

Chapter 2

Efforts and a Future Direction toward Securing Human Resources for Science, Technology and Innovation and Promoting Their Activities

In light of socioeconomic changes and the current status of human resources for science, technology and innovation, Chapter 1 clarified that it is necessary to create “a human resources system that affords high mobility,” “an environment where diverse human resources can play active roles” and “platforms for the co-creation of new knowledge and value,” in the development of a future human resource system.

This chapter analyzes current efforts and challenges associated with these three points, as well as clarifying the direction of future efforts towards realizing them.

Section 1

The establishment of a human resources system that affords high mobility: eliminating the “intergenerational gap in mobility”

As discussed in Chapter 1, there is the problem of how to eliminate the “intergenerational gap in mobility” among researchers at Japanese universities and public research institutions. In order for researchers to play active roles at appropriate positions according to their abilities and wishes and to appropriately develop their careers, this is a problem urgently requiring a solution.

To that end, it is necessary to improve the mobility afforded by posts occupied by senior researchers and to increase opportunities for young researchers to take up challenging posts. In addition, it is necessary to encourage doctoral degree holders to not only serve as researchers at universities or public research institutions, but also to work at various occupational positions and to play active roles. This would include those of researchers at private companies, research administrators, technicians, research management personnel, research assessment personnel, intellectual property-related personnel, science communicators, teachers at elementary, junior high and high schools, and civil servants. Also, there is a need to review the traditional employment system toward promoting transfers between sectors, in addition to encouraging business people to return to university to study.

In light of these points, this section discusses problems, efforts and a future direction toward the construction of a human resources system that affords high mobility from three viewpoints: “a strategy for improving the mobility of all researchers,” “the diversification of career paths” and “a new system” that can give life to the first two points.

1 A Strategy for Improving the Mobility of All Researchers

According to the results of the *Survey about Mobility of Researchers and Diversity of Research Organizations* published by the National Institute of Science and Technology Policy in March 2009, in response to questions concerning disincentives to the improvement of research personnel mobility, quite a few respondents gave answers such as, “The salary system of retirement benefits and the welfare system work against transfers,” “Considering the continuity of research and education, it is difficult to transfer personnel,” “Since the number of posts has been reduced, there are no positions to transfer to” and “When the position is tenured, it is difficult to transfer the holder of that position.”

However, as factors for improving the mobility of researchers, many people gave answers such as, “the

introduction of fixed-term contracts,” “the implementation of a system for open recruitment” and “personnel policies that prohibit internal promotion.” In addition, with regard to factors that hinder the promotion of transfers for researchers with poor performance, the most commonly cited factors were “problems concerning employment contracts” and “problems of securing positions.”

In summary, to improve the mobility of researchers, the following two measures are needed.

- Improving employment conditions by eliminating factors hindering mobility, such as the system of retirement payments, and otherwise reforming the employment system
- Promoting mobility by providing incentives to researchers and their institutes

However, excessively increasing mobility can lead to the destabilization of employment, to decreases in the appeal of a research career and to persistent shrinkages of human resources, which are the complete opposite of what is intended. In addition to considering the two above-mentioned measures, it is necessary to consider how to enhance the appeal of research careers and how to create a sustainable human resources system.

Also, since improvements in the mobility of human resources are associated with how researchers are treated, it is necessary to consider how to protect the positions of researchers. Those concerned are expected to consider the future of the research community in Japan and to understand how critical researchers are to the future. Also, they are expected to work independently toward helping researchers find satisfaction and new challenges in their work on the basis of transparent and fair performance evaluations under the appropriate governance at each institute. The government needs to take various measures to improve the mobility of researchers at universities and public research institutions and to explain the purpose and the necessity of mobility improvements to researchers, public research institutions, research communities and related institutions appropriately and on a timely basis, in order to deepen their understanding. Additionally, it is important to require supervisors of organizations to make efforts to strengthen their governance.

(1) Promoting mobility of researchers by improving research environments

1) Expanding the introduction of an annual salary system

The retirement benefit system is designed to work in conjunction with the lifelong employment system; therefore, when an employee moves from one organization to another, the retirement benefits are usually reduced. This is a particularly important factor inhibiting senior researchers from changing positions. To solve this problem, it would be more effective to introduce an annual salary system that is independent of the payment of retirement benefits.

The introduction of an annual salary system would also make it possible to determine researchers' salaries according to their performance and ability. Therefore, if researchers are offered a better salary by another institute, they might choose to transfer to that institute. This can serve as an incentive.

In contrast, when an annual salary system is applied to researchers who have been working under the traditional salary system, a portion of the retirement benefits that would have been paid to them in the future will be paid over the salary. This leads to various problems, such as increases in the amount of salary paid or questions regarding the handling of retirement benefits for the period that they worked at the previous institute. It is hoped that each institute will independently examine the introduction of the annual salary system after considering these points and that the government will provide an incentive to institutes as necessary, in order to advance this system.

Currently, an annual salary system, the form of which varies from institute to institute, is applied to more than 3,000 researchers at 13 incorporated administrative agencies for R&D, including RIKEN and the Japan Aerospace Exploration Agency (JAXA) (FY2013). With respect to universities, there is no statistical data concerning the overall picture of teachers to whom an annual salary system is applied. However, according to the data on remuneration and salaries of executives and regular employees published by national university corporations, the annual salary system has already been introduced at some national university corporations, and has been applied to at least 3,000 faculty members (Table 1-2-1).

Table 1-2-1 / Main R&D Corporations and Universities that Have Introduced an Annual Salary System

Corporate name (Governing ministry)	Number of faculty members to whom an annual salary system is applied (persons)	University	Number of faculty members to whom an annual salary system is applied (persons)
RIKEN (MEXT)	1,430	Osaka University	500
JAXA (MEXT)	413	Tohoku University	425
Japan Agency for Marine-Earth Science and Technology (JAMSTEC) (MEXT)	342	Kyoto University	405
Japan Science and Technology Agency (JST) (MEXT)	320	Nagoya University	401
Japan Atomic Energy Agency (JAEA) (MEXT)	131	Hokkaido University	232
National Cancer Center (NCC) (MHLW)	114	University of Tsukuba	227
National Center of Neurology and Psychiatry (NCNP) (MHLW)	88	Tokyo Institute of Technology	193
National Center for Global Health and Medicine (NCGM) (MHLW)	68	University of Tokyo	121
National Cerebral and Cardiovascular Center (NCVC) (MHLW)	67	Chiba University	90
National Institute of Radiological Sciences (NIRS) (MEXT)	60	Kobe University	80
National Research Institute for Earth Science and Disaster Prevention (NIED) (MEXT)	55		
National Center for Geriatrics and Gerontology (NCGG) (MHLW)	46		
National Center for Child Health and Development (MHLW)	39		

Source: MEXT based on the *Remuneration and Salaries of Executives and Regular Employees*

Source: MEXT based on subcommittee material on the reform of incorporated administrative agencies by the Administrative Reform Promotion Council. (The numbers of staff are as of April 1, 2013.)

2) Expansion of fixed-term appointment for senior researchers

According to current labor legislation in Japan, if researchers are working under a labor contract with no fixed term, it is difficult to radically alter their positions or to expect them to change careers, even if their performance evaluations have not been favorable. If this is depriving other capable human resources of opportunities to play active roles, then it can lead to declines in the R&D capacity of the country.

In light of these points, each institute should clearly articulate the expectation for each individual position and the abilities that are expected of the holder of that position, with the institute conducting regular performance evaluations of researchers. Based on these performance evaluations, researchers will

obtain positions where they can reach their full potential. Research institutions and researchers are expected to make these proactive efforts. It is believed that the expansion of fixed-term appointments for researchers in more senior positions is an effective means of widening these opportunities and encouraging researchers to pursue new career paths.

In addition, when researchers, including young researchers for whom fixed-term appointments are expanding, work under short-term contracts, they have only a limited period of time during which they can concentrate on research, since they have to take the time to secure their next job. This situation can make it difficult to fairly evaluate their performance, and it can lead to employment instability among researchers.

In this regard, the *Act on Enhancement of Research and Development Capacity and Efficient Promotion, etc. of Research and Development, etc. by Advancement of Research and Development System Reform* and the *Act on Term of Office of University Teachers, etc.* were proposed as legislation by Diet members at the 185th Session of the National Diet (extraordinary Diet session) and was promulgated in December 2013. According to the act, researchers at universities and R&D institutes are subject to special provisions of the *Labor Contract Act*, which provides that the period of time researchers have to work before they are eligible for tenured employment contracts will be extended to ten years. This provision has been in effect since April 1, 2014.

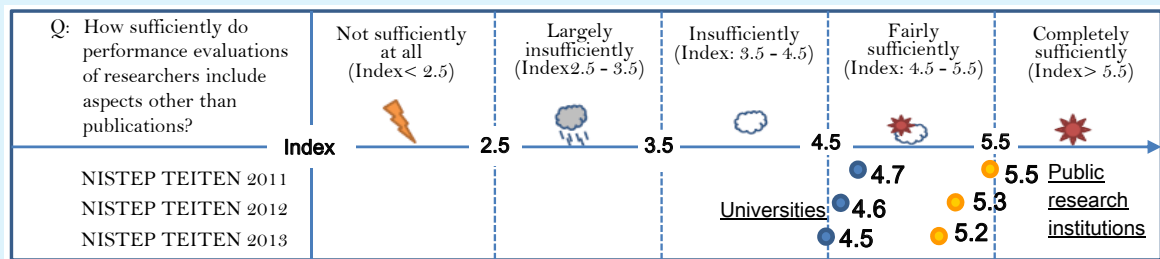
This provision has made it possible for researchers to improve their capabilities, to accumulate research achievements and to be properly evaluated during their labor contract period, which can lead to ensuring job security and promoting transfers to other research institutions. It is expected that each institution will give considerable attention to this systematic revision and will build a system that can balance employment stability with employment mobility.

3) Implementation of proper performance evaluations

It is critical to build a transparent and fair evaluation system, while improving mobility.

When evaluating the abilities and performance of researchers, it is important to conduct the evaluation from a broad perspective by giving consideration to various abilities and aptitudes as well as by giving due consideration to the development of young researchers and providing support for them. The results of the NISTEP TEITEN survey show the degree to which researchers perceive that their performance evaluations include aspects other than just publications. However, there are concerns that, researchers are increasingly feeling that they are not evaluated in such a way (Figure 1-2-2).

Figure 1-2-2 / Status of Performance Evaluations for Researchers (Expert Survey Results)



Source: MEXT based on the NISTEP Analytical Report for 2013 NISTEP Expert Survey on Japanese S&T and Innovation System (2013 NISTEP TEITEN survey) NISTEP Report No.157 (April 2014)

Universities and R&D institutions are required to improve the rules and the system for conducting proper and effective evaluations within the purpose of the institute. They must take responsibility for operating their rules and their system, based on the *National Guideline on Methods for Evaluating Government R&D*. In evaluating researchers at universities, it is particularly important to give consideration to their educational performance as well as to their research performance, since most researchers at universities also teach.

4) Other improvements in research environments

The reform of the salary system and the personnel system toward improving the mobility of human resources has the potential to cause disappointment to researchers at any given institute, so it is expected that some people might object to such reforms. To carry out reforms under such circumstances, leaders of institutions need to exercise strong leadership, so reforms are also needed regarding the support for their leadership.

Furthermore, since the need for continuity of education and research is often pointed out as a factor hindering mobility improvements, there is also a need to determine how to balance mobility against continuity of education and research.

(2) Incentives for promoting mobility improvements of researchers

Since the lifetime employment system is deeply entrenched in Japan, it is difficult to imagine that mobility can be improved only by improvements in the research environment. Therefore, it is also important to give incentives to researchers and institutions in promoting improved mobility.

With regard to incentives for researchers, it is expected that universities and other institutions will secure researchers by offering high salaries through the introduction of an annual salary system. Thus, an annual salary system can serve as an incentive to encourage transfers.

In addition, helping researchers to work at other institutions can substantially improve the coordination and interactions between organizations and sectors, which will also contribute to lowering the psychological barrier that researchers might have towards transferring between sectors. To promote the transfer of researchers, institutions are expected to develop and utilize a “combined salary” system that allows researchers to receive salary from another institution.

In addition, by utilizing projects implemented by the government, an institution that has accepted researchers may be able to offer challenging positions and attractive research environments to these researchers and to deploy excellent research support personnel around them. It is also considered effective to create an environment in which researchers cannot secure a stable post simply by staying at the same institution. This can be done through the introduction of personnel policies such as the thorough implementation of an open application system and the restriction of internal promotion.

As for incentives for institutions: for example, introducing a system that allows funds to be applied for indirect costs is considered to provide an incentive for institutions to acquire excellent researchers. Also, providing strategic benefits (budget allocations, etc.) to institutions that take an active stance toward mobility improvements can serve as a great incentive.

(3) Construction of a Sustainable System

Even if a human resources system that affords high mobility is instituted, if it does not look attractive to those considering to become researchers, then competent young people will not be drawn to positions at universities and public research institutions, potentially resulting in a long-term decline in the R&D capacity of our country. Therefore, it is important to consider the factors that can contribute to the establishment of a sustainable system. These factors might include: offering higher positions to top level researchers based on proper performance evaluations, granting a wide range of discretionary power in research, deploying research support personnel and paying high salaries according to research ability.

In this regard, it should be noted that there is a substantive difference between the average salaries of university professors in the USA and those of university professors and researchers at incorporated administrative agencies in Japan. Whereas the average annual income of professors at major universities in the USA exceeds 15 million yen, the average salary of professors at national universities in Japan (under the mandatory retirement system) is about 10 million yen (Table 1-2-3). With regard to the salaries of researchers at incorporated administrative agencies, the average salary of research fellows at the National Institute of Advanced Industrial Science and Technology (AIST) is about 9.5 million yen, and the average salary of researchers at positions equivalent to a research director at RIKEN, where an annual salary system is employed, is about 11.5 million yen¹.

Therefore, it is important to match salaries to the results and abilities of researchers, as well as to make the salary level in line with those in other countries, through the introduction of an annual salary, merit pay or other system.

Table 1-2-3 / Average Annual Incomes of Faculty Members (Professors): Japan vs. the USA

University (USA)	Annual income (million yen)	University (Japan)	Annual income (million yen)
Columbia University	18.8	University of Tokyo	11.2
Stanford University	18.4	Tokyo Institute of Technology	10.6
University of Chicago	18.1	Kyoto University	10.4
Harvard University	18.0	Nagoya University	10.3
Princeton University	17.8	Osaka University	10.3
New York University	16.6	Kyushu University	10.2
University of Pennsylvania	16.6	Tohoku University	10.1
Yale University	16.5	Hokkaido University	9.8
Duke University	16.0	University of Tsukuba	9.8
California Institute of Technology	15.9		
Massachusetts Institute of Technology	15.9		

Note: The figure uses an exchange rate of 88.75 yen to the dollar, the average exchange rate for 2012 and 2013.

Source: MEXT based on the website of The American Association of University Professors (2012-2013)

(<https://chronicle.com/article/2013-AAUP-Faculty-Salary/138291>) and *Remuneration and Salaries of Executives and Regular Employees at National University Corporations* (FY2012)

It is also important to ensure the maximum stability of employment, while increasing the mobility of researchers. To this end, institutions should establish types of employment such as tenure-track positions,

¹ However, it should be noted that average salaries of institutions cannot be directly compared, since salaries can be influenced by multiple factors, such as average age, region-based cost-of-living adjustments and the like.

fixed-term positions and pay standards in a well-balanced manner for young researchers, researchers in mid-ranking positions and researchers in senior positions, in addition to promoting the career progression of researchers and placing the right people in the right jobs according to their abilities. At the same time, it is expected that job opportunities will be expanded. This can be done by, for example, promoting the diversification of career paths of the doctoral degree holders at institutions by appointing them to various positions, such as research administrator, project manager and teaching staff, and by applying fixed-term contracts that result from extension to ten years of the period of time researchers have to work before they are eligible for tenure, under the special provision of *the Labor Contract Act*.

Since it is extremely difficult for a single institution acting alone to ensure stable posts for young researchers, it would also be effective to build a consortium among multiple universities and public research institutions and to cooperate with private companies and foreign research institutions with a view to increasing the mobility of researchers, in addition to advancing the construction and firm establishment of a system that allows researchers to secure stable employment and develop their careers.

In addition, a new system is required in which senior researchers who are successful at soliciting external funding are retained, on the condition that they continue to do research for the institution while also engaging in research support, research management and teaching, based on the researcher’s expertise.

(4) Efforts of universities and incorporated administrative agencies toward mobility improvements of researchers

Currently, various reforms are being advanced at universities and incorporated administrative agencies. In advancing those reforms, further examinations are being made on important points, such as reinforcement of leadership by the chief of an organization, and the implementation of appropriate evaluations for teachers and researchers. It is hoped that these systemic reforms will be on going, so as to improve the mobility of all researchers.

1) University reform

In November 2013, MEXT announced the *National University Reform Plan*, in which the Ministry emphasized measures aimed at giving lasting competitiveness and delivering significant value to national universities by maximizing the strengths and characteristics of each university and building a system under where universities can improve and develop. At the same time, further examinations are being made on how to improve the flexibility of personnel systems and salary systems by promoting the introduction of an annual salary system. In particular by introducing an annual salary system and a “combined salary system” to the payment methods for 10,000 teachers during the period for accelerated reform (FY2013-2015) in fields where teacher mobility is particularly required.

In addition, the Subdivision on Universities, Central Council for Education of MEXT compiled the *“Promotion of Governance Reform at Universities (Summary of Deliberations)”* in February 2014. In response to the rapid changes in social environments and the growing expectations of society for universities, the summary declares that it is critical to build a governance system that allows universities to conduct self-management under the leadership of the president. This would allow universities to take full advantage of their faculties of educational research and to serve as hubs for the development of human resources and innovation, while competing with other universities, both domestic and foreign. In addition,

with regard to the reinforcement of the leadership of the president, the selection and performance evaluation of the president and the clarification of the role of faculty meetings, the summary calls for each university to perform an overhaul and re-examination of its governance system proactively and autonomously, with a view to maximizing the functions of the university for education, research and contributions to regional society. Japan is also expected to implement effective institutional reforms and to provide substantial support of the leadership of the president and the promotion of changes in the consciousness of faculty members.

Based on these discussions, MEXT introduced the Bill for the *Partial Amendment of the School Education Act* and the *National University Corporation Act* at the 186th Session of the National Diet, in order to proactively support institutional reform by each university. Among the bill's aims are the following: to enhance the system for supporting the president by enabling the vice-president to share presidential authority, to enhance the university's ability to make prompt, proper decisions by clarifying points discussed at faculty meetings and by declaring that it is the president who makes final decisions, in addition to increasing the transparency of the selection of the president by disclosing the standards for such selection at national university corporations and the selection results.

2) Establishment of a new system for R&D corporations

Consideration is given to the establishment of a new system for incorporated administrative agencies that conduct R&D. The *Basic Policy on the Reformation of Incorporated Administrative Agencies*, approved by the Cabinet in December 2013, classifies such agencies into three groups, one of which is "R&D-oriented public corporations." Each agency is expected to build governance according to its classification. According to the policy, an R&D-oriented corporation is expected to promote the introduction of a flexible remuneration and salary system by announcing the implementation of performance-based compensation, including an annual salary system, towards of the objective of maximizing R&D results. With regard to the pay standards of researchers, it is possible to set the standards higher than those of national public officers in light of the mature of R&D work, if the R&D work is regarded as being performed effectively and efficiently.

In addition, those R&D-oriented institutes that are expected to produce world-leading results and to serve as foundations of science, technology and innovation based on the national strategy for international competitiveness will be initiated as the tentatively named Specified National Research and Development Corporations, with the chiefs of the corporations being expected to implement reforms of personnel systems, including how researchers are treated, and being expected to take necessary measures, such as the construction of a flexible salary system, with a view to building a research system that can maximize R&D results.

2 The Promotion of Active Participation by Doctoral Degree Holders in Various Arenas of Society

(1) Reform of doctoral education

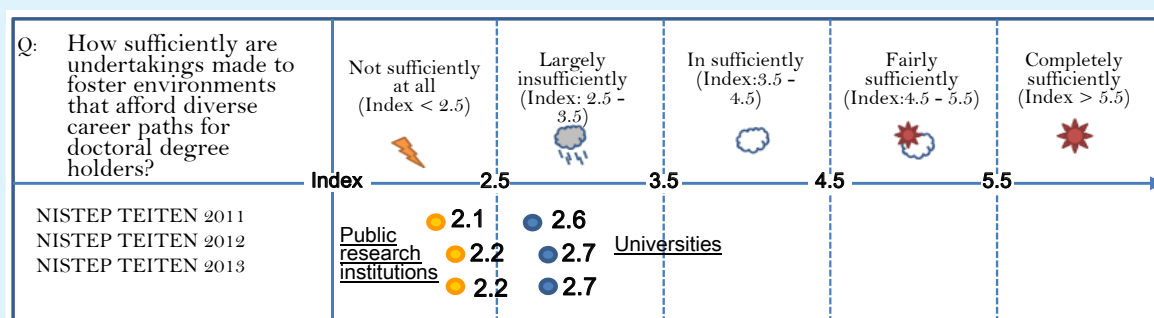
1) Changes in attitudes toward doctoral degrees and doctoral course education

In the 1990's, doctoral education quantitatively improved in our country. Such improvement was not simply for training researchers in universities, but also for training personnel with other high professional

competence in order to meet the diverse needs of society.

However, although many faculty members and doctoral students aspired to research careers, the number of posts for teachers and researchers did not increase and private companies did not hire many graduates with doctorate degrees. This has led to doctoral degree holders having not played active enough roles in various arenas of society, in addition to becoming a major factor in the excessive mobility of young researchers who have completed doctoral courses. The results of the NISTEP TEITEN survey clearly reflect the recognition that improvements in research environments are insufficient to enable graduates with doctoral degrees to select various career paths (Figure 1-2-4).

Figure 1-2-4 / Efforts at Improving Research Environments Such That Graduates with Doctoral Degrees Have Various Choices of Career Paths (Expert Survey Results)

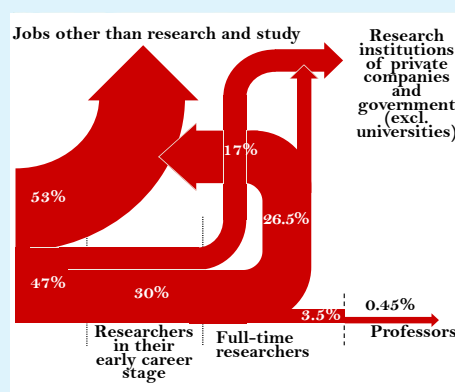


Source: MEXT based on the NISTEP the Analytical Report for 2013 NISTEP Expert Survey on Japanese S&T and Innovation System (2013 NISTEP TEITEN survey) NISTEP Report No. 157 (April 2014)

In addition, the report, “The Scientific Century,” compiled by the Royal Society, a scientific society in the United Kingdom, clearly shows the career paths for researchers who have obtained doctoral degrees and points out the reality that only a handful of doctoral students can eventually become university professors. The report stresses the need for measures to promote the securing of employment and flexibility of employment that allows talented scientists to look forward to challenging, long-lasting careers (Figure 1-2-5).

It is first necessary for students, teachers and society to change their attitudes toward doctoral degrees and doctoral course education for the sake of

Figure 1-2-5 / Careers within and beyond Science



Source: MEXT based on The Royal Society, *The Scientific Century*

diversifying the career paths of doctoral degree holders, in light of efforts being made in other countries. Students pursuing doctoral degrees have to recognize that they have to cultivate their career paths by themselves with an eye to a wider range of career paths, including positions at private companies as well as positions as faculty members. Teachers who accept students are expected to help the students to become competent enough to pursue their broad career paths, including as researchers, instead of simply regarding

doctoral students as “a research workforce.” Society is required to make deliberate efforts to utilize the advanced professional competence of researchers in various fields and to treat these students appropriately.

Based on this acknowledgment, all parts of society, including universities and private companies, have to consider how they can cultivate and utilize the abilities of doctoral degree holders and implement necessary measures. It is also important to provide financial support for doctoral students so that the best students can choose to enter a doctoral course without having financial concerns.

However, unlike the United Kingdom, Japan has not organized systematic data on the career paths of doctoral degree holders. Such data need to be secured and utilized in future policies.

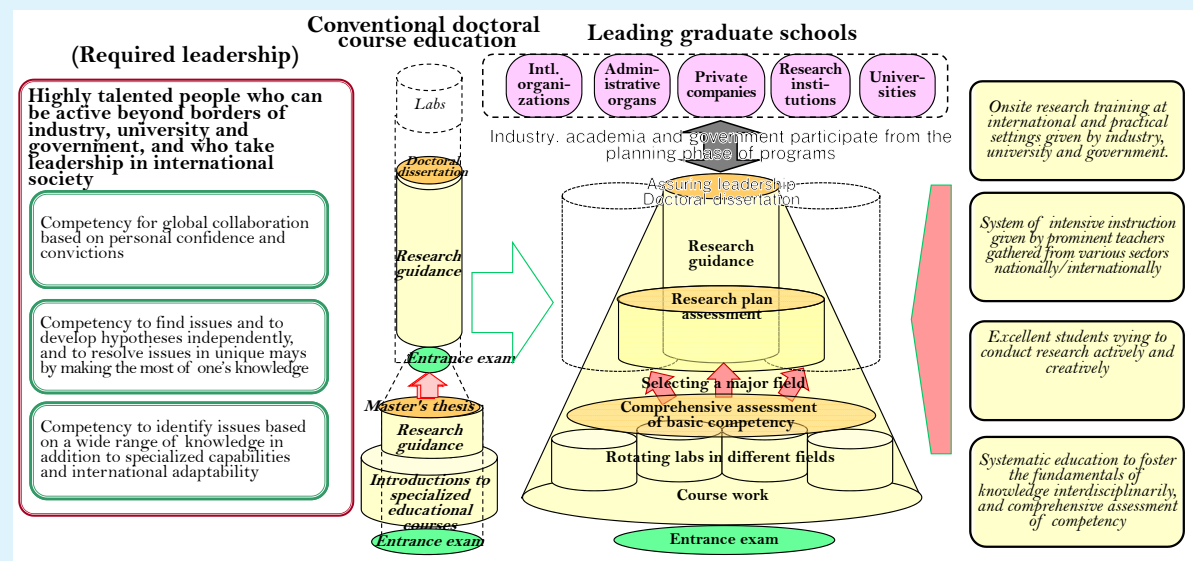
2) The creation of leading graduate schools

MEXT has decided to implement a policy that promotes measures for the further improvement and reinforcement of graduate education. This is based on the *Graduate School Education in a Globalized Society* report of the Central Council for Education (January 31, 2011) that was published by the Central Council for Education and on the *2nd Guidelines on Measures for the Promotion of Graduate School Education* (approved by MEXT on August 5, 2011) based on *the Report of the Central Council for Education*.

The policy emphasizes the importance of promoting reforms in graduate education with the aim of training doctoral degree holders who can meet the demands of society. Specifically, since FY2013 MEXT has been promoting the Program for Leading Graduate Schools in order to support fundamental reforms which will realize graduate education that will lead to the creation and development of a world-class, high-quality degree program that transcends disciplinary boundaries and integrates master's programs and doctoral programs. This program is also being promoted to enable leading graduate schools to bring together first-class instructors and students from Japan and abroad. It also promotes the participation of industry, academia and government with the goal of fostering top level students who will become global leaders with broad vision and creativity, enabling them to play active roles in industry, academia and government (Figure 1-2-6).

Under this program, students are encouraged to develop the ability to see the big picture through systematic coursework, a multiple-major system and research lab rotations, to cultivate internationality through long-term overseas education and to develop practical skills and establish career paths through internships in Japan and abroad. In addition, students can also develop their independence, creativity and expertise through activities under a guidance system that is supported by the close coordination of industry, academia and government. With the aim of training leaders who will shoulder the future of our country, 62 programs are being implemented at 30 universities.

Figure 1-2-6 / Schematic of a Leading Graduate School



Source: MEXT

(2) The promotion of active participation in private companies

1) Attitude of private companies

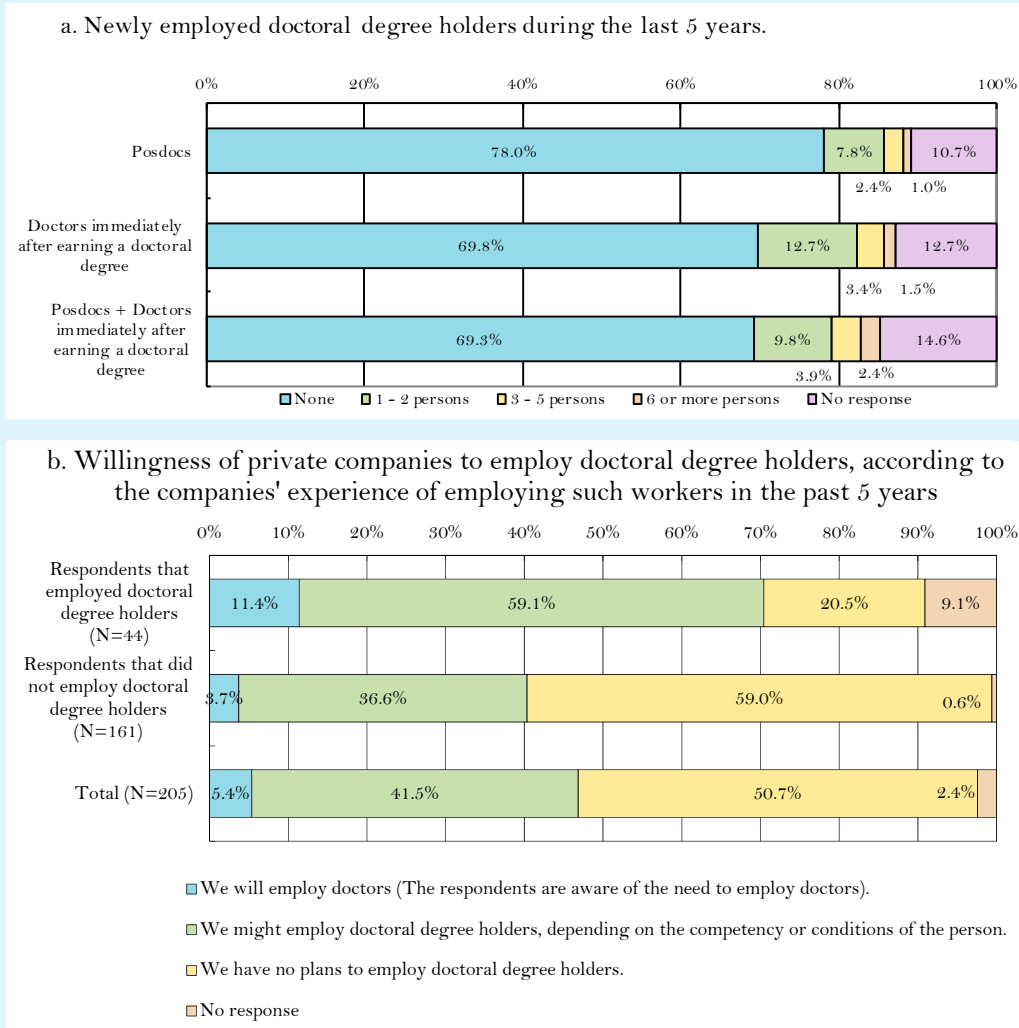
As shown in Part I, Chapter 2, Section 2 (3) about 12% of private companies employ doctoral degree holders for research and development, but only about 2.5% of private companies employ personnel who have worked as post-doctoral researchers.

In contrast, according to the *Survey on the Possibility of Utilizing Personnel with Advanced Skills, Such as Postdocs, at Small and Mid-sized Enterprises* conducted by METI, about 70% of enterprises that have employed young researchers (postdocs and doctoral degree holders) in the past five years reported the intention of employing them again (Figure 1-2-7).

In addition, with regard to the comparison between the growth in job performance of young researchers after employment to growth in their job performance expected by the employer before employment, about 70% of postdocs and doctoral graduates immediately after earning their doctoral degrees were given evaluations such as “They grew more than expected” or “They grew roughly as expected.” Their deep knowledge in specialized fields, high ability and potential, and capabilities beyond their specialized fields lead to high evaluations (Figure 1-2-8).

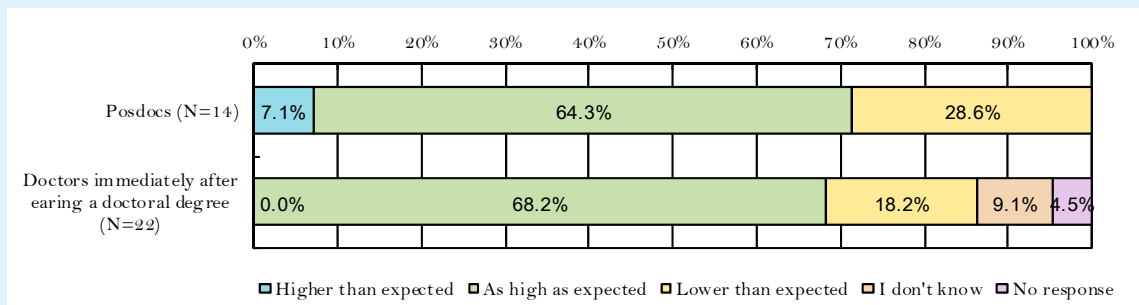
From this, it is concluded that private companies come to realize the usefulness of personnel with advanced skills, such as postdocs, after hiring them.

Figure 1-2-7 / Employment Record of Postdocs and the Like (during the past 5 years) and the Recruitment Intentions of Private Companies



Source: METI FY2011 Industrial Technology Research Project the *Survey on the Possibility of Utilizing Personnel with Advanced Skills, Such as Postdocs, in Small and Mid-sized Enterprises* (March 2012)

Figure 1-2-8 / Job Performance Growth for Doctoral Degree Holders: Actual vs. That Expected by the Employer before Employment

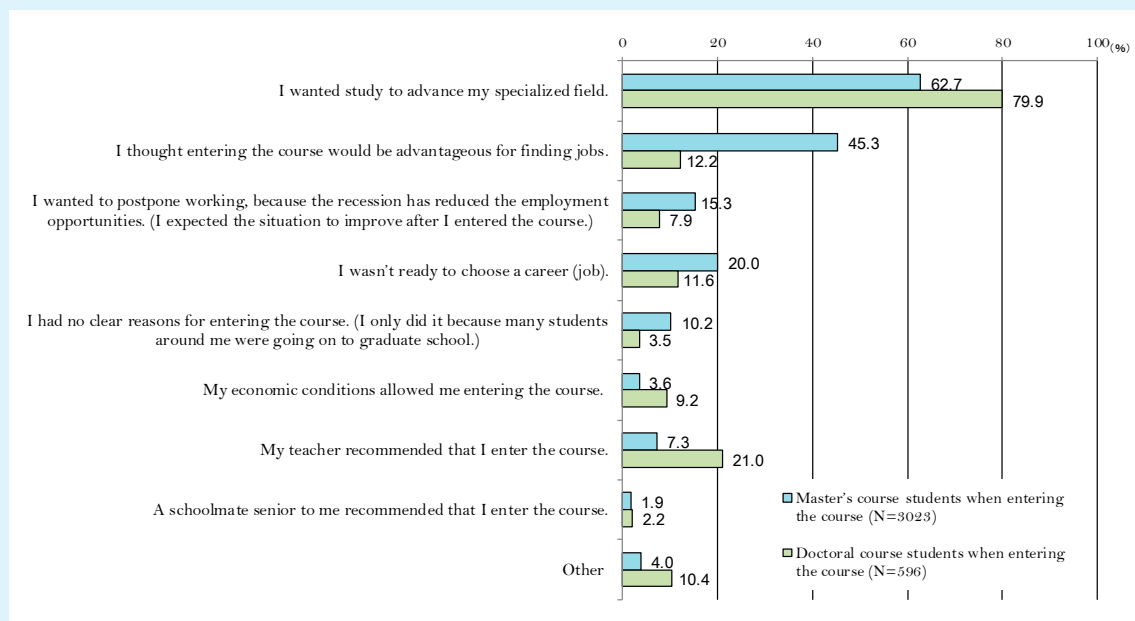


Source: METI FY2011 Industrial Technology Research Project, the *Survey on the Possibility of Utilizing Personnel with Advanced Skills, Such as Postdocs, in Small and Mid-sized Enterprises* (March 2012)

2) Attitudes of doctoral graduates toward private companies

As discussed in Chapter 1, since most doctoral students and postdocs aspire to academic positions, there is a tendency for them not to consider the option of employment at private companies. As indicated by survey results compiled by the Cabinet Office in FY2009, far fewer respondents selected the item “advantageous for employment” to a question regarding the reason for pursuing a doctoral degree, than selected the same item to a question regarding the reason for pursuing a master’s degree (Figure 1-2-9).

Figure 1-2-9 / The Expectations of Students Pursuing Master's or Doctoral Degrees

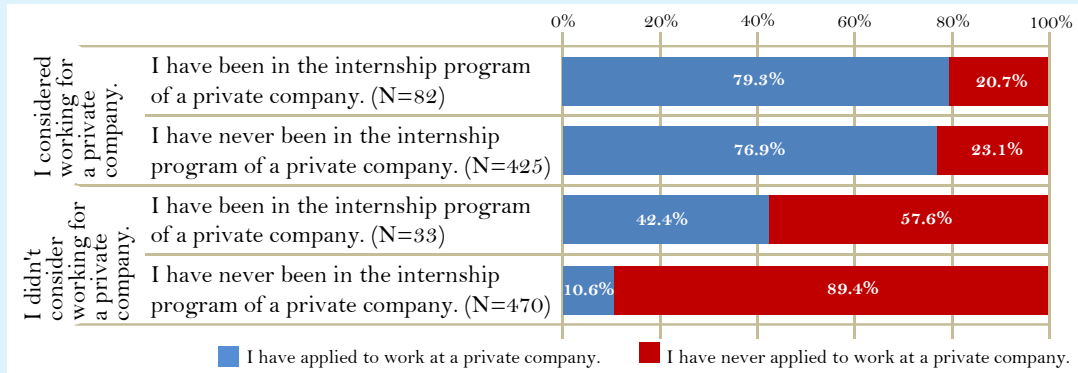


Note: The survey was of students in natural science courses.

Source: Created by MEXT based on the Cabinet Office’s *Basic Research for Reinforcing Measures for Developing Science and Technology Personnel* (March 2010)

NISTEP analyzes whether students who recently completed doctoral programs applied to work at private companies, as a function of whether such students had worked as interns at such companies. Among doctoral graduates who had not considered working at private companies when they started their doctoral course, 42.4% of those with internship experience and 10.6% of those without internship experience applied for employment at private companies. This would indicate that internship experience at private companies can inspire doctoral students to consider working at private companies (Figure 1-2-10).

Figure 1-2-10 / Internship Experience at Private Companies and Application for Employment at Private Companies Viewed in Light of Attitudes toward Working at Private Companies



Note: Questions asking about their interest in working at private companies were in check-box format, so “no answer” does not necessarily mean that a respondent is not interested in working a private company. However, in this survey report, “no answer” is regarded as meaning “not interested.”

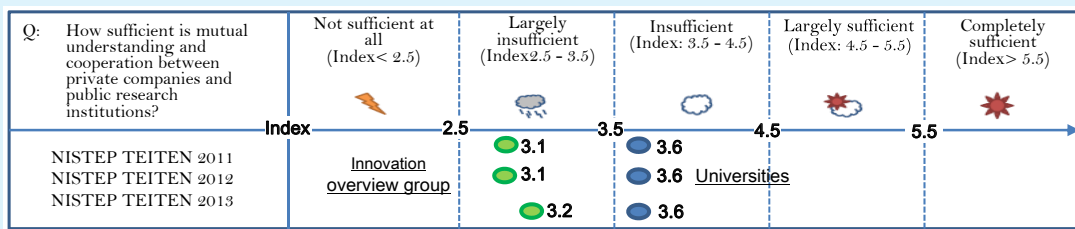
Source: National Institute of Science and Technology Policy, *Analysis of Job-seeking Attitudes and Activities of Doctoral Graduates from Universities in Japan during Fiscal 2010, Research Material No. 212* (June 2012)

3) Career development through cooperation with private companies

Private companies have come to recognize the usefulness of doctoral degree holders after observing their work performance at the companies. In addition, internship experience at private companies during doctoral studies leads to increased interest among doctoral degree holders in working at private companies. Giving doctoral and postdoc students the experience of internships at private companies would be an effective way of promoting the diversification of career paths for researchers.

The results of the NISTEP TEITEN survey reflect the strong recognition that mutual understanding and cooperation between universities/ incorporated administrative agencies and private companies in the development of human resources for R&D are not sufficient: They must cooperate more closely in promoting the participation by doctoral degree holders at private companies, based on a common understanding of doctorate degree holders by persons concerned (Figure 1-2-11).

Figure 1-2-11 / Status of Mutual Understanding between Universities/Incorporated Administrative Agencies and Private Companies toward Human Resource Development (Results of an Attitude Survey)



Note: “Innovation overview” refers to a group of respondents (the innovation overview group) from representatives of industry and intermediaries (venture capital managers, persons concerned in offices for university-industry collaboration at universities, think tanks, media, etc.).

Source: MEXT based on the NISTEP *Analytical Report for 2013 NISTEP Expert Survey on Japanese S&T and Innovation System (2013 NISTEP TEITEN survey)*, NISTEP Report No. 157 (April 2014)

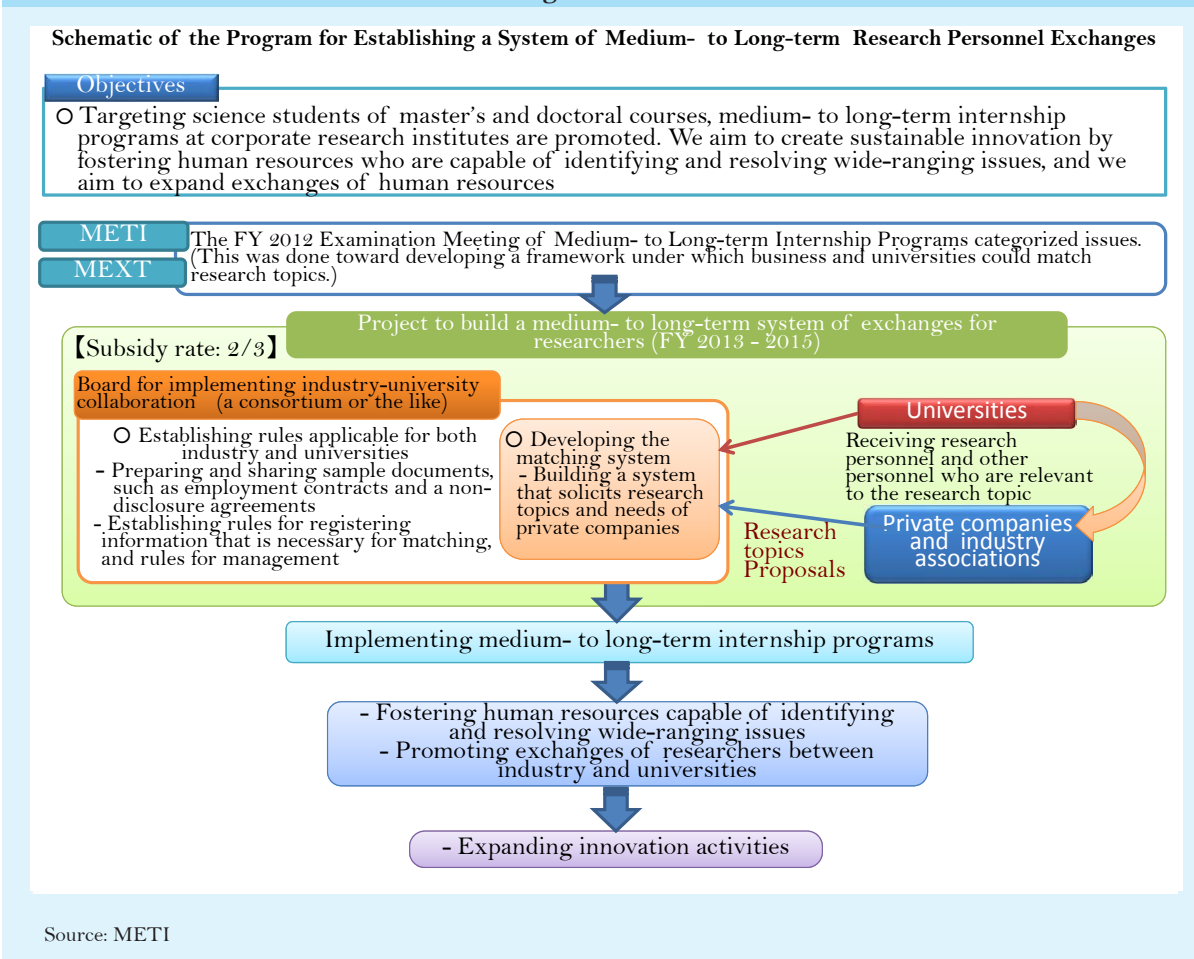
Based on this, MEXT is promoting the Career Development Program for Postdoctoral Fellows, with

cooperation between universities, incorporated administrative agencies and private companies.

In this program, MEXT encourages graduate students to experience long-term (longer than three months) internships. As of September 2012, 1,127 interns from 36 universities had been sent for internships to a total of 761 companies (50 of them international companies). In addition, 189 doctoral students and 371 postdocs of the 999 people who had completed long-term internships (513 doctoral students and 486 postdocs) took positions at private companies. There have been positive comments from companies that accepted doctoral graduates and postdocs, such as that their attitudes toward doctoral graduates and postdocs have changed for the better and that doctoral graduates and postdocs have helped companies to solve problems during their internships.

Moreover, METI is supporting universities and private enterprises in the creation of a framework consisting of multiple universities and private enterprises, toward promoting the development of human resources with the cooperation of industry and academia and toward promoting active personnel exchanges among industry, academia and government. Under this framework, private enterprises can propose a research theme and accept research personnel from universities depending on the types of themes. It is hoped this will lead to the expansion of medium- to long-term research internships and the promotion of cooperative industrial-academic activities and the mobilization of human resources, along with the development of human resources for innovative study (Figure 1-2-12).

Figure 1-2-12 / Schematic of the Program for Establishing a System of Medium- to Long-Term Research Personnel Exchanges

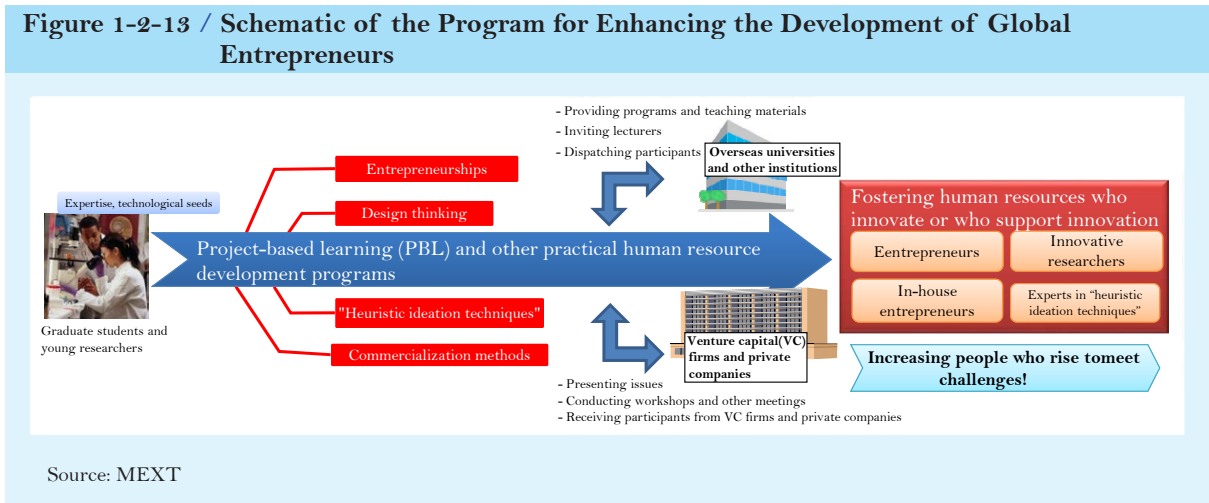


(3) Diversification of career paths

1) Educational program for young researchers

Doctoral degree holders are expected to acquire highly advanced research capabilities and knowledge that supports their research, so that they may take the initiative in various fields in society, such as industry, research support and education, by applying their knowledge and abilities. However, in order for researchers who have spent their lives in academia to be of use in industry, it is important for them to have broad vision, to cultivate abilities to define and solve problems, to become business-conscious and to cultivate a spirit of entrepreneurship on the basis of their expertise, instead of only accumulating the specialized knowledge of their research fields. Universities and research institutions are expected to provide an education which fulfills that purpose.

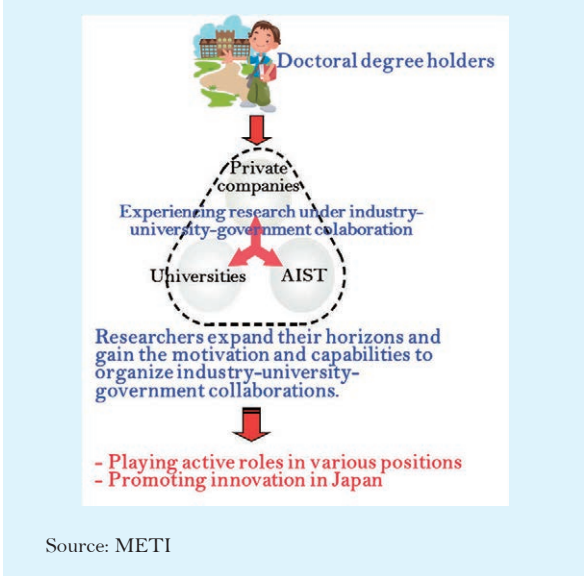
Since FY2014, MEXT has implemented the Program for Enhancing the Development of Global Entrepreneurs. In this program, which fully utilizes the human resource development function of universities, young researchers, including postdocs, can enjoy a practical human resource development program that employs Project-Based Learning (PBL) and similar programs in collaboration with venture companies and foreign universities (Figure 1-2-13).



In addition, AIST accepts young researchers with doctoral degrees as postdocs (AIST Post-Doctoral Research Scientists) and is implementing the AIST Innovation School. This school aims at fostering a broad vision and communication skills to cooperate with experts from other fields, as well as science and technology (S&T) knowledge in a specific area of expertise (Figure 1-2-14).

From FY2008 to 2013, AIST offered seven classes and accepted 235 students; thus, it has been promoting the development of innovative human resources through on-the-job training (OJT) at private companies. As of 1 April 2013, 76% of the 215 trainees who completed the course in the first to sixth graduating classes had found employment and 40% of them had taken a position at a private company. These results indicate that the school has produced good results.

Figure 1-2-14 / Schematic of the AIST School of Innovation



2) Reeducation of personnel in industry

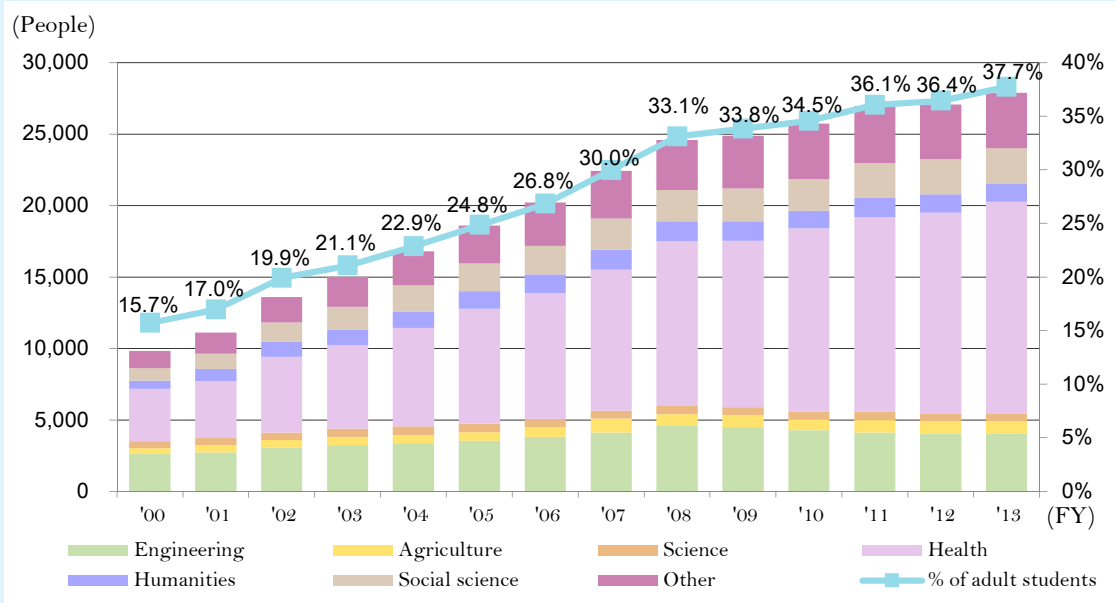
Just as it is important to utilize doctoral degree holders to benefit all of society, it is equally important for researchers and technical experts who are engaged in R&D at private companies to return to universities as mature learners, so that they may come in contact with world-leading science and technology, and enhance their R&D capabilities.

Encouraging personnel in industry to undergo re-learning programs (recurrent education) at universities is also important, so that they may acquire new skills and re-learn knowledge outside of their fields in response to advances in technology and the situation of Japanese industry. This is also important for transferring human resources across boundaries and gathering them to research areas where the need is large.

Furthermore, through students accepted from private companies by universities, industry-academia partnerships can be reinforced and other students in the same laboratory will be inspired to broaden their vision. Those interactions will lead to universities getting a better understanding of what problems private companies are facing and the type of personnel needed by them.

In recent years, the number of adult students in doctoral courses has greatly increased, although most of them are in the field of health (Figure 1-2-15). The number of students in engineering fields, which are fields closely related to industry, is higher than in FY2000, but it has gradually declined since peaking in FY2008.

Although universities have made continuous efforts to offer various re-learning programs for personnel in industry, they are expected to make further efforts to increase the attractiveness of such programs in collaboration with industry with the aim of promoting the re-learning programs. Also, enterprises can elevate their technical strengths by accepting personnel who have undergone re-learning programs, which is also expected to lead to the enhanced competitiveness of the entire country. Therefore, it is considered important for the country to take measures to support these programs.

Figure 1-2-15 / Number of Doctoral Students Who Continued to Work during Their Doctoral Program

Source: MEXT based on the *School Basic Survey*

3 A New System That Contributes to the Promotion of Mobility and Career Paths of Researchers

In promoting mobility improvements and the cultivation of diverse career paths, it is important to ensure stable employment for researchers by providing a sufficient number of a variety of positions. Realistically, that is beyond the scope of a single institution.

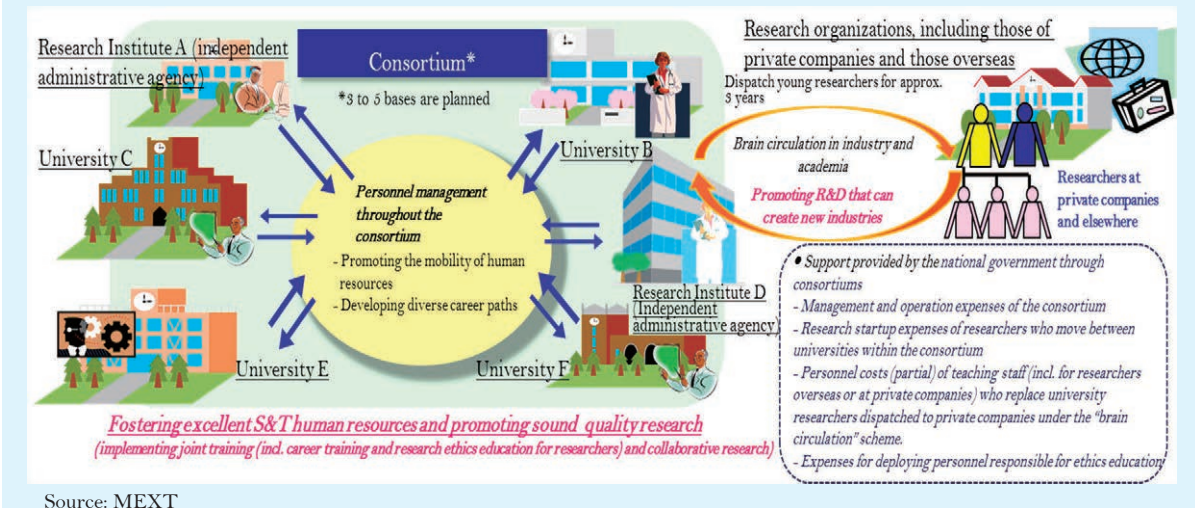
To meet this challenge, universities, public research institutions and public companies from various sectors are expected to make concerted efforts to provide a certain number of stable positions for researchers and research support personnel. They are also expected to formulate a new system with high mobility that allows researchers to play active roles at multiple research sites or projects with employment prospects for the future.

The development of this system will enable researchers to gain research experience at research institutions and private companies overseas, and at universities and public research institutions in Japan. Through these experiences, researchers can advance their careers and obtain positions appropriate to their competency and aptitude. Also, the development of this system is expected to contribute to the cultivation of various career paths for researchers, including that of research support personnel for doctorate degree holders, in addition to playing a significant role in the training and ensuring of human resources that can play a key role in enhancing partnerships among universities, public research institutions and private companies.

Toward this end, MEXT has been implementing the Project for the Establishment of a Consortium for Scientific and Technological Human Resource Development since FY2014. Under this project, multiple universities and public research institutions will create a consortium and make united efforts in promoting the mobility of excellent young researchers and research support personnel, thus ensuring stable employment and career development under the human resource management system of the entire consortium (Figure 1-2-16).

In the future, further study has to be made with the aim of building a system that will contribute to the promotion of mobility and career paths of researchers in light of the activities of the consortium.

Figure 1-2-16 / Schematic of the Consortium for Science and Technology Human Resources



Column 1-6

Mobility of Researchers in the USA

In the USA, the mobility of human resources throughout society, including in government and at private companies, is extremely high. According to the U.S. Bureau of Labor Statistics (hereinafter: the BLS), the average length of service of average workers in the USA (overall mean) was 4.6 years (as of January 2012), and in terms of age group, it is 3.2 years between the ages of 25 to 34 and 5.4 years between the ages of 25 to 54, a span of 30 years. This shows that the average worker in the USA changes jobs six times between the ages of 25 and 54, which is the period when labor productivity is the highest. In contrast, the average length of service of average workers in our country (overall mean) was 11.9 years (as of June 2011) and it was 11.4 years¹ between the ages of 25 to 54, a span of 30 years. This indicates that workers in our country do not change jobs as often as those in other countries.

Most Americans lead lives of greater freedom than Japanese enjoy, not tied to a specific place or group of people. This is regarded as closely reflecting their history and culture. According to an article by a researcher working overseas², undergraduate students usually do not go on to study at the graduate school of the same university, and this trend in mobility can be seen among researchers at tenure-track positions and high-ranking persons such as deans or presidents. The mobile lifestyle of Americans is reflected in their academic world.

In the USA, teaching staff at universities are no different from people in other professions in tending to be on the lookout for better job opportunities. In the USA, it is not a major decision for a university teacher to apply for a teaching position at another university, and turning down offers does not lead to conflict. The freedoms and rights of individuals are respected to the maximum extent, which is the best thing about the U.S. Researchers take the initiative in negotiating counteroffers in pursuit of the optimum research environments (salary, research space, content and load of teaching, etc.) and living environments. Counteroffers made by the current university in order to keep a researcher who is about to leave are viewed by people outside the current university as representing how much that researcher has contributed to the quality of the current university. Behind the spread of counteroffers as a recruitment system for faculty members (researchers) lies the idea that faculty members always belong to the larger world of academia and that if they can earn a higher reputation from the outside world, they should be evaluated as such on campus too, since their value as researchers depends on external evaluation. In light of this, in the USA, there can be differences in how teachers of the same age and the same position are treated. Under such a system, which is far from a non-merit-based system, they view the treatment they receive as reflecting an assessment of their capabilities, which also serves as an incentive for them to make further efforts to work under better conditions.

In the USA, people respect the freedoms and rights of individuals to the maximum degree, and the principle of competition is widely accepted in society as a natural thing. This is regarded as a major factor that leads to the wide spread of recruitment systems with counter offers and the production of positive mobility among researchers.

¹ The Japan Institute for Labor Policy and Training, *Databook of International Labour Statistics 2013*. (March 2013)

² *Comparative Physiology and Biochemistry, News from Overseas, Vol. 18, No. 2*

Mobility Status of Researchers in Europe

In Europe, based on the recognition that securing researchers and their mobility are crucial factors for the improvement of S&T capabilities and economic growth, the Mobility Patterns and Career Paths of EU Researchers (MORE) Project started in 2008 with the aim of understanding the current situation of researchers' mobility¹.

Under the project, statistical data was collected and researchers were surveyed by questionnaire. From these, investigations were made on the number and mobility of researchers in Europe and elements that affect their mobility. The final report was compiled in 2010. Furthermore, with a view to examining, improving and combining the results of the MORE Project, the MORE2 Project was implemented, and the final report was compiled in August 2013.

The same report makes eight policy proposals. Among them are the establishment of common definitions of "mobility" and the definition of various aspects of "mobility," the promotion of activities of doctoral degree holders at private companies, collaboration with European researchers working overseas and support for their return to their countries, and the careful examination of advantages and disadvantages of mobility. In addition, clarification was made of the overall situation regarding the number of researchers, the career paths and the employment and mobility status of researchers, mainly those working at institutions for higher education.

Main points discussed in the MORE2 written report (only the portions pertaining to mobility)

Number of researchers

- Researchers in the 27 EU countries number 2.44 million (a full-time equivalent labor force of 1.59 million).
- Researchers accounted for 0.66% of the labor force (active population) as of 2010, which is higher than the figure for 2000 (0.49%) but lower than those of the USA and Japan.

International mobility

- 14% of recent doctoral awardees earned their doctoral degrees overseas and 18% of them engaged in research abroad when they were pursuing their doctoral degrees. (They earned doctoral degrees in their own countries.)
- 31% of researchers at institutions for higher education (hereinafter: researchers) have had at least 3 months of research experience abroad (after obtaining doctoral degrees), and about 40% of them (12% of the total) transferred to new positions during the past ten years.
- 17% of the researchers had at least 3 months of research experience abroad more than ten years ago, and simply combining them with the above-mentioned researchers indicates that 48% of the researchers had at least 3 months of research experience abroad.
- 41% of the researchers had at least 3 months of experience in studying abroad during the past ten years (after obtaining doctoral degrees), but 31% of the researchers did not have research experience abroad during the same period.

Cross-sectoral transfer

- 23% of the researchers experienced cross-sectoral transfer as doctoral students: 4% went to private companies, 9% went to private non-profit organizations, and 10% went to governmental organizations.
- 30% of the researchers experienced cross-sectoral transfer after obtaining their doctoral degrees: 12% went to private companies, 7% went to private non-profit organizations, and 15% went to governmental organizations. Additionally, 13% of researchers have held positions both within and beyond academia.

Motivations and obstacles regarding international transfers

- The primary motivation of researchers for international transfers was "career development," followed by "research collaboration with leading researchers," "superior facilities and equipment" and "the acquisition of research funds." "Social status and job security" are not emphasized so much.
- With regard to transfers that involve changes in the types of work, "career development" was cited as a primary motivation for transfer, followed by "opportunity to take a new post."
- In contrast, obstacles to transfers are almost the same for young researchers as for senior researchers: The primary one is "difficulty of acquiring funds for transfer and research," followed by "difficulty of securing of appropriate post."
- Researchers who have not experienced transfers tend to think that family problems would make their transfer difficult.

Effects of international transfers

- Most researchers feel that international transfers have a great impact on the improvement of research results and research capabilities. In addition, many researchers think international transfers result in the acquisition of cutting-edge research skills and the formation of an international network, in addition to contributing to high-quality results.
- However, not a few researchers point out that international transfers can lead to reductions in salary and job opportunities. This is probably because they missed opportunities for career development in their own countries by experiencing unwanted transfers.

¹ <http://ec.europa.eu/euraxess/index.cfm/services/researchPolicies>