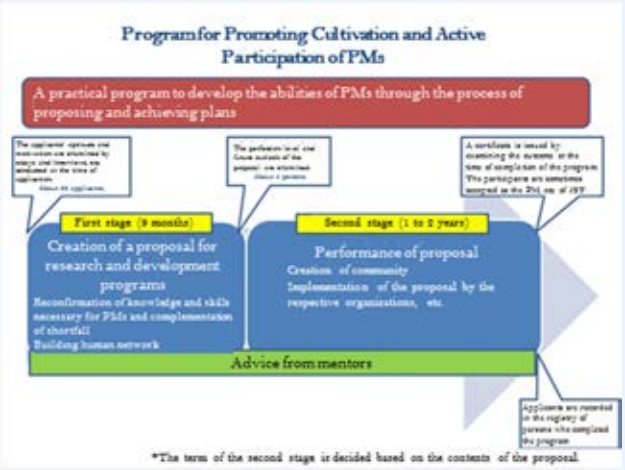
Source: Japan Science and Technology Agency "FY2016 Application Guidelines for the Program for Promoting Cultivation and Active Participation of Program Managers (PMs)

The cultivation program consists of two stages, i.e. first stage and second stage. In the program, participants acquire the abilities necessary for PMs by expanding their human network with the researchers, etc. of universities, research institutions and companies while acquiring the knowledge and skills necessary for PMs through the process from planning research and development programs to the partial performance thereof in two stages (Figure 1-2-57).

1 Council on Competitiveness-Nippon (COCN) "Cultivation of personnel for creation of innovation" (March 13, 2013)

The "Impulse Paradigm Change Through Disruptive Technologies Program" (hereinafter referred to as "ImPACT") promoted by the Cabinet Office is engaged in the establishment and performance of the system to support the activities of PMs. It is working to achieve an outcome by actually performing the program. As a similar measure, the programs directors (PD), sub-program directors (sub PDs) and innovation strategy coordinator (Strategy Cs) of the Cross-ministerial Strategic Innovation Promotion Program (hereinafter referred to as "SIP") promoted by the Cabinet Office and the project leaders (PLs) of or from companies in the Center of Innovation Program promoted by the Japan Science and Technology Agency or the Research Leaders (RLs) that belong to research institutions including universities are playing a key role in each program and are promoting research and development activities. These activities are expected to show a behavior model to the industry segments of Japan to work on open innovation.[1][2]

■Figure 1-2-57 / Program for Promoting Cultivation and Active Participation of PMs

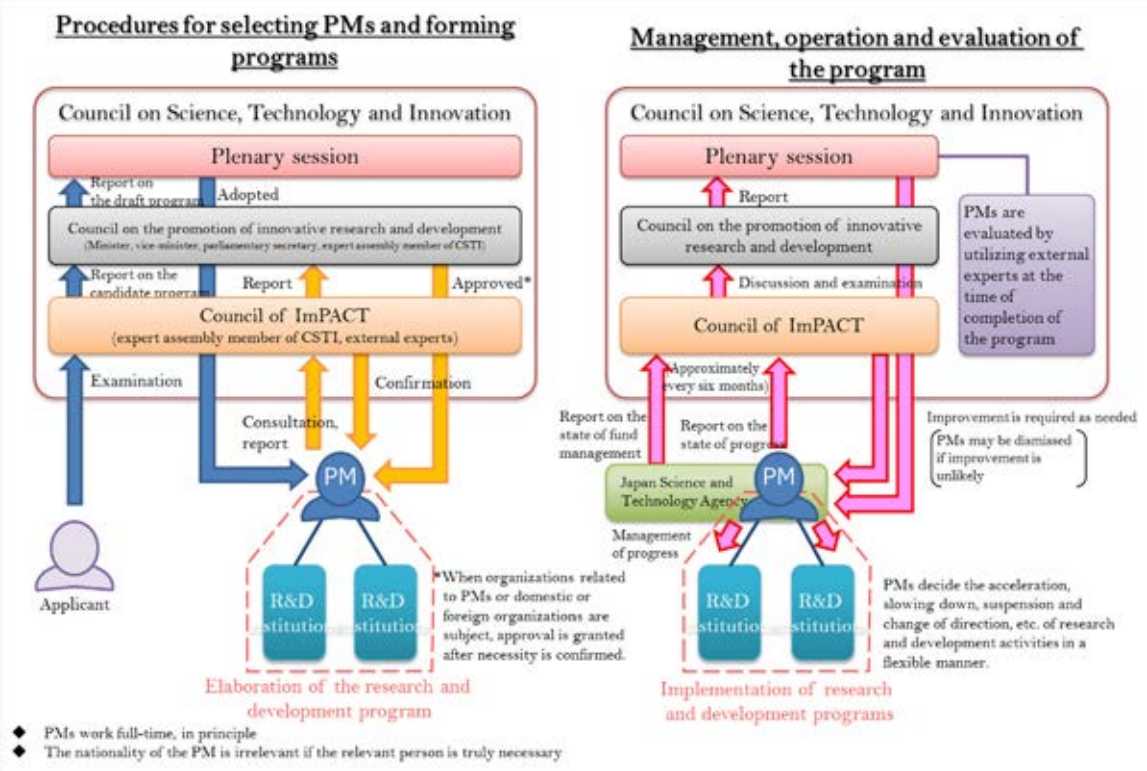


Source: Japan Science and Technology Agency "FY2016 Application Guidelines for the Program for Promoting Cultivation and Active Participation of Project Managers (PMs)"

In particular, PMs of ImPACT are selected by the Council for Science, Technology and Innovation, granted great authority and are engaged in the planning, implementation and management of research and development programs by casting researchers as producers. Personnel for PMs are cultivated through practices by delegating greater authority to PMs and promoting challenging research and development activities with high risk and high impact (Figure 1-2-58).

1 Cabinet Office "Application guidelines for program managers under the Impulse Paradigm Change Through Disruptive Technologies Program (ImPACT)" (April 2015)
2 Cabinet Office "Operational guidelines for the strategic innovation creation program" (revised on March 31, 2016)

■Figure 1-2-58 / Research and development program with the PM system



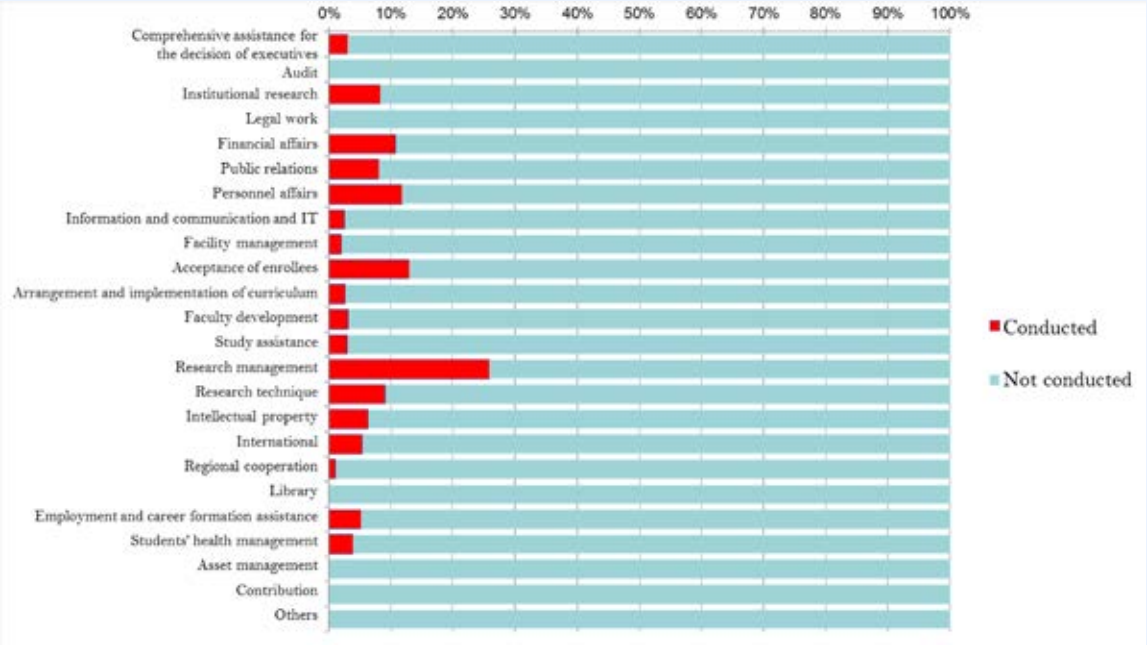
Source: Cabinet Office "Application guidelines for program managers under the Impulse Paradigm Change Through Disruptive Technologies Program (ImPACT)" (April 2015)

(ii) Measures for securing and cultivating URAs

As shown in Subsection 1(1), Section 1 of this Chapter, universities have quantitative and qualitative shortfalls with respect to URAs and thus it is necessary to establish a mechanism wherein universities can secure employment with safeness. Moreover, not only is it important to simply secure financial resources for employment but also it is essential that appropriate personnel evaluation according to the contents of the business be carried out by clearly establishing the position of the URAs, etc. in the organization as professionals. However, according to a survey carried out by MEXT, the ratio of organizations that "Do not conduct" evaluation focused on professional staff members was high in any job and the same evaluation method used for general administrative staffs and faculty members seems to be used rather than a personnel evaluation according to professional staff members (Figure 1-2-59).

In order to solve the quantitative and qualitative shortfalls in URAs, etc., it is necessary to clarify the career track of URAs, etc. and attract talents by securing safe employment and offering appropriate treatment.

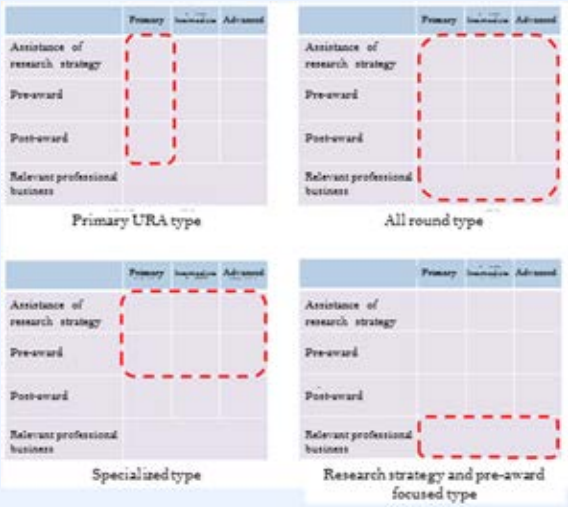
■Figure 1-2-59 / State of Implementation of Evaluation According to the Job Type of the Professional Staff Members of Universities



Source: Survey commissioned by MEXT "Report on the survey on the actual state of utilization of professional staff members at universities" (November 2015)

MEXT started to operate a project for "Development of a System to Cultivate and Secure Research Administrators" in FY2011, with an aim to develop an environment for activation of the research activities of researchers, enhance the system to promote research activities through strengthening of research and development management and diversify the career track of persons engaged in science and technology so as to introduce and establish the position of URAs in universities as a job category with high expertise. Since FY2013, MEXT has also started to operate the "Project for promotion of enhancement of research universities" and is promoting the employment, cultivation and utilization of URAs at the selected university institutions.[1][2]

■ Figure 1-2-60 / Variation in job characteristics



Source: The University of Tokyo "Standard for URA skills" (March 31, 2014)

In FY2013, the required functions and duties as well as the abilities required of URAs were analyzed and examined based on the actual state of research activities in universities under the cooperation between the University of Tokyo

1 Makiko Takahashi "General theory, what are research administrators?" (FY2013)
2 MEXT "Establishment of a system to cultivate and secure research administrators –application guidelines" (February 2012)

and RU11 to compile the skill standards related to URA. The skill standards consist of a total of 22 duties, the breakdown of which is 13 general duties obtained by classifying duties into three categories in chronological order and 9 duties including technology transfer, international cooperation and cooperation with the education, etc. that would be necessary for each project or organization. It can be utilized for grasping the actual state of the URA personnel of each university, establishment of the objectives, evaluation of the education, employment and the skills of the URAs themselves.[1]

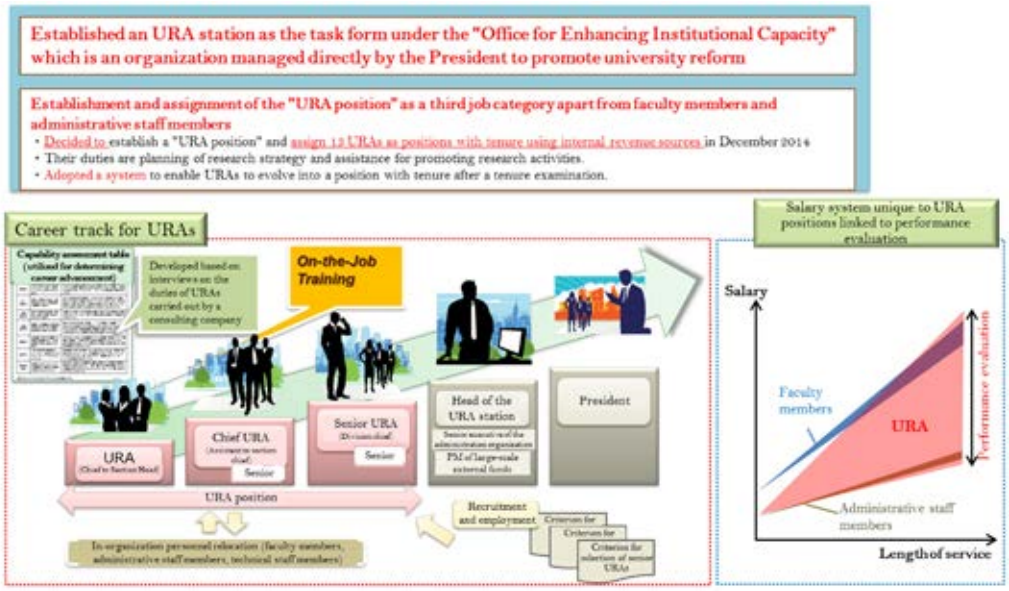
In applying the skill standards, the allocation of the job characteristics of URAs such as the mission of URAs and place for establishment of the URA organization before the adoption of the project (pre-award) and after the adoption (post-award) differs for each university and thus, the function of URAs is categorized based on the job characteristics (Figure 1-2-60).

The skill standards are a package for the system of common knowledge and skill and is expected to appropriately be used according to the organizational structure and job sharing at each university. In fact, some universities are taking measures to clearly define the position of URAs in the organization as a professional job category, resulting in the establishment of a network between universities. It is further expected in the future that a network according to each category will be activated and measures/efforts for establishment of professional works will be autonomously implemented based on a network organization.[2]

1 The University of Tokyo "Establishment of a system to cultivate and secure research administrators (creation of skill standards)" (May 2014)
2 Council for Advancing Structural Reform, materials of MEXT "Examination for enhancement of the ability to create innovations" (February 23, 2017)

Case Study 10 Hokkaido University

At Hokkaido University, the "URA station" was established under the Creative Research Institution which is a university-wide organization for planning cross-departmental research system, in 2012. Since the "URA station" has been located under the "Office for Enhancing Institutional Capacity" which is an organization operated directly under the President to promote university reform in 2015, URA has been developed into managerial personnel for universities who are as important as researchers in the university activities in the society from the framework of personnel in charge of assisting researchers to reduce the burden of each researcher. In fact, in December 2014, apart from faculty members and administrative staff members, the position of "URA" was established and assigned as a third job category with the mission of establishing and reforming a university-wide system to maximize the functions of the organization and it has also been decided to assign 13 URAs as "positions with tenure" by using internal revenue sources. The university has also independently prepared a capability assessment table based on the interviews on URA work conducted by a consulting company and has clarified the career track to become senior management in the university by applying a salary system specific to URAs that is linked to their performance.

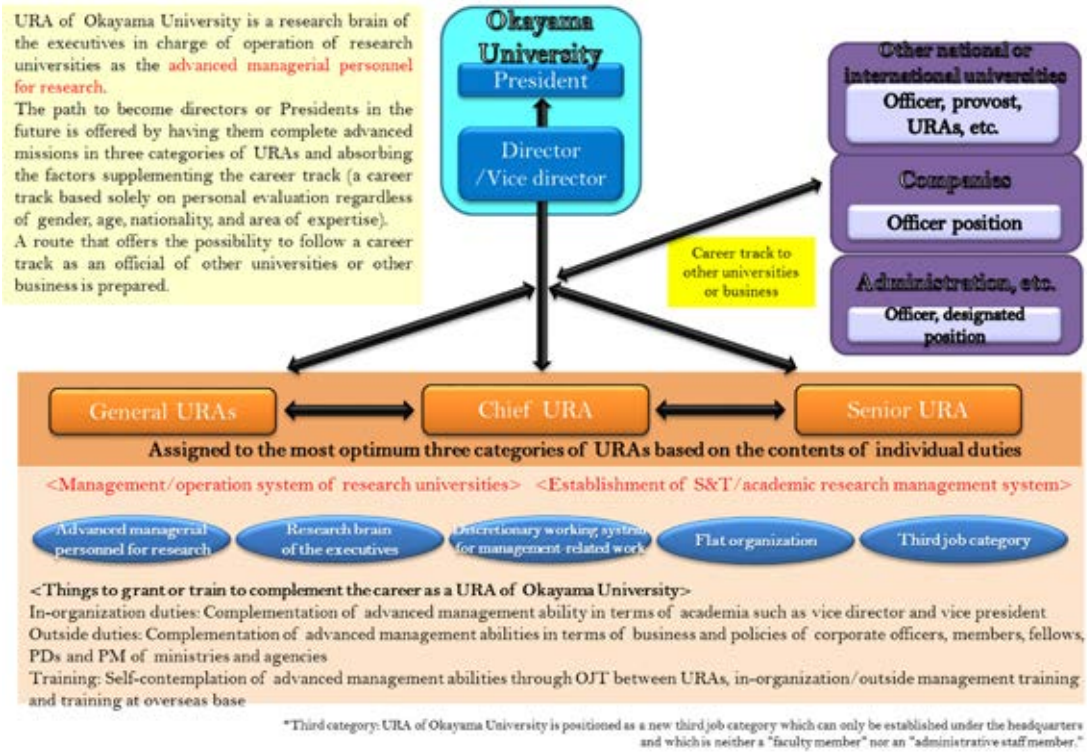


Source: Hokkaido University "Function of URA Station under the Office for Enhancing Institutional Capacity" FY2016

Case Study 11 Okayama University

At Okayama university, URAs have been positioned directly under the control of the President to serve as the research brain organization of the administration to act together with the administration officer in charge of research and the vice president. They are treated as advanced managerial personnel for research activities that carry out operation and management of universities in terms of research activities instead of support personnel for research assistance. In particular, they represent the university in terms of research and are assigned to the position of a manager of research activities who respond in an "interorganizational manner" based on the management decisions with respect to each industry-academia-government organization. The position of URAs has been administered by using the internal funds of the university at the time of their establishment and every rule has been established for URAs as a third job category. In addition, the number of URAs has been increased to match the scale of the organization or financial resources of the university by adopting the "project for promoting enhancement of research universities" and utilizing the business funds. It instantaneously adopted a "discretionary working system for management-related work" as a working form and established a system where URAs can work in a flexible manner. In addition, URA is a flat organization with no hierarchical relationships. As for the evaluation system, the university has established evaluation rules specific to URAs and has also presented a career track to join the executives such as an officer by focusing on the evaluation after employment and enabling promotion and pay raises on a timely basis regardless of the length of terms of office if high evaluation is obtained.

Several vice directors have already been promoted and are widely involved in university management including not only research fields but also the fields of planning, evaluation and general affairs that constitute the core of university management. In addition, Okayama university can be characterized by establishing a mechanism wherein promotion to executives including officers is not a "career track to senior management with a view to cultivating general URAs from young persons into officers while compiling their career tracks. In fact, one of the general URAs has been promoted to vice director.



Source: Website of Okayama University Research Administration Office

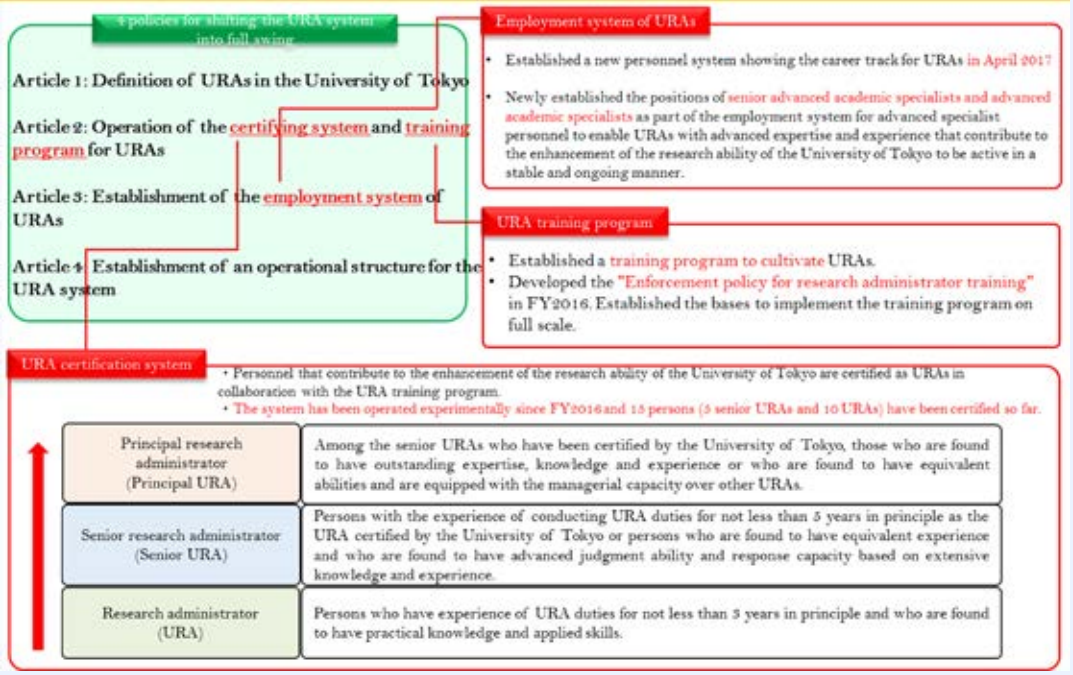
Case Study 12 The University of Tokyo

On September 29, 2016, the University of Tokyo developed an "Enforcement policy for the research administrator system of the University of Tokyo" to enhance the research ability of the university and qualitatively improve its research activities based on the "Basic policy for the research administrator system of the University of Tokyo" (established in March 2014) (Fig. 1-2-61).

In addition, the university enacted the "Regulations on Senior Advanced Academic Specialists and Advanced Academic Specialists of the University of Tokyo" as the rules prescribing the new personnel system for full-time faculty and administrative staff members that would show the career track for URAs on September 29, 2016, while introducing a new system for certifying URAs and a training program therefor, and has started operating such systems from FY2017.

Fig. 1-2-61 / Enforcement policy for the URA system of the University of Tokyo

Definition of URAs	URA refers to a person who has the ability to take the initiative in carrying out the following duties with advanced expertise with an aim to widely promote various activities related to the academic research of the University of Tokyo which is a university and to advance academic research in a stable and constant manner.	
	①	Duties to carry out surveys, analysis and planning in relation to academic research on campus.
	②	Duties to carry out surveys, planning, internal and external negotiations and filing of applications for acquiring research funds.
	③	Duties to carry out management, administration, evaluation, internal and external negotiations and reports in relation to research after acquiring research funds.
	④	Other duties related to the duties set forth in the preceding items.
Certifying and training URAs	Under the definition prescribed in the preceding Article, the relevant person undergoes an appropriate examination and is certified as the URA of the University of Tokyo according to his/her abilities.	
Employment environment of URAs	An employment system for advanced specialist personnel will be established to enable URAs with advanced expertise and experience, etc. that contribute to the enhancement of the research ability of the University of Tokyo to be active in a stable and ongoing manner.	
Operational structure of the URA system	The headquarters and departments cooperate regarding the effective participation of URAs in the research activities on campus and an organizational structure for strategic and systematic utilization of URAs will be established.	



Source: The University of Tokyo "Enforcement policy for the URA system" (decided by the board of directors on September 29, 2016)

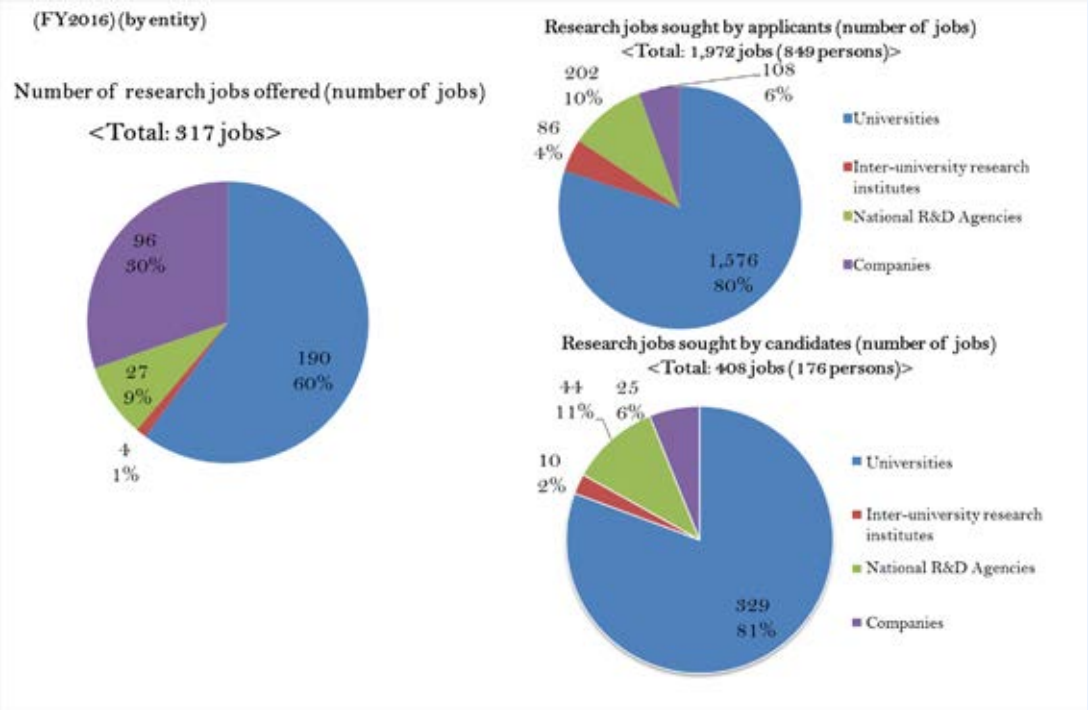
④Seeds-creating personnel

Chapter 1 indicated that while researchers, in particular, doctorate holders with advanced research abilities and abundant knowledge, are expected to take the lead in creating seeds, the number of such doctorate holders engaging in research activities in Japan is smaller than in other countries. In addition, the mobility of human resources has been stagnant over the past ten years in Japan, showing that the number of researchers who moved from universities and national R&D agencies to private companies has been small.

Under such circumstances, in order to create a stable and independent research environment for young researchers at industrial, academic, and government research institutions, MEXT launched the Leading Initiative for Excellent Young Researchers in FY2016. Among young researchers including postdoctoral fellows who applied for research grants in the first fiscal year of the initiative, most researchers wished to engage in research at universities, and only a relatively small number of them wished to move to different sectors (Figure 1-2-62). In fact, while fields such as machinery, electrics, and information technology continued to see a high demand for research personnel among companies, a large number of researchers were engaged in fields where the demand for research personnel is not very high. Thus, the needs for human resources in industry do not match well with the products of higher education (Figure 1-2-63).

In order to encourage doctorate holders to play an active role in diverse spheres of society as human resources who are expected to take the lead in creating seeds, industry and academia should make joint efforts to present various career paths to doctorate holders, and take measures to enhance their understanding of the connection of science and technology to society and industry through industry-academia collaborative research.

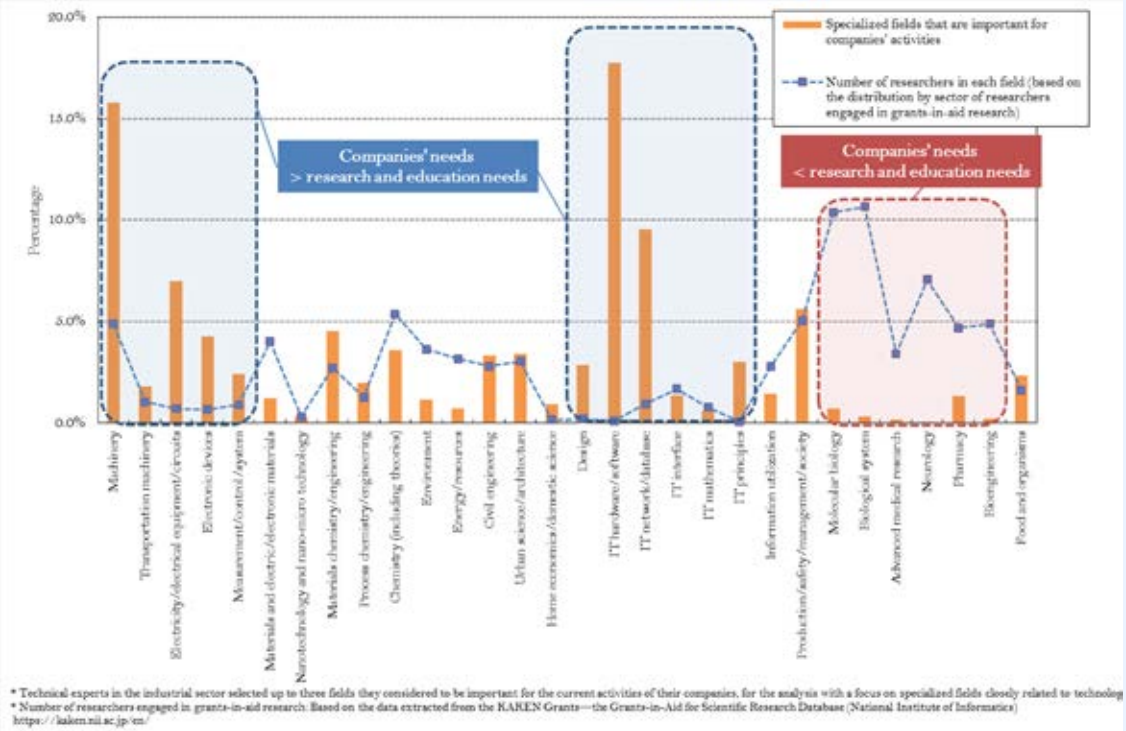
■ Figure 1-2-62 / Comparison between research jobs offered by research entities and those sought by applicants under the Leading Initiative for Excellent Young Researchers



* The data of the number of research jobs sought is collected by asking the applicants or candidates about the research jobs: up to three jobs, for which they would negotiate with the research entities individually if they were selected as excellent young researchers, and adding up the results (gross total). The graphs of "Research jobs sought (number of jobs)" show the number of research jobs under negotiation, by entity.

Source: Council for Science and Technology, Committee on Human Resources, *Encouraging Doctorate Holders to Play an Active Role in a Variety of Sectors* (January 16, 2017)

■ Figure 1-2-63 / Specialized fields that are important in companies' current activities, and their views on university education in these fields



Source: METI, *Survey Results on the Demand in Industry* (February 10, 2017)

While universities are expected to promote the assignment of mentors and coordinators who are capable of providing advice on career development, with the use of the leading initiatives such as the mid to long-term research internships and the Program for Leading Graduate Schools, industries should make efforts to cultivate and secure research personnel by reviewing the recruitment, assignment and treatment of doctorate holders, after identifying the capabilities of individual doctorate holders through industry-academia-government collaborative research. In addition, in order to enhance the mobility of personnel beyond the boundaries of sectors, organizations, and departments, various initiatives will be required to collect innovative examples of the use of the cross-appointment system and promote challenges concerning research in such fields closely related to and combined with specialized fields of prospective doctorate holders (e.g. students in master's programs and undergraduate students). [1][2]

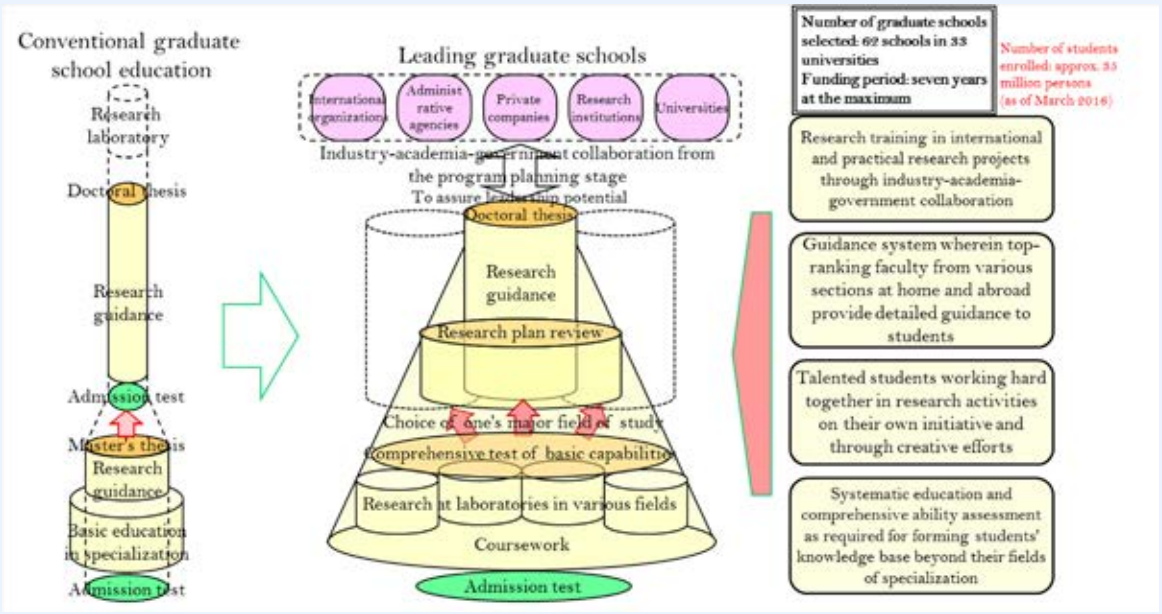
(i) Initiatives in Graduate School Education Reforms

In FY2011, MEXT launched the Program for Leading Graduate Schools as an initiative to cultivate doctorate holders and encourage them to play an active role in industry. This program aims to promote the development of excellent students who are both highly creative and internationally attuned beyond the boundaries of their fields of specialization and who will play leading roles in the academic, industrial and governmental sectors across the globe, establish career paths for doctoral graduates, and create a virtuous

1 Council for Science and Technology, Committee on Human Resources, *Encouraging Doctorate Holders to Play an Active Role in a Variety of Sectors* (January 16, 2017)
2 METI, *Survey Results on the Demand in Industry* (February 10, 2017)

cycle that supports doctorate holders in playing an active role in diverse sectors (Figure 1-2-64).

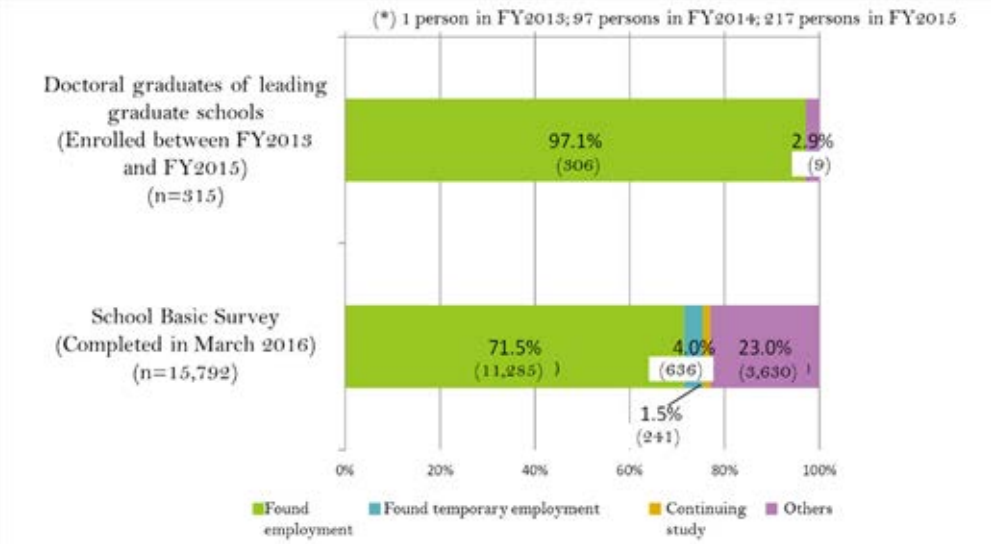
■Figure 1-2-64 / Outline of the Program for Leading Graduate Schools



Source: MEXT (FY2016)

In this funding program, among 315 students who completed the doctoral programs by the end of FY2015, 306 students (97.1%) gained employment, showing a higher rate of employment than among all postdoctoral students (71.5%) (Figure 1-2-65). About one out of three graduates of doctoral programs at leading graduate schools found a job and began playing an active role in various sections in their workplaces such as private companies, research institutions, universities, and government agencies in and outside the country (Figure 1-2-66).

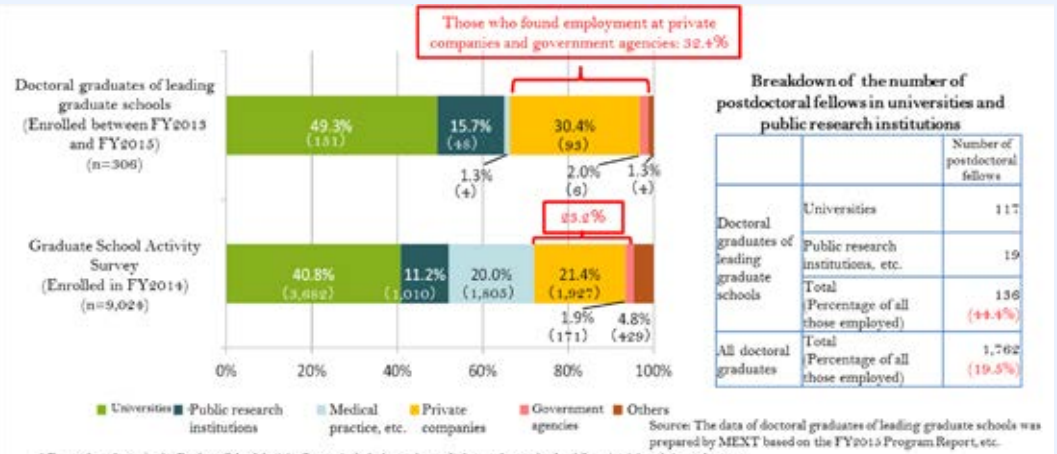
■ Figure 1-2-65 / Employment situation of doctoral graduates of leading graduate schools (1)



* Doctoral graduates in the School Basic Survey include those who completed the required coursework but withdrew from their study before earning a doctoral degree.
* Graduates who were "temporary employed" in the School Basic Survey are those who found employment for temporary income and engaged in work for a period of less than one year or in part-time work regardless of the period of employment.
* All postdoctoral fellows are included in "Found employment."
* "Others" include those who are searching for jobs.

Source: The data of doctoral graduates of leading graduate schools was prepared by MEXT based on the FY2015 Program Report, etc.

■Figure 1-2-66 / Employment situation of doctoral graduates of leading graduate schools (2)



Breakdown of the number of postdoctoral fellows in universities and public research institutions

		Number of postdoctoral fellows
Doctoral graduates of leading graduate schools	Universities	117
	Public research institutions, etc.	19
	Total (Percentage of all those employed)	136 (44.4%)
All doctoral graduates	Total (Percentage of all those employed)	1,762 (19.5%)

Source: The data of doctoral graduates of leading graduate schools was prepared by MEXT based on the FY2015 Program Report, etc.

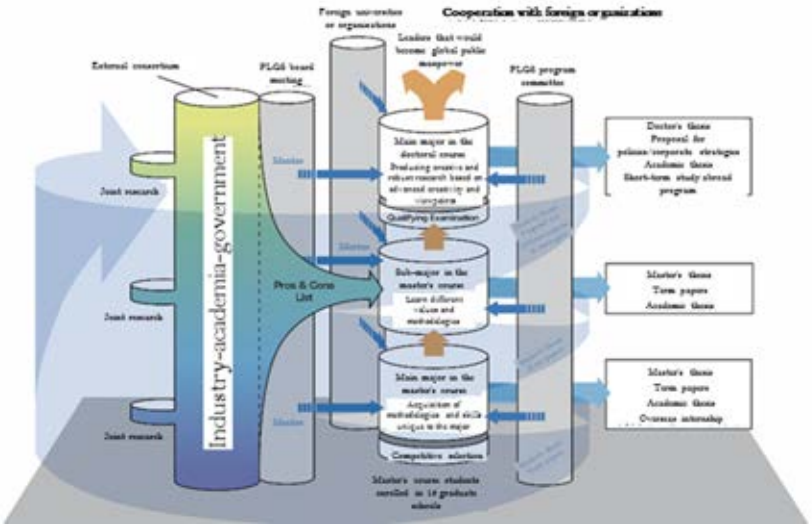
* Doctoral graduates in the Graduate School Activity Survey include those who studied at graduate schools while maintaining their employment.
* Doctoral graduates in the Graduate School Activity Survey include those who completed the required coursework but withdrew from their study before earning a doctoral degree.
* The Graduate School Activity Survey does not provide necessary data for identifying the types of entities to which 1,762 postdoctoral fellows belong. Therefore, the data was obtained from the Survey on Postdoctoral Fellows Regarding Employment and Careers (December 2014, NISTEP; 73.6% in universities and 26.4% in other entities) and was proportionally divided between universities and public research institutions.

[Major places of employment]
(Universities and public research institutions) Hokkaido University, Tohoku University, Chiba University, University of Tokyo, Tokyo Institute of Technology, Tokyo Gakugei University, Nagoya University, Kyoto University, Osaka University, Kyushu University, Tokyo Metropolitan University, Keio University, Waseda University, University of Oxford, University of London, Massachusetts Institute of Technology, University of California, National Astronomical Observatory of Japan, High Energy Accelerator Research Organization, RIKEN, National Institute of Infectious Diseases, National Institute for Environmental Studies, New Energy and Industrial Technology Development Organization, Max Planck Society, etc.
(Private companies and government agencies) Asahi Kasei, NEC, Otsuka Pharmaceutical, Sekisui Chemical, Chugai Pharmaceutical, Terumo, Toshiba, Panasonic, Hitachi, Fuji Film, Deloitte Touche Tohmatsu LLC, Bosch, MEXT, JPO

Source: MEXT (FY2016)

Case Study 13 Keio University

Under the "Science for Development of Super Mature Society," Keio University has established an educational environment where students can earn a total of three degrees (i.e. master's degree for the sub-major that significantly goes beyond the framework of the main major in addition to the master's degree and a doctor's degree for the main major with a high level of expertise) in five years and develop their abilities to find problems, solve them and plan based on the mentoring in small groups from an industrial and social perspective thanks to the effective combination of the realization of full scale fusion of humanities and sciences and education based on industry-academia-government collaboration. The university also provides the students with the opportunity to acquire new awareness through the "water cooler" effect by establishing systems for overseas internship or short-term study abroad programs or a platform where personnel of different fields can interact. In March 2016, nine students joined the business departments of the industrial world and central government ministries and agencies, etc.



Source: Website of Keio University

It is also necessary to promote the cultivation of "knowledge professionals" including excellent researchers who lead the academic world on the global level and entrepreneurs who play the leading role in implementing knowledge in society. Accordingly, we will accelerate a discussion process with the aim of launching a new program, tentatively called "Program for Excellent Graduate Schools," in FY2018, in order to enable integrated education of different fields such as a combined field of humanities and sciences, and cutting-edge education in the fields where Japan has advantage, and establish collaboration among multiple universities, research institutions, private companies, and international organizations. This program is expected to promote initiatives for cultivation of research personnel, such as participation of students in industry-academia joint research, recruitment of doctorate holders by companies, and advance agreement between universities and companies in research partnership with regard to areas where students are allowed to present research results in their papers, and encourage active investment in companies based on an inter-organizational relationship.[1]

1 Expert Committee on Excellent Graduate Schools (tentative name), *Basic Concept on the Program for Excellent Graduate Schools (tentative name)* (April 2016).

(ii) Action Plan for Industry-Academia-Government Collaborative Initiatives on Human Resources Development in Science and Technology

The Industry-Academia-Government Collaborative Roundtable on Human Resources Development in Science and Technology (hereinafter referred to as the "Roundtable"), which was mentioned in Chapter 1, shared the understanding of the existing challenges on the three subjects of focus: "measures for matching the needs for human resources in the industrial world with the higher education curriculum, and improving professional education," "measures for promoting the empowerment of postdoctoral personnel in industry," and "expanding the future basis for human resources in the fields of science and technology, and enhancing the curriculum of elementary and secondary education." In August 2016, the Roundtable compiled initiatives that should be launched with priority through industry-academia-government collaboration in FY2016, in a document titled "Action Plan for Industry-Academia-Government Collaborative Initiatives on Human Resources Development in Science and Technology" (hereinafter the "Action Plan").[1]

Under the theme of "measures for matching the needs for human resources in the industrial world with the higher education curriculum, and improving professional education," educational institutions should carry out initiatives through collaboration with industry to cultivate human resources in the fields of mathematics and information and technology which support Japan's growth fields (e.g. security, AI and robotics, IoT, and big data). These initiatives may include establishing a network of industry-academia collaboration for practical education and providing short-term intensive educational programs through industry-academia collaboration (e.g. intensive courses which issue certificates of completion) by, for example, encouraging working people to go back to university to learn (e.g. the Brush-up Program for Professionals). In addition, with regard to fields where educational opportunities are decreasing despite the increasing demand for human resources in industry, the industrial sector should take measures to cultivate human resources by providing donations for lectures and scholarship funds to universities.

As "measures for promoting the empowerment of postdoctoral personnel in industry," with the aim of tripling investment by companies in universities over the next ten years, educational institutions should put higher priority on industry-academia collaborative activities and reinforce systems as necessary to allow such activities to be prepared for the full-scale launch of industry-academia collaborative research. In addition, while educational institutions should provide students with more opportunities to participate in industry-academia collaborative research, industries should make efforts to cultivate and secure human resources by reviewing the recruitment, assignment and treatment of doctorate holders, after identifying the capabilities of individual doctorate holders through industry-academia-government collaborative research.

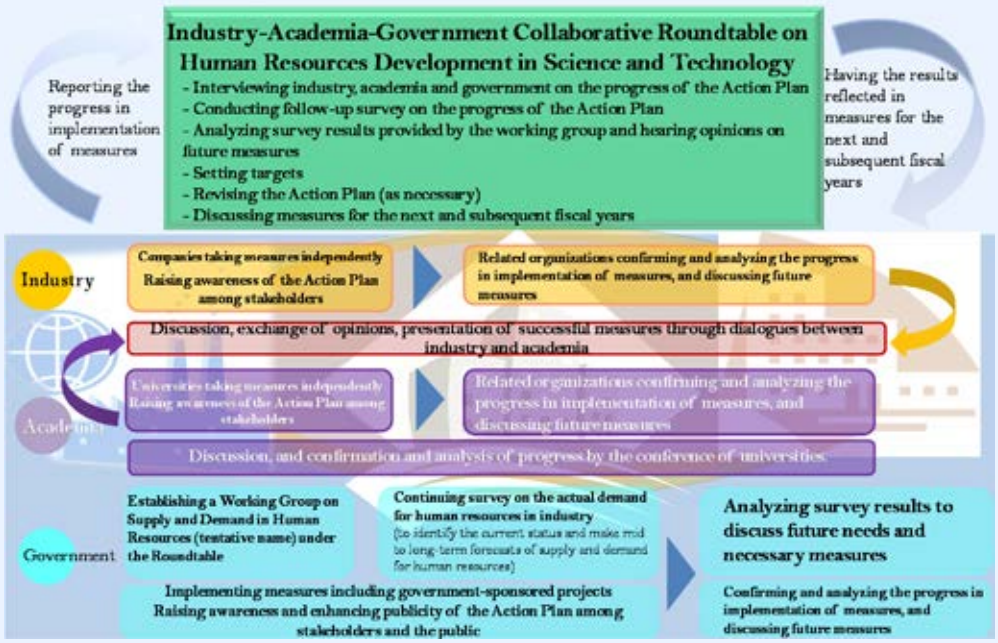
With a view to "expanding the future basis for human resources in the fields of science and technology, and enhancing the curriculum of elementary and secondary education," it is important to take measures to show clear visions of career paths in the fields of science and technology so as to make more students and women interested in working in these fields, and strengthen measures to expand the future basis for human resources in these fields and enhance the curriculum of elementary and secondary education. From this

1 Industry-Academia-Government Collaborative Roundtable on Human Resources Development in Science and Technology, *Action Plan for Collaborative Industry-Academia-Government Initiatives on Human Resources Development in Science and Technology* (August 2016)

viewpoint, educational institutions and industries, in cooperation with boards of education, should further promote initiatives to increase the interest of children in science and mathematics, by means such as providing children with science experiments and lessons on demand and developing teaching materials.

In the future, the Roundtable will work to put the Action Plan into practice, follow up and confirm the progress in the measures taken by industry, academia and government every fiscal year, and study and implement initiatives to promote the efforts of each sector to cultivate human resources in the fields of science and technology, while revising the plan as necessary, with the aim of enhancing the quality and quantity of human resources in these fields (Figure 1-2-67).

■ Figure 1-2-67 / Cycle to increase effectiveness of the Action Plan (after the development of the plan)

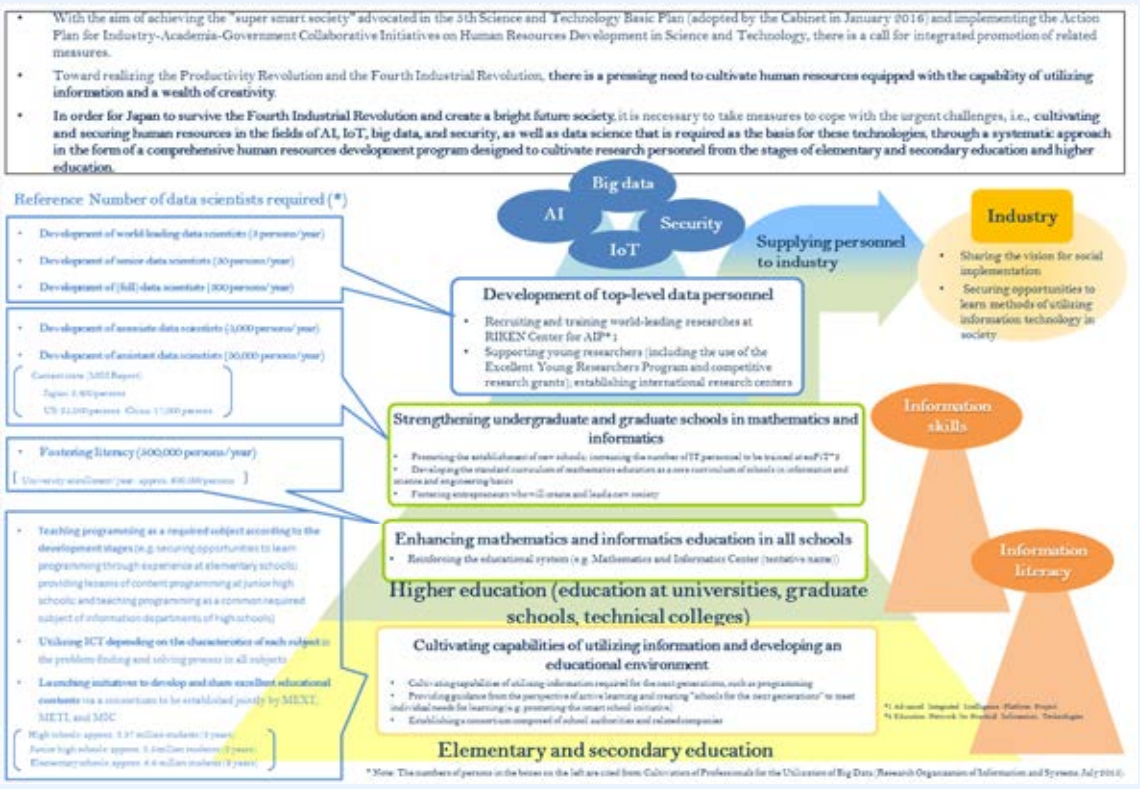


Source : Created by MEXT (FY2016)

Toward achieving the Fourth Industrial Revolution, the development of AI, IoT, big data, and security, as well as data science that is required as the basis for these technologies, has been recognized as a pressing challenge. Accordingly, the government has indicated a policy of taking systematic measures to cultivate and secure human resources in these fields as a comprehensive human resource development program designed to cultivate research personnel from the stages of elementary and secondary education and higher education[1] (Figure 1-2-68).

1 MEXT, *Initiatives toward Achieving "Super Smart Society"* (November 24, 2016)

■Figure 1-2-68 / Comprehensive Human Resource Development Initiative Toward the Forth Industrial Revolution
—Comprehensive Human Resources Development Program Focusing on AI, IoT and Big Data for Creating Future Society—



Source: MEXT, *Initiatives toward Achieving "Super Smart Society"* (November 24, 2016)

This section focused on managerial personnel for innovation, entrepreneurial personnel, coordinating personnel, and seeds-creating personnel as human resources that Japan needs in order to promote open innovation but currently faces a shortage of in both quality and quantity, and reviewed the current challenges and indicated the future directions toward cultivating and securing these types of personnel.

The future directions toward cultivating and securing these types of personnel have some features in common which can be categorized into the following three points. Firstly, universities, public research institutions, and industries should make collaborative efforts to share a common view on the quantitative and qualitative goals that need to be achieved to secure the necessary human resources and clarify career paths and positions for each type of personnel. It is also necessary to increase opportunities to learn from leading cases of international exchange of personnel and other successful cases. Secondly, efforts should be made to implement various human resources development programs and establish networks through which the ongoing initiatives can be continued. Thirdly, challenging or cross-sectional R&D projects should be promoted, with a view to enhancing the competencies of research personnel that are required for innovation through participating in research projects and applying the successful practices as role models.

Lastly, in order to facilitate these human resource development initiatives, it is necessary to promote the exchange of people among all organizations concerned: including startups, across fields, rather than making personnel stay in the same organization, and make efforts to create an environment where one can try again after failure, thereby pushing forward a virtuous cycle of human resources through optimal

assignment of personnel in the whole society.

Section 2 Discussions in the Government and Role of Each Sector

The Council of Industry-Academia-Government Dialogues for the Promotion of Innovation, for which MEXT and METI jointly serve as the executive office, the Industry Collaboration and Regional Support Subcommittee of the Council for Science and Technology, the Council for Science, Technology and Innovation, and the METI Industrial Structure Council have discussed the various challenges of open innovation. In November 2016, the Guidelines for Fortifying Joint Research Through Industry-Academia-Government Collaboration were presented with specific measures to address challenges that universities and public research institutions face in the course of carrying out full-scale industry-academia-government collaboration among organizations.

In connection with startup creation and development, the Headquarters for Japan's Economic Revitalization presented a vision for the startup ecosystem as an initiative titled "Venture Challenge 2020" in April 2016. The Growth Strategy Council—Investing for the Future and the Council for Advancing Structural Reform have been discussing the direction of the government's future policy in this area.

Furthermore, the Open Innovation Co-Creation Congress, convened under the initiative of Minister of MEXT Hirokazu Matsuno, gathered the experience and knowledge of stakeholders to discuss specific reform measures for open innovation.

Based on the discussion in the previous section on the challenges and analyses concerning full-scale industry-academia-government collaboration among organizations, startup creation and development, and securing and cultivating personnel, and while taking into consideration the discussion within the government, the objective of this Section is to indicate the action that each sector is expected to take in order to solve the problem.

1 How to remove obstacles to open innovation

In Table 1-2-69, the major challenges explained in Section 1of this Chapter are divided into three categories: (i) institutional factors based on laws, regulations and administrative guidance; (ii) factors relating to internal rules and practices of universities and R&D agencies and the awareness of stakeholders; and (iii) factors related to the shortage of resources including funds and expert personnel. In the process of promoting open innovation, it is necessary to identify obstacles in terms of institutions and internal practices, and study how to remove these obstacles.

Table 1-2-69 / Summary of major challenges discussed in Section 1

In the table below, the major obstacles are sorted out into the three categories: (i) institutional factors based on laws, regulations and administrative guidance; (ii) factors relating to internal rules and practices of universities and R&D agencies and the awareness of stakeholders; and (iii) factors derived from the shortage of resources including funds and expert personnel.

	Specific challenges	Major factors
Organization management of universities and R&D agencies for full-scale collaboration	○ Planning and proposal of attractive joint research, etc. ✓ It is difficult to develop cross-departmental plans and proposals led by the headquarters. ✓ Personnel expenses for faculty, researchers, postdoctoral fellows and students are not included in the joint research expenses, which is behind the lack of responsibility in the participation of these research personnel. ✓ The facilities are not sufficiently maintained or improved, and therefore not attractive to companies.	(ii) There is a misunderstanding that research personnel cannot be included in joint research expenses, and rules for students' participation in joint research have not been established. (iii) There is a shortage of coordinators with business sense or funds for enhancing functions of facilities.
	○ Negotiation, adjustment and progress management related to joint research, etc. ✓ Excessive emphasis is placed on the model contract, making it difficult to proceed with negotiation for a contract. ✓ Risk of delay due to the different manners of time management	(ii) A flexible model contract has not been developed, and the awareness of risk management and progress management is insufficient.
Organization management of universities and R&D agencies for full-scale collaboration	○ Intellectual property management and risk management ✓ It is difficult to conduct management appropriately for inter-organizational large-scale collaborative research.	(ii) IP management or risk management is not clearly recognized in the context of business management, and related rules have not been developed (or the existing rules are not applicable organization-wide). (iii) There is a shortage of personnel responsible for IP strategy or risk management.
	○ Strengthening the headquarter functions ✓ It is difficult to secure sufficient personnel due to lack of independent or stable financial resources. ✓ The top management lack management experience.	(ii) Independent financial resources that can be used strategically or management personnel capable of creating innovation have not been sufficiently developed or secured.
	○ Others ✓ Research funds are allocated in a manner not suitable for receiving the long-term support required for innovation.	(i) Government-subsidized research funds are allocated as a single-year budget and cooperation with companies in setting research themes is not sufficient.

	Specific challenges	Major factors
Designing incentives for collaboration at universities and R&D agencies	○ Incentive for researchers	
	✓ Researchers' commitment to industry-academia-government research collaboration is not fully taken into consideration in performance evaluation or reflected in their salary or research environment.	(ii) Rules for conducing flexible personnel evaluation according to the content of work and reflecting the evaluation results in allocation of resources have not been sufficiently developed.
	○ Incentive for universities and R&D agencies (strengthening financial base)	
	✓ As the industry-academia-government collaboration increases, the financial pressure becomes heavier due to the imprecise calculation of research expenses.	(ii) Rules for calculating research expenses have not been developed.
	✓ National university corporations cannot earn sufficient licensing income because they are required to sell off the shares obtained from their joint venture partners as royalties for licensing their patents.	(i) There is a time limit for converting the shares into cash.
	✓ It is difficult to donate appraisal assets to universities, etc.	
	✓ National university corporations and R&D agencies are incapable of conducting flexibly asset management using their own income.	(i) Under the Act on General Rules for Incorporated Administrative Agency, investment of surplus funds is allowed only in safe assets, and there is limitation to leasing land. (*1) (iii) There is a shortage of personnel for fund raising and investment.
Preparedness of companies	✓ Departments or personnel specialized in industry-academia-government collaboration are insufficient. ✓ The top management does not make the necessary effort to indicate a vision and share it within the organization. ✓ Support for startups is insufficient.	(ii) The top management and employees lack sufficient awareness of open innovation.
Startup creation and development	✓ It is difficult to raise funds particularly in the initial phase.	(iii) There is a shortage of gap funds.
	✓ National university corporations and R&D agencies are not allowed to receive assets other than donations and licensing royalties in the form of shares or share options.	(i) According to the MEXT notice (*2), national university corporations, except for those prescribed in the National University Corporation Act, are allowed to receive shares and share options only as donations and licensing royalties. (i) There are no provisions regarding the acquisition of shares and share options by R&D agencies, which are equivalent to the provisions of the MEXT notice issued in relation to national university corporations.
	✓ The number of R&D agencies that may invest in startups is limited.	(i) Only three agencies under the Research and Development Capacity Improvement Act are allowed to invest in startups. (*3)
	✓ Products manufactured by startups are not taken into consideration in government procurement.	(i) There is no government procurement scheme that takes products manufactured by startups into consideration.
Securing and cultivating of personnel	✓ The mobility of people is low particularly between universities and companies, which makes it difficult for them to fully share their knowledge and resources.	(ii) The cross-appointment system and the advantage of using it are not sufficiently understood, while various complicated adjustments are necessary for using it.
	✓ There is a shortage of managerial personnel, entrepreneurial personnel, coordinating personnel, research seeds-creating personnel.	(ii) There is a shortage in training programs including those under industry-academia-government collaboration financed by private investment, and career paths are not clear. In particular, efforts for cultivating personnel through industry-academia-government collaboration, including the use of private investment, are insufficient.

*1: Following the amendment to the National University Corporation Act (effective as of April 1, 2017), national university corporations are now allowed to invest in startups under certain conditions.

*2: 2004 Notice of MEXT on Higher Education No. 1012 dated March 29, 2005, Notice from Director-General, Higher Education Bureau and Director-General, Research Promotion Bureau "Treatments in the case where national university corporations and Inter-University Research Institute Corporations acquire stocks as contribution or consideration for licenses (Notice)"

*3: The three agencies are: Japan Science and Technology Agency, New Energy and Industrial Technology Development Organization, and National Institute of Advanced Industrial Science and Technology. However, under individual laws, the New Energy and Industrial Technology Development Organization and the National Institute of Advanced Industrial Science and Technology are not allowed to make cash contributions to startups.

Source: Prepared by MEXT.

2 Institutional reforms required from the government

(Discussions toward removal of institutional obstacles)

Table 1-2-68 shows obstacles categorized as (i) institutional factors based on laws, regulations and administrative guidance. These obstacles have been pointed out by experts in the private sector during discussions at the Open Innovation Co-Creation Congress, the CSTI, and the Growth Strategy Council—Investing for the Future established under the Headquarters for Japan's Economic Revitalization. The government needs to analyze the institutional obstacles to promotion of open innovation and use the results to steadily implement the necessary measures.

Specifically, from the perspective of giving more incentives to universities and R&D agencies for engaging in full-scale industry-academia-government collaboration and encouraging them to build organization management systems, it is necessary to take measures to enable them to secure independent and stable financial resources, such as by allowing them to acquire and hold shares and share options of startups in more cases, developing an environment where they can raise external funds including donations more easily, and enabling them to use these funds more freely.

It is also necessary, from the perspective of further promoting startup creation and development, to enable R&D agencies to invest in startups, allow universities and R&D agencies to acquire shares and share options of startups in more cases, and develop an environment where they can raise funds more easily such as through the use of government procurement.

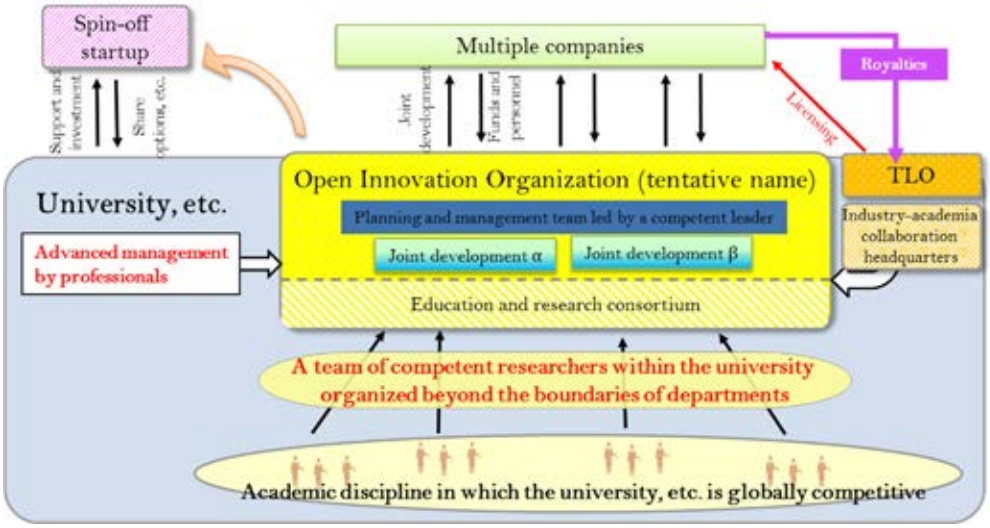
In addition, from the perspective of facilitating the connection between research achievements of universities and R&D agencies and business concepts of companies, it is necessary to develop an integrated support scheme for supporting the entire process of R&D from the initial phase through to the POC (Proof of Concept) phase, which also covers the activities for obtaining intellectual property and starting up startups.

(Support for initiatives of universities and R&D agencies)

Since, as mentioned earlier, the Guidelines for Industry-Academia-Government Collaboration have been developed to present specific measures to address challenges that universities and R&D agencies face in the course of carrying out open innovation, the government is expected to encourage universities and R&D agencies to engage in industry-academia-government collaboration more actively by referring to these guidelines.

Along with the diversification of schemes for industry-academia-government collaboration and the increase of complexity of the roles that should be played by universities and R&D agencies, where excellent knowledge and competent personnel are concentrated, universities and R&D agencies are expected to serve as a platform for creating an advanced knowledge-based industry jointly with the existing industries. Accordingly, they are expected to develop a system wherein the president or chairperson is authorized to organize competent researchers beyond the boundaries of departments so as to place industry-academia-government collaboration under central control by specialists in commercialization and intellectual property management. The Open Innovation Co-Creation Congress has been discussing an "Open Innovation Organization" (tentative name)—a mechanism that, while meeting such expectations, will also accelerate measures in an integrated manner to solve challenges that universities and R&D agencies may face in the course of full-scale industry-academia-government

collaboration. This movement is expected to accelerate open innovation in Japan and enable universities and public research institutions to achieve further development. The government needs to consider effective support measures for universities and R&D agencies that are willing to participate in this reform.



Concept of an "Open Innovation Organization" (tentative name)
Source: MEXT.

(Encouraging companies)

As pointed out by the R&D and Innovation Subcommittee of the Industrial Structure Council Committee on Industrial Science and Technology Policy and Environment in its report titled "Initiatives for Promoting Innovation" issued in May 2016, the government needs to take measures, such as presenting successful examples, to encourage companies, including those that are still not aware of the importance of open innovation, to carry out concrete corporate activities. In addition, it is important to encourage companies to make continuous investments in R&D activities with higher uncertainties without hesitation, from a mid- and long-term perspective. Accordingly, the government needs to promote organizational reforms of universities and R&D agencies and encourage companies to invest in R&D activities carried out by universities and R&D agencies by, for instance, raising awareness of the R&D-related tax system.

Meanwhile, the government should also continue discussing obstacles to promotion of open innovation carried out by companies.

(Promotion of effective matching of technology seeds and needs)

In order to effectively match technology seeds and needs and promptly put cutting-edge technological achievements into application in society, it is necessary to push forward initiatives to foster an environment where various types of existing matching programs autonomously and actively promote the exchange among a wider range of more diverse parties, through collaboration beyond the business or organizational boundaries and bridge linking to share such seeds.

(Promotion of the cultivation and recruitment of personnel)

Innovation is created by people, so concerted efforts among industry, academia and government should

be made to cultivate and secure personnel. In particular, cultivating entrepreneurial personnel is an essential initiative to promote the creation and development of not only startups launched by universities and R&D agencies but also all startups in Japan. The government needs to consider measures to secure and cultivate the necessary personnel through cooperation among universities, R&D agencies, industries and other stakeholders.

3 Actions that universities and R&D agencies should take

In order to accelerate the solution of challenges involving universities and R&D agencies indicated in Section 1, universities and R&D agencies should refer to the Guidelines for Industry-Academia-Government Collaboration and make the necessary efforts to remove obstacles related to organization management and practice. In particular, there is a call for organization management reforms that improve the management of organizations and increase efforts towards open innovation initiatives in an integrated manner, while paying attention to the creation of incentives to researchers, etc. for encouraging them to change their mind-set.

In order to carry out the reforms, it is necessary to promote initiatives that are suited to the circumstances of each organization, while learning from precedent cases indicated in the guidelines.

①Organization management reforms required for universities and R&D agencies to invite investment and achieve growth

(Strengthening the headquarters functions)

As indicated in Section 1 of this Chapter, strengthening the headquarters functions is a common issue involved in various problems. This is particularly important in the process of carrying out cross-sectional collaboration led by the headquarters.

To achieve this, it is necessary to first bring departments together by enabling the president or chairperson to manage the organization by the top-down approach. In this context, the president or chairperson should take the lead in clarifying the importance of open innovation within the framework of organization management and the vision on how to develop the organization, including the enhancement of education and academic research, in an effort to carefully build a consensus within the organization.

It is also necessary to prepare a system for supporting the president or chairperson in the management of the organization. Initiatives should be carried out to cultivate and secure diverse expert personnel, including those specialized in intellectual property management and risk management, and encourage them to play their roles actively.

(Securing a system for fulfilling the responsibility for carrying out joint research)

Universities and R&D agencies need to secure independent financial resources and assign appropriate personnel in order to present attractive research proposals to the industrial sector and fulfill their responsibility for carrying out joint research. To this end, they need to clearly identify maintenance and operation costs of large equipment for joint use and indirect costs such as personnel expenses for coordinators, and define the sharing of expenses between the headquarters and the respective departments within their organizations. Then, they should invite investment from the industrial sector more actively through negotiating with the collaborative partners, while taking into account the circumstances of each

organization by referring to the Guidelines for Industry-Academia-Government Collaboration and the precedent cases.

In particular, it is necessary to establish a system for including the personnel expenses for full-time faculty members and researchers in the joint research expenses based on appropriate effort management so that the research personnel can engage in joint research in a more responsible manner. In addition, it is desirable to encourage post-doctoral fellows and students to participate in joint research actively if they wish to do so, and in order to develop rules for this purpose, it is necessary to take into consideration both the consistency with the educational policy of each organization and the development of human resources through joint research.

(Securing independent financial resources and strategic allocation of resources)

In order to carry out the initiatives mentioned above, it is essential to secure stable financial resources and allocate these resources strategically. With an increasing investment from private companies into universities and R&D agencies, it is necessary to create a virtuous cycle wherein universities and R&D agencies secure funds from various sources—including not only public funds but also income from startups they launched and income from patent licensing, donations and other funds from the private sector, and funds from overseas—, and use these funds to improve their educational and research abilities and enhance their competitiveness, resulting in further promotion of industry-academia-government collaboration.

As discussed in Section 1 of this Chapter, schemes for joint research which may have increased the financial pressure on universities and R&D agencies must be changed. To achieve this, as mentioned earlier, an appropriate method should be applied to calculate joint research expenses, and universities and R&D agencies should strive to acquire funds that can be used for their future development. The industrial sector clearly expressed its intention to make more investments in universities with a view to strengthening their infrastructure for education and research activities.[1] Accordingly, universities and R&D agencies should increase their efforts to invite investment from the private sector by presenting the appropriate basis for calculation of expenses and improving their management ability in terms of reporting the progress and results in joint research. If they meet these conditions, they should next consider where to allocate their resources from a strategic viewpoint, including strengthening the headquarter functions.

②Designing incentives for researchers

In order to establish a scheme for encouraging competent researchers to participate in industry-academia-government collaboration actively, it is important for each organization to design incentives for its researchers.

As indicated in Section 1 of this Chapter, in order to encourage researchers to take a step toward a new joint research project regardless of the significant reduction of the time they can use for their research activities, universities and R&D agencies should develop a system and framework for supporting researchers such as by reducing the burden of clerical work. In addition, they should also take measures to properly evaluate researchers' commitment to industry-academia-government collaboration and carefully

1 Japan Business Foundation (Keidanren), Fortifying Joint Research through Industry-Academia-Government Collaboration: Expectations for Universities and R&D Corporations Leading Innovation" (February 2016).

build an internal consensus for having evaluation results reflected in the salary and research environment.

③Feedback of research output into society through revitalization of startups launched by universities and R&D agencies

Universities and R&D agencies are expected to establish in their own organization management a system for creating and developing startups and promote the efficient and effective application of research results in society. They are also expected to create a virtuous cycle wherein they can secure profit, through commercialization, as necessary for supporting their infrastructure and growth. While taking into consideration the government's review of the existing systems and provision of public assistance, they should carry out reforms strategically to, for example, establish their own gap funds, like those seen in Europe and the United States, and develop an intellectual property management system from the perspective of startup creation.

In particular, universities, as institutions for higher education and research, have a significant role in developing entrepreneurial personnel. In order to develop personnel with a broad vision, universities should encourage students to participate in industry-academia-government collaborative research, engage in research work under internship, and study abroad, so that students can directly experience leading cases of open innovation, and should also support the building of student networks.

4 Actions that the industrial sector is expected to take

As indicated in Chapter 1, in the midst of a period of transformation, the industrial sector also needs to establish new values through open innovation. However, the infrastructure to achieve this is still inadequate and many problems are left unsolved, as explained in Chapter 1 and Section 1 of this Chapter. Companies need to reform their mind-set and change their attitude, raising awareness of the importance of open innovation as a management technique.

The same open innovation approach is not suitable for all private companies. Before collaborating with external entities, companies should review and identify their own resources as well as their strength and weakness. On the basis of these factors, they should establish a framework for connecting external knowledge and internal knowledge, while also taking into account the possibility of open and closed strategies.

In particular, in the course of making mid to long-term R&D investments to create technology that may lead to future innovation, an effective approach for companies is to carry out open innovation jointly with universities and R&D agencies as collaboration partners. In this case, companies are expected to recognize that there is a virtuous cycle wherein the growth of universities and R&D agencies becomes the source of the innovation that leads to the creation of further innovation at companies, and, as their growth partners, enhance investment in anticipation of the mid and long-term development of universities and R&D agencies.

Meanwhile, corporate venture capitals have become more active recently. Large companies and small and medium enterprises should collaborate more with startups to create an ecosystem for innovation.

On the premise of self-reform of universities and R&D agencies, the industrial sector is expected to accelerate initiatives to achieve the goal presented in the Japan Revitalization Strategy 2016, i.e., to triple investment by companies in universities and R&D agencies.