## ■Appendix/Strategic Innovation Promotion Program (SIP) Second Period

| Subject | Outline | R&D content |
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| Fundamental cyberspace technologies using big data and AI | Establish and commercialize the world's most advanced human interaction technologies (sense/cognitive technology development, etc.) by merging language and non-language information in real space, data exchange platforms and AI coordination. | (1) Fundamental technologies for human interaction<br>In order to develop "Fundamental technologies for human interaction" that enable high-level coordination of humans and AI in nursing care, education, service and other fields where human-AI collaboration is believed to be effective, develop advanced technologies to provide personalized support for situation assessment and communication by collecting and structuring non-verbal data on human actions and cognition, and advanced interactive processing technologies that enable memorization, integration, recognition and judgment of information obtained through multiple senses.<br>(2) Cross-cut data coordination platform<br>R&D for cross-cut data sharing and utilization in order to coordinate data separately held in industry, government and academia and supply the data as big data usable for AI<br>(3) Fundamental technology for AI-AI coordination<br>Develop protocols, vocabularies, algorisms, etc. for automatic cooperation and coordination of multiple AIs so that they can cooperate to automatically adjust win-win conditions, etc. |
| Fundamental digital data processing technologies in physical space | Develop and commercialize the world's most advanced fundamental technologies that enable high-performance sensing, highly efficient data processing and close coordination with the cyber side. | (1) Common fundamental technologies for IoT solution development<br>In order to build a common base that enables even people who are not IT experts to easily solve difficult problems by gathering, processing and using data from the real world, develop technologies that simplify construction and operation of IoT systems.<br>(2) Ultra-low power consumption IoT chip and innovative sensor technologies<br>Downsize sensors, reduce their power consumption and develop room temperature power generation technologies in order to create sensors that can be used in environments without power sources and fields where data acquisition is difficult with existing technologies.<br>(3) Social implementation technologies for Society 5.0<br>Create concrete application cases for social implementation of common fundamental technologies for IoT solution development. |

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| Cyber and physical security matching an IoT society | Promote what will be the world's cutting-edge "cyber and physical security measure base" that can be used for protection of the entire supply chain including SMEs, while at the same time strengthening cooperation with the United States and European and other countries to ensure international standardization and social implementation in order to protect various IoT equipment and establish the safety and security of the entire society toward secure Society 5.0. | (1) R&D of technologies for "creation of trust and certification"<br>In order to ensure and certify security of individual components of IoT devices and the supply chain, develop: chips that are loaded onto individual IoT devices and detect unauthorized processing; authenticity determination technologies to detect mixing of unauthorized IoT devices, and; technologies for assessment of reliability of operation procedures of equipment assembly and subsequent verification<br>(2) Development of technologies for "trust chain construction and distribution"<br>In order to enable selection of reliable partner companies when building a new supply chain, build a "credible place" for mutual monitoring of participating companies, and a "Trust Store" for cross reference of reliable equipment, procedures, etc.<br>(3) Development of technologies to "examine and maintain trust chains"<br>In order to maintain reliable supply chains, develop technology to speed up detection and analysis of and response to security abnormalities, and operation technologies to build reliable supply chains beyond the boundaries of countries and industries. |
| Automatic driving (expansion of systems and services) | Establish the world's most advanced core technologies (e.g. technologies on collection and distribution of road traffic information including signal and probe information) that are cooperation areas of auto manufacturers, construct a basis for realization of Level 3 automatic driving on open roads and commercialize the technologies. | (1) Development and verification of an automated driving system (demonstration experiment)<br>In order to expand practical application of automated driving from highways to general roads, verify technologies toward realization of automated driving based on infrastructure cooperation through demonstration experiments in actual traffic environments by using traffic environment information including signaling and merging support information.<br>(2) Development of fundamental technologies toward practical application of automated driving<br>In order to advance automated driving technologies, develop evaluation tools to simulate pedestrians, weather conditions and traffic environment in a virtual space and technologies to provide traffic environment information.<br>(3) Fostering social acceptance of automated driving<br>In order to foster social acceptance, hold events for citizens, local governments, etc. and assess impacts of reduction of traffic accidents caused by automated driving.<br>(4) Strengthen international cooperation<br>The government is sending out information to the world and promoting standardization for international cooperation |

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| Materials revolution through an integrated materials development system | Toward substantial reduction of material development cost and time, realize and commercialize the world's most advanced inverse problem materials integration (prediction of optimum materials, processes and structures based on the desired performance) and thereby contribute to the development of super high-performance materials and establish a reliability evaluation technology. | (1) Development of fundamental technologies of inverse problem materials integration (MI)<br>In order to realize inverse problem MI that predicts optimum materials, processes and structures based on the desired performance, develop: new computation modules; technology to design structure from atoms; a system that integrates them, and: database underlying the development of structural materials.<br>(2) Application of inverse problem MI to practical structural materials<br>In order to apply inverse problem MI to actual structural materials, develop: practical members using carbon fiber reinforced plastics (CFRP), aluminum alloys, etc. taking advantage of inverse problem MI, and; new powder processing technologies including three dimensional laminating molding. |
| Society 5.0 realization technology using photon/quantum | Develop and commercialize the world's most advanced processing technologies using light quantum technology (e.g. laser machining), optoelectronic information processing and communication (quantum cryptography). | (1) Laser machining<br>In order to achieve the world's top-level processing productivity in the manufacturing industry, which includes 90% reduction of lead time of initial condition selection of laser machining, the government is developing: a laser machining system that sophisticatedly merges simulator and laser machining; a highly light-resistant and high accuracy spatial light modulator technology, and; research to increase the output of the government's first photonic crystal laser.<br>(2) Photon quantum communication<br>For social implementation of services of safe and secure communication and cryptography, the government is developing quantum cryptography devices, and a quantum secure cloud system that provides new concealed applications including completely concealed data transmission, backup storage and secondary use.<br>(3) Optoelectronic information processing<br>Toward the world's fastest processing of combination optimization for smart manufacturing, the government is developing the next-generation accelerator basis to select the optimum computer. |

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| Smart bioindustry and agricultural infrastructure technology | For the food industry value chain, covering the range from production and distribution up to recycling with focus on agriculture, demonstrate model cases of the food value chain that reduce environmental burden using "Bio X Digital," which also targets "the venous system" including export expansion of agricultural products and processed goods, strengthening of production fields (productivity improvement and workload reduction) and container packaging recycling. | (1) Sustainability of agriculture<br>In order to strengthen agricultural management, improve productivity of unit farm household and increase the number of new farmers, the government is developing: a smart food chain that automatically collects various data from production to consumption, uses AI, etc. to optimize a series of food chains and make two-way connection of information from production to distribution and sales, and; smart production technologies and systems.<br>(2) Sustainability of food<br>In order to stabilize the demand and supply balance, reduce food waste and supply food in accordance with market needs, the government is developing crop varieties through data-driven breeding taking advantage of big data and biotechnologies, and a system for evaluation of health effects of agriculture, forestry and fisheries products and foods.<br>(3) Sustainability of food-related global resource environment<br>In order to use nonedible parts as material, enhance functions and added value of food-based bio materials and reduce the environmental burden of bio industries, the government is developing technologies for selective extraction of nonedible parts and productization of all components, and molecular structure design and control technologies for use of bio materials and efficient implementation. |
| Energy system of IoE society | Carry out concept design of the energy system that contributes to optimization of energy demand and supply, develop common fundamental technologies (power electronics) and conduct practical application R&D (wireless power transmission system), while at the same time advancing system development and standardization for social implementation. | (1) Design of an energy system for an IoE society<br>In order to study design of an energy system for a society where renewable energy is the main power source, the Energy Management Study Group takes a leadership role in designing an energy management system of an IoE society where dispersed power sources including solar cells, storage batteries, hydrogen generation and electric car are connected through power electronics devices. |

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| | | (2) Common fundamental technologies for IoE<br>In order to realize the Universal Smart Power Module (USPM) that can always highly efficiently handle fluctuating power sources such as renewable energy and is expected to replace existing power converters, we are developing MOSFET that is a kind of field effect transistor capable of low-cost and high-speed digital control, and devices taking advantage of gallium nitride, which can be a fundamental technology of wireless power supply.<br>(3) IoE application R&D<br>In order to realize energy management using long-distance, highly efficient, high-power and highly safe wireless electric power transmission technology, the government is improving the efficiency of wireless power transmission to indoor sensors and information equipment, flying drones, etc. and developing transmission control technology |
| Enhancement of national resilience (disaster prevention/mitigation) | Construct an information system to support decision making by the national and municipal governments by using satellites, AI big data and other latest science and technologies in case of a large-scale disaster. | (1) Development of an integrated system to support evacuation and emergency activities<br>In order to support the government's broad-area evacuation and emergency activities to ensure evacuation of every citizen, the government is developing technologies for speedy utilization of information on social dynamics using big data at the time of disaster, and observation/analysis of 1) disaster situations by using satellites, etc. for the government's disaster prevention activities, and 2) typhoons and trainings with necessary probability and lead-time for broad-area emergency response, evacuation activities, etc.<br>(2) Development of an Integrated system for disaster response by municipalities<br>In order to support decisions on evacuation advisory/order by municipalities, the government is developing an information processing technology to analyze big data in a short period of time and automatically extract information necessary to determine the timing of designation of evacuation areas and issuing of evacuation advisory/order. |

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| Advanced diagnosis and treatment system at AI hospitals | Develop, construct and socially implement the "AI hospital system" using AI, IoT and big data to provide advanced medical services and improve efficiency in hospitals (drastic reduction of burden on doctors and nurses.) | (1) Construction of highly secure medical information database and development of technologies to extract and analyze useful medical information using the database<br>In order to construct a multilingual medical system consisting of clinical, image, pathology, biochemistry and other data, and with due consideration to protection of personal information and cyber attack defense, the government is constructing a highly secure medical information database and developing technology to extract and analyze useful medical information using the database<br>(2) Automatic documentation of medical records using AI, development of an interactive communication system based on AI for informed consent and development of diagnosis/treatment system using AI<br>In order to improve patients' satisfaction and reduce burden on medical workers, the government is developing AI technology applicable to medical record creation and informed consent, and an AI platform for medical use to support the process from diagnosis to selection of optimal treatment.<br>(3) Development of very precise blood and other examinations with application of AI technology, which helps reduction of burden on the patients and very early diagnosis of cancer relapse, etc.<br>Develop very precise blood and other examinations with application of AI technology, which is useful for identification of cancer patients, and very early diagnosis of relapse/recurrence, in order to reduce burden on the patients.<br>(4) Research evaluation by demonstration experiments based on the installation of AI hospital functions in medical practice<br>In order to construct a more convenient system for medical practice, install developed technologies and sensors in hospitals and promote learning of diagnosis/judgment system by an AI technology system.<br>(5) Technology standardization/ open-close strategy for dissemination of systems, which include IP management related to AI hospital R&D, and matching for public-private collaboration<br>In order to spread developed technologies to medical practice, solve various social challenges (e.g. cost, IP strategy) involved in digitalization and utilization of medical information. |

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| Smart material distribution service | Utilize data handled in the processes from production to distribution, sales and consumption in a streamlined manner, build and commercialize optimized production and distribution systems. | (1) Technology concerning logistics and sales channel data infrastructure<br>In order to build a logistics/sales channel environment that can create innovations by increasing vertical and horizontal connectivity of players in a supply chain, and create values including on-demand service and traceability, the government is developing and expanding prototypes of logistics and sales channel data infrastructure integrating the supply chain of each industry from the upstream to downstream parts, and developing technologies for their sophistication and data infrastructure construction.<br>(2) Automatic data collection technology contributing to labor saving and automation<br>For visualization of logistics and sales channel data held by various players in the supply chain by using innovative technologies, the government is developing an automated data collection system to obtain various kinds of information including traceability, load factor and loading state, with the aim of automatically collecting not-yet obtained information and importing the information into the logistics and sales channel data infrastructure. |
| Innovative deep sea resource survey technology | Toward utilization of rich ocean mineral resources within the exclusive economic zone of Japan, lead the world in establishing, demonstrating and commercializing technologies to survey ocean resources deeper than 2,000m below sea level. | (1) Abundance survey and analysis of marine mineral resources including rare earth mud<br>The government is conducting synoptic resources assessment in order to narrow places with high development possibility of sediment containing rare earth (rare earth mud) in the sea area surrounding Minami-Torishima within the exclusive economic zone of Japan.<br>(2.1) Development of deep sea resource mapping technologies (a technology to operate multiple deep sea autonomous unmanned vehicles (AUVs) and a deep sea terminal technology)<br>In order to capture real images of a wide variety of deep sea resources in sea areas from 2,000m to 6,000m below sea level, the government is developing a technology to simultaneously operate multiple AUVs and a deep sea terminal technology for charging, which enables long submersion of AUVs<br>(2.2) Development of deep sea resource production technologies (technologies for loosening, collecting and lifting of rare earth mud)<br>For continual collection of rare earth mud on the deep sea floor, the deep sea scientific drilling vessel CHIKYU is used for demonstration of a series of operations in an actual sea area from mud loosening (making rare earth mud easier to collect,) and collection to lifting (transporting mud through liquid circulation in a pipe) onto the ship. |

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| | | (3) Demonstration of a marine resource survey and development system<br>For stepwise advancement of future contracts of oceanographic investigations and industrialization of resource development, an integrated demonstration of the developed survey and production system has been conducted using the environmental impact assessment method. |