Projects in the Robotics and Artificial Intelligence Fields 2022

International Robot Exhibition 2022 (March 9 to 12, 2022)

New Energy and Industrial Technology Development Organization

About NEDO

- NEDO is a national research and development agency that creates innovation by promoting technological development necessary for realization of a sustainable society.
- NEDO acts as an innovation accelerator to contribute to the resolution of social issues by developing and demonstrating high-risk innovative technologies having practical application.

NEDO's Missions

Addressing energy and global environmental problems

NEDO actively undertakes the development of new energy and energy conservation technologies. It also conducts research to verify technical results. Through these efforts, NEDO promotes greater utilization of new energy and improved energy conservation. NEDO also contributes to a stable energy supply and the resolution of global environmental problems by promoting the demonstration of new energy, energy conservation, and environmental technologies abroad based on knowledge obtained from domestic projects.

Enhancing industrial technology

With the aim of raising the level of industrial technology, NEDO pursues research and development of advanced new technology. Drawing on its considerable management know-how, NEDO carries out projects to explore future technology seeds as well as mid- to long-term projects that form the basis of industrial development. It also supports research related to practical application.

Three Initiatives Based on NEDO's Fourth Five-Year Plan

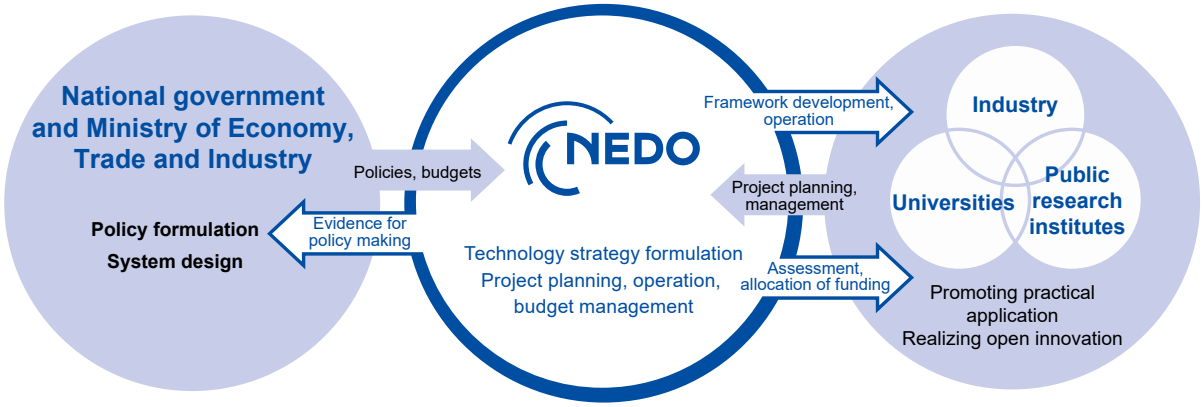
Managing Technological Development to Utilize Results in Society

Fostering Technology-Based Startups

Determining the Direction of Mid- to Long-Term Technology Development

Positioning of NEDO as an Innovation Accelerator

In order to contribute to the resolution of social issues, NEDO formulates technology strategies and project plans and, as part of its project management, establishes project implementation frameworks by combining the capabilities of industry, academia, and government. NEDO also promotes technology development by carrying out, evaluating, and allocating funding to promising projects to accelerate the practical application of project results.



Missions and Activities

Message from the Director General

NEDO started research and development of robot technologies in the 1990s and has developed robots in various fields such as services, manufacturing, disaster response, and infrastructure maintenance in order to support the development of the robotics industry in Japan.

NEDO has carried out research and development on AI through studies on intelligent robots. At present, NEDO is working to develop core technologies for next-generation AI as well as to develop and practically implement AI with an eye to Society 5.0 in addition to AI for robot brains. Recently, NEDO has started development projects on AI that evolves together with humans by presenting the process and basis of inference for facilitating cooperation and collaboration with humans as well as remote technology to share people's sensations among remote locations.

In addition, NEDO has carried out research and development on UAVs (drones) as an extension of its studies on robots for infrastructure maintenance. NEDO has also made efforts to support safe flights, such as the establishment of performance evaluation methods as well as development and demonstration of a traffic management system toward the lifting of the ban on level 4 flights in 2022. In FY2022, NEDO started research and development of advanced air mobility, the scope of which includes eVTOL (electric Vertical Take-Off and Landing).

Our work is not limited to the fields of robotics and AI. We have developed and demonstrated automated driving systems as well as developed aircraft electrification technologies.

Needless to say, NEDO is committed to the research and development of robots. For example, NEDO is developing elemental technologies to realize industrial robots that can be applied in fields where the introduction of robots has not been progressing, such as the production of multiple products in small quantities.

NEDO works in such diverse fields in collaboration with many companies, research institutes, and universities.

At present, we face urgent, significant social issues such as responding to the spread of infection and reducing greenhouse gases. Meanwhile, digital technologies are dramatically evolving and spreading, greatly affecting society and the economy. In addition, people hope that cutting-edge technologies in the fields of robotics and AI will be speedily applied to solve social issues.

NEDO will continue to develop and demonstrate high-risk innovative technologies in robotics and AI projects with the aim of solving social issues as an innovation accelerator that promotes the practical application of research results.

September 2022

Director General, Robot and Artificial Intelligence Technology Department, NEDO
FURUKAWA Yoshinori

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Missions and Initiatives

NEDO is researching and developing state-of-the-art robots and AI that can be used in various situations in society and drones, aircraft, automated driving, and other technologies based on that technology base to contribute to building a smart society. We are trying to utilize new technologies in society while conducting research and development from a long-term standpoint.

Main Projects

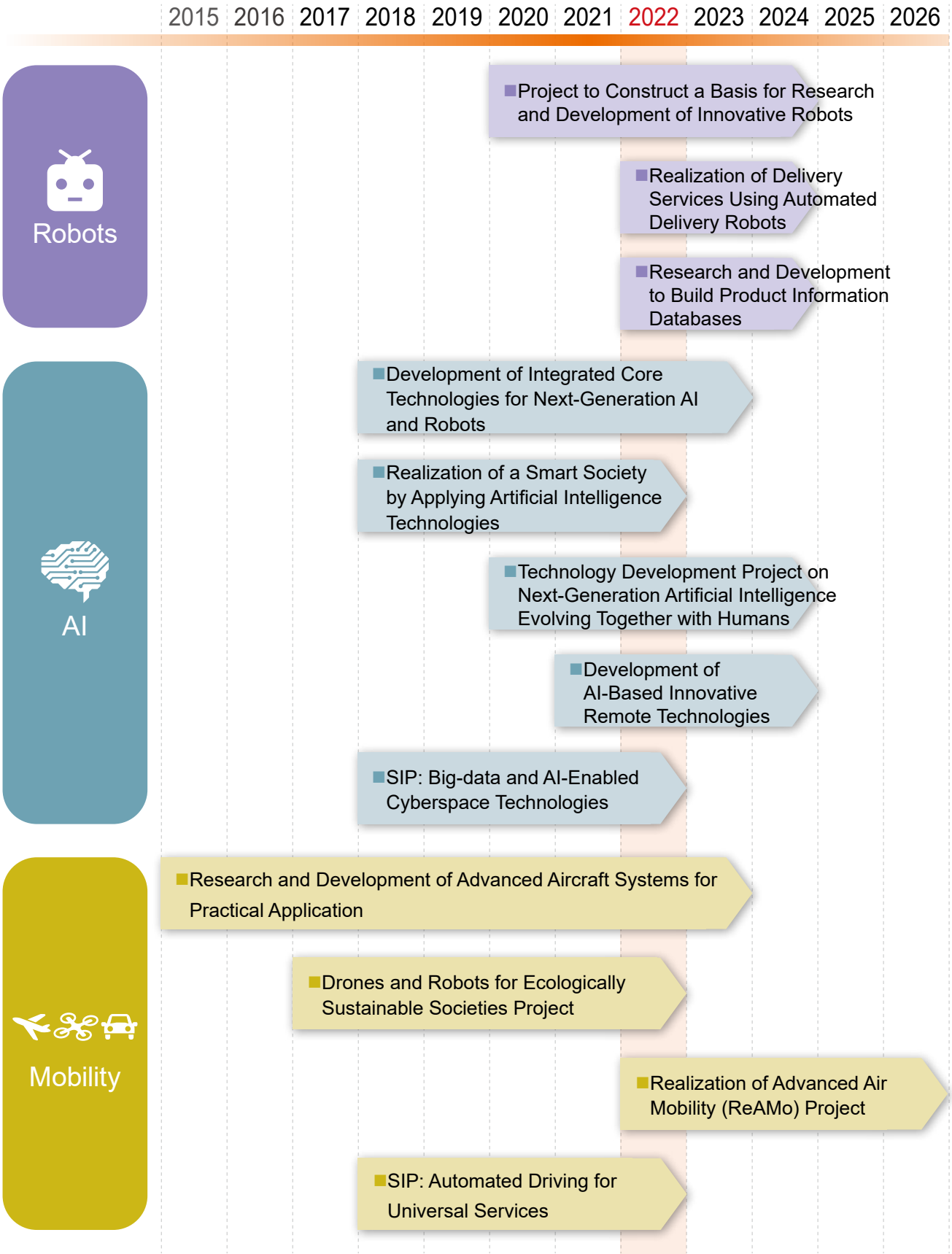
Robots

AI

Mobility

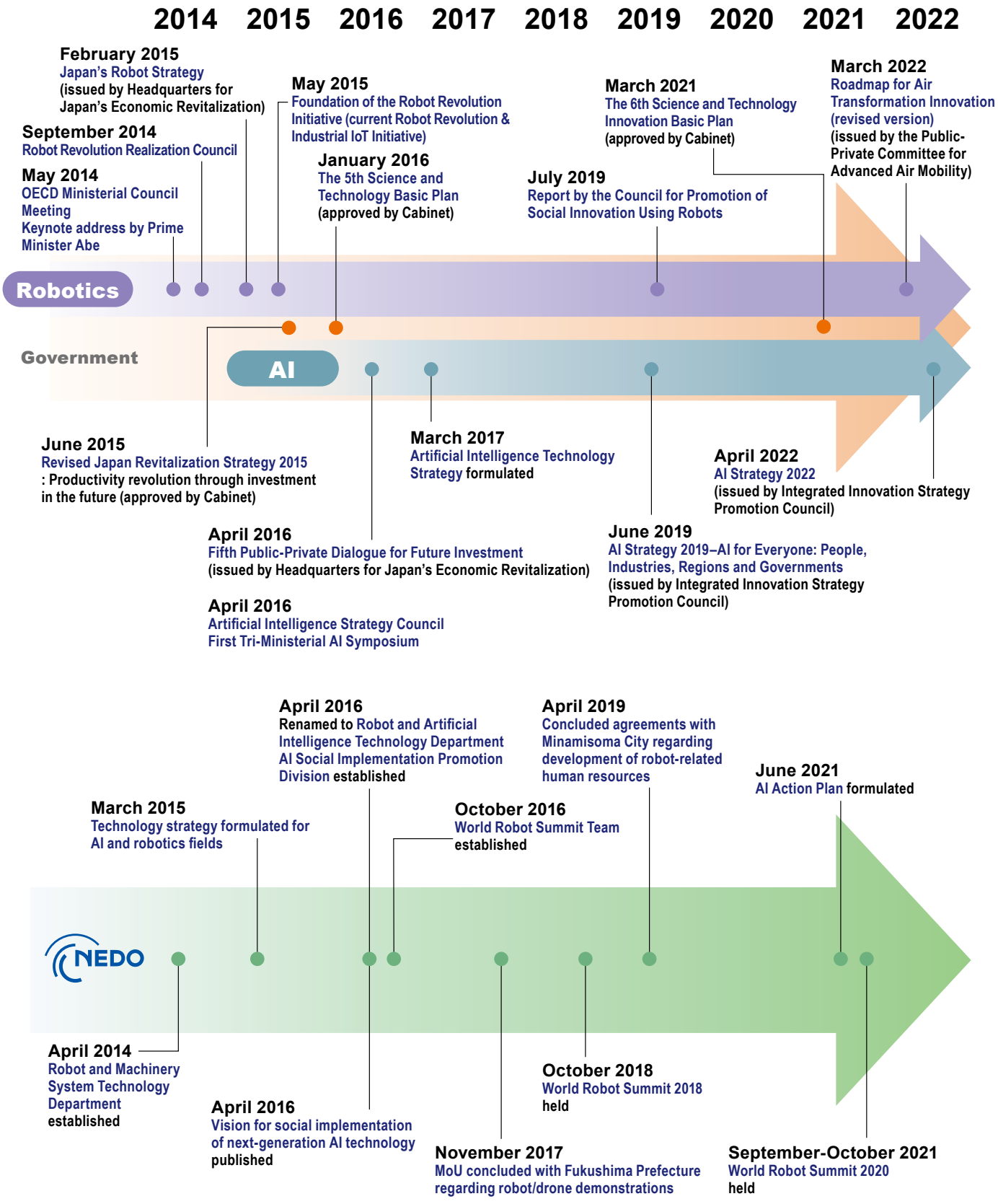
* SIP: Cross-ministerial Strategic Innovation Promotion Program

Chronology of Projects



* SIP: Cross-ministerial Strategic Innovation Promotion Program

Policies and Milestones for Robot and Artificial Intelligence Technology Department



Project to Construct a Basis for Research and Development of Innovative Robots

Project period	FY2020–FY2024	Budget	510 million yen (FY2022)

PMgr = Project Manager

Project Overview

This project is aimed to realize robots that can be applied in fields where the introduction of robots has not been progressing, such as the production of multiple products in small quantities, by promoting the development of elemental technologies important for industrial robots. This project is also intended to develop technologies by going back to the underlying science in addition to improving or enhancing existing technologies, make innovations, for example, by adopting technology seeds in different fields where robots have not been utilized, and strengthen the international competitiveness of robots, including automated delivery robots.

PMgr
TAKEBA Hiroshi
Technical Researcher

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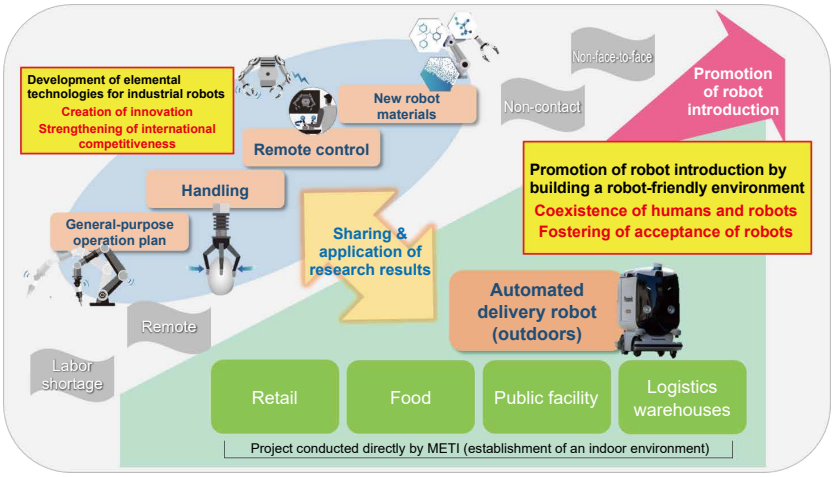


Description of Research and Development

① General-purpose operation planning technology

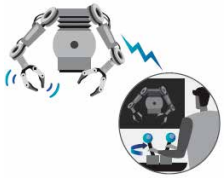
Establishment of a database of the technology involved in grasping/holding movements and the work targets of industrial robots and development of the necessary logics and algorithms to optimize work plans using the established database to verify robot system development.

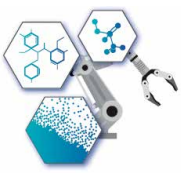
② Handling-related technology

Development of an end effector that enables linkage with databases and other devices equipped with sensing technologies, and a robot hand that can stably grasp/hold various targets including amorphous objects.

③ Remote control technology

Development of signal transmission criteria for 5G communications and other applications to ensure safe and secure control of visual, force sense, voice and other kinds of data, even if there is communication delay or disturbance, and a communication method that reduces the fatigue of operators through quantitative evaluation of the influence of operational delay on the human senses.





④ New robot material technology

Evaluation/examination of the applicability of resins and composite materials by establishing specifications that are mainly necessary for robots, such as strength, rigidity, heat-resistance and durability, and development of technology to integrate pressure, vibration, temperature and other sensor materials into robots and to realize wireless power supply and self-power generation.

Reference: ROBOT Industrial Basic Technology Collaborative Innovation Partnership https://robocip.or.jp/

Project to Construct a Basis for Research and Development of Innovative Robots (R&D Item 5)
Realization of Delivery Services Using Automated Delivery Robots

Project period	FY2022–FY2024	Budget	170 million yen (FY2022)

PMgr = Project Manager

PMgr
TSURUTA Takehiro
Chief Officer

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Project Overview

NEDO is developing automated delivery robot technology with the aim of realizing remote, non-face-to-face, and non-contact last-mile distribution (delivery services from logistics bases, retail stores, and other locations to residences and other destinations). NEDO will set development goals with a particular focus on commercialization and service provision as well as accelerate its initiatives. NEDO plans to conduct demonstration experiments in sequence using the developed automated delivery robot outdoors at four locations in Japan, including downtown areas.






Description of Research and Development

Regarding last-mile distribution (delivery services from logistics bases, retail stores, and other locations to residences and designated destinations), society faces issues such as a shortage of drivers due to a surge in package deliveries and other causes partly as a result of the spread of COVID-19. In this context, needs for remote, non-face-to-face, and non-contact delivery are increasing in last-mile distribution. In addition, prompt realization of new delivery services using automated delivery robots is required to address the shortage of drivers. Related activities became more active this year. Specifically, the Robot Delivery Association was founded under a private initiative in February. The Act Partially Amending the Road Traffic Act, which includes a legal framework for low-speed, small, automated delivery robots, was approved in April and is scheduled to come into force by 2023.

Against such a backdrop, NEDO has been working on the Technology Development to Realize a New Delivery Service Using Self-Driving Robots Project*1 since 2020. This project aims to quickly realize automated delivery robots and to maintain logistics services even in emergencies such as the COVID-19 pandemic. NEDO has also conducted demonstration experiments to operate automated delivery robots in housing complexes, downtown areas, commercial facilities, industrial areas, and the like to strengthen supply chains. In addition, NEDO has conducted analysis and examination of efforts toward facilitating social acceptance and other aspects in order to realize new delivery services.

Presently, NEDO has set new goals and challenges with a particular focus on commercialization and service provision in the Project to Construct a Basis for Research and Development of Innovative Robots (this project) so as to further accelerate the realization of remote, non-face-to-face, and non-contact automated delivery services in last-mile distribution and to proceed with development.

This project will also involve collaboration with the Government-Private Council for the Realization of Deliveries Using Automatically Operating Robots*2 (established in September 2019), and information related to the following matters will be provided to the Council.

- Clarification of use cases playing core roles in commercialization
- Safety evaluation concerning the specifications of automatically operating robots and the establishment of a system for their safe operation
- Examination/establishment of systems, laws, regulations, etc. concerning the utilization of automatically operating robots

*1 Technology Development to Realize a New Delivery Service Using Self-Driving Robots Project: https://www.nedo.go.jp/activities/ZZJP_100184.html
*2 Government-Private Council for the Realization of Deliveries Using Automatically Operating Robots: https://www.meti.go.jp/shingikai/mono_info_service/jidosoko_robot/index.html

Technology Development Project on Next-Generation Artificial Intelligence Evolving Together with Humans
Research and Development to Build Product Information Databases

Project period	FY2022–FY2024	Budget	310 million yen (FY2022)
PL	TSUJII Junichi (Director, Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology)		

PL = Project Leader; SPMgr = Sub-project Manager

Project Overview

SPMgr
AKABANE Akiko
Chief Officer

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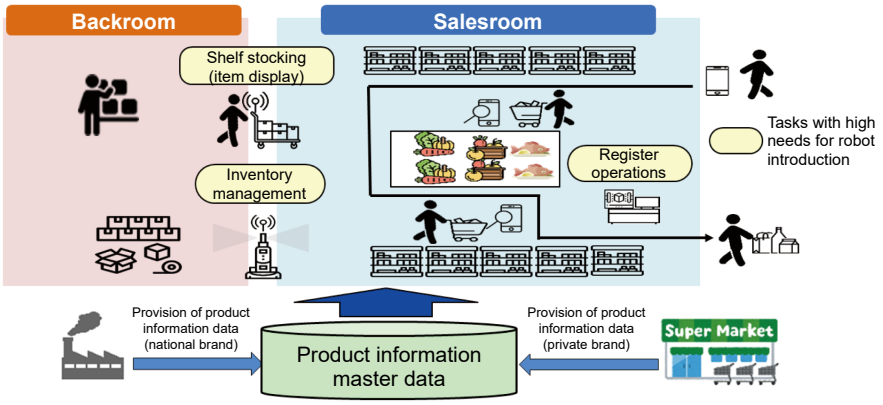
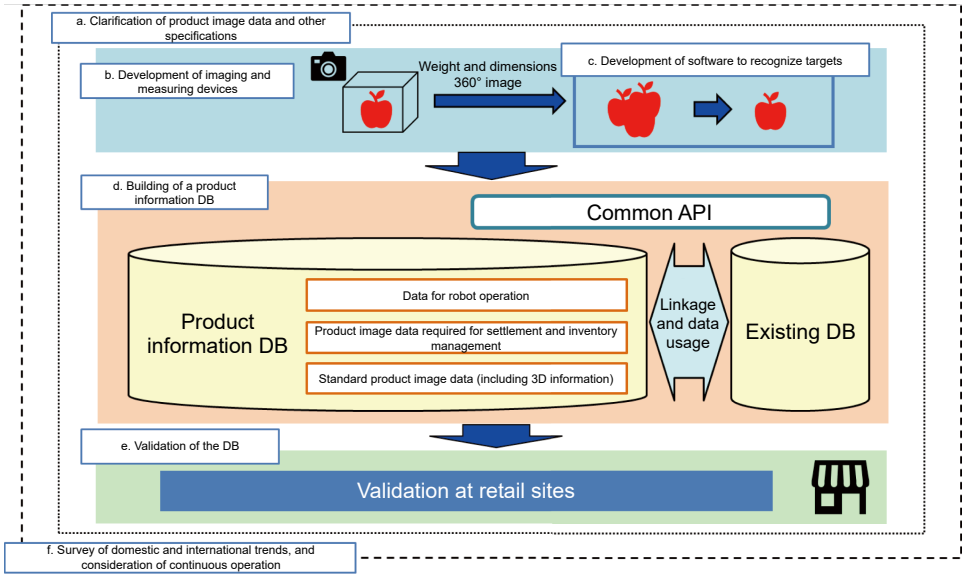
At retail stores such as supermarkets and convenience stores, shelf stocking (item display), inventory management, and register operations are labor-intensive tasks with high needs for robot introduction. In addition, retail stores handle numerous products and receive new products on a daily basis. This project aims to use AI to efficiently recognize product images and to build a product information database in which the recognized products are registered in order to detect products that have gone out of stock and to use robots to display items automatically.



Description of Research and Development

Under the theme adopted for this project, the National Institute of Advanced Industrial Science and Technology is conducting research and development so that robots can efficiently recognize product images and perform other processing using AI in order to detect products that have gone out of stock on retail store shelves, manage inventory, and grasp and automatically display products. Specifically, the following projects are planned.

a. Clarification of product image data and other specifications
b. Development of imaging and measuring devices
c. Development of software to recognize targets
d. Building of a product information DB
e. Validation of the DB
f. Survey of domestic and international trends, and consideration of continuous operation



Development of Integrated Core Technologies for Next-Generation AI and Robots

Project period	FY2018–FY2023	Budget	1.4 billion yen (FY2022)
PL	HIGUCHI Tomoyuki (Professor of the Department of Data Science for Business Innovation, Faculty of Science and Engineering, Chuo University) HORI Koichi (Executive Director, National Institutes for the Humanities)		

PL = Project Leader; PMgr = Project Manager

Project Overview

PMgr
ATARASHI Atsushi
Technical Researcher

This project involves the conduct of research, development, and demonstration to reduce the time required for the deployment of artificial intelligence technologies to 1/10th of the current situation in the focused areas of productivity and mobility, for which early social implementation of artificial intelligence technologies is required. This project is also aimed to establish common base technologies to enlarge the application fields of artificial intelligence technologies. This project promotes these themes with agile development methods to accelerate social implementation of AI to capture new markets. Improved productivity brought about by the deployment of artificial intelligence technologies is expected to reduce energy consumption and CO_2 emission.

Description of Research and Development

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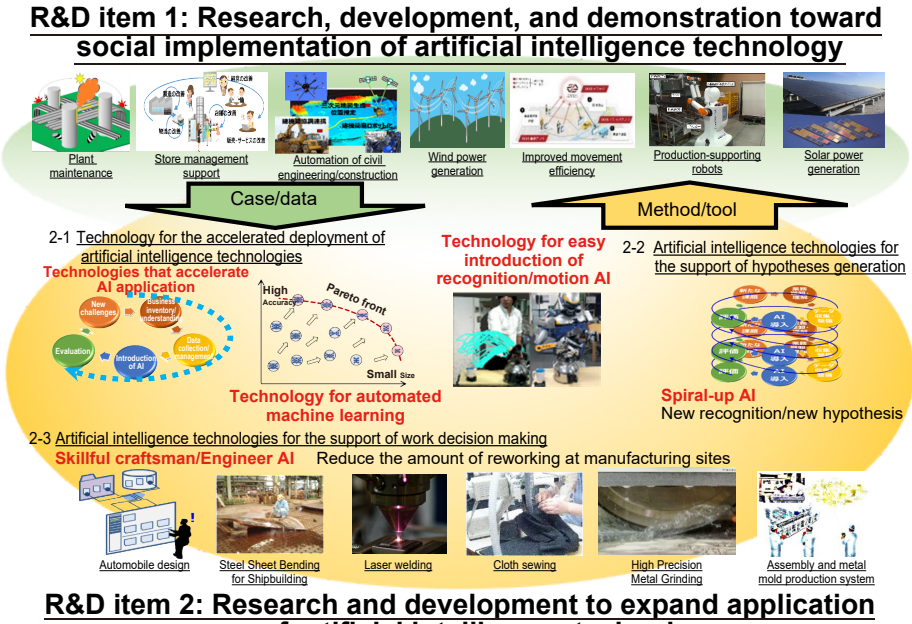
This project involves the conduct of research, development, and demonstration of 15 research and development themes under two research and development items to reduce the time required for the deployment of artificial intelligence technologies to 1/10th of the current situation in the focused areas of productivity and mobility, for which the early social implementation of artificial intelligence technologies is required. This project is also aimed to establish common base technologies to enlarge the application fields of artificial intelligence technologies. This project promotes these themes with agile development methods to accelerate social implementation of AI to capture new markets.

R&D item 1:

Conduct agile research, development and demonstration for the implementation of (1) business analysis, identification of issues and data collection/accumulation/processing, (2) development and application of artificial intelligence modules, (3) demonstration in actual fields and (4) establishment of an evaluation system and feedback on the development/application of new artificial intelligence technologies using productivity, spatial movements and other issues targeting priority areas.

R&D item 2:

Conduct development of “technologies to accelerate the deployment of artificial intelligence technologies” that involve business inventory, analysis and improved efficiency related to the deployment of artificial intelligence; “artificial intelligence technologies that assist the generation of hypotheses” to realize a management simulation system that can identify the relationship between objective variables and generate/evaluate/propose advanced hypotheses; and “artificial intelligence technologies supporting work-related decision-making” that automatically identify problems and points to improve and support non-expert judgments by systematizing tacit knowledge on manufacturing technology information and modeling skilled engineer decisions.



Reference: Introduction of Project: Development of Integrated Core Technologies for Next-Generation AI and Robots
https://www.nedo.go.jp/content/100905869.pdf

Realization of a Smart Society by Applying Artificial Intelligence Technologies

Project period	FY2018–FY2022	Budget	1.37 billion yen (FY2022)
PL	TSUJII Junichi (Director, Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology) KAWAKAMI Takayoshi (Partner/Managing Director, Industrial Growth Platform, Inc.)		

PL = Project Leader; PMgr = Project Manager

Project Overview

PMgr
KATO Hiroaki
Chief Officer

This project concerns the conduct of research and development to promote the social implementation of artificial intelligence technologies in the three high-focus areas of the strategy of artificial intelligence technologies of *productivity; health, medical care, and welfare; and mobility*.

This project specifically concentrates on research, development, and demonstration for the realization of a smart society combining cyber- and physical space with the use of artificial intelligence modules and data-acquisition sensor technologies that have been researched, developed, and deployed so far, and also applying research and development infrastructures.

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Description of Research and Development

Productivity

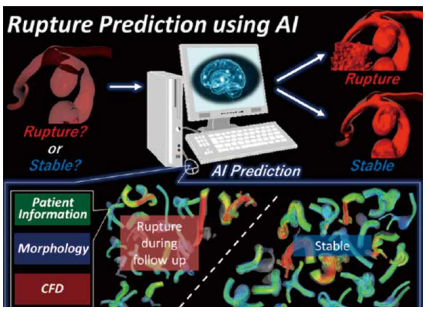
Plant factory

Data collaboration analysis
Establishment of a data base for large-scale data analysis by solving the difficulty of cross-disciplinary data sharing

Value chain efficiency AI system for plant factories etc.
Adoption of AI-based growth control and demand forecasting to streamline the value chain from plant factories and other facilities to consumers

Smart food chains
Contribution to the expansion of markets and creation of new industries through overall optimization of food chains using AI

Health, medical services, and welfare



Stroke prevention

Stroke prediction system
AI system that can determine the risk of cerebral aneurysm rupture, enabling appropriate diagnosis/treatment

AI smart coaching technology
Realization of a smart society where people can have a long healthy life

AI assistance for engineering antibody mimic
Contribution of the development of new drugs by constructing a platform for efficient development of protein-based molecularly-targeted drugs

AI for pharmaceutical formulation design
Proposing multi-purpose optimized formulation in terms of effectiveness, safety and quality

Mobility

3D map

3D maps for transportation
Realization of eco systems based on 3D map information

Innovative drone AI technology
Realization of drones that “do not fall/are safe even if they fall” with AI technology

Explainable AI for decision basis
Risk evaluation conducted according to grounds for judgment verbalized by AI

Contribution to practical applications such as safe, reliable automated driving services

Autonomous decentralized traffic signal system
Realization of efficient/smooth traffic flows with autonomous decentralized signals using AI

Introduction of Project: https://www.nedo.go.jp/content/100906019.pdf (Japanese)
Introduction of activities on the NEDO Channel: https://www.youtube.com/playlist?list=PLZH3AKTCrVsXNJtm2MLPYDfNOv2S0lAcL (Japanese)
NEDO LABO TALKS: https://www.youtube.com/watch?v=ej1rV8o93zo (Japanese)

Technology Development Project on Next-Generation Artificial Intelligence Evolving Together with Humans

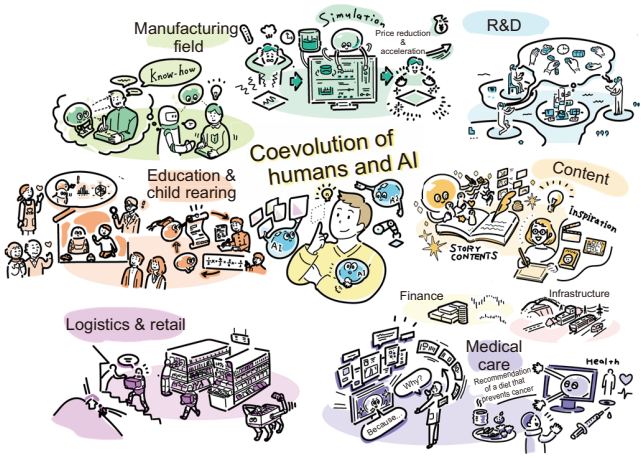
Project period	FY2020–FY2024	Budget	2.71 billion yen (FY2022)
PL	TSUJII Junichi (Director, Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology)		

PL = Project Leader; PMgr = Project Manager

Project Overview

AI technology is among the technologies expected to solve social issues such as the reduction in the working age population associated with population aging. However, AI has yet to be applied to fields as deeply and widely as society expects. This is due mainly to three issues. First, output from AI is sometimes difficult to explain. Second, there is insufficient expertise on quality assurance of AI systems. Third, for some tasks, it is difficult to gather the large amount of data required for AI to learn.

This project aims to solve these issues by building an AI system that mutually interacts, grows, and evolves with humans.



PMgr
SHIBATA Yoshifumi
Chief Officer

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Description of Research and Development

Research and development of basic technologies for AI systems that grow and evolve together with humans is conducted towards the smooth social application of those AI systems.

R&D Item 1:
Development of basic technology for AI systems evolving together with humans

①-1 Development of a framework for AI systems evolving together with humans

①-2 Development of basic technology for explainable AI

■ Presentation of inference processes and grounds together with AI inference results

AI systems — Human

①-3 Development of basic technology for AI that can understand and learn human intentions and knowledge

■ AI understands human intentions and knowledge and learns them together with data

①-4 Research and development to build product information databases (added in FY2022)

■ Building of a shareable product DB to expand applications of AI in the logistics and retail industries

Sharing of R&D-related data and R&D results

Development of basic technology to solve the following issue to allow the application of "AI systems evolving together with humans" in the real world

Issue: Quality assessment/control methods for AI have not yet been established and their absence is obstructing the application of AI technologies in the real world.

R&D Item 2:
Establishment of AI evaluation/management methods that can be trusted in the real world

Issue: Application of AI technologies is difficult in areas where there is only little learning data to be obtained, or where it is costly to collect data.

R&D Item 3:
Development of AI that can easily be constructed/introduced

Reference: Release of "Machine Learning Quality Management Guidelines"
https://www.digiarc.aist.go.jp/publication/aiqm/index.html

Development of AI-Based Innovative Remote Technologies

Project period	FY2021–FY2024	Budget	500 million yen (FY2022)
PL	HARADA Tatsuya (Professor of The Research Center for Advanced Science and Technology, The University of Tokyo)		

PL = Project Leader; PMgr = Project Manager

Project Overview

PMgr
TOMURA Masaharu
Technical Researcher

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The need for remotization for social and economic activities that are free of spatial and temporal constraints such as telework and online meetings is rapidly increasing in response to the spread of COVID-19. However, the effects of remotization on productivity improvement are limited. This is because of a problem with remotization that has come to light, namely, that the situation at the remote locations cannot be known precisely. In particular, remotization is not sufficiently spreading in labor-intensive, mainly face-to-face work environments, because information critical to conduct work cannot be transmitted. As a result, these types of businesses have experienced an economic shock from suspension of business activities.

To spread the remotization of social and economic activities to a wider range of fields and improve productivity, the project is aimed at establishing an innovative remote technology base that allows the user to grasp the situation in the field remotely as well as, or even better than an actual visit by estimating the situation at the remote place and making it so that the other party can effectively recognize information, not only visually and aurally, but also using other senses such as through haptics.

Description of Research and Development

The following five research and development themes are addressed as part of this project to develop the following two technical bases; the situation estimation AI system to estimate the situation in a remote environment in a sophisticated way, and the AI system that presents the situation through advanced XR to effectively convey information.

① Development of bidirectional remote tactile communication AI system using ultrathin haptic MEMS
Reference: https://www.aist.go.jp/aist_j/aistinfo/bluebacks/no33/

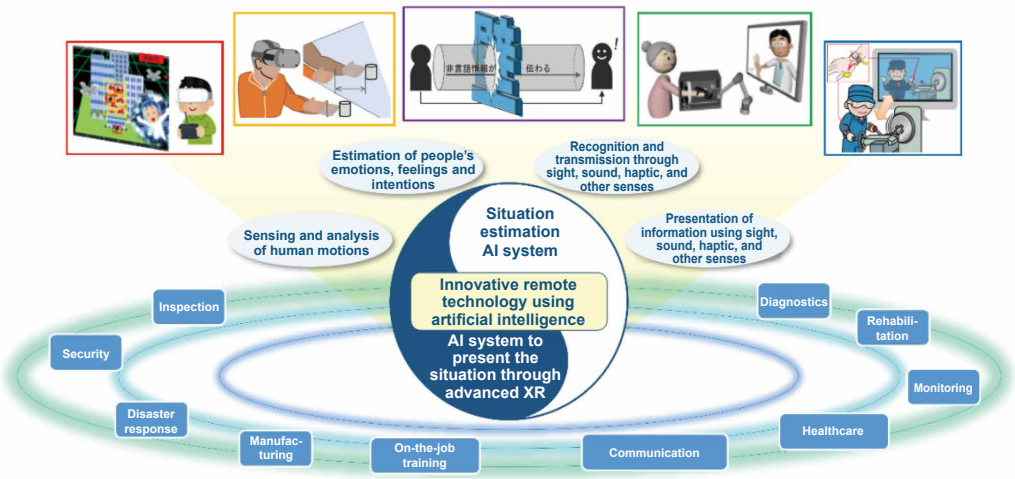
② Development of remote palpation system by making Contact Reality
Reference: https://www.nedo.go.jp/content/100937782.pdf

③ Building a multisensory XR-AI technology base and linkage of mutual care with health guidance for remote rehabilitation
Reference: https://unit.aist.go.jp/harc/nedo-xrai-healthcare/

④ Research and development of an innovative drone remote technology to realize avatars in the sky using AI and XR
Reference: https://www.nedo.go.jp/content/100937784.pdf

⑤ Emotion Embodied Avatars: Novel Remote Communication with Motion Unit AI
Reference: https://www.icd.riec.tohoku.ac.jp/research/projects/project_eea/

We conduct research and development setting the establishment of a technical base as the final goal of the project and assuming use cases.



Every field in society supports remotization after the end of the project because the established technical base is applied.

Strategic Innovation Promotion Program (SIP): Big Data and AI-Enabled Cyberspace Technologies

Project period	FY2018–FY2022	Budget	2.14 billion yen (FY2022)
PD	ANZAI Yuichiro (Executive Director and Chief Executive Officer, the Tokyo Foundation for Policy Research)		

PD = Program Director; PMgr = Project Manager

Project Overview

PMgr
OGAWA Takao
Chief Officer

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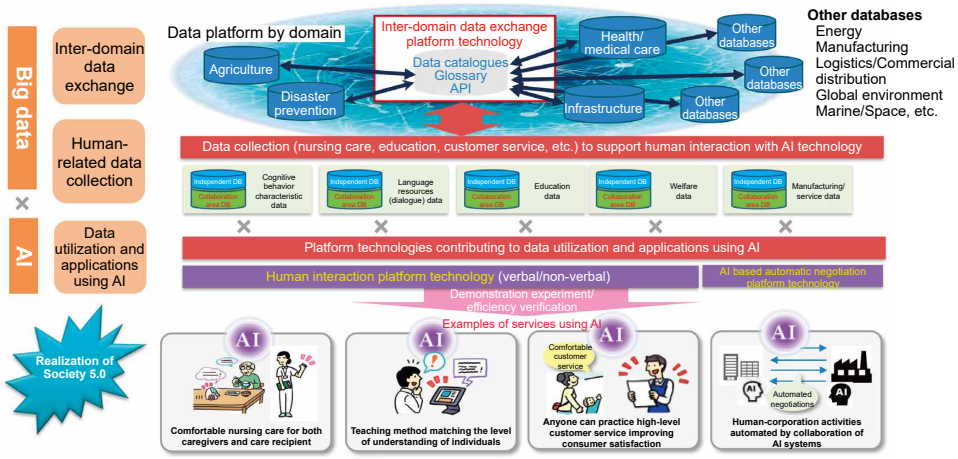
It is essential to create a system in which cyberspace and physical space are interconnected to realize Society 5.0. However, there are still various development-related factors and issues that need to be resolved. This project will particularly establish “human interaction platform technology,” “inter-domain data exchange platform technology,” and “AI-based automatic negotiation platform technology,” the subcategories of “cyberspace platform technology,” which will conduct social implementation of cyber-physical systems utilizing big data and AI.



Description of Research and Development

(1) Human interaction platform technology

(1-1) Cognitive interaction support technology: Advanced interaction support technology that collects and structures verbal and non-verbal data related to human cognition and behavior to enable AI to support and enhance human interaction, and supports situational decision-making and communication with others based on individual needs.

(1-2) Advanced multimodal dialogue technology: Advanced dialogue processing technology that enables multimodal memorization, integration, cognition, and judgment for human-AI collaboration

(1-3) Learning support technology: Technology that individually optimizes education and learning activities by collecting big data related to teachers and students from educational sites and combining them with AI

(1-4) Nursing-care support technology: Technology that reduces the burdens on both caregivers and care recipients by collecting big data related to them from nursing care sites and combining them with AI

(2) Inter-domain data exchange platform technology: Inter-domain data exchange platform technology for inter-domain data sharing/utilization and establishment of a system to promote distributed and federated inter-domain data exchange for one-stop provision of these data.

(3) AI-based automatic negotiation platform technology: Technology for automatic negotiation and collaboration between multiple AI platforms

Reference: Cross-ministerial Strategic Innovation Promotion Program (SIP) Phase 2: Big Data and AI-Enabled Cyberspace Technologies
https://www.nedo.go.jp/english/activities/activities_ZZJP_100158.html

Research and Development of Advanced Aircraft Systems for Practical Application

Project period	FY2015–FY2023	Budget	2.23 billion yen (FY2022)

PMgr = Project Manager

PMgr
MATSUKI Hideo
Chief Officer

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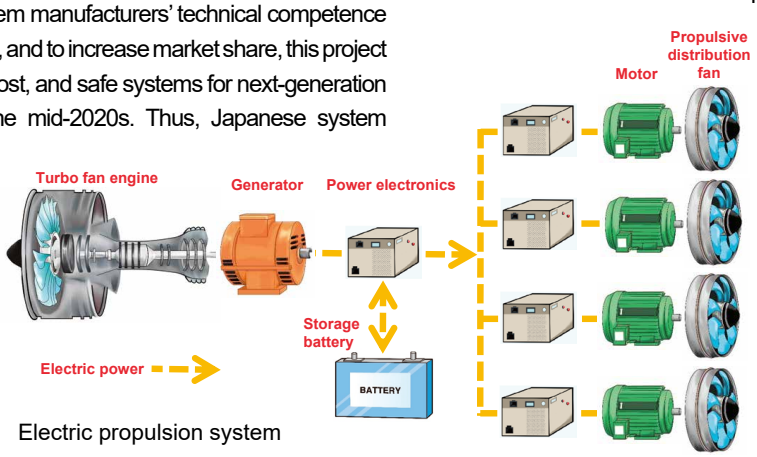
Project Overview

Aircraft components other than the basic structure (e.g. fuselage, wings, and similar sections) and engines are collectively called "systems." There are many system types, such as flight control, air-conditioning, electric, hydraulic and fuel. They have a direct impact on the function and performance of aircraft, and are indispensable elements of aircraft operation. Demands for passenger aircraft are expected to grow dramatically with a doubling of the number over the next 20 years. Aircraft systems, which account for approximately 40% of the total aircraft value, are thus very important.

To take advantage of Japanese system manufacturers' technical competence to enter the system market on a full scale, and to increase market share, this project is intended to develop lightweight, low-cost, and safe systems for next-generation aircraft that can enter service from the mid-2020s. Thus, Japanese system manufacturers will enhance their competence as system integrators to become Tier 1 manufacturers, and contribute to the further development of the Japanese aircraft industry.

In FY2022, this project is focusing on the research and development of a next-generation electric propulsion system.



Electric propulsion system

Description of Research and Development

High-efficiency, high-output electric propulsion system

A high-efficiency, high-output density electric propulsion system using superconductor technology. It will be driven by electricity generated with a gas turbine. Superconductor equipment will be cooled by LN2 using the cold heat of the fuel (LH2, etc.). Basic and systematization research will be promoted for superconductor power generators/cables/motors, low-temperature operating inverters, cooling systems and other devices, with the focus on trial production and evaluation of 500 kW-class fully superconducting motors and 1-MW superconductor propulsion systems, with the aim of realizing electric engine systems for 100- to 200-passenger aircraft.

Lightweight storage batteries

Design of cells and battery control systems and evaluation of prototypes will be conducted to develop storage battery systems required for electric aircraft. Conversion to electric aircraft engines is expected in the future to reduce the environmental burden and other purposes, but existing storage batteries are still too heavy for use on a practical level. To realize practical energy level of lightweight storage batteries for aircraft, research and development of storage batteries using sulfur as the positive electrode active material will be promoted. Particular effort will be made in the research and development of porous carbon particles containing sulfur.

Electric hybrid system

A new-generation electric engine system to replace the existing propulsion systems will be applied to realize dramatically lower fuel consumption and environmental burden. In addition to measures against global warming, the system will contribute to the improvement of the safety and operability of moving vehicles utilizing the improved controllability realized by more sophisticated engine systems. Materials and structures that will enable high-voltage use at high altitudes, a specific challenge concerning the introduction of electric propulsion, will be identified, and on-land demonstration of a next-generation electric engine system will be conducted with the focus on electric control and heat/air management systems.

Motor control system for propulsion

A globally competitive product will be developed by including multiphysics optimum analysis in design and applying superior element technologies to the motor inverter to create a high-power high-density air-cooled motor inverter system. Consideration for certification will also be conducted to realize the motor control system for propulsion.

Drones and Robots for Ecologically Sustainable Societies Project

Project period	FY2017–FY2022	Budget	190 million yen (FY2022)
PL	OSUMI Hisashi (Professor, Chuo University) HARADA Kenya (JAXA) HAYASHI Eiyu (Nikkan Kogyo Shimbun, Ltd.)		OKADA Hiroyuki (Professor, Tamagawa University) TADOKORO Satoshi (Professor, Tohoku University) YOKOKOHJI Yasuyoshi (Professor, Kobe University) EGUCHI Amy (Assistant Professor, University of California, San Diego)

PL = Project Leader; PMgr = Project Manager

Project Overview

It is hoped that the use of drones and robots will help conserve energy, particularly in the logistics sector where there is demand for energy-efficiency due to increased deliveries of small parcels and lighter load ratios, as well as in the infrastructure inspection sector where there is an urgent need to reduce the use of resources by ensuring longer live-spans at infrastructure facilities through effective and efficient inspections.

This project aims to encourage the development of drones and robots that can be used in sectors such as logistics, infrastructure inspections, and disaster response, while also establishing systems and conducting test flights in preparation for their increased utilization.

Domestic and overseas trends of the systems, technologies, standardization, and other aspects of eVTOLs will be also surveyed.

Acting PMgr
(①-(1), ③-(1))
UMEDA Hideyuki
Director General

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PMgr
(③-(2))
HOSOYA Katsumi
Chief Officer

Description of Research and Development

① Development of performance evaluation methods for robots and drone devices

(1) R&D of performance evaluation methods
Establish performance evaluation methods for each sector and robot type, for various types of robots.

(2) R&D to improve energy-saving performance (completed in FY2019)
Develop technology for energy-efficient systems required for increasing the continuous operating time of various types of robots.

(3) R&D on the energy management of UAV (completed in FY2021)
Research and develop peripheral systems such as the energy management system required for increasing the continuous safe operating time of various types of robots.

② Development of UAV Traffic Management System and collision avoidance technologies (completed in FY2021)

(1) Development of UAV Traffic Management System
Develop various functions and systems to ensure that UAVs can be operated safely, based on the Traffic Management System developed under the project which include functionalities for information provision, traffic management and integrated traffic management.

(2) Development of UAV collision avoidance technologies
Develop technologies that enable UAVs to detect objects either on land or in midair, so that they can avoid collisions when flying in real time.

③ Promotion of international standards related to robots and drones

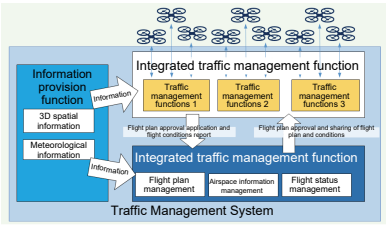
(1) De jure standards
While cooperating on the international level, conduct studies to identify trends among international organizations and other groups around the world promoting standardization, and carry out activities linking the results of this project to international standards.

(2) De facto standards
Technology is being developed at tremendous speeds and robots are the key to developing de facto standards, so Japan will gather information regarding the latest global technology trends and promote methods to accelerate technology development using rules formulated in Japan.

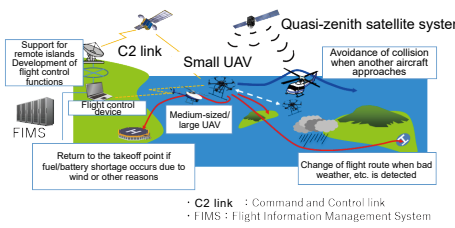
④ Study on leading research on eVTOLs (completed in FY2021)

For eVTOLs, extract elements that must be technologically verified by 2025, create verification items and a demonstration plan, and organize items to be technologically verified and other items to realize automatic and autonomous flights and a dense flight schedule after 2025.

Development of UAV Traffic Management System

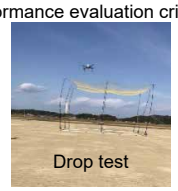


Development of UAV collision avoidance technologies



R&D of performance evaluation criteria

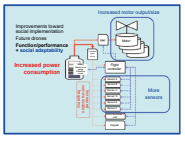
Wind-tunnel test

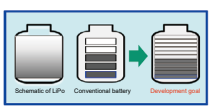


Drop test

Human head collision test

R&D on the energy management of UAV





Reference: Drones and Robots for Ecologically Sustainable Societies Project https://nedo-dress.jp/en/
World Robot Summit (WRS) https://wrs.nedo.go.jp/

Realization of Advanced Air Mobility (ReAMo) Project

Project period	FY2022–FY2026	Budget	2.93 billion yen (FY2022)

PMgr = Project Manager

Project Overview

PMgr
MORI Masato
Chief Officer

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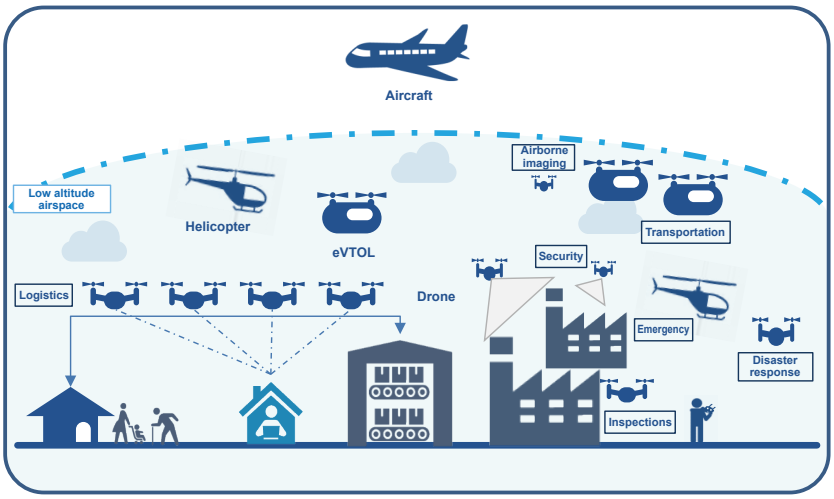
As contact-less operation has come to be required due to the COVID-19 pandemic in addition to higher operational efficiency to address labor shortages and the increase in logistics, forms of advanced air mobility (drones and eVTOLs) are expected to reduce energy use and facilitate the free movement of people and goods without human intervention. To realize these expectations, both the safety of advanced air mobility and efficiency in automatic, autonomous traffic are necessary.

This project aims to develop the technologies required to realize advanced air mobility, such as performance evaluation methods for drones and eVTOLs and technology for comprehensive traffic management for drones, eVTOLs, and existing aircraft to share low altitude airspace in order to reduce energy use and to achieve safe, efficient air transportation.



Description of Research and Development

R&D item 1: Development of performance evaluation methods

(1) Development of drone performance evaluation methods

Develop methods and other procedures to properly evaluate and prove the performance of aircraft, systems, and peripheral technologies with a focus on first-level aircraft identification as per the Civil Aeronautics Act.

(2) Development of eVTOL performance evaluation methods

Develop methods and other procedures to properly evaluate and prove the performance of aircraft, systems, and peripheral technologies in order to prove the airworthiness of eVTOLs.

(3) Development of safety evaluation methods for one pilot-to-multiple drones operation

Compile risk assessment methods and other information required to operate multiple drones by a single pilot in reference to the flight demonstration examples in R&D item ①-(4) in order to establish safety evaluation methods.

(4) Development of elemental technologies for aircraft and systems to operate multiple drones by a single pilot

Develop elemental technologies for aircraft and systems required to operate multiple drones by a single pilot, and carry out demonstration flights in categories III and II in one-many traffic.

R&D item 2: Development of traffic management technologies

Consider, research, and develop how drones, eVTOLs, and existing aircraft should share airspace, and develop comprehensive traffic management technologies for drones, eVTOLs, and existing aircraft to share low altitude airspace.

Strategic Innovation Promotion Program (SIP): Automated Driving for Universal Services

Project period	FY2018–FY2022	Budget	2.48 billion yen (FY2022)
PD	KUZUMAKI Seigo (Company Fellow, Advanced R&D and Engineering Management Division, Toyota Motor Corporation)		

PD = Program Director; PMgr = Project Manager

Project Overview

PMgr
TANAKA Takahiro
Technical Researcher

There are high hopes for the change in society that the realization of automated driving will bring about. This project is intended to ensure that industry, academia and government work together to promote the research and development of automated driving technology in the areas of cooperation, validate the technology through field operational tests and other activities, and plan how to use it in society with an aim to reduce traffic accidents and traffic congestion and resolve social issues such as securing mobility in underpopulated areas, alleviating driver shortages concerning logistics and transportation services for the realization of Society 5.0. NEDO supports the entire project as an administrative organization.

Description of Research and Development

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In this project, research and development in the areas of cooperation are promoted in the following four fields.

I. Development and evaluation of automated driving systems (FOTs: Field Operational Tests)

Build the driving environment required for automated driving including the road transportation infrastructure in the Tokyo waterfront area and local areas. Industry, academia and government will conduct field operational tests together to verify the technological specifications of infrastructure and examine continuous local profitability with the help of local residents, local governments, and other parties.

II. Development of core technology for the practical use of automated driving

Conduct fundamental research and development including the use of geographical data in the automated driving field, creation and distribution of transportation environment information, safety assessment technology in virtual space, detection of external threats and actions against them to ensure cybersecurity, and consideration of the optimum communication method for each automated driving use case.

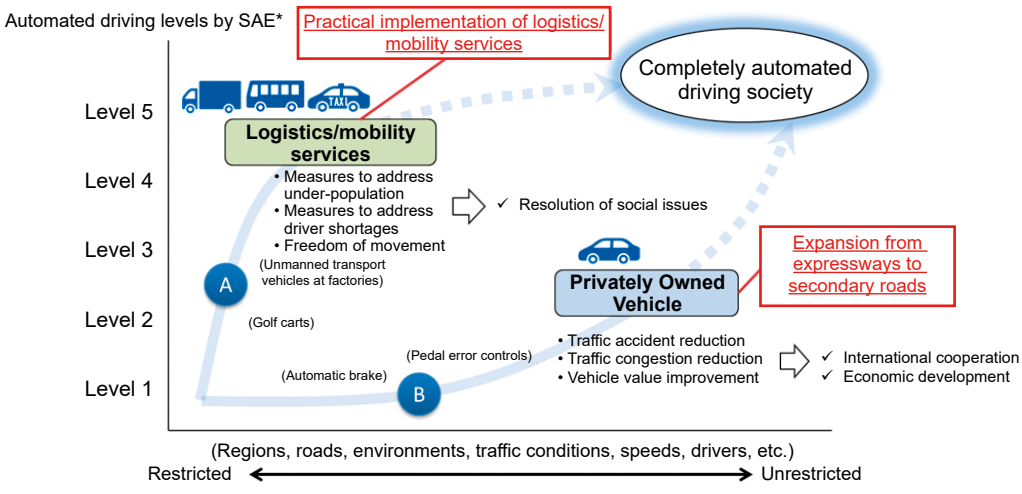
III. Fostering the public acceptance of automated driving

To spread automated driving, clarify the value and issues, distribute information for correct public understanding, and measure the effects of the distribution of that information. In addition, assess the social and economic impact of automated driving and conduct studies to solve social issues such as reduction in traffic accidents and support for people with limited mobility.

IV. Strengthening international collaboration

Promote insight sharing, joint research, and human interaction with other countries where automated driving is being studied and the environment for practical application is being established including Germany and the EU to ensure industrial competitiveness and gain a leading position in international standards in the above three fields.

Website on automated driving: https://en.sip-adus.go.jp/



* Society of Automotive Engineers, a standardization body in the United States

Green Innovation Fund Project

Overview

In October 2020, Japan declared that it would be carbon neutral by 2050 and set a goal to reduce emissions of greenhouse gases to zero in total by 2050. This goal significantly advances the policy that the government already had and requires extraordinary efforts to achieve. We must largely accelerate our current efforts through structural reform in the energy and industry sectors and innovation based on bold investments.

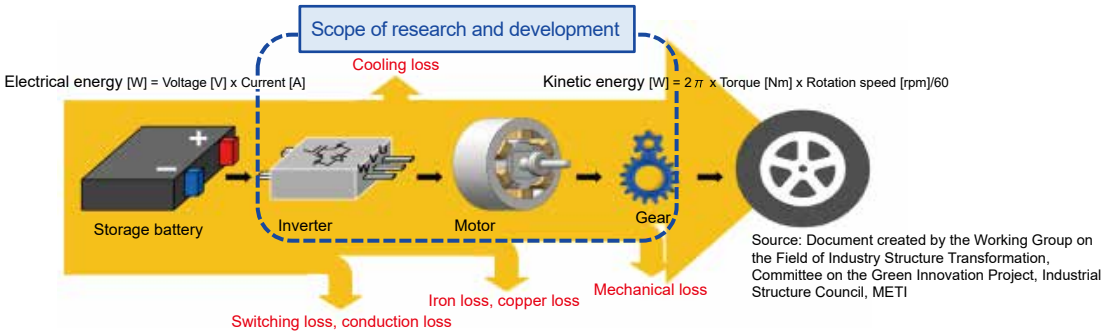
For this purpose, a fund of 2 trillion yen has been established as the Green Innovation Fund Project at NEDO. The organization will share specific ambitious goals in the public and private sectors, and will continuously support companies and other entities that work on these as management issues starting from research and development to demonstration and social implementation for 10 years.

The Robot and Artificial Intelligence Technology Department is carrying out the following two projects.

● Next-generation storage battery and motor development

(R&D item 2) High-efficiency and high-power-density technologies for mobility-related motor systems

This project aims at improving the performance of motor systems (in terms of cost reduction, size and weight reduction, and efficient thermal management) and is attempting to solve many different technological issues, to reduce the use of rare metals and rare earths frequently used in motor components, and to develop materials with low supply chain risks in order to enhance the industrial competitiveness of motors that will support the future electrification of automobiles.



● Development of in-vehicle computing and simulation technology for energy saving in electric vehicles

This project aims at conducting research and development for thorough energy saving, guaranteeing the performance for level 4 automated driving with in-vehicle computing (automated driving software and sensor system), and building the simulation base to accelerate and advance the development of EVs and other vehicles in the supply chain as a whole, assuming a distributed architecture (edge processing orientation).

(R&D item 1) Open platform software for automated driving

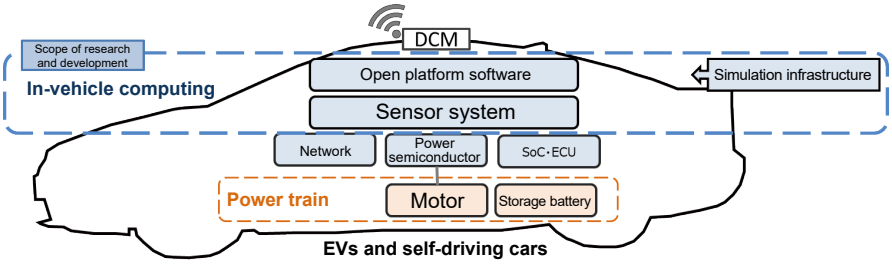
Research and develop high-performance, low-power, open platform software for automated driving that contributes to reducing power consumption by at least 70% compared to existing technologies, guaranteeing functionality for level 4 automated driving in most driving environments.

(R&D item 2) Automated driving sensor system

Research and develop a high-performance, low-power, automated driving sensor system that contributes to reducing power consumption by at least 70% compared to existing technologies, guaranteeing functionality for level 4 automated driving in most driving environments in terms of perception and recognition.

(R&D item 3) Electric vehicle simulation infrastructure

Establish a method for building simulation models of entire EVs using digital twin required to realize level 4 automated driving that supports SOTIF (Safety of The Intended Functionality) in a format shareable by Japanese automobile and parts manufacturers that has a kinetic simulation precision of at least 90% at a level in which the performance verification period using actual equipment can be halved for early practical application of EVs and self-driving cars.



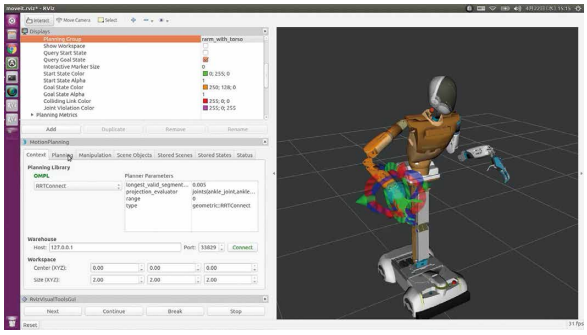
Reference: https://green-innovation.nedo.go.jp/ (Japanese)

Human Resources Development

Workshop aiming at the vitalization of human resource development/exchange and technical research to maintain, disseminate, and improve the common robot software technologies which can accelerate system integration

NEDO allows a wide range of robot engineers to leverage common software technologies for robots using open source software (OSS) and holds a workshop aiming at the vitalization of human resource development/exchange and technical research to maintain, disseminate, and improve the common robot software technologies which can accelerate system integration to maintain and improve the software on a continuous basis.

The workshop features not only for the education of common robot software technologies, and also for establishing systems for opportunities of human resource exchanges related to common robot software and constant maintenance/improvement of the technologies.

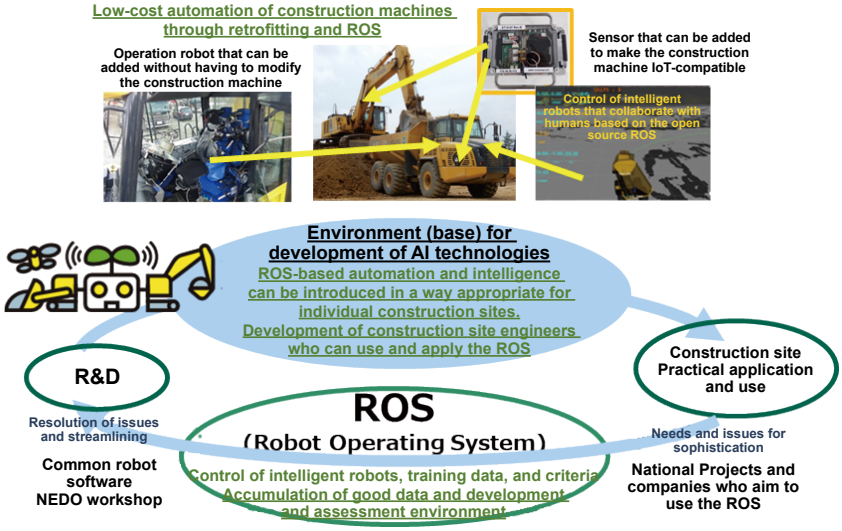


Reference: https://robo-marc.github.io

Courses to develop ROS human resources for small and mid-sized construction companies

Japanese small and mid-sized construction companies have high needs for work automation at civil engineering and construction sites in order to solve issues in their industry (reduction in the sizes of their workforces and aging of their workers). However, small and mid-sized construction companies cannot afford to invest in state-of-the-art automated construction machines. To solve this issue, low-cost automation of existing construction machines through retrofitting and use of open Robot Operating System (ROS) intelligent software has been studied and developed.

In this project, an educational program is organized to develop human resources that can start working immediately and can apply their knowledge to various construction sites through acquisition of autonomous robot technologies for construction work, mathematical knowledge on intelligent software, and knowledge on how to leverage the ROS and intelligent software as well as field work. As a result, small and mid-sized construction companies can develop human resources who can leverage intelligence software and an environment for a virtuous circle of research and development and field use has been established.

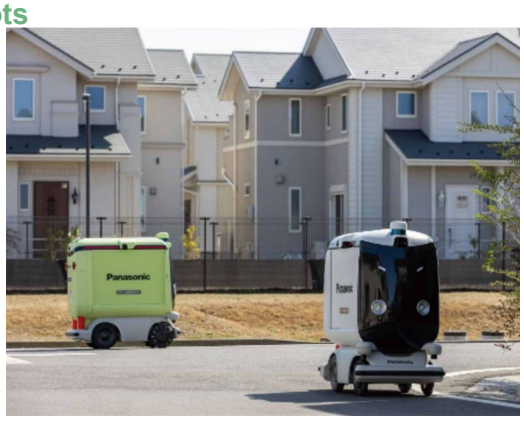


Website for the courses to develop ROS human resources for small and mid-sized construction companies
https://retrofit-ai.com

Workshop on activation of human resource development/exchange and research to spread and develop delivery services that use self-driving robots

NEDO will conduct a human resource development project to realize a new delivery service that uses self-driving robots. We will organize results obtained from the “Technology Development to Realize a New Delivery Service Using Self-Driving Robots” project and release them at seminars and on other occasions to provide information related to matters such as the performance required to ensure safety and guidelines for improving social acceptability for businesses and other organizations that are making plans for a delivery service that uses self-driving robots. NEDO has planned a series of five seminars*. We also organize human interaction to accelerate the realization of the service and conduct peripheral research on the operational safety standards and how to verify robot safety and so on.

*https://www.nedo.go.jp/activities/AN_00011.html



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