Chapter 2 Present Efforts Toward and Issues Regarding Pilot Projects and Creation of Innovation

In Chapter 2, we provide an overview of the present efforts of various countries toward pilot projects and the creation of innovation, and introduce the state of the efforts of the MLIT regarding pilot projects for new technologies and services, as well as an analysis of issues in innovation in the national land and transport sectors based on various research results, and what will be required of future efforts toward innovations.

Section 1 Efforts of Various Countries Toward Pilot Projects and Creation of Innovation

Given the conditions of foreign countries, each of the major countries considers policies for science, technology and innovation to be major policies for their national development, and has strived to expand investment and otherwise intensify efforts in those areas in recent years. The following is an overview of the development of their efforts.

1 Development of Science, Technology and Innovation Policy in Foreign Countries

Japan and other major countries are setting research- and development-related investment targets in their policies for science, technology and innovation (Figure 2-1-1).

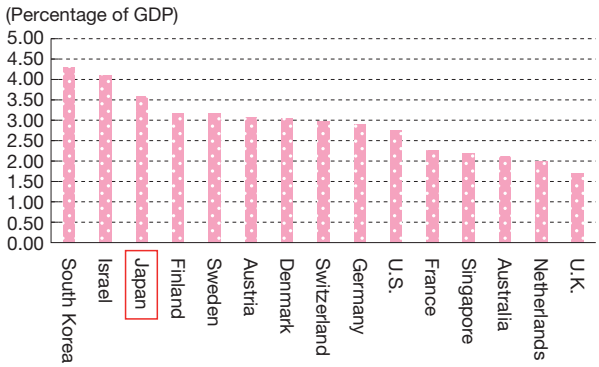
Figure 2-1-1 Research and Development Investment Targets in Japan and Other Countries

Country/Region	Public/ Private Total Investment Target as a Percentage of GDP (Target Year)	Government Investment Portion (Target Year)	Private Investment Portion	Plan Duration (Unit: Fiscal Years)	Sources
Japan	4.0% (2015)	Government research and development investment target: 1.0% (based on costs related to science and technology, not the cost of research and development)		2011-2015	The 4th Science and Technology Basic Plan (2011-2015) (governed by the New Growth Strategy (2010)), the Japan Revitalization Strategy (2014)
U.S.	3.0%	—	—	2009-	Strategy for American Innovation (2009/2011), Transformation and Opportunity: The Future of the US Research Enterprise (PCAST) (2012)
EU	3.0% (2020)	A total of 77 billion EUR is listed as the EU budget under programs related to research and development/innovation (plans in progress)	—	2010-2020 (Public/private totals of member countries) 2014-2020 (EU budget)	Public/private total: Europe 2020 (2010-2020) EU budget: Horizon 2020 (2014-2020)
U.K.	—	Department for Business, Innovation & Skills (BIS) Scientific Research Budget: Maintain resource budget of 4.7 billion GBP from previous plan (2011-2014) in FY2015.*1 Research Infrastructure: Invest a total of 5.9 billion GBP in research infrastructure from FY2016 to FY2020.	—	2015 (BIS scientific research budget) 2014- (Research infrastructure)	BIS Scientific Research Budget: Science Research Budget Allocations 2015/16 (2014) Research Infrastructure: Our Plan for Growth: Science and Innovation (2014)
France	3.0% (2020)	—	—	～2020	2011 National Reform Programme*2
Germany	3.0% (2020)	1.0% (written as "1/3") (2020)	2.0% (written as "2/3")	2005-2015 (public/private total) by 2015 (public/private individual)	Public/private total: 2005 National Reform Programme, Qualification Initiative (2008), 2011 National Reform Programme Public/private individual: National Reform Programme (2011-)
Finland	4.0% (2020)	Real annual increase of 2% (policy guidelines developed in 2011 set out a target of 1.2% of GDP by 2020)		2015～2020	Government target: Reformative Finland: Research and innovation policy review 2015-2020 (2014) Research and Innovation Policy Guidelines for 2011-2015 Public/private total: 2011 National Reform Programme
Israel	—	—	—	—	(No national strategy exists for these sectors)
China	2.2% (2015) 2.5% (2020)	—	—	2011-2015 2006-2020	12th Five-Year Plan for Energy Science and Technology Development (2011-2015) National Medium- to Long-Term Plan for the Development of Science and Technology (2006-2020)
South Korea	—	Invest 92.4 trillion KRW during the plan, which is 24.4 trillion KRW more than the Lee Myung-bak administration invested	—	2013-2017	3rd Science and Technology Basic Plan (2013-2017)

*1 A resource budget is a budget allocated for research expenses and personnel expenses, and accounts for most of the budget for research and development (Source: JST/CRDS Science and Technology and Innovation Trend Report: U.K., 2015)
*2 The National Reform Programme is the economic growth strategy that the EU member countries have presented to the European Commission every April since 2011 as part of the Europe 2020 framework.
Source: Survey Analysis of Investment Targets Regarding Research and Development (Survey Analysis Installment of Policy Issues Regarding the Promotion of "Science for Policy" in Science, Technology and Innovation Policy (5))
MEXT (survey contracted to the Mitsubishi Research Institute)
Source) Cabinet Office 5th Science and Technology Basic Plan, Collection of Reference Materials

Among each country's research and development expenditures as a percentage of GDP, the high percentages of South Korea and Israel stand out. In addition, the top five countries in innovation rankings by country[Note 38] invest at least 2.5% of GDP into research and development (Figure 2-1-2).

Figure 2-1-2 Research and Development Expenditures as a Percentage of GDP

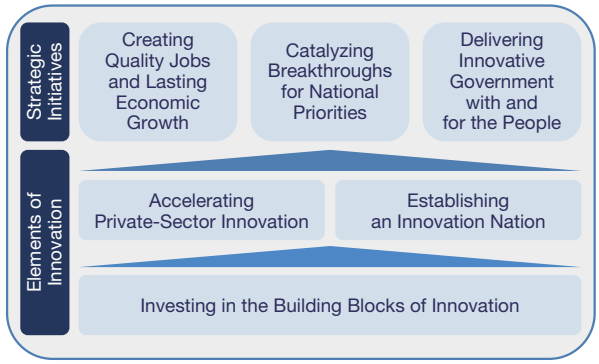


Source) Prepared by the MLIT based on OECD "Main Science and Technology Indicators"

(Trends in the U.S.)

Under the 2015 Strategy for American Innovation announced in October 2015, the U.S. is working to ensure a world-leading position as an innovation-creating nation, to respond to national issues such as becoming a healthy and long-lived society and lasting growth, and to further intensify the focus on government support for innovation and upfront investment in future economic growth. The principal elements of the strategy are investment by the federal government, the acceleration of efforts by the private sector, and the development of innovative human resources, and these building blocks are the basis of the government's aims to create quality jobs and lasting economic growth, catalyze breakthroughs to make progress on key national priorities, and develop an innovative government with and for the people (Figure 2-1-3). The goal to invest in the building blocks of innovation sets out targets such as achieving total research and development expenditures (total private-sector and government research and development expenditures) of 3% of GDP, and emphasizes the strengthening of public-private partnerships and education in science, technology, engineering and mathematics (STEM) to cultivate the bearers of innovation. In addition, the American government has promoted research and development for advanced manufacturing technology with the aim of reviving the manufacturing industry, and considers that revival a priority matter in research and development conducted through intergovernmental cooperation.

Figure 2-1-3 Principal Elements of the 2015 Strategy for American Innovation



Source) Prepared by the Center for Research and Development Strategy of the Japan Science and Technology Agency based on the 2015 Strategy for American Innovation

Note 38 Trends in innovation rankings through the years (Figure 1-2-3). The five countries are Switzerland, Israel, Finland, the U.S. and Germany.

(Trends in Europe)

In March 2010, the European Union (EU) adopted a new strategy: Europe 2020. The Europe 2020 strategy regarding research, development and innovation is called "Innovation Union," and in December 2013, Horizon 2020 was adopted as a framework program for realizing this strategy. The three priorities of Horizon 2020 are excellent science, ensuring industrial leadership, and tackling societal challenges (Figure 2-1-4), and intensive investment is promoted under this program. The program sets out the target of achieving research and development expenditures of 3% of GDP.

In Germany, the High-Tech Strategy, which was developed in August 2006, is promoted as the basic strategy for science, technology and innovation policy. The strategy was renewed in July 2010 as High-Tech Strategy 2020, and sets out future-oriented projects that involve cross-sectoral efforts in five sectors to which Germany devotes energy: climate/energy, health/nutrition, transport, social safety, and communication/digitization. In November 2011, Industry 4.0, which heralds a fourth industrial revolution, was proposed as a new future-oriented project, and is being promoted as a joint action plan of industry, academia and government toward advancing the manufacturing industry. Germany achieved total research and development expenditures of 3% of GDP in FY2012, and the third New High-Tech Strategy, which was announced in September 2014, explored approaches to the promotion of continued innovation, identified sectors with significant momentum in the promotion of innovation, and conducted research on a preferential basis in those sectors (Figure 2-1-5). Policies for strengthening collaboration between industry and academia and for enhancing the power of small and medium-sized enterprises (including incubation) have been identified as guidelines for resolving these challenges.

Figure 2-1-4 Societal Challenges in the EU's Horizon 2020

Societal Challenges	Priorities
Health, demographic change and well-being	Understanding of diseases, health and welfare, prevention of diseases, treatment and management of illnesses, etc.
Food security, sustainable agriculture, etc.	Sustainable agriculture and forestry, food product manufacturing for healthy, safe dietary habits, fishery resources development, etc.
Secure, clean and efficient energy	Low-cost/eco-friendly power supply, development of alternative fuels and portable energy resources, etc.
Smart, green and integrated transport	Green transport, mobility improvement, congestion reduction, safety expansion, global-level leadership for the European transport industry, socioeconomic research and multifaceted investigations for policy formulation, etc.
Climate action, resource efficiency and raw materials	Challenging and adapting to climate change, sustainable management of natural resources, environmental monitoring, etc.
Inclusive, innovative and reflective societies	Closing the research and innovation gap between European countries, European cultural research, etc.
Establishment of secure societies	Fighting crime and terrorism, understanding and combating terrorist ideology, cybersecurity, etc.

Source) Documents of the Center for Research and Development Strategy of the Japan Science and Technology Agency

Figure 2-1-5 Societal/Technological Challenges Extracted from German Policy Documents

Priority Challenges	Technology Noted in Policy Documents
Action toward digitization	IoT, big data, IT security, cloud computing, etc.
Sustainable energy production, consumption	Power to Gas, thermal storage, efficient energy, solar energy, wind power, biomass, solar thermal energy, energy-optimized buildings, energy conservation, energy systems, etc.
Innovation-creating labor	Service sector digitization, etc.
Living healthily	Individual medical care, preventive care, pharmaceutical design, medical care technology, etc.
Smart traffic, transport	Electric vehicles, electricity storage, car sharing, car weight reduction, fuel cells, aeronautical technology, maritime technology, etc.
Ensuring safety	IT security, privacy protection, etc.

Source) Documents of the Center for Research and Development Strategy of the Japan Science and Technology Agency

In the United Kingdom, Our Plan for Growth: Science and Innovation, a new strategy that was announced in December 2014, sets out six elements to make the U.K. the best country in the world for science and business: deciding priorities, nurturing scientific talent, investing in scientific infrastructure, supporting research, catalyzing innovation and participating in global science and innovation (Figure 2-1-6). In addition, despite the fiscal austerity policy under which the entire government operated, the government decided to increase the level of investment in scientific research to the level of FY2010 by FY2015, and to roughly double the FY2015 budget for facilities, buildings and other science and technology infrastructure compared to the previous year.

France Europe 2020, a basic strategy that emphasizes compliance with Horizon 2020, was developed in France in July 2013. France Europe 2020 was updated in March 2015 to include approaches and priority issues in research and development in light of societal challenges (Figure 2-1-7), and indicates research and development regarding the computerization of the manufacturing industry and the use of IoT and big data among its priority issues. In terms of France's investment targets regarding research and development, France Europe 2020 does not set out any target values for research and development expenditures as a percentage of GDP. However, the National Reform Programme, under which France submits economic growth strategies to the European Commission each year under the European Semester framework, sets out a target value of total public and private research and development expenses of 3% of GDP.

Figure 2-1-6 Societal/Technological Challenges Extracted from U.K. Policy Documents

Six Elements	Societal/Technological Challenges in the Determination of Priority Sectors
(1) Deciding priorities	(1) Big data and energy efficient computing
(2) Nurturing scientific talent	(2) Commercial use of satellites and space
(3) Investing in scientific infrastructure	(3) Robots and autonomous systems
(4) Supporting scientific research	(4) Synthetic biology
(5) Catalyzing innovation	(5) Regenerative medicine
(6) Participating in global science and innovation	(6) Agricultural science
	(7) Advanced materials and nanotechnology
	(8) Energy and its storage

Source) Documents of the Center for Research and Development Strategy of the Japan Science and Technology Agency

Figure 2-1-7 Societal Challenges in French Research Strategies

Societal Challenges	Approaches to Research
Management of resources and adaptation to climate change	Sustainable management of natural resources, environmental/climate risk assessment and counteraction, eco-technology/biotechnology, etc.
Clean energy	Systems for using a diverse array of renewable energies, efficiency improvement, etc.
Industrial renewal	Factory digitization, new material design, cooperation involving sensors and instrumentation, etc.
Health and social welfare	Multi-scale analysis of living organisms, establishment of core research centers for research and treatment, etc.
Food security and population dynamics	Healthy and sustainable nutritional intake, integration of production systems, etc.
Sustainable transport and urban systems	Urban observation, proposal of new methods of transport, technology toward sustainable cities, etc.
Information and communication society	5G network, IoT, big data, human-machine collaboration, etc.
Innovative, integrative and adaptive societies	Research toward social integration, development of new innovation indicators, etc.
Space/aeronautics for Europe	Earth observation, data communication/navigation, space observation/exploration technology, etc.
Freedom and security of European civil society	Prevention/anticipation of risks and threats, integrated approaches to crisis management, etc.

Source) Documents of the Center for Research and Development Strategy of the Japan Science and Technology Agency

(Trends in Asia)

In February 2006, the Chinese government announced the National Medium- to Long-Term Plan for the Development of Science and Technology, a 15-year plan that calls for the enhancement of independent innovation capacity through the fulfillment of the target for total research and development expenditures (2.5% of GDP by 2020), the strengthening of priority sectors, and other efforts in pursuit of making China an innovation-driven country with world-class science and technology by 2020. In May 2015, the Chinese government devised Made in China 2025, a road map for the development of its manufacturing industry over the ensuing decade, in light of factors such as the actions of advanced nations toward the advancement of manufacturing industries on the strength of telecommunications technology development, and the condition of the Chinese economy due to the rising cost of domestic labor and other factors. Made in China 2025 sets out goals for the dynamic development of China's manufacturing industry through the advancement of its level of computerization for the purpose of streamlining manufacturing and improving quality.

In July 2013, the South Korean government developed the 3rd Science and Technology Basic Plan, which sets out specific measures for advancement in five strategic sectors (the High-Five Strategies) to create new industries through the fusion of science, technology and ICT and improve quality of life for South Korean citizens, among other aims. Numerical targets for investment have been set; investment targets include a five-year target for the government to invest 92.4 trillion KRW in research and development, and for 40% of that government investment in research and development to support fundamental, foundational research.

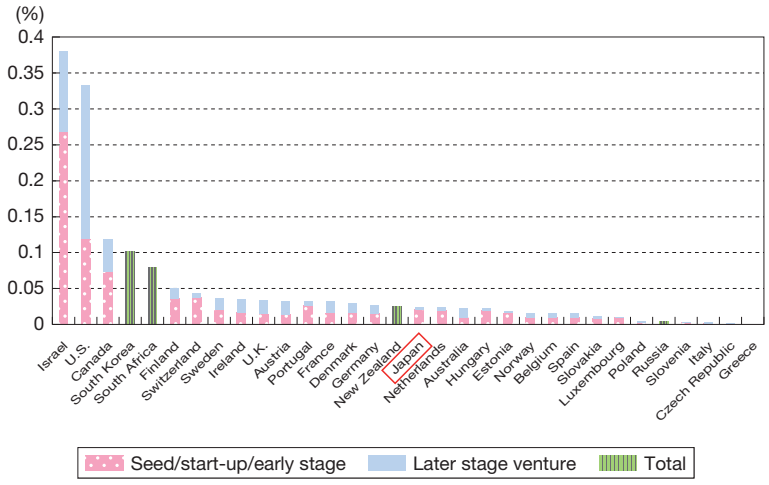
2 Examples of Efforts toward Innovation Creation in Foreign Countries

(1) Support for Venture Company Creation

Venture companies are playing an increasingly important role in industrial metabolism and the creation of innovation. In the U.S., initial investments built on venture capital (VC) create a large volume of venture companies, namely from universities and research institutes, and some of these grow into massive corporations[Note 39].

Among each country's VC investment as a percentage of GDP, the figures for Israel and the U.S. stand out above the other countries. In addition, in the top four countries in innovation rankings by country[Note 40] since 2015, the proportion of VC investment in the initial stages is higher than Japan's (Figure 2-1-8).

Figure 2-1-8 VC Investment as a Percentage of GDP (2015)



Note: The figures for Japan, South Africa and Israel are from 2014
Source) Prepared by the MLIT based on "Entrepreneurship at a Glance 2016"

Note 39 "FY2015 Annual Cabinet Report on the Japanese Economy and Public Finance"

Note 40 Trends in innovation rankings through the years (Figure 1-2-3). The four countries are Switzerland, Israel, Finland and the U.S.

■SME innovation research program in the U.S.

Many large, innovation-oriented venture companies are founded in the U.S., and they grow rapidly and function as the drivers of economic development. One frequently mentioned factor for their success is the Small Business Innovation Research (SBIR) Program, an innovation research program for SMEs under which the government provides a foundation for their growth. The SBIR Program provides competitive subsidies for commercializing the research outcomes of SMEs with superior technology (products), and government offices with research and development budgets of 100 million USD or greater are obligated to contribute a set proportion (roughly 3%) of their annual budgets to the program. The multi-phase screening method, or "stage gate" process[Note 41], serves the important function of bridging the gap between the research phase and commercialization known as the "valley of death," and is widely recognized in the U.S. as a catalyst for innovation.

Figure 2-1-9 U.S. SBIR Program

■ Three-Phase Selection Process

	Objective	Maximum Grant	Duration	Adoption Rate
Phase 1	Concept verification (F/S)	$150,000	Six months	Roughly 16%
Phase 2	Continuation/ development (R&D) from Phase 1	1 million USD (determined by Phase 1 outcomes)	1-2 years	Roughly 59%
Phase 3	Practical application	Award only (promotion of fundraising outside the program)	None	—

■ Comparison with Japanese SBIR (SME Technical Innovation Program)

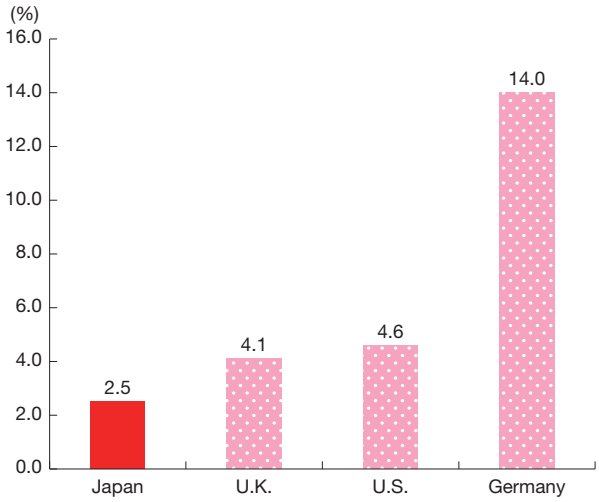
	U.S.	Japan
Participating Government Offices	11	7
Budget Allocation	Now that budget allocation is compulsory, 200 billion JPY is secured each year.	Determination of expenditure target amounts for SMEs (nonbinding targets)
Screening Process	Competition is ensured through three phases of screening performed by all government offices together.	The introduction of multi-phase screening is limited to a portion of ministries and agencies (NEDO, etc.).

Source) "Investigative Research Regarding Evaluation of Innovation Creation Environment on a Corporate/Social System Level", MLIT

(2) Collaboration between Industry, Academia and Government

Collaboration between industry, academia and government is one way to create innovation by transferring knowledge created in universities to the industrial sector for the purpose of encouraging sustainable economic growth. The percentage of private-sector responsibility for university research expenditures in the U.K., U.S. and Germany is higher than that of Japan (Figure 2-1-10).

Figure 2-1-10 Private Sector Responsibility for University Research Expenditures



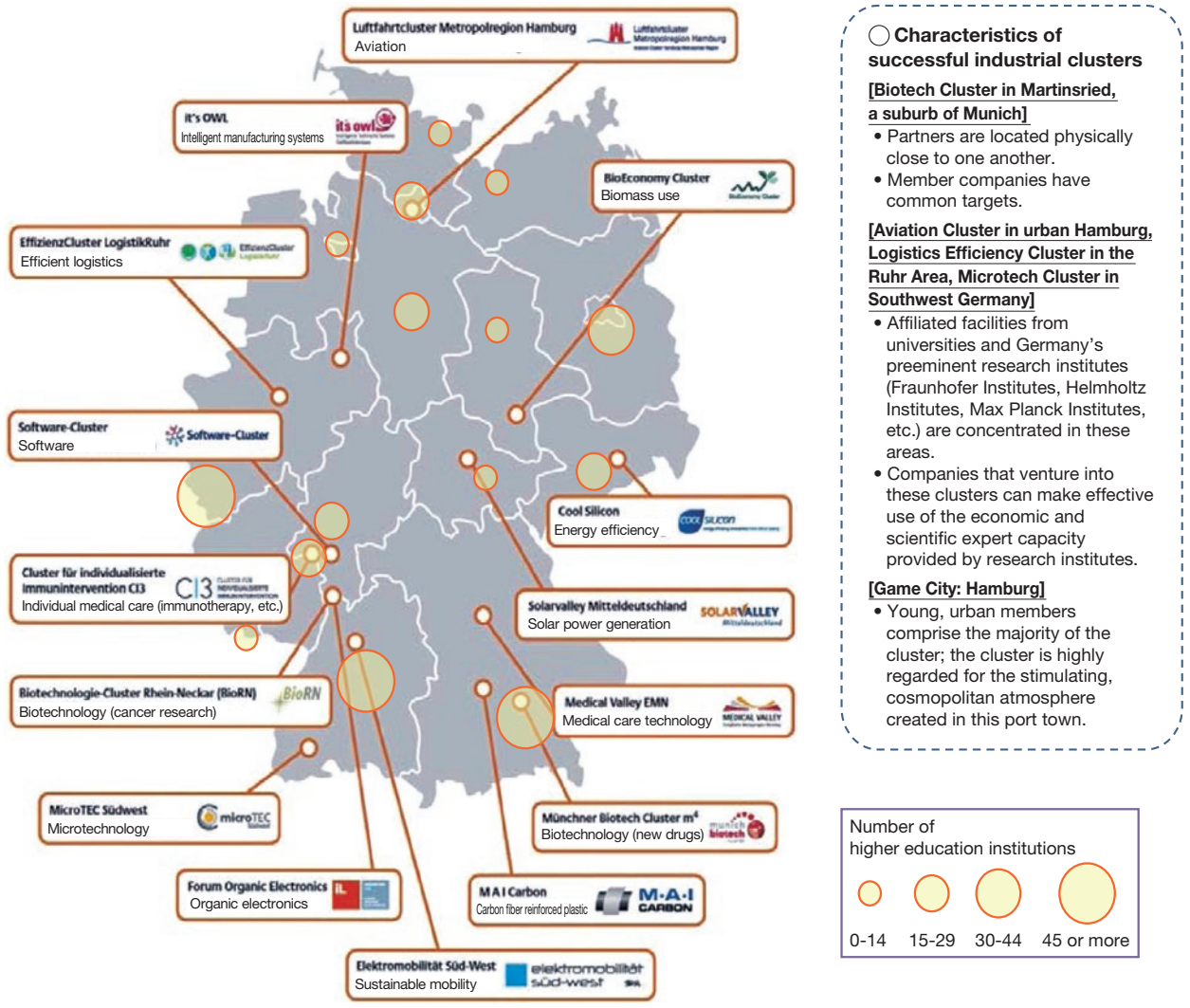
Source: U.K., U.S., Germany: Prepared by the METI based on the OECD Science, Technology and R&D Statistics database (February 2015)
Japan: Prepared by the METI based on the 2014 Survey of Science and Technology Research (MIC)
Note: Figures for the U.S. and Germany are from 2012, figures for the U.K. are from 2013, and figures for Japan are from FY2013.
Source) "The Current Situation Surrounding Private Company Innovation", METI

Note 41 A system for specific subsidies and the like that comprises multiple stages, in which investigations and discussions (F/S) regarding research and development and project feasibility are conducted in the first stage, and screening is conducted in ensuing stages under the assumption that entities will be screened and selected as the phases progress.

■ Selection of innovative clusters in Germany

Germany was home to many excellent universities, public research institutes funded by the federal and state governments (Max Planck, Fraunhofer, etc.) and corporate laboratories, but they suffered heavy damage during World War II. Years later, the unification of East and West Germany spurred the intensification of research in new sectors such as biotechnology and telecommunications, which had lagged during the country's separation, and the government created a Cluster Creation Program under which it designated themes for each region; provided support for collaboration between universities, research institutes, companies and other entities; and promoted regional innovation through this collaboration between industry, academia and government. Using the bio sector as an example, this program encouraged the growth of the world's preeminent bio cluster, and by 1999, Germany was home to more bio companies than any other country in Europe. Presently, several hundred industrial clusters exist throughout Germany, and the federal government is actively involved in ensuring that the regions do not compete against each other by encouraging the formation of industrial clusters in each region that are distinct from others[Note 42]. Germany's advanced scientific and technological potential and the strong collaboration between industry, academia and government[Note 43] that underlie it are the foundations of Industry 4.0 (2011-) (Figure 2-1-11).

Figure 2-1-11 Innovative Clusters in Germany



Source) Prepared by the MLIT National Spatial Planning and Regional Policy Bureau based on documents from Germany Trade & Invest, and the German Federal Ministry of Education and Research website

Note 42 The federal government selects 15 industrial clusters in a competitive format, and promotes innovation through the unified efforts of universities, research institutes, major corporations, small and medium-sized enterprises, financial corporations and others.

Note 43 Regional networks comprised mainly of universities (105 general universities and 211 technical universities) are responsible for helping companies overcome challenges in the technological innovation process.

Column

Tsukishima-sō

Column

A new style of company dormitory complex on Tsukishima is creating a stir. Despite being a dormitory for company employees, the complex incorporates features of shared housing, and instead of being restricted to employees of one company, it has residents from a variety of companies. This makes Tsukishima-sō a place for lively interactions among business people from different industries and differing generations. So what kinds of people live in Tsukishima-sō?

The proprietor is Inui Global Logistics Co., Ltd., which owns real estate in the Tsukishima and Kachidoki areas. Tsukishima-sō was built as a redevelopment project on a parcel of land that was formerly the site of a bowling alley and rental condominiums. Initially, the plan was to build a structure two hundred meters tall and containing luxury rental condominiums, but after investigating actual demand for properties that fulfilled the desire for residences near workplaces, Inui Global Logistics converted these plans into an arrangement for a company dormitory complex designed as shared housing, consisting of three buildings, each twenty-five meters tall. In addition, instead of housing the employees of a single company, Inui Global Logistics entered into corporate contracts with several companies, creating a system in which each company could use up to fifty rooms to house employees.

The complex has a total of 644 individual rooms and common facilities, including a kitchen and dining room, gym, communal baths, a home theater room, study rooms, and meeting rooms. The individual rooms are built along simple lines, but in addition to places for basic activities such as sleeping and changing clothes, there are comfortable, attractive common facilities that encourage sharing. In addition to the shared facilities on the ground floor, each residential floor has a shared living space, based on a concept called "cluster living," allowing the residents to prepare simple meals and spend their leisure time. No more than five employees from any single company can live in a cluster, so interactions with employees of other companies occur easily.

At present, forty-one companies from a wide range of industries are using this dormitory complex, including think tanks, chemical manufacturers, real estate companies, trading companies, and financial services companies; about 80% or more of the residents are in their twenties, with slightly fewer than 70% being male and slightly more than 30% being female. The companies apparently wanted their own employees to increase communication skills through encounters with employees of other companies, and in fact, residents use the kitchen-dining area to hold dinner parties and gather with other residents who have similar interests and hobbies in the common rooms. They also hold lively study sessions in a presentation format, where they share knowledge and experiences connected with their own specialties.

Since the collapse of the bubble economy and continued stagnation of the economy, most companies have given up their employee dormitories, and at present, there is a move away from company-owned company housing to rented company housing. As a result, however, interactions among employees of different workplaces and different age groups are said to have decreased. In these circumstances, company dormitories like Tsukishima-sō, where employees enjoy newer and deeper interactions with employees of other companies and with people of other generations while they are young, may be effective in encouraging open innovation.

Figure 2-1-12 Tsukishima-sō

Source) Inui Global Logistics Co., Ltd.

Figure 2-1-13 Events at Tsukishima-sō

Source) Inui Global Logistics Co., Ltd.

Section 2 Status of Efforts toward the Social Implementation of New Technologies and Services by the Ministry of Land, Infrastructure, Transport and Tourism

1 Policies of the Ministry of Land, Infrastructure, Transport and Tourism

Japan is leading the world in the entry to an era of fully fledged population decline, and in order to realize sustainable economic growth against this background, it will be essential for the nation to vigorously pursue a "productivity revolution" that will enable it to overcome the restrictions on supply and the shortfalls in labor power consequent upon a declining population. As indicated in the Japan Revitalization Strategy 2016 (approved by the Cabinet in June 2016), the use of technological breakthroughs encompassing the IoT, AI, big data, and robots and sensors (the "Fourth Industrial Revolution") is one major key toward the realization of this goal. The exploitation of the latest technologies will also be extremely important in realizing effective and efficient implementation of schemes against a background of increasingly stringent fiscal restrictions.

With 2016 set as the year in which Japan's productivity revolution begins, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has proceeded with efforts toward the realization of increased productivity, and views the advancement of the social implementation of new technologies as an important perspective to achieve this goal.

Seeking to further increase the effectiveness and efficiency of planning and implementation in the administration of land, infrastructure, transport and tourism toward the realization of a sustainable society, in March 2017, the MLIT established a new Ministry of Land, Infrastructure, Transport and Tourism Technology Basic Plan, covering items including the advancement of technological research and development, the effective use of technology, and the cultivation of human resources to support technology policy.

(1) Productivity Revolution Projects

In order to realize sustainable economic growth in an era of population decline, it will be essential to (i) increase the potential growth rate by increasing productivity, and (ii) create and discover new markets. In addition, in order to respond to fears of manpower shortages in numerous industries as a consequence of the decline in the productive population, it will be vital both to secure future workers by promoting innovation in working styles, and to increase productivity to make it possible to realize the same amount of work with less manpower.

Because the MLIT is working at sites throughout the country, engaged in the provision of social capital, and oversees a wide range of industries that support the foundation of the nation's economic activities, in particular the transportation and construction industries, its role in increasing productivity in Japan is necessarily a significant one. Under the leadership of the MLIT Productivity Revolution Headquarters (headed by the Minister of the MLIT), established in March 2016, the Ministry has therefore selected and is promoting 20 advanced projects (Productivity Revolution Projects) as initiatives toward the realization of increased productivity involving the efforts of the Ministry as a whole. Taking the increasing severity of fiscal restrictions into consideration, the selection of Productivity Revolution Projects seeks to realize the maximum possible output from minimal input, and thus focuses on projects that (i) advance the development and social implementation of new technologies, (ii) make comprehensive use of existing stock, and (iii) involve the modification of systems or their operation. With 2017 as the year for the advancement of the productivity revolution, in addition to steadily advancing these Productivity Revolution Projects, the Ministry will work to ensure that the concept that provides the foundation for the productivity revolution, the active exploitation of new technologies, becomes entrenched not only in the area of approaches to the realization of economic growth, but also in the entire range of measures involved in the administration of land, infrastructure, transport and tourism, encompassing the guarantee of safety and security, and the guarantee of a comfortable living space (Figure 2-2-1).

Figure 2-2-1 MLIT Productivity Revolution Projects

Source) MLIT

- Pinpoint responses to traffic congestion
- Maritime productivity revolution (P61)
- Fee structure making intelligent use of expressways (P68)
- Productivity revolution in logistics (P60)
- Realization of the next generation of cruises
- Innovation in road-based logistics
- Compact Plus Network
- Tourism industry innovation
- Promotion of optimal use of real estate
- Sewage system innovation
- Infrastructure maintenance revolution (P64)
- Rail productivity revolution
- Rehabilitation of dams
- Traffic safety measures utilizing Big Data
- Air transport infrastructure revolution
- Overseas expansion of Quality Infrastructure
- Promotion of i-Construction (P55)
- Automotive ICT revolution (P59)
- New development of residential living industries
- Creation of a meteorological business market (P67)

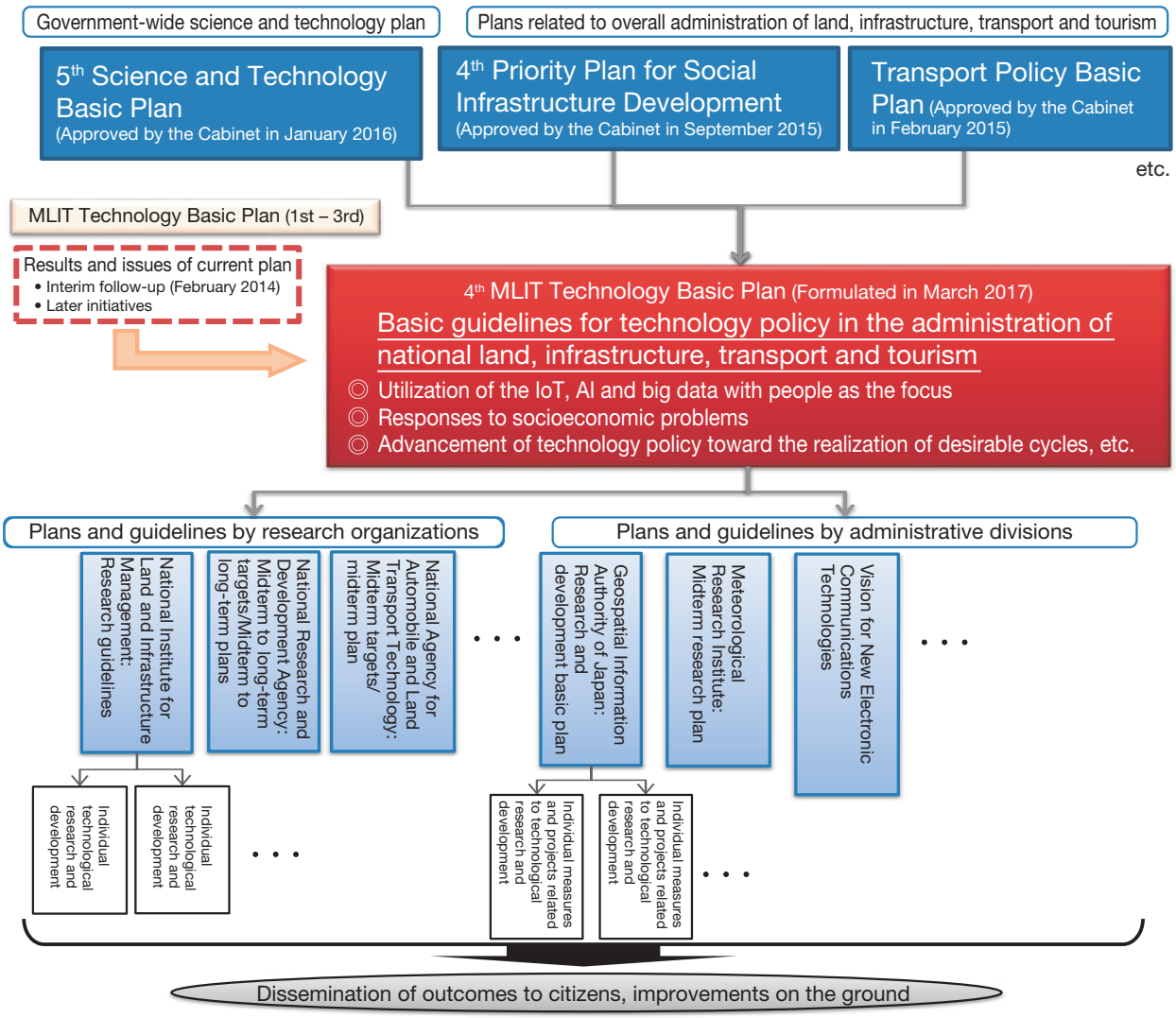
(2) The MLIT Technology Basic Plan

The Ministry of Land, Infrastructure, Transport and Tourism has formulated the new MLIT Technology Basic Plan (the 4th MLIT Technology Basic Plan), extending to fiscal 2021, as a basic guideline for technology policy, including technological development, in the administration of Japan's land, infrastructure, transport and tourism. The new plan has three pillars – the use of the IoT, AI, and big data, with people as the focus; responses to socioeconomic problems; and the advancement of technology policy that will realize desirable cycles. It seeks to realize a sustainable society by promoting a revolution in productivity and a reform of working styles through the creation of new value.

Making use of open innovation, which is the active incorporation of knowledge and technologies from outside a specific organization, will be essential to further advancing technological research and development. Given this, while following the previous plan in advancing technological development and planning and implementation in an integrated fashion with the entire scope of technology policy as its subject, the new plan also adds a focus on the realization of desirable cycles in which the comprehensive utilization of technology leads to the spontaneous creation of new technologies, and specifies the necessary perspectives and the target orientation for the advancement of technological research and development.

By providing Japan's research organizations, industries, universities, and learned societies with MLIT's guidelines for technological research and development and the cultivation of human resources, in addition to fostering a shared awareness between industry, academia and government, the plan seeks to advance technological research and development effectively and efficiently, promoting collaboration between the three groups, with each becoming a major actor and realizing their optimum efforts (Figure 2-2-2).

Figure 2-2-2 Positioning of Formulation of 4th MLIT Technology Basic Plan



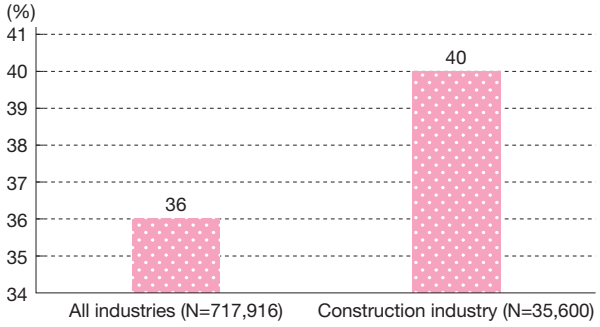
Source) MLIT

2 Initiatives Related to Innovation

■ Promotion of i-Construction

At present, of the approximately 3.26 million skilled workers engaged on construction sites in Japan (as of 2016), approximately one-third are aged 55 or above. The construction workforce is aging, and there is a strong possibility that large numbers of workers will retire within the next 10 years due to age and other factors. In addition to this projected mass retirement of older workers in the construction industry, the high rate of younger skilled workers in the industry leaving their jobs represents a concern (Figure 2-2-3). A survey of companies and construction industry workers who had left their jobs showed that four reasons for employees leaving their positions were shared among the top eight reasons for both groups: "It is difficult to take

Figure 2-2-3 Comparison of the Job Separation Rate Up to the Third Year (All Industries and the Construction Industry)

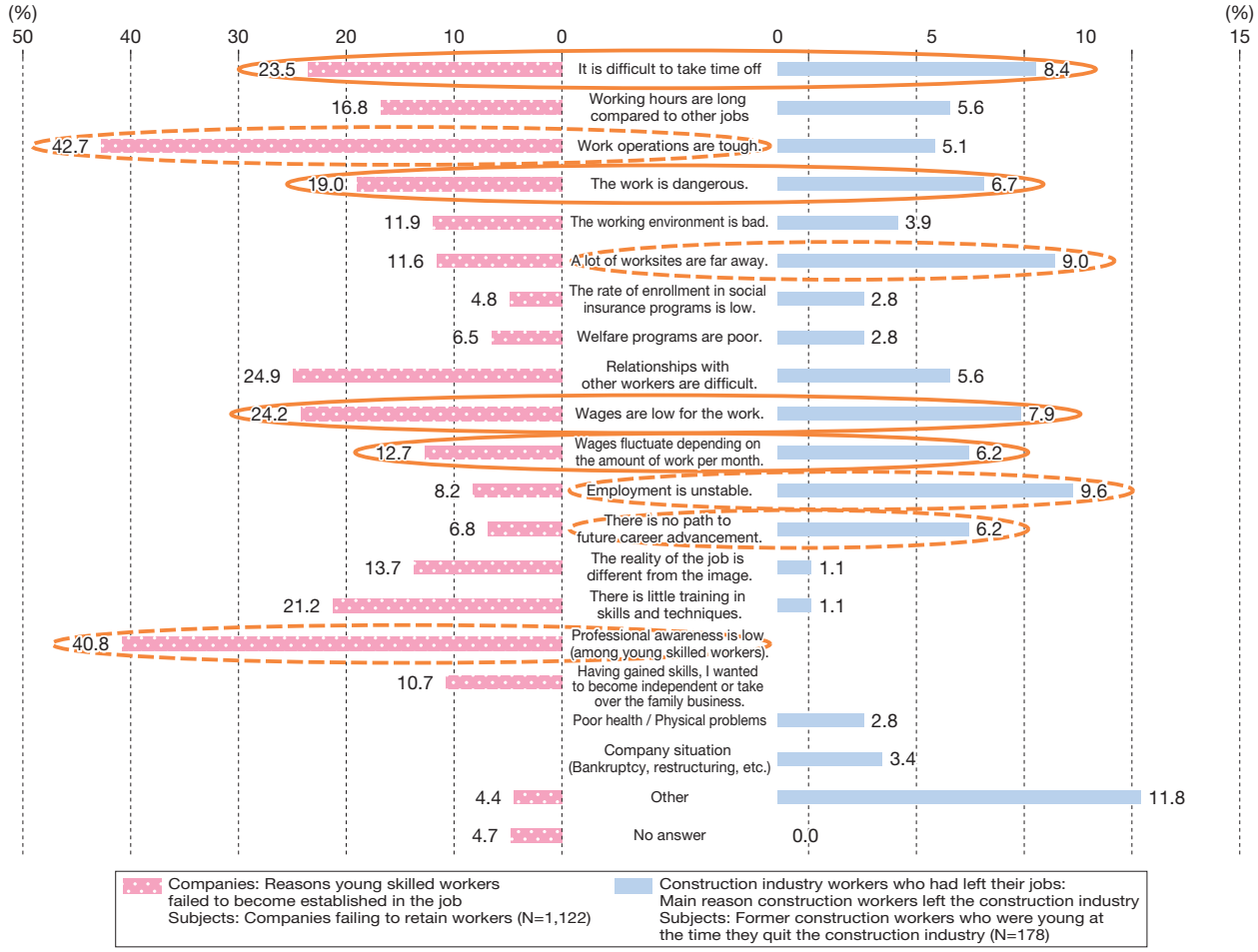


(Note) Subjects were new employees who graduated in March 2013
Source) Prepared by the MLIT based on "Status of Job Separation among New Graduates," Ministry of Health, Labour and Welfare

time off," "The work is dangerous," "Wages are low for the work," and "Wages fluctuate depending on the amount of work per month" (Figure 2-2-4).

Based on the awareness of the issues among companies and the actual situation of younger workers leaving their jobs, the MLIT is pushing ahead with initiatives that look at the coming decline in Japan's working population and seek to increase the productivity of the construction industry while maintaining on-site capability through the use of ICT, which is displaying dramatic development.

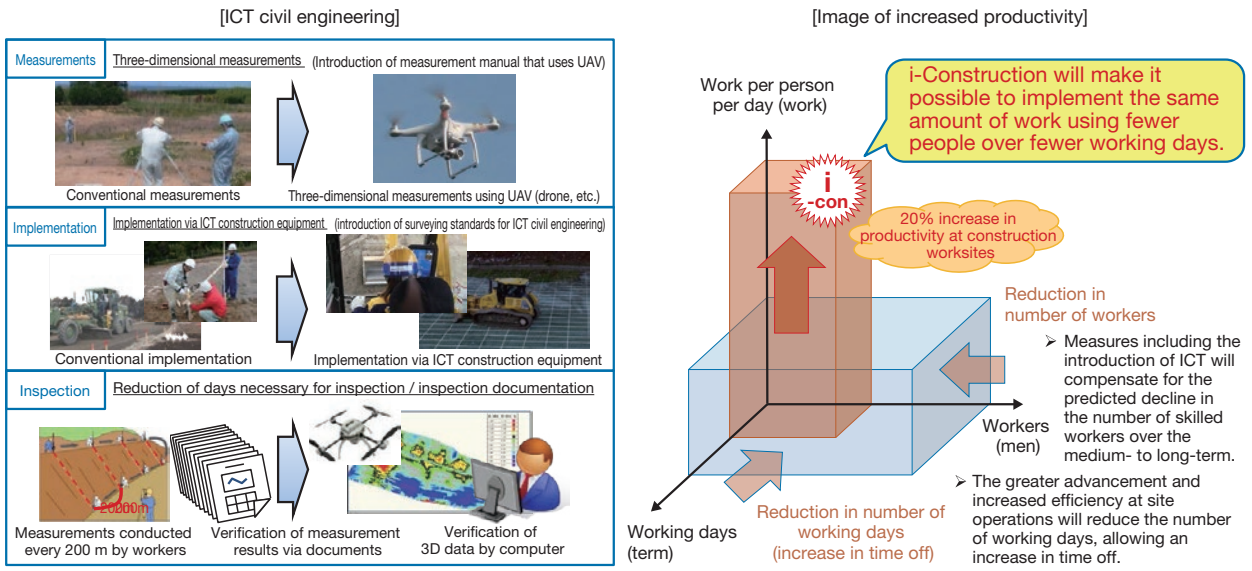
Figure 2-2-4 Reasons Companies Consider That Young Skilled Workers Fail to Become Established in the Job / Main Reason (Young) Construction Workers Left Their Positions



Source) Prepared by the MLIT based on "Survey of Status of Employment Management (Fiscal 2012)," Ministry of Health, Labour and Welfare

The construction industry is simultaneously an agent in the provision of social capital and an agent in the protection of the areas in which it operates, one that assists in guaranteeing the safety and security of Japanese society and plays an indispensable role in the preservation of the national territory. In order to allow the industry to fulfill these roles even as Japan's population declines and ages, it will be essential to increase productivity in the industry, while at the same time increasing wage levels and reforming working styles (for example by increasing time off). The MLIT is therefore advancing the concept of "i-Construction" (Figure 2-2-5), which will apply the latest technologies, including ICT, to all construction industry processes, from survey and measurement, through design, implementation and inspection, to maintenance management and renovation, with the aim of realizing a 20% increase in the productivity at construction worksites by fiscal 2025. In fiscal 2016, the three leading measures pushed ahead were the application of ICT in all areas of construction (ICT civil engineering), the comprehensive utilization of ICT in construction processes including cutting and embankment work, following the setting of 15 new standards and surveying standards to enable the use of three-dimensional data; the adoption of overall optimization, for example the regularization of standards for concrete work; and the standardization of construction periods, etc., through measures including the use of two-year government bonds and providing obligatory assurances of national subsidization of multi-year construction projects.

Figure 2-2-5 i-Construction: The application of ICT and Other Technologies to All Construction Industry Processes, from Survey and Measurement, through Design, Implementation, and Inspection, to Maintenance Management and Renovation



Source) MLIT

As of March 2017, ICT civil engineering has been implemented in 584 construction projects. In the Chubu-Jukan Nyukawa West Section Road Construction Project, conducted in Nyukawa Town, Takayama City, Gifu Prefecture, the contractor made active efforts to utilize ICT civil engineering, including measurement verification by drone (UAV) and cutting slope molding using machine-controlled (MC) backhoes (Figure 2-2-6). The use of UAV and ICT construction machinery in this project considerably reduced the construction period (by around 30 days, from 36 days to 7 days), principally by reducing the number of days necessary for measurement, and enabled even inexperienced operators to bring procedures to completion with a high level of accuracy. In addition to this, the automation of measurement and slope shaping eliminated the danger of accidents such as workers falling from slopes.

Figure 2-2-6 Cutting Slope Molding Performed by an MC Backhoe During the Chubu-Jukan Nyukawa West Section Road Construction Project, Takayama City, Gifu Prefecture

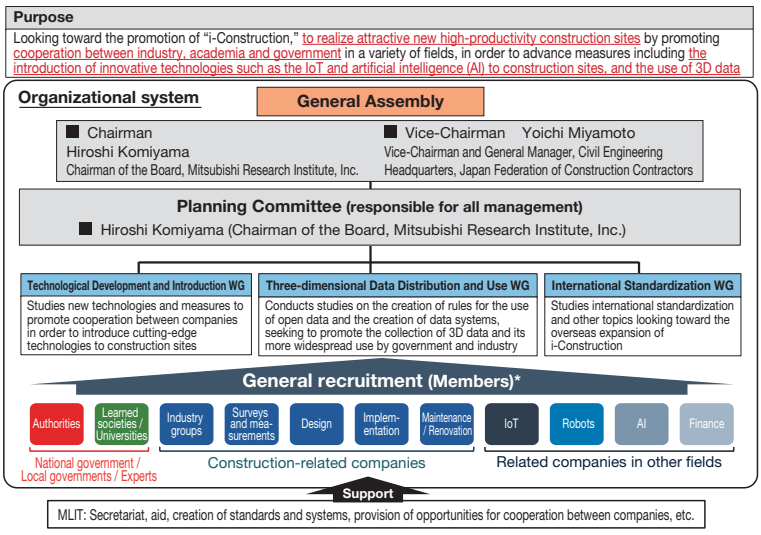
Source) MLIT

The Oita River Dam Construction Project being conducted in Oita City, Oita Prefecture, is also making active use of ICT, which has improved efficiency. For example, as a result of the use of UAV measurements, measurements that previously required six-man teams are now performed by teams with a minimum of two members. In addition, the development of a unique construction production system has enabled linked operations by automatic dump trucks and automatic bulldozers, and surface compaction by automatic vibrating rollers, advancing the automation of dam construction. Because it is possible for multiple pieces of construction machinery to operate and conduct procedures based on instructions input into a tablet in advance, it is possible for operatives to oversee procedures even if they are not highly skilled.

The use of ICT is also expanding among local governments. In the first ICT civil engineering project ordered by Niigata Prefecture, the Itakura Ward Kokugawa Area Landslide Prevention Project, the company implementing the project used the ICT construction equipment in its possession and also made efforts to develop operators able to deploy the equipment. In addition to reducing the construction period, it was reported from the worksite that by reducing the amount of operations conducted around heavy machinery, the application of ICT construction equipment helped prevent accidents caused by contact with the machinery, thus increasing safety. In order to further spread the use of ICT, the MLIT has held workshops for the regional construction industry and local government personnel at 468 locations throughout the country, attended by more than 36,000 people.

In addition, the Ministry established the i-Construction Promotion Consortium in January 2017, seeking to promote the realization of attractive high-productivity new construction sites by promoting cooperation between industry, academia and government in a variety of fields in order to advance measures including the introduction of innovative technologies (the IoT, AI, etc.) to construction sites and the use of 3D data. This consortium has three Working Groups: The Technological Development and Introduction WG, which studies new technologies and measures to promote cooperation between companies in order to introduce cutting-edge technologies to construction sites, the Three-dimensional Data Distribution and Use WG, which conducts studies toward the creation of rules for the use of open data and the creation of data systems, seeking to promote the collection of 3D data and its more widespread use by government and industry, and the International Standards WG, which studies international standardization and other topics looking toward the overseas expansion of i-Construction (Figure 2-2-7).

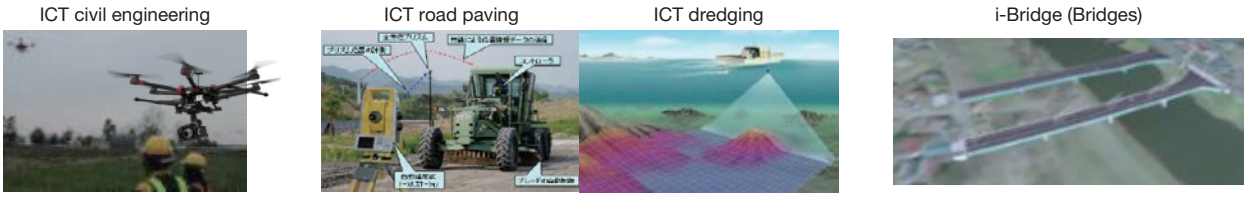
Figure 2-2-7 The i-Construction Promotion Consortium



Source) MLIT

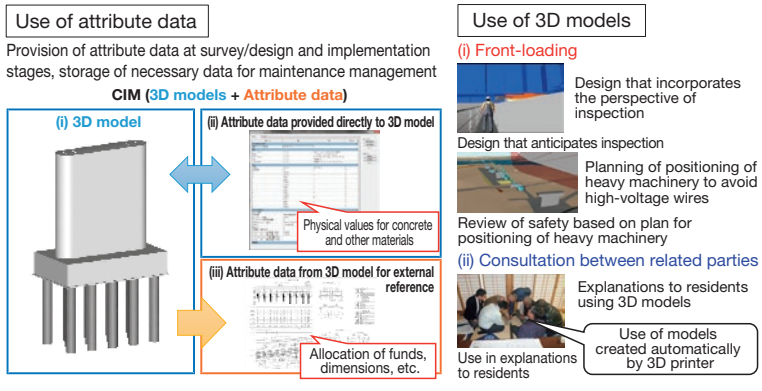
In the future, the Consortium intends to expand the range of construction work in which ICT is used (expansion of application to road paving and dredging, trials of use on bridges, etc.), to introduce CIM, and, via the activities of the i-Construction Promotion Consortium Working Groups and other parties, to introduce new technologies to construction sites and boost measures for their promotion and the realization of more widespread use, thereby realizing attractive new construction sites that offer good wages, the ability to take adequate time off, and hope for the future (Figures 2-2-8 and 2-2-9).

Figure 2-2-8 Expansion of Range of Construction Projects in Which ICT Is Used



Source) MLIT

Figure 2-2-9 Concept of CIM Model

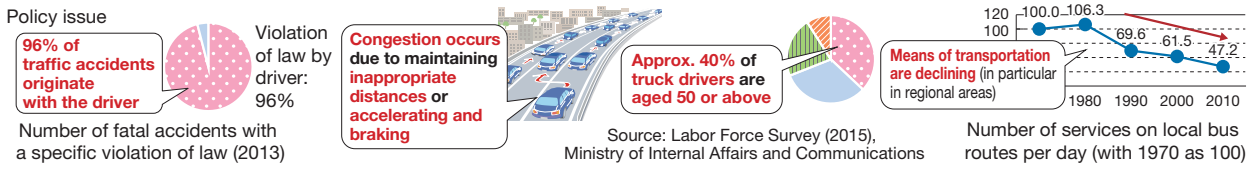


Source) MLIT

■ The automotive ICT revolution

It is claimed that today, 96% of traffic accidents originate with the driver. Autonomous driving can be expected to have a significant effect in alleviating the various issues associated with automotive transport, for example by reducing accidents, easing traffic congestion, assisting in responding to the decline in public transport as a result of Japan's declining birthrate and aging population, and boosting international competitiveness. In addition, among other effects, the practical realization of autonomous driving technologies will increase safety, increase transportation efficiency, and allow the creation of new transport services, and can thus be expected to make a major contribution to increased productivity (Figure 2-2-10).

Figure 2-2-10 Status of Policy Issues Expected to Be Resolved by Autonomous Driving



Source) MLIT

A survey of trends in the passenger vehicle market conducted by the Japan Automobile Manufacturers Association (JAMA) in fiscal 2015[Note 44] showed "Safety will increase" as the most frequent answer among respondents to the question "What do you expect from autonomous driving?". However, "I have concerns about safety" was the most frequent answer to the question "Why are you not interested in autonomous driving?" Both responses reveal a high level of concern regarding safety. As can be seen from these results, in order to ensure that innovations are accepted by society, it will be essential to eliminate anxieties concerning new technologies and services. In order to do so, it will be vital to ensure safety via more advanced technological research, and to formulate rules and verify systems for the social implementation of technologies and services.

Looking toward the practical realization of autonomous driving, a diverse range of businesses and governments in countries around the world are working together on R&D and tests toward the improvement of technologies such as radar, cameras, laser scanners, and vehicle technologies, and the formulation of rules and the verification of systems are proceeding. Competition is fierce to take the lead in the field of autonomous driving.

To allow Japan to lead the world in this area, the MLIT has proceeded with studies of advanced digital maps, technologies utilizing ICT, and methods allowing safe and smooth communication between drivers and systems, the formulation of rules in areas such as international standards for road-vehicle cooperation systems and other autonomous driving technologies, and social trials and social implementation. In November 2016, the Ministry established the MLIT Autonomous Driving Strategy Headquarters, which is organizing issues to be studied toward the practical realization of autonomous driving, and holding discussions regarding matters including proving trial plans and the provision of the necessary environment. The Ministry has also established a study group considering the liability for damages in the case of autonomous driving, which is studying issues of liability in relation to the Automobile Liability Security Act, and formulating rules while taking into consideration factors such as ensuring rapid aid to victims of accidents, realizing an acceptable financial burden, and the status of discussions in the area internationally.

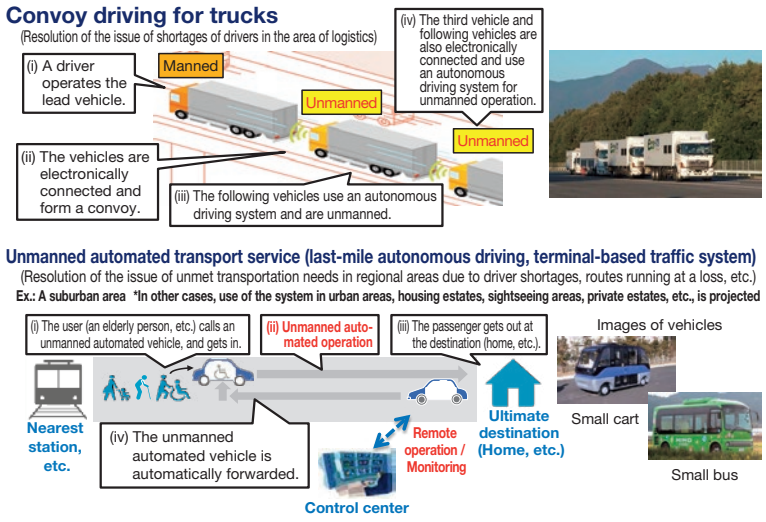
In the future, the Ministry intends to select areas for proving trials of an autonomous driving service in mountainous areas that uses roadside stations as bases, and to commence these trials from summer 2017. In addition, looking toward the commercialization of a convoy driving technology for trucks on expressways between Tokyo and Osaka (in which the vehicles following the first in the convoy will be unmanned) from fiscal 2022, and an unmanned automated transport service from fiscal 2020, from January 2018 the Ministry intends to hold proving trials with human subjects in the following vehicles[Note 45], and, in collaboration with the Ministry of Economy, Trade and Industry, to conduct initiatives in the area of last-

Note 44 Based on a survey of households that own cars throughout the country and other respondents conducted from August 19 to September 17, 2015. Autonomous driving was not divided into phases in this question.

Note 45 Proving trials with human subjects in the following vehicles are trials in which the lead vehicle is operated by a driver, and the operation of the following vehicles is automated, but human subjects are present in the vehicles. From January 2019 the viability of the automated convoy system, in which the following vehicles will be unmanned, will be verified on the basis of the status of the subjects in the following vehicles.

mile autonomous driving (Figure 2-2-11). These measures can be expected to assist in the practical realization of autonomous driving, help secure a means of transport for the elderly and others who have difficulty with regard to mobility, supplement public transport systems, resolve shortages of drivers, and promote international expansion based on the technologies and expertise acquired.

Figure 2-2-11 Vision for Private Enterprise Projects

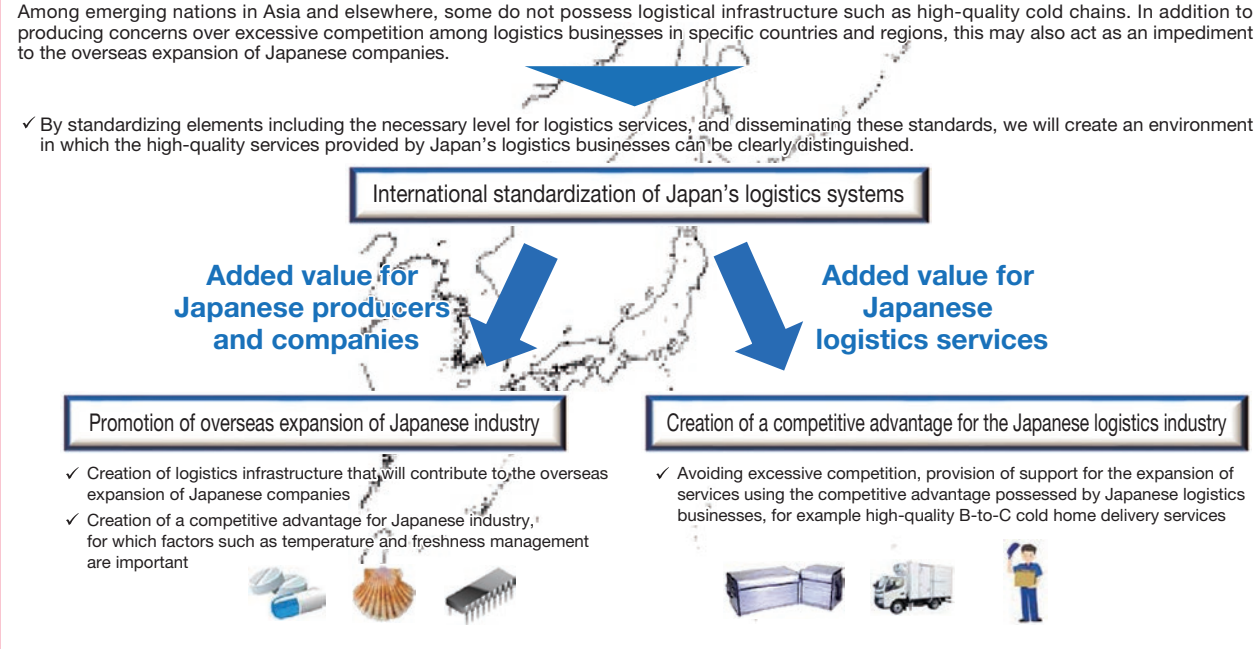


Source) Materials submitted by the Ministry of Economy, Trade and Industry to the 5th Growth Strategy Council – Investing for the Future

■ A Revolution in logistics productivity

In addition to being marked by a shortage of truck drivers and other workers, contemporary logistics in Japan is also facing various inefficiencies – for example, truck loading rates have declined to around 40%. Seeking to respond to Japan's future shortage of labor power and contribute to economic growth, the MLIT is advancing a revolution in logistics productivity that will significantly increase the "smartness" of logistics by means of the realization of increased efficiency in procedures and increased added value. Specific initiatives include the promotion of measures including modal shift and joint transportation and delivery using the framework of the revised Act on Advancement of Integration and Streamlining of Distribution Business, the promotion of the introduction of open delivery boxes to reduce re-delivery by home delivery services, the provision of support for drone port systems for logistics to realize parcel delivery by small, unmanned vehicles, and informing relevant parties of the design and management of buildings with consideration of logistics.

Figure 2-2-12 Increased Productivity through International Standardization of Japan's Logistics Systems



Source) MLIT

With regard to the realization of increased added value in particular, at present the Ministry is working to support the overseas expansion of Japanese logistics businesses by promoting the international standardization of Japan's logistics systems, and by this means to increase the quality of logistics services in other countries. As the globalization of supply chains proceeds and logistics demand increases in countries in Asia and elsewhere, the international standardization of Japan's logistics systems and their positioning as the market standard will be essential in order to effectively support the overseas expansion of Japanese logistics businesses[Note 46]. The establishment of cold chains, including cold home delivery in particular, is expected to progress, with increases in standards of living due to factors including increasing wages in ASEAN and other nations furthering the provision of high added value in logistics. Japanese logistics businesses are currently actively advancing into the field of cold chain logistics in these nations. In order to support the overseas expansion of Japanese logistics businesses, in March 2016, the MLIT established a review committee that includes representatives of logistics businesses, industry groups and administrative bodies, and is working toward the international standardization of Japan's logistics systems. As a result, in February 2017, the British Standards Institution (BSI) issued the world's first standard, PAS 1018, based on the cold home delivery services offered by Japan's logistics businesses. In the future, the Ministry is aiming toward the formulation of an ISO standard; ISO standards function as international standards. In addition, in fiscal 2018, within the framework of Japan-ASEAN transport cooperation, the Ministry intends to formulate guidelines toward the improvement of the quality of cold chain logistics in the ASEAN region in collaboration with ASEAN governments. The Ministry will work to further expand this international standardization by lobbying in forums including policy dialogues with foreign governments. In addition to establishing an environment in which cold chain logistics can be used safely and securely in nations in Asia and throughout the world, these efforts toward international standardization can be expected to contribute to the realization of greater convenience in daily life, the provision of support for SMEs, the development of electronic trading, and the expansion of markets including markets for agricultural products and pharmaceuticals (Figure 2-2-12).

■ The Maritime Productivity Revolution (i-Shipping and j-Ocean)

In the area of maritime affairs, the Ministry has positioned a maritime productivity revolution, aiming toward the realization of strong industry, high growth and prosperous regions, as part of the Productivity Revolution Project, and is advancing its efforts via the twin prongs of "i-Shipping," an initiative that seeks to increase the productivity of the shipbuilding industry and reduce fuel waste and eliminate accidents in shipping operations, and "j-Ocean," an initiative that seeks to enable Japanese maritime industry to build a larger share in the ocean development market (Figure 2-2-13).

Between 1956 and 2001, Japan's shipbuilding industry was the world's best in terms of constructed tonnage, and at its maximum, its market share was more than 50%. However, with the rise of China and South Korea in this area, Japan's industry has dropped to number three in the world, and its market share has declined to approximately 20%. Against this background, the i-Shipping initiative seeks to enhance the competitiveness of the Japanese shipbuilding industry by increasing productivity in every phase of the process, from the development and design of ships through construction to operation, via the application of technologies including ICT.

In the category of development and design, the i-Shipping initiative seeks to halve the development time for new ship configurations. By focusing on conventional development that relies on a repeated process in which optimal ship configurations are studied and their performance verified in a test tank, allowing improvements to be made, the initiative is working to reduce development time for new ships by realizing advanced CFD in order to replace some of the water tank tests.

In the areas of construction and operation, looking toward the realization of increased efficiency and sophistication in design and production in the fields of shipbuilding and the manufacture of onboard equipment, and in ship operation via the application of technologies including the IoT and big data (which are displaying marked development at present), in fiscal 2016 the Ministry provided support for the development of four innovative shipbuilding technologies and seven advanced ship technologies. In addition, the Act concerning the Partial Revision of the Maritime Transportation Act and the Mariners Act, which specifies the establishment of a system of authorization for plans, for example for the introduction of advanced ships, was enacted on April 12, 2017, in order to promote the R&D, construction, introduction and diffusion of ships using these advanced technologies (Figure 2-2-14).

Note 46 "Concerning the Basic Orientation, etc., for Physical Distribution Policy" (a report published in December 2015 by the Council for Social Infrastructure and the Traffic Policy Council) states that: "Given the fact that Japan's physical distribution businesses display the world's highest standards of service and expertise in precision services tailored to customer needs (such as high-frequency, low-volume delivery and fixed-time delivery), cold chains, home delivery systems, etc., it will be important for Japan to proactively work with other Asian nations to establish Asian standards. In order to do so, it will be necessary to consider initiatives that allow Japan to regularize the nation's physical distribution systems and take the lead in international standardization."

In addition, the field of ocean development (ocean-floor oil and gas fields, etc.) is expected to expand over the medium to long term with increasing global demand for energy, and this represents an important new market for Japan's maritime production (shipbuilding industry, onboard equipment manufacturing industry, maritime transportation industry, etc.). The j-Ocean initiative seeks to increase technological capacity, productivity and other parameters across a wide range, from the design and construction of ships and other equipment to their operation, in order to tap into these growth markets.

Figure 2-2-13 Maritime Productivity Revolution (i-Shipping and j-Ocean)

Maritime production that supports Japan

[Shipbuilding]
- Domestic parts procurement: **91%**
- Production in regional areas: **94%**

[Maritime transportation]
- Japanese export and import freight shipping: **99.6%**

The new ocean development market
- World market: **40 trillion yen**
- Future growth market
- Will contribute to growth in Japan and the ability to secure resources
- Ocean development requires a large number of ships, and will therefore be important to Japan.

FPSO: Floating Production, Storage and Offloading vessel
O&M: Operation and maintenance

· innovation
· Information
· IoT…

i-Shipping

Maximal use of existing maritime production resources

Synergistic effect

Increase in appeal and competitiveness of maritime production to allow access to new markets

j-Ocean

· Japan — Growth and securing resources for Japan
· joint — Cooperation
· J-Curve — Growth in the shape of a "J"

◆ Introduction of ICT in all phases, from ship development and construction to operation, in order to increase competitiveness of shipbuilding and maritime transportation

◆ Realization of increased technical capacity, etc., in Japan's maritime production across a wide range of areas, from the design and construction of ships, in particular those employed in ocean development, to operation

Share of world new ship construction volume (Sales)
2015: 20% (2.4 trillion yen) → 2025: 30% (6 trillion yen)

Outlook for sales in ocean development field
2010s: 3.5 trillion yen → 2020s: 4.6 trillion yen

The **Maritime Productivity Revolution** created by these two projects has been positioned as part of the Ministry's Productivity Revolution Project, and is being vigorously promoted.

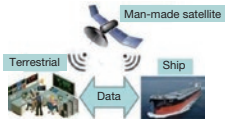
Source) MLIT

Figure 2-2-14 System for Authorization of Introduction, etc. of Advanced Ships

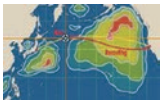
Advanced ships

Ships able to boost the quality of transportation services

○ Ships fitted with advanced technologies, including maritime broadband communications technologies
⇒ **More efficient operation**



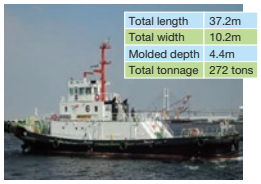
Realization of efficient operation using broadband communications

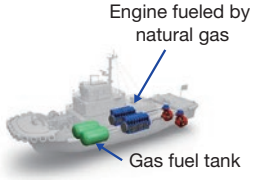


Selection of safe and economical route

Maintenance

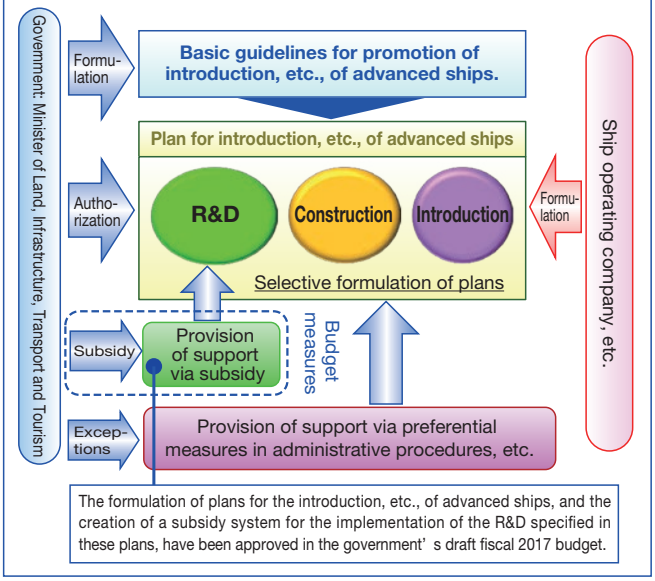
○ Ships fueled by natural gas (cleaner than petroleum)
⇒ **Reduction of environmental burden**





Natural gas-fueled tugboat "Sakigake" (in service from September 2015)

System for authorization of introduction, etc., of advanced ships.



The formulation of plans for the introduction, etc., of advanced ships, and the creation of a subsidy system for the implementation of the R&D specified in these plans, have been approved in the government's draft fiscal 2017 budget.

Source) MLIT

Column

Enhancing and Promoting Training in Shipbuilding at Technical High Schools

There were about twenty high schools that had shipbuilding courses centered on naval architecture during the industry's peak period in the 1970s, but that number had fallen to three[Note 1] as of 2011. However, even as Japan's global share of the shipbuilding industry has grown in recent years, the need for enhanced training in shipbuilding at technical high schools has once again grown in regions where the industry is concentrated. A course in shipbuilding was instituted in FY2016 at Ehime Prefectural Imabari Technical High School, and specific plans for enhancing training in shipbuilding have emerged, including the establishment of such a course at Kagawa Prefectural Tadotsu High School in April 2017.

In the pioneering example of Imabari Technical High School, systems were constructed to support shipbuilding education at the school. In addition to the traditional classroom instruction and school-based technical training, the school joined forces with local shipbuilders and companies that manufacture ship equipment and machinery, the Imabari Regional Shipbuilding Technology Center (a shared site for technological training), the National Maritime Research Institute, and Ehime University, which dispatched lecturers, provided practical training at worksites, and offered training in three-dimensional CAD[Note 2]. The program received high marks for its innovative nature, including the participation of local companies, local governments, research institutes, and national government bodies in a framework involving links among industry, academia, and government. In FY2016, Imabari Technical High School was designated as a "super professional high school"[Note 3] by the Ministry of Education, Culture, Sports, Science, and Technology.

Furthermore, in order to promote training in shipbuilding and to promote the enhancement of training programs, the Ministry of Land, Infrastructure, Transport, and Tourism undertook a joint project with technical high schools, shipbuilding companies, and industry organizations in FY2016, with the aim of producing attractive teaching materials in shipbuilding for high school students. In addition, these organizations will cooperate with MLIT in FY2017, creating training programs for shipbuilding instructors in order to promote continuing education for these instructors and to strengthen shipbuilding instruction at the high school level.

Figure 2-2-15 Technical Training at a Shipbuilding Plant

Source) MLIT

Figure 2-2-16 Touring a Shipbuilding Plant

Source) MLIT

Note 1 Shimonoseki Technical High School (Yamaguchi), Susaki Technical High School (Kōchi), Nagasaki Technical High School (Nagasaki)

Note 2 Computer-assisted design and drawing

Note 3 With the objective of training persons skilled in specialized trades and able to be active on the front lines of society, the Ministry of Education, Culture, Sports, Science and Technology designated ten specialized high schools that are making cutting-edge and superior efforts. In FY2016, fifty-five schools applied for this distinction.

Figure 2-2-17 Roundtable Discussion at a Shipbuilding Plant with Successful Graduates

Source) MLIT

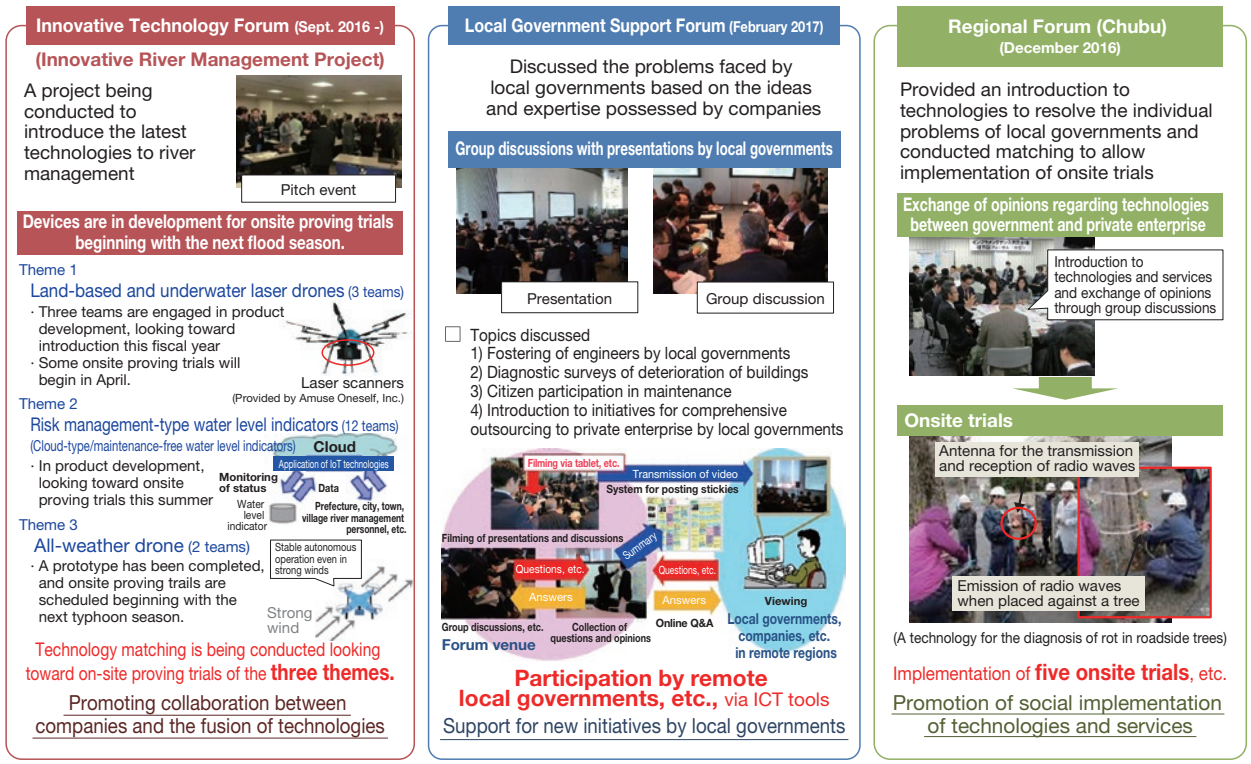
■ Japan Infrastructure Management Council

Having positioned 2013 as the first year of its maintenance regimen, in May 2014 the MLIT formulated the Plan for Extending the Life of Infrastructure (Action Plan), and is working to respond to deteriorating infrastructure. In order to allow the steady implementation of the plan, it will be essential to make efforts to realize strategic maintenance, for example by reducing and standardizing the total cost of infrastructure maintenance. To speed up these efforts, the National Council for Infrastructure Maintenance[Note 47] was established in November 2016 as a platform to bring together industry, academia, government and the people to enable a full mobilization of technology and knowledge, and to allow efforts toward the maintenance management and upgrading of infrastructure by society as a whole. Diverse actors participate in the National Council. In addition to representatives of construction companies, the council features the participation of representatives of companies in a wide range of industry fields, including information and communications technologies, big data analysis, materials, and machining technologies, regional administrations, NPOs, and others. The National Council provides an official forum in which, using the methods of open innovation, members extend their discussions while exchanging information on concrete issues and matters of concern, and determine directions for technological development and measures for the resolution of problems. Since the establishment of the National Council, five forums, dealing with innovative technologies, support for municipal administrations, the fostering of engineers, citizen participation, and the Kinki region headquarters, have been organized, and are implementing concrete initiatives including the Innovative River Management Project, which is attempting to introduce the latest technologies, including IT and aerial measurement technologies, to river management, and the Regional Forum (including trials), which is promoting exchanges between different industries, looking toward the resolution of problems chiefly among municipal administrations in the Kinki and Chubu regions. The Local Government Support Forum, held in February 2017, is working to promote effective information exchanges and discussions between government and private enterprise (through initiatives including question-and-answer sessions with municipal administrations and other entities in remote regions using ICT) and the horizontal rollout of advanced initiatives throughout the country (Figure 2-2-18).

Note 47 As of March 21, 2017, the National Council for Infrastructure Maintenance had 492 members.

Figure 2-2-18 Concrete Initiatives for Fiscal 2016

<Examples of forums that have already been established or held>



Source) MLIT

Using the methods of open innovation, the Innovative River Management Project is urgently seeking to implement the latest technologies, including IT and aerial measurement technologies, in river management and to increase the sophistication of both river management and disaster response. As the project's first stage, in November 2016, a public call was issued for participation in open innovation toward the practical realization of 1) land-based and underwater laser drones, 2) cloud-type maintenance-free water level indicators, and 3) all-weather drones. Looking toward rapid onsite implementation, pitch events[Note 48] were held in December 2016 and January 2017, and development teams were formed (three teams for Theme 1, 12 teams for Theme 2 and two teams for Theme 3); the earliest experimental onsite measurements will be conducted from April 2017[Note 49].

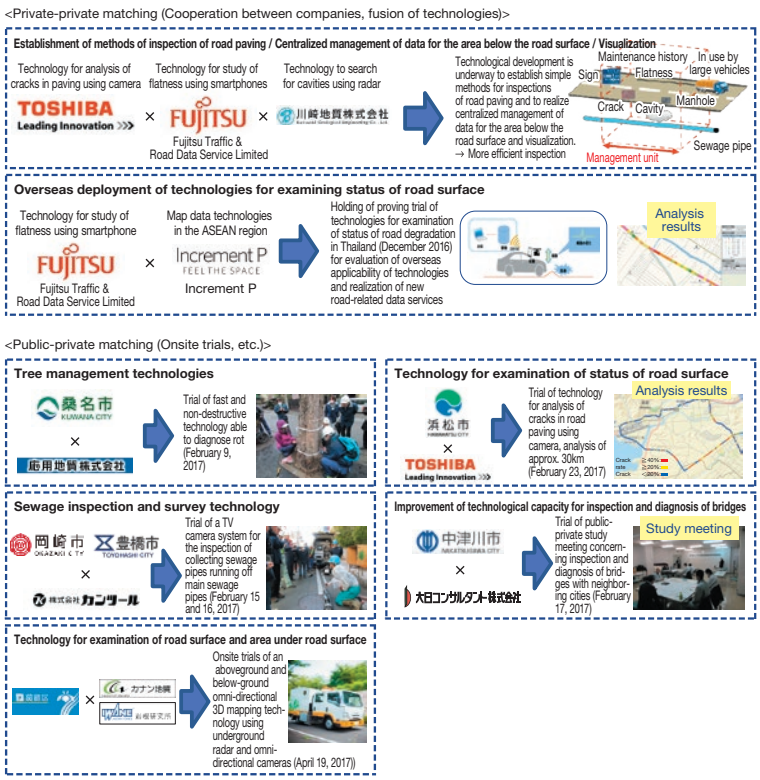
As a result of efforts of this type to promote open discussion between industry, academia, government and public, on-site trials are advancing steadily via cooperation between companies and matching between the public and private sectors (Figures 2-2-19 and 2-2-20).

Note 48 Pitch events are events at which the respective participants bring details of the technologies that they can offer, and offer presentations and hold Q&A sessions and information exchanges in relation to the required technological specifications. These events allow interaction between companies, supporting business matching and the rapid creation of development teams toward implementation.

Note 49 Amuse Oneself, Inc., and Pasco Corporation are scheduled to conduct the first onsite proving trial for Theme 1 (Land-based and underwater laser drones) in the Yura River system (managed by the Kinki Regional Development Bureau) in late April 2017.

By means of these initiatives, we will make use of diverse technologies and the know-how of the private sector at every stage of infrastructure maintenance, working to promote innovation that will realize the infrastructure maintenance productivity revolution, in addition to developing and invigorating the maintenance industry.

Figure 2-2-19 Outcomes of Cooperation between Companies and Technology Matching



Source) MLIT

Figure 2-2-20 Status of Matching in Innovative River Management Project

Establishment of cooperation in procedures using strengths of companies, etc.

● **Land-based and underwater laser drones (Three teams (Six people))**

[Structural] Development of drones, laser scanners (device manufacture)
· Amuse Oneself, Inc. · Luce Search Co., Ltd.

× Collaboration

[Nonstructural, ICT] Map data processing, presentation of river data
· Pasco Corporation · Asia Air Survey Co., Ltd.
· Aero Asahi Corporation · Foundation of River & Basin Integrated Communications, Japan

● **Cloud-type maintenance-free water level indicators (12 teams (21 people)) (Risk management-type water level indicators)**

[Structural] Development of water level indicator devices (Device manufacture)
· Oyo Corporation · Sakata Denki Co., Ltd. · Osasi Technos Inc.
· Nippon Koei Co., Ltd. · Oki Electric Industry Co., Ltd. · Sonic Corporation
· Nippon Antenna Co., Ltd. · NiGK Corporation · Pacific Consultants Co., Ltd.
· Ara Software Co., Ltd. · e-Trust Inc. · Tohken Engineering Co., Ltd.

×

[Nonstructural, ICT] Data processing, communications technologies
· National Institute of Information and Communications Technology · Clealink Technology Co., Ltd. · Japan Radio Co., Ltd.
· Fujitsu Ltd. · Foundation of River & Basin Integrated Communications, Japan · NTT DOCOMO Inc.
· NEC Networks & System Integration Corp. · Token C.E.E. Consultants Co., Ltd. · Hitachi, Ltd.

● **All-weather drones (Two teams (Five people))**

[Structural] Drone development (Device manufacture)
· Amuse Oneself, Inc. · Fulltech Inc.

×

[Nonstructural, ICT] Image processing, communications technologies, maintenance and operation
· Miraito Technologies Corporation · Nippon Engineering Consultants Co., Ltd.
· NTT Group, National Telecommunications Engineering Group

Source) MLIT

■ Creation of a meteorological business market

With the development of technologies such as the IoT and AI, a dramatic increase in productivity in a wide range of industries can be anticipated through the use of meteorological data. This will support services in a wide range of fields; for example, it will be possible to use photographs supplied by ordinary people in making forecasts, and to provide services, even routing services, to shipping, aviation and rail businesses, while considering not only meteorological data but factors such as speed and low fuel consumption, and taking into account the characteristics of the freight being carried and the status of the industry. In March 2017, the Ministry established the Meteorological Business Promotion Consortium[Note 50], the purpose of which is to match industries and meteorological services. The Consortium is moving ahead strongly to create and invigorate new meteorological businesses using cutting-edge technologies such as the IoT and AI. In the future, the Consortium will share information and knowledge regarding meteorological data, conduct proving trials toward the formulation of advanced case studies of the use of meteorological data, hold discussions concerning responses to problems looking at the use of the data, and organize regional Meteorological Business Forums.

Figure 2-2-21 Creation of a Meteorological Business Market

Source) MLIT

In addition, the Japan Meteorological Agency is working to make the data it holds open data. In May 2013, the Agency established a dedicated website enabling users to gain a quantitative understanding of the climate risk occasioned by changes in the weather and the atmospheric temperature, to allow the reduction of risk or the seizing of business opportunities. To make it easier for companies and farmers to use the data in their responses to climate risk, the site's content includes an introduction to methods of analyzing how the climate is related to elements such as product sales and the raising of agricultural products and actual case studies of responses. The site also makes available past measurement data for regions throughout the country. In addition to being able to specify a period and download the past data, users can also obtain temperature predictions for two weeks or one month ahead.

In the future, geographic information system (GIS) data will be formulated and published for the forecast divisions[Note 51] used for different types of data, and meteorological data and actions to be taken will be translated into multiple languages to allow the creation of an environment enabling meteorological data to be provided to overseas visitors to Japan and others.

Open innovation and open data initiatives will be pushed ahead in meteorology-related fields aiming toward the realization of a 200-billion yen[Note 52] boost in GDP by 2020 (Figure 2-2-21).

Note 50 At its establishment, the Consortium had 207 members.

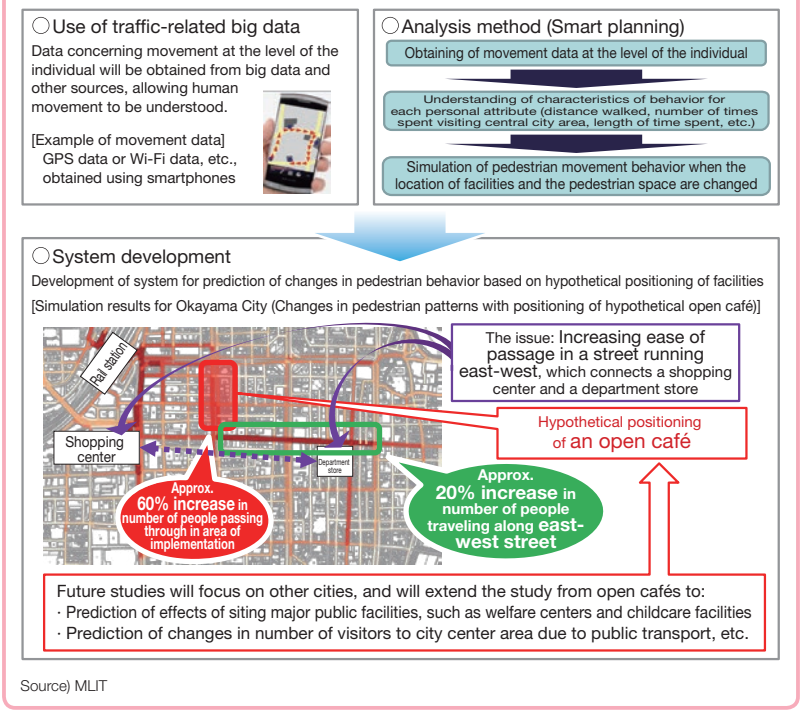
Note 51 The regional divisions used in weather forecasts are specified by the Japan Meteorological Agency Forecast and Warning Regulations. Each prefecture is divided into a number of primary subdivision units; warnings and alerts are issued for secondary subdivision units.

Note 52 Estimated as an effect of the avoidance of cold weather damage in the agricultural industry, optimal inventory management in the retail industry, increased sales by meteorological businesses, etc.

■ A new form of town planning using traffic-related big data (Promotion of smart planning)

Town planning up to the present has considered the siting of public facilities and other buildings based on static analysis, using data such as that concerning population distribution and the status of siting of other facilities. However, today an environment is being formed that allows dynamic analysis using big data, made up of data concerning movement at the level of the individual, obtained from GPS data, Wi-Fi data and other data types via smartphones. The MLIT is engaged in the development of "smart planning," which will simultaneously optimize user convenience and corporate business activities, based on "behavior data" for each personal attribute, obtained using this traffic-related big data.

Figure 2-2-22 Promotion of Smart Planning



Source) MLIT

In fiscal 2016, using Okayama City as a case study, in response to the problem of increasing the ease of getting around in the central city area, a system for the prediction of changes in pedestrian patterns when an open café was hypothetically established was developed, and the effect of implementation of the measure was studied. In future, based on the findings obtained, the system will be upgraded in order to make predictions regarding the siting of major public facilities such as welfare centers and childcare facilities in addition to open cafés, etc., and to predict changes in factors such as the number of visitors to the city center in relation to public transport. The goal in doing so will be to make possible town planning that optimizes the entire city via public-private collaboration (Figure 2-2-22).

■ Toll structure making intelligent use of expressways

With regard to the toll structure in use on Tokyo expressways, the interim report of the National Arterial Road Task Force of the Panel on Infrastructure Development's Road Subcommittee (published on July 30, 2015) indicates the necessity for the introduction of a policy-based toll structure that would organize and unify the toll structure and realize seamless tolls based on points of origin and destination, following the "Three Principle of Intelligent Metropolitan Tolls."

Based on these guidelines, and taking into consideration the status of development of Tokyo's three expressway ring roads, the toll structure on the inner route of the Metropolitan Ken-O Expressway, which struggled with differences in the particulars of establishment, factors including toll standards and vehicle classifications depending on route and section, was transformed from a road development-oriented toll structure into a use-oriented toll structure based on distance traveled in April 2016 (Figure 2-2-23).

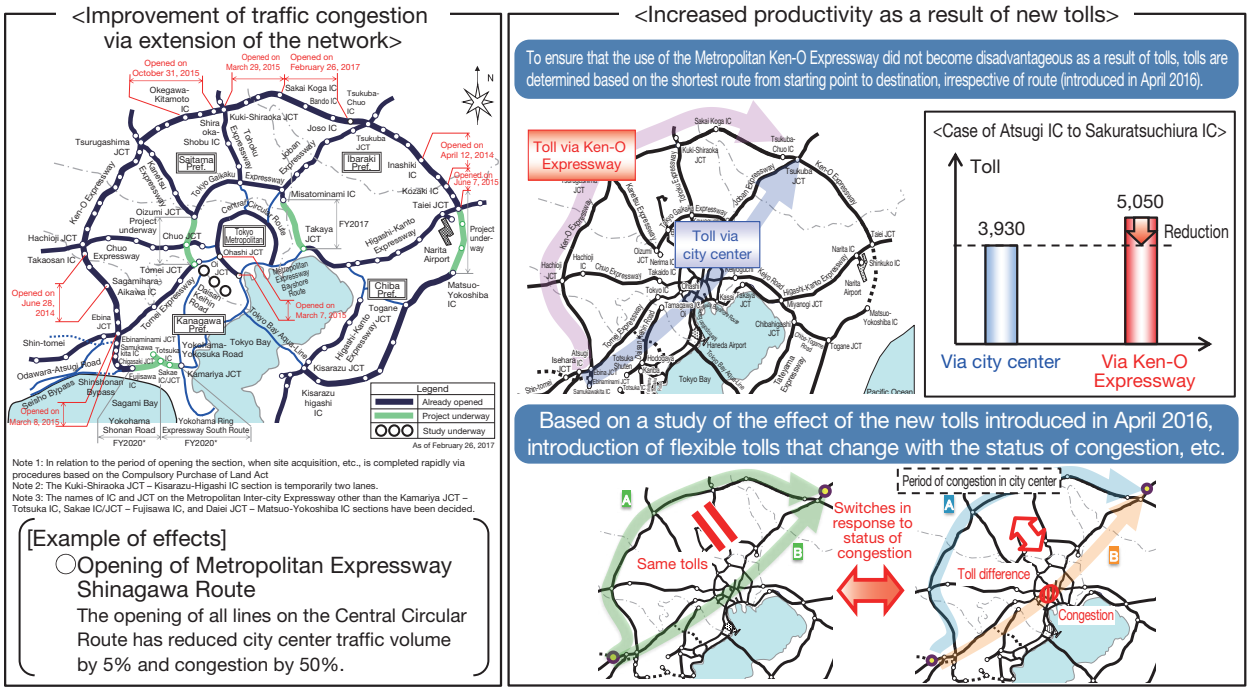
The main points of the new expressway tolls are unification of toll standards in suburban areas on an existing national expressway and unification of vehicle classifications into five classifications.

In addition, taking into consideration policy issues in inner urban areas in relation to matters such as road traffic and the environment, seamless tolls based on the shortest distance between the points of origin and destination are being introduced to ensure that the use of the Metropolitan Ken-O Expressway does not become disadvantageous as a result of tolls.

Following the introduction of the new expressway tolls, traffic shifted from passing through the city center to the outer ring road. Through traffic in the center of the city was reduced by approximately 10% (in the case of the section between the Tomei Expressway and the Tohoku Expressway, through traffic in the city center has been reduced by approximately 50%). As a result, traffic volume on the Metropolitan Expressway has been reduced by approximately 1%, and time lost to traffic congestion has been reduced by approximately 10%. In addition, the extension of the network and the reduction of

toll standards has promoted the use of the Metropolitan Ken-O Expressway, increasing its traffic volume by approximately 30%, and the situating of new physical distribution facilities along the expressway has increased approximately 4.6-fold.

Figure 2-2-23 Overview of New Tolls on Expressways in Metropolitan Area



Source) MLIT

In addition, to ensure more effective and intelligent use of expressways in the Kinki region, in June 2017, distance-based tolls using the existing national expressway suburban sections will be introduced, vehicle classifications will be unified into five classifications, and a new toll structure will be introduced based on considerations including the securing of resources for future extension of the network.

■ The Linear Chuo Shinkansen

Superconductive linear technology is a world-class advanced technology developed in Japan. Unlike conventional rail, it does not make use of friction between the wheels and the tracks; magnetic force between superconductive magnets installed in the train and coils in the guideways enables operation with no contact, making it possible to realize stable ultra-high-speed operation of 500 km/h.

In 1962, two years before the opening of the Tokaido Shinkansen route, the Institute for Rail Technology of the Japanese National Railways began research on next-generation high-speed rail. Later, at a public test held as an event commemorating the centenary of rail in Japan, levitation at 60 km/h was realized on the 480m track at the institute[Note 53].

The fourth Comprehensive National Development Plan (National Land Agency, 1987) states that "With regard to the Chuo Shinkansen[Note 54], from a long-term perspective, in addition to proceeding with surveys, research on new technologies including magnetic levitation and efforts to increase the sophistication of existing technologies in order to reduce construction costs will be promoted toward the realization of a high-quality rail system." Following the reform of Japanese

Note 53 During a manned test in April 2015, a maximum speed of 603 km/h was recorded.

Note 54 The Chuo Shinkansen is a new shinkansen originating in Tokyo and terminating in Osaka, planned based on the Nationwide Shinkansen Railways Construction and Improvement Act. The shinkansen plan was incorporated in the Basic Plan in 1973, and the surveys required by the Act were conducted. In February 2010, the Minister of Land, Infrastructure, Transport and Tourism consulted with the Transport Policy Council, and the Chuo Shinkansen Working Group of the Railway Task Force of the Council's Land Transport Subcommittee conducted a review. The construction plan settled on in May 2011 specified the use of superconductive magnetic levitation (superconductive linear) as the drive method, with a maximum speed of 505 km/h.

National Railways, the Railway Technical Research Institute (previously an incorporated foundation, and now a public interest incorporated foundation) took over research duties and advanced research and development. In April 2007, the Central Japan Railway Company announced its goal of beginning operation of the Chuo Linear Shinkansen between the Tokyo metropolitan area and the Chukyo metropolitan area as an alternative transportation route to the Tokaido Shinkansen. In July 2009, the Technological Evaluation Committee for Superconductive Magnetic Levitation Rail found that prospects were excellent for the development of technologies to realize an ultra-high-speed mass transportation system, including on the operational front. In May 2011, the Central Japan Railway Company was designated as having responsibility for both the business and construction aspects of the project, and a construction plan was formulated and instructions regarding construction were issued to the company. In October 2014, the Minister of Land, Infrastructure, Transport and Tourism approved a construction implementation plan.

The development of superconductive linear technologies has been advanced jointly by the Central Japan Railway Company and the Railway Technical Research Institute, following the Basic Plan for the Development of Superconductive Magnetic Levitation Rail Technologies, based on a 1990 directive from the Minister of Transport. Given that the period for technological development specified in the Basic Plan concluded in fiscal 2016, the Central Japan Railway Company and the Railway Technical Research Institute reported to the 20th Technological Evaluation Committee for Superconductive Magnetic Levitation Rail regarding the future direction for technological development in February 2017. This report was reviewed and accepted. As a result, the MLIT approved changes to the Basic Plan for the Development of Superconductive Magnetic Levitation Rail Technologies in March 2017.

Figure 2-2-24 Examples of Town Planning Initiatives along the Linear Chuo Shinkansen Route

Prefecture	Designation	Responsible entity	Date
Tokyo Metropolitan	Toward the realization of "true region-building in which Tokyo and regional areas flourish together" – Comprehensive Strategy for Tokyo –	Tokyo Metropolitan	November 2015
Kanagawa Prefecture	Plan for the Establishment of a Center for Wide-area Exchange in Sagamihara City	Sagamihara City	August 2016
Nagano Prefecture	Basic Vision for Development of Areas Around Linear Chuo Shinkansen Stations	Iida City	June 2015
Gifu Prefecture	Basic Plan for Development of Areas Around Linear Chuo Shinkansen in Gifu Prefecture	Gifu Prefecture Study Group for Strategy Regarding Utilization of the Linear Chuo Shinkansen	March 2015
Aichi Prefecture	Vision for Town Planning Around Nagoya Station	Nagoya City	September 2014

Source) MLIT

Superconductive linear technology can be considered an innovation that has been through multiple verifications of safety, created through long years of technological development and proving trials conducted jointly by government and private enterprise. In the future, the MLIT will make the most of the socially-implemented superconductive linear technologies to link major cities and create "super-mega-regions," will support initiatives for regional revitalization (access roads, development of areas around stations, development of tourist areas, provision of public transport, etc.), and will work toward the international deployment of superconductive linear technologies by urging their introduction in the US. These efforts can be expected to boost linkage between cities via higher-speed travel, increase the international competitiveness of major cities, realize redundancy as a preparation for disasters such as a Nankai Trough earthquake, and contribute to regional revitalization and international initiatives using superconductive linear technologies (Figures 2-2-24 and 2-2-25).

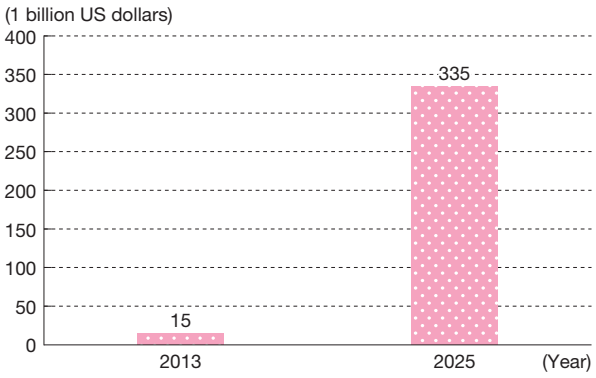
Figure 2-2-25 Town Planning Using the Linear Chuo Shinkansen

Source) Materials presented by Iida City to the Inadani Municipal Government Conference on the Utilization of the Establishment of the Linear Chuo Shiinkansen in Regional Development (January 2017)

■ Responses to the sharing economy

The sharing economy is described as "activities contributing to economic revitalization, which make usable assets, etc. (including intangible assets such as skills and time) possessed by individuals, etc., available for use by other individuals, etc., via Internet-based matching platforms" ("Interim Report of the Sharing Economy Review Meeting"[Note 55]). By enabling existing resources to be used efficiently and allowing individuals to provide and receive a wide range of services, the sharing economy can contribute to the resolution of problems facing Japan via the creation of new solutions and innovation. At the same time, however, the sharing economy presents a number of issues, including protecting the privacy of users, ensuring safety, creating rules and harmonizing the new economy with existing lifestyles.

Figure 2-2-26 Projected Increase in Revenues in the Sharing Economy Industry



(Note) P2P loans, crowd funding financing, online staffing, P2P accommodation services, car sharing and music and video streaming
Source) Prepared by the MLIT from PwC "The sharing economy – sizing the revenue opportunity"

The scale of the global sharing economy market is expected to reach approximately 335 billion US dollars in 2025[Note 56] (Figure 2-2-26). In Japan itself, some sharing services have begun to be provided by businesses originating overseas, among others, making responses essential.

(Responses to home sharing)

Internet-based services matching individuals for home-sharing have recently taken off throughout the world, and in Japan also, home-sharing services utilizing these matching services are rapidly becoming more widespread.

The MLIT believes that the use of home-sharing services will be important in responding to issues such as satisfying the needs of the rapidly increasing number of foreign visitors to Japan and the lack of sufficient accommodation to meet demand in large cities, and that in realizing the use of these services, it will be an urgent task to create rules with a focus on ensuring public hygiene and avoiding problems, for example with local residents, and to respond to illegal home-sharing (operating a hotel business without permission). Given this, the Ministry presented a draft bill concerning the residential accommodation business to the Diet in March 2017. The bill was passed on June 9.

(Responses to car sharing)

In 2014, the MLIT published "Concerning the Treatment of One-way Car Sharing in Rent-A-Car-Type Car Sharing." This statement indicated that when rent-a-car-type car sharing was conducted via a one-way arrangement, when it is recognized that vehicle management can be implemented through the use of IT, etc., irrespective of whether the handover or the return of the vehicle is conducted in an off-street parking facility, this parking facility can be authorized as a vehicle allocation office, and this office can be recognized as the base for the use of the vehicle, as stipulated in Article 7, Item 1(5) of the Road Transport Vehicle Act.

As a result, the number of vehicles used in one-way rent-a-car-type car sharing increased from 160 at the end of fiscal 2014 to 460 at the end of fiscal 2015, an almost three-fold increase.

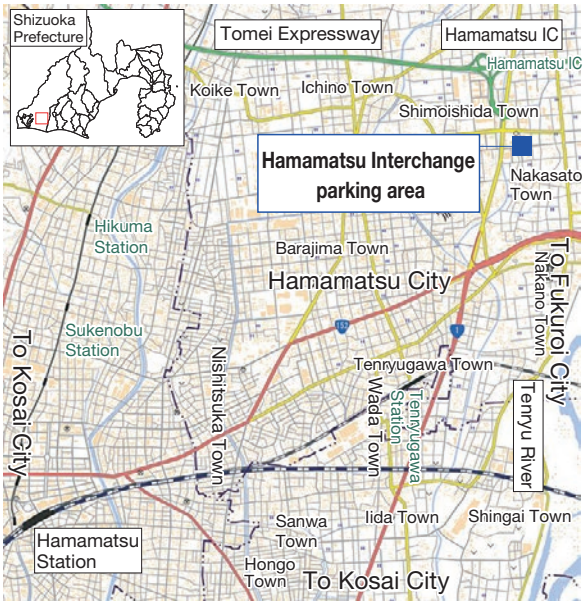
In order to promote further social implementation, in fiscal 2016, the Ministry conducted social trials of car sharing involving small vehicles using the road space and social trials of high-speed buses and car sharing (Figure 2-2-27).

Note 55 Comprehensive Information Technology (IT) Strategy Office, Cabinet Secretariat (November 2016)
Note 56 As of 2013, the scale of the industry is reported to have been approximately 15 billion US dollars.

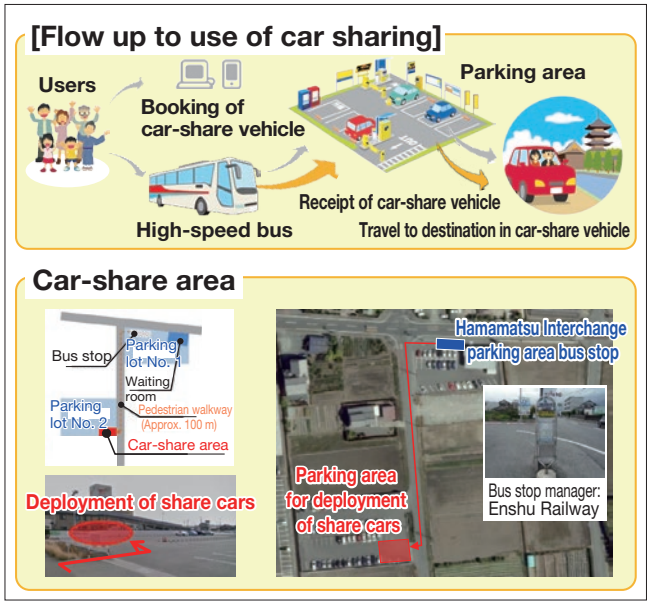
Figure 2-2-27 Overview of Social Trial of High-speed Buses and Car Sharing (Hamamatsu Interchange Parking Area)

Trial venue: Hamamatsu Interchange parking area (Higashi Ward, Hamamatsu City, Shizuoka Prefecture)
Participants: Enshu Railway Co., Ltd. / Times24 Co., Ltd.
Trial period: November 15, 2016 (Tues) – October 31, 2017 (Tues) (scheduled)

Map of trial position



Method of use of car sharing



Source) MLIT

(Responses to ride sharing)

"Ride sharing[Note 57]" using private cars is predicated on the driver of the private car having sole responsibility for the carriage of passengers, without any entity being responsible for operational management, vehicle maintenance, etc. The acceptance of compensation for the carriage of passengers under these conditions presents problems from perspectives including the guarantee of safety and the protection of users, and necessitates extremely careful consideration.

It should be noted that ride sharing using private cars is prohibited in countries including Germany, France, Britain (London), and South Korea.

At the same time, the Ministry believes that in Japan, it will be important to increase convenience and productivity in legal passenger carriage services that are acceptable to society using ICT, and has set aside the necessary expenses for proving trials toward the realization of new services including, for taxis, an advance fare confirmation service and a ride-sharing service using smartphone taxi booking apps in its draft budget for fiscal 2017.

Note 57 A service in which the driver of a private car uses that car to convey another person to a destination for money. Smartphone apps, etc., act as the intermediary between the driver and the passenger.

Column

A Medium- and Long-Distance Ride Matching Service

According to the Road Transportation Act, individually owned automobiles are not, as a rule, permitted to provide transport for pay. On the other hand, when a driver receives compensation from a passenger for expenses that he or she would not have incurred without taking such a trip, such as gasoline costs, highway tolls, and parking fees, this does not count as transport for pay, so it is outside the purview of the Road Transportation Act.

The medium- and long-distance ride matching service "notteco" began offering its services in 2007. It matches drivers with riders who pay for their share of gasoline costs and highway tolls.

This service recruits riders over the Internet, and the gasoline and highway toll expenses involved in the trip are shared among the riders. Since ride sharing increases the number of persons per vehicle and reduces the number of vehicles on the road, it contributes to lessening the burden on the environment, alleviating traffic congestion, and solving the problem of finding a parking space.

The company announced in the spring of 2017 that it has begun an experimental project in Teshio Town, Hokkaido, where obtaining transportation for everyday needs has become a problem. It is experimenting with a new means of transport that will link Teshio with the city of Wakkanai City, conducting a pilot project in cooperation with Teshio Town.

Figure 2-2-28 Schema of the Medium- and Long-distance Ride Matching Service

Source) notteco

■ Fire-resistant timber materials, etc.

Timber materials are a recyclable and renewable resource, and the use of timber materials in housing and construction, etc., helps to revitalize forests, and is important from the perspectives of regional revitalization and responses to global warming.

Public buildings are highly visible and have a high symbolic value, and the construction of public buildings from wood could therefore be expected to increase awareness of the importance of using timber materials and of the virtues of wood. However, after the war, as Japan sought to create cities that would not be prone to the threat of fire, demand for highly fire-resistant buildings increased, and at the same time, there were concerns that large-scale felling during the postwar reconstruction period would deplete Japan's forestry resources and devastate the national land. Because of this, there was a period in which the use of timber materials in public buildings was controlled, and even today, the level of use of timber materials is low. Against this background, the Act on the Promotion of the Use of Timber Materials in Public Buildings, etc. (Act No. 36 of 2010) entered into force in October 2010. With the goal of increasing demand for the entire range of timber materials, including the realization of a ripple effect to the construction of normal buildings such as residences, this Act seeks to promote the use of timber materials with an emphasis on public buildings, in which the rate of timber construction is low and latent demand can be projected. The inclusion of stipulations regarding performance in building standards in the 2000 revision of the Building Standards Law represents another starting point. Demand for and expectations of timber construction are increasing, and a variety of businesses are currently engaged in the development of timber materials.

Seeking to promote the use of timber materials, since 2011 the MLIT has conducted fire tests and other tests on actual large-scale timber buildings, and is studying safety in relation to fire, for example performance in the rapid prevention of the spread of fire. In addition, following the enactment of the Act on the Promotion of the Use of Timber Materials in Public Buildings, etc., in March 2013, the Ministry formulated Guidelines for the Construction of Fire-resistant Timber Buildings (Government Facilities), which compiles technical items relevant to the construction of fire-resistant timber buildings, a subject involving a high degree of technical difficulty. In June 2013, the Ministry formulated Guidelines for Introducing the Use of Timber Materials to Government Buildings, which compiles technical items related to the use of timber materials, chiefly at the design stage, and focuses mainly on buildings used for applications other than as office buildings. These were followed in May 2015 by Points to Consider in relation to the Rational Design of Timber Government Buildings, which seeks to assist contractors and designers with little experience of timber buildings working on government building projects in implementing rational design, covering details that affect the construction cost and period, such as procurement of timber materials, selection of timber materials for major structural sections, and examination of joint sections, and in May 2016 by Points to Consider in relation to Maintenance that will contribute to Adequate Preservation of Government Facilities using Timber Materials (Draft).

In addition, in April 2016, the Ministry of Agriculture, Forestry and Fisheries and others revised the Plan to Promote the Use of Timber Materials in Government Buildings. In addition to formulating a new Technology Basic Plan, the MLIT is continuing to work toward the creation of new construction materials and new construction methods for the timber building market and to realize their implementation, for example by conducting projects that take the lead in timber building technologies in order to increase demand for timber materials, while maintaining a focus on building safety.

Other than this, in addition to the use of timber construction and the use of wood in interior fittings for the venues to be used for the 2020 Tokyo Olympics and Paralympics, further progress in the use of a diverse range of timber materials, including cross-laminated timber (CLT[Note 58]) and new timber members, can be expected.

■ Construction of LNG bunkering bases

Compared to fuel oil, natural gas displays excellent environmental performance, emitting minimal carbon dioxide, nitrogen oxide and sulfur oxide, and there is already a global transition underway from the use of oil to the use of natural gas for land-based applications.

At sea also, a transition from the use of conventional petroleum-based fuels to the use of clean LNG fuels[Note 59], which present a lower environmental burden, has begun; for example, special marine zones have been established in North America and Europe in which regulations on exhaust gas emissions from ships are more stringent, and the International Maritime Organization (IMO) decided in October 2016 to begin strengthening regulations on the sulfur concentration in ship fuels in ordinary waters, including around Japan from 2020. In North America and Europe, which have pioneered vessel exhaust gas regulations, container, cruise and other ships able to use LNG as fuel are appearing. Looking to the future, it will be essential to promote the use of LNG fuel in ships in the Asian region also as regulations become more stringent.

In Japan, two companies, Tokyo Gas (which has been conducting studies in the area since the latter half of the 1950s) and the Tokyo Electric Power Company, its partner in the joint project, have built the world's first joint LNG supply system for power generation and gas supply. In August 2015, the LNG-fueled ship Sakigake was introduced. A tugboat able to use LNG as fuel, the Sakigake is a ship that provides assistance when large ships that are unable to turn in a small radius enter or leave port and dock or leave shore. Because it is necessary for the ship to move ships and structures much larger than itself, it is provided with powerful engines, enabling the realization of operation as a tugboat, which are subjected to the most severe fluctuations in load of any ships. At present, the Sakigake operates in the ports of Yokohama and Kawasaki, and is supplied with LNG fuel using a truck-to-ship method.

Singapore is a central location for fuel oil bunkering (the supply of fuel to ships), but while the nation is making active efforts in the area of LNG bunkering, it is lacking in LNG base facilities, and it lacks expertise in the operation of, and the supply of fuel to, LNG-fueled ships. As a result, at present, there are almost no LNG bunkering bases in the Asian

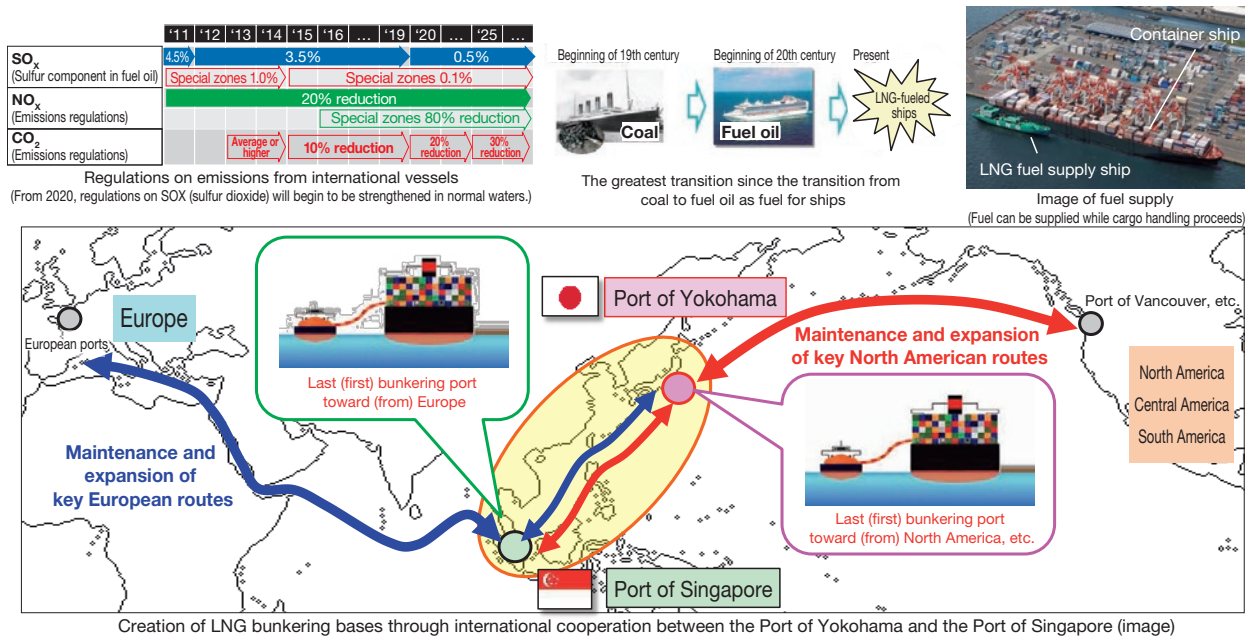
Note 58 Cross-laminated timber is a laminated and bonded timber construction material formed such that the direction of the fibers in each laminated board is at right angles to the fibers in the surrounding boards.

Note 59 LNG is an abbreviation of liquefied natural gas. It is natural gas that has been chilled to -162 degrees or below, turning it into a liquid. Because it is necessary to store LNG under high pressure, it is essential to establish infrastructure for pressure management, etc.

region. Japan is the world's largest importer of LNG, possesses a large number of existing LNG bases contiguous to the port of Yokohama, operates the Sakigake and has begun LNG bunkering for the vessel. The potential for taking the lead in the area of LNG bunkering in cooperation with Singapore by exploiting these advantages is now under study. In October 2016, in an effort to promote the introduction of LNG-fueled ships, a memorandum of understanding (MOU) concerning cooperation in the development of LNG as a maritime fuel was signed by eight representatives of seven countries, including Japan and Singapore, looking toward the creation of an international network of LNG bunkering bases.

In an effort to advance the creation of bunkering bases in Japanese ports and to promote the introduction of, and stimulate demand for, LNG-fueled ships that will reduce the burden on the maritime environment, the Review Committee for Measures toward the Establishment of an LNG Bunkering Base in the Port of Yokohama[Note 60] was established in June 2016. The importance of Japan taking the initiative and assuming a leadership role in this area has been reported to the Committee. With the participation of experts, private sector businesses and relevant government agencies, the MLIT launched the Review Committee for Technologies for the Realization of LNG-fueled Work Vessels in December 2016 as a technological review committee looking toward the use of LNG as a fuel for work vessels employed by regional development bureaus and the like. Adhering to the guideline of studying LNG fueling with marine environment improvement vessels as model vessels, the committee examined matters including problems and design conditions related to the installation of LNG-fueled equipment.

Figure 2-2-29 The Orientation Japan Should Adopt in Relation to LNG Bunkering



Source) MLIT

The MLIT will continue to advance the creation of LNG bunkering systems for large vessels in Japan's ports, in advance of the rest of the Asian region, and to ensure that Japan takes the lead in international cooperation. By increasing the number of visits to Japanese ports by LNG-fueled vessels, these initiatives can be expected to contribute to enhancing the international competitiveness of Japan's ports and to stimulating economic growth in Japan.

Section 3 Issues in Innovation in the National Land and Transport Sectors, and Requirements for Future Efforts toward Innovation

In this section, we use investigations regarding innovation and other materials to analyze the condition and issues of

Note 60 Looking toward the creation of LNG bunkering bases in the Asian region in cooperation with the Port of Singapore and other ports, the committee is studying the establishment of Japan's first bunkering base in the Port of Yokohama, a strategic international container port.

innovation activities in industries related to national land and transport. In addition, we use the results of an attitude survey (national attitude survey) we administered to the general public to clarify the conditions under which society will accept new technologies and services, and discuss the creation of further innovation in the national land and transport sectors and what will be required of pilot projects in the future.

1 Present State and Issues in Innovation in the National Land and Transport Sectors

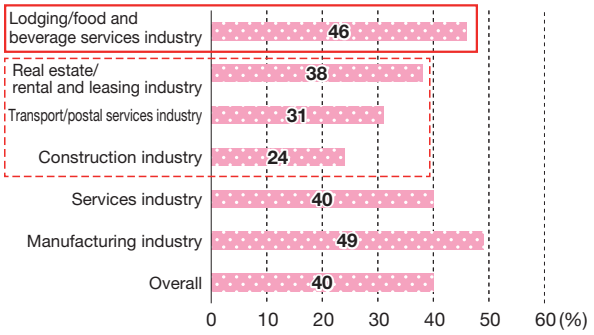
(1) Corporate Efforts and Issues

The following is an analysis of the innovation realization and the state and issues of innovation activities in industries related to national land and transport (the construction industry, the real estate and rental and leasing industry, the transport and postal services industry, and the lodging, food and beverage services industry), based largely on the results of the Fourth Round of the Japanese National Innovation Survey[Note 61] conducted by the National Institute of Science and Technology Policy of the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

(Innovation realization and the implementation status of innovation activities)

Of the companies involved in land, infrastructure, transport and tourism that realize innovation (companies that realize product innovation, process innovation, marketing innovation or organizational innovation)[Note 62], 46% in the lodging, food and beverage services industry realize innovation, which is greater than the 40% average for all industries. In contrast, the figures for the real estate and rental and leasing industry (38%), the construction industry (31%), and the transport and postal services industry (24%) are below average (Figure 2-3-1).

Figure 2-3-1 Percentage of Companies that Realize Innovation (Out of All Companies)



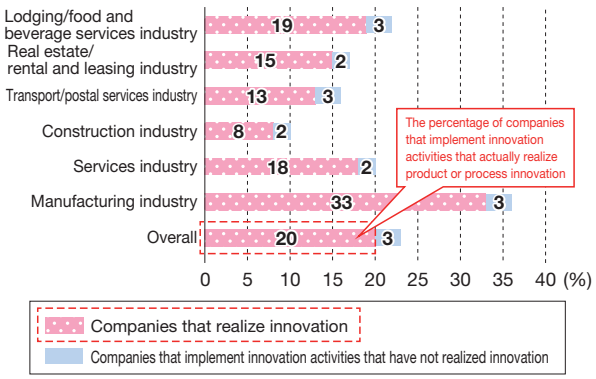
Note: The percentage of companies that realize innovation in a given industry is the number of innovation-realizing companies divided by the total number of companies in that industry.
Source) Prepared by the MLIT based on the "Fourth Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

Note 61 A general statistical survey implemented in October 2015 by the National Institute of Science and Technology Policy under MEXT. The Fourth Round of the Japanese National Innovation Survey investigated corporate activities executed during the three-year survey reference period from FY2012 to FY2014. The survey population comprised 380,224 private companies with at least 10 full-time employees. A questionnaire was administered to a sample of 24,825 companies selected from the population, and 12,526 companies returned valid responses (a valid response rate of 50%).

Note 62 In the Fourth Round of the Japanese National Innovation Survey, innovation was classified into the following four categories: (i) Product Innovation: The introduction of new or vastly improved products or services into the market; (ii) Process Innovation: The introduction of new or vastly improved manufacturing processes or distribution methods within the company; (iii) Marketing Innovation: Sweeping changes to product or service design or packaging, and the introduction of new marketing methods regarding sales channels, merchandising methods or pricing methods within the company; (iv) Organizational Innovation: The introduction of new methods within the company regarding business practices, workplace organization or external relations.

The survey also investigated the implementation status of innovation activities regarding product innovation and process innovation[Note 63]. Overall, 23% of companies implement innovation activities regarding product or process innovation, and 20% are actually realizing product or process innovation; most companies implementing innovation activities are actually realizing product or process innovation. This demonstrates that the low percentage of companies that implement innovation activities in industries related to national land and transport is connected to the low percentage of companies actually realizing innovation (Figure 2-3-2).

Figure 2-3-2 Percentage of Companies that Implement Innovation Activities (Out of All Companies)



Note: The percentage of companies that implement innovation activities in a given industry is the number of companies that implement innovation activities divided by the total number of companies in that industry.
Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

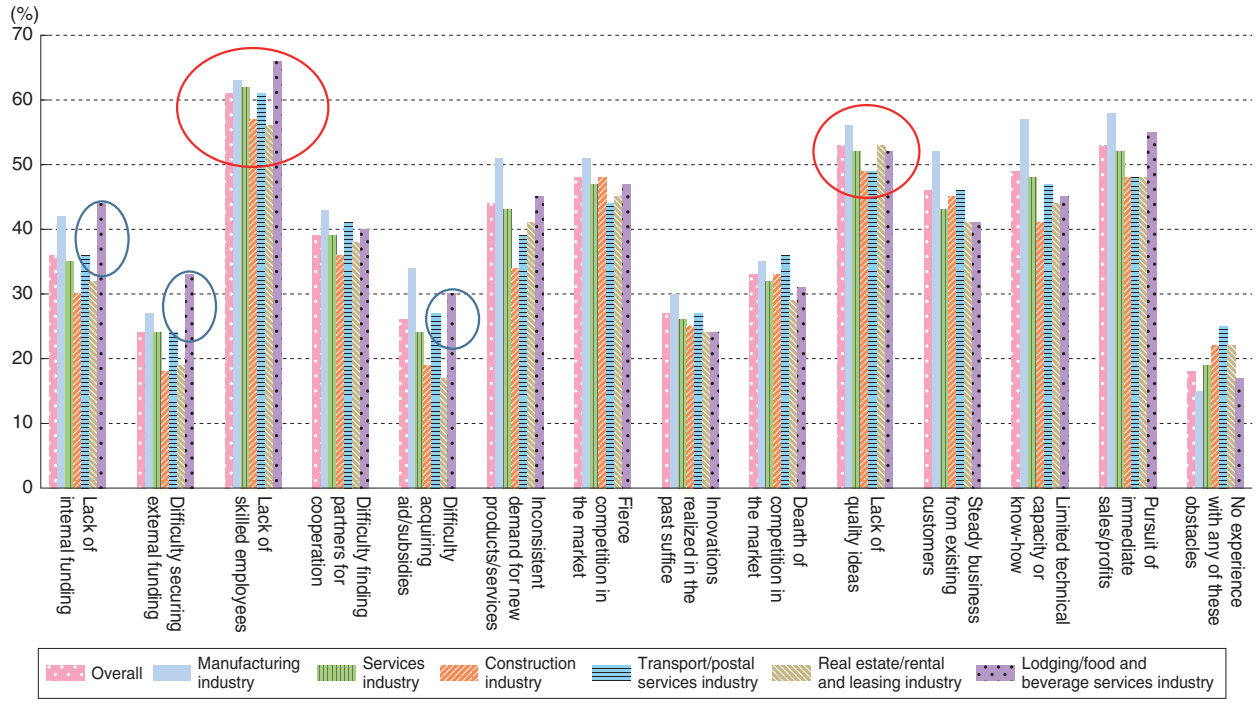
(Obstacles to innovation)

In line with overall trends, many companies indicated the lack of skilled employees, the lack of quality ideas, and the pursuit of immediate sales and profits as obstacles to innovation (Figure 2-3-3).

As for individual industries, a high percentage of companies in the lodging, food and beverage services industry indicated the lack of internal funding and other financial problems as obstacles. One major reason for this is the burden of investing in facilities and the like faced by hotels and Japanese inns, which are included in the lodging, food and beverage services industry, and which use buildings and facilities to provide services to customers. According to the FY2015 Basic Survey on Small and Medium Enterprises conducted by the Small and Medium Enterprise Agency (Figure 2-3-4), the fixed asset ratio (the ratio of fixed assets (buildings, land, etc.) to net assets) of the lodging industry and food and beverage services industry was 697%, and the debt ratio (the ratio of debt (loans, etc.) to net assets) was 827%, both of which are substantially higher than those of other industries (Figure 2-3-4). The fact that loans from financial institutions and the like are invested in fixed assets is one reason investment in innovation is so limited.

Note 63 Companies that implement innovation activities are defined as companies that actually realized product or process innovation, and companies that implemented activities toward realizing product or process innovation, but ceased those activities before they actually realized innovation.

Figure 2-3-3 Obstacles to Innovation



Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

Figure 2-3-4 Fixed Asset Ratios and Debt Ratios

Note: Fixed asset ratio = Fixed assets / Net assets x 100; Debt ratio = Debt / Net assets x 100
Source) Prepared by the MLIT based on the "FY2015 Basic Survey on Small and Medium Enterprises" conducted by the Small and Medium Enterprise Agency

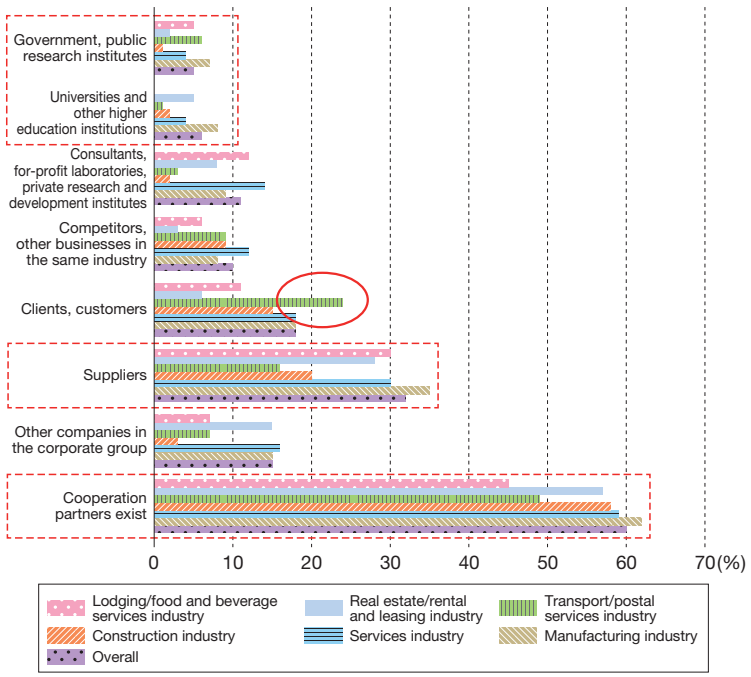
(Efforts toward open innovation, etc.)

As for the percentage of companies that cooperate with other companies and organizations to implement innovation activities, the transport and postal services industry and the lodging, food and beverage services industry trail overall industries by more than 10 points (Figure 2-3-5).

As for the nature of the cooperation partners, overall, the highest percentage of companies cooperate with suppliers, but the highest percentage of companies in the transport and postal services industry cooperate with clients and customers. In addition, the percentage of companies in the construction industry that cooperates with the government, public research institutes, and universities and other higher education institutions is lower than that in other industries.

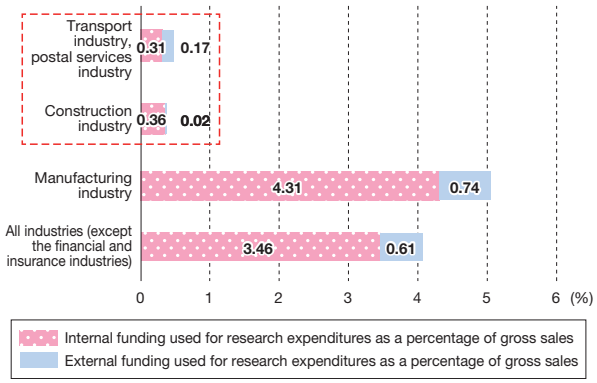
The state of research and development, which is one source of innovation, reveals that a low percentage of companies in the construction industry, the transport industry, and the postal services industry conduct research and development, and that companies in those industries spend less than 1% of their gross sales on research expenditures, which is low compared to the manufacturing industry average and the overall industry average (Figure 2-3-6). In addition, the percentage of externally funded research expenditures in the construction industry is extremely low.

Figure 2-3-5 Cooperation with Other Companies/Organizations in the Implementation of Innovation Activities



Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

Figure 2-3-6 Research Expenditures as a Percentage of Gross Sales



Note: These figures are percentages of research expenditures as a percentage of gross sales for companies that conduct research and development.
Source) Prepared by the MLIT based on the "FY2016 Survey of Research and Development (MIC)"

(Outcomes of innovation realization)

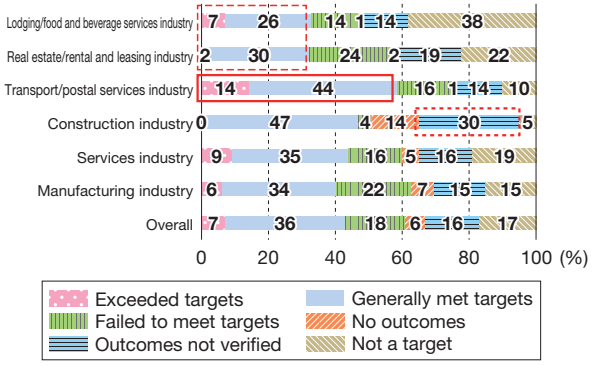
Now we will focus on the achievement of outcomes of innovation realization.

We will compare the achievement of two outcomes of product innovation: Developing new markets (market development), and maintaining and improving customer and product unit prices through the creation of high value-added (creation of high value-added). As for market development, 58% of companies in the transport and postal services industry achieved outcomes that exceeded their targets, a level of achievement that is greater than the overall figure of 43%. In contrast, companies in some industries are not well suited to proactive efforts toward market development; the level of target achievement among companies in the lodging, food and beverage services industry and real estate and rental and leasing industry are 33% and 32%, respectively, and a high percentage of companies in those industries make no efforts toward market development (Figure 2-3-7). As for the creation of high value addition, 20% of companies in the construction industry produced outcomes that exceeded their targets, which is extremely low compared to the 45% of overall companies that achieved their targets (Figure 2-3-8). This is likely because companies in the construction industry win

business by executing various kinds of construction to meet buyers' demands, and could be related to the lack of research and development investment demonstrated in Figure 2-3-6.

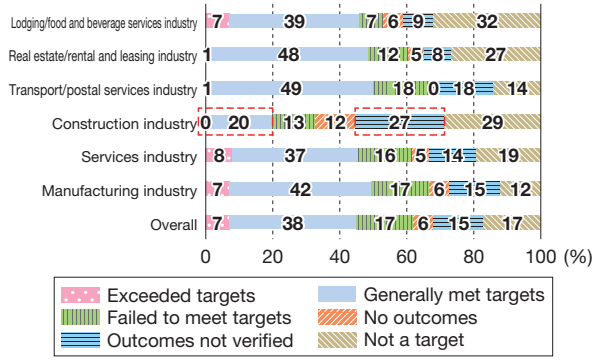
In addition, a substantially high percentage of companies in the construction industry indicated that they did not verify outcomes in terms of market development (30%) or the creation of high value addition (27%).

Figure 2-3-7 Outcomes from the Realization of Product Innovation (Target: Market Development)



Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

Figure 2-3-8 Outcomes from the Realization of Product Innovation (Target: Maintaining and Improving Customer/Product Unit Prices through the Creation of High Value-Added)

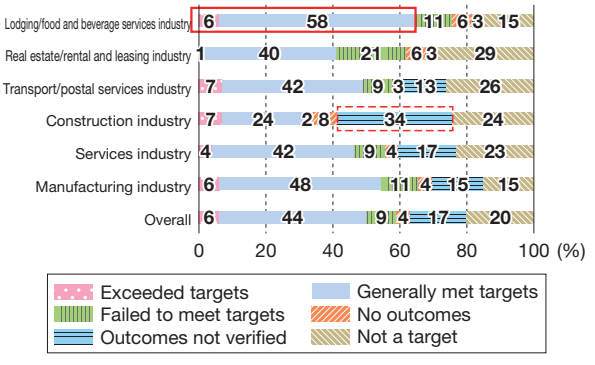


Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

Next, we will look at two outcomes of process innovation: cost reduction, and improving capacity and flexibility to deal with demand fluctuations (readiness for demand fluctuations). As for cost reduction, 64% of companies in the lodging, food and beverage services industry produced outcomes that exceeded targets, which is greater than the overall figure of 50% (Figure 2-3-9). As for readiness for demand fluctuations, 62% of companies in the transport and postal services industry produced outcomes that exceeded targets (Figure 2-3-10).

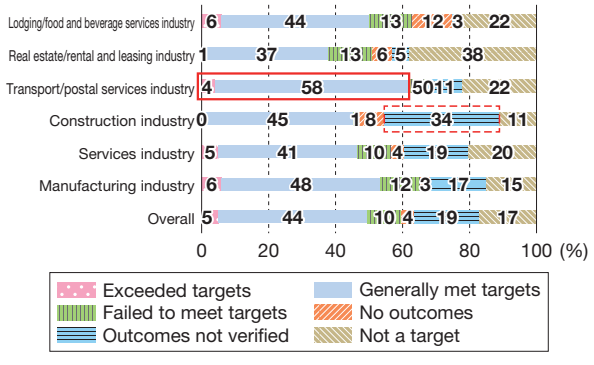
A substantially high percentage (34%) of companies in the construction industry indicated that they did not verify outcomes in terms of cost reduction or readiness for demand fluctuations.

Figure 2-3-9 Outcomes from the Realization of Process Innovation (Target: Cost Reduction)



Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

Figure 2-3-10 Outcomes from the Realization of Process Innovation (Target: Improving Capacity/Flexibility to Deal with Demand Fluctuations)



Source) Prepared by the MLIT based on "the Fourth Round of the Japanese National Innovation Survey Statistical Report" by the National Institute of Science and Technology Policy under MEXT

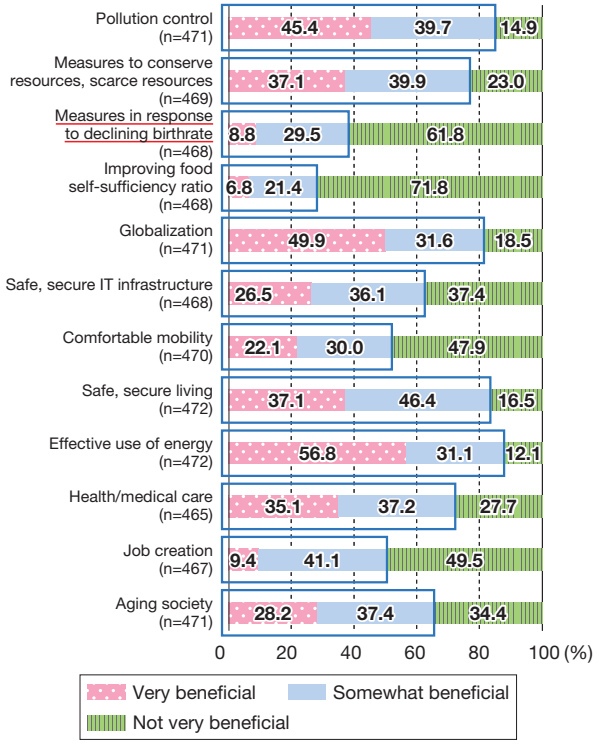
Companies in the transport and postal services industry are steadily achieving targets in both product and process innovation. Companies in this industry emphasize cooperation with customers and clients with needs in the course of implementing innovation activities, and this could be linked to the realization of product and process innovation. In contrast, the level of target achievement through innovation in the construction industry is low for all outcome items. In addition, a high percentage of companies in the construction industry do not verify outcomes, and there is a need to implement effective innovation activities, and for governments and the industry as a whole to continue to build systems to proactively and effectively use and evaluate new technologies and the like.

(Response to societal challenges)

As a country that leads the way in tackling societal challenges, Japan must take action in response to a variety of societal challenges. Although these societal challenges can be interpreted as business opportunities, few companies have taken the initiative to create research and development themes that address them. While 38.3% of companies believe that Japan's declining birthrate offers opportunities for business development (Figure 2-3-11), only 15.0% of companies have created research and development themes that address Japan's declining birthrate (Figure 2-3-12). Companies recognize that this development can be positive for business in the future, but their prioritization of immediate sales and profits and the difficulty companies face in attempting to formulate resolutions or markets on their own could explain why none are able to conduct targeted research and development.

Figure 2-3-11 Business Development Opportunities Presented by Societal Challenges

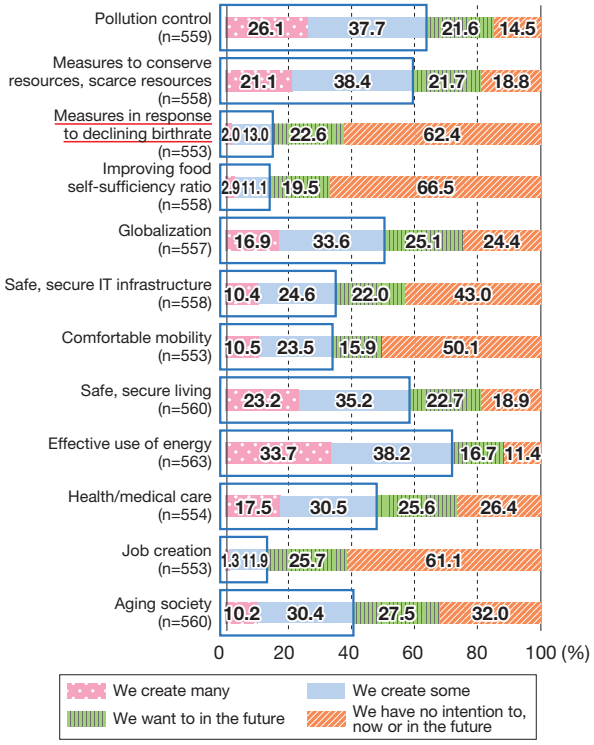
Question: Do you believe that the following societal challenges could contribute to the development of your company's business sector in the future?



Source) Prepared by the MLIT based on the "FY2012 Industrial Technology Survey Report" from METI

Figure 2-3-12 Creation of Research and Development Themes Inspired by Societal Challenges

Question: Does your company create research and development themes that address future societal challenges?



Source) Prepared by the MLIT based on the "FY2012 Industrial Technology Survey Report" from METI

(2) Public Awareness of Innovation

The MLIT conducted a national attitude survey to explore the extent to which society has incorporated new technologies and services in the national land and transport sectors, and to gauge the need for

Figure 2-3-13 New Technologies/Service Categories in the National Attitude Survey

National Land/Infrastructure Improvement Sector	Transport Sector	Lifestyle Sector
・Citizen reporting of infrastructure deficiencies, participation in maintenance ・SNS disaster information systems ・Navigation systems to assist in evacuation ・Compact cities ・Intelligent robots for work in the field ・Robots for disasters ・Buried sensor-linked warning/evacuation assistance systems ・Technology that integrates accident history and geographic information ・Train car preventive maintenance/malfunction prediction systems ・Satellite-linked disaster prevention systems	・Fully autonomous vehicles ・Driver-assistance systems ・Ride sharing ・Linear Shinkansen ・Traffic accident prevention sensors ・Real-time traffic information services ・Connected cars ・Automated delivery services ・Home delivery using drones ・Seamless positional information, inside or outside ・Navigation systems for elderly people or disabled people	・Private residence accommodation services ・Telecommuting ・Distribution of existing housing ・Smart housing ・Living assistance robots for home use ・Virtual reality tourism ・Home use of augmented reality/virtual reality technology ・Home delivery boxes ・Shared housing

Source) MLIT, "National Attitude Survey"

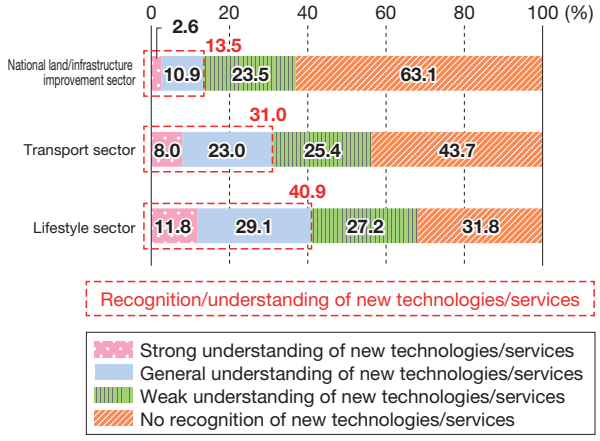
implementing pilot projects[Note 64]. The following are observations based on the results of that survey. Note that results of the survey, which investigated the degree of recognition of specific new technologies and services, as well as the public's interest in using them and requirements for bringing them into widespread use, were consolidated and aggregated into three categories: the national land and infrastructure improvement sector, the transport sector, and the sector involving living (the lifestyle sector) (Figure 2-3-13).

(Recognition, interest, and requirements for widespread use)

As for sector-specific recognition of and interest in using new technologies and services, only 13.5% of respondents indicated that they recognized or understood technologies and services in the national land and infrastructure improvement sector, the lowest degree of recognition among the three sectors; however, 70.1% of respondents said that they wanted to use those technologies and see those technologies realized, which was the highest percentage among the three sectors. The national land and infrastructure improvement sector involves many new technologies and services related to disaster prevention and reduction; the strong interest observed in the survey and factors such as the increasing intensity of disasters in recent years suggest that the general public's interest in disaster prevention, response and the like is increasing. However, the public's recognition and understanding of these new technologies and services is low, and pilot projects should include elements for improving recognition (Figure 2-3-14, Figure 2-3-15).

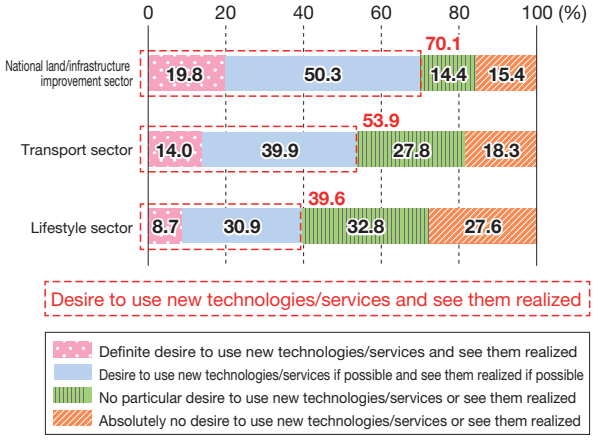
In contrast, recognition in the lifestyle sector was the highest among the three sectors, but interest was the lowest; pilot projects should include elements for the formation of an environment that makes the technologies and services easy for the general public to accept.

Figure 2-3-14 Recognition of New Technologies/ Services (By Sector)



Source) MLIT, "National Attitude Survey"

Figure 2-3-15 Interest in Using New Technologies/ Services (By Sector)

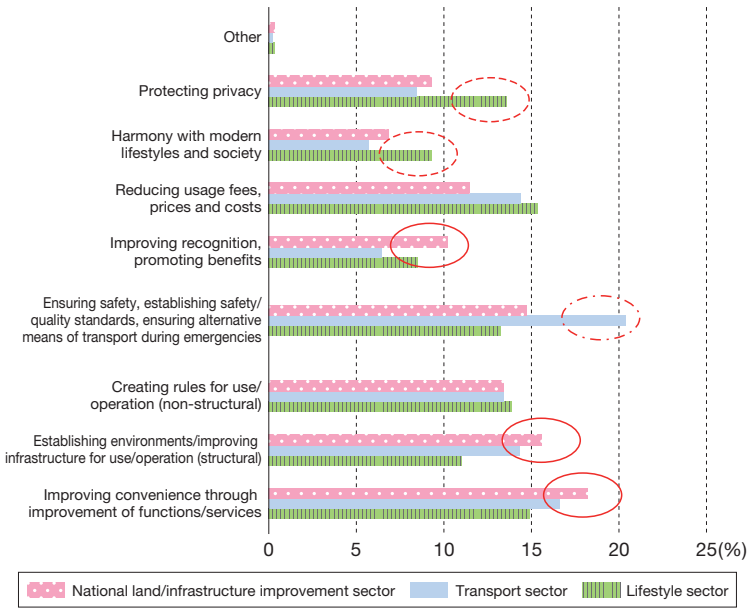


Source) MLIT, "National Attitude Survey"

Note 64 The survey was administered online to individuals throughout Japan in March 2017 (1,500 people responded). The survey was administered to 50 people in each of 30 categories: Two categories of gender (male, female), five categories of age range (20s, 30s, 40s, 50s, 60s), and three categories for place of residence (the three major metropolitan areas (which include Saitama Prefecture, Chiba Prefecture, Tokyo Prefecture, Kanagawa Prefecture, Gifu Prefecture, Aichi Prefecture, Mie Prefecture, Kyoto Prefecture, Osaka Prefecture, Hyogo Prefecture and Nara Prefecture), regional cities (addresses in prefectures and government-designated cities other than those in the three major metropolitan areas), and other regions.

As for requirements bringing new technologies and services into widespread use, compared to the other two sectors, for the national land and infrastructure improvement sector, a relatively high number of respondents indicated the need to improve convenience through an improvement in functions and services and to establish environments and improve infrastructure for use and operation (structural), as well as many responses that indicated the need to improve recognition and promote the benefits of the new technologies and services over existing technologies and services. For the traffic sector, the highest number of respondents indicated the need to ensure safety, establish safety and quality standards, and ensure alternative means of transport during emergencies; there is likely a need to improve technical safety as well as provide a psychological sense of security. For the lifestyle sector, compared to the other two sectors, a higher number of respondents indicated the need to protect privacy and attain harmony with modern lifestyles and society; there is a need to mitigate the disharmony and new risks caused by the introduction of new technologies and services (Figure 2-3-16).

Figure 2-3-16 Requirements for the Widespread Use of New Technologies/Services (By Sector)



Source) MLIT, "National Attitude Survey"

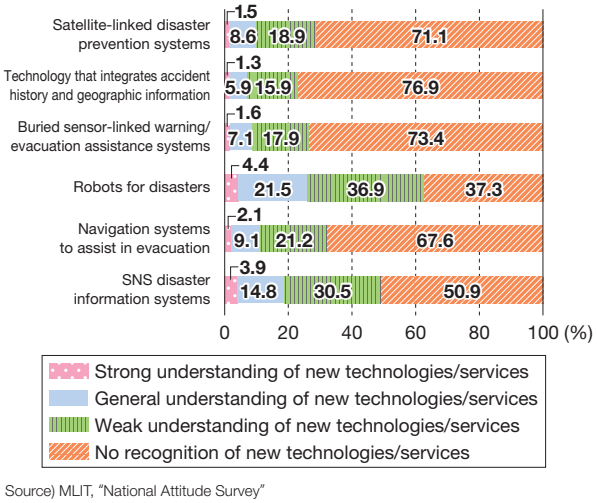
Next, we will analyze trends for each topic.

(Disaster prevention and reduction)

We will examine six new technologies and services related to disaster prevention and reduction in the national land and infrastructure improvement sector: Satellite-linked disaster prevention systems, technology that integrates accident history and geographic information, buried sensor-linked warning and evacuation assistance systems, robots for disasters, navigation systems to assist in evacuation, and SNS disaster information systems.

Except for robots for disasters, fewer than 20% of respondents indicated that they recognized and understood these new technologies and services. Images of robots for disasters being used in major earthquakes and disasters in recent years have been broadcast in the media, which is likely why recognition of robots for disasters is higher than for the other five technologies and services (Figure 2-3-17).

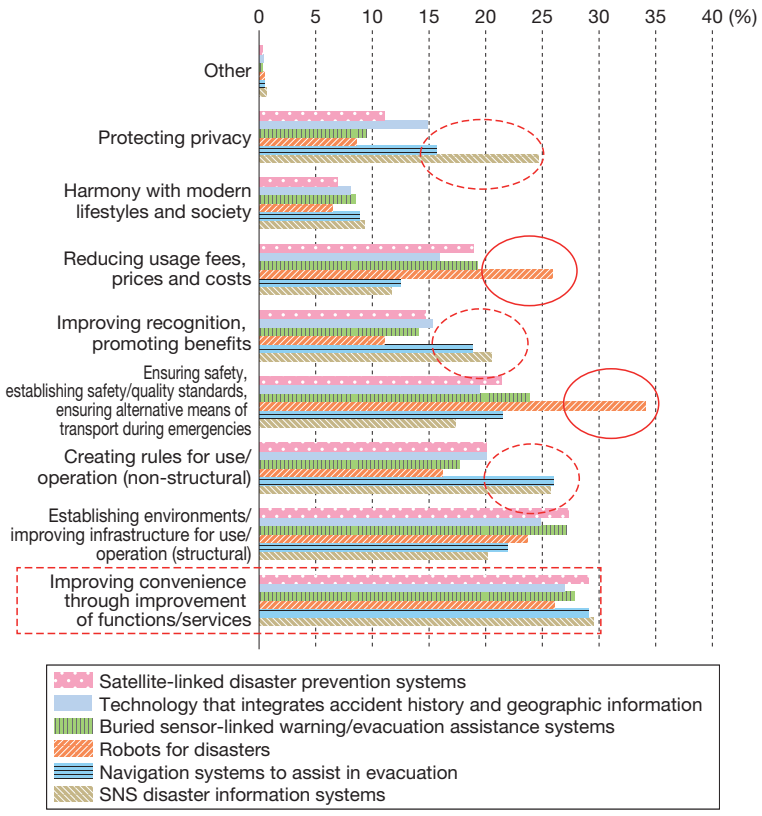
Figure 2-3-17 Recognition of New Technologies/Services (Disaster Prevention/Reduction)



Source) MLIT, "National Attitude Survey"

A large number of respondents indicated that improving convenience through improvement of functions and services is required to bring these new technologies and services into widespread use, but a substantially higher number of respondents indicated the need to ensure safety, establish safety and quality standards, ensure alternative means of transport during emergencies, and reduce usage fees, prices and costs for robots for disasters than for the other five new technologies and services. In addition, more respondents indicated the need to create rules for use and operation (non-structural), improve recognition, promote benefits, and protect privacy for navigation systems to assist in evacuation and SNS disaster information systems than for the other four new technologies and services. Each and every member of the general public will come into direct contact with these new technologies and services during disasters; there is a need to create rules for non-structural aspects as well as to undertake efforts to improve recognition and protect personal information (Figure 2-3-18).

Figure 2-3-18 Requirements for the Widespread Use of New Technologies/Services (Disaster Prevention/Reduction)

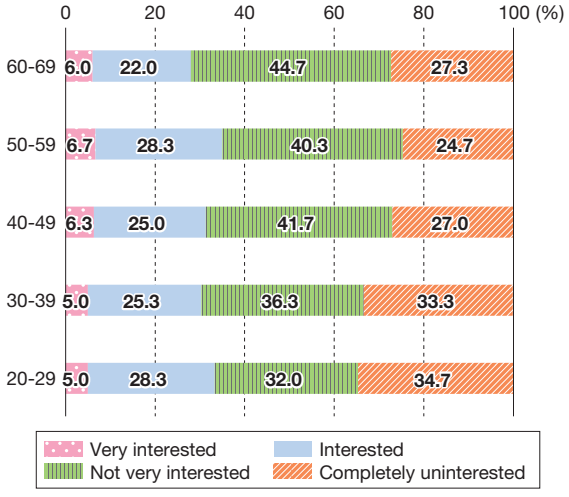


Source) MLIT, "National Attitude Survey"

(Sharing Economy)

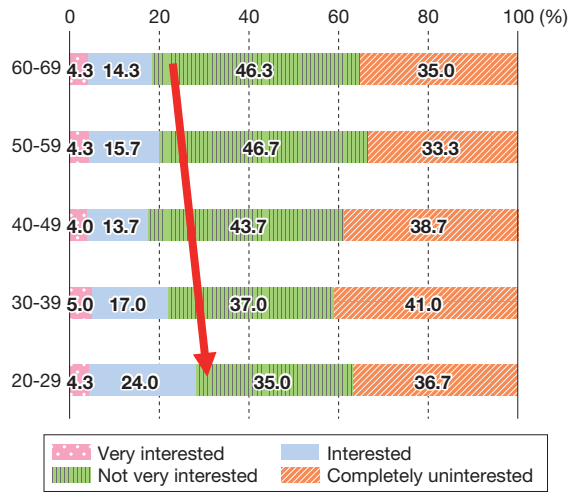
What does the general public think about the new worldview known as the sharing economy (Chapter 2, Section 2) and of the new services it creates? We will examine ride sharing, private residence accommodation and shared housing. The youngest age range expressed the strongest interest in using private residence accommodation and shared housing, but interest in using ride sharing was strongest among people in their 50s; trends vary across age ranges (Figure 2-3-19) (Figure 2-3-20) (Figure 2-3-21).

Figure 2-3-19 Interest in Using Ride Sharing (By Age Range)



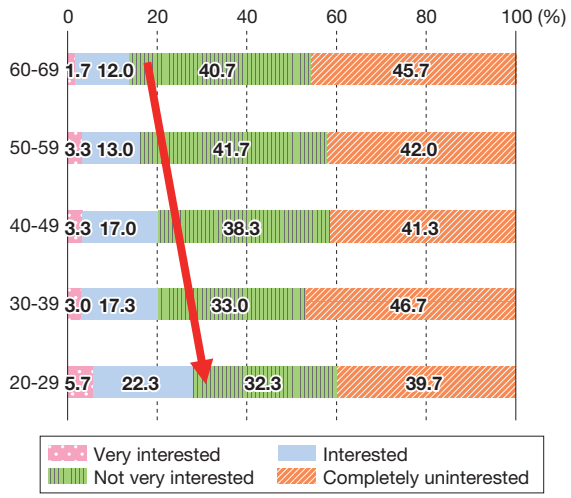
Source) MLIT, "National Attitude Survey"

Figure 2-3-20 Interest in Using Private Residence Accommodation (By Age Range)



Source) MLIT, "National Attitude Survey"

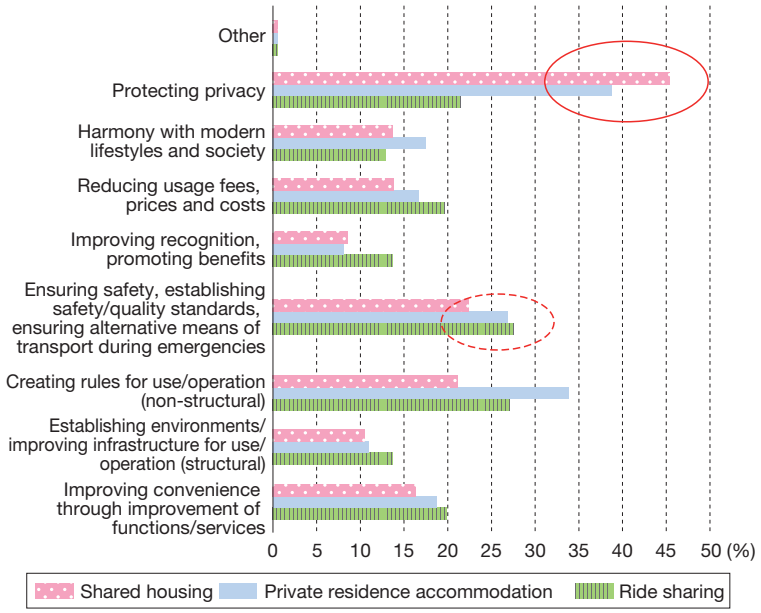
Figure 2-3-21 Interest in Using Shared Housing (By Age Range)



Source) MLIT, "National Attitude Survey"

As for requirements for the widespread use of these new technologies and services, for shared housing and private residence accommodation, the highest number of respondents indicated the need to protect privacy; for ride sharing, the highest number of respondents indicated the need to ensure safety, establish safety and quality standards, and ensure alternative means of transport during emergencies, followed by the need to create rules for use and operation (non-structural) (Figure 2-3-22).

Figure 2-3-22 Requirements for the Widespread Use of New Technologies/Services (Sharing Economy)

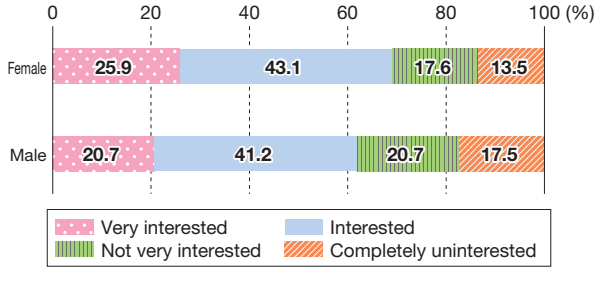


Source) MLIT, "National Attitude Survey"

(Logistics)

We will examine three new technologies and services related to logistics: Home delivery boxes, home delivery using drones, and automated delivery services using autonomous driving, etc. As for interest by gender, both male and female respondents indicated the strongest interest (over 60% for both genders) in using home delivery boxes over the other new technologies and services. Home delivery boxes continue to be introduced, mainly in the Greater Tokyo area, and it appears that people recognize the benefits, convenience and other positive aspects of this service. As

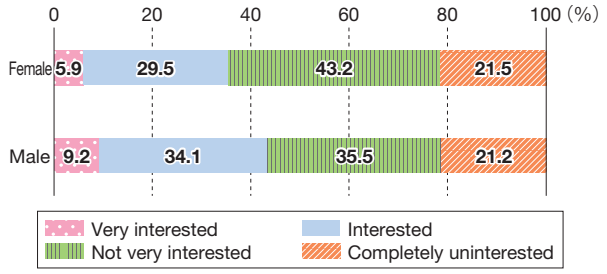
Figure 2-3-23 Interest in Using Home Delivery Boxes (By Gender)



Source) MLIT, "National Attitude Survey"

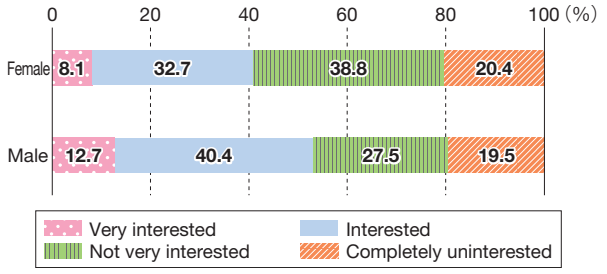
for home delivery using drones and automated delivery services, female respondents indicated lower interest than male respondents (Figure 2-3-23) (Figure 2-3-24) (Figure 2-3-25).

Figure 2-3-24 Interest in Using Home Delivery by Drone (By Gender)



Source) MLIT, "National Attitude Survey"

Figure 2-3-25 Interest in Using Automated Delivery Services (By Gender)

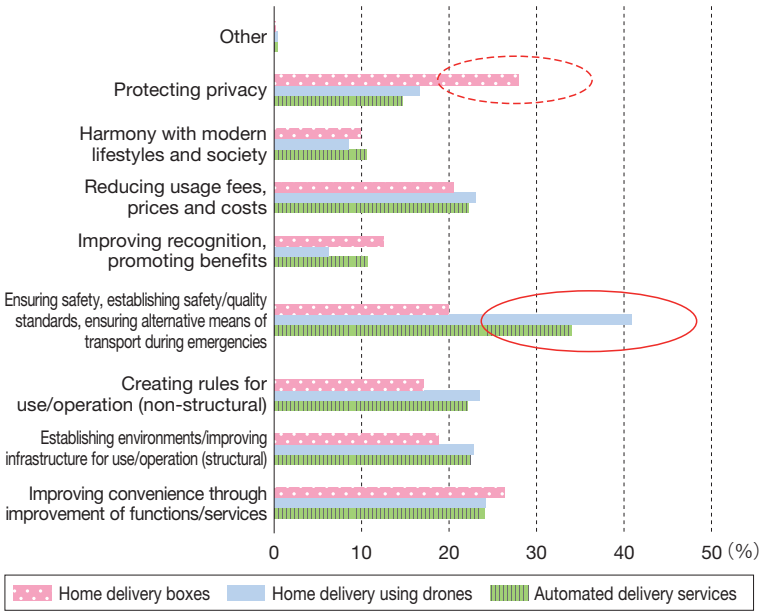


Source) MLIT, "National Attitude Survey"

As for requirements for the widespread use of these new technologies and services, for home delivery using drones and automated delivery services, the highest number of respondents indicated the need to ensure safety, establish safety and quality standards and ensure alternative means of transport during emergencies. For home delivery boxes, the highest number of respondents indicated the need to protect privacy, followed by the need to improve convenience through improvement of functions and services (Figure 2-3-26).

As indicated previously, there are various requirements for pilot projects for new technologies and services in the national land and transport sectors, and efforts must be undertaken in response to the status of the development of innovation sectors, technologies and the like.

Figure 2-3-26 Requirements for the Widespread Use of New Technologies/ Services (Logistics)



Source) MLIT, "National Attitude Survey"

2 Requirements for Promoting Innovation in the National Land and Transport Sectors

In light of public awareness of innovation and the condition and issues of innovation activities in the national land and transport sectors, we will focus on innovation creation and pilot projects in the following examination of requirements for promoting innovation in the national land and transport sectors.

(1) Strengthening Innovation Creation Capacity

(Creating environments for a diverse range of people to flourish and introducing new technologies, etc., to improve productivity)

As in other industries, the lack of skilled human resources in industries related to national land and transport present a major obstacle against innovation; innovation requires the efforts of a diverse range of people, and the creation of an environment in which those people can flourish.

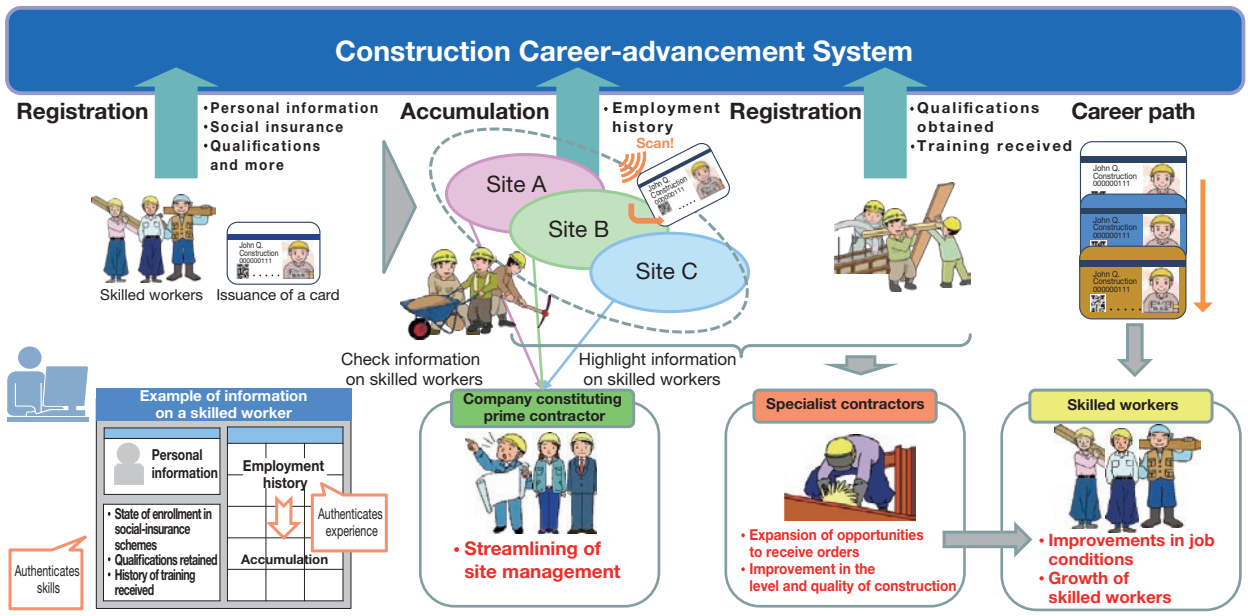
There is a strong perception of male-dominated workplaces in the construction and transport industries, and efforts are being made throughout those industries to create environments where women can flourish and to reform those percep-

tions. However, the efforts of a diverse range of people, including but not limited to women, are what brings the winds of change into a company. It is crucial to avoid inflexible, conventional ways of thinking and make proactive efforts toward human resources by developing work environments and education systems that cater to a wide range of people and styles of working. Moreover, human resources assessment, smooth communication and other efforts are likely required to link the flourishing of a diverse range of people to innovation.

In addition, new technologies, systems and the like are being introduced in various industries in pursuit of addressing the lack of labor and improving production efficiency. These efforts lead to more opportunities to devote more time and human resources to innovation activities; it is important to effectively and proactively use this extra time and these extra human resources.

In addition to the efforts to improve productivity through the i-Construction initiative described in Chapter 2, Section 2, the MLIT and the construction industry are working to establish a Construction Career Boosting System for properly evaluating the skills and experience of engineers, leading to improved treatment, and other aims (Figure 2-3-27). In addition, the Consortium for Securing and Developing Construction Industry Labor, which was established in October 2014, encourages relevant organizations to secure and develop human resources and works to horizontally develop examples of efforts; efforts such as these where entire industries act as one are important.

Figure 2-3-27 Construction Career-advancement System



*Accumulated data are accessed by concerned parties in the construction industry according to the purpose for which they are used

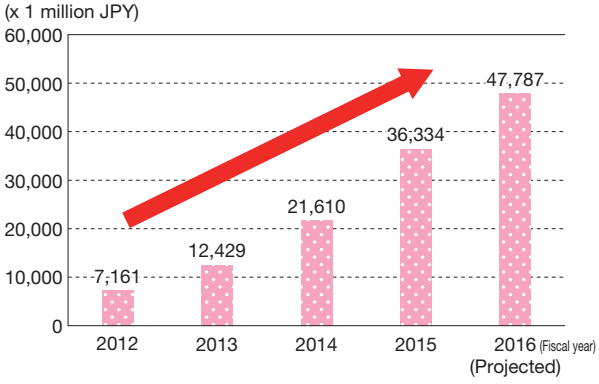
Source) MLIT

(Stimulation of innovation activities through various fundraising methods)

It is important to use various fundraising methods to provide financial support to reduce cash deficits in the lodging, food and beverage services industry, as well as to stimulate entrepreneurial activities and other actions in industries related to national land and transport.

At present, the main methods of fundraising are direct financing, namely through stocks and corporate bonds, and indirect financing from financial institutions; however, the use of crowdfunding to raise funds online has increased in recent years as a method of direct financing (Figure 2-3-28). Crowdfunding enables businesses that may not have

Figure 2-3-28 Market Scale Shift to Domestic Crowdfunding



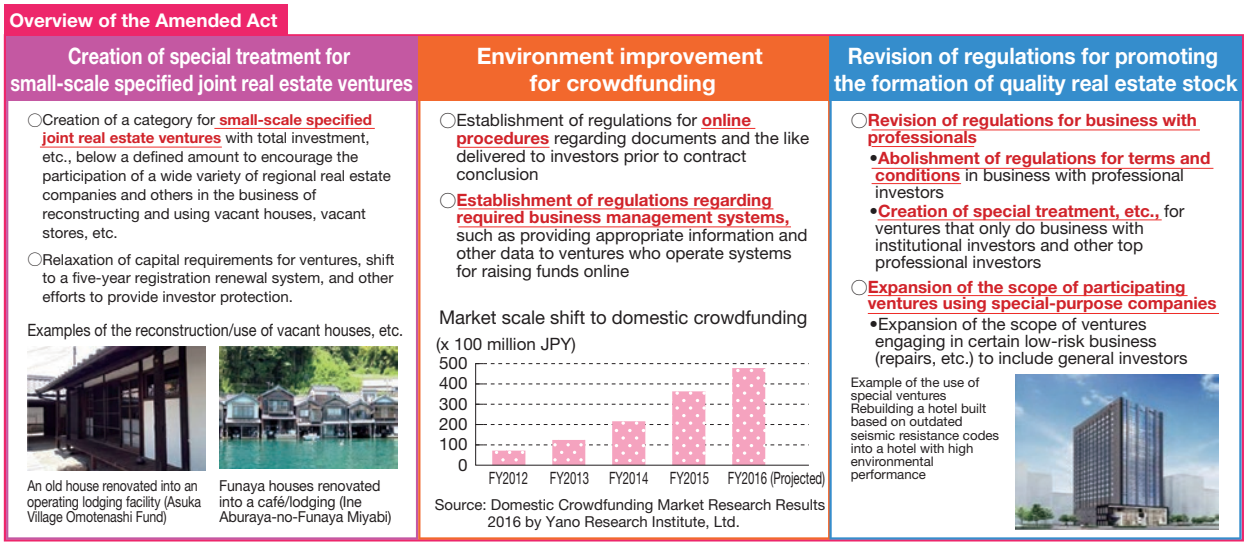
Source) Prepared by the MLIT based on "Domestic Crowdfunding Market Research Results 2016" by Yano Research Institute, Ltd.

a track record but that exhibit novelty and promise to raise funds from supporters who find that the descriptions of those businesses resonate with them; newly established companies, SMEs and other entities that have difficulty obtaining support from financial institutions are turning to crowdfunding. In addition, fundraising can generate interest in the market for a company and serve as a marketing tool to help companies learn the market's evaluation of them.

Crowdfunding has come into use in facility repairs in the tourism industry, and in the reconstruction of vacant houses and old houses in the countryside and in other ways in real estate investment. In light of these developments, the Act to Partially Amend the Act on Specified Joint Real Estate Ventures, which was established on May 26, 2017, sets out environment improvement, including computerization, to account for crowdfunding in addition to transactions conducted on paper by specified joint real estate ventures[Note 65], and relaxed the capital requirements for venture participation, and otherwise promoted the entry of regional real estate companies, ventures with new ideas and other new entities into this business (Figure 2-3-29).

Government aid must also be used effectively. For example, for support related to industrial promotion, it is important to clarify the objectives of the support, and to flexibly determine support periods and methods that correspond to types of business and projects in order to promote the ability of ventures to help themselves continue doing business. In the future, we must promote innovation in the national land and transport sectors by stimulating entrepreneurial activity through efforts to discover and cultivate venture companies, and not only through financial support. In addition, it is important to work toward the widespread adoption of innovation by providing aid and other support to purchasers of new products and services (and not only to the businesses that produce them), as is done with the eco-car tax reduction, the clean energy vehicle introduction promotion subsidy, and the special tax measure for certified Long-Lasting Quality Housing.

Figure 2-3-29 Overview of the Act to Partially Amend the Act on Specified Joint Real Estate Ventures



Source) MLIT

(2) Promotion and Enhancement of Pilot Projects for Innovation

(Open innovation, open data)

The promotion of efforts toward open innovation in the national land and transport sectors is a critical part of the drive to improve productivity and take action to tackle societal challenges.

To improve productivity, it is important to use ICT and know-how from other industries, and to make efforts to promote the development of new services and products and to improve production efficiency. For example, Pokémon Go, an augmented reality game developed by the American company Niantic, Inc., was a social phenomenon, and cases in which

Note 65 Ventures that receive contributions in the association style and pay dividends to investors from profits from the sale or leasing of real estate.

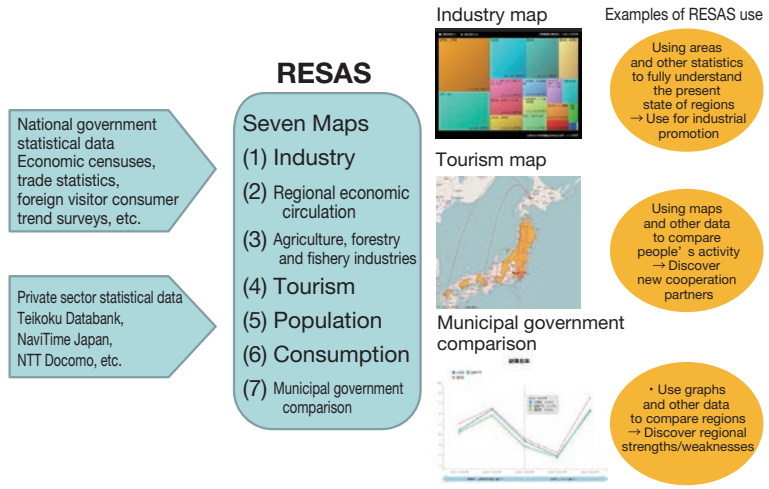
the game was used to attract tourists and create business demonstrate how technological development and new services from other industries can produce innovation in the national land and transport sectors. In addition, the cooperation with customers and clients in the implementation of innovation activities in the transport and postal services industry is connected to business development from the source of needs, and such cooperation in which venture companies and outside companies complement lacking know-how can be a catalyst that creates new innovations.

Regarding global technical innovations that use AI, ICT and the like, Japan must band together to drive forward with technological development and pilot projects. For example, autonomous driving technology requires technological development that combines AI, sensor technology and a variety of other technologies. To move toward putting this technology to practical use, the establishment of vehicle safety standards and rules for liability for damages and accidents and the like, action to accommodate the technology on roads and other infrastructure, verification testing and other efforts to improve public acceptance must be taken, and cooperation between industry, academia and government are critical toward this endeavor.

As for the declining birthrate, aging population, environmental problems and other societal challenges, it is difficult for private companies to project the future, formulate markets, and move forward with research and development and project development on their own. Tackling societal challenges leads to new business opportunities for companies, and the government must involve experts, private companies and others in the determination of approaches and formulation of markets.

Finally, as computerization continues to progress, efforts toward open data will become more important. The Regional Economy and Society Analyzing System (RESAS), provided by the Cabinet Office, aggregates data from the public and private sectors and expresses how money circulates throughout regions, the nature of transactions between regions, tourism trends and demand, and other information in chart, graph and other visual formats in an effort to visualize information (Figure 2-3-30). Local governments use RESAS to fully understand the nationalities, travel ranges and other information about foreign tourists who visit their regions, which enables them to extract priority areas and countries in which to focus tourism promotion, and is useful in their development of tourism policy. Effectively opening data from the private and public sectors in this way encourages the use of information and promotes voluntary innovation activities by companies and local governments based on objective data.

Figure 2-3-30 Overview and Uses of RESAS



Source) MLIT

(Creating a foundation for social acceptance of innovation)

As demonstrated by the national attitude survey and the efforts for the pilot project for autonomous driving described previously, for society to accept new technologies and new services, it is necessary to ensure technological safety and elicit a sense of safety in users and throughout society by establishing rules and conducting field testing. For example, for the use of drones and other small unmanned aircraft in the logistics business, efforts are being made to establish an environment that is conducive to commercialization of the technology, while the performance is improved, systems are established, and other efforts are made to alleviate the general public's uncertainty regarding the safety of the technology.

In addition, it is necessary to resolve the disharmony between the way the general public lives and regional societies, and to establish environments in which innovations can be used effectively. For example, private residence lodging is rapidly becoming common in Japan, but trouble with neighbors and other problems have become societal challenges. In March 2017, the MLIT submitted a bill for private residence lodging business to the Diet, and the bill was passed into law

on June 9, 2017, and is indicative of our efforts to promote the spread of sound private residence lodging services that take regional circumstances into account.

(Establishing a PDCA cycle for innovation)

Among companies that realize innovation are many companies that have not achieved their targets or verified outcomes. It is important to create a PDCA cycle in which current innovation activities are connected to subsequent innovation activities through the establishment of targets and the verification of outcomes. It is also effective to standardize evaluation criteria for quality, technology and other factors throughout industries and establish common best practices in order to create targets for individual companies to aim for.