AIST Report 2017

Social and Environmental Report

Full Research
in Society,
for Society

National Institute of
Advanced Industrial Science
and Technology
AIST

CHARTER

Full Research in Society, for Society

National Institute of Advanced Industrial Science and Technology (AIST), An Independent Administrative Institution

The common goal of humankind is to realize a society in which every person can enjoy a comfortable life. Science and technology can lead the way to such a society. The mission entrusted to AIST and its staff, as members of the scientific community, is to develop science and technology that complements society and the environment.

We, the staff members of AIST, recognize our mission and responsibility to society. We work towards the realization of such a society through research and development in industrial science and technology.

■ Accurate Assessment of Social Trends

We endeavor to ascertain social trends and needs at every level of society from local communities to the international stage, to identify key issues promptly, and to propose scientific and technological solutions in collaboration with other organizations.

■ Creation of Knowledge and Technology

We value each person's autonomy and creativity and display our collective strength through collaboration and synergy, creating new knowledge and innovative technology based on advanced research efforts.

■ Application of Research Findings

We contribute to Japan's industrial development by applying our research findings to academic pursuits, intellectual infrastructure development, technology transfer, and policy proposals. We endeavor to enhance and disseminate science and technology through human resources development and the open sharing of information.

■ Responsible Conduct

We are actively involved in improving our own abilities and our working environment in order to perform our duties more effectively. We respect both the letter and the spirit of the law and maintain a strict sense of ethics in all our affairs.

Charter of the Environmental Safety

- We strive to promote research activities that contribute to the global environmental protection and the security of mankind and pursue our work to realize a safe and reliable society of high quality of life harmonious with the environment.
- In compliance with the applicable laws and regulations related to environmental protection, we establish the autonomous standards of the institute such as Safety Guideline, etc. and with this in mind, we shall endeavor to conserve environment and promote health and safety at all times.
- We promote the dissemination of information related to the environmental protection and make every effort to be in harmony with and coexist with the local community. Naturally, in case of disasters or emergencies, we take prompt and proper measures to deal with the situation.

Furthermore, in conformity with the 'principles of disclosure,' we shall endeavor to return the knowledge acquired and accumulated to society.

Editorial Policy

The National Institute of Advanced Industrial Science and Technology (AIST) first published an environmental report in fiscal year (FY) 2004. Since FY 2010, AIST has published the AIST Report, which is an environmental report combined with a report on its activities on corporate social responsibility (CSR).

AIST Report 2017 Social and Environmental Report provides easily comprehensible introductions to research activities of particular interest to society, including a special article on AIST's Artificial Intelligence Research Center, which is aimed at further deployment in society of artificial intelligence (AI), a major topic in recent years. AIST Report also describes AIST research that addresses urgent problems with the development of energy efficiency, infrastructure inspections, and healthcare equipment, and work on technology transfers to effectively provide the fruits of AIST's technological research to industry. Through this content, we hope that our many stakeholders will understand AIST's diverse activities and that a deeper relationship of trust will be built between AIST and society.

Detailed data on environmental report-related activities at each research base are available on AIST's website.

AIST's official website:
www.aist.go.jp/index_en.html

Activities covered by the report
Research activities at all AIST research bases

Period covered by the report
April 2016 to March 2017

Areas covered by the report
Key areas covered include organizational governance, human rights, labor practice, fair operating practice, community involvement, environmental report, occupational health and safety and open innovation activities.

Rounding of numbers
Numbers are rounded off to the specified whole number.

Referenced guidelines and other sources
- 2012 Environmental Report Guidelines, Ministry of the Environment
- Law Concerning the Promotion of Business Activities with Environmental Consideration by Specified Corporations, etc., by Facilitating Access to Environmental Information, and Other Measures
- Guidance on Information to be Provided in the Environmental Report (3rd Edition), Ministry of the Environment
- ISO 26000: 2010 Guidance on Social Responsibility, Japanese Version, Japanese Standards Association

Scheduled date of the next edition
September 2018 (Japanese edition)

Table of Contents

To realize a sustainable society by building low-carbon, sound material cycle in harmony with nature, the National Institute of Advanced Industrial Science and Technology (AIST) conducts seamless R&D from fundamental and basic research in non-competitive areas that are difficult for businesses to address to technological developments that can be commercialized and industrialized in cooperation with business, particularly focusing on green, life and information technologies. Since embarking on our Fourth Medium- to Long-Term Plan (five years) in April 2015, we have promoted entrepreneurial activities to spur on industry in Japan and contribute to the development of society; our policies for action are "transfers of innovative technologies" and "goal-oriented basic research that leads to technology transfers."

Under a special measures act that came into force in October 2016, AIST became a designated national research and development institute, together with the Institute of Physical and Chemical Research (RIKEN) and the National Institute for Materials Science (NIMS). With this designation, AIST is expected to play greater roles to raise the standards of science and technology in Japan and to contribute to improvements in people's lives and to economic development. To meet these expectations, we are striving for world-class R&D and staff development.

In March 2017, the global news agency Reuters published rankings of how the world's national research institutes drive innovation, based on data on academic papers and patents. AIST was ranked fifth, alongside the world's best-known national research institutes.

Many researchers from around the world are coming to AIST's Tsukuba Center, Fukushima Renewable Energy Institute, and Tokyo Waterfront Bio-IT Integrated Technology Base to conduct R&D in cooperation with AIST. Including visiting researchers from businesses, universities and elsewhere along with postdocs and temporary researchers, 8000 to 9000 staff are conducting research activities at all times at AIST.

For AIST to transfer the fruits of its research to industry and ensure return of the benefits to society, a system is necessary to clearly set the goals of research and efficiently link the fruits of research to innovation. Since last year, AIST has been promoting Open Innovation Laboratories (OIL), establishing collaborative research bases within the grounds of universities. By leveraging the research in which each university excels in combination with the technologies in which AIST is strong, we are laying a direct path from basic research to application research and practical development, with the aim of speeding up R&D. We have already set up and commenced OIL activities at seven universities around Japan. In our collaborations with business, we are promoting the establishment of "corporate brand labs," collaborative laboratories within AIST branded with the names of partner enterprises, using funds provided by those enterprises. AIST is assisting these enterprises in research fields particular to their business needs, with the goal of promoting effective and efficient R&D. So far we have set up these labs with seven enterprises and are conducting cooperative research. In our collaborations with public bodies, we have started cooperative research

National Institute of Advanced Industrial Science and Technology (AIST)
President

Ryoji Chubachi

Conducting World-class R&D and Contributing to Japan's Industry and Society

—Creating open platforms for research activities and driving staff development—

pursuing high-level targets with RIKEN to cope with anticipated society's problems in 2050. This collaboration centers on young researchers from the two institutes and is aimed at producing world-beating technologies at the global leading edge.

Another facet of AIST's research activities are the seven regional research bases that we have around the country, each of which is focused on R&D addressing the characteristics and needs of its region and is engaged in activities to return the fruits of its research to local enterprises. Last year, we opened contacting sites for collaboration in Ishikawa Prefecture and Fukui Prefecture. We are working assiduously to meet the needs of enterprises on the Sea of Japan side of the country, which has previously lacked research bases. AIST will continue to strengthen such functions and collaborate closely with universities and public bodies in the regions, concentrating on research activities that are important for those regions.

Considering staff development as a key to success, AIST is pursuing a range of initiatives. For exchanges of staff, we have adopted the cross-appointment system. By inviting personnel from universities and businesses and providing AIST researchers to other organizations, we are promoting exchanges of researchers and working to blend and develop diverse technologies. To support financial resources for graduate students to continue the research they are interested in, we are running a research assistant system and supporting the development of young researchers. We have also been holding the AIST Innovation School, directed at postdocs and graduate students, to provide practical experience of research activities at AIST and business practices; we are nurturing research personnel who can immediately contribute in industry and research institutes.

Today's Japan is facing a range of problems. For industry, it has been observed that Japanese companies' ability to generate innovations might be weakening and that their international competitiveness is declining. The ability to build up new industries such as the Internet of things (IoT), artificial intelligence and robotics is a major challenge for the future.

Meanwhile, the effects of climate change caused by global warming are appearing more often in various parts of the world. Japan itself has suffered many disasters, such as record-breaking rainstorms, and the danger of large earthquakes, as demonstrated by the Great East Japan Earthquake, remains at a high level. Disaster prevention measures against such natural disasters are urgent. Along with measures to deal with the aging of public infrastructure and the like, these are major issues that directly affect people's lives.

The role of science and technology in facing these economic and social problems is greater than before and the expectations for public research institutes are rising. Science and technology, by providing routes to solutions to the problems facing society, producing new innovations and creating next-generation industries, is a great driving force for continuing growth of Japan's economy.

As a research institute leading the way for science and technology in Japan, I believe AIST must play a central role in bringing together forces that will contribute to Japan's industrial development and build a sustainable society. This report outlines our major research activities and our future research strategy. It also describes our efforts in many institutional matters: governance and welfare programs; staff training initiatives; support for a proper work–life balance; the promotion of diversity in aspects such as support for the participation of female staff and foreign researchers, and the employment of people with disabilities; strengthening compliance; environmental safety management; and the establishment of fair business practices such as reasonable procurement.

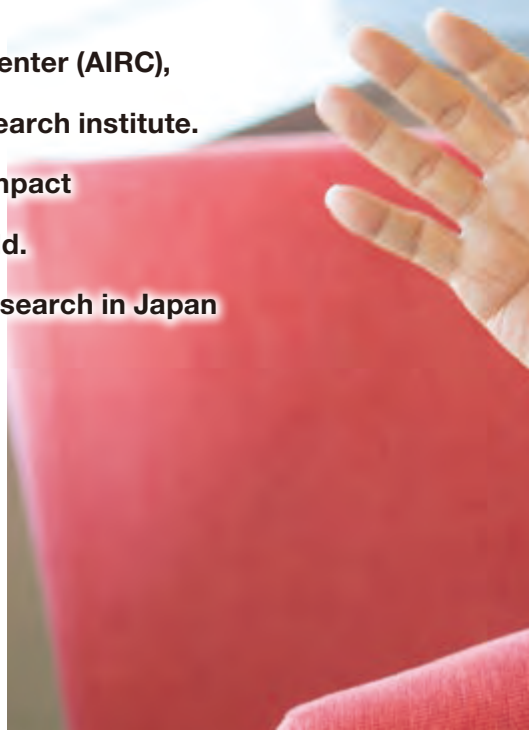
AIST is improving its research activities, presenting its activities to society, and enhancing the transparency of its activities. In this way, AIST is raising the understanding of stakeholders, winning trust from society, and improving the effectiveness of its research.

We hope that you will understand our work and we look forward to receiving your continued support.

A Hub Dedicated to AI Research

Linking AI research with deployment in society

On May 1, 2015, AIST opened the Artificial Intelligence Research Center (AIRC), the first research base dedicated to AI research in a Japanese research institute. As the age in which AI is rolled out into society finally arrives, an impact comparable to the industrial revolution is going to change the world. We asked Junichi Tsujii, Director of AIRC, how AIRC will drive AI research in Japan in the future.



A hub for the creation of innovation

Director Tsujii explains: "When you mention artificial intelligence, people assume that giant American IT corporations such as Google and Amazon are out in the lead. However, artificial intelligence is not limited to a narrow scope but fundamentally encompasses technologies that support the foundations of society in a wide range of fields, including health, medical care and welfare, pharmaceuticals, transport systems, autonomous driving, manufacturing, telecommunications, services, and finance. I want AIRC to be a hub for focusing on the industries that are Japan's strengths and the problems that affect Japan, and for R&D of AI that is suitable for Japan's circumstances."

In developing AI, it is essential that basic research be closely linked with application research. Moreover, because fields of application are expanding rapidly, cooperative research between specialists in various fields and collaborations on practical implementation between industry, academia and government are necessary. AIST established AIRC to be at the heart of all this.

"In building AI into the infrastructure of society, we must develop new technologies and business models after obtaining real-world data. We are now in a period of transition: Can we put our trust in competition between private enterprises as in the past, or should we involve public bodies and build social consensus while development progresses? What AIRC is aiming at is a Japanese model in which, in contrast to the corporation-led American model, public bodies coordinate AI technologies. Stakeholders in AI have become extremely diverse in the past five or six years; the organizations involved have different data, technologies and business models, and they are covering greater expanses of society. Our goal is for AIRC to be a hub that brings these stakeholders together and creates innovation."

AI that is suitable for Japan's circumstances

AIST's initiative has attracted attention abroad; other countries are becoming more active in launching their own R&D efforts. France and the UK have set up research centers

Profile

Artificial Intelligence Research Center
Director

Junichi Tsujii

Awarded a PhD in engineering from Kyoto University Graduate School in 1973. Associate professor at Kyoto University; professor at University of Manchester from 1988; professor at Tokyo University Graduate School from 1995; principal researcher for Microsoft Research Asia (Beijing) from 2011; Concurrent post as a professor at University of Manchester.

with similar orientations to Japan, and Industry 4.0* in Germany is setting a course for the roll-out of AI technologies.

So, what do we mean by AI that is suitable for Japan's circumstances?

Tsujii sees in AI the power to make designs for industry and society: "Japan has great strength in manufacturing and leads the world in industrial robotics. We can improve our industrial competitiveness by combining these strengths with AI. In the first stage, we will improve the quality of technology and rationalize manufacturing. In the second stage, we will improve the quality of products. In the third stage, we will change our industrial structures and create new value. To achieve that is our ultimate objective."

There is even more to the role of AI. Tsujii talks of the great importance of adopting an approach that will improve quality of life.

"In the context of a rapidly aging society, there are questions as to how to lower the costs of medical care and welfare, raise the quality of services, and how to compensate for the declining working population. AI will play an increasingly important role in solutions to the problems affecting Japan."

Can we cope with a social revolution?

As AI becomes embedded in various aspects of society, our lifestyles and industries will undergo great changes. Will Japan be well placed to cope with this social revolution?

"The biggest issue is the differences between the established cultures of the IT industry and traditional industries. The IT industry has led the way with AI and has a culture of creating value through open approaches. In contrast, traditional industries such as manufacturing industries have a culture of protecting knowledge with patents and intellectual property.

※: Industry 4.0
A national project started in Germany with the aims of deploying AI and IoT technologies, making all stages in production and distribution more automated and efficient, and improving productivity. It has since rolled out to other countries, advancing through initiatives such as "the connected factory," which aims to link up many manufacturers for overall optimization, and "the smart factory," which incorporates AI in intelligent robots and the like.

From the perspective of AI development, new business models are created by opening up large volumes of data, but this is a cause of strong resistance from traditional industries. The most important thing is to employ data in forms that meet people's needs. It will be necessary to create frameworks in which parties providing data will gain benefits and can build win–win relationships with parties using the data. This also applies to personal information. For example, in the field of medicine, the idea is that patients themselves will control their data, and if data is provided to other parties, the patients will benefit accordingly."

Obtaining data from the real world is difficult and it will be necessary to create new rules for managing data, but Japan is more receptive to AI than are other countries.

"As soon as you mention AI in Europe, you hear arguments that it is going to take people's jobs or is going to take control of our lives, but you rarely hear these arguments in Japan. This is because we perceive greater risks in the decline of the working population and feel that we should be proactive in deploying AI. I also think that there is less resistance among the Japanese to non-human entities acting intelligently."

Humans and AI can compensate for one another's weaknesses

The major goals of AIRC's research are to produce "AI that can be embedded in the real world," "AI that solves problems in cooperation with humans," and "AI that can be explained." In order to develop AI with strong knowledge of and affinity with humans, we have established two pillars for research. The first is research into engineering neural AI and neurocomputing based on the human brain; the second is research into AI that combines data and knowledge to be capable of complicated judgments, decisions on action, and explanations of its processes.

"It is not enough for AI to act autonomously on the basis of provided information; if how judgments are being made cannot be clearly explained, the technology is not really usable. For example, consider AI supporting a doctor. AI is good at discovering patterns from large volumes of data from past examinations and may rarely make oversights in diagnosis. However, we cannot expect every detail of a patient's situation to be entered as data. The doctor may make more accurate judgments by taking account of information and experiences that are not included in the data. In other words, both humans and AI have weaknesses. By compensating for one another's weaknesses, they become capable of higher quality judgments. Therefore, AI's ways of thinking and acting must change to take account of the interplay between AI and humans, and it must be possible to explain judgments."

Three areas that make use of Japan's strengths

How will AI research progress in reality, and in which fields will Japan's strengths manifest themselves? Tsujii mentions three areas, "AI for human life," "AI for manufacturing," and "AI for science."

(1) AI for human life

"This is about introducing AI into medical care and welfare, service industries, transport infrastructure and so forth to

create more pleasant lifestyles. For example, AIST leads the world in research on nursing robots that are deployed and work in people's homes. We have an advantage in being able to make use of the digital human technologies that AIST excels in.

"Japan has also created service industries that treat particular details as important. For example, convenience stores fine tune their stock in accordance with region, season, and weather; this sort of thing is typical. By introducing AI into these service and retail industries, we can further develop Japan's culture of assiduous hospitality."

(2) AI for manufacturing

"Introducing AI into niche manufacturing, Japan's original strength, and fields such as industrial robotics and the IoT will create new demand. Because Japan is blessed with many experienced engineers who can be excellent models, we can reproduce "craftsmanship" in AI. Japanese industries that have an abundance of expert staff in various fields have the potential to be powerful partners in AI research. We have a very advantageous situation."

(3) AI for science

"Japan owes its position as a developed country to many excellent scientists and engineers. However, in the future I think it is unlikely that individual geniuses will do the research; if we do not systematically speed up research by using AI based on abundant data, we will fall behind the rest of the world. We aim to combine science and technology with AI in a wide range of fields, including basic sciences, life sciences, clinical sciences, and materials sciences."

Interdisciplinary research that overcomes barriers by interpersonal connections

Interpersonal connections and staff development are important parts of AIRC's mission. The number of private businesses we have as cooperative research partners is over 40. We have set up collaborative research laboratories in which close collaboration with business is possible, have set up a consortium for information exchange with about 100 companies participating, and have promoted collaboration with venture companies. We have had about 80 researchers visit from universities under the systems for cross-appointments (see page 28) and visiting researchers, and we have closely collaborated with public research institutes. As well as the about 50 researchers from other countries affiliated with the center, we are strengthening our connections with overseas research institutes, including concluding an MOU on research cooperation with the German Research Center for Artificial Intelligence (DFKI).

"What is required for future AI research is the development of interdisciplinary research that brings together researchers and engineers from various fields. Because Japan is still a society of vertical divisions, collaboration to overcome the barriers between organizations is difficult. However, now that AIRC exists, horizontal collaboration between universities, companies, and countries will be easier. When researchers in various fields work together, even substantial problems can be solved. Although there is a great shortage of staff for AI research, AIRC is an open organization with high staff mobility. Through cooperative research at AIRC, I hope we will produce many people who are equipped with interdisciplinary skills."

The intention is to be proactive in creating systems for promoting interchanges and collaboration.

A society of open personnel and open data

AIRC is currently running a number of projects, such as a project to develop an integrated cancer treatment system that uses AI. AIRC is achieving results in many areas: the AIST AI Cloud (AAIC) has been ranked third in the world in the Green 500 List (a global ranking of energy efficiency performance of supercomputers) and ranked first in the world for cooling systems; and we are developing a system for regular inspections to prevent detection failures in public infrastructure with acoustic checks using AI.

Tsujii concludes on an optimistic note: "There are many people suited for these times in Japan; in start-ups, young people are taking up interesting challenges and overcoming barriers. If personnel and data are not shut away in silos but can move around freely, they will have great power to change Japan. By setting up an open platform for AI, I hope that AIST can show the world that Japan is still here."

The "Living Lab," a development and testing ground for AI that supports everyday living in the real world. The behaviors of humans in a living environment are observed, which can lead to new services.

Organizational Governance

Aiming to create an honest and transparent organization based on the principle of developing a sustainable society

AIST R&D in the Fourth Medium- to Long-Term Plan

In building a sustainable society, there is a need for solutions to the challenges of the 21st century, including global warming, energy supply, and the rapidly decreasing and aging population. We have established and are pushing ahead with R&D on three pillars that we at AIST should focus on in regard to these challenges—green technologies to enable a comfortable and environmentally-friendly society; life technologies to enable healthy, safe and secure lifestyles; and information technologies to enable a super-smart society.

Basic Policy for the Fourth Medium- to Long-Term Plan

This year was the midpoint of the Fourth Medium- to Long-Term Plan period that began in 2015. Activities in the fourth plan are based on the following basic policy to conduct world-class research and transfer the fruits of the research in accordance with the institutional image that we aspire to: "Through world-leading research taking account of the needs of society and industry, and transfers of the fruits of this research, contributing to the sustainable development of society with a focus on innovation and winning the trust of society."

Identifying strategic issues with consideration for the needs of society and industry

Through technology marketing activities, we are accurately identifying the needs of society and the needs of industry, strategically setting research topics, and flexibly modifying and creating research execution systems. For example, in order to conduct R&D that more closely relates to the strategies of business, we have set up seven collaborative laboratories in AIST branded with the names of companies, and are progressing with research in cooperation with these companies.

Driving innovation in the regions

At our regional research bases, we are identifying important research topics (headlines) in consideration of characteristics such as clusters of industries in those regions, conducting world-class R&D, forming relationships with public research organizations, learning about the needs of small and medium-sized enterprises, transferring technologies from AIST as a whole, and supporting local industries. We are currently working in 157 collaborations (such as contract research) with regional businesses.

Research system that can win strong trust from the nation's people

To continuously progress in research activities that can win the trust of business and society, and to ensure trustworthy research results and transparent operations, we are working to strengthen safety management and operations management systems, understand sources of risk and prevent problems from arising, and improve governance in the conduct of our operations. For example, we are reviewing our research notebook management system and working on more thorough management of research results.

Driving open innovation to combine know-how from Japan and other countries

We are actively working to bring many excellent technology seeds and personnel to AIST from universities in Japan and abroad and from public research organizations and businesses in Japan's regions, thereby improving AIST's research potential and driving open innovation as the heart (hub) of an innovation system for Japan. For example, we have appointed 175 innovation coordinators around the country, who are gathering the seeds of new technologies and cultivating human resources.

Training and welcoming people who will create innovation

With personnel systems that can make use of staff of different categories and ages and the introduction of systems to accurately evaluate their contributions to the institute, we are training and bringing in people who will create innovation. For example, we are inviting excellent researchers under the cross-appointment system (44 appointments in FY 2016) and the research assistant system (174 in FY 2016).

AIST Research Strategy for 2030

Introduction

Since the establishment of AIST in 2001, we have conducted research to develop industrial technology in Japan and enhance innovation, under the slogan "bringing technology to society." During the Fourth Medium- to Long-Term Plan period (FY 2015 to FY 2019), AIST is promoting R&D with the focus on "bridge-building between technology and industry" and "goal-oriented basic research for bridge-building." The speed of change in the progress of science and technology and in industrial and social trends in recent years has been remarkable. In the next 10 or 15 years, science and technology will become ever deeper and more complicated, and completely new academic fields will appear, which will surely resonate and be incorporated in industry and society to build new evolution. Accordingly, in AIST we have considered visions of industry and society in 2030 and formulated the "AIST Research Strategy for 2030," which we announced in a press release on June 28, 2016.

To see details of the AIST Research Strategy for 2030, please use this QR code.

Research Strategy

This research strategy presents four new models (goals) for industry and society, which are described below. By using the technology seeds that AIST has already cultivated and our R&D potential, we aim to conduct R&D towards realization of these goals and spearhead scientific and technological innovation. With the creation of next-generation industries in mind, we are taking up the challenge of creating new industries: to overcome problems such as population decline and aging, global warming, and infectious diseases; to protect security in the information society into the IoT era; and to develop safe and secure industries and society.

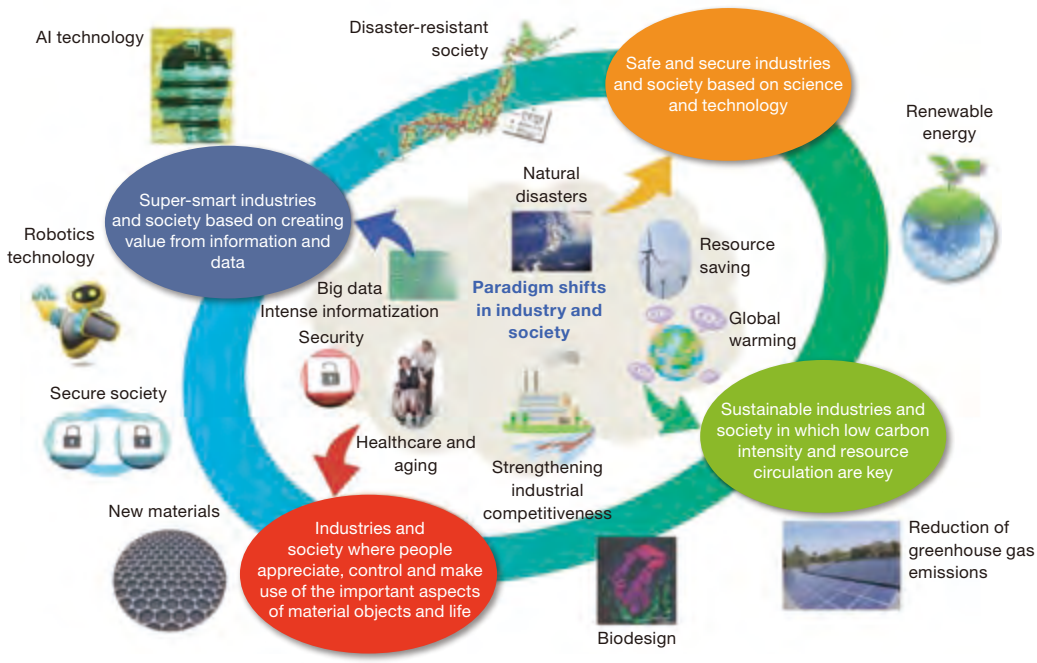
The four goals and initiatives (outline)

1. Super-smart industries and society based on creating value from information and data
2. Sustainable industries and society in which low carbon intensity and resource circulation are keys
3. Industries and society where people appreciate, control and make use of the important aspects of material objects and life
4. Safe and secure industries and society based on science and technology

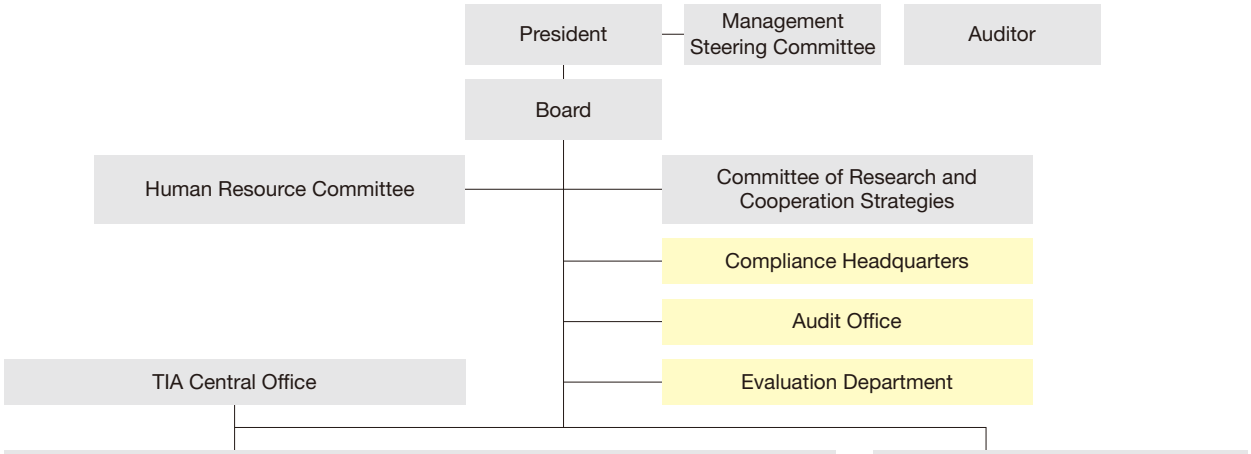
Conclusion

This research strategy presents a vision of the future in 2030 that is based on AIST's current values. However, if we look ahead to 2050, social structures will have changed greatly and the scientific technologies that are needed will have undergone great changes. The values applied to new technologies, new products and new services that appear in the future may be very different from those of today. Therefore, through everyday research activities, academic exchanges with universities and research institutes, collaboration and cooperation with industry, and conversations with society, AIST will continue to review and update its research strategy.

●AIST's Research Strategy for 2030



AIST Organization Chart (as of June 1, 2016)



Department of Energy and Environment

- Research Institute of Energy Frontier
- Research Institute of Electrochemical Energy
- Research Institute for Energy Conservation
- Environmental Management Research Institute
- Research Institute of Science for Safety and Sustainability
- Research Center for Photovoltaics
- Renewable Energy Research Center
- Advanced Power Electronics Research Center

Department of Life Science and Biotechnology

- Biotechnology Research Institute for Drug Discovery
- Biomedical Research Institute
- Health Research Institute
- Bioproduction Research Institute
- Molecular Profiling Research Center for Drug Discovery

Department of Information Technology and Human Factors

- Information Technology Research Institute
- Human Informatics Research Institute
- Intelligent Systems Research Institute
- Automotive Human Factors Research Center
- Robot Innovation Research Center
- Artificial Intelligence Research Center

Department of Materials and Chemistry

- Research Institute for Sustainable Chemistry
- Research Institute for Chemical Process Technology
- Nanomaterials Research Institute
- Inorganic Functional Materials Research Institute
- Structural Materials Research Institute
- Interdisciplinary Research Center for Catalytic Chemistry
- CNT-Application Research Center
- Research Center for Computational Design of Advanced Functional Materials
- Magnetic Powder Metallurgy Research Center

Department of Electronics and Manufacturing

- Nanoelectronics Research Institute
- Electronics and Photonics Research Institute
- Advanced Manufacturing Research Institute
- Spintronics Research Center
- Flexible Electronics Research Center
- Advanced Coating Technology Reserch Center
- Research Center for Ubiquitous MEMS and Micro Engineering

Geological Survey of Japan

- Research Institute of Earthquake and Volcano Geology
- Research Institute for Geo-Resources and Environment
- Research Institute of Geology and Geoinformation
- Geoinformation Service Center

National Metrology Institute of Japan

- Research Institute for Engineering Measurement
- Research Institute for Physical Measurement
- Research Institute for Material and Chemical Measurement
- Research Institute for Measurement and Analytical Instrumentation
- Center for Quality Management of Metrology

Planning Headquarters

Research and Innovation Promotion Headquarters

Environment and Safety Headquarters

General Affairs Headquarters

AIST Tokyo Headquarters

AIST Tsukuba

Fukushima Renewable Energy Institute, AIST

AIST Tokyo Waterfront

AIST Hokkaido

AIST Tohoku

AIST Chubu

AIST Kansai

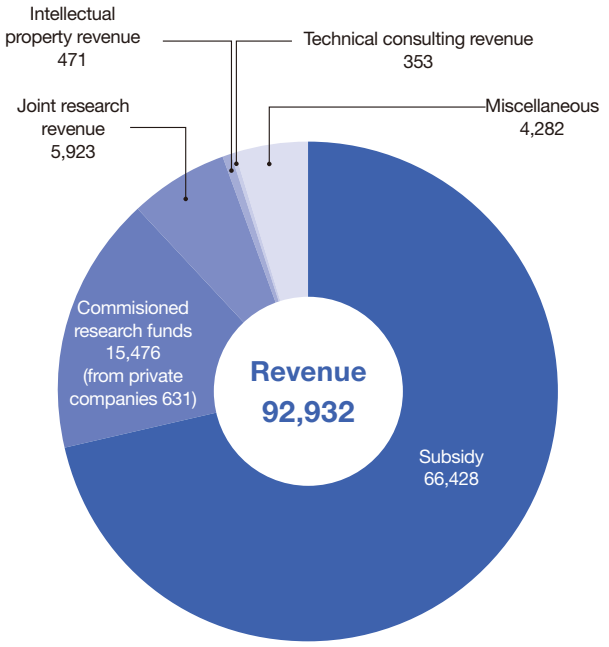
AIST Chugoku

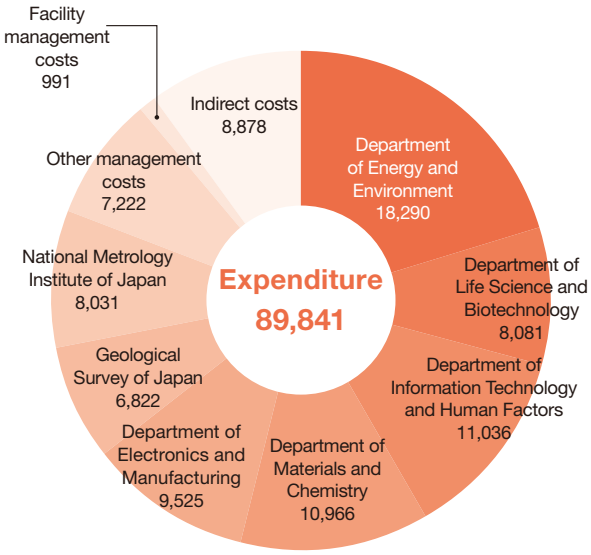
AIST Shikoku

AIST Kyushu

Revenue and Expenditure

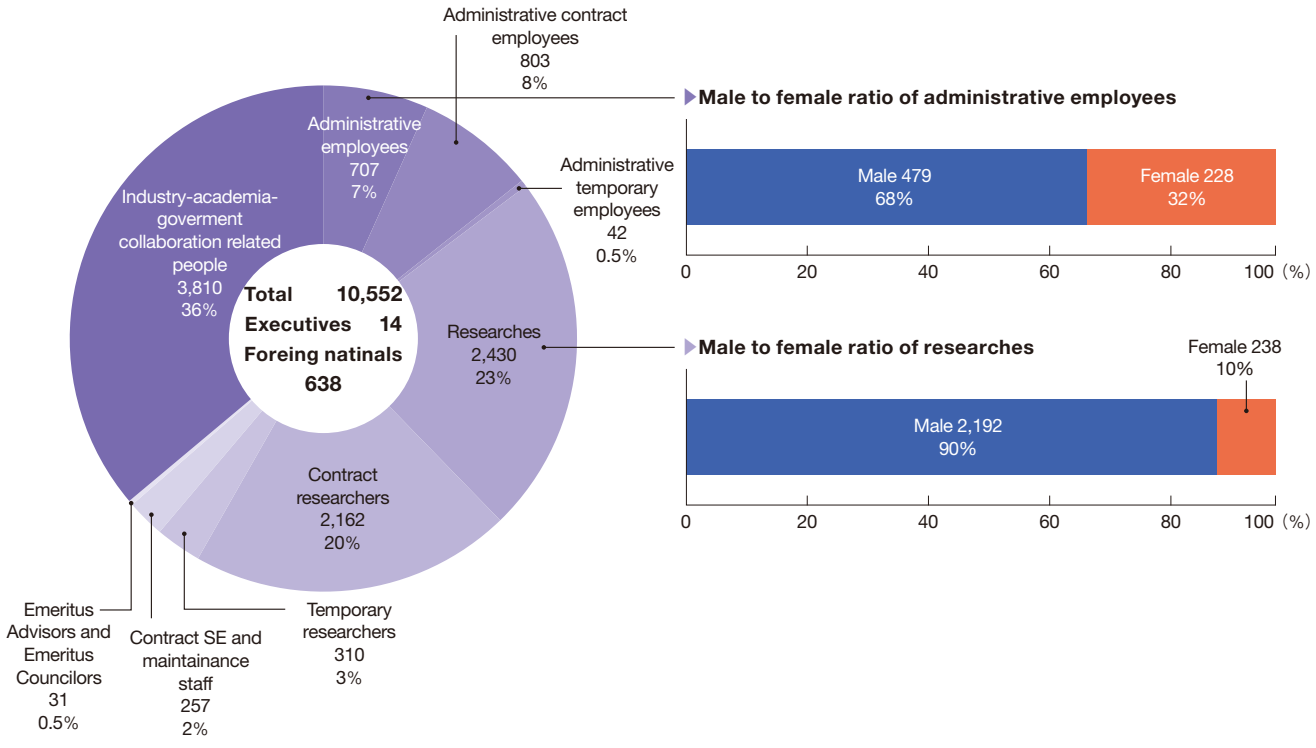
●Financial results for FY 2016（unit: million yen）





Notes1: Total may ont became 100% due to rounding off.
Notes2: The amounts of revenue and expenditure are adapted from the "Financial Statement" prescribed in Article 38 of the Act on General Rules for Incorporated Administrative Agencies.

Staff (as of March 1, 2017)



Promotion of Compliance

The compliance headquarters conducts AIST compliance activities and addresses research misconduct.

Compliance activities

With the objectives of raising awareness of compliance among our staff and steering the organizational culture in a better direction, AIST conducts the following compliance activities.

(1) We hold weekly meetings at which we collect risk information from job sites and the president gives instruction on appropriate response policies. We also hold monthly liaison meetings with managers to share risk information.

(2) In training provided to new employees, we help them understand the fundamentals of compliance. We also provide training to unit directors and research group leaders to enable them to review their knowledge of compliance and raise their awareness of compliance management.

(3) Compliance headquarters staff conduct on-site training in which they are dispatched directly to research units in the regional bases and AIST Tsukuba, explain the importance of compliance face-to-face, describe examples of misconduct, and provide easily understood explanations of the origins of misconduct and the precautions to take

(4) As part of our compliance promotion activities, to deepen employees' understanding of compliance, we produce and distribute a monthly educational document, the compliance newsletter ("Compla-Dayori"), based on examples in familiar situations.

Addressing research misconduct

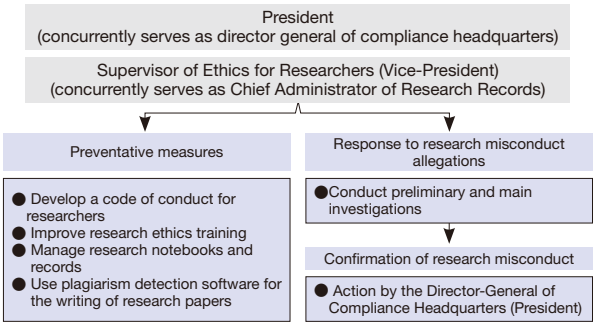
(1) When research misconduct was alleged, AIST took strict action in accordance with the research misconduct rules and determined that there was no misconduct.

(2) In on-site training of research units and management training for unit directors and research group leaders (16 sessions), we have raised awareness of the Code of Conduct for Researchers and how to avoid research misconduct.

(3) We have achieved stable operation of a research records management system, which is a register for collective administration of the information in research notebooks. By continuously updating manuals and FAQs to disseminate knowledge of this system throughout the institute, we have maintained a validation rate for research notebooks above 99% with the introduction of this system.

(4) We are encouraging the use of plagiarism detection software introduced to support the prevention of research misconduct, such as accidental plagiarism. It was used 483 times in FY 2015 and 725 times in FY 2016, an increase of around 50%.

●Response to research misconduct at AIST



Disclosure of Information and Protection of Personal Information

Disclosure of information

To increase the transparency of AIST's activities and fulfil its accountability requirements, AIST proactively discloses information on its website and by other means in accordance with the Act on Access to Information Held by Independent Administrative Agencies (implemented October 1, 2002).

Protection of personal information

In accordance with the Act on the Protection of Personal Information Held by Independent Administrative Agencies, etc. (implemented April 1, 2005), AIST has established a privacy policy and Rules on the Protection of Personal Information at AIST, to protect the individual's rights and interests while ensuring that activities at AIST are conducted properly and smoothly.

Every year, self-inspections for personal information protection and information security are conducted, to raise awareness of the proper management of personal information relating to executives and staff and of information security compliance.

Information disclosure desk and personal information protection desk

Requests for information disclosure in accordance with the Act on Access to Information Held by Administrative Organs and the Act on the Protection of

Personal Information Held by Administrative Organs can be made through these desks and the website of AIST Tsukuba and other regional research bases. Each desk also provides help on the procedures for disclosure and personal information protection. Only requests for information disclosure can be made through the website.

●Year-to-year numbers of requests for disclosure of information and personal information

FY	Information disclosure	Personal information
2013	6	0
2014	9	2
2015	5	1
2016	3	0

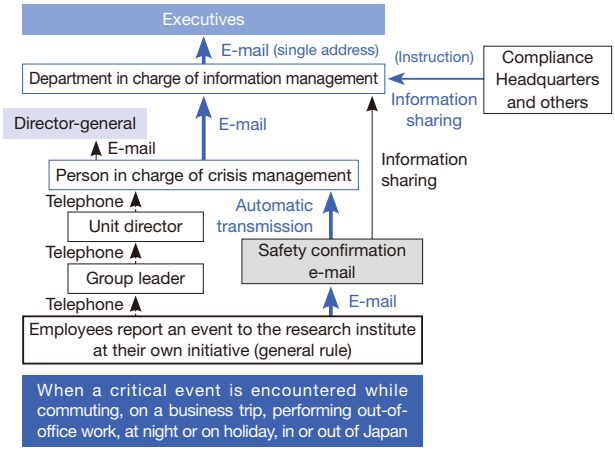
Improving the Information Transmission System in Case of Critical Events

AIST has improved the in-house information transmission system for rapid crisis responses in cases such as terrorist acts and storm and flood damage. We have reorganized reporting routes to quickly and reliably inform the President of potential dangers even during holidays. We have also taken the following actions:

●Introduced a system in which employees report an event at their own initiative and the department in charge can manage it
●Made it possible for information to reach AIST executives quickly

●Assigned persons in charge of crisis management at the regional bases and at each Tsukuba site facility
●Unified and disseminated the e-mail address for safety confirmation reporting

●Information transmission system in case of critical events



Internal Audit

At AIST, in collaboration with the auditor and the accounting auditor, the audit office, which is defined as an independent organization under the direct control of the President, monitors whether work is being properly and efficiently conducted and recommends improvements in work practice. Its aims are as follows: (1) improve the effectiveness and efficiency of work; (2) comply with laws relating to business operations; (3) protect assets; and (4) ensure the reliability of financial reports and the like. The purpose of these internal audits is not to identify work-related problems and bring up issues (i.e., problem-identifying) but to advise on the most effective improvements based on mutual understanding through a thorough discussion of any identified problems (i.e., problem-solving) and thus to support the audited departments.

In FY 2016, the audit office conducted an audit to determine whether the facilities for collaborative and cooperative research with industry, academia and government (Open Space Laboratories*) were being optimally managed. It confirmed that, in general, these activities were being properly conducted. Continuing from the previous year, the audit office performed a comprehensive audit of all operations at the research unit level and confirmed that, in general, these activities were being properly conducted. The audit office made suggestions and advised the audited departments to make improvements as soon as possible in respect of issues identified in terms of the compliance, effectiveness and efficiency of activities. In addition, the audit office conducted follow-up audits of the progress of improvements suggested in the previous year's internal audits. Improvements are being made as appropriate.

●Collaboration in audits

	Internal audit ⟷ Collaboration ⟷ Auditor audit		Collaboration ⟷ Accounting auditor audit
Scope of audit	○Operational audit ○Accounting audit ○Compliance audit	○Operational audit ○Accounting audit	○Accounting audit
Points of audit	○Activities as a whole ○Appropriateness of risk management and development and operation of internal control systems ○Improvement of work process efficiency	○Activities as a whole ○Decision-making by the President ○Creation and operation of internal control systems ○Appropriateness of financial statements	○Appropriateness of financial statements (effectiveness of internal control systems)

* : Open Space Laboratories (OSL) have been established at six regional bases (Hokkaido, Tohoku, Tsukuba, Chubu, Kansai, and Tokyo Waterfront). They conduct R&D in collaboration with industry, academia and government to support the creation and growth of new industries and venture companies and make use of the institute's technological potential.

Successful Development of a Mobile Pathogen Tester: Innovation in On-site Healthcare With AIST Technology

There have been problems in recent years with epidemics caused by new viruses and bacteria. In response, we have developed a mobile pathogen tester (a real-time PCR device) that can rapidly identify a virus or bacteria causing infection in the field, which will help to stop the spread of infection quickly.
The tester is a small, lightweight device that can be carried in one hand; it provides the world's fastest analysis times, around 10 minutes.

The challenge of making a PCR device faster and smaller

The PCR technique for amplifying target genes in testing for infections such as influenza, norovirus or O157 is widely known, but there were several problems with the existing PCR technique.

Hidenori Nagai, leader of the Advanced Medical Devices Research Group, tells the story of development: "A common problem with the PCR technique was that it took at least an hour to make a measurement. In addition, the testing equipment was only available at special facilities. You could not get the results and start treatment until a day or more later. During outbreaks of dangerous new viruses such as Ebola or Zika, this time lag contributes directly to the spread of infection and endangers life. Therefore, we worked to reduce the size of a PCR device so that testing could be performed rapidly in the field."

Through the development of microchannel devices and the establishment of technologies to quickly amplify genes, the group managed to reduce the measurement time to around ten minutes. What drew attention in the early stages was that the device was about the size of a small attaché case. However, the stated objective from the beginning had been "pocket size"; so, they aimed at further reductions in size.

"A fluorescence detector developed by Nippon Sheet Glass Co., Ltd. (NSG) is a key component for checking whether a gene has been amplified. The research challenge of employing this detector in a mobile pathogen tester was selected for the Japan Science and Technology Agency Development of Advanced Measurement and Analysis Systems Program, and cooperative research with NSG and Go!Foton Inc. was begun."

AIST set up a venture company, "jTAS Inc." and accelerated development towards practical implementation.

Technology to quickly and precisely control temperature

Currently there is fierce global competition to reduce the size and increase the speed of PCR devices. AIST achieved great reductions in size and weight (200 mm 100 mm 50 mm, 500 g) while maintaining accuracy. Only AIST has managed to achieve both the world's fastest measurement times of around ten minutes and high sensitivity in the PCR technique. We asked Nagai about

Biomedical Research Institute
Group Leader, Advanced Medical Devices Research Group
Hidenori Nagai

Profile

the technologies that enabled this outstanding performance and their mechanisms.

"The PCR technique uses a reaction that employs heat. A sample is heated to close to 100ºC, unzipping the dual helix structure of DNA, and then the temperature is lowered to around 50°C and the DNA is copied. This is repeated 40 to 50 times. Changing a temperature takes time, and a device that is equipped with a heater for heating and a Peltier element for cooling will inevitably be large.

"The device we have developed does not have a Peltier element or cooling system; instead, it is equipped with heaters for two temperature bands, a high temperature and a low temperature. The temperature of a sample is changed quickly just by moving the sample in a channel in a small plastic substrate. The temperature is accurately controlled by stopping the sample over the desired heater. This technology is the key."

The substrate with the microchannels can be mass produced at low cost by ordinary injection molding. The group produced a system that is low in cost and easy for anybody to use with a view to putting it on the market as a competitive product.

The product is called GeneSoC®, the word "gene" with the abbreviation "SoC," which is short for "Sensor on a Chip." Nagai named it to express the meaning that a device can be used as a sensor when it becomes this fast, reflecting the Japanese word "jinsoku," which means quick.

Hope for use in many locations and applications

Because the developed device can be battery powered, one major advantage is that it can be used in a wide range of situations, such as in moving ambulances and aircraft.

"NSG's compact fluorescence detector has no problem at all with the vibrations in an ambulance, because it is based on optical communications technology for use in vehicles. NSG has also proved that it can be used at altitudes of 2000 m or more, altitudes that aircraft fly at, and is a very reliable component."

When the device is deployed to healthcare sites, the causes of infectious diseases can be identified and the spread of infection can be suppressed. In addition, it will be very useful for food safety, such as in quarantines of bird flu, foot-and-mouth disease and the like, and in food mislabeling checks of rice, meat and so forth. Nagai expects use in a very wide range of applications.

"I anticipate that the device can be used for pre-shipping testing of shampoos, cosmetics, detergents and such, and for oral bacteria checks associated with dental implant treatments. There are also possibilities for use in, for example, identifying individuals by testing saliva in forensics, studying the evolution of organisms at the genetic level, and testing for environmental pollution. What I would like to achieve is testing for the three big infections: HIV, tuberculosis and malaria. Our goal is to bring accurate examination technology to places that are beyond the reach of clinics, to enable rapid responses and save lives."

Innovation from AIST to the world

When the development of the mobile pathogen tester was completed in February 2017, we were hearing calls from many people saying that they wanted to use it straight away; the possibilities for new applications and industries are blossoming.

Future R&D will have two major themes. One is developing reagents for inspection subjects with partner companies, at the same time establishing corresponding pre-treatment technologies. The other is working on further reductions in size in order to achieve the original objective of a pocket-size device.

"The reason we specified pocket size is that we want the device to be easily usable in households, as electronic thermometers are. If testing like that performed in hospitals can be carried out in households in the future, patients can receive accurate examinations without leaving home. If they can then obtain appropriate medicines from nearby pharmacists, remote healthcare will be achieved. Developing the advanced clinical and testing devices necessary for this is an important part of AIST's mission" explains Nagai. The mobile pathogen tester brings this innovation to society; it will be deployed around the world.

The developed mobile pathogen tester
(the device on the left is a battery for a smartphone)

Revolutionary Results From Applying Phosphorescent Materials and Coating Technologies to Independently Developed LED Lighting, Leading Towards a Safe, Secure, Energy-efficient Society

Phosphorescent materials that store light and emit light are useful for safety, security and energy efficiency in many ways, such as evacuation signage during power outages.
AIST has developed new phosphorescent materials suitable for LED lighting, which is becoming more and more common.
In combination with an independent revolutionary coating technology, the "Photo MOD process," the scope of applications is widening.

Problems arising in society with the spread of LED lighting

Phosphorescent materials are used in tall buildings, places where crowds gather and so forth, in safety guidance signs, guidance tracks, danger warning signs and the like. The Advanced Coating Technology Research Center is developing green devices and has already produced many achievements, such as high-performance phosphorescent materials, red phosphorescent materials, and the development of high-luminance phosphor film through the photo metalorganic deposition (MOD) process. We asked Tetsuo Tsuchiya, Deputy Director of the center, about the latest challenge in developing new phosphorescent materials.

"The importance of phosphorescent materials that can continue to emit light even in power outages was re-emphasized in the evacuation operations after the Great East Japan Earthquake. Phosphorescent materials absorb ultraviolet light that is included in fluorescent lighting, incandescent lighting and the like, and then emit visible light. In recent years, this kind of lighting has been progressively replaced with LED lighting that, in saving energy, does not produce ultraviolet light. In an increasing number of situations, even where phosphorescent materials emit light, it is faint and only lasts for a short time. This is a problem for society. In response, we put our experience in technology to use and embarked on cooperative research with Tateyama Kagaku Group, with the aim of developing phosphorescent materials that are excellently matched to LED lighting."

Developing high-luminance, long-persistence phosphorescent materials

A major aspect of this research is the progress that was made in both developing phosphorescent materials and developing coating technologies.

The team succeeded in making a phosphorescent material that exhibited excellent characteristics, with about three times previous levels of brightness (luminance) and a persistent afterglow about twice as long even with LED lighting. The key points of the development were precise control of materials by a chemical solution process and a new synthesis process.

"A phosphor material has a host material composed of several metals, into which a small amount of an activator material for producing light is included. The proportions of all the materials must be precisely controlled and they must be uniformly mixed. A process

Deputy Director, Advanced Coating Technology Research Center
Team Leader (concurrent post), Green Device Materials Team
Tetsuo Tsuchiya
Profile

that uses a solution in which a metal composition can be altered by tiny amounts and uniformly mixed is best. Therefore, we employed a chemical solution process using metalorganic compounds." The Photo MOD process was used in developing the materials.

Rapid progress to practical application thanks to the Photo MOD method

The Photo MOD process is a technology developed independently by AIST that can coat ceramics in air at room temperature. One advantage is that, because no heat treatment is required, ceramic films can be formed on a wide range of materials such as plastics, metals and glasses. Tsuchiya explains that materials development can be greatly accelerated with the Photo MOD process.

"The Photo MOD process encompasses a number of techniques; in the development of these materials, we used chemical solutions and lasers. To be specific, we prepared a composition by dripping a chemical solution whose composition was altered in tiny amounts onto a glass substrate and irradiating it with a laser at room temperature to cause synthesis. Because there was no need for heating, we could perform analysis immediately after the laser irradiation. Thus, we achieved very rapid materials development."

The Photo MOD process was also useful in the stage of practical application of the developed phosphorescent materials. Durability of a film prepared by coating with this process was noticeably improved compared with a film containing a resin prepared by a conventional process. Namely, "In a conventional process, a phosphorescent material is set with a resin and then fixed to a ceramic. One problem is the resin rapidly degrading when illuminated with ultraviolet light, which lowers the luminance. With the Photo MOD process, by contrast, a ceramic phosphor film can be coated onto a resin. Taking advantage of the merits of the two materials—the hardness of a ceramic and the lightness of a resin—we developed an excellent phosphor sheet with great durability and with a phosphor material capable of high-luminance, long-persistence light emission."

Diverse applications from safety to energy efficiency

When the succession of results of the development of novel phosphorescent materials and high-intensity phosphorescent sheets produced by the Photo MOD process were published, enquiries flooded in from over 40 companies in Japan and abroad. With additional advantages such as flexible coatings and multi-color phosphorescence, the team anticipates application to a wide range of applications in the future.

"The phosphorescent materials we have developed will be useful for safe evacuation guidance during disasters; for energy efficiency in lighting, billboards and the like; and for preventing counterfeiting of official documents. We expect them to be used in a wide range of situations, such as high-speed trains, cars, home construction, clocks, and plant factories. The ultimate ambition is to enable production of an energy-efficient lighting system by, for example, sticking a phosphorescent sheet to a window or ceiling, and providing all nighttime illumination just with light collected in the daytime. If this can be achieved, I think it will provide a powerful technique for tackling energy problems and will be very significant for society."

Recycling-oriented processes to protect the global environment

AIST has an application support team for transferring technology to society, which supports the creation of business models. While appreciating reactions to the team's contributions to industry, Tsuchiya also keeps an eye on contributions to the global environment.

With a view to the future, Tsuchiya talks of being ready to take on research that will contribute to a safe, secure and convenient society: "Recycling of discarded domestic electronic goods and the like is currently growing apace but the fact is that increasingly huge amounts of energy are being used in recycling processes. To prevent this waste, we want to create new recycling-oriented manufacturing processes so as to increase the lifetimes of products in which ceramics are coated by the photo MOD process, and so as to extend the useful lifetimes of products by applying partial coatings when malfunctions occur. As a public research institute, AIST has a duty to take a broad view including preservation of the global environment as well as creating business models."

High-intensity phosphor films produced by the Photo MOD process

Using Camera's Digital Images for High-precision Inspections of Deterioration in Bridges; Easier Checking for Aging and Damage of Bridges and Highways That Could not Be Inspected Previously

Half a century has passed since Japan's period of high economic growth; roads, bridges and tunnels are aging. As the need for measures for quicker checking of this creaking infrastructure becomes more obvious, AIST has developed a revolutionary technology that can measure deflection of bridges just with images from digital cameras. This inspection technology for public infrastructure is inexpensive and highly reliable: it will contribute to preserving the safety of society.

Applying measurement technology from space structure to bridges

The trigger for Shien Ri of the Non-destructive Measurement Group embarking on the development of a public infrastructure inspection technology was when the risks from damage and wear to public infrastructure were made manifest by the Great East Japan Earthquake and the ceiling collapse in the Chuo Expressway Sasago Tunnel. He explains that even though inspections were urgent, the implementation of inspections was not making progress.

"The soundness of a bridge is evaluated from deflections produced in the bridge when vehicles pass over. Previously, it took several days to construct scaffolding, connect the bridge to the ground with piano wires, and install displacement gauges. This investigation was expensive, sometimes dangerous, and measurements could not be inspected where there was a gorge, the sea, a lake or the like under the bridge."

A comprehensive solution to these problems is a new technology employing a sampling Moiré method. Simply by imaging with a digital camera from the foot of the bridge, deflections that occur when vehicles pass over can be measured with high precision. The cost is about half that of the previous method, and the duration of measurement is about an hour, which is a considerable saving.

"The sampling Moiré method was originally used for measuring displacements in stiffness testing of space structures (i.e., rocket motor cases). We had used the technique in cooperative research with the Japan Aerospace Exploration Agency (JAXA) and the National Institute for Materials Science (NIMS). We then applied this very-high-precision leading-edge technology to public infrastructure inspections, bringing its range of applications closer to home. Because it is simple and inexpensive, it can be used for large numbers of inspections. It is useful for screening to identify which bridges should be given priority for maintenance."

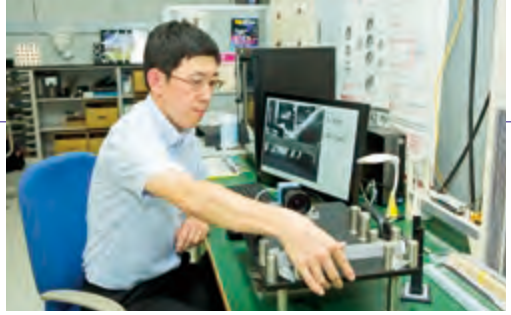
It also means that bridges that were previously inspected with the human eye can now be quantitatively evaluated with a "scientific eye."

Using Moiré to visualize deflections

Moiré is a striped pattern that is produced by variations in grating pitch when sets of regular lines are overlaid. In the sampling Moiré method, a captured image of a subject with a grid pattern is processed to produce a Moiré pattern. Slight deflections are measured from phase difference of the Moiré pattern before and after deformations.

"The imaging elements of a digital camera are arranged in a perfectly regular grid pattern. Therefore, if

Research Institute for Measurement and Analytical Instrumentation
Senior Researcher, Non-destructive Measurement Group
Shien Ri
Profile



there is a repeating pattern in the surface of a bridge, the two grids are overlaid, and a Moiré pattern can be produced simply by photographing the bridge. By applying phase analysis to the Moiré pattern, we can visualize deformations of the bridge. Because measurements can be made without being affected by the brightness of surroundings, it can be employed for inspections of outdoor infrastructure."

Measurements from the foot of a bridge regardless of location

There were two breakthroughs behind Ri's success in the application of this public infrastructure inspection technology. One was that he could conduct comprehensive field testing in cooperative research with the Tohoku Region of East Nippon Expressway Company, Ltd. (NEXCO East Japan) and Nexco-Engineering Tohoku Company, Ltd.

"We conducted verification testing of nine bridges on the section of the Joban Expressway between the Joban Tomioka interchange and the Yamamoto interchange before it opened. These bridges were located on sites that made it difficult to perform measurements with the conventional method. We applied markers to balustrades of each bridge, and photographed the bridge with a digital camera while a test vehicle drove over it. From the results of displacement analysis, we were able to verify that the method had an accuracy equivalent to that of the conventional method."

The other breakthrough was establishing an innovative technology that could make measurements along the longitudinal axis of a bridge (a line joining entry and exit points of the bridge) during verification testing. There was no need to set up a camera perpendicular to the bridge; even bridges in mountainous areas and over gorges, the sea and lakes could be measured easily.

Ri reflects on this significant development in practical application that emerged in the field: "Originally, image observations were poor for measurements in the bridge axis direction, which is the near-to-far orientation. However, at the time when the verification testing was conducted, locations at which cameras could be installed were limited by the effects of the Great East Japan earthquake such as radiation. Therefore, we had to work on making measurements in the longitudinal bridge axis direction. We managed to develop a new deflection measurement algorithm. If we had just been researching in the lab, I don't think this method would have been devised."

Expanding demands for simplicity and high precision

This infrastructure inspection technology uses commercially available digital cameras; its great appeal is that anyone can easily capture images. In May 2015, AIST set up a venture company, the Japan Infrastructure Measurement Co., Ltd., and started to provide data analysis services. Enquiries have come from many quarters, such as for measurements of bridges over the Joban Expressway in Tsukuba City.

"For the metropolitan expressways in the Tokyo region, verification testing has been conducted using markers attached to traffic cones. In addition to being mostly elevated, many sections of the metropolitan expressways have complex curves and aging has progressed. However, many elevated sections have never been measured because traffic restrictions cannot be imposed. Because traffic restrictions are unnecessary when our technology is used, there have been calls from transport administrators for its use. I would very much like to see inspections done before the Tokyo Olympics in 2020."

Expanding the range of application to the microscale

The group is now ambitiously advancing their research to improve precision further, reduce costs, simplify operation, and expand the range of applications.

"We are developing long-term monitoring technologies for rail tracks and tunnels, and technologies to present analysis results on mobile devices. Because measurements are possible as long as there are repeating patterns, we are also working on applications at the microscale. To be specific, the technology can probably be used for evaluating samples with a microscope, evaluation at the atomic level, and so forth in a range of fields such as quality improvement of semiconductor components."

In the future, we hope to spread this technology around the world by transferring it to developing countries in which infrastructure construction is ongoing.

“There is nothing more encouraging than hearing from the field ‘We want this technology.’”

Ri is continuing his unceasing efforts to refine the technology.

Setup for verification testing with digital Moiré technology

Promotion of Research and Development

AIST promotes research activities "in society, for society" with awareness of the role of industrial science and technology.

Establishing Cooperative Research Laboratories

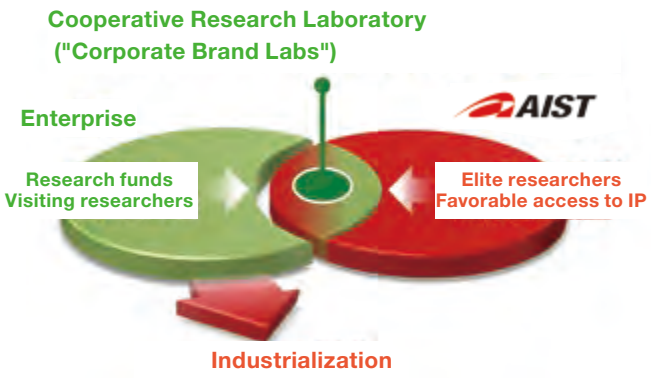
In order to conduct R&D that is more closely aligned with the strategies of business, AIST has identified enterprises as "partner enterprises" and set up Cooperative research laboratories in AIST called "Corporate brand labs" or corporate brand laboratories" that are branded with the names of these enterprises.

Each partner enterprise provides research resources such as researchers and research funds, and AIST provides researchers, research facilities and intellectual property. Visiting researchers from the enterprise cooperate with the AIST researchers on R&D.

Corporate brand labs set up since FY 2016

- **NEC–AIST AI Cooperative Research Laboratory**
  (established June 1, 2016)
  R&D for decision-making in unforeseen situations with technology combining simulations with AI
- **SEI-AIST Cyber Security Cooperative Research Laboratory**
  (established June 1, 2016)
  R&D relating to security technology for IoT products
- **Zeon–AIST Nanotube Industrialization Cooperative Research Laboratory**
  (established July 1, 2016)
  R&D relating to the mass production of carbon nanotubes by high-efficient synthesis methods based on the Super Growth and next-generation synthesis methods
- **TICO-AIST Cooperative Research Laboratory for Advanced Logistics**
  (established October 1, 2016)
  R&D for the development of advanced industrial vehicles and distribution systems employing robotics and AI technologies
- **Panasonic-AIST Advanced AI Cooperative Research Laboratory**
  (established February 1, 2017)
  Building computer environment infrastructure for operation support systems and AI based on advanced interaction technologies and robotics technologies
- **NGK SPARK PLUG–AIST Healthcare Materials Cooperative Research Laboratory**
  (established April 1, 2017)
  R&D focusing on materials for clinical and healthcare products
- **TEL-AIST Cooperative Research Laboratory for Advanced Materials and Processes**
  (established May 1, 2017)
  R&D towards the development of new materials, new process technologies and mass production technologies for next-generation electronic devices to achieve higher integration densities and lower power consumption in semiconductor devices

●The concept of Cooperative Research Laboratories ("Corporate brand labs")

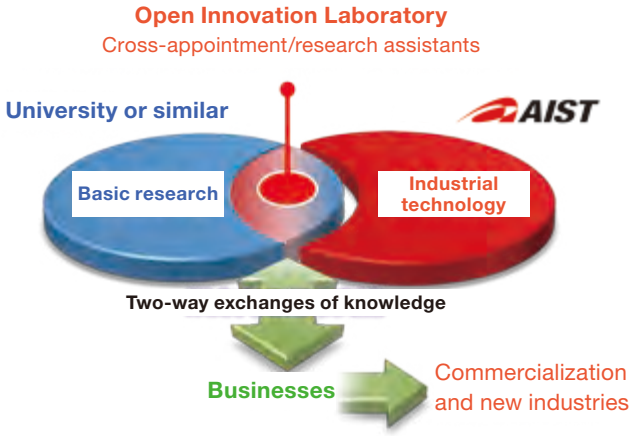


Open Innovation Laboratories (OIL)

AIST has been working since FY 2016 on the preparation of Open Innovation Laboratories, which are industry–academia–government collaborative research bases set up on university campuses and such. OIL has three objectives: (1) seamless performance of basic research, applications research, development and testing; (2) speeding up research by such measures as using the cross-appointment system to bring together university faculty and AIST researchers; and (3) developing practical doctoral personnel with a broad perspective who can actively participate in industry.

As of July 2017, we had established and begun research in OIL at eight bases: Nagoya University, The University of Tokyo, Tohoku University, Waseda University, Osaka University, Tokyo Institute of Technology, Kyoto University and Kyushu University. With OIL, we can combine basic research by universities with the goal-oriented basic research and applied technology development that are AIST's goals, facilitating transfers of technology to the industrial world.

●The concept of OIL



● Opening Ceremony for Real World Big-Data Computation Open Innovation Laboratory (Tokyo Institute of Technology)

●OIL examples

	AIST-Nagoya U GaN Advanced Device Open Innovation Laboratory (GaN-OIL) • Based on the technology of blue LED which Japan realized first in the world, we aim at early practical application of power semiconductors using gallium nitride (GaN).		**AIST-Osaka U Advanced Photonics and Biosensing Open Innovation Laboratory (PhotoBIO-OIL)** • We will conduct research and development of biosensing technology to elucidate mechanisms of organisms and to realize epoch-making drug creation, drug effect, toxicity evaluation, and infectious disease diagnosis, by integrating nanophotonics technology and biodevice technology.
	AIST-U Tokyo Advanced Operando-Measurement Technology Open Innovation Laboratory (OPERANDO-OIL) • Operando-measurement technology will lead to elucidation of functional mechanisms and visualization of manufacture processes. The acceleration of development of materials, devices is expected.		**AIST-Tokyo Tech Real World Big-Data Computation Open Innovation Laboratory (RWBC-OIL)** • Our mission is to advance the high-end processing and applications of big data in the real world, utilizing high performance, scalable computing as well as AI-based analysis technologies on world-leading computing infrastructure.
	AIST-Tohoku U Mathematics for Advanced Materials Open Innovation Laboratory (MathAM-OIL) • We will systemize technology for materials modeling research by means of mathematical science, such as discrete geometric analysis, and computational materials science. We will clarify the principle of correlation among the structures, functions, and processes of materials, and will accelerate materials development.		**AIST-Kyoto Univ. Chemical Energy Materials Open Innovation Laboratory (ChEM-OIL)** • By creating innovative materials based on new concepts and developing them into chemical energy devices, we will contribute to realizing a low carbon society by 2050that is aimed at in the Energy and Environment Innovation Strategy.
	AIST-Waseda U Computational Bio Big Data Open Innovation Laboratory (CBBD-OIL) • We are aiming at elucidating life phenomena and mechanisms of diseases and the creation of innovative drugs and supplements, by integrating biological big data and information infrastructure technology for life information analysis.		**AIST-Kyushu University Hydrogen Materials Laboratory (HydroMate)** • By developing materials for safe and economical utilization of hydrogen, we aim to expand utilization and application technology of hydrogen.

Participation in Technology Research Associations

AIST has become a member of Technology Research Associations, the members of which provide researchers, research funds, and equipment and perform joint research and development of technologies used in industry. AIST contributes to the projects of these Associations by developing research plans, performing research, and using research outcomes.

Particularly by providing our people and place to the Associations, we aim to serve as a place for collaboration and creation where different organizations and people can meet and exchange knowledge through the Associations' projects. We thus aim to help promote open innovation.

AIST's "people" participate in the Associations' projects as researchers, project leaders or board members. We also provide our facilities and equipment as "places" for use by researchers from industries and universities participating in the Associations to intensively carry out their research.

Participation in Technology Research Associations in FY 2016

- AIST participated in 22 Associations.
- Intensive research projects were performed at AIST (12 Associations marked with the letter "A" in the table).
- AIST's researchers served as project leaders and managed whole projects (7 Associations marked with the letter "B" in the table).
- AIST's managers served as directors (18 Associations marked with the letter "C" in the table).
- AIST provided technical guidance and support, as well as know-how of equipment use.

●Technology Research Associations of which AIST is a member (as of March 31, 2017)

	Technology Research Association			
1	Photovoltaic Power Generation Technology Research Association (PVTEC)	A		C
2	Lithium Ion Battery Technology and Evaluation Center (LIBTEC)	A		C
3	Fuel Cell Cutting-Edge Research Center Technology Research Association (FC-Cubic)	A		C
4	Technology Research Association for Single Wall Carbon Nanotubes (TASC)	A	B	C
5	International Standard Innovation Technology Research Association (IS-INOTEK)			C
6	Stem Cell Evaluation Technology Research Association (SCA)			C
7	Photonics Electronics Technology Research Association (PETRA)	A		C
8	Chemical Materials Evaluation and Research Base (CEREBA)	A		C
9	Japan Advanced Printed Electronics Technology Research Association (JAPERA)	A		C
10	Technology Research Association for Next Generation Natural Products Chemistry	A	B	C
11	NMEMS Technology Research Organization Technology Research Association	A	B	C
12	Control System Security Center (CSSC)			C
13	Minimal Fab Development Association	A	B	C
14	Technology Research Association of Highly Efficient Gene Design (TRAHED)	A		
15	Technology Research Association of Magnetic Materials for High-Efficiency Motors (MagHEM)	A	B	C
16	International Research Institute for Nuclear Decommissioning (IRID)			C
17	Manufacturing Technology Research Association of Biologics (MAB)			
18	Thermal Management Materials and Technology Research Association (TherMAT)		B	C
19	Innovative Structural Materials Association (ISMA)			
20	The Research Association of Automotive Internal Combustion Engines (AICE)			
21	Technology Research Association for Future Additive Manufacturing (TRAFAM)		B	C
22	Geological Carbon Dioxide Storage Technology Research Association (CCS)			C

Deployment of Innovation Coordinators

AIST is strengthening its function of transferring technology to society by deploying 72 (as of December 2016) innovation coordinators responsible for liaising with external bodies such as companies and universities and for coordinating collaboration. In order to quickly and accurately understand diverse needs according to the characteristics of different industries, the innovation coordinators are assigned to various research domains. They are improving the organization of cross-sector marketing activities spanning different domains and regional research bases, and uniting the Research and Innovation Promotion Headquarters, domains and research units in promoting collaboration with the outside world.

By developing comprehensive, cross-sector marketing activities, the innovation coordinators are contributing to the creation of innovation through new business ventures and connections between different fields.

The innovation coordinators

Opportunities for Industry–Academia–Government Collaboration and Researcher Invitation

AIST supports R&D and product development of private companies by conducting joint research, commissioned research, and testing and calibration as well as by providing technology consulting, technical advices, and research materials. In addition, AIST explores potential applications of new technologies in collaboration with companies and universities—for example, through the operation of AIST Consortiums— with the aim of developing new markets.

Active invitation of external researchers

Acceptance of external researchers for joint research

Number of researchers accepted in FY 2016: 2,405

AIST provides researchers from our joint research partner institutions with an access to AIST's state-of-the-art facilities to conduct effective joint research.

Joint research program involving transfer of human resources

Number of researchers transferred to AIST under this program in FY 2016: 6

Under this joint research program, researchers from our joint research partner institutions are temporarily stationed at AIST. (The partner institution bears the cost equivalent to the amount of the personnel expenses in the form of research expenses.) Researchers from both our partner institutions and AIST can thus deepen their research collaboration and accelerate their R&D, taking full advantage of our research infrastructure and human resources.

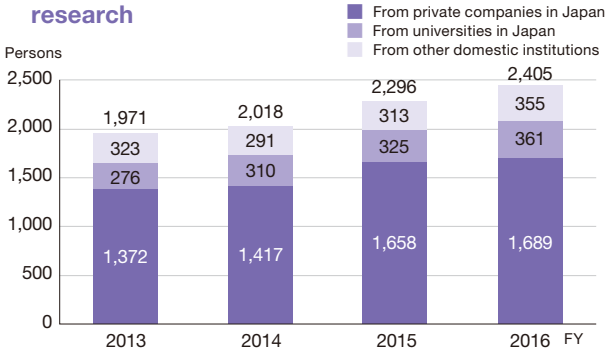
A platform for industry–academia–government collaboration

AIST recruits members from, and collaborates with, various companies and organizations to organize thematic research association (AIST Consortiums). We explore potential application of cutting-edge technologies and aim at promoting R&D and creating new markets. As of July 1, 2017, there are 44 consortiums; they provide a platform for pairing corporate businesses and exchanging information.

Examples of AIST Consortiums

- **Artificial Intelligence (AI) Technology Consortium.**
  This consortium promotes the creation of co-creative value by using AI technology and big data.
- **Nano-cellulose Forum**
  This is an all-Japan based industry-academia-government forum established in 2014 to accelerate R&D, commercialization and standardization of nanocellulose referred to as a future new material.

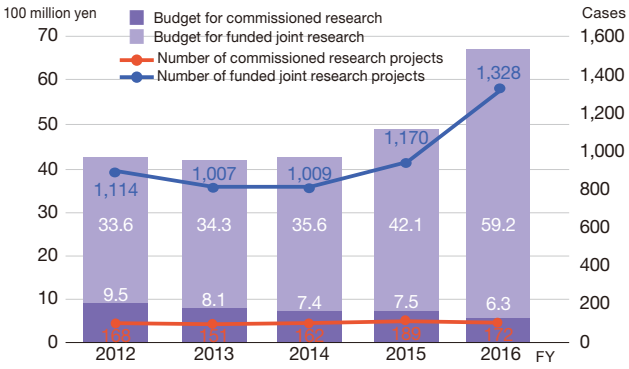
●Acceptance of external researchers for joint research



Joint and commissioned research projects conducted in past years

Our joint research is R&D projects between AIST and our cooperative partners—companies, universities, or public research institutions with common objectives and goals—with the aim of creating innovative results that cannot be achieved by individual research. Commissioned research is a type of R&D project conducted solely by AIST under contract with a company or other organization. Through this service, companies can use AIST's research potential to offset their lack of necessary technology to proceed with their own R&D project. Technology consulting is a system by which AIST—a multidisciplinary group of professionals—provides solutions based on its cutting-edge research capability and abundant knowledge to overcome challenges that companies cannot solve by themselves. In FY 2016, as technology consulting became known inside and outside AIST, we conducted 275 technology consulting, which has significantly increased from 84 cases in FY 2015.

●Joint and commissioned research with companies



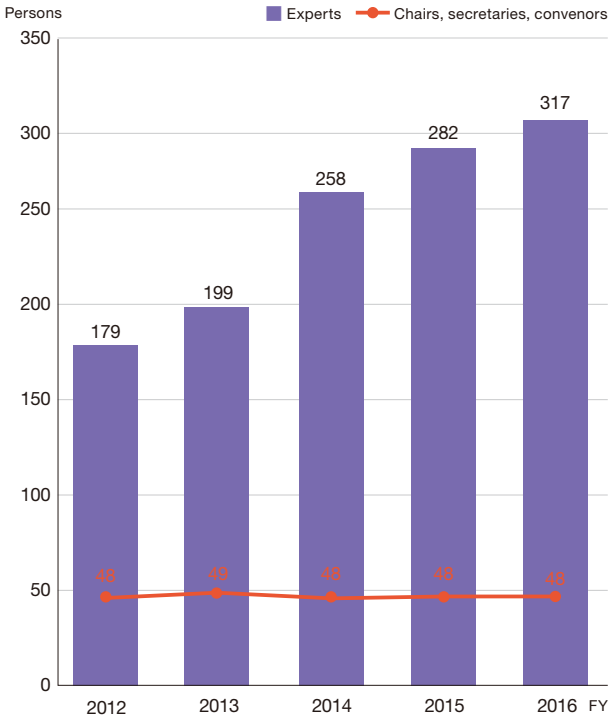
Promotion of International Standardization

We promote standardization activities utilizing our R&D achievements. AIST staff have been playing a key role in the committees of international standards development organizations, such as the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC): 48 employees serve as chairs, secretaries, or convenors, and 317 employees participate as experts.

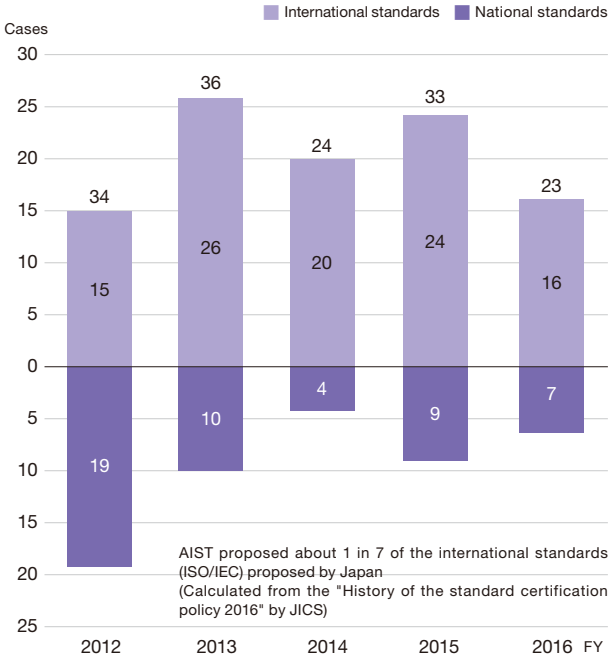
In FY 2016, we proposed 23 national or international standards, including those for fluorescence-based oxygen sensors and fine ceramics.

From FY 2011, AIST holds the Symposium on Strategies for International Standardization every year to enhance standardization efforts by sharing the importance and issues of standardization and certification with relevant parties in industry, academia, and government sectors. In FY 2016, AIST and NEDO jointly held a symposium with the theme of "Transition to Smart Energy Management World from Japan: Standardization and Intellectual Property Strategy for Realizing Resilient Societies."

●Contribution of AIST staff to international standardization activities



●Number of proposed standards



Increase in Global Presence

AIST has increased its global presence through enhanced cooperation with overseas research institutions and inter-organizational exchange of personnel. As part of the enhancement of the cooperation, AIST and RIKEN co-hosted the 5th Global Summit of Research Institute Leaders in October 2016. The purpose of this summit is to provide an opportunity for leaders from research institutions to meet and discuss the future of science and technology, the role of each research institution, and collaboration among research institutions. Representatives from 20 research institutions in 11 countries gathered and actively discussed the theme "Collaboration between research institutes and industry to solve social problems." AIST's president Ryoji Chubachi attended and gave a lecture entitled "Collaboration between AIST and Industry."

The 5th Global Summit of Research Institute Leaders

Strengthening of International Research Networks to Address Global Issues

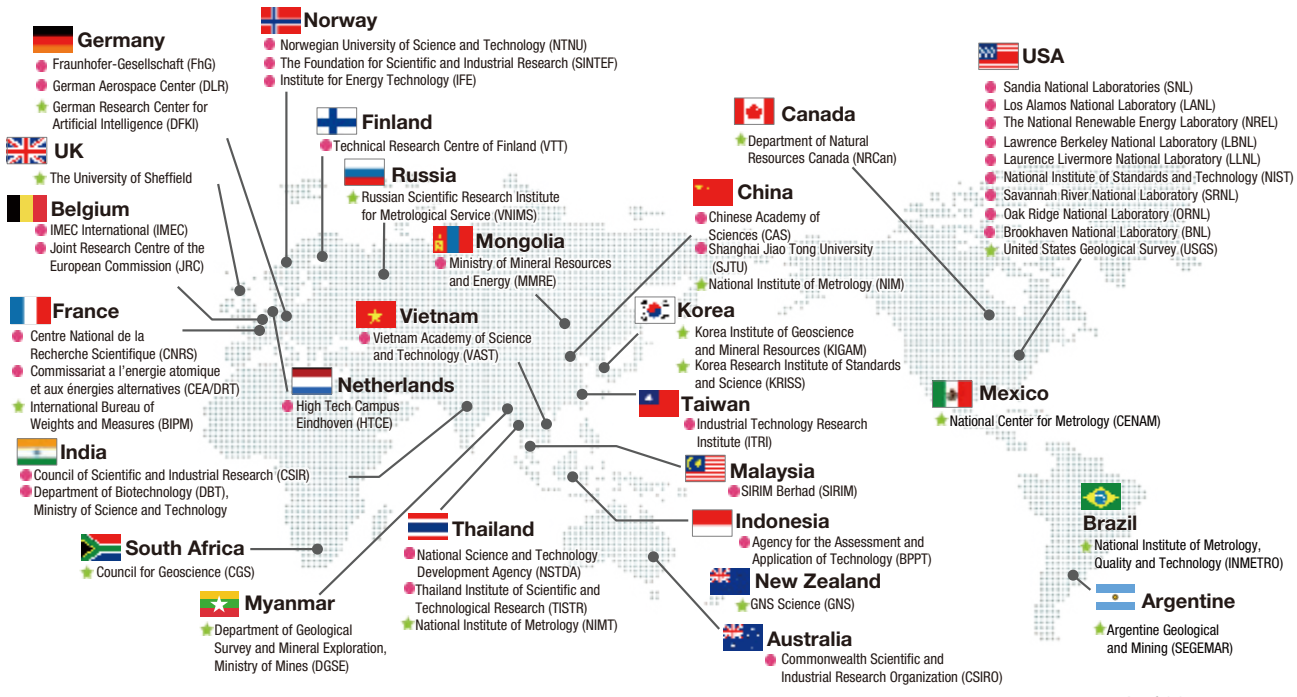
AIST has partnership under memoranda of understanding (MOUs) on comprehensive research collaboration with 32 research institutions worldwide, and engages in the development of international research networks. Under these MOUs, we aim to address global issues through joint research and personnel exchanges with overseas research institutions. In April 2016, we held a symposium with Shanghai Jiao Tong University (SJTU) of China. Having held the initial symposium in 2014, this second symposium provided a place for active discussion to the researchers of glyco-medical engineering and risk management.

In August 2016, we signed a renewed MOU on comprehensive research collaboration with the Industrial Technology Research Institute (ITRI) of Taiwan. We have held workshops to promote research cooperation with ITRI five times so far, and have also achieved success in joint research projects in such fields as energy and metrology. With this background, we confirmed our mutual intent to continue this collaboration and to strengthen our research partnership for mutual benefit.

Symposium with SJTU (April 2016)

List of MOUs

● : Comprehensive MOUs : 32
★ : Specific MOUs (excerpts) : 42



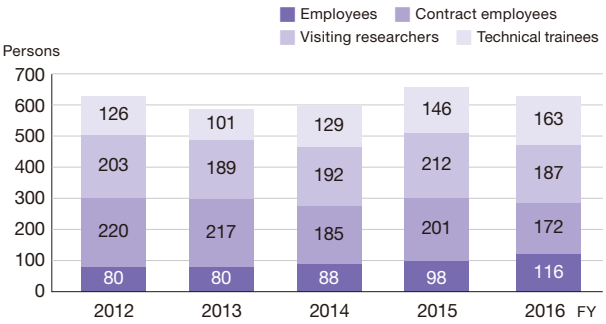
As of July 2017

Invitation to Foreign Researchers

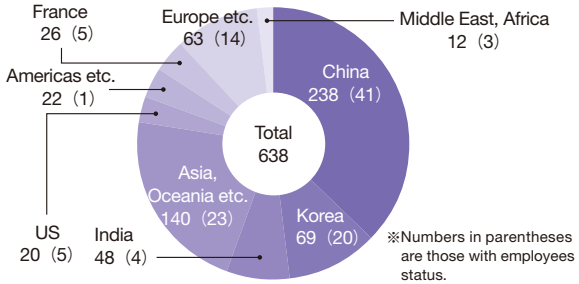
To enhance cooperation with overseas research institutions and to develop an international network of researchers, we actively accept researchers from universities and research institutions outside Japan. In FY 2016, a total of 638 foreign researchers engaged in research at AIST.

In terms of regional statistics, more than 70% were from Asia with those from Europe making up the second largest group. We will continue to develop close collaboration with overseas research institutions through personnel exchange.

●Number of foreign researchers accepted



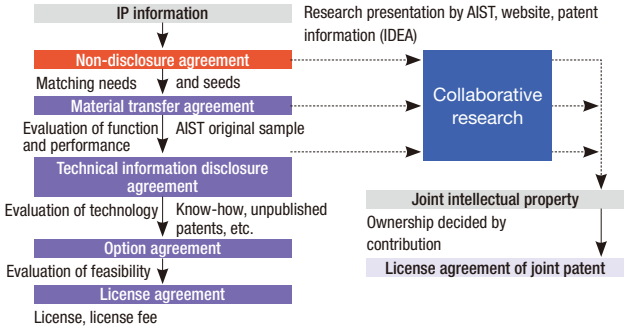
●Number of foreign researchers accepted in FY 2016 by country and region



Technology Transfer Activities

It is AIST's mission to contribute to the development of the economy and industry by disseminating its research achievements in society. To achieve this mission, AIST develops a strategic approach to obtain intellectual property (IP) rights, and appropriately maintain and manage such IP rights so that the research achievements lead to technology transfer. In addition, AIST is strongly and powerfully promoting technology transfer centering on intellectual property.

●Technology transfer process



Technical Advice Service

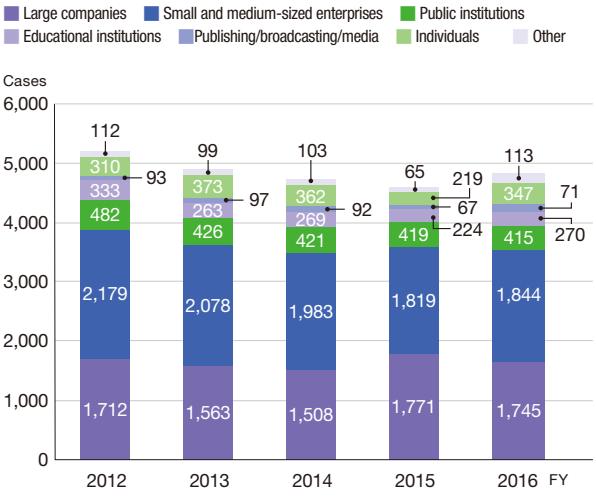
AIST welcomes technical questions and requests of joint research not only from companies but also from academia, media, and other public research institutions. The general advice desk provides answers to the questions and requests by consulting appropriate scientists at AIST, such as technical advisers, innovation coordinators, and researchers.

Example of technical advise service

[Consultation request] The client was a manufacturer of bathing equipment for nursing homes. They were aware of customers' demand to minimize the risk of drowning. The question was how to estimate the risks and detect danger, or what to do to minimize the risks.

[Actions taken and answers given] An expert provided the client an estimation of bathing postures from body figures and bathtub sizes, some hints on drowning detection sensors and other design solutions.

●Number of technical consultations



Innovation School

AIST's Innovation School is working to broaden the horizons of young researchers and to raise their awareness using a specially developed curriculum. It aims to train them to be ready to contribute to innovation.

To address increasingly complicated social issues, we need to develop innovative technologies by combining the ideas and technologies of AIST and external organizations. For this we need personnel who can play a central role in collaboration. AIST actively accepts young researchers with PhDs, and master's and PhD students, and trains them so that they have scientific and technological knowledge in specific areas of expertise. They are given opportunities to develop communication and cooperation skills they need to work with experts in different fields from a broader perspective.

In FY 2016, we employed 18 postdoctoral researchers and conducted lectures, seminars and long-term business training. To improve our education programs for graduate students, we ran a one-year doctoral course (for doctoral postdocs and graduate students) and a half-year basic research skills course. A total of 29 students completed programs of lectures, seminars and technical training.

Curriculum of the Innovation School

① Lectures and exercise at AIST

- Lectures on philosophy and management and on the activities of researchers in industry, academia, and government and of corporate executives
- Lectures and exercises on topics such as standardization and research, intellectual property and research, design thinking, risk assessment, and career development
- Lectures on a research approach of integrating and configuring component technologies based on research scenarios
- Exercise to improve skills in presenting research in ways that can be understood by people from different fields

② Research at AIST

- Working on research topics in laboratories
- Experiencing research covering the process from basic research to product development in a seamless way
- Acquisition of business manners

③ On-the-job training with companies (about 3 months on average)

Students of the school are sent by AIST to companies to learn the following through experience:

- Importance of the procedures used to conduct research, the speed of technology development, and cost awareness
- Importance of teamwork and collaboration with other departments.

Expanding the vision and providing opportunities to young researchers

Students of the school say such things as "I found that the knowledge and the experience in my research is also applicable to companies," or "The communication skills learned in the school was helpful." They realize from experience that there are a variety of opportunities to work as researchers; to develop such insights as "The most important thing is the awareness that I work in an organization," or "You need to share a language with those with expertise in each area;" and to broaden their horizons. Companies that have accepted trainees say that "We gained valuable technological knowledge from the students," or "The students inspired those of our employees who were from the same generation." The companies rate the trainees' research capabilities and work attitudes highly.

Since the school started, 259 students have completed the postdoc course program and have discovered their new potential. They are working in a variety of areas in companies, universities, and public research institutions.

The lecture by the president

An Innovation School lecture

10th class report session of the Innovation School

AIST Research Assistant Program

To develop human resources with world-class, high-level expertise and practical research ability that produce results leading to innovation, AIST provides the AIST Research Assistant Program to hire graduate students with high levels of ability. This program allows talented graduate students to focus on research for their degrees without financial difficulties. By participating in AIST's R&D activities which meet social needs, students can develop the ability to plan and conduct the advanced research, which is crucial for R&D activities. In FY 2016, 44 graduate students in doctoral programs and 130 graduate students in master's programs engaged in R&D at AIST.

Voices of research assistants

I attained the research position I wanted to work at. There I had experiences that would not have been available at university. (second-year master's program student)

This is a valuable position in which I am surrounded by high-level researchers and I can raise my own level. (third-year doctoral program student)

●Employment requirements for AIST Research Assistants

(as of July 2017)

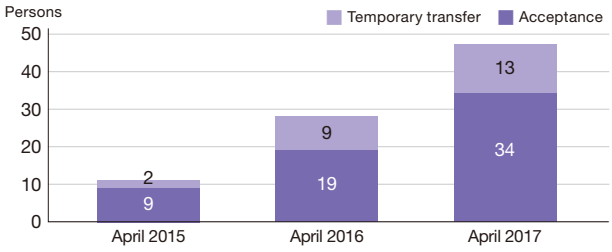
Candidate	Graduate students in PhD programs	Graduate students in master's programs
Requirements	Superb R&D and paper-writing abilities that contribute highly to the promotion of AIST R&D projects, and independent execution of duties with staff guidance.	R&D and paper-writing abilities that help promote of AIST's R&D projects, and independent execution of duties with staff guidance.
Days of employment	Avg. 10-14 days/month	Avg. 4-14 days/month
Salary	1,900 yen/hour (approx. 200,000 yen/month for 14 working days)	1,500 yen/hour (approx. 80,000 yen/month for 7 working days)
Number of employed graduate students in FY 2016	44	130

Cross-appointment Program

To create a cross-institutional research system, in November 2014 AIST established a cross-appointment program. This program allows a researcher to enter into employment contracts with two institutions or more, and he/she can work as a regular researcher for each of them. Interchange of researchers between AIST and the other institutions will increase mobility of human resources among academic, industrial, and governmental sectors. As a core institution for transfer of technology, AIST is expected to adopt superior technology seeds produced by fundamental research by universities and to promote transfer of technology for practical application of research outcomes and creation of new industries.

Today, we accept 34 researchers from 12 universities and 1 institution, and send 13 researchers to 9 universities and 1 institution. (As of April 1, 2017)

●Number of program users



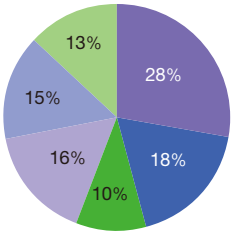
TIA collaborative research program ("Kakehashi")

Kakehashi (meaning "linking bridge") is a program supporting collaboration among the five core organizations of TIA (AIST, National Institute for Materials Science, the University of Tsukuba, High Energy Accelerator Research Organization, and the University of Tokyo). Since it started in FY 2016, the program has supported projects with the aims of finding "seeds" and "sprouts" of research and technology at various stages, nurturing the buds of new innovation through collaboration, and transferring the fruits to industry.

First TIA "Kakehashi" Outcomes Report Meeting

Around 250 participants from research and educational institutions and business attended the First TIA Kakehashi Outcomes Report Meeting on July 4, 2017. TIA will continue to promote the Kakehashi program to bring about further collaboration and grow research and technology "seeds" and "sprouts" together for new innovations.

●Various fields studied under the Kakehashi program



- Medical care and biotechnology
- Electronics and devices
- Environment and energy
- Measurement
- Materials and processing
- Common fundamental technology

The First TIA Kakehashi Outcomes Report Meeting

Activities in FY 2016

In FY 2016, 39 projects were selected from new research fields, including biotechnology and computational materials science, as well as numerous fields covering interdisciplinary areas. Many collaborative organizations were formed with Kakehashi as a start, and many workshops and symposia were held.

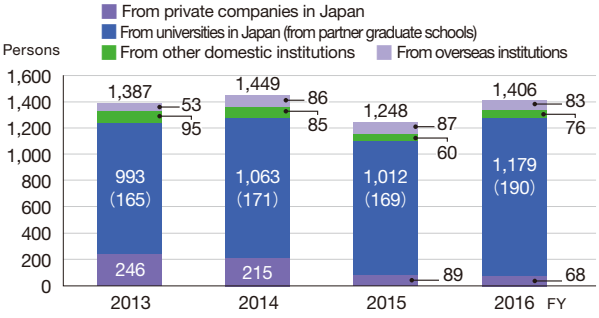
Technical Training

The technical training is a program where AIST accepts researchers, engineers, and students from companies, universities, and public research organizations for defined periods and provides them with an opportunity to study technologies under the instruction of AIST researchers. The program may also be used for the purposes of short-term technical training (internships) and educational programs for academic credits, which are both designed mainly for university students. In FY 2016, 1406 trainees participated in this program.

Collaboration with partner graduate school programs

Using the knowledge and experience gained at AIST, AIST researchers teach as guest professors at graduate schools that have cooperation agreements with AIST. AIST provides technical training to graduate students, and AIST researchers advise them on their research.

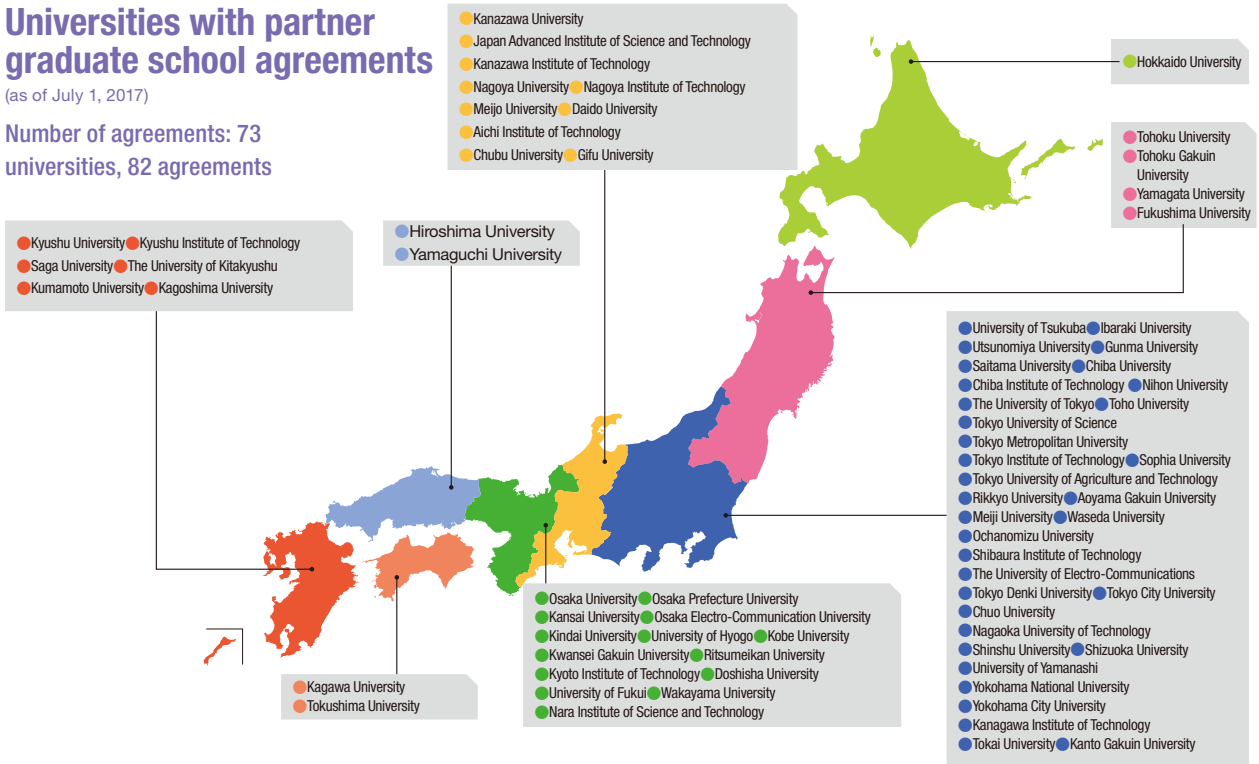
●Number of trainees on technical training



Universities with partner graduate school agreements

(as of July 1, 2017)

Number of agreements: 73 universities, 82 agreements



Voices of trainees

"I was able to conduct my research as a learner because there were many experienced researchers and technical personnel around me." (A trainee from a university)
"It was a fruitful experience to have lengthy discussions about earthquakes, volcanoes, and disaster prevention with many researchers." (A trainee from an autonomous body)

Labor Practices

We aim to ensure global and local environmental conservation and the safety and health of all people at AIST.

Occupational Health and Safety

As would be expected in laboratories, AIST uses substances and equipment that may affect the human body and the environment, such as various chemical substances, high-pressure gases, radioactive materials, genetically modified organisms, nano-materials, laser equipment, and machine tools. Accordingly, AIST has an Environmental Safety Charter in place to create a work environment in which all people working here can do so in a safe and healthy manner. AIST is working to improve the health and safety of its employees as a top priority.

Safety and Health Committee meetings and site meetings of AIST bases

Safety and health managers hold Safety and Health Committee meetings, which are attended by labor and management representatives, at each AIST site and research base every month to discuss health and safety issues.

Representatives from each AIST department at the base discuss safety and health issues at the Safety and Health Committee meetings and at other site meetings. The results of the meetings are communicated to all employees through departmental meetings and the like.

Establishment of the Safety and Health Guideline

AIST has a “Safety and Health Guideline” in place, based on the Environmental Safety Charter, that set forth a code of conduct to ensure safety in handling hazardous chemicals and high-pressure gas cylinders and in performing experiments.

The guidelines provide the basis for employee safety education and for laboratory work. They are reviewed annually and updated as necessary. In FY 2016, in light of the occurrence of a dust explosion (see p. 59, "Reports on Accidents that Occurred in FY 2016"), precautions against dust explosions were added; also incorporated into the guidelines were precautions for the handling of liquefied gas to prevent spills of liquefied gas during transport and specified chemical substances that were added in a revision of the Ordinance on Prevention of Hazards Due to Specified Chemical Substances.

Emergency response management

We conduct disaster and fire drills so that we can take prompt action to minimize damage in the event of emergencies such as disasters and accidents.

To ensure a means of communication with the regional research bases in the event of a disaster, we also conduct communication drills using a disaster management radiotelephone system; this system has been installed at all of AIST's research bases. In FY 2016, we used the Earthquake Early Warning on Disaster Prevention Day to run a coordinated national earthquake early warning drill. We also used a safety confirmation system* that was installed in FY 2015 for a safety confirmation drill in preparation for a major disaster.

In anticipation of disasters such as earthquakes, we have stockpiles of food and emergency items; we check, review, and replace them on a regular basis.

* In the event of a disaster, the safety confirmation system automatically sends bulk safety confirmation emails to employees. It automatically collects the results and displays them on the web.

A fire drill

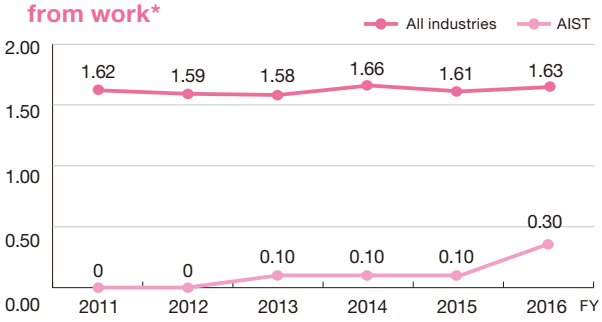
Prevention of accidents

In the event of a work-related accident, an investigation and analyses are conducted to determine the cause. The relevant work is put on hold until recurrence-prevention measures are implemented, and information on the accident is communicated to all employees to prevent similar accidents.

AIST holds a Safety Management Report Meeting every morning. At this meeting, AIST connects 13 research bases across the country through a teleconferencing system to exchange information on (1) accidents at the regional research bases, AIST Tsukuba, and other sites, and (2) near-miss incidents and health issues. The aim is to share details of recurrence-prevention measures and thus improve safety and health.

We kept the total number of accidents at AIST in FY 2016—as well as the number of accidents resulting in injury associated with laboratory work—at low levels. The number of people falling over while walking increased from FY 2015 to FY 2016; we conducted safety education to encourage danger awareness even outside research sites. We introduced a new Occupational Safety Month and encouraged accident prevention behaviors both during work and on the way to and from work.

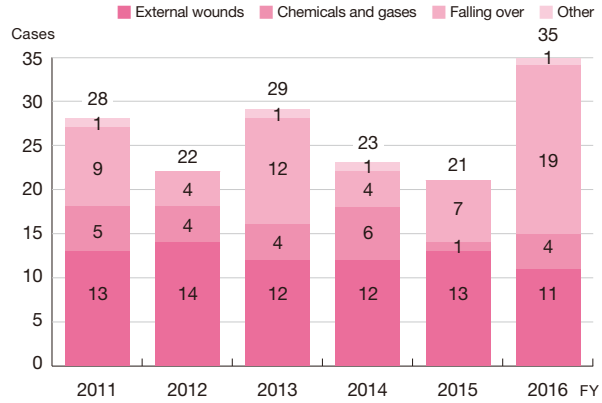
●Incidence of accidents resulting in absences from work*



***: Incidence of accidents resulting in absences from work**

Frequency of accidents expressed as the number of casualties from industrial accidents per million cumulative work hours.Incidence of accidents resulting in absence from work = number of casualties from industrial accidents / number of cumulative work hours 1,000,000.

●Number of accidents resulting in injury



Safety education and support for license acquisition

AIST accepts many researchers, engineers and students from businesses, universities and the like for cooperative research, technical training and so forth. With a view to preventing accidents, AIST runs a number of safety training programs and classes, both for employees and for visitors from other organizations.

Safety education provided when employees are hired and when there is a change in work details is managed by an internal safety education management system, which allows participation history and program contents to be checked. To broaden learning opportunities, an e-learning system is used in parts of the safety training for life science experiments.

A program of education and training for animal experiments teaches participants how to design a suitable experimental plan and gives them the knowledge and attitudes needed to conduct experiments; it is based on the 3Rs stipulated by law, namely Replacement (i.e., use alternative methods), Reduction (reduce the number of animals used), and Refinement (reduce pain). AIST has made it compulsory for those responsible for hazardous chemicals in quantities exceeding a given amount to obtain a Hazardous Materials Engineer's License. In this way, we are committed to improving safety management in our laboratories. Also, we actively support employees in acquiring licenses. For example, we host a course on the skills required for a Health Officer's License and a course on the skills required for a Chief Technician's License for Using Organic Solvents.

In FY 2016, AIST started a new high-pressure gas safety course to give participants accurate information on how to handle high-pressure gases and to promote accident prevention. In addition, risk assessments of chemical substances have become mandatory in an amendment of the Industrial Safety and Health Act; we gave four briefing sessions and are promoting the enforcement of risk assessments.

●Main education and training programs and workshops held in FY 2016

Program	No. of sessions	No. of participants
Course on skills required for a Health Officer's License	2	39
Course on skills required for a Chief Technician's License for Using Organic Solvents	2	57
Course on skills required for a Chief Technician's License for Using Specified Chemical Substances	2	53
High-pressure gas safety course	3	1,209
General safety workshop (for all those responsible for hazardous chemicals, etc.)	4	596
Education and training for recombinant DNA experiments (e-learning participants)	1	1,063
Education and training for animal experiments (e-learning participants	1	260
Education and training on human ethics in life science experiments	1	220
Education and training for biosafety	2	31
Education and training for those involved in animal experiments	1	94
Course on safe driving	19	1,713
Joint radiation education and training (for radiation workers)	3	251
X-ray education and training (for new users of X-ray equipment)	87	273
Course on compliance with laws and regulations on radioactive materials (for managers)	1	53

Hiring Regional Employees by Open Recruitment at AIST

The work conducted by AIST's headquarters and operational organizations includes routine work such as purchasing, asset management, and employee benefit management which can be done more effectively by engaging highly experienced employees.

A skilled contractor and a temporary employee who have been working at AIST for a certain period of time can be candidates for employment by AIST under the fixed-term regional employment system (i.e. employing administrative staff who are not transferred from one region to another). AIST has hired 35 people as personnel in total, and these employees have been working at head office and in operational organizations. We received dozens of applications, and 6 applicants were hired at AIST Tsukuba in the fiscal year 2017. The employees can work for up to 2 years, however, they have a chance to be hired under the indefinite-term employment system based on evaluations of their work performance. 11 employees have been rehired under the indefinite-term employment system in the fiscal year 2017.

AIST will continue to hire fixed-term regional employees to support research and development, innovation, and other activities.

●Number of persons newly employed each year

FY	Number of persons employed
2012	2
2013	5
2014	5
2015	7
2016	10
2017	6

Support for Work–life Balance

Support for compatibility between work and child-raising/nursing care

AIST is working to develop a work environment that makes it possible to manage both work and childcare or nursing care responsibilities. The tables on the following page show the numbers of employees who used the leave programs, etc.

As a measure to support childcare, child daycare facilities where those who work at AIST can temporarily leave their children are available at three research bases (AIST Tsukuba, AIST Chubu and AIST Kansai). Private childcare and babysitting services operating under contract with AIST are available for those who visit research bases with no childcare facilities, or major cities. In addition, a seminar with an outside expert was held on the topic of "women's health at different life stages," which is a crucial topic for achieving work–life balance.

In support of nursing care, a seminar on the topic of dementia was given by an outside expert and information was distributed, providing knowledge of dementia and how to deal with it. Including those studying in preparation for the future, over 150 employees took part. After the seminar, information on nursing care support systems in AIST was issued.

Information on childcare and nursing-care services is available on the Intranet sites "Childcare Square" and "Nursing-Care Square," which provide information on the relevant programs.

AIST has a flextime system and a discretionary-work system in place to allow flexible work arrangements; the flextime system is used by 31% of employees, and 55% use the discretionary-work system. These work systems are useful for many employees to support work–life balance, regardless of whether they have childcare or nursing care responsibilities.

Action Plan to Support the Development of Next-Generation Human Resources

To meet the objectives of the third Action Plan to Support the Development of Next-Generation Human Resources, AIST produced and distributed a leaflet outlining a project to expand use of its childcare and nursing-care support programs. In FY 2016 AIST also held briefings on the childcare and nursing-care support programs at AIST Tsukuba, AIST Shikoku and AIST Kyushu. AIST encourages employees to use their annual paid leave. The proportion of employees taking vacations of at least five consecutive days (including national holidays and weekends) has risen above 70%. In March 2017, the fourth Action Plan to Support the Development of Next-Generation Human Resources was approved and published. While containing similar content to the previous plan, the new plan is focused more on individually tailored support.

Campaign to keep meetings between 9 and 5

With the Project for the Act of Promotion of Women's

Participation and Advancement in the Workplace, AIST has raised the proportion of female managers above 5% during the Fourth Medium- to Long-Term Plan. Accordingly, AIST is running a campaign to keep meetings between 9 a.m. and 5 p.m. to encourage female participation, by promoting more efficient administrative work and organization of the workplace environment. Campaign posters have been put up at AIST sites to raise awareness among employees. This initiative has been praised by other organizations, which are considering running similar initiatives.

Childcare support telecommuting system

As a measure to moderate the career disruption caused by life events and support participation by research workers with time constraints, a system for working from home has been launched in line with the institute's action plan under The Act on Promotion of Women's Participation and Advancement in the Workplace. After a trial run, the system was rolled out in October 2016. With this telecommuting system, at the request of an employee, the employee can perform their work duties from home using computing and communications equipment for a period subject to approval by the President. At the end of FY 2016, 12 people (two men and 10 women) were using the system.

●Numbers of people who used the various leave programs

	FY 2014		FY 2015		FY 2016	
	Male	Female	Male	Female	Male	Female
Leave to care for sick children	101	178	116	185	110	192
Special childcare leave	28	13	43	11	32	11
Extended childcare leave*	1	26	3	33	4	27
Nursing care leave	39	25	47	30	51	37
Extended nursing care leave*	0	0	0	2	1	0

* Number of employees starting the leave within the fiscal year

●Numbers of employees who used child daycare services (totals)

	FY 2014		FY 2015		FY 2016	
	Permanent employees	Contract employees	Permanent employees	Contract employees	Permanent employees	Contract employees
AIST Tsukuba	1,276	971	1,202	864	1,135	1,016
AIST Chubu	26	88	43	93	7	33
AIST Kansai	248	115	228	15	190	10
Private child daycare facilities and babysitters	32	0	13	0	7	1

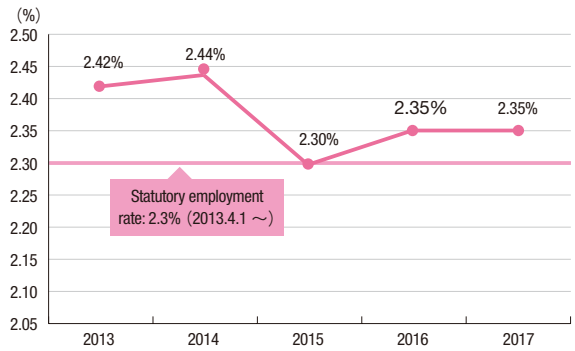
In a seminar

Efforts to Hire People with Disabilities

AIST actively hires people with disabilities. In April 2013, the statutory employment rate for people with disabilities was increased to 2.3%. We hired people with disabilities at every opportunity and achieved the statutory employment rate. (The disability employment rate as of June 1, 2017 was 2.35%.)

We create a work environment that helps the physically challenged work with ease and provides support for them in cooperation with each region's Support Center for People with Disabilities. Thus, we aim to increase the percentage of physically challenged people who are taken on as employees and remain at work. (This percentage was 88.37% in FY 2016.)

●Change in employment rates for people with disabilities (% of June 1 of each year)

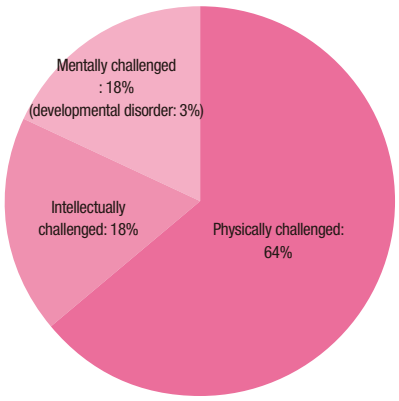


●Percentages of people with disabilities remaining at work

FY	2011	2012	2013	2014	2015	2016
Number of people at the beginning of the fiscal year	77	80	88	86	91	87
Number of people who left AIST within the fiscal year	5	7	7	14	12	10
Employee turnover rate	6.49%	8.75%	7.95%	16.28%	13.19%	11.49%
Employee retention rate	93.51%	91.25%	92.05%	83.72%	86.81%	88.51%

●Employment rates by disability type

As of June 1, 2017



Response to the Disability Discrimination Elimination Act

On April 1, 2016, the Act on the Promotion of Elimination of Discrimination against Persons with Disabilities (Disability Discrimination Elimination Act) was implemented. This law aims to create a tolerant and inclusive society in which everyone can live in peace without being discriminated against because of their disabilities.

In line with the law, AIST put in place a system to promote the elimination of discrimination against people with disabilities; we developed guidelines specifying what attitudes and actions employees should take in dealing with disability issues, and we established consultation services at research bases throughout Japan to provide advice to people with disabilities and those working with them. Moreover, to further deepen employees' knowledge and understanding of the law, we have continued to invite experts to hold study sessions and we have provided an e-learning system.

As a result of these efforts, we can accept advance requests for people with disabilities to participate safely in events held by AIST, can cater for particular disabilities (providing parking close to the event location for wheelchair users, giving descriptions using flipcharts showing clear visual images to aid people with hearing disabilities, and such), and are helping employees to understand the issues. We have also worked to contribute to regional communities, including holding discussions with local social workers about AIST's initiatives to support people with disabilities.

By continuing these efforts, we will enhance awareness and support to people with disabilities among employees of AIST both in their everyday work and in life in general.

A leaflet for an open day at AIST Tsukuba

If you need any assistance or particular arrangements, please talk to the nearest staff member.

Activities of Intellectually or Developmentally Challenged Teams

AIST has set up Challenged Teams, made up of people with intellectual challenges and developmental challenges, at AIST Tsukuba, AIST Chubu and AIST Kansai. Each year, with reference to regional minimum wages, these people are employed on contracts at wages above the minimum wage for the region. They perform clerical support work, environment improvement work and the like with the support of instructors.


Bespoke reusable newspaper bags for an international conference


Putting leaflets into envelopes to be handed out at an open day

AIST Tsukuba

The AIST Tsukuba Challenged Team assists with clerical duties and works to improve the environment; there are now 11 team members and four instructors. At the request of the offices, the team mainly transported papers, shredded discarded documents, did recycling and cleaning work, and put leaflets into envelopes that were later handed out to the public at an open day. This year, they made bespoke reusable newspaper bags to hold documents for an international conference, earning favorable comments from international delegates.

AIST Chubu

The AIST Chubu Challenged Team now has four team members and one instructor. Their activities include tasks such as weeding the grounds, cleaning and setting up meeting rooms, setting up venues for events, and collecting and sorting waste generated at the research base. Recently they have performed important work in boxing and organizing documents requiring incineration. Their activities have become essential to continuing research work at the base. In addition, the team members make envelopes from disused maps; these sturdy envelopes are extensively used by the base's employees.



Collecting waste materials from a lab office Sorting and bundling waste materials

AIST Kansai

The AIST Kansai Challenged Team welcomed a new instructor in April 2017; there are now two team members and one instructor. They work to improve the landscape at the site, mainly cutting grass and clearing fallen leaves. On rainy days and extremely hot days, they are assigned to shredding discarded documents, putting stickers on envelopes, and cleaning floors in the buildings. At the request of each department, they also help to rearrange furniture in meeting rooms and transport waste materials to collection points.



Cutting grass at AIST Kansai

Barrier-free Maps

A barrier-free map shows buildings with toilets and elevators suitable for wheelchairs, parking spaces for people with disabilities, and the like.

Locations requiring extra attention for access, because of steps or the like, and locations that are inaccessible to wheelchairs are also shown. Contract employees with wheelchairs check the sites in person and the maps are updated accordingly.

Health Management and Mental Health

General and special medical examinations are performed in spring and autumn every year. We strive to increase the percentage of employees who undergo medical examinations by raising awareness that they are required to take these examinations, including health screening. As follow-up care after medical examinations, an industrial physician and industrial health staff provide health advice. We provide support to improve the performance of individual employees and AIST as a whole by detecting and preventing employees' health disorders and illnesses in their early stages.

To address mental health issues, we have developed a unified Mental Fitness Program in accordance with the directives and guidelines of the Ministry of Health, Labor, and Welfare. Four programs based on the Mental Fitness Program are implemented in a continuous and planned way. They focus on (1) self-care; (2) line care through implementation of education and training and seminars; (3) care by in-house industrial health staff and others through face-to-face counseling with an industrial physician and industrial health staff and support in returning to work; and (4) care by external resources through the use of external mental health organizations.

From FY 2016 we have introduced a stress check system (once a year) to encourage awareness of stress situations of staff and to promote workplace improvement to create a comfortable workplace. By doing this, we are making efforts to strengthen measures to prevent staff from suffering mental health disorder.

●Numbers and percentages of permanent and contract employees who underwent periodic medical examinations (including health screening), 2012–2016

Top: percentage of examinees.
Bottom: no. of examinees/ total no. of eligible employees

FY	2012	2013	2014	2015	2016
(1) Employees (excluding (2)) *1	98.4% 2,937 / 2,986	99.9% 2,990 / 2,993	99.9% 2,965 / 2,966	99.6% 2,978 / 2,989	99.7% 3,022 / 3,031
(2) Contract employees *2	88.8% 2,072 / 2,330	99.9% 2,136 / 2,139	100.0% 2,252 / 2,252	100.0% 2,150 / 2,150	99.9% 2,319 / 2,322

*1 Excluding those on extended childcare leave and sick leave and those on long leave due to overseas relocation
*2 Social insurance policyholders only

●Numbers of permanent and contract employees (including temporary employees) who underwent special medical examinations in FY 2015–2016

Top: no. of examinees/ total no. of applicable employees in spring.
Bottom: no. of examinees/ total no. of applicable employees in autumn

Special medical examination		FY2015			FY2017		
		Permanent employee	Contract employee	Total	Permanent employee	Contract employee	Total
Medical examination for organic solvent poisoning prevention	Spring	745 / 745	652 / 652	1397 / 1397	761 / 761	631 / 631	1392 / 1392
	Autumn	736 / 736	663 / 663	1399 / 1399	759 / 759	682 / 682	1441 / 1441
Medical examination for specified-chemical poisoning	Spring	409 / 409	298 / 298	707 / 707	446 / 446	323 / 323	769 / 769
	Autumn	417 / 417	312 / 312	729 / 729	444 / 444	352 / 352	796 / 796
Medical examination for ionizing radiation exposure	Spring	329 / 329	88 / 88	417 / 417	326 / 326	80 / 80	406 / 406
	Autumn	320 / 320	85 / 85	405 / 405	320 / 320	83 / 83	403 / 403
Medical examination for lead poisoning	Spring	8 / 8	6 / 6	14 / 14	10 / 10	8 / 8	18 / 18
	Autumn	8 / 8	6 / 6	14 / 14	11 / 11	7 / 7	18 / 18
Medical examination for laser injury	Spring	216 / 216	72 / 72	288 / 288	270 / 270	106 / 106	376 / 376
	Autumn	66 / 66	31 / 31	97 / 97	42 / 42	12 / 12	54 / 54
Medical examination for pneumoconiosis	Spring	6 / 6	12 / 12	18 / 18	9 / 9	15 / 15	24 / 24
	Autumn	2 / 2	2 / 2	4 / 4	4 / 4	2 / 2	6 / 6
Medical examination for asbestos exposure	Spring	2 / 2	1 / 1	3 / 3	6 / 6	2 / 2	8 / 8
	Autumn	6 / 6	2 / 2	8 / 8	6 / 6	2 / 2	8 / 8

●Numbers of employees with significant findings*1 from AIST's medical examinations, and numbers of employees who received face-to-face counseling

①Number of employees with significant findings, and their percentages of the total

Year		2012	2013	FY	2014	2015	2016
With significant findings (Rated C)	No. of employees	816	785	With significant findings (D-diagnosed)	423	103	117
	Percentage of employees	18.5%	15.3%		8.1%	2.8%	2.5%
With significant findings (Rated D)	No. of employees	481	483	With significant findings (E-diagnosed)	598	818	970
	Percentage of employees	10.9%	9.4%		11.5%	21.0%	20.5%

[1] Numbers of C- and D-rated persons cover the period 2011–2013.
Numbers of D- and E-diagnosed persons cover FY 2014-2015

②Numbers of employees who received counseling, and their percentages to employees with significant findings

FY		2012	2013	FY	2014	2015	2016
With significant findings (Rated C)	No. of employees who received counseling	775	712	With significant findings (D-diagnosed)	350	71	98
	Percentage of employees who received counseling	95.0%	90.7%		82.7%	68.9%	83.8%
With significant findings (Rated D)	No. of employees who received counseling	473	470	With significant findings (E-diagnosed)	569	801	862
	Percentage of employees who received counseling	98.3%	97.3%		95.2%	97.9%	88.9%

●Flu shots (at AIST)

FY	2012	2013	2014	2015	2016
AIST Tsukuba/Tokyo	1,706	1,782	1,837	1,912	1,927
Regional research bases	502	532	555	543	538
Grand total	2,208	2,314	2,392	2,455	2,465

●Other activities

FY	2012	2013	2014	2015	2016
Refreshing exercise	167	291	304	243	219
Emergency first-aid workshop	148	145	175	188	154
Seminar	10	93	64	73	133
Workshop (training)	179	252	162	180	407

Definition of criteria:
● Before FY 2013
A: within normal range; B: follow-up examination required;
C: detailed examination required; D: treatment required
● After FY 2014
A: no anomalies;
B: mild abnormalities but no interference with daily life;
C: follow-up examination required;
D: health advice required;
E: treatment required;
F: counseling required (applicable only to special medical examinations)

●Face-to-face counseling with an industrial physician, and health consultation FY 2016

		Tsukuba	Hokkaido	Tohoku	Chubu	Kansai	Shikoku	Chugoku	Kyushu	Tokyo	Tokyo Waterfront	Fukushima
Industrial physician	Body	877	234	43	117	210	24	43	14	42	39	8
	Mental	363	2	7	62	68	1	21	7	1	50	12
Industrial health staff		1,311	591	33	345	400	43	40	68	73	104	337
Total		2,551	827	83	524	678	68	104	89	116	193	357

Fair Operating Practices

Aiming at an organization that is trusted by society, we conduct our activities with sincerity

Conflict-of-interest management

The promotion of industry–academia–government collaborations and the dissemination of research achievements are important parts of AIST's mission. If an executive or staff member derives personal gain from a partner organization, he or she needs to properly manage any situation in which there is a conflict of interest between his/her personal gain and the research duties and responsibilities required by his/her role as an executive or staff member of the public research institution AIST.

AIST has formulated rules to implement conflict-of-interest management and applies this management to such cases.

In FY 2016, AIST conducted periodic conflict-of-interest self-report surveys of executives and staff twice (in August in the first half of the fiscal year and March in the second half). All of those surveyed (3206 in the first half and 3230 in the second half) reported on conflicts of interest. Six of them were considered to have possible conflicts of interest in ongoing industry–academia–government collaborations and were interviewed by an external conflict-of-interest counsellor to clarify their situations. Everyone reporting a possibility of personal gain, including the six mentioned above, was informed of points to bear in mind in the conduct of industry–academia–government collaborations in the future.

In medical research, in order to improve the protection of subjects and the transparency of research, conflict-of-interest management is included in AIST's Ethical Principles for Medical Research Involving Human Subjects.

AIST set up a conflict-of-interest management committee for clinical research in October 2016 under the oversight of the Legal Office and the Bioethics and Biosafety Management Office. This committee conducted six investigations in FY 2016.

Information Security

AIST provides information security training to all users of our information network on a continuous basis, so that they can improve their understanding of the information security policy of AIST. This enables appropriate use of the network with awareness of responsibility. In addition, we confirm the degree of understanding and permeation of our policy among the users through regular self-inspections for personal information protection and information security as well as information security audits.

Information security training

AIST requires all the executives and staff to take information security training every year, to implement and improve information security awareness. The content of the training is reviewed every year and the newest measures on information security are presented.

Self-inspections for personal information protection and information security

We implement self-inspections of executives and staff to see whether appropriate measures are taken for information security in accordance with our security policy. Almost all of our eligible staff conducted self-inspections in FY 2016.

Information security audit

AIST conducts information security audits within the institute to objectively evaluate whether information and the information security system are properly used, managed, and operated. In FY 2016, in order to enhance the information security of AIST as a whole, we conducted information security audits of 60 units.

Implementation of Security Export Control

The security export control is an important effort in maintaining peace and security in the international community. In Japan, in addition to the regulations on weapons trade itself, the export of goods and transfer of technologies that may be used for the development and manufacture of weapons are regulated according to the "Foreign Exchange and Foreign Trade Act" to prevent the proliferation of weapons of mass destruction and excessive accumulation of conventional weapons. Therefore, companies and institutions that may develop relationships with overseas companies and institutions must have tight export control.

In FY 2004, AIST formulated Rules for the Security Export Control and gave notification of them under the title "Internal Compliance Program" to the Ministry of Economy, Trade and Industry. In accordance with these rules, we have tight security export controls in place. Security Export Control activities include: (1) communicating the latest information on export control within AIST; (2) export control training for AIST staff; (3) export control instruction to individual staff members; (4) classification and transaction screening; and (5) conducting internal audits.

In recent years, as collaborative research with overseas research institutes and universities is promoted, there has been an increase in the importance of raising awareness of security export control among employees. Accordingly, security export control is in place as mentioned above, and individual employees are now fully aware of security export control.

AIST will continue to promote further implementation of security export control in the future to maintain peace and safety as a member of the international community.

Implementation of Rational Procurement Processes

In accordance with "promoting measures for rational procurement by Independent Administrative Institutes" (approved by the Minister for Internal Affairs and Communications on May 25, 2015) and bearing in mind the characteristics of our duties and operations, AIST has adopted and publicized the AIST Rational Procurement Policy to autonomously and continuously rationalize procurement while assuring fairness and transparency, using a plan–do–check–act cycle.

To be specific, we are working to implement rational procurement with the following policies: (1) analysis of the circumstances and reasons for procurement (competitive contracts and non-competitive negotiated contracts, and the outcomes of single bid situations); (2) areas requiring particular attention (working for appropriate negotiated contracts, working to reduce single bid situations, and sharing of personnel training and information); (3) careful governance of procurement (clarity and general understanding of procurement contracting rights, efforts to improve fairness, transparency and competitiveness, maintaining functions within the institute for checking negotiated contracts, appropriate thoroughness of inspections, and efforts to prevent occurrences and recurrences of scandal); (4) self-evaluation; and (5) a system to promote rational procurement.

Test of Procurement of Services to the Market at AIST Tsukuba

In accordance with the Cabinet Decision on the "Principle of Public Service Reform, etc." (July 15, 2011), concerning facility maintenance at AIST Tsukuba, eight services under one group have been provided for the 3 years from FY 2012 to FY 2014.

To ensure competition in FY 2015 and into the future, these eight services, which had been integrated into one group, were reviewed and reintegrated into five groups. The services will be provided over a 3-year period from FY 2015 to FY 2017.

The five groups are: (1) maintenance and management of facilities, (2) management of planting, (3) security work and building-cleaning work, (4) operation and management of the Research Collaboration Center, Science Square Tsukuba, and at the Geological Museum, and (5) driving, maintenance, and management of cars.

The main results of the services in FY 2016 are as follows:

Maintenance and improvement of the quality of services

- Understanding each other's work (holding work report meetings)
- Ensuring safety
- Ensuring continuity of work
- Being environmentally friendly
- Ensuring a comfortable facility environment

Average satisfaction rates in a questionnaire survey of facility users:

Operation and management of the Research Collaboration Center (Sakura Kan) 97% (recommended minimum approval rate 90%)
Operation and management of the Research Collaboration Center (Keyaki Kan) 99% (recommended minimum approval rate 90%)
Operation and management of Science Square Tsukuba 97% (recommended minimum approval rate 90%)
Operation and management of the Geological Museum 93% (recommended minimum approval rate 90%)

Community Involvement

Building a trusting relationship with the community, including awareness of being a member of society

The Geological Museum

The Geological Museum is an exhibition facility for showing and teaching the public about the research outcomes of geological surveys conducted by the Geological Survey of Japan, which is part of AIST. The Museum presents geological specimens found in the geological surveys and comprehensive information about the geology under our feet in ways that are easy to understand.

Some of the exhibitions in the Geological Museum were renovated in the spring of 2017.

The focus of the renovation was the installation of wooden decking on an outside terrace and rest area on the second floor, to create a new exhibition space. Exhibitions that were previously dispersed through the museum were gathered together in this area and an indoor rest area: the Mount Tsukuba Area Geopark exhibition, rocks and mineral specimens from northern Ibaraki Prefecture, and an exhibition of historical photographs of Lake Kasumigaura. Now the geology, rocks and minerals of the local region can be viewed by people relaxing in an open area. Insects made of stone, created by application of thin section techniques for geological research, are also exhibited.

The number of visitors to the museum in FY 2016 was 41,613, up by 2191 from FY 2015.

The Geological Museum, providing information on geology to society

Wooden decking installed in the outside terrace area

Exhibits brought together in the altered layout

- Closed on Mondays except for national holidays (closed on the next weekday instead), and from December 28 to January 4
- Opening hours: 9:30 a.m. to 4:30 p.m.
- Enquiries to the Geological Museum
  TEL: +81-29-861-3750
  FAX: +81-29-861-3746
  www.gsj.jp/Muse/en/

Open Day Events

AIST holds open days at several sites each year to show the fruits of our research to the general public and deepen their understanding of AIST's activities. Open days are planned as an opportunity to narrow the gap between the public and scientists, with experiments and equipment-making projects inspiring children's interest in science and technology, guided tours of facilities that are usually not open to the public, and so forth. At the AIST Tsukuba open day in 2017, AI technology, a topic of interest to the public, was explained in a special presentation titled "The Growth of Artificial Intelligence." Events were also held at nine other AIST bases around the country. The AIST open days in FY 2017 received 14,468 visitors.

A guided tour

The AI presentation

Voices of participants (excerpts from a questionnaire)

- Meeting the researchers was a good experience. The children also enjoyed trying different things.
- It was good to be able to put questions directly to people who do research.
- The children enjoyed making science crafts. It was wonderful to listen to the jazz performance while we had our lunch.
- I come every year. Even adults can enjoy it. I'm looking forward to next year.
- There are so many things to enjoy, one day is not enough.

Delivery Lectures and Experimental Classes

"Delivery Lectures" and "Experimental Classes" are face-to-face promotional activities in which research staff from AIST visit schools and other public facilities in different regions and give simple explanations of the fields in which they are experts.

In a Delivery Lecture, a researcher gives an easy-to-understand introduction to their research, and describes the work of AIST to a broad range of people from children to adults. Experimental Classes provide opportunities to encounter the wonder of science in demonstrations, experiments and equipment-making projects for children to study while having fun, making science and technology more familiar. In 2016 one of the lecturers, Masaki Shimomura, was recognized for his remarkable achievements in science teaching in Tsukuba City and was awarded the title "Tsukuba Science Education Meister."

An Experimental Class

I know there are many people who want to develop a culture in which science and technology are seen as fun and I will continue to participate in these activities. I hope that Japan's science community appreciates and will support these initiatives.

Lecturer
Masaki Shimomura

Human Rights

We create an environment where all those related to AIST treat each other with respect.

Respect for Basic Human Rights

A wide variety of people work at AIST, including executives, permanent employees, contract employees, temporary employees, visiting researchers, technical trainees, contractors, visitors participating in industry–academia–government collaborative programs, and visitors participating in international collaborative programs. We work with the awareness that it is important to have an attitude of respect for each other, regardless of title or position.

From the "Compliance Guideline"

Paragraph 1: Respect for human rights
– We respect human rights. We do not say or act in any way that ignores human rights.

1. We respect basic human rights. We do not discriminate against people on the basis of race, nationality, age, sex, religion, belief, or social status.
2. We do not say or act in any way that ignores human rights, including by harassment.

Respect for human rights in research activities

AIST carries out research involving human subjects. These are categorized into two. One is ergonomic experiments which are carried out as human factors research. The other is medical and health research, which are required to be carried out under the Ethical Guidelines for Medical and Health Research Involving Human Subjects. These kinds of research are further classified into applied biomedical engineering experiments and the experiments with human derivative samples.

In FY 2016, 32 new research projects and 125 ongoing research projects involved ergonomic experiments, 37 new research projects and 76 ongoing research projects involved experiments with human derivative samples, and 4 ongoing research projects involved applied biomedical engineering.

Before an experiment, the Committee on Ergonomic Experiments, which includes six external members, reviews and approves experimental protocols in accordance with the Declaration of Helsinki* to ensure the safety and scientific validity of experiments. Namely, these experiments are reviewed by ethical review committees, the Committee for the Ethics on the Applied Biomedical Engineering and Technology and the Committee for the Ethics on the Experiments with Human Derivative Samples, respectively. In addition, a special committee for the management of conflict-of-interest on medical and health research, Conflict of Interest Management Committee for Clinical Research, was organized in FY 2016, and it reviewed 6 cases.

In practice, a thorough oral and written explanation of the details of the experiment and of the right to revoke consent is given to the experiment's participants. In this way their human rights and dignity are respected.

*: Ethical Principles for Medical Research Involving Human Subjects is a code of conduct of ethical principles adopted by medical researchers at the 18th WMA General Assembly at Helsinki. It regulates medical research involving human subjects.

Harassment Prevention

Harassment hurts the dignity of the person being harassed and causes emotional distress and disadvantage. Conversely, if a person who conducted an act of harassment with no intention to do so is held responsible for that act, he or she may suffer from adverse health effects. The presence of harassment may lead to deterioration in the work environment, reduced motivation to work, and adverse effects on the results of research. AIST has internal rules in place and provides training to make the workplace free of harassment.

Harassment prevention measures

・AIST has in place rules for handling workplace harassment and sexual harassment and has defined procedures for the prevention of harassment.
・AIST provides employees and managers, and counselors placed at AIST work sites, with training on how to prevent harassment and provide counseling for harassment victims. We also held a seminar targeting all employees to re-recognize the need to prevent harassment.

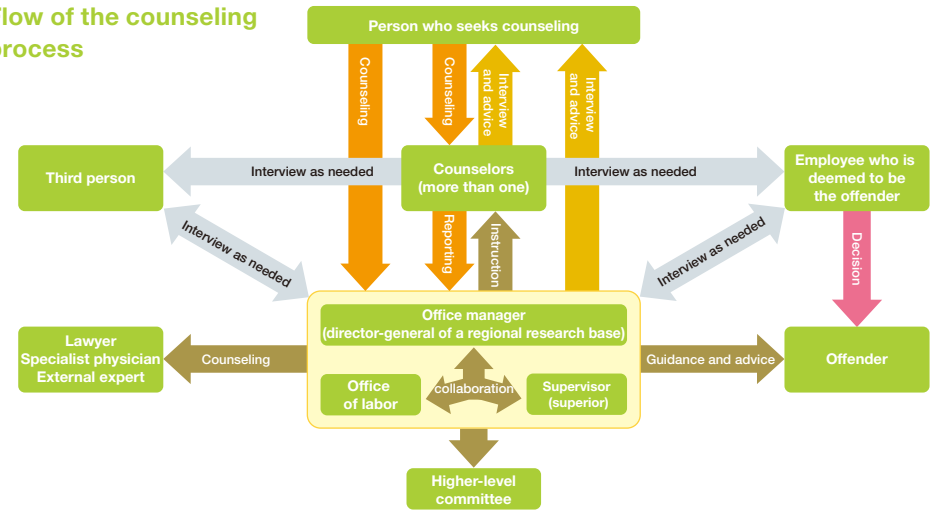
Counseling system

Each site has workplace harassment counselors. The counselors work to counsel, investigate, and mediate so that harassment victims are not distressed and suffer alone as a result of their experience. If the line of management or a counselor cannot address a harassment issue, a higher-level committee reviews the issue and recommends the appropriate actions, which are then taken. In addition, we create an environment that helps harassment victims to seek counseling. We also provide email and telephone counseling by industrial physicians or external organizations to protect people's privacy.

●Training programs provided on harassment in FY 2016

Training program	Trainees	Objectives	Number of trainees in FY 2016
New Employee Training	New AIST employees	As part of training in the attitudes, basic knowledge, and skills required to perform their work, participants learn the basics of harassment issues and harassment prevention.	109
e-learning training	Permanent employees, contract employees	As part of their learning of the basic organizational ethics and rules of AIST, participants learn the basics of harassment issues and harassment prevention.	5,665
e-learning training (English)	Foreign researchers and contract employees who have difficulty in understanding Japanese	Same contents as e-learning training (in English)	122
Harassment Counselor and Sexual Harassment Counselor Training	Harassment counselors and sexual harassment counselors	Participants learn the harassment prevention knowledge and skills required by counselors. These include face-to-face counseling techniques based on lectures and role-play sessions.	30
Harassment Prevention Seminar	AIST employees who wish to attend the seminar	Participants learn the basics of harassment issues and harassment prevention through lectures and work.	97

●Flow of the counseling process



- Those who seek counseling can include people other than the employees involved (i.e. they can be the employee who is deemed to be the offender, the employee who is deemed to be the victim, or someone else, such as a colleague or supervisor).
- Counseling can be sought by means of a face-to-face meeting, telephone call, email, letter, or fax.
- Seeking counseling causes no disadvantage.
- Adequate consideration is given to the protection of privacy, and any information acquired in the course of counseling is kept strictly confidential.

Enlightenment and Activities of Diversity Promotion

Diversity is essential for creative research. AIST developed in October 2015 “Measures to promote diversity in the 4th Medium- to Long-term target period”(hereinafter referred to as “promotion measures”). We aim to realize a work environment that can make full use of the value and ideas brought by various attributes (gender, age, nationality etc.) of employees. AIST has set up the following five plans and has been taking a variety of steps to implement them: 1. proactively hiring female researchers and making the most of their abilities; 2. supporting foreign researchers in their recruitment and work; 3. achieving work–life-balance; 4. developing careers; and 5. comprehensively promoting diversity.

The goal for the percentage of female researchers employed at AIST in the Period of the 4th Medium- to Long-Term Plan (FYs 2015 to 2019) is 18% or higher; this exceeds the percentage of women employed in research in the 3rd period (16.7%) (FYs 2010 to 2014). To increase the percentage of female researchers employed at AIST, we ran a recruiting campaign to increase the number of female applicants. We also held a roundtable meeting for female science students and AIST’s female researchers and conducted laboratory tours. We are thus striving to discover and hire talented female researchers. An event for female students held in FY 2016 attracted 65 women from 35 universities across Japan, and for some, it has opened doors to engaging in research at AIST. Regarding managerial positions, we aim to foster next-generation female managerial personnel and achieve a percentage of females in managerial positions of at least 5% in the 4th period.

We conduct employee seminars and training sessions to raise and disseminate awareness of diversity. We give lectures on the promotion of diversity at each training session for newly hired employees, group leaders, and mid-career researchers to deepen the understanding of diversity among all employees, including male employees.

In FY 2016, at AIST Tsukuba, we conducted training twice (once for female staff only) to encourage career improvement for applicants from the research and clerical workforce. In January 2017, we also held lectures by invited female staff with experience in research leadership at companies to support career build-up, and we are also working on career formation support.

In addition, as one of the managing institutions of the Diversity Support Office (DSO), which is an organization to enhance cooperation with domestic research and educational institutions and to strongly promote diversity, AIST, with the help of others, is holding information-exchange meetings, issuing newsletters and so forth.

Moreover, AIST was selected as an “Initiative for the implementation of a diverse research environment (collaboration type),” a subsidized project to develop human resources in science and technology, the Ministry of Education, Culture, Sports, Science and Technology in FY 2016, together with the University of Tsukuba and IBM Japan, and we intend to further promote the “Project for the Act of Promotion of Women’s Participation and Advancement in the Workplace.”

We were also awarded Eruboshi, a certified logo based on the law to promote women in the workplace. We will continue to run a variety of programs to promote diversity.

Round-table discussion with female students and researchers

The *Eruboshi* logo: certification mark Level 3

Support for Foreign Researchers

As part of the development of a work environment for foreign researchers at AIST, we provide work support and information in English. AIST International Center (AIC) provides foreign researchers with guidance, consultation and help for living and staying in Japan in English. AIC staff members can act as proxies and file applications for foreign researchers to the Mito Branch Office of the Tokyo Regional Immigration Bureau; this is the service most often requested by foreign researchers. In FY 2016, we filed 129 applications for extension of period of stay and the like. These accounted for about half of all applications that we filed. The number of requests for assistance is rising.

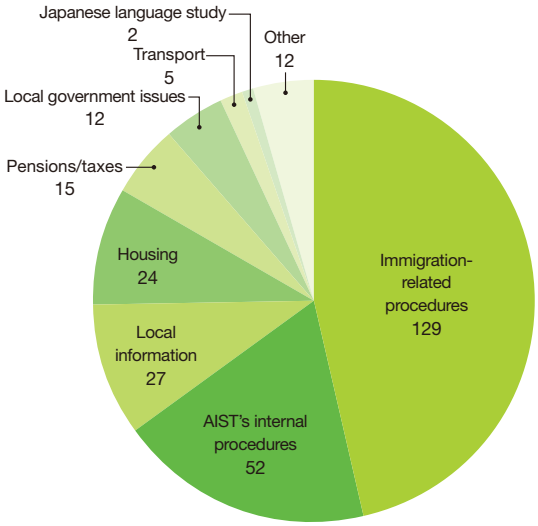
The AIC Japanese language course is the second most popular service. In FY 2016, a total of 52 researchers took the class. Busy foreign researchers can go back to their work in the laboratory after taking a Japanese class within AIST, which is very advantageous for them. We also provide flower arrangement and tea ceremony courses for foreign researchers and their families. In collaboration with the departments responsible, we hold AIC seminars to introduce various AIST systems to foreign researchers in English. In FY 2016 we held two seminars, one titled "Activities of Innovation Center for Technology Transfer and Startups" and the other "Patent Application Procedures in AIST," with about 20 participants at each seminar. In response to questionnaires, almost all participants said that they were pleased with the courses but would like AIC to run more seminars on the institute's procedures.

In FY 2015, AIC started a roughly monthly e-mail newsletter (AIC News Letter). Sixteen issues had been produced up to the end of FY 2016; it now has over 80 subscribers. The newsletter provides broad and timely information on, for example, schedules for filing applications to extend the period of stay, announcements and reports on AIC events, and links to explanations of AIST systems.

On the AIST English website, we have added a section describing support for life at AIST Tsukuba and in the local area, and made information easier to access from the home page. Foreign visitors to AIST and foreign researchers at AIST can easily obtain useful information through the website. In addition, we reviewed the organization of the English content on AIST's intranet, encouraged information-sharing between departments, and improved the English pages. We are running an e-learning course in English for foreign managers who lack understanding of Japanese, to teach them about AIST's organization, ethics and rules.

In collaboration with the departments responsible, we are providing integrated support, from living and staying in Japan to learning the language.

●Breakdown of consultations in FY 2016




Completion of the Japanese language course


The flower arrangement course


AIC Seminar "Activities of Innovation Center for Technology Transfer and Startups"


AIC seminar "Patent Application Procedures in AIST"

Environmental Report

Toward realization of a sustainable society,
we promote environment-minded R&D.

Environmental Policy

To build a sustainable society, AIST has a Charter of Environment and Safety in place. Its aim is to bring the results of research and development to society, as well as to incorporate environmental considerations into the research and development process. Under the Charter of Environment and Safety, we have set an Environment and Safety Policy to proactively work with a keen awareness of the importance of ensuring global and local environmental conservation, and the health and safety of everyone working at AIST. This is done keeping in mind AIST's characteristic as a research institute that handles a wide variety of chemicals and poisonous substances.

Charter of Environment and Safety

- We promote research that helps to conserve the global environment and human safety; we aim to realize a safe, secure, and high quality life and a society in harmony with the environment.
- We comply with laws and regulations on environment and safety, set our own standards such as guidelines, and seek to increase efforts in environmental conservation and promotion of health and safety on a daily basis.
- We actively disseminate information on environment and safety and seek to achieve harmony and integration with the local community. We take prompt and appropriate actions in the event of an accident or disaster and seek to pass on the lessons learned to society under the principle of disclosure.

Environment and Safety Policy

1. We proactively conduct research that contributes to conservation of the environment and the development of a healthy and safe society.
2. We comply with laws, regulations, ordinances, and agreements on the environment, health and safety, set our own management standards, and seek to further improve environmental conservation, health and safety.
3. We seek to reduce the consumption of energy and resources and the generation of waste, and thus aim to reduce loads on the environment.
4. We seek to prevent pollution and work-related accidents, to take prompt and appropriate actions in the event of an emergency, and to prevent the spread of damage.
5. We are developing a management system for effectively and efficiently conducting activities to ensure environmental conservation, health and safety with the participation of all members of AIST; we seek continuous improvement.
6. We actively disclose environmental, health and safety information by publishing environmental reports and disclosing information to promote communication with society.

The Outlook for Fukushima Renewable Energy Institute (FREA)

The world's energy situation and global environmental context have changed rapidly since the beginning of 2017, with the American government's response to the Paris Climate Accord and geopolitical concerns about Qatar in the Middle East. Trends in oil prices and the future of greenhouse gas reduction efforts around the world continue to be uncertain. In these circumstances, expanding the use of renewable domestic energy sources and establishing reliable utilization systems remain firmly important; society's expectations are clearly rising.

Recently Europe, particularly the countries of the European Union, has accelerated the deployment of renewable energy. High costs of electricity generation from renewable energy sources have been a problem but, as measures against global warming and for the diversification of electricity sources, the governments of many countries have introduced subsidy systems and accelerated the roll-out of renewable energy since 2000. Consequently, expanding markets and price competition have led to rapid falls in material, equipment and construction costs. The generation costs of offshore wind power in countries such as Germany, Belgium and Denmark have started to become price-competitive with coal power, sometimes reaching the 5 cents per kWh range.

Compared to Europe, Japan is somewhat lagging in rolling out the use of renewable energy. As would be expected, the big problem is costs. Solar power and wind power together currently account for about 4% of total electricity generation in Japan. Because solar, wind and geothermal power are natural energy sources that are susceptible to variations, ingenuity is required to reliably supply continuous power. Therefore, it is important that we take a broad view of the technological development of renewable energy sources that are suitable for the geography and climate of Japan—from generation to transport, storage, and reliable utilization—in accordance with coherent policies. The hydrogen carrier production, storage and distribution technologies that we have been researching and developing are a part of this.

FREA's mission is to promote leading-edge R&D of renewable energy that is open to the world and to contribute to regional recovery after the Great East Japan Earthquake by bringing new industries to the region. Since FREA opened in April 2014, we have collaborated with a wide range of research institutes in Japan and abroad and with universities, businesses, and local governments such as Fukushima Prefecture and Koriyama City. By producing renewable energy technologies that are suitable for Japan, improving industrial competitiveness and training industrial personnel, we are contributing to the reconstruction and recovery of industry in the region affected by the disaster.

We are now conducting R&D focused on solar power, wind power, geothermal power, ground source heat, hydrogen carrier production and utilization, and the problems of energy networks. In April 2016, we opened the Smart System Research Facility that is capable of large-scale testing of power conditioners, which are vital equipment for the utilization of renewable energy. There are only a few such facilities in the world. In the future, we will continue to work on improving our research organization.

The government is currently considering plans to use renewable energy produced in Fukushima Prefecture by utilizing hydrogen carrier at the Tokyo Olympics in 2020. Renewable energy is a topic of great interest for young people; our AIST research base should play a major role in the education of the students and young researchers who will become the next generation of researchers. We are strengthening our links with educational institutions such as universities.

FREA Director-General
Masaru Nakaiwa

Environmental Targets and Results

Major environmental targets and results are summarized below. Details of the content and results for each item are available on the relevant pages.

●Environmental targets and results

CO_2 emissions (details on P. 51)
【Target】 Reduce by average of 4% compared with FY 2014 over 3 years from FY 2017 to FY 2019 (target value: 119,000 t-CO_2)
【Result】 112,000 t-CO_2 in FY 2016 (◎)

Promotion of green procurement (details on P. 60)
【Target】 100% procurement rate for designated procurement items
【Result】 100% procurement rate for designated procurement items (○)

Promotion of green contracts (details on P. 61)
【Target】 Sign an exemption contract for power supply and industrial waste disposal in principle
【Result】 Signed an exemption contract for power supply and industrial waste disposal in principle (○)

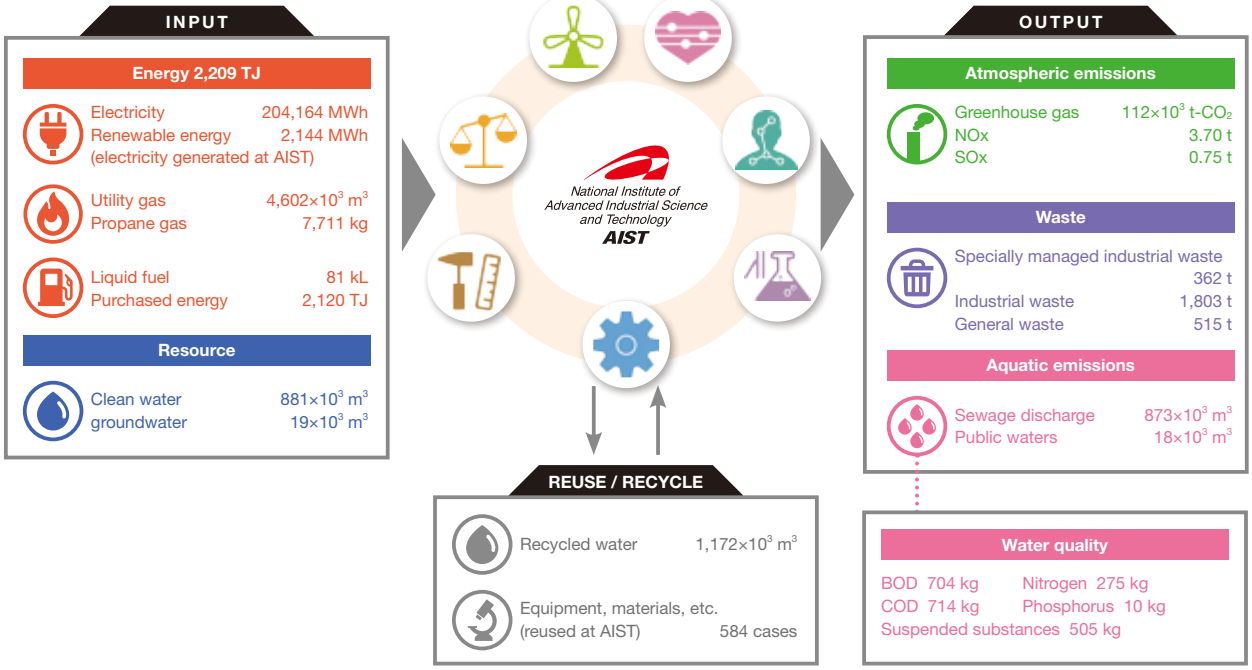
(Legends)

◎ above the target; ○ achieved the target; △ almost achieved the target, × below the target

Overview of Environmental Loads

AIST assesses the environmental loads generated by its business so as to reduce these loads and pay due care to the environmental effects of its activities. The table below shows the amounts of energy used and the wastes released through AIST's business.

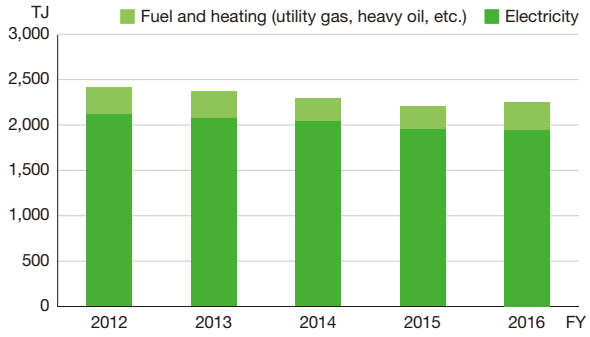
●Amounts of energy used and wastes released through AIST's business



Rationalization of Energy Use

AIST, as a specified business operator stipulated by the Act on Rationalizing Energy Use, promotes the rationalization of energy use. Although the amount of energy used in FY 2016 was 1.1% higher than in the previous year, the five-year rolling average of base unit energy consumption was 97.1%, below the benchmark of 99% given in the act. In business evaluations by class published by the Agency for Natural Resources and Energy (Ministry of Economy, Trade and Industry), AIST is recognized as an organization with good energy efficiency.

●Changes in amounts of energy used

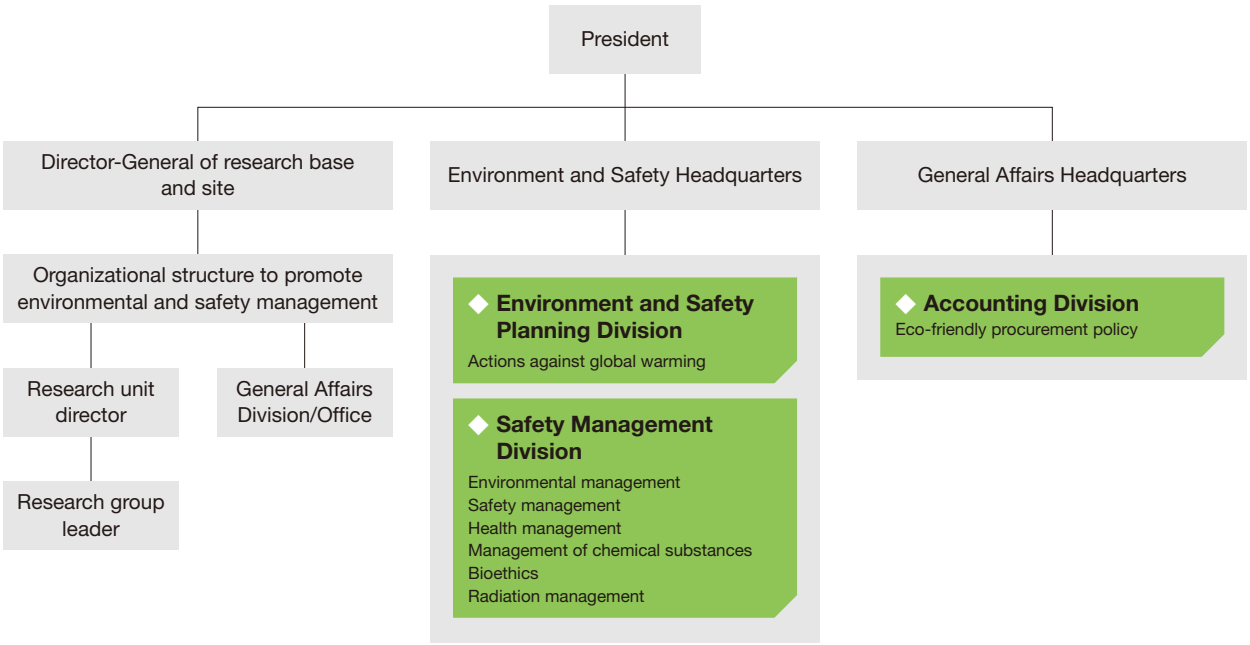


Developing a System to Implement Environmental Policies and Actions

AIST's headquarters organizations (Environment and Safety Headquarters, General Affairs Headquarters) and business organizations (regional research bases and sites) work strongly together to implement our environmental policies and actions. The Environmental and Safety Headquarters determines policy for the reduction of greenhouse gas emissions—an ongoing issue—and the General Affairs Headquarters develops and monitors AIST's green procurement policy.

These policies are embodied in the implementation plans of each regional research base and site under the leadership of the Director-General.

●Structure for environment and safety projects

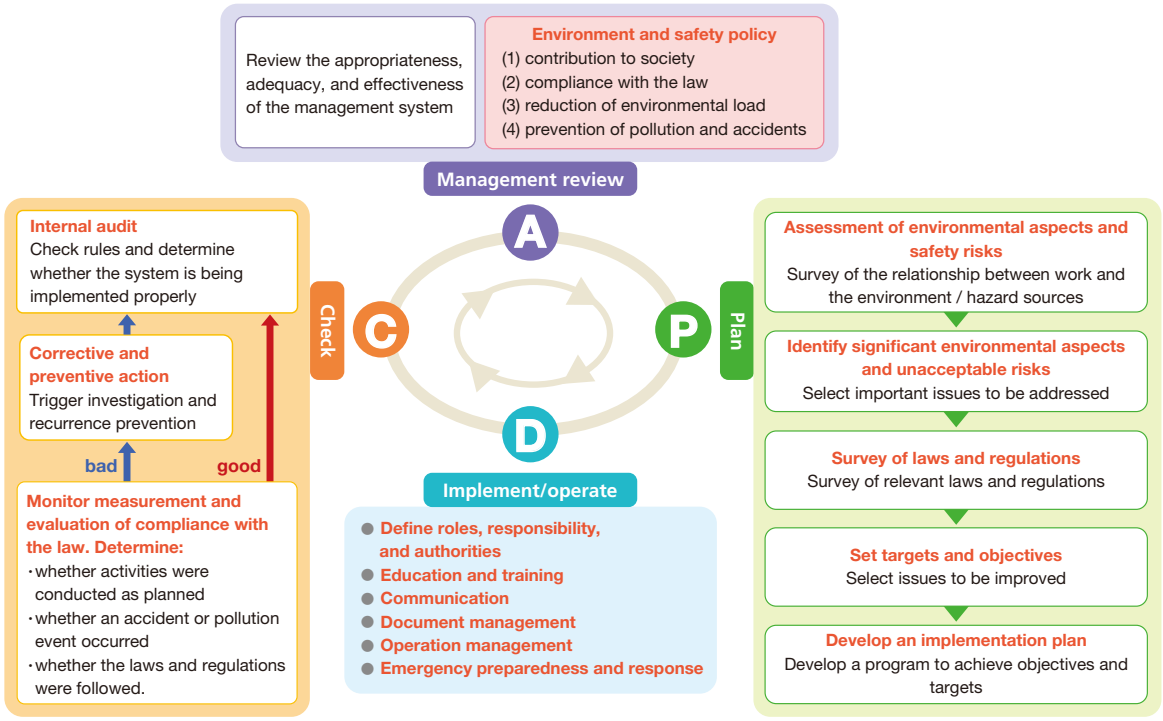


Environmental Management System

AIST has its own environmental and safety management system (ESMS) in place. It combines two subsystems: an environmental management system to reduce the environmental impacts of its activity and preserve the natural environment, and an occupational health and safety management system to reduce potential risks in the workplace and improve health and safety.

In FY 2016, we conducted an internal audit of the environment and safety at each research base and site, and we checked the implementation status of the management program.

●Structure of AIST's environmental and safety management system



Environmental Education

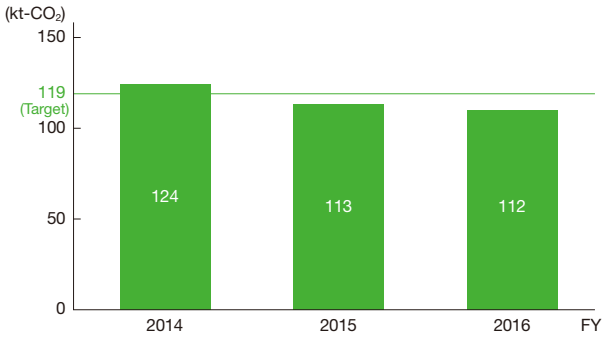
AIST provides environmental education on issues with significant environmental impacts—such as how to treat liquid wastes and vent gases from research and how to sort and remove waste—to new employees and those who have joined AIST under the industry-academia government exchange program, the international exchange program, and dispatched workers. We are continuing to enhance our environmental education and training.

Actions against Global Warming

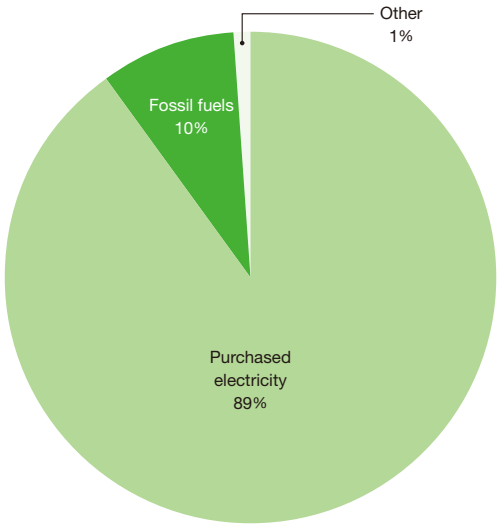
AIST sets a target and implementation plan for reducing greenhouse gas emissions as part of the effort to reduce environmental load substances generated from our business. In FY 2016, AIST promoted research facility integration to achieve the target of reducing greenhouse gas emissions by 4 % from the FY 2014 level (on average) for the 3 years from FY 2017 through FY 2019, a target of the Fourth Medium- to Long-Term Plan. As a result, AIST achieved an 9.3 % reduction compared to FY 2014, and 0.9% compared to FY 2015 in greenhouse gas emissions.

Our greenhouse gas emissions are expected to increase because of an increase in research and development activities promoted by open innovation.

●Change in CO_2 emissions for the year



●Breakdown of sources of CO_2 emissions



Reducing CO_2 Emissions by Using Renewable Energy

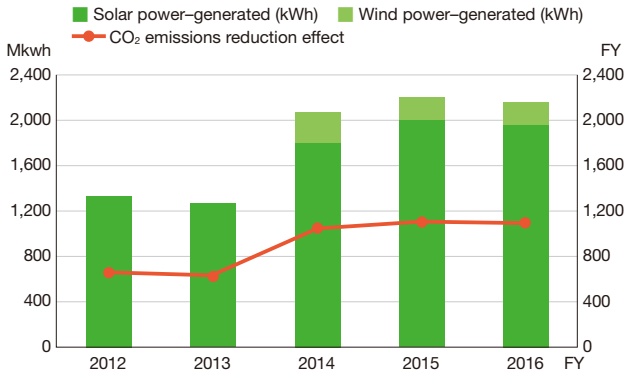
AIST has introduced solar power-generation facilities to AIST Tsukuba, and also to AIST Tohoku, AIST Tokyo Waterfront, AIST Chubu, AIST Kansai, AIST Chugoku, and AIST Kyushu. Our existing solar power systems are being used effectively, and solar and other renewable energy systems have been installed in our new buildings.

The amount of solar power generated in FY 2016 was 1,890 MWh. This is equivalent to the annual power use of 525 households and helped reduce CO_2 emissions by 1010 t/year.

In FY 2016, 177 MWh of wind power was generated. This was equivalent to a CO_2 emission reduction of 93 t/year.

Solar power generation system at AIST Tokyo Waterfront

●Progress in renewable power generation and CO_2 emissions reduction



Appropriate Management of Chemical Substances

As AIST conducts research, it uses a wide variety of chemicals usually in small quantities. Chemicals are properly used and stored to prevent fuming, flaming, and leaking and are properly treated for disposal.

[Treatment of liquid waste and vent gas after the use of a chemical]

Liquid waste: At AIST Tsukuba, inorganic liquid waste is rendered harmless in the treatment facility on the premises and is then discharged into the public sewerage system. AIST Tsukuba decided to outsource the disposal of all organic liquid waste to an industrial waste treatment service provider, starting in FY 2013. Regional research bases outsource the disposal of their organic and inorganic liquid wastes to industrial waste-disposal service providers.

Effluent gas: Toxic vapor-producing chemicals are used in fume hoods, and the toxic vapors are discharged through effluent gas detoxification systems. By using the integrated chemical management system described below, AIST provides each researcher with information on the chemicals that may be used only in a fume hood and must be discharged only after being rendered harmless.

Chemical Substances Integrated Management System

A wide variety of chemicals used in research are registered in the Chemical Substances Integrated Management System at the time of delivery. Via AIST's intranet, the Chemical Substances Integrated Management System allows all employees to view, at a glance, information on the laws and regulations applicable to the chemicals being used and on the properties and handling of the chemicals (SDS*). Also, the system gives a quick view of the amounts of hazardous materials (under the Fire Service Act) and high-pressure gases that may be stored in each room. The system is used to collect information on chemicals that are subject to the PRTR*2 (Pollutant Releases and Transfer Register) below and should be reported to government agencies.

*1 Safety Data Sheet: a document that provides information on the risks, toxicity, physicochemical properties, handling precautions and so forth of chemicals

*2 PRTR Act: The official name of the PRTR Act is "The Act on Confirmation, etc. of Release Amounts of Specific Chemical Substances in the Environment and Promotion of Improvements to the Management Thereof." Facilities that use any of the 462 designated Type 1 chemicals in quantities of more than 1 ton/year (more than 0.5 tons in the case of some chemicals) must report the amount released to the environment and the amount transferred to other facilities (the amount sold and the amount disposed of by waste-disposal service providers).

Collecting Information on Released Chemical Substances

AIST reports on the releases and transfers of chemicals subject to the PRTR Act* and applicable municipal ordinances. At AIST, the following chemicals are used in large quantities: organic solvents to dissolve or extract various organic compounds; hydrogen fluoride to clean semiconductors; and ferric chloride to treat hydrogen fluoride liquid waste. These chemicals may only be used in a fume hood and must be discharged only after being rendered harmless, and their use must be reported every year.

●Amounts of chemicals reported under the Chemical Control Program

Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Tsukuba Central 5	Chloroform (kg)	1,200	230	0	990
	Hexane (kg)	1,300	320	0	930
	Dichloromethane (kg)	1,600	270	0	1,300
AIST Tsukuba West	Hydrogen fluoride and its water-soluble salt (kg)	3,200	0	230	500
	Ferric chloride (kg)	56,000	0	0	0

After use, all of the ferric chloride changes to insoluble ferric fluoride and ferric hydroxide. There are no releases and transfers.

[Tokyo Metropolitan Government]

Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Tokyo Waterfront	Chloroform (kg)	110	20	0	90
AIST Tokyo Waterfront (Bio and IT Fusion Research Base)	Acetone (kg)	130	20	0	110
	Chloroform (kg)	100	10	0	90
	Methanol (kg)	290	20	0	270

Releases and transfers of chemicals subject to the Ordinance on an Environment to Ensure the Health and Safety of the Residents of Tokyo (chemicals used in quantities of more than 100 kg)

[Osaka Prefectural Government]

Research site	Substance	Amount used	Amount released	Amount transferred	
			Air	Sewer	Waste
AIST Kansai	VOC (kg)	2,300	150	0	2,200

Ordinance on the Preservation of the Living Environment of Osaka Prefecture (chemicals used in quantities of more than 1 ton)

Storage of PCB waste

At each research base and site, polychlorinated biphenyl (PCB) waste from condensers and transformers is stored as specially controlled industrial waste in accordance with statutory guidelines. A Specially Controlled Industrial Waste Manager inspects the stored PCB waste once a month to make sure it is properly stored.

In FY 2016, we analyzed PCB concentrations in waste materials (condensers, reagents, etc.) and classified the waste materials into PCB waste (high concentration or low concentration) and non-PCB waste. Non-PCB waste was disposed of as industrial waste; PCB waste was disposed of systematically. With a view to final disposal, products using PCBs were carefully recovered and inspected at each research base and site.

We are contracting out the disposal of high- and low-concentration PCB waste to the Japan Environmental Storage and Safety Corporation (JESCO) and a licensed detoxification service provider to systematically complete the disposal within the period specified by law.

●Disposal and storage of PCB waste

Waste type	Quantity stored at the end of FY 2015	Analysis results in FY 2016	Quantity classified in FY 2016	Quantity stored at the end of FY 2016
Condensers	19	+13	12	20
Stabilizers	3,681	+1	1,959	1,723
Transformers	6	+2	1	7
Oils/paints (L)	277	0	171	106
Other contaminated materials	4,534	(-900+1)*	23	3,612

* In the 2016 report, 900 g of waste cloth was counted as 900 contaminated items. This is now counted as 1 item.

Inspection after recovery

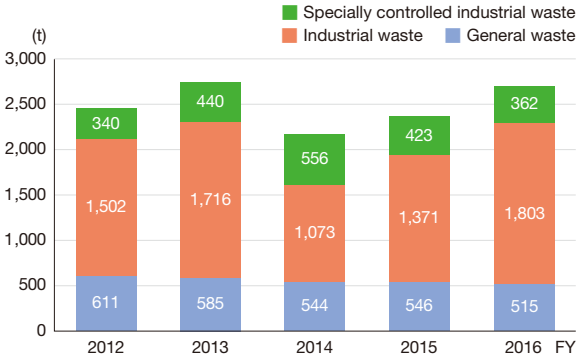
Storage of PCB waste

Reduction in Waste Generation

AIST seeks to reduce waste by applying 3R (Reduce, Reuse, Recycle) principles and thus to reduce environmental loads. We are focusing particularly on the reuse of research equipment, because this reuse can also contribute to cost savings (see "Effective use of resources" below).

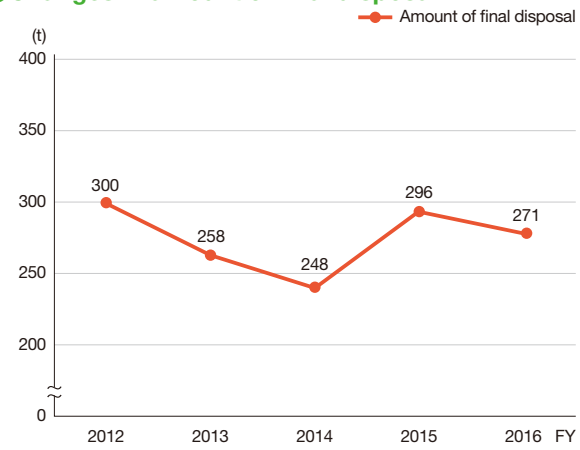
As part of our responsibility as a waste generator, every year we conduct an on-site inspection of waste treatment facilities to make sure the waste is appropriately treated. In FY 2016, we conducted on-site inspections of 80 intermediate and final waste treatment and landfill facilities. In order to reduce landfill waste, we are working on reuse of waste materials.

●Changes in amounts of disposed waste



The increase in waste production in 2016 is due to the closure of the Bio building of AIST Kansai.

●Changes in amount of final disposal



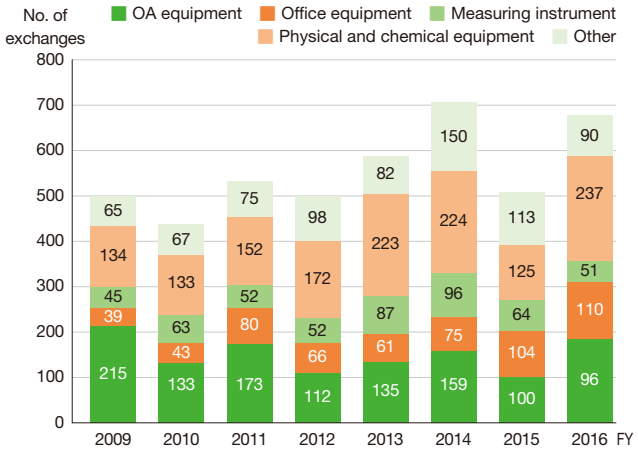
●Breakdown of waste generated (FY 2016)

Waste type	Amount disposed of (t)	Amount landfilled (t)	Percentage of waste landfilled (%)
General waste	515	88	17.1
Industrial waste	1,803	151	8.4
Plastic waste	406	81	19.8
Metal scrap	309	2	0.8
Sludge	124	13	10.5
Glass/concrete/ ceramic waste	43	7	16.4
Slag	127	0	0
Other	794	48	6.0
Specially controlled industrial waste	362	32	10.8
Flammable waste oil	56	5	9.5
Strong acids	203	1	0.4
Infectious waste	18	16	89.8
Waste oil (hazardous)	4	1	17.2
Sludge (hazardous)	6	0	1.4
Acid waste (hazardous)	11	0	0.8
Other	64	9	14.1
Total	2,680	271	10.4

Effective Use of Resources

Since 2005, an intranet-based Article Recycling System has been in place to exchange information on necessary and unnecessary items, including research equipment, OA equipment, furniture, and consumables, and to promote recycling within AIST. We also give away items no longer used at AIST to external organizations. In these ways we facilitate the reduction and reuse of waste.

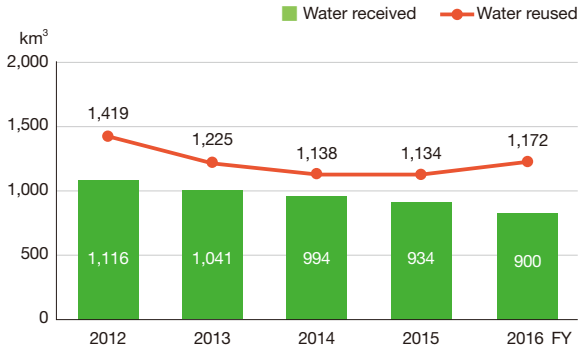
●Number of exchanges of items for recycling



Conservation of Water Resources

At AIST Tsukuba, AIST Tokyo Waterfront and AIST Chubu, research wastewater is neutralized, reduced, and reused for use as water for cooling laboratory equipment and flushing.

●Changes in the amounts of water received and reused



●Breakdown of water received in FY 2012–2016

FY	2012	2013	2014	2015	2016
Clean water	1,082	1,003	964	914	881
Ground water	34	38	30	20	19
Industrial water	0	0	0	0	0
Total	1,116	1,041	994	934	900

Wastewater treatment facility at AIST Tsukuba

Compliance with the Convention on Biological Diversity and the Cartagena Act

In 1992, the cooperation of many countries, including Japan, led to the adoption of the Convention on Biological Diversity to allow comprehensive conservation of biodiversity and sustainable use of biological resources. The Cartagena Protocol was created to protect biodiversity through the safe transport, handling, and use of those living modified organisms that could have adverse effects on the conservation and sustainable use of biodiversity. In Japan, the Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms (the Cartagena Act) came into effect in 2004.

To comply with the Cartagena Act, AIST holds committee meetings attended by external experts to conduct preliminary reviews of experiments involving living modified organisms and the handling of living modified organisms. In addition, to obtain the knowledge needed for compliance and to conduct the appropriate experiments, AIST requires researchers and research assistants to undergo education and training once a year. There were 190 target experiments in FY 2016. We conduct on-site inspections of laboratories that use living modified organisms to ensure that the organisms are labeled as specified in the Act, that they are stored correctly, and that containment measures are taken to prevent dispersal of the organisms. We also provide on-site instruction as needed. By learning from cases of inappropriate handling that have occurred outside AIST, we continue to implement measures to prevent the occurrence of such incidents by confirming the purchase of reagents and microorganisms in advance, and by providing information—and calling attention— as needed to those responsible for experiments. We have a system in place at each research site to provide support and guidance in this regard and thus seek to conserve biodiversity.

To comply with international rules based on the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (Access and Benefit Sharing (ABS)), AIST set up a consultation service in the research planning office of the Department of Life Science and Biotechnology in February 2017. This consultation service can provide consistent advice on the details of measures that should be taken across each department; it responded to 13 enquiries in FY 2016.

Environmental Compliance

We aim to promote AIST's compliance with laws and regulations, social norms, internal codes of conduct for researchers, and internal rules, and to turn AIST's Charter, "*Full Research* in Society, for Society," into a reality.

We take the following environmental protection actions to help conserve the global environment and create a sustainable society:

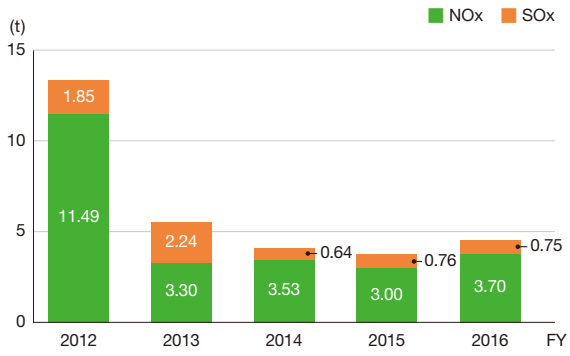
1. We comply with international environmental regulations and the environmental laws and regulations of the government and municipalities, and we work to prevent pollution and conserve the natural environment.
2. We promote research that helps to conserve the global environment and human safety, and we proactively work to improve energy efficiency, save natural resources, and promote recycling.

Prevention of Air Pollution

The major sources of air pollutants at AIST are the boilers used as cold heat sources in air-conditioning. To reduce sulfur oxide (SOx) emissions, we use mainly city gas and kerosene as fuel for the boilers.

Twice a year (once for heating boilers) we measure the concentrations of NOx and SOx in the exhaust gas generated. The measurement results were all below the regulation standards specified in the Air Pollution Control Act.

●Changes in atmospheric environmental loads



Releases of Fluorocarbons (CFCs)

In accordance with the Act on Rational Use and Proper Management of Fluorocarbons, AIST is checking for releases of fluorocarbons in periodic inspections and spot checks of refrigeration and air conditioning equipment and the like, with the aim of restricting emissions of fluorocarbons into the atmosphere. In FY 2016, during maintenance of turbo refrigerators and the like in Tsukuba Central 1 and Tsukuba West, 534 t-CO_2e of HCFC*1 refrigerant was recovered and 936 t-CO_2e of HFC*2 was refilled; therefore, an estimated 402 t-CO_2e was released.

*1: HCFCs are refrigerants classified as specified fluorocarbons that damage the ozone layer.
*2: HFCs are refrigerants classified as CFC substitutes that do not damage the ozone layer. However, they are greenhouse gases and are being progressively replaced with non-fluorocarbon refrigerants.

●Estimated releases of CFCs (FY 2016)

Type	R-number	Estimated t-CO_2e released by R-number	Estimated t-CO_2e released by type
HCFC	R22	-434	-534
HFC	R123	-100	
	R134a	865	936
	R404A	-35	
	R407C	-116	
	R410A	221	
		Total	402

Prevention of Water Pollution

At AIST, the fourth and subsequent washing waters from the laboratories are sent as research wastewaters to the wastewater treatment plants. The wastewater undergoes processes such as pH adjustment, coagulation and sedimentation, filtration, and activated charcoal absorption to meet municipal effluent standards. It is then discharged into the public sewerage system.

To prevent water containing hazardous substances from leaking into groundwater, in accordance with the Water Pollution Prevention Act, AIST conducts periodic inspections of buried wastewater pipes. The results of the periodic inspections were that damage was discovered in some pipes at AIST Tsukuba, AIST Kansai, AIST Chugoku and AIST Shikoku. However, it was verified that only water that did not contain hazardous substances from the fourth and subsequent washing waters had been discharged; there was no pollution of groundwater or soil.

Wastewater treatment plant at AIST Tsukuba

Monitoring of groundwater at AIST Kansai and AIST Chubu

Arsenic exceeding groundwater standards was detected in a groundwater survey conducted in April 2012 at AIST Kansai. Hence, the water quality of groundwater observation wells has been measured on a regular basis under the guidance of the government of Ikeda City, where AIST Kansai is located. We will continue this monitoring.

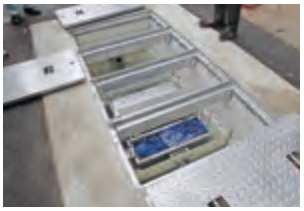
Fluorine and fluorine compounds exceeding the standards were detected in the soil at AIST Chubu in a survey conducted in June 2012. One groundwater observation well was drilled. Under the guidance of the government of Nagoya City, where AIST Chubu is located, the water quality of the groundwater is measured once a year to prevent the spread of contamination. In the measurements of water quality taken in FY 2016, no particular issues were identified. We will continue this monitoring.

●Results of groundwater analysis at AIST Kansai (units: mg/L)

Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)	Sampling month	Measurement of arsenic and arsenic compounds (standard: ≤ 0.01 mg/L)
April 2016	0.011	October 2016	0.052
May 2016	0.022	November 2016	0.017
June 2016	0.005	December 2016	0.035
July 2016	0.005	January 2017	0.009
August 2016	0.012	February 2017	0.010
September 2016	0.010	March 2017	0.009

Improving the water quality of kitchen effluent at AIST Tsukuba

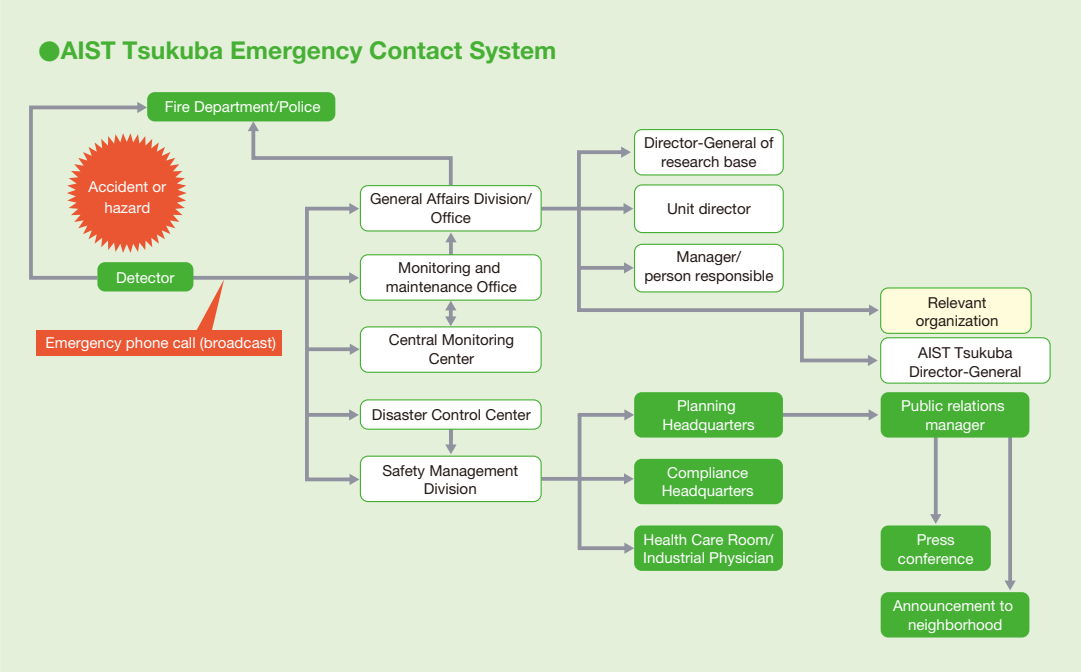
To improve the water quality of kitchen effluent, oil–water separators and grease traps were installed in the kitchens in November 2016.



An oil-water separator installed in the kitchens at AIST Tsukuba

Accidents Affecting the Environment

To ensure compliance with environmental laws and regulations, AIST has an Environmental and Safety Management System (ESMS) in place. No accidents occurred in FY 2016. We have a system to minimize damage in the event of an accident.



Drills to prepare for environmental accidents

AIST conducts contact, communication, and emergency action drills to minimize damage in the event of an environmental accident such as leakage of oils and chemicals. In FY 2016, we conducted 18 drills across all research bases simulating events such as leakage of hazardous materials from rooftop exhaust cleaning equipment and leakage of research wastewater during transport. We will continue to conduct drills for various environmental accidents on a regular basis.

●Number of conducted drills

FY	2012	2013	2014	2015	2016
No. of cases	6	7	10	20	18

Scene of an environmental accident drill

Noise and vibration measurement

To prevent noise generated by research institutions and facilities from adversely affecting the surrounding environment, AIST conducted voluntary periodic measurements of noise at all research bases. The results were all below the standards.

Reports on Accidents that Occurred in FY 2016

Dust explosion* at AIST Tsukuba West

On June 15, 2016, during cleaning of semiconductor fabrication equipment in a clean room in AIST Tsukuba West, an explosion and fire occurred. A worker suffered second-degree burns to the face and arm. After this accident, AIST set up an accident investigation committee, investigated the causes of the accident, and took measures to prevent a recurrence. The cause of the accident was particles of reaction by-products such as silicon and silicon compounds, which had adhered to the interior of the equipment, being lifted up by suction during the cleaning and being ignited by static electricity. To prevent a recurrence, the Safety and Health Guideline was revised (see p. 30), maintenance procedures and operations were reviewed, and the frequency of cleaning of components was adjusted. We take this accident seriously and we will improve our procedures to prevent a recurrence.

* Dust explosion: In a situation in which small solid particles of flammable material are suspended in air containing oxygen at a concentration that meets certain conditions, an explosion may occur if an ignition source such as a spark is present. As well as metal powders and such, dust explosions can be caused by flour, sugar and the like.

Damage caused by the dust explosion

Chlorine gas leak at AIST Kansai

On June 22, 2016, when a pipe was being detached from a chlorine gas cylinder at AIST Kansai, a tool was accidentally applied to the main valve of the cylinder, the valve was opened for a short time, a worker inhaled a small quantity of the gas, and the worker was taken to hospital. Measures to prevent a recurrence have been put in place, such as ensuring that protective gear is always available, disseminating the operational procedures manual, and regularly inspecting the cylinders.

Fire at AIST Tsukuba East

On October 4, 2016, an electric heater at AIST Tsukuba East was left connected to the electricity supply and a fire started from the heater. The fire was quickly extinguished with a fire extinguisher.

As measures to prevent a recurrence, the operations manual and the organization of the safety management were checked, electricity supply indicators were made more visible, and temperature monitoring devices were installed.

Complaints from neighborhood residents

The fire at AIST Tsukuba East

AIST Tsukuba and AIST Kansai received one complaint each from neighborhood residents about overgrown branches of trees and noise; measures were taken to prevent further complaints.

Green Procurement and Green Contract

Green procurement activities*

When purchasing products, parts, or materials that are necessary for conducting R&D and when subcontracting external services for processing and prototype manufacturing, AIST considers not only quality and price but also environmental loads, and engages in green procurement that gives priority to products and services with little environmental load.

To promote green procurement, every year AIST publicizes the procurement policy that sets the procurement goal for eco-friendly goods, based on the "Act on Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities (Green Purchasing Act)" and the "Basic Policy for Promotion of Procurement of Eco-friendly Goods and Services."

Every year, AIST also publicizes the procurement policy that promotes procurement from working facilities for the disabled, based on the "Act on Promotion of Procurement of Goods from Facilities Employing People with Disabilities by the State and Other Entities" (Act on Promotion of Priority Procurement of Goods Made by People with Disabilities). In addition, AIST adopts a procurement method that evaluates companies on whether they promote work–life balance for women, as an effort related to public procurement and use of grants to promote the success of women in the workplace.

Status of procurement of eco-friendly goods

In FY 2016, AIST purchased 231 items in 19 categories among the 270 items in 21 categories designated in the Green Purchasing Act (types of eco-friendly goods and services to be preferentially purchased by the government and other organizations). Excluding one item (media storage cases) because of their required functions and performance, AIST achieved 100 % procurement rate for each designated procurement item (i.e. those that met the criteria established by the government for items that reduce environmental loads). The environmental loads are also considered in purchasing eco-friendly products (such as trash bags) that are not designated procurement items.

Number of hybrid vehicles owned by AIST

As of April 2017, of the 70 AIST-owned vehicles for business (including research), 6 are hybrid vehicles, 1 is a plug-in hybrid vehicle, and 4 are electric vehicles. In replacing the automobiles, preference will be given to hybrid and low-emission vehicles.

* For details on green procurement, please refer to the following page:
http://www.aist.go.jp/aist_j/procure/kouhoyou/green/

●Purchase results of major designated procurement items

Area	Item		Target	Total quantity purchased	Purchase of specified purchase items	Target attainment
Paper	Photocopier paper		100%	99744.1472kg	99744.1472kg	100%
	Forms		100%	216.4kg	216.4kg	100%
	Coated paper for inkjet color printers		100%	226.384kg	226.384kg	100%
	Toilet rolls		100%	13575.2kg	13575.2kg	100%
	Tissue paper		100%	8544.7kg	8544.7kg	100%
Stationery	Mechanical pencils		100%	690	690	100%
	Mechanical pencil leads		100%	428	428	100%
	Ballpoint pens		100%	14,008	14,008	100%
	Marker pens		100%	17,364	17,364	100%
	Pencils		100%	2,141	2,141	100%
	Media cases		100%	730	453	62%
	Glue (solid)		100%	2,732	2,732	100%
	Files		100%	114,946	114,946	100%
Office furniture, etc.	Chairs		100%	1,095	1,095	100%
	Desks		100%	1,169	1,169	100%
OA equipment	Photocopiers, etc.※	Purchased	100%	19	19	100%
		Leased/rented (new)		15	15	
		Leased/rented (extension)		223	223	
	Scanners	Purchased	100%	184	184	100%
		Leased/rented (new)		0	0	
		Leased/rented (extension)		0	0	
	Paper shredders	Purchased	100%	78	78	100%
		Leased/rented (new)		0	0	
		Leased/rented (extension)		0	0	
	Recording media		100%	11,019	11,019	100%
	Toner cartridges		100%	7,828	7,828	100%
	Ink cartridge		100%	6,476	6,476	100%
Vehicles, etc.	Non-general official vehicles	Purchased	100%	5	5	100%
		Leased/rented (new)		2	2	
		Leased/rented (extension)		4	4	
Fire extinguishers	Fire extinguishers		100%	105	105	100%
Services	Passenger transportation		100%	1,811	1,811	100%

※ Photocopiers, combination units, digital photocopiers with expandable functions

Green Contract Activities

When signing contracts with contractors and suppliers, AIST promotes a green contract that takes into consideration reduction of greenhouse gases on the basis of the "Act on Promotion of Contracts of National Governments and Other Entities Involving Due Care for Reduction of Greenhouse Gas Emission (Green Contract Act)." In FY 2016, we signed the following green contracts.

For automobile purchases, we evaluated the price and environmental performance (fuel economy) of 4 vehicles for lease in a comprehensive evaluation bidding system in which the bidder with the highest rating entered into the contracts.

For contracts for power supply, we adopted the environmental threshold system at AIST Tohoku, AIST Tsukuba Central and East, AIST West, AIST Kansai, and AIST Kyushu.

The system was also adopted for 21 industrial waste contracts for collection, transport, and disposal.

●Number of green contracts

Type of green contract	Number of cases
Automobile purchase	4
Contract for power supply	5
Industrial waste	21

Third Party Views

The AIST Report 2017: Social and Environmental Report

Director, Workers Club
for Eco-harmonic
Renewable Society (NPO)
Tamio Yamaguchi

Before writing this Third Party View, I reviewed and commented on an early draft of the report. My comments were passed to the relevant departments; their responses were collated into "actions in FY 2017" and "actions in subsequent years" and returned to me. I think this ability to respond with sincerity is evidence of a strong passion for self-assessment and self-improvement.

What is expected of the AIST report is that it clearly describes the initiatives a designated national research and development institute claiming to be "in society, for society" is pursuing in accordance with areas of change—in how it responds to the current state of society and in society's demands—and with unchanging principles of action. As described in the lead-off article, continuing improvements are building on one another to meet these expectations.

Two points attract particular attention in regard to trends in the state of society over the past years; this report aids evaluation of how these points are being addressed. The first point is the progress of R&D systems and personnel development in AIST. People involved in research and science policy often claim that Japan's science and technology is in a malaise. There are demands that we move beyond the doctrine of self-sufficiency, as manifested in the centralized research institute model that unites all stages from basic research to commercialization in a single enterprise. Moreover, the "Comprehensive Strategy on Science, Technology and Innovation 2017," which was approved in June 2017, emphasizes the importance of securing excellent research bases and a research environment that produces research in diverse academic fields.

This report presents a range of responses to these needs. At the heart is open innovation. The report describes innovation coordinators being dispatched around the country to create hubs for an innovation system in Japan, thereby facilitating open innovation. The report also describes the states of progress of various initiatives: the Open Innovation Laboratories (OIL), collaborative research bases located on the sites of universities; "corporate brand labs," collaborative laboratories within AIST that are branded with the names of partner enterprises; and the launch of the Artificial Intelligence Research Center (AIRC). The report tells of effective use of the existing variety of systems for staff training and the development of young researchers into research staff who are ready for immediate action in industry and research institutes.

The second point is how we will manage artificial intelligence (AI), which is key to our economy and society progressing into the next stage of the information society, known as the "fourth industrial revolution" or "Society 5.0." The rapid development of AI looks set to transform society; some say that we will reach "the singularity," when AI surpasses human capabilities, in 2045.

It is also claimed that the more data AI can learn from, the smarter it will become. While these visions are spectacular, there are also concerns, such as mass unemployment as human jobs are replaced, a breakdown in social relations, and the domination of data by a few leading businesses resulting in near-monopolies in products and services.

The lead-off interview with Junichi Tsujii, Director of AIRC, provides clear and appropriate answers to address these concerns. Tsujii first suggests a "Japanese model," in which public organizations coordinate their efforts, and proposes three pillars as criteria for research. He soothes our concerns in saying that "both humans and AI have weaknesses; so, by compensating for one another's weaknesses, they become capable of higher quality judgments."

Finally, there is the matter of action on the sustainable development goals (SDGs) declared in previous years. The efforts of Japanese business have advanced to an outside-in approach of specifying the targets to be aimed at according to the needs of society and the world from the stage of mapping each company's efforts. Research systems (outside-in open innovation) and research outcomes must be presented in the report with a strong awareness of how AIST itself is contributing to the SDGs.

Workers Club for Eco-harmonic Renewable Society (Junkan Workers Club): A citizens group that investigates, with a global perspective, the form of a society in harmony with the natural ecosystems that will be passed on to the next generation. The goal of the club is to study, support and put into practice measures leading to a sustainable mode of society for regional citizens, businesses and governments. At CSR workshops within the club, the group studies and proposes appropriate forms of CSR.
URL: junkanken.com

On the publication of the AIST Report 2017

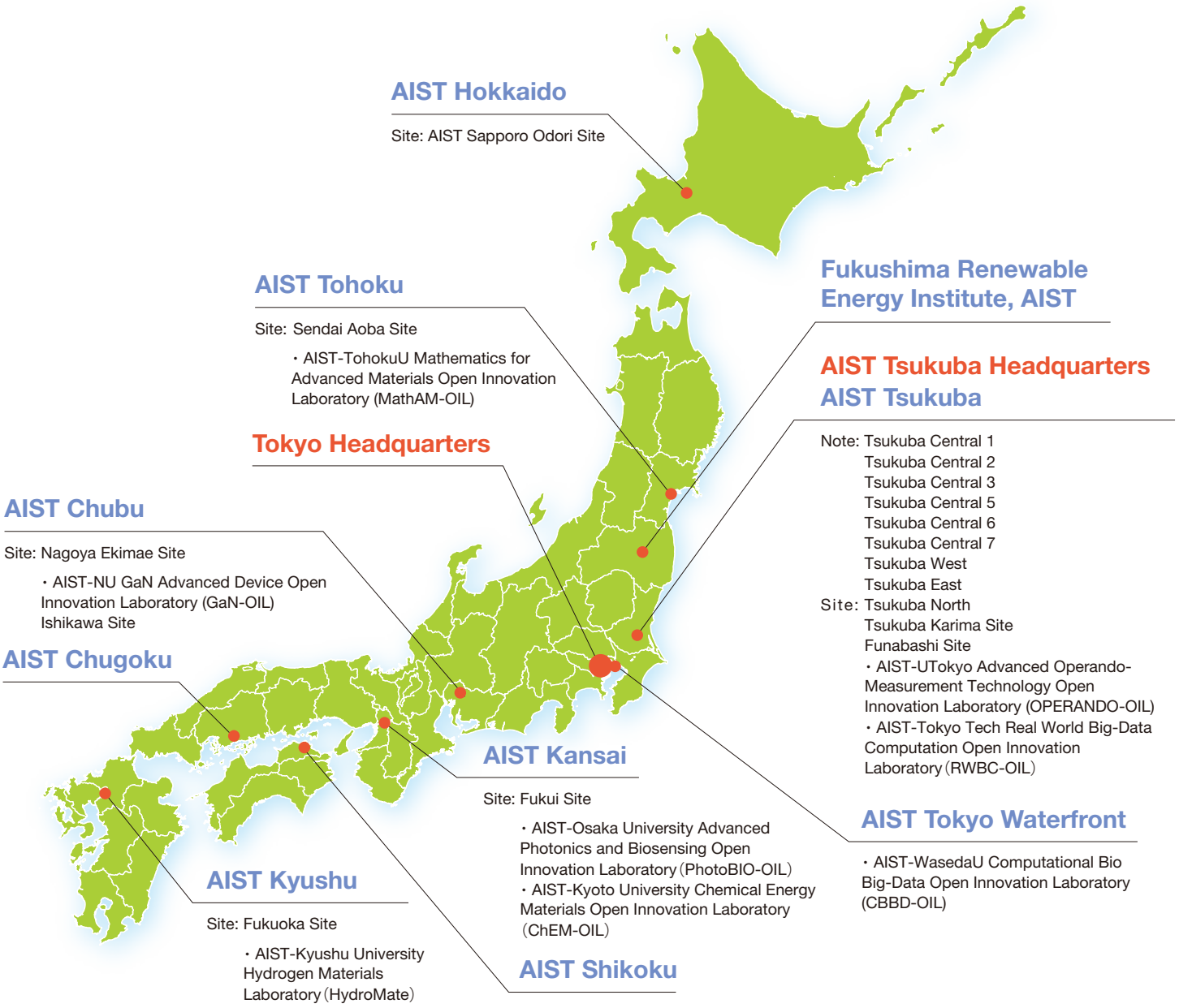
Deputy Director-General, Planning Headquarters
Hiroki Yotsumoto

AIST has been publishing environmental reports since 2004. Since 2010, the AIST Report: Social and Environmental Report has been compiled and published in accordance with ISO 26000, with the scope of the report widening to cover research bases across the country in addition to AIST Tsukuba and adding reports on initiatives relating to the environment, workplace safety and health, and corporate social responsibility.

This year's report introduces a range of initiatives by AIST aimed at creating innovation. In the lead-off interview, the Artificial Intelligence Research Center is presented as an example of an open innovation platform. The research reports describe examples of transfers of the fruits of research on a mobile pathogen tester, phosphorescent materials suitable for use with LED lighting, and public infrastructure inspection technology. There are also reports on new initiatives in R&D promotion systems, with open innovation laboratories being established on the campuses of universities and collaborative laboratories with partner enterprises being established within AIST.

For AIST, with the motto "in society, for society," it is our duty and our mission to present AIST's activities to the many stakeholders who want to hear about them in a form that is easy to understand. With this report, we are striving to connect to build relationships of deeper trust with society.

Research Bases (as of Sept. 30, 2017)



AIST Hokkaido

Site: AIST Sapporo Odori Site

AIST Tohoku

Site: Sendai Aoba Site

- AIST-TohokuU Mathematics for Advanced Materials Open Innovation Laboratory (MathAM-OIL)

Tokyo Headquarters

AIST Chubu

Site: Nagoya Ekimae Site

- AIST-NU GaN Advanced Device Open Innovation Laboratory (GaN-OIL) Ishikawa Site

AIST Chugoku

AIST Kyushu

Site: Fukuoka Site

- AIST-Kyushu University Hydrogen Materials Laboratory (HydroMate)

AIST Shikoku

AIST Kansai

Site: Fukui Site

- AIST-Osaka University Advanced Photonics and Biosensing Open Innovation Laboratory (PhotoBIO-OIL)
- AIST-Kyoto University Chemical Energy Materials Open Innovation Laboratory (ChEM-OIL)

Fukushima Renewable Energy Institute, AIST

AIST Tsukuba Headquarters

AIST Tsukuba

Note: Tsukuba Central 1
Tsukuba Central 2
Tsukuba Central 3
Tsukuba Central 5
Tsukuba Central 6
Tsukuba Central 7
Tsukuba West
Tsukuba East

Site: Tsukuba North
Tsukuba Karima Site
Funabashi Site

- AIST-UTokyo Advanced Operando-Measurement Technology Open Innovation Laboratory (OPERANDO-OIL)
- AIST-Tokyo Tech Real World Big-Data Computation Open Innovation Laboratory (RWBC-OIL)

AIST Tokyo Waterfront

- AIST-WasedaU Computational Bio Big-Data Open Innovation Laboratory (CBBD-OIL)

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