Impulsing Paradigm Change Through Disruptive Technologies (ImPACT) Program : Summary of Each Program's Achievements

July 2020

Future Innovation Research Division

Cabinet Office

A Program Summary of ImPACT

Background to its Establishment

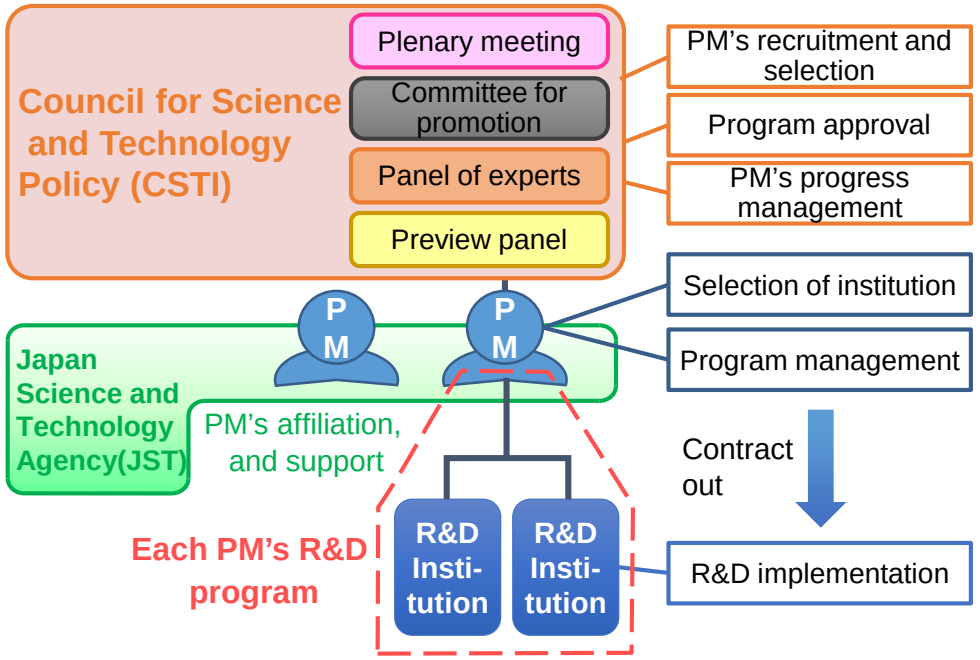
- Its establishment was decided based on the Comprehensive Strategy on Science, Technology and Innovation, and the Japan Revitalization Strategy (Cabinet decision on June, 2013).

- Fifty-five billion yen was allocated to the supplementary budget for 2013, and the Act on Japan Science and Technology Agency was partially revised to establish the five-year fund.

Project Schemes

○Promote high-risk, high-impact R&D to create disruptive innovations that will bring about major changes in the state of industry and society.

- Referred to **the structure of US DARPA (the Defense Advanced Research Projects Agency)** which was successful in creating disruptive innovation through high-risk research.
- Introduced a method unprecedented in Japan to **provide budgets and authority** not to researchers but to program managers **(PMs)** who have the role to plan, carry out, and manage R&D as the producer.
- PMs demonstrate their ability to make good judgments, **to bring together top-level research institutions**, and strongly promote disruptive R&D**.**



PMs Management of R&D Programs

Creation of R&D program | **Implementation of R&D program**

Design of entire R&D → **Selection of excellent researchers** → **Management of R&D**

Show ideas to realize the concept, and formulate a "hypothesis to success"

Gather necessary technologies and human resources, try to integrate different fields, and take leadership of the team

Manage the progress of R&D, and flexibly judge and rule on acceleration, deceleration, suspension, and changes in direction

ImPACT Program Manager (PM)

(Allocated Amount: Yen) *Rounded to the nearest 100 million yen

ITO Kohzo (4.9 bn.)
Realizing Ultra-Thin and Flexible Tough Polymers

GODA Keisuke (3.0 bn.)
Cell Search Engine
- Turning Serendipity into Planned Happenstance -

SANO Yuji (3.5 bn.)
Ubiquitous Power Laser for Achieving a Safe, Secure and Longevity Society

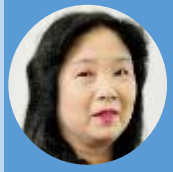
SAHASHI Masashi (4.5 bn.)
Realization of ultimate eco-IT equipment that can be used for a long time without charging

SANKAI Yoshiyuki (3.5 bn.)
Innovative Cybernic System for "ZERO Burdening-care Society"

SUZUKI Takane (3.0 bn.)
Super High‐Function Structural Proteins to Transform the Basic Materials Industry

TADOKORO Satoshi (3.6 bn.)
Tough Robotics Challenge (TRC)

FUJITA Reiko (3.4 bn.)
Reduction and Resource Recycle of High Level Radioactive Wastes through Nuclear Transmutation



MIYATA Reiko (2.7 bn.)
Ultra High-Speed Multiplexed Sensing System Beyond Evolution for the Detection of Extremely Small Quantities of Substances

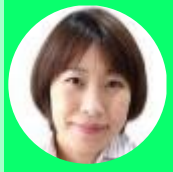
YAGI Takayuki (3.0 bn.)
Innovative Visualization Technology to Lead to Creation of a New Growth Industry

YAMAKAWA Yoshinori (3.3 bn.)
Actualize Energetic Life by Creating Brain Information Industries

YAMAMOTO Yoshihisa (3.0 bn.)
Advanced Information Society Infrastructure Linking Coherent Ising Machines and Quantum Secure Network

SHIRASAKA Seiko (2.0 bn.)
Small Synthetic Aperture Radar Satellite System for On-Demand Observation

NOJI Hiroyuki (1.8 bn.)
Artificial Cell Reactor Technology for an Enriched and Secure Society and New Bioengineering



HARADA Kanako (1.6 bn.)
Bionic Humanoids Propelling New Industrial Revolution

HARADA Hiroshi (2.3 bn.)
An Ultra Big Data Platform for Reducing Social Risks

：Selected on June 24, 2014

：Selected on September 18, 2015

革新的研究開発推進プログラム
ImPACT
Impulsing Paradigm Change through Disruptive Technologies Program

Realizing Ultra-Thin and Flexible Tough Polymers

ITO Kohzo
PM

PM's Challenge

- Aim for energy saving and dramatic durability improvement of various products and services, including vehicles.
- Develop "flexible tough polymers," more light-weight and tougher new plastic materials (polymers) that replace existing metal structural materials.

[Main achievements]

(1) Achieved almost the same toughness as before plus ten-fold elongation at break of polymers for car body structure.

(2) Developed approximately 50% lighter-weight transparent polymers with strength required for sunroof.

(3) Developed components of actual car size, and made and demonstrated concept car of 90% polymer (by volume).

[Impact on industry and society]

(1) Contribution to reduced environmental load (energy saving) by making lighter-weight cars.

(2) Contribution to product safety improvement by expanding into plastic components of prosthetic limbs and wearable goods.

[Other achievements]

- Promoted cooperation and formed cross-sectional human network through industry-academia matrix operating structure.
- Published approximately 300 original papers.

Created light-weight, flexible and tough polymers that contribute to society via increased safety, security, and that has low environmental impact.

Demonstrated car evolution by introducing components using "flexible tough polymers"
(Display and test drive experience implemented in Tokyo, Osaka, Kobe, and others.)

∗Result of iron ball (227g) drop test (8.5m)

Expansion to other components besides cars: prosthetic running blades

- Improve strength 5%
- Not split in two without broken pieces during destruction

↓

Safety improvement

(Left) Tough polymer CFRP composite Delamination (Not broken)

(Right) Conventional CFRP composite Broken

Cell Search Engine
- Turning Serendipity into Planned Happenstance -

GODA
Keisuke PM

PM's Challenge

- Aim for innovation in bioindustry and healthcare by ultimately streamlining identification and selection of cells that require tremendous time and effort in conventional biology and medical science.
- Develop and demonstrate cell search engine that turns serendipity into planned happenstance.

[Main achievements]

(1) Succeeded in development and demonstration of cell search engine with artificial intelligence. (Published in journal *Cell*.)

(2) More than 1000 times faster than conventional technology.

[Impact on industry and society]

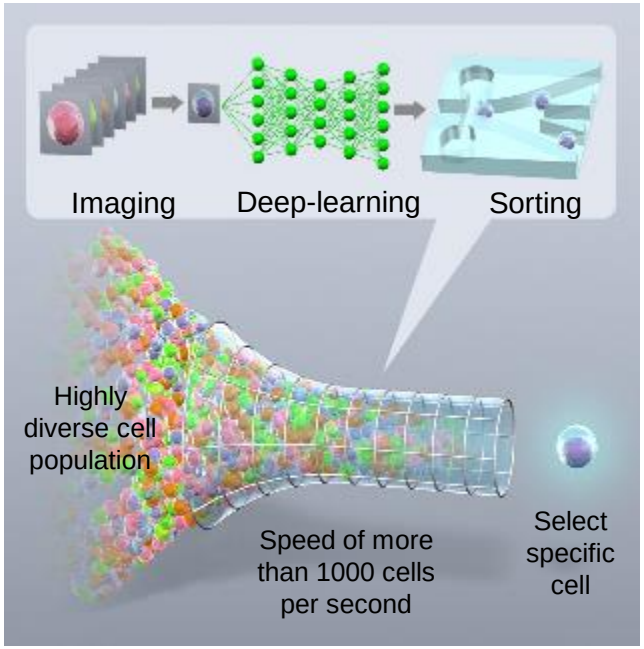
(1) Succeeded in ultra high-speed sorting of algae gene variants that perform unique photosynthesis. (Shortened work which previously required half a year to 40 minutes.) →Contribute to prevention of global warming, biofuel development, and increase in grain production.

(2) Succeeded in ultra high-speed sorting of platelet clump in blood that causes thrombosis. (Shortened work which previously required one day to one minute.) →Contribute to overcoming cerebral infarction (national affliction), the top-ranked factor in being bedridden.

[Other achievements]

- Venture established: 3 companies (CYBO, Cupido, Live Cell Diagnosis)
- Achievement symposium was published in journal *Nature*.

Developed the world's first base technology that performs fluorescence observation and comprehensively identifies cells one by one and selects desired cell according to analysis results using real-time deep-learning.



Nitta et al., *Cell* 175, 266 (2018)

Expected application examples

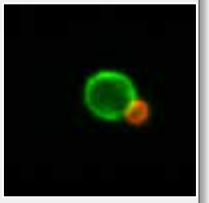
<Green innovation>

Prevention of global warming

Biofuel

<Life innovation>

Thrombosis test



Detection of cancer

Ubiquitous Power Laser for Achieving a Safe, Secure and Longevity Society

SANO Yuji
PM

PM's Challenge

- Demonstrate concept of miniaturization of XFEL (X-ray Free Electron Laser) from order of 1km to trailer size by laser wake field acceleration technique to make it accessible and useful in developing materials.
- Miniaturize "high-power pulse laser" usable in infrastructure maintenance and medical treatment, etc., so anyone can use it anytime, anywhere, contributing innovation and creation of industries.

[Main achievements]

(1) Succeeded for the first time in the world in laser acceleration of electron with sufficient stability and reproducibility in an unique laser multistage scheme.

(2) Developed and verified the world's shortest period undulator*1 that does not require fine tuning.

*1 laser generator

(3) Realized palmtop-sized power lasers with a new structure that can enhance cooling of laser medium and increase laser power.

[Impact on industry and society]

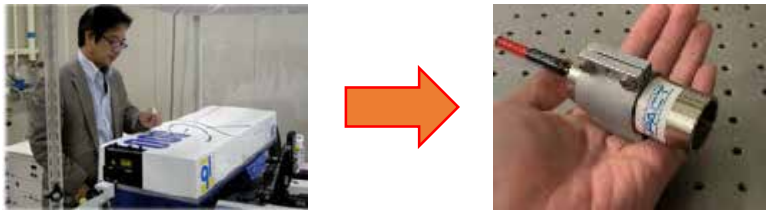
(1) Productized and began sales of palmtop-sized high power lasers by domestic companies. Applications in manufacturing, infrastructure maintenance, healthcare, security, etc., are expected.

(2) Application to drug development, etc., through early realization of XFEL miniaturization is expected.

[Other achievements]

• Opened "laser trial platform for users," and founded a consortium to expand laser applications.

Developed, productized, and began sales of world's smallest (palmtop-size) and low-cost ultra compact power lasers.



Conventional　　Developed product

Application examples

Manufacturing

Strengthen materials by iron ball　　Strengthen materials by laser

Infrastructure maintenance

Set up inspection scaffolding　　Inspect by laser from drone

Healthcare

Treatment of birthmarks and brown spots

Security

Monitoring of hazardous objects　　Automated baggage screening machine　　Airport luggage screening machine

Realization of ultimate eco-IT equipment that can be used for a long time without charging

SAHASHI Masashi PM

PM's Challenge

- Resolve social challenges such as explosively growing data processing, and suppressing the increased device power consumption.
- Realize ultimate eco-IT device to enable ultra-low power consumption by magnetic memory (MRAM) through world-leading spintronics technology*1.

＊1 Technology that brings out various functions by using two properties called electric charge and magnetic (spin) in electronics

[Main achievements]

(1) For the first time in the world, succeeded in developing a non-volatile microcontroller unit (equipped with magnetic memory) with ultra-low power consumption performance, which can be driven by indoor light battery.

(2) Demonstrated for the first time in the world a new writing principle that enables both significant improvement*1 of writing speed and high writing endurance *2 in voltage-driven magnetic memory.

＊1 more than 10 times writing speed, ＊2 writing endurance of 10^{15} or more

[Impact on industry and society]

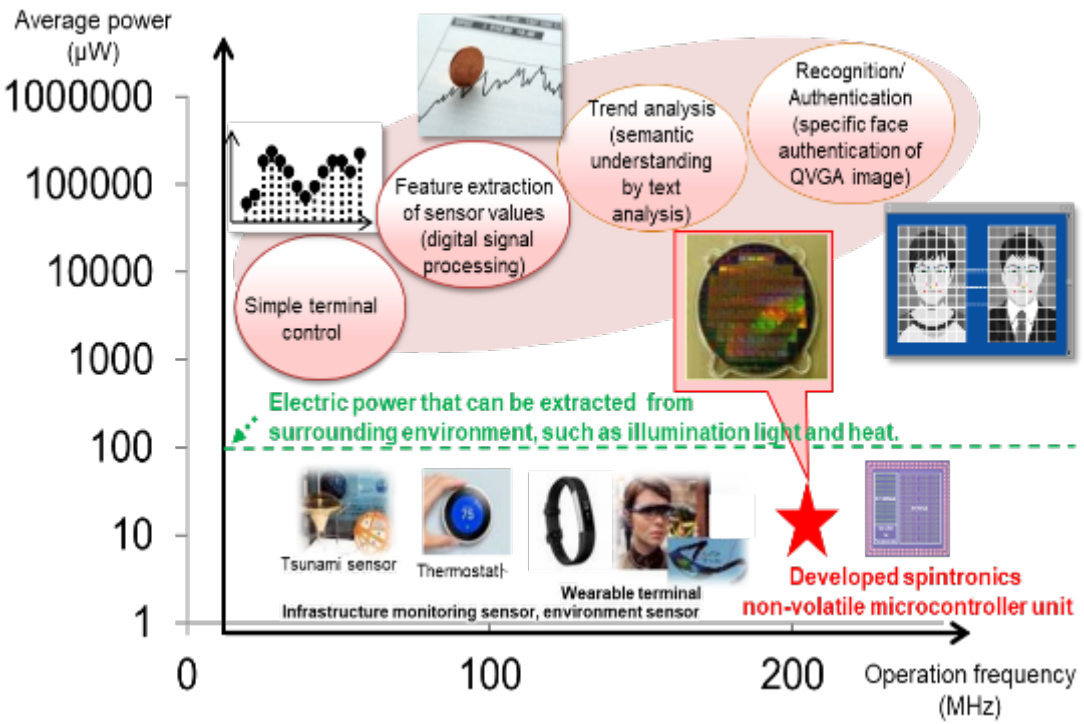
(1) More than 90% reduction in power consumption is expected in distributed cooperative systems such as in-vehicle/IoT and so on, and approximately 50% in digital information appliances.

(2) In the second phase of SIP, challenge the social implementation on the system side.

[Other achievements]

- Patents: 216 applications (102 applications)*3, 88 registrations (50 registrations)*3
  ＊3 Number in brackets are overseas.
- Papers: 257 (*Nature*-related journals, etc., including those adopted in major international meetings such as ISSCC and Joint-MMM Intermag, and invited lectures)
- Venture established: two companies (Spin-Orbitronics Technologies, Inc., Power Spin Inc.)

Developed non-volatile microcontroller unit that can drastically reduce power consumption in IoT/AI era, and innovative technology of magnetic memory.



Innovative Cybernic System for “ZERO Burdening-care Society”

SANKAI
Yoshiyuki PM

PM’s Challenge

- Simultaneously develop technical initiatives of “Innovative Cybernic System” that improves, regenerates and assists human functions through a fusion/combination of the human brain-nervous system and robot information system, and social initiatives. Also, challenge to solve the social issue of burdening-care in a seriously super-aging society with a declining birthrate, and to create innovation. --> Realization of future society, “Society 5.0/5.1,” which fused “Human” + “CyberPhysical space” and creation of the new “Cybernics Industry”!

[Main achievements]

(1) Prototype of Wearable Cyborg HAL for children. Regeneration of patient’s function with complete spinal cord injury, and academic findings. Significant improvement of ambulatory function of the early stage bedridden elderly. Toilet-docking robot. Cybernic interface which acquires brain-nervous and physiological systems, etc.

(2) Construction of Cybernic system that connects brain-nervous system to a supercomputer/cloud.

[Impact on industry and society]

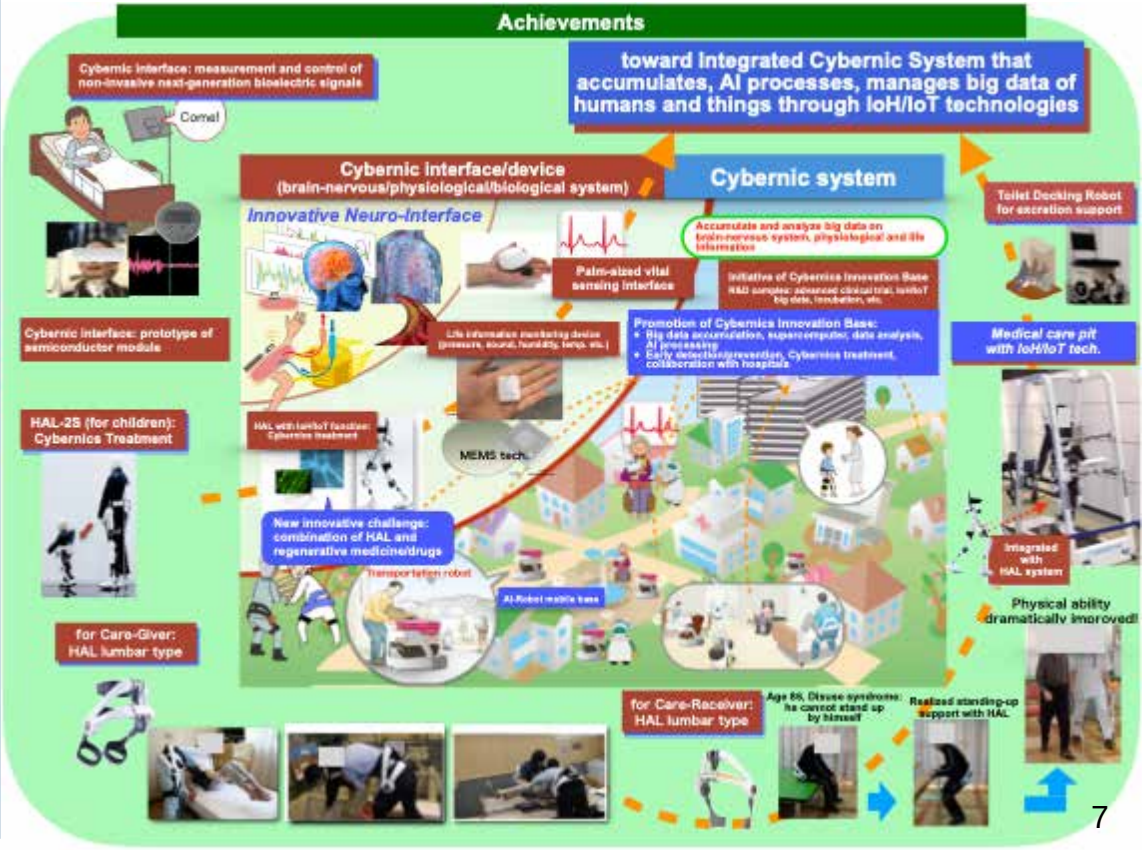
(1) Realized JIS and international standardizations for wearable cyborg-type robots for medical, well-being and life support.

(2) Established cooperative body for “Cybernics Industry” creation, “CEJ Fund,” and started activity during the ImPACT Program period.

[Other achievements]

- Outreach: more than 250 cases
  Received visits through G7 (science and technology) and G20 (digital economy and trade) and explained Cybernics tech and industry to ministers. Disseminated to key government and business leaders in and out of Japan.

Established a leading model in order to realize “ZERO Burdening - care Society,” by fusing neuromuscular/physical systems, robots and information systems



Super High - Function Structural Proteins to Transform the Basic Materials Industry

SUZUKI
Takane PM

PM's Challenge

- To break away from the creation of goods that rely on depleted resources such as oil, establish design and production processes for artificial structural proteins*1 with performance and functions exceeding natural proteins.
- Create new industries by expanding artificial structural protein materials to fields with high needs of next generation materials such as apparel and rubber products.

*1 Proteins with structural roles like spider silk and skin

[Main achievements]

(1) Constructed the world's first structural protein integrated DB*1. By using this knowledge, designed artificial structural protein which suppressed the shrink factor by 90%*2 when contacting with water.

*1 Database *2 Compared to when R&D started.

(2) Developed composite material using artificial structural proteins for the first time in the world, and improved strength, elasticity, and stretch compared with existing composite materials.

[Impact on industry and society]

(1) Creation of sustainable goods can be expected by breaking away from depleted resources.

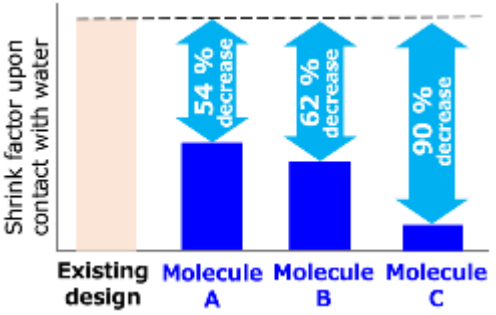
(2) Application to clothing, and test production of transportation equipment components, etc., of fiber and composite material made by artificial structural proteins.

[Other achievements]

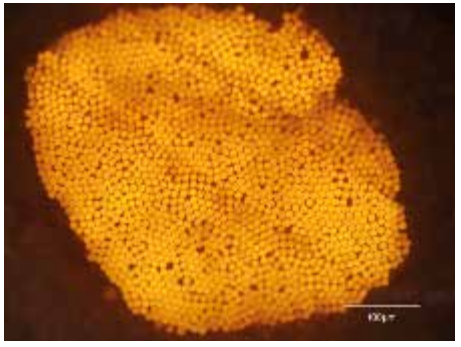
- Established Intelligence Consortium to construct and manage patent portfolio and build a platform for application to society.

Developed artificial structural protein fiber which is great in strength, stretch and water resistance, and utilize it for clothing, etc.

Designed artificial structural protein with improved water resistance by utilizing data gathered from natural spider silk. Overcame shrinkage by water, which is an issue for protein fibers.



Established 1000 hole mass production process with small diameter of 13μm



Applied the said fiber to a surface cloth for outer jackets, which are exposed to water. Limited sale in December 2019 from GOLDWIN, Inc.

Application of composite material to auto products. Confirmed performance advantages by comparison to existing products.

Tough Robotics Challenge (TRC)

TADOKORO Satoshi PM

PM's Challenge

- With the aim of having remote autonomous robots save human lives and conduct emergency construction work in extreme environments assumed at the time of disasters, develop essential technologies for robots that are tough to contribute to disaster prevention, emergency response and advanced recovery, and build the foundation to ripple into industry.

[Main achievements]

(1) Aerial robot that can gather information by flying even under bad environmental conditions, such as strong wind (15 m/s), and heavy rain (300 mm/h).

(2) Snake-shaped robot that can enter narrow places in rubble and industrial facility to search, inspect and extinguish fires. (World first)

(3) Cyber-rescue dog suit that can monitor rescue dog's search and provide direction for action. (World first)

[Impact on industry and society]

(1) Went into action during heavy rain in northern Kyushu and in West Japan, and Kumamoto earthquake, etc. The fire department adopted several dozen aerial robots.

(2) Japan Rescue Dog Association uses the dog suit in their monthly training.

(3) Expansion of use in peacetime, such as inspection of hard to access places, is expected.

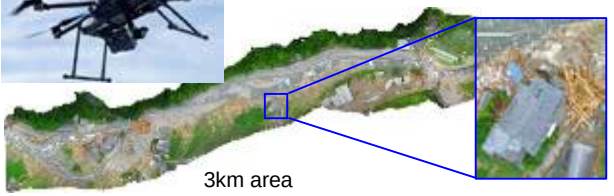
[Other achievements]

(1) Open field evaluation forums held in a simulated environment in the Fukushima Robot Test Field, etc. (twice a year, 500 participants)

Developed a systems and element technology for realization of a "tough and robust" robots, and demonstrated during field evaluation meetings.

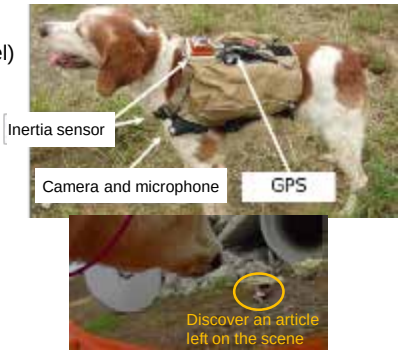
Aerial robot

Used during heavy rain in northern Kyushu
(Ortho-image acquired, resolution 2 cm/pixel)



3km area

Cyber-rescue dog



Snake-shaped (cord) robot

(small diameter)

Landslide during heavy rain in West Japan
Investigated a collapsed house

(large diameter)

Inspect by climbing ladder

Look of field evaluation meeting

Reduction and Resource Recycle of High Level Radioactive Wastes through Nuclear Transmutation

FUJITA Reiko
PM

PM's Challenge

- Aim at zero by reducing burden of disposing of high-level radioactive wastes (HLW) and through resource recycling.
- To realize the above, establish a new disposal process concept, to convert long lived fission products (LLFP *1) included in HLW to nuclides with short-lived nuclides or useful precious metals.

*1Radioactive materials whose half-life is 100,000 years or more.

[Main achievements]

(1) Developed a method to recover only odd-nuclides including LLFP of palladium (Pd) isotopes (separation of even- and odd-nuclides) for the first time in the world. Throughput is 100,000 times larger than the previous study.

(2) Conducted demonstration test of nuclear transmutation by irradiating LLFP ^{107}Pd (half-life 6,500,000 years) with a deuteron beam for the first time in the world, and completed conceptual plant design of large-capacity accelerator facility that realizes nuclear transmutation.

[Impact on industry and society]

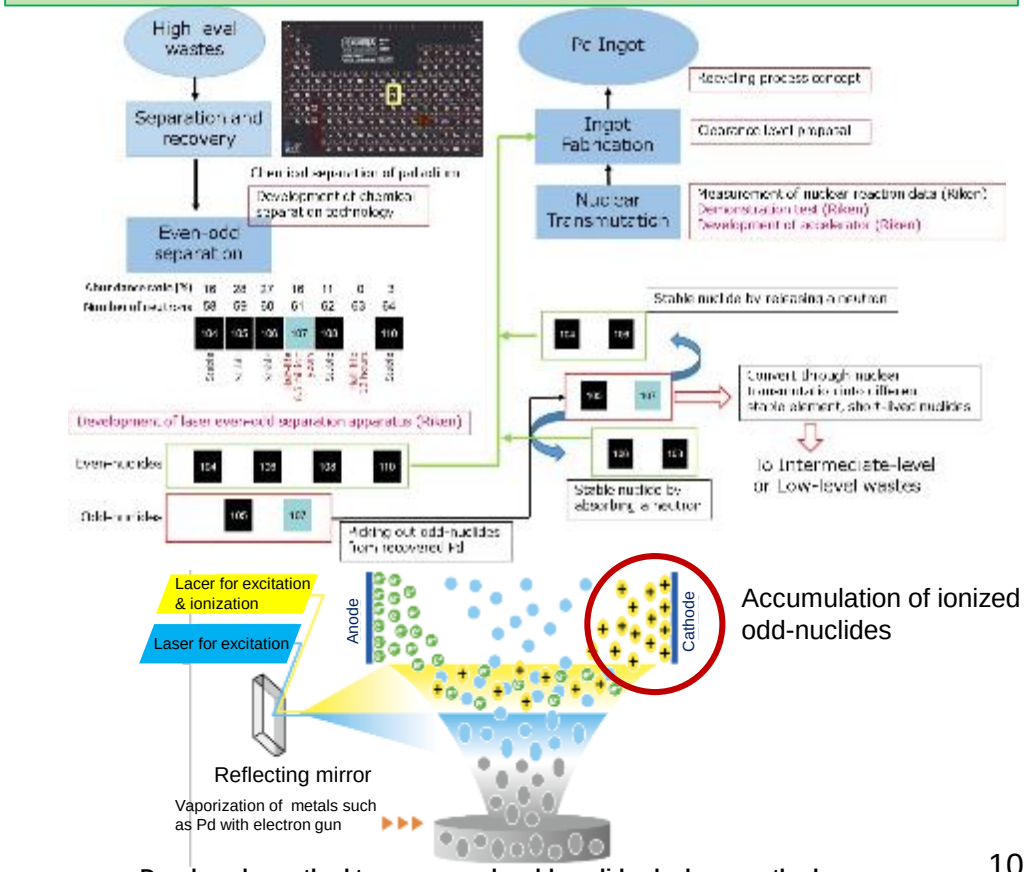
(1) Reduce radioactive waste generated and its heat volume by converting LLFP to nuclides with short-lived nuclides, and potential to reduce disposal cost.

(2) Potential to recover useful resources from radioactive waste.

[Other achievements]

• Received the 21st century Invention Award at the National Invention Award for 2018.

Succeeded in detoxifying high-level radioactive palladium for the first time in the world



Developed a method to recover only odd-nuclides by laser method

Ultra High-Speed Multiplexed Sensing System Beyond Evolution for the Detection of Extremely Small Quantities of Substances

MIYATA Reiko
PM

PM's Challenge

- Preparing for future crises such as in public health relating to occurrence of pathogenic drug-resistant bacteria and new pathogenic viruses, or air quality, etc.
- Establishing the principle of a "nanoelectronic device" that can easily detect and identify various highly sensitive hazardous and dangerous substances around us at the single molecule level.

[Main achievements]

(1) Developed highly sensitive sensor that can identify viruses and fine particles, etc., at the single particle level on the basis of the current change passing through microscopic nanopore*1 space with AI .

*1 nano(10^{-9}) sized microscopic hole

(2) Developed highly sensitive artificial olfactory system that discriminates odors from mixed gas components with AI by studying the olfactory principle of insects.

[Impact on industry and society]

(1) Provide method that enables quick and easy detection of mixed bacteria and viruses.

(2) Visualization of hazard and toxicity based on odors is expected.

[Other achievements]

- Establishment of venture : 1company (Aipore, Inc.)
- Artificial olfactory system is on the commercialization study phase by a participating company (Panasonic Corporation).

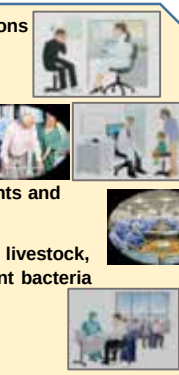
Developed on-site multiplexed sensing systems against threats of bacteria, viruses, chemical substances, etc.

Smart nanopore system

portable prototype

Assumed applications

- Early detection of human infections
- Early detection of drug-resistant bacteria in human
- Monitoring for hospitals and nursing care facilities
- Sensing for pharmaceutical plants and food factories
- Monitoring viruses of birds and livestock, and monitoring of drug-resistant bacteria
- Detection of anthrax spores



- Smart nanopore sensing system detects bacteria and viruses at the single particle level

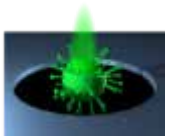


Image showing viruses, etc., passing through nanopore space

Artificial olfactory system

Nanowire concentrating chip

16Ch chemoresistance

Assumed applications

- World top-level **high sensitivity**
- Possible to respond to **general various smells (air quality), not a specific odor.**

image of device

- Health monitoring

- Biogas authentication

- Living space/ Hygiene management

- Driver monitoring

- Quality management

- Explosives/ Poison gases detection

- Victim detection

- Detection of signs of fire

Innovative Visualization Technology to Lead to Creation of a New Growth Industry

YAGI
Takayuki PM

PM's Challenge

- Create new industry in medical, cosmetic and non-destructive inspection fields through 3D imaging of fine blood vessels, etc. with non-invasive and non-ionizing radiation, which cannot be realized by existing methods.
- Establish a real-time visualization technology with high resolution by a photoacoustic imaging method.

[Main achievements]

(1) Realized real-time 3D imaging with high resolution, and Visualized flow pattern of lymphatic vessel for the first time in the world.

(2) Visualized tumor-associated vasculature blood vessels of breast cancer for the first time in a human, and suggested contribution to the improvement of the accuracy of breast cancer diagnosis.

[Impact on industry and society]

(1) Possibility of early detection of lymphedema and breast cancer, etc., and applying assessment of therapeutic effect are suggested. It is also expected to be applied to early diagnosis of disease safely and easily.

[Other achievements]

- Venture established: one company (Luxonus)
- Created interdisciplinary fusion fields in measurement technology development, including artificial intelligence.

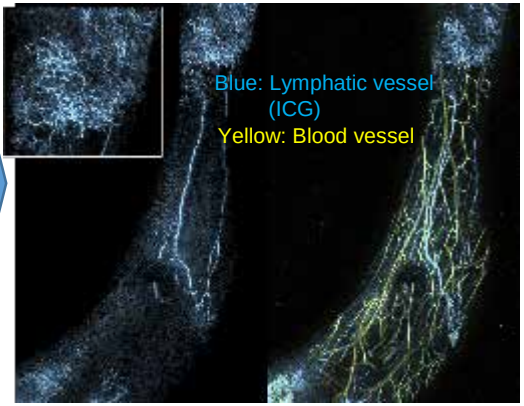
Realized 3D visualization technology for vascular network and lymphatic vessels high-resolution and large area, and suggested potentiality for clinical applications for the first time in the world

Existing method to imaging lymphatic vessels

Lymphoscintigraphy (Radioactive agent 99mTc)

ICG Fluorescence angiography

Developed method: photoacoustic lymphangiography



<Assumed fields>

Early detection of breast cancer
Examination and postoperative assessment of lymphedema
Risk assessment of lifestyle-related diseases, etc.

Actualize Energetic Life by Creating Brain Information Industries

YAMAKAWA
Yoshinori PM

PM's Challenge

- Make it possible for people to maintain brain and mental health by addressing stress and preventing cognitive impairment in a simplified method, and aim to create world-leading brain information industries.
- With the above goal, aim to develop methods that enables measuring individual's brain information in a portable type, and to establish the world's first control method to optimize brain activity pattern.

[Main achievements]

(1) Demonstrated potential of preventing cognitive function decline through neurofeedback*1.

*1 Technology to adjust brain activity pattern

(2) Developed brain image decoding technology by using massive MRI*2 data analysis technology.

*2 Magnetic Resonance Imaging

(3) Demonstrated android control*3 by brain waves.

*3 Control of additional limb (hands or feet from the third hand/foot), etc.

[Impact on industry and society]

(1) Road map of brain function improvement technology.

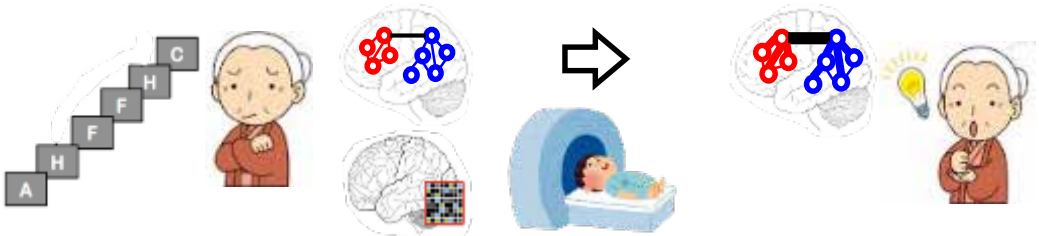
(2) Potential to develop human function such as multitasking enhancement.

[Other achievements]

- Acquired international standards for brain information sharing and indicators to promote brain health maintenance. (H.861.1, H.861.0)

Developed a number of revolutionary technologies towards use of brain information such as control of additional limb by brain waves

<Prevention of cognitive function decline through neurofeedback>



Neurofeedback by fMRI

<Android control by brain waves>

Control of android additional limb by brain wave

<Future image>
Multitasking enhancement

Advanced Information Society Infrastructure Linking Coherent Ising Machines and Quantum Secure Network

YAMAMOTO
Yoshihisa PM

PM's Challenge

- Development of Coherent Ising Machine: Combine quantum and classical properties of light to realize high-speed/low energy computing for combinatorial optimization problems.
- Realization of secure communication and data storage: Combine quantum key distribution and secret sharing.

[Main achievements]

(1) Succeeded in developing 2000-bit Coherent Ising Machine (CIM). An idea of quantum-classical hybrid computing is well received both inside and outside of Japan.

(2) Established secure data storage system combining quantum cryptography and secret sharing. Demonstrated a practical-level distributed storage network including the Tokyo metropolitan area.

[Impact on industry and society]

(1) Possible to find an optimum solution at high speed/low energy, through which dramatic efficiency improvement can be expected in various industrial fields.

(2) Secure IT system with no danger of data breach and falsification, even though computer performance will be improved.

[Other achievements]

- CIM research is continuing at NTT Physics & Informatics Laboratories in Silicon Valley, USA, after the ImPACT project.

Developed a novel computing machine that combines quantum and classical properties of light and solve combinatorial optimization problems at ultra high speed.

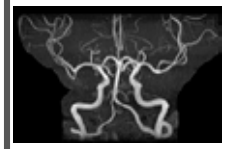
CIM computing device

- Operating at room temperature and atmospheric pressure
- Large problem size (N=2000 spins) can be processed.

Examples of assumed application

Drug discovery: Increase accuracy of lead optimization, and shorten time for drug development.

Radio communication: Optimize real time for frequency of a number of base stations, to optimize communication capacity.



Compressed sensing: Reproduce an original image from insufficient image data

Fintech: Optimize a trade-off between profits and risks. (Portfolio optimization)

Small Synthetic Aperture Radar Satellite System for On-Demand Observation

SHIRASAKA Seiko PM

PM's Challenge

- Develop a small satellite[*1] system using radio waves to perform observation even at night and under adverse weather conditions.
- Aim for acquisition of global-scale high-frequent observation data to develop satellite business responsive to the temporal and spatial needs of continuous monitoring from outer space.

[*1] synthetic aperture radar (SAR) satellite

[Main achievements]

(1) Realized highly compact storage of large antenna by original method. Simultaneously realized world top-class reduction in size and weight (1/10 compared to convention).

(2) Reduced manufacturing cost to 1/20 or below*, and enabled global-scale and high-frequent observation by deployment of multiple satellites.

*Previously 10 billion yen or more, reduced to 500 million yen or less.

[Impact on industry and society]

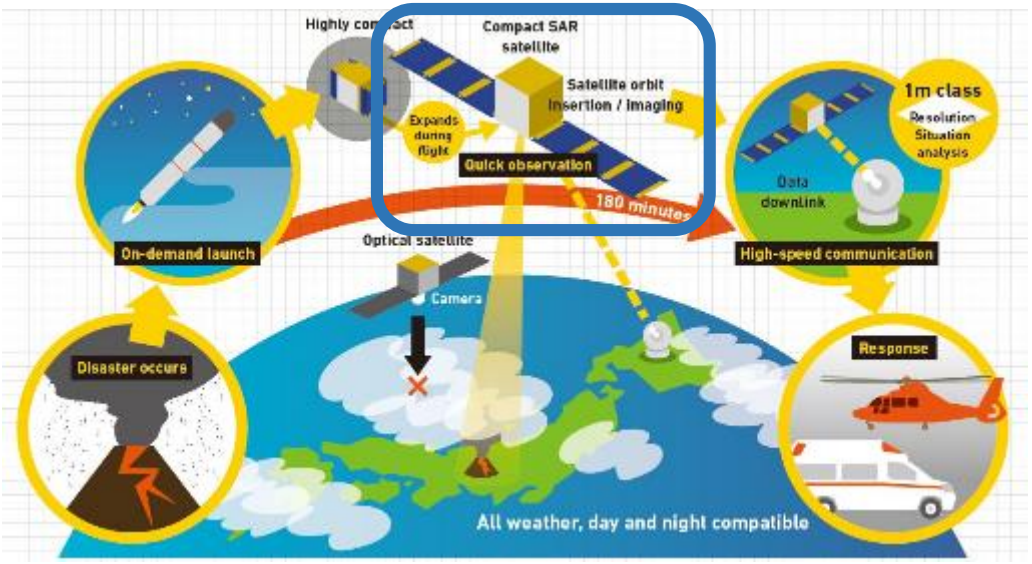
(1) We have a better outlook on understanding damage in several dozen minutes to several hours when responding to an emergency, even at night and under adverse weather conditions.

(2) Expect development of new satellite business (figure on right) through satellite data acquired by high-frequent observation.

[Other achievements]

- Establishing a start-up company (Synspective, Inc.) Procured capital of 10.9 billion yen in one year and five months since start of business. (World's fastest, and largest size in Japan)

Open road to commercialization of SAR satellite (Demonstration satellite No.1 scheduled for 2020 launch)



Examples of applications (Example of new satellite business)


Security surveillance of overseas plant


Monitoring of infrastructure aging


Surveillance of unidentified ship


Arctic route identification

Artificial Cell Reactor Technology for an Enriched and Secure Society and New Bioengineering

NOJI Hiroyuki
PM

PM's Challenge

- Create new bioindustries that can artificially synthesize useful substances by implementing technology for rewriting genetic codes in a bottom-up manner.
- Develop "artificial cell reactor" as a basic technology for the above, and innovate a wide variety of bioindustry fields; *in vitro* diagnostics , DNA synthesis/assembly, industrial enzyme, and drug discovery.

[Main achievements]

(1) Established a new bioassay format, termed 'Digital bioassay' such as digital ELISA*1 of which detection sensitivity is over 100 times better than that of the highest class of the commercialized method, and for which analysis time and ease of administration are far superior. Developed single-particle detection of influenza virus with a smartphone-based device (right photo).

(2) Established a new cell-free DNA assembly technology that realizes a 10-times faster reaction for genome-sized DNA. Kit samples were developed and widely tested in biotech companies and academia.

[Impact on industry and society]

(1) Early diagnosis based on mobile systems for on-site/at-home diagnostics (decentralization of diagnostics).

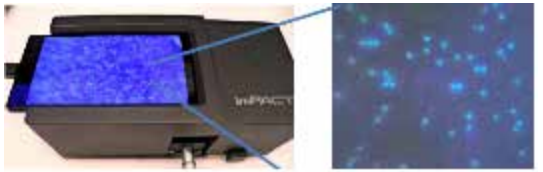
(2) Creation of new biotech market such as vaccine development and regenerative medicine is expected.

- One venture company (OriCiro genomics) was established for DNA assembly technology and another to be established in 2020 for virus detection.

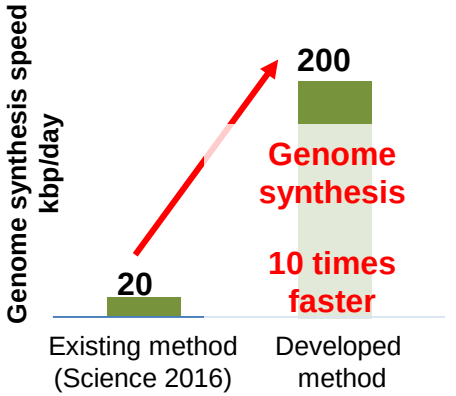
*1. Enzyme-Linked Immuno Sorbent Assay

Create new bioindustries by using artificial cell technology

Influenza detection by easy-to-administer, highly sensitive digital ELISA



Application example) Influenza virus detection by using a smartphone



Creation of a new bio industry is expected through innovative bio basic technology

Bionic Humanoids Propelling New Industrial Revolution

HARADA
Kanako PM

PM's Challenge

- Quickly deliver innovative technology seeds to society by establishing R&D and evaluation frameworks with less trial and error, and demonstrate the concept in the medical device industry, etc.
- Quantitatively understand qualitative sensory expressions and human skills using Bionic Humanoids; elaborate dummies equipped with sensors.

[Main achievements]

(1) Precise measurement and accurate replication of mechanical properties of tissues was studied, resulting in three Bionic Humanoids platforms for eye, endonasal, and endovascular surgical applications.

(2) Development and evaluation of SmartArm, a versatile surgical robot using a pair of industrial robotic arms, was accelerated by the use of the Bionic Humanoid platforms.

[Impact on industry and society]

(1) Bionic Humanoids can contribute to better surgical education and training.

(2) Application of the Bionic Humanoids concept can lead to fast and efficient R&D and evaluation of new products including innovative medical devices.

[Other achievements]

- Venture companies established: Medridge Co.,Ltd. and Blue Practice Co., Ltd.
- Good Design awards: Bionic-EyE™ and Bionic-Brain

Three specialized Bionic Humanoid platforms: for surgical education and training; R&D and evaluation of SmartArm.

Bionic Humanoid platforms

Eye Surgery/ Bionic-EyE

Endonasal surgery/ Bionic-Brain

Endovascular surgery/ Bionic-Vasculature

Three specialized Bionic Humanoid platforms have been developed by replicating the anatomy and mechanical properties of the target organs and tissues

SmartArm

SmartArm was developed and evaluated within three years by using the Bionic Humanoid platforms

An Ultra Big Data Platform for Reducing Social Risks

HARADA
Hiroshi PM

PM's Challenge

- Contribute to the realization of a knowledge-intensive society through fusion of cyberspace and physical space for which Society 5.0 aims through enormous data use that far exceeds current big data.
- Integrate "wireless communication network" technology that collects diverse and large volumes of data from a wide area, and "big data processing" technology which analyzes large volume of data at high speed.

[Main achievements]

(1) Realized R&D of wireless communication system with area coverage of over 100 km to collect social big data and its international standardization and commercialization.

(2) Developed and demonstrated super high-speed database (DB) that can process ultra big data*1 in medical practice within a few minutes. Transferred to the field site high-speed*2 DB technology to process anonymization.

*1 200-billion scale medical receipt data, *2 Processing time: approx.20 mins.⇒10 seconds or so.

[Impact on industry and society]

(1) A wireless communication system was used in support activity for torrential rain in West Japan (Aug. 2018).

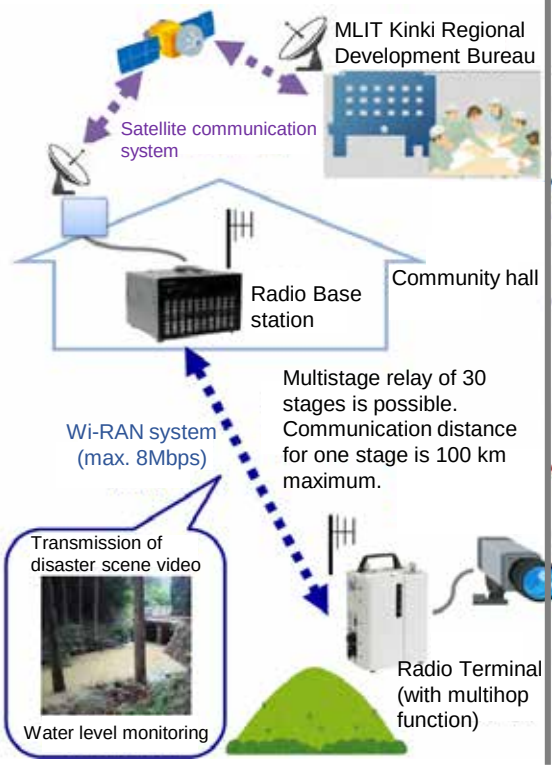
(2) Demonstrated practical use for government statistics, medical data analysis by local governments such as Mie Prefecture, and medical policy planning.

[Other achievements]

- With respect to the wireless communication system, four cases have already been commercialized.
- Developed integrated data collection and analysis system from multiple different cardiovascular medical facilities.

Developed basic technologies to form cyberspace for realization of Society 5.0. Actual use has started in various fields, such as disaster prevention and medical care.

Wireless communication system: utilized during torrential rain in West Japan(Aug. 2018)



Ultra Big Data processing engine: demonstration of practical use