(4) Expansion of financial support for doctoral students

In order to secure excellent researchers, it is necessary to encourage talented students to proceed to doctoral courses and to provide them with financial support. Therefore, the 3rd Basic Plan aims to enable about 20% of doctoral students to receive financial support equivalent in amount to their living expenses.

To this end, MEXT enhanced, as a priority, support for doctoral students that is provided through the "JSPS Research Fellowship for Young Scientists" and expanded the amount of competitive funds that can be used to appoint students as teaching assistants (TA), which lets graduate students assist educational activities, and as research assistants (RA), which allows doctoral students to participate in research projects conducted by universities. The "JST Basic Research Programs" also has been supporting the employment of excellent doctoral students as RAs.

The Japan Student Services Organization implemented loan programs for those who have ability but are not possible to go to school due to economic reasons, and exemption of repayment for those who achieved especially outstanding results.

3 Development of Human Resources that Meet Social Needs

(1) Nurturing competent human resources through industry-academia collaboration

For Japan to maintain its prowess in industrial technologies and achieve sustainable development, it is important to develop, by taking account of the needs of the society including the industrial sector, competent persons that meet such needs and that can adapt to change in the needs. To do so, it is essential for universities, companies, and other actors to construct cooperative relationship to work together.

Therefore, MEXT and METI are promoting the "Industry-Academia Collaboration for Fostering Competent Human Resources [literal translation]" to provide opportunities to communicate and carry out the activities in relation to human resources between universities and industries, and implemented the "Career Development Program for Foreign Students from Asia" to attract excellent foreign students from Asian countries to Japan and promotes their activities within Japanese corporations.

MEXT promotes development of human resources through industry-academia collaboration at universities, by the Support Program for Fostering Manufacturing Engineers [literal translation], which supports fostering of engineers involved in manufacturing through cooperation of regional communities and industries, and the Program for Service Innovation Human Resource Development, which cultivate competent human resources contribute to creation of innovations through improvement in service productivity.

MEXT implemented the Strategic Program for Fostering Environmental Leaders under the Special Coordination Funds for Promoting Science and Technology, in order to establish centers at which foreign students from Asian and other countries can study together with Japanese students so that competent persons who have the leadership potential to solve environmental problems in developing countries (called environmental leaders) can be fostered. At present, project is going on in 12 organizations.

MOE has been implementing the project to establish an industry-academia-government collaboration, "Environmental Consortium for Leadership Development (EcoLeaD)," based on the "Vision of University-led Environmental Leadership Initiatives for Asian Sustainability," which was set forth in March 2008, to train people (green human resource) to work on socio-economic green actively.

METI supports the program for fostering competent human resources through industry-academia

collaboration based on the achievements of the above-mentioned Industry-Academia Partnership.

In small and medium enterprises, passing down of techniques and skills, as well as training and acquisition of young technicians are becoming immediate problems. Hence, METI implemented measures to support fostering competent human resources by enhancing practical training programs through the collaboration of industries, technical colleges, and administration in the respective regions to send technicians from industries to technical colleges and also by providing on-site practices to students and teachers. In addition, METI has implemented dissemination and promotion of a program for the systematic fostering of basic skills in various areas at universities, which comprise of "capacity to step forward," "capacity to think out," and "capacity to work in team," so that university students can develop the abilities that are required by society through industry-academia collaboration.

(2) Promotion of the activities of Ph.D holders in Industry or else

Amid the deepening and diversifying relationship between S&T and society, it is necessary to secure various career paths where competent human resources such as Ph.D holders and post-docs that lead the growth of Japan, can play an active role not only at universities and research institutions but also in various fields of society such as the industrial sector and public administrations. Thus, MEXT has implemented project, the "Young researchers training program for promoting innovation" (Special Coordination Funds for Promoting S&T) and supporting long term internship in companies for doctoral students and post-docs and in FY 2010 so far 23 organizations are promoting this project.

The AIST is recruiting Ph.D holders for joint research projects to train human resources capable of making contributions to the corporation immediately, based on coordination or collaboration agreement with corporations. In addition, to foster competent persons who can contribute to innovation in industries, namely the personnel who possess advanced knowledge in specialized fields, communication skills that enable cooperation with experts from different fields and have broader perspectives and cooperativeness, AIST has established the "AIST School of Innovation" where post-docs and doctoral students engage in research projects at AIST or receive on-the-job training (OJT) at companies for practical high-level education.

METI is trying to promote and recruit for creating next-generation industries such as a low carbon society and medical technologies to reinvigorate the local economies. However, since it is difficult to secure high-level R&D human resources, in FY 2010, METI has implemented the "Project to support employment and training of people in the advanced technologies for next-generation in small-medium sized enterprise" to support recruitment and training of people in the advanced technologies while collaborating with local universities, public research institutions, private sector, local governments etc, (13 centers were selected).

(3) Development of diverse human resources responsible for utilizing and returning knowledge to society

(Development of competent human resources related to intellectual properties and management of technology)

In order to promote the creation of innovation, it is necessary to foster competent human resources capable of creating, protecting and utilizing intellectual properties and those capable of effectively leading

the results of R&D to the creation of market value based on understanding of both technology and business management.

MEXT promotes voluntary efforts by universities in this regard by supporting educational projects related to intellectual properties. For the purpose of fostering advanced professionals in areas such as management of technology, professional graduate schools with a total of 184 majors were in place as of May 2010.

(Training S&T communicators)

To be supported by the citizens and to promote S&T with the citizens, it is necessary to foster and promote the activities of S&T communicators, personnel suited for promoting communications between scientists/engineers and ordinary people by explaining S&T in an easy-to-understand manner and by conveying the concerns of the society to scientists/engineers.

The National Museum of Nature and Science has opened the "Science Communicator Training Program" and the National Museum of Emerging Science and Innovation is actively promoting efforts to foster S&T communicators through activities such as developing and explaining exhibitions.

(Fostering and securing engineers)

To become an advanced S&T-oriented nation, it is necessary to create industrial frontiers and strengthen international competitiveness through technological innovation, as well as to strengthen the technological platform. For this purpose, efforts are being made to foster sufficient leading engineers through the following policies

1) Professional engineer system

The professional engineer system was established with the enactment of the Professional Engineer Act in 1957 (revised in 1983). It aims to contribute to the improvement of S&T and the development of the national economy through sound engineering, by conferring the qualification of professional engineer on those who possess advanced and specialized abilities in applying S&T to planning and design work.

In order to become a professional engineer, it is required to pass the national examination that judges whether the applicants possess highly specialized application abilities in individual 21 fields of specialization. Then, registration is needed. The examinations are held annually. Examination consists of two steps. The first stage requires specialized knowledge that is equivalent to engineering degree graduate, and the second-stage requires highly specialized application ability of the knowledge in there fields. In FY 2010, 8,017 applicants passed the first stage examination, and 4,117 applicants passed the second stage examination. The breakdowns of the successful applicants for the second stage examination are listed in the Table 2-3-1.

Table 2-3-1/ The breakdowns of the certified professional engineers in FY 2010

Technical Discipline	Applicant (persons)	Certified (persons)	Rate of certified people (%)
Mechanical Engineering	976	229	23.5
Marine & Ocean	10	3	30.0
Aerospace	30	6	20.0
Electrical & Electronics Engineering	1,472	213	14.5
Chemistry	147	31	21.1
Textiles	27	6	22.2
Metals	132	40	30.3
Mining	29	7	24.1
Civil Engineering	15,304	1,927	12.6
Water Supply & Sewerage	1,714	330	19.3
Environmental Engineering	628	78	12.4

Technical Discipline	Applicant (persons)	Certified (persons)	Rate of certified people (%)
Agriculture	878	189	21.5
Forest	271	63	23.2
Fisheries	136	30	22.1
Industrial Engineering	156	38	24.4
Information Engineering	618	63	10.2
Applied Science	777	150	19.3
Biotechnology & Bioengineering	78	15	19.2
Environment	745	121	16.2
Nuclear & Radiation	164	38	23.2
Comprehensive Technical Management	3,570	540	15.1

Source: Created by NEXT

2) Supporting the continuous development of engineer abilities

JST supports engineers in acquiring extensive basic knowledge in S&T and knowledge of failure by providing internet educational tools for self-learning that cover the respective areas of S&T and across different areas at http://weblearningplaza.jst.go.jp/, as well as the Failure Knowledge Database at http://shippai.jst.go.jp/ that includes failure cases until end of March 2011, in the S&T field together with lessons learned from failures.

3) Others

MEXT held the "Conference of collaborators in relation to how practical education should be for engineers in universities [literal translation]" for the purpose of further enhancing the training of engineers, and examining how to train necessary capacities and skills of engineers in the "program to foster expert engineers" and to maintain the quality of education for engineers which is summarized in the report in June 2010. In the future, investigation research will be conducted to set up "Attainment of goals categorized by fields [Literal translation]" for education of engineers in universities, based on the learning

outcome evaluation standards outlining the career path of engineers to the "Desired image of engineers."

AIST continued the program to foster expert engineers, in order to train engineers to acquire advanced expertise useful for R&D by utilizing its versatile research activities and the cutting-edge research infrastructure.

4 Expanding the Range of Next-generation S&T-related Human Resources

To foster next-generation S&T-related human resources, the government has systematically promoted the enhancement of mathematics and science education. This creates an environment in which children at the level of elementary, lower secondary education can become friendly with and learn S&T and develops an effective environment that fosters the ability of children who are interested in mathematics and science.

The CSTP has promoted S&T extensively by planning and implementing activities including poster presentations on Super Science High School (SSH) and discussion with Nobel prize scientists at "Science and Technology Festa in Kyoto" held in the Kyoto International Conference Center in June 2010.

(1) Fostering children brimming with intellectual curiosity

In order to enhance observation and experiment activities and the capabilities of teachers in elementary school science classes, JST utilizes outside personnel including undergraduate (graduate) students, and retired teaching staffs as nature study support staff in the "Science education assistants allocation program." In FY 2010, the program was implemented in all of the prefectures and government-designated cities. Collaborating with the school boards, universities and graduate schools have implemented support project to train teachers in elementary and junior high school to be the central personnel with excellent instructing capability in mathematics and science education in their schools or in the community. In FY 2010, 12 universities are receiving support. It is also implementing "Science Partnership Project," as a collaboration project among schools, boards of education, universities, and science museums, emphasized in hands-on and problem-solving approaches, intending for enhancing their interest and intellectual curiosity regarding S&T, natural sciences, and mathematics. More specifically, these initiatives include educational activities such as observations and experiments supervised by front-line researchers and engineers, and science camps (residential learning activities) for hands-on S&T lessons in the latest research environment, and other activities. In addition, JST is engaged in the development of digital materials for science education and provision of such materials to schools via internet.

In MEXT, efforts are underway, based on the Act for Promotion of Science Education [literal translation], to systematically enhance the facilities and equipment used in science and mathematics education at elementary, lower secondary, and upper secondary schools, as they are insufficient in number and outdated in many cases.

METI is implementing the "Education support project utilizing part-time outside lecturers [literal translation]" to create curriculums of elementary school sciences classes in connection with the technologies owned by local corporations, to discover part-time outside lecturers from industrial professionals, including corporate technicians, etc., and to construct local networks in the industry-academia and among educational institutions, among other projects.

METI supports career education to encourage children to understand work through the first-hand experience of manufacturing technology, etc. The ministry launched a coordinator fostering program for

the further enhancement of career education in response to the increasing need for coordinators to combine the industry with local schools. In addition, to help lower and upper secondary school students flesh out their future career perspectives and improve the effectiveness of their classes by showing knowledge-society linkage and careers in engineering while utilizing local industrial engineers and facilities, METI not only executed development and verification tests of the programs designed to locate cooperative enterprises and link industrial technology with basic knowledge acquired through education, but developed networks between organizations of industry and academia in the "Project targeted at school students for fostering engineering-related personnel [literal translation]."

(2) Development of the individuality and capacity of talented children

MEXT promoted, with the support of JST, the development of S&T-related personnel capable of playing an active role internationally by designating upper secondary schools and other schools that focus on science and mathematics education as Super Science High Schools. Specifically, efforts are underway to develop and implement curriculums that do not follow the National Curriculum Standards and promoting research projects. In FY 2010, 125 upper secondary schools engaged in unique efforts in this regard. In addition, it is implementing the "Project to support science and mathematics students [literal translation]" to promote intensive projects to enhance motivation and capacity of the students who have already shown strong learning motivation in mathematics and science fields in universities with the faculties of natural sciences, for the purpose of fostering significant S&T human resources.

JST supports domestic competitions of international S&T contests in mathematics, physics, chemistry, biology, informatics, geography, earth science, etc., the dispatch of Japanese teams to international competitions, and international contests within Japan. (In FY 2010, the International Chemistry Olympiad was held in Tokyo.) (Figure 2-3-2) It also implements the program "Fostering Next-generation Scientist" to foster excellent, aspiring scientists by supporting projects carried out by universities in order to provide a continuous supply of high-level, evolutionary learning experiences outside the schools throughout the year to pupils who have excellent motivation and ability in science and mathematics.

The Japan Patent office creates textbooks and side readers to enhance IP literacy for students in elementary schools, junior high schools, high schools, technical colleges, and universities through the National Center for Industrial Property Information and Training (INPIT) and offer these materials for free to institutions when requested. It also holds seminars for elementary to university students and teachers throughout the country using these textbooks and side readers.

In addition, it hosts patent contests and design patent contests for the purpose of enhancing the understanding towards the IP system through first-hand experience for high school and university students. Excellent inventions and designs contributed to the contests will be the actual candidate for patent protection while the students actually take the procedures of patent or design registration applications.

Furthermore, it is important to develop the individuality and capacity of talented pupils and students, and improvement in the interconnection between upper secondary schools and universities is essential for that. In this regard, in FY 2010, about 70% or more of universities adopted the admission office (AO) entrance examination, which comprehensively evaluates the applicants' capacity, aptitudes, motivation, and so on.

Figure 2-3-2/ Winners of International Science and Technology Contests in FY 2010

International Mathematics Olympiad, Kazakhstan

From the left,

Genki Shimizu	11th gr. Nada Jr. & Sr. H.S., Silver
Takuma Kitamura	10th gr. Nada Jr. & Sr. H.S., Silver
Akio Kishikawa	12th gr. Kurume Univ. Jr. & Sr. H.S., Gold
Shutaro Inoue	12th gr. Nada Jr. & Sr. H.S., Gold
Hiroki Koshiyama	11th gr. Koyogakuin Jr. & Sr. H.S., Silver
Naoto Kura	12th gr. Seikogakuin Jr. & Sr. H.S., Honorable mention

International Physics Olympiad, Croatia

From the left,

Yuui Sawa	12th gr. Nada Jr. & Sr. H.S., Honorable mention
Ayako Mano	12th gr. Nanzan Girls' Jr. & Sr. H.S., Bronze
Ryusuke Hamazaki	12th gr. Eiko Gakuen Jr. & Sr. H.S., Silver
Ryosuke Masuda	12th gr. Osaka Seiko Gakuin Jr. & Sr. H.S., Bronze
Atsushi Yamamura	11th gr. Nada Jr. & Sr. H.S., Bronze

International Chemistry Olympiad, Japan

From the left;

Hiroki Uratani	11th gr. Shiga Prefectural Zeze H.S., Bronze
Kenichi Endo	12th gr. Eiko Gakuen Junior and Senior H.S., Gold
Kengo Kataoka	12th gr. Jr. & Sr. H.S. at Komaba, Tsukuba Univ., Silver
Hayate Saito	11th gr. Nada Jr. & Sr. H.S., Gold

Photos: (Math) Mathematical Olympiad Foundation of Japan, (Physics) Japan Physics Olympiad Committee, (Chemistry) ICHO Japan Committee, (Biology) Japan Biology Olympiad, (Informatics) The Japanese Committee for the IOI, (Geography) Japan International Geography Olympiad Committee, (Earth Science) Japan Earth Science Olympiad Committee

International Biology Olympiad, Korea

From the left,

Tomoyuki Mikamai	11th gr. LaSalle Jr. & Sr. H.S., Silver
Tomohito Minakuchi	12th gr. The Kaisei Jr. and Sr. H.S., Silver
Saori Kurihara	11th gr. Hokkaido Sapporo Nishi H.S., Gold
Risa Sakamoto	12th gr. Shibuya Jr. & Sr. H.S., Silver

International Olympiad in Informatics, Canada

From the left,

Masaki Hara	11th gr. Jr. & Sr. H.S. at Komaba, Tsukuba Univ., Gold
Hiroshi Yamashita	12th gr. Nada Jr. & Sr. H.S., Silver
Kensuke Imanishi	11th gr. Yachiyoshoin Gakuen Jr. & Sr. H.S., Silver
Shogo Murai	10th gr. The Kaisei Jr. and Sr. H.S., Gold

International Geography Olympiad, Taiwan

From the left,

Taro Suzuki	12th gr. Tajimi Nishi H.S.
Kazuhiro Noda	12th gr. Hiroshima Gakuin Jr. & Sr. H.S.
Atsushi Taguchi	12th gr. Jr. & Sr. H.S. at Komaba, Tsukuba Univ, Bronze
Yuta Tanaka	11th gr. Jr. & Sr. H.S. at Komaba, Tsukuba Univ.

International Earth Science Olympiad, Indonesia

From the left,

Kenta Takeuchi	12th gr. Seiko Gakuin Jr. & Sr. H.S., Silver
Takashi Kawashima	12th gr. Shizuoka Prefectural Iwata-Minami H.S., Silver
Taichi Onishi	11th gr. Hakuyo Jr. & Sr. H.S., Silver
Kazuhiro Noda	12th gr. Hiroshima Gakuin Jr. & Sr. H.S., Gold