
2014 R&D strategy

R&D: A key driver in Hitachi's global growth

Solution-oriented R&D for Hitachi Global Business

10 April 2014

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1. Foreword

2015 Mid-term Management Plan

- Achieving Growth and Hitachi's Transformation -

Innovation

Strengthen service businesses that maximize the utilization of IT and bring about innovation

Global

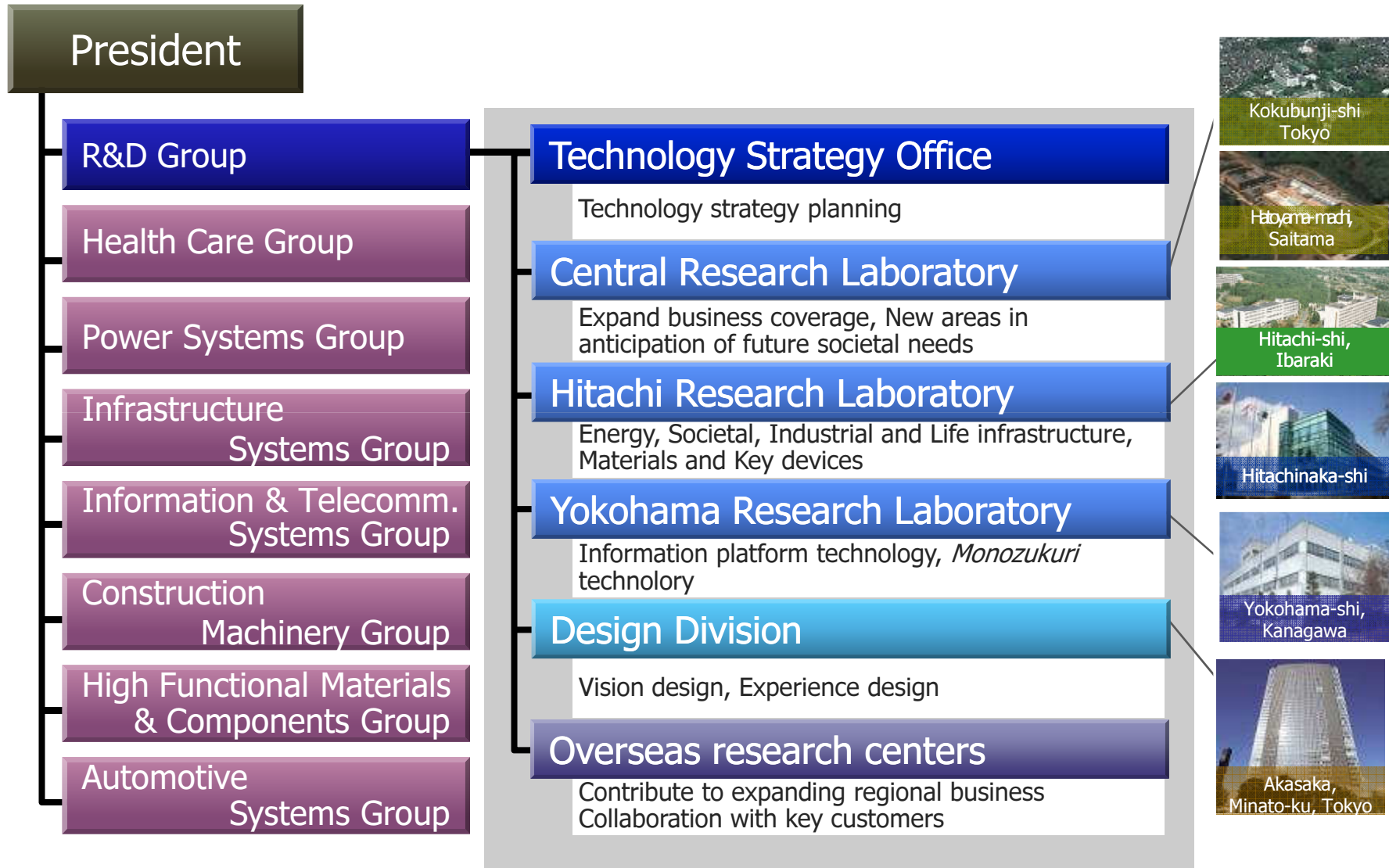
Deliver Innovation to Customers and Society globally

Transformation

Transform Hitachi:
To deliver innovation by standardized and speedy operation

| Management focus | R&D directives |
|-------------------|---|
| 1. Innovation | <ul style="list-style-type: none">• Promote R&D to expand service business• Development of innovative technology to support world-class No. 1 product business |
| 2. Global | <ul style="list-style-type: none">• Contribute to overseas business through Global One Hitachi approach |
| 3. Transformation | <ul style="list-style-type: none">• Transform through a customer-driven R&D model |

1-3 R&D organization



*as at April 2014

1-4 R&D: Key Driver for Global Growth

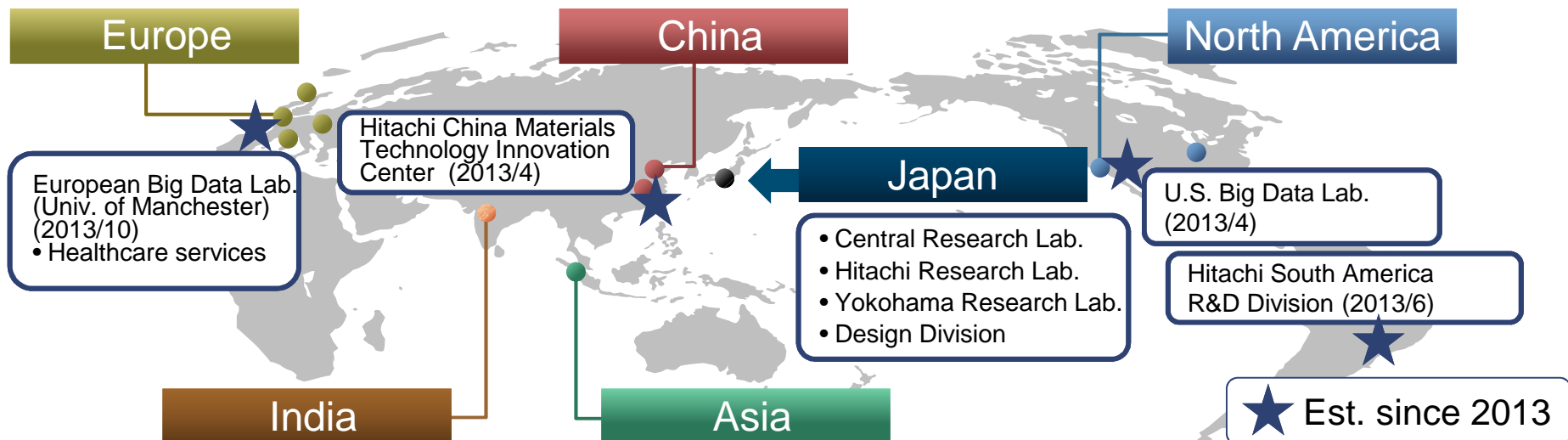
Expand the Social Innovation Business globally
- Leveraging R&D capability and global network -

Promote open innovation with customers and business partners for contributing to solve customers' issues

Closely tied to customers locally providing R&D capabilities

Develop the world-class cutting-edge R&D with combining systems, products and IT on the Cloud

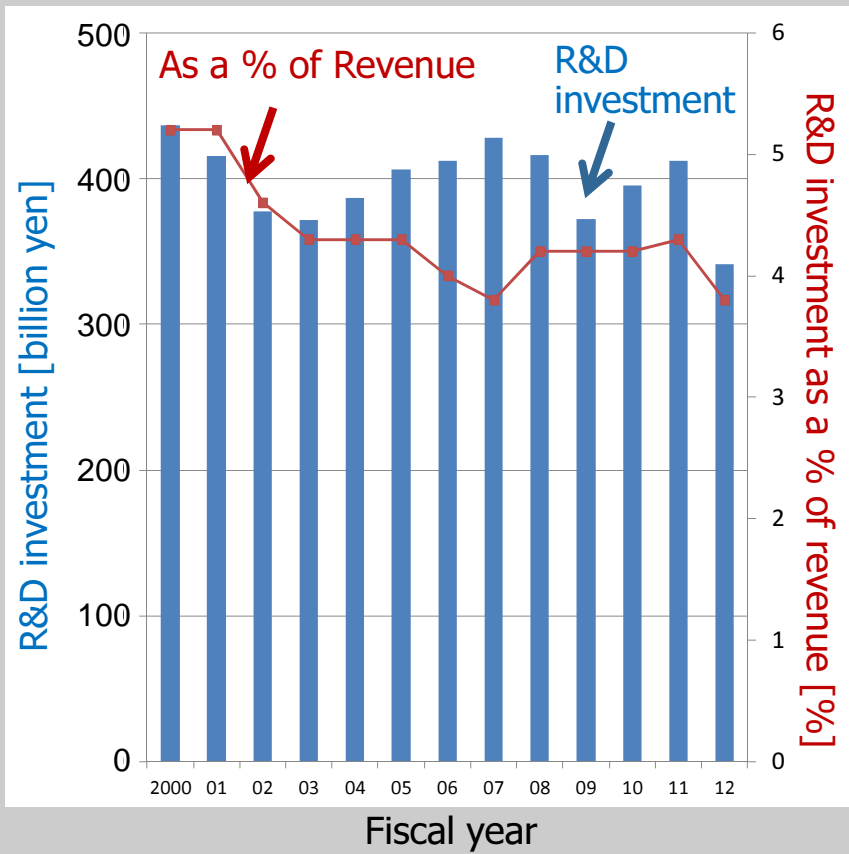
Increase and enhance global R&D bases



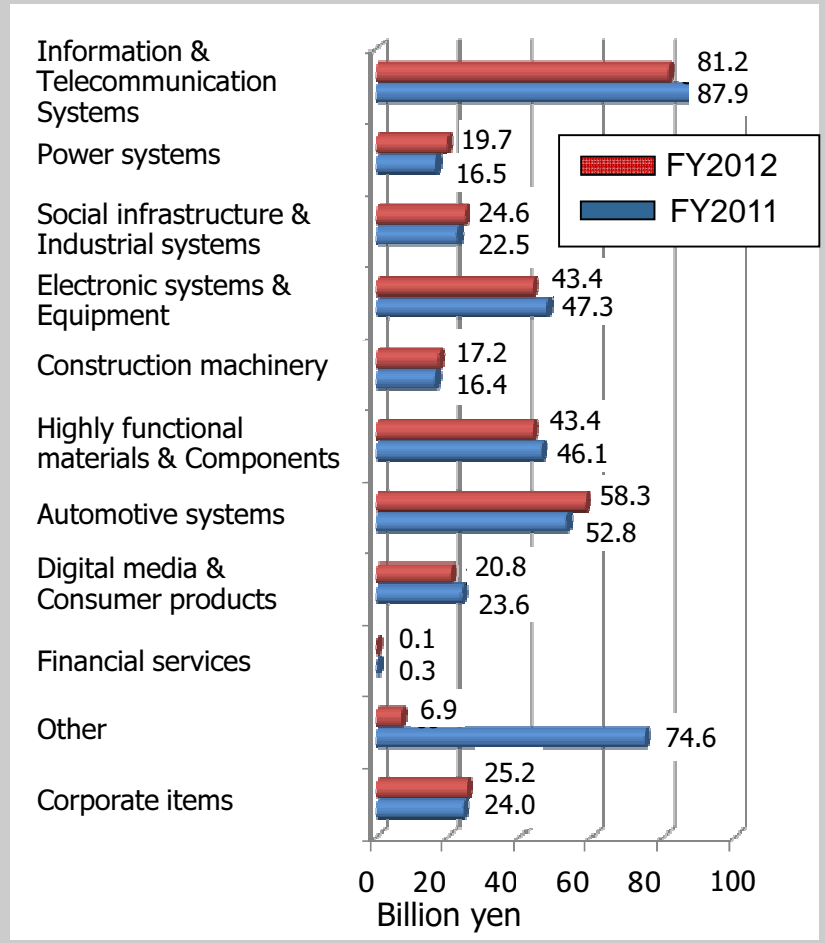
1-5 Hitachi Group R&D investment

Approx. JPY400 billion invested in Hitachi Gr. R&D, approx. 4% of revenue

R&D investment trend

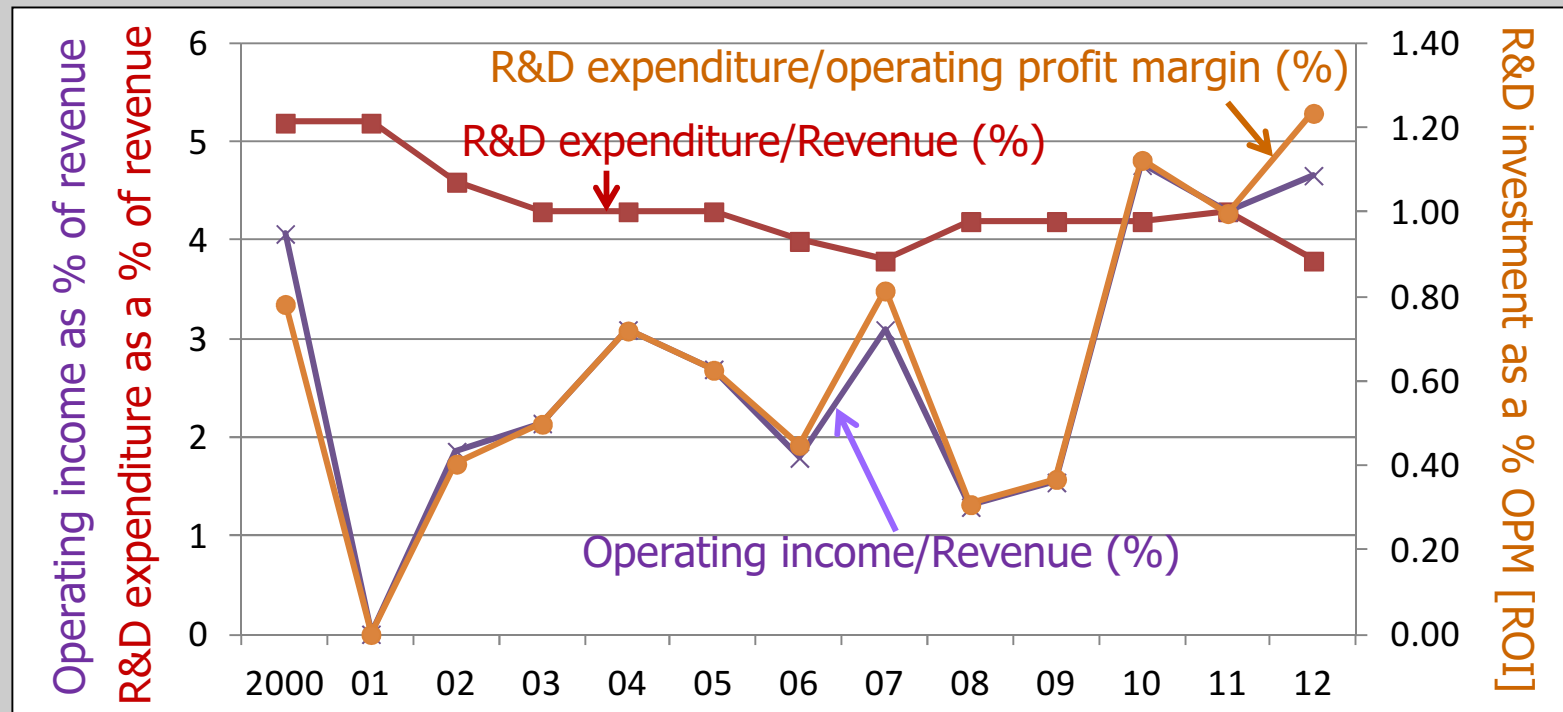


R&D investment trend by business segment



1-6 Hitachi Gr. R&D investment efficiency & personnel

Annual trend in R&D investment return

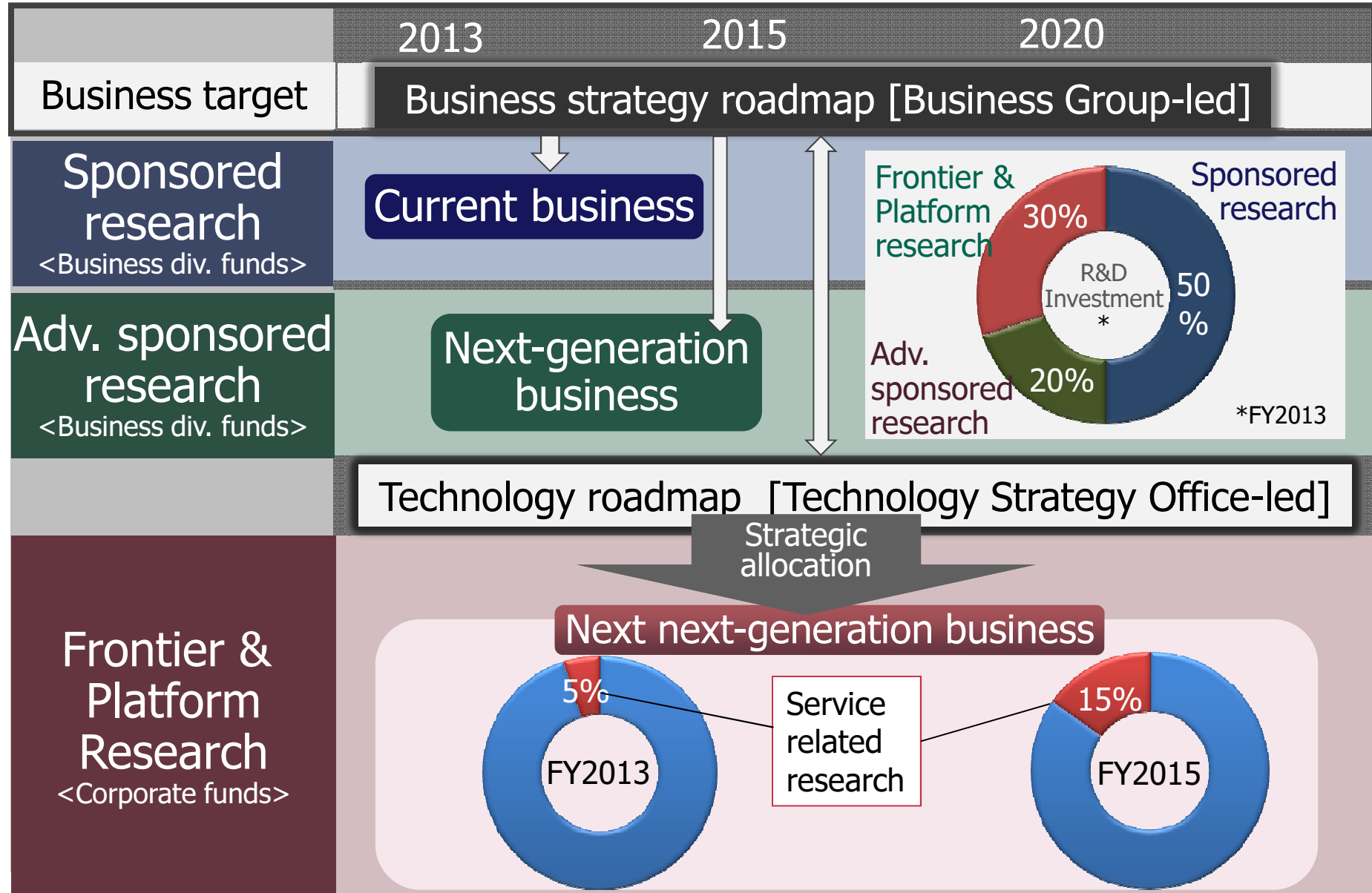


Annual trend in number of R&D personnel

| | FY2012 | FY2013 | FY2014* |
|---------------|--------------|--------------|--------------|
| Hitachi, Ltd. | 3,410 | 3,280 | 3,250 |
| Subsidiary | 1,850 | 1,620 | 1,720 |
| Total | 5,260 | 4,900 | 4,970 |

*forecast

1-7 Strategic allocation of investment



2. Leading Social Innovation Business

2.1 Innovating to a customer-driven R&D model

Transform to a customer-driven research model for the growth of Social Innovation Business globally



1. Uncover and share problems held by customers

Uncovering and sharing the fundamental objectives, potential needs of customers



Ethnographic research



2. Continuous co-creation with customers

Greater innovation by quickly repeating the cycle of uncovering and solving problems



Ex Approach



3. Develop innovation from a vision of the future

Illustrate future social issues and a society where those issues have been resolved, and develop disruptive technology to achieve this vision



Vision design

2-1-2 Ethnographic research

Provide solutions by extracting potential problems and hidden needs that customers may not be aware through on-site observations by researchers



- Research on maintenance of UK rail cars
Ethnographic research on maintenance work was conducted at the Ashford Depot of the high-speed passenger train Class 395
→ Derive measures to improve on-site work efficiency



■ Other research examples

- North America Data center (storage management software)
Proton beam therapy equipment construction site
- China Software development site
- Germany Needs survey of construction machinery
- Australia Construction machinery maintenance activity
- South Africa "
- Mozambique "
- Egypt Plant construction site



2-1-3 Ex Approach

Share and analyze problems & solutions for operation and services with stakeholders in the planning phase, to effectively develop system requirements



Record: 65* cases of upstream research applied (2009-2013)

| | | |
|---|--|--|
| Point of customer contact/ Back office | <ul style="list-style-type: none"> External marketing Sales agents Sales counter Call center | Investigate worker-hour for tasks, visualize issues (Retail) |
| | | Establish customer management system (Retail) |
| | | Improve call center system (Electric power company) |
| | | Reform external marketing operations (Insurance company) |
| Maintenance operations, etc. | <ul style="list-style-type: none"> Equipment maintenance Construction System mgmt. Disaster prevention | Reform distribution operations, staff training (Electric power company) |
| | | Improve plant construction process management system (Hitachi Group) |
| | | Visualize data center work issues (Hitachi Group) |
| | | Develop disaster prevention solution for evacuation shelters (Municipal govt.) |

* Number within the Information & Telecommunications Systems Company, Hitachi, Ltd.

2-1-4 Vision Design

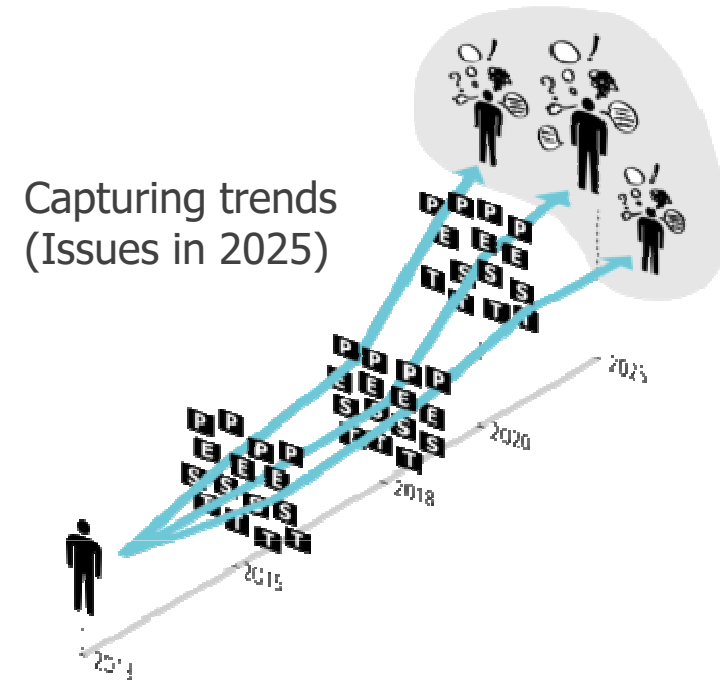
Capture future societal issues, and illustrate them in detail from citizens' perspective as a solved problem in society



Kizashi

PEST analysis

P: Politics E: Economy
S: Society T: Technology



Vision design of UK healthcare in 2025 led to collaboration with NHS GM*



Diabetes prevention service for the U.K.

Health guidance to insured citizens to prevent diabetes (10% medical expenses in UK)

Insurer Hospital Insured

NHS GM

*NHS GM: National Health Service England (Greater Manchester)

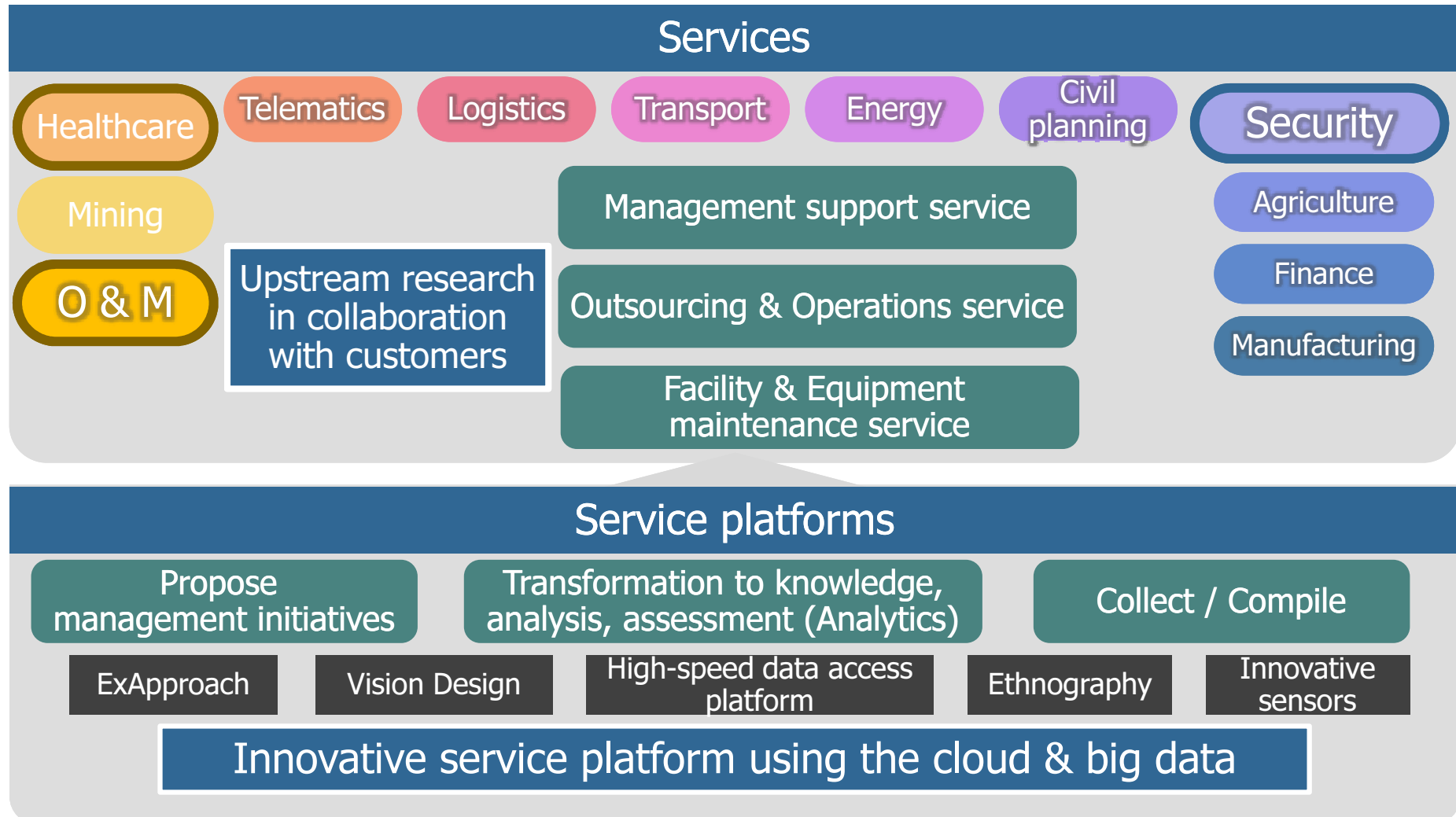
2. Leading Social Innovation Business

2.2 Expanding service business

2-2-1 Research strategy to expand service business

Identify customers' issues & needs, and achieve innovation through service business

2015 Mid-term Management Plan target: Ratio of revenue from services* 30% (FY2012) ⇒240% (FY2015)



2-2-2 Healthcare services

Identify customer issues/needs

[Customer]

- Health insurance association

[Issues]

- Preventing disease & promoting health of subscribers
- Revitalize business by controlling medical expenses

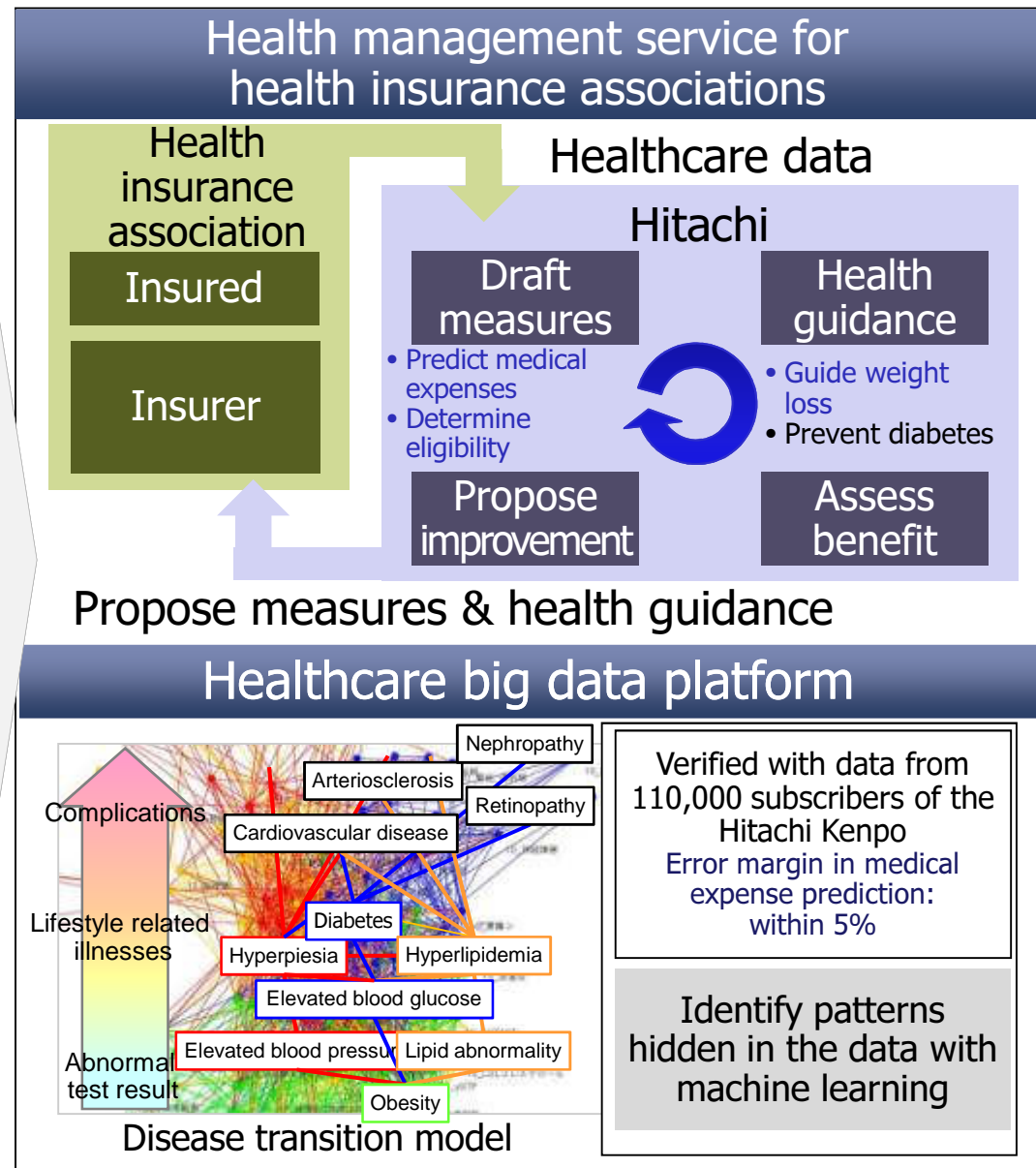
Ministry of Health, Labour and Welfare
"Data Health Project" (2015 ~)

[Pre-emptive activities by Hitachi Kenpo]

- Coverage: Hitachi Group employees
Interventive guidance "Harasuma Diet"
- Successful weight loss 50%
 - Difference of JP 60,000 yen* for 3 year cumulative medical expense



* Business example 14 on health insurance business based on data analysis of employees, in the 2013 health business casebook of the Ministry of Health, Labour and Welfare, Japan

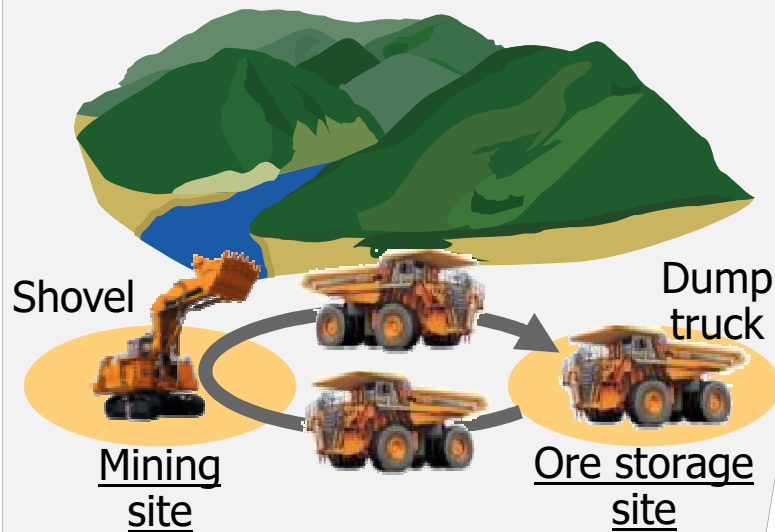


2-2-3 O&M services

Identify customer issues/needs

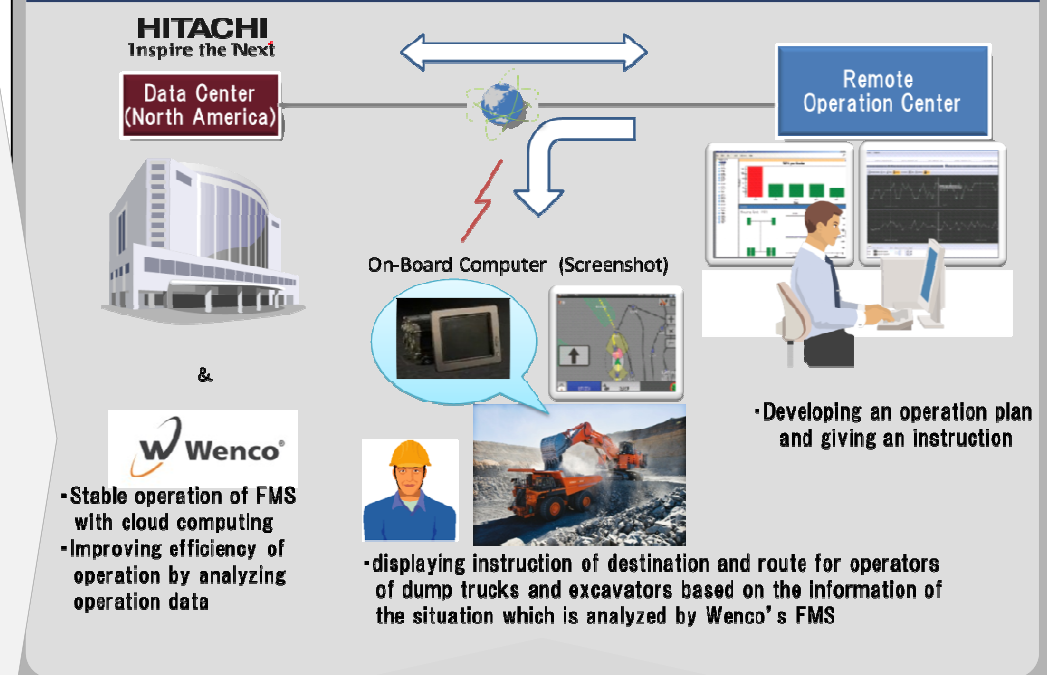
- [Customer]
- Mining company

- [Issues]
- Increase the management efficiency of mining equipment operations
 - Introduction to small mines or remote mines



FMS: Fleet Management System
WENCO: Wenco International Mining Systems Ltd.

Cloud-based service for mining operations management



O&M service platform

Global e-Service on TWX-21

| | | | |
|-----------------------|----------------------|---------------------|-------------------|
| Data collection (M2M) | Equipment management | Document management | Big data analysis |
|-----------------------|----------------------|---------------------|-------------------|

2-2-4 Physical security services

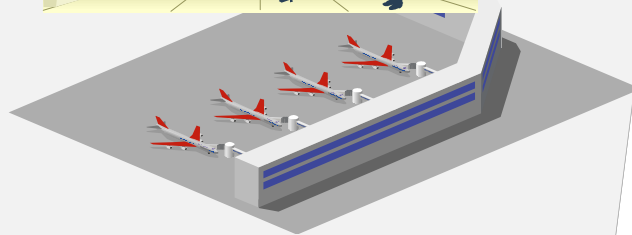
Identify customer issues/needs

[Customer]

- Facility management company
- Municipal government offices

[Issues]

- Wide area security
- Diverse risk management
- Increased convenience



Security service for large-scale important facilities

Integrated IT management service
for important facilities

Surveillance system



Entry procedure



Hand luggage inspection



Security gate

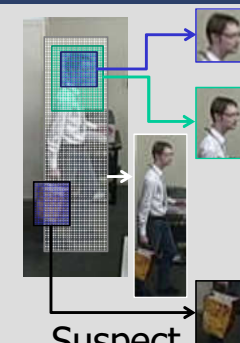
Service platform



Finger vein
authentication
technology
for touch panels



Multiple location
dangerous substance
detection technology



Suspect
tracking
technology

2-2-5 Cyber security services

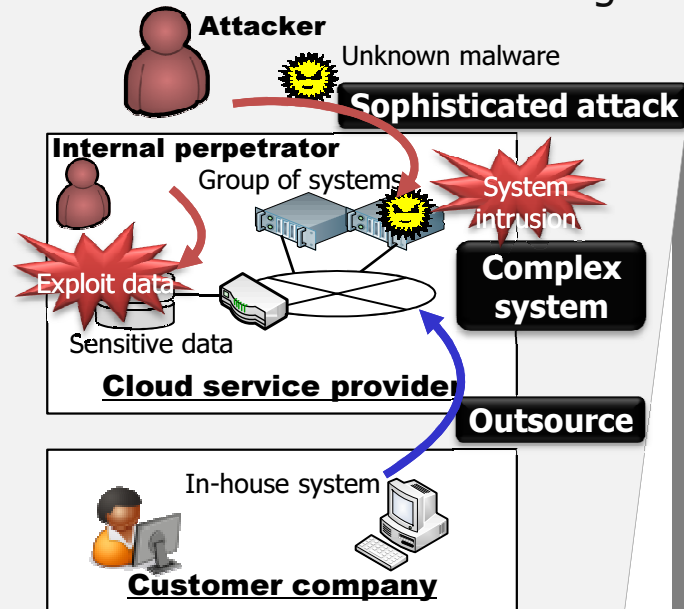
Identify customer issues/needs

[Background]

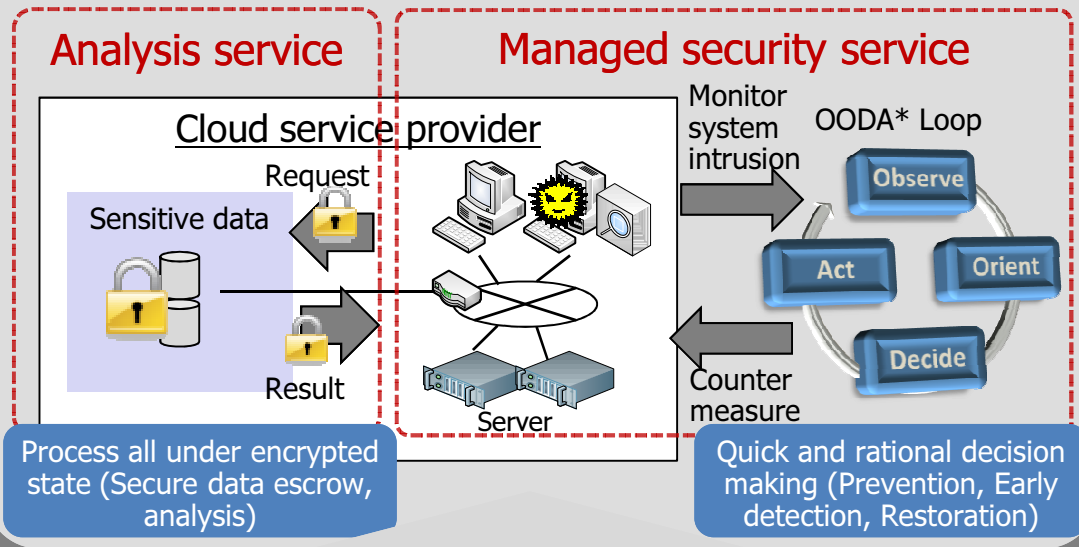
- Increasingly sophisticated cyber attacks
- Increasingly complex information systems
- Outsourcing of tasks (cloud)

[Issues]

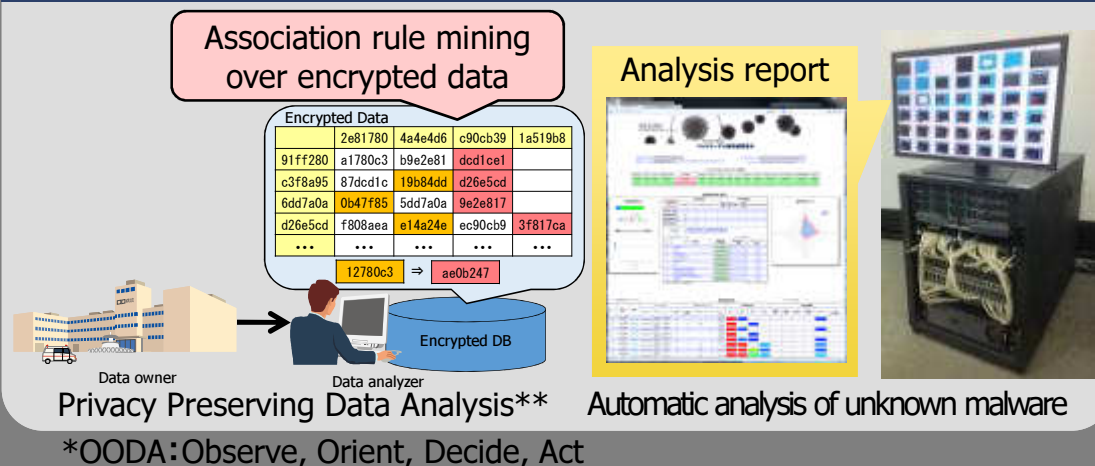
- Establish pre-emptive technical measures against unauthorized access and information leakage



Incidence-prepared security service



Security platform technology














** The searchable encryption method developed is part of research results from the 2010 project commissioned by the Ministry of Internal Affairs and Communications, for "R&D of technology for information security countermeasures in large-scale virtual server environments." © 2014 Hitachi, Ltd. All rights reserved.

2. Leading Social Innovation Business

2.3 Enhancing world No. 1 product business

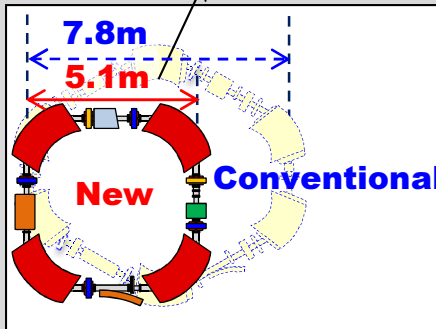
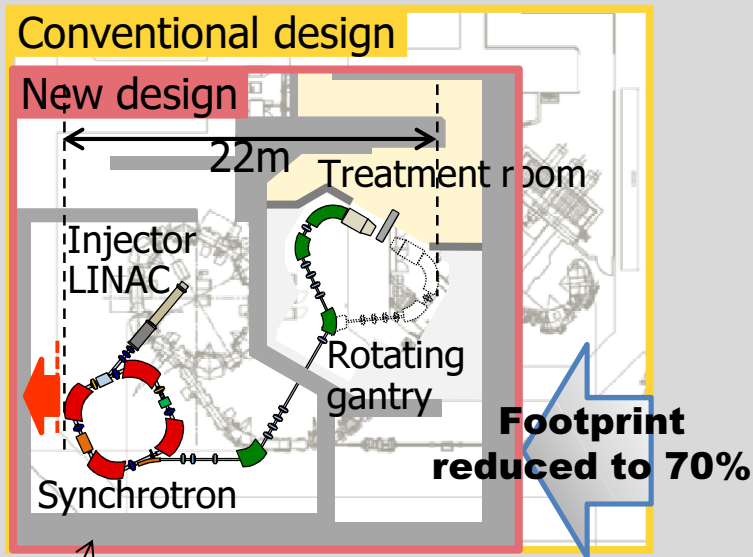
2-3-1 Contributing to No. 1 products business

| | | | |
|---|---|-------|---|
| Health Care Group | 3T MRI | 2-3-2 |   |
| | Proton beam cancer therapy equipment | | |
| Power Systems Group | Nuclear power multinuclide removal facility | 2-3-3 |   |
| | 5MW off-shore wind turbine | | |
| Infrastructure Systems Group | European rail signaling System verification | 2-3-5 |   |
| | Wind tunnel test facility | 2-3-5 | |
| Information & Telecommunication Systems Group | Flash module | 2-3-6 |   |
| | Data access platform | 2-3-6 | |
| Construction Machinery Group | Hybrid shovel | |  |
| High Functional Materials & Components Group | Dysprosium-free magnets | |  |
| Automotive Systems Group | Technology for automatic operation | 2-3-7 |  |

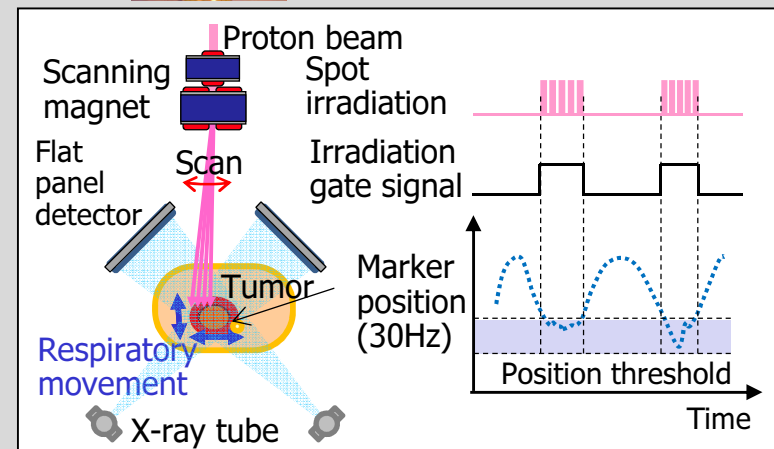
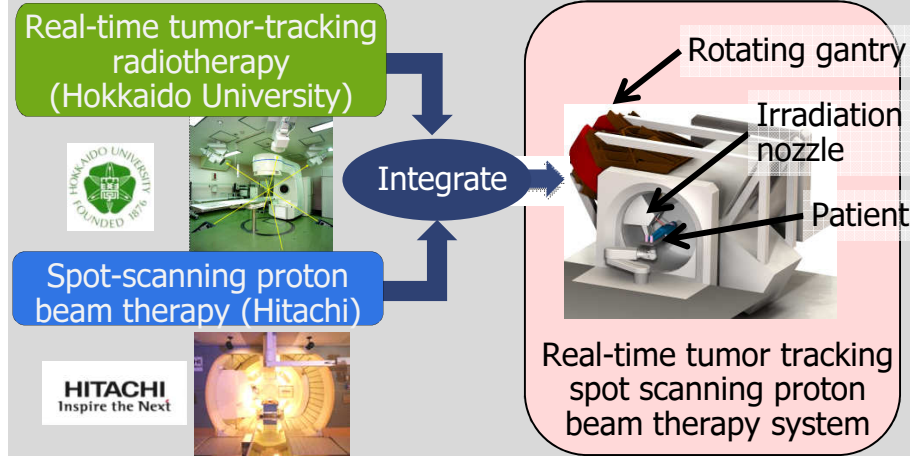
2-3-2 Particle beam cancer therapy technology

Proton beam therapy system PROBEAT-RT

Compact system 70% previous model



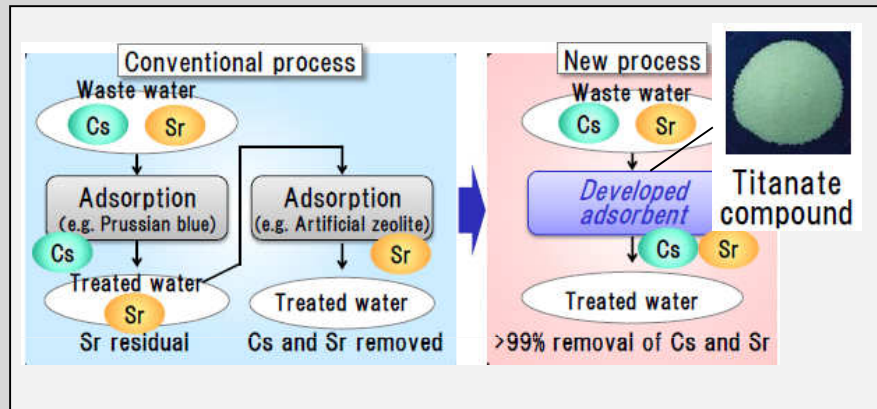
Applicable to moving organs



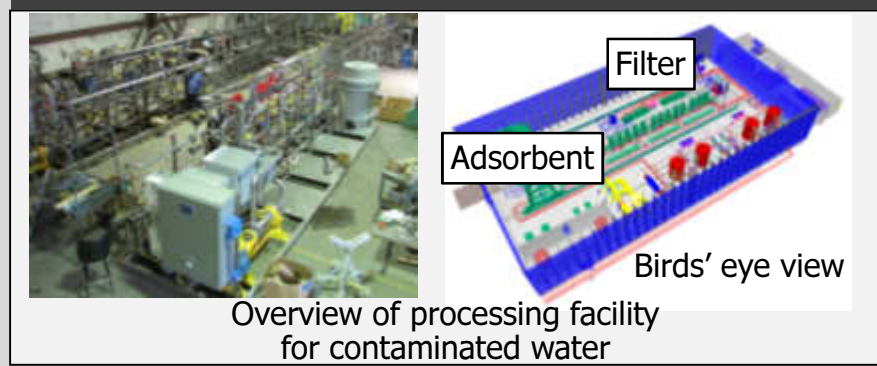
*A part of this technology was developed together with Hokkaido University under the Funding Program for World-Leading Innovative R&D on Science and Technology ("FIRST Program") initiated by the Council for Science and Technology Policy, and granted by the Japan Society for the Promotion of Science (JSPS). **This integrated therapy has been submitted for manufacturing & marketing approval under the Japanese Pharmaceutical Law. © 2014 Hitachi, Ltd. All rights reserved.

Technology development for Fukushima restoration

Adsorbent for simultaneous removal of 2 radioactive substances



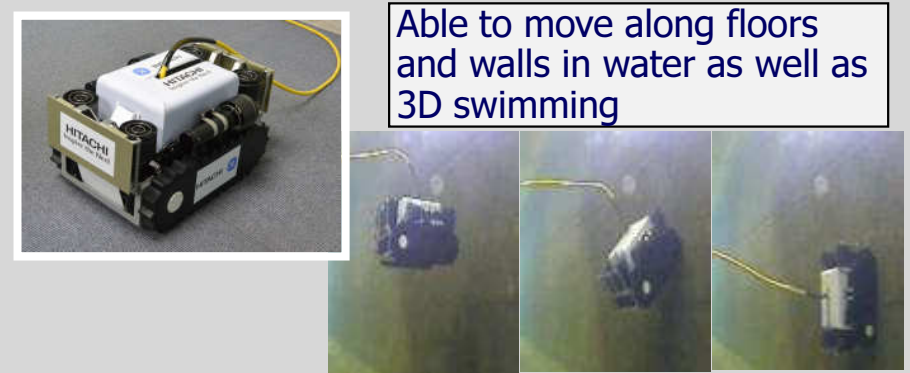
80% waste reduction by simultaneous adsorption and filter use



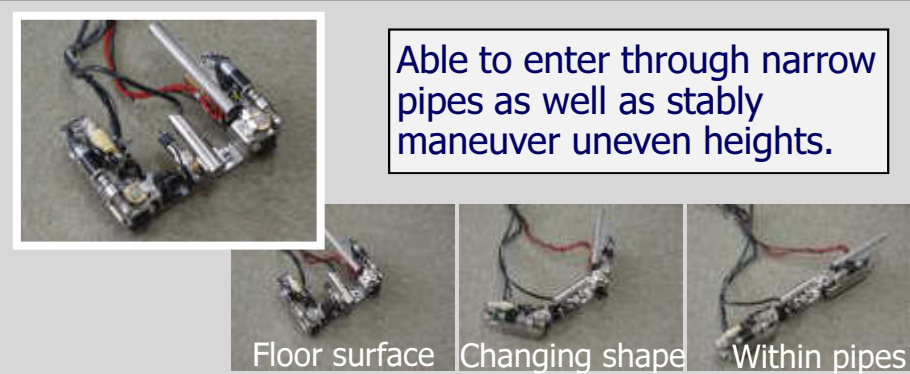
Received order for multinuclide removal facility (METI project; Operation planned from mid FY2014)

Submersible shape-changing robot to investigate narrow spaces

Submersible crawling swimming crawler



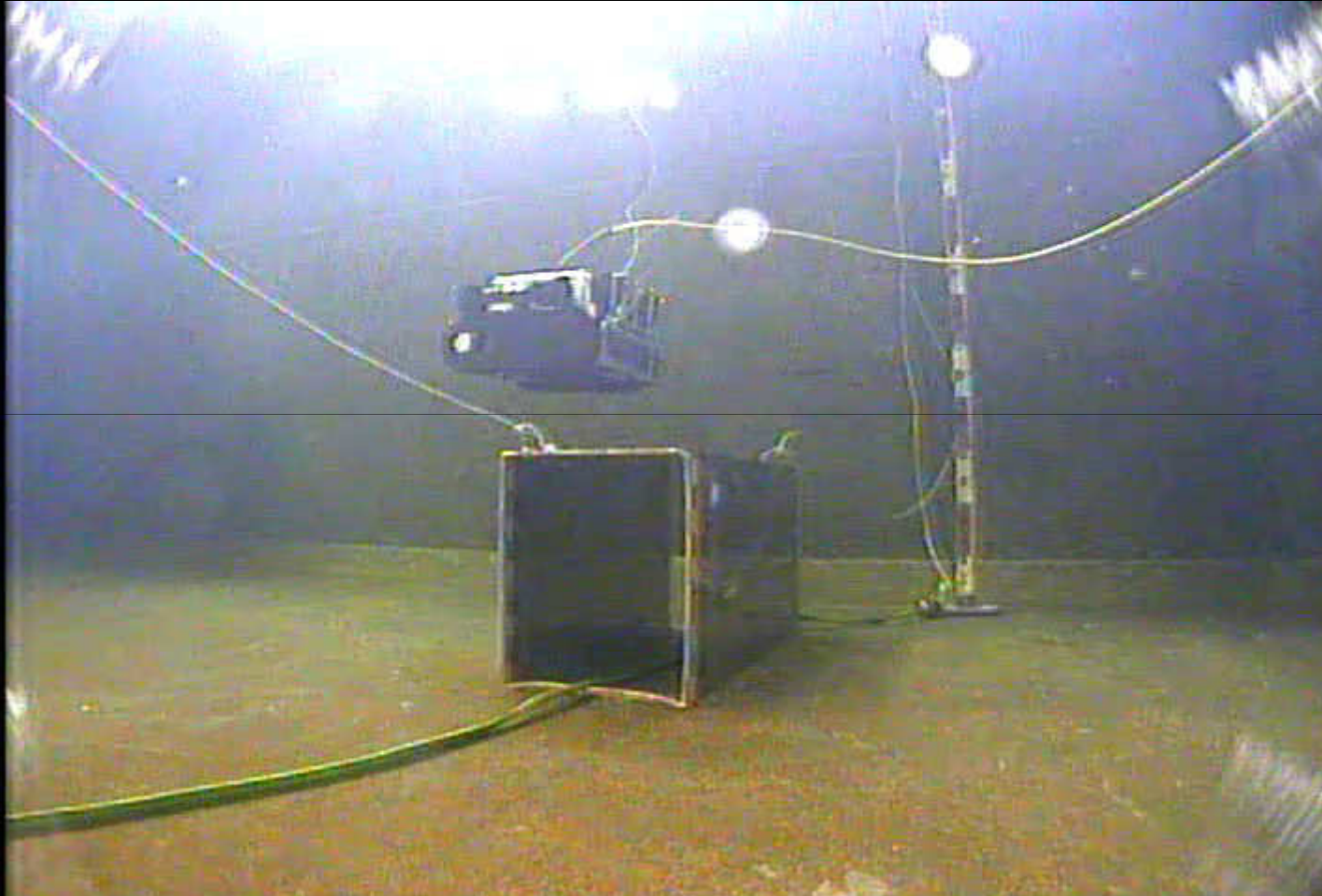
Shape-changing crawler



Switching traveling function by changing joint positions

Technology development for
2-3-4 Fukushima Daiichi Nuclear Power Plant

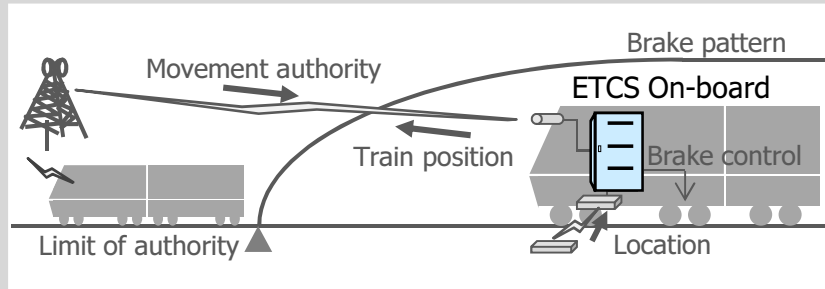
HITACHI
Inspire the Next



Certification acquired for expanding European rail business

European rail signaling system safety certification

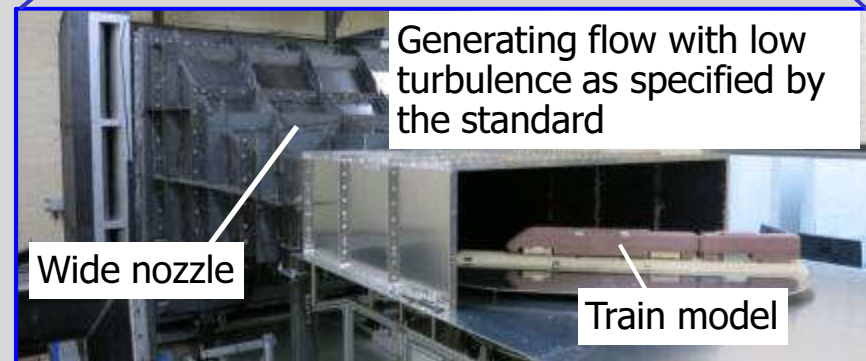
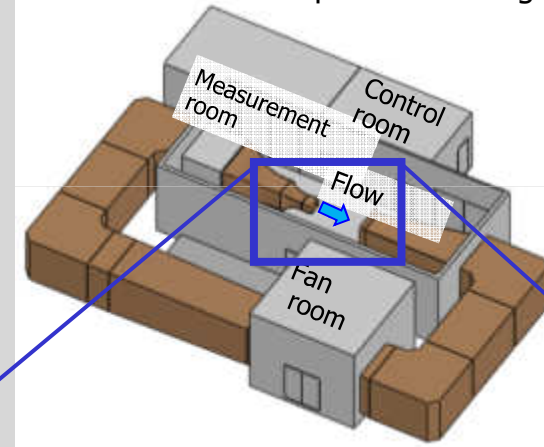
SIL4 certification attained
(highest safety integrity level)



ETCS: Standardized European rail signaling system for interoperability across European countries

European standard compliant crosswind safety assessment facility

EN14067-6 compliancy confirmed
(In a testing facility specially constructed to simulate crosswind environments that trains will experience during operation)



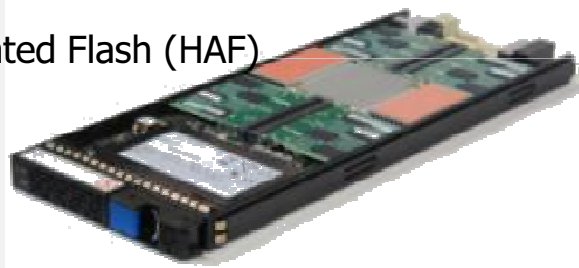
Platform for big data & cloud services

Flash module: HAF

Original flash module realizing high-speed data processing at low cost

- Throughput: Approx. 3× SSD*¹, 182× HDD*²
- Response time: Equiv. to SSD, 12.5× HDD

Flash module
Hitachi Accelerated Flash (HAF)



Physical volume: 1.6TB, 3.2TB
(Commercialized Nov. 2013)

Technology developed

1. High reliability: On-line data refresh function (regular data diagnosis/recovery function)
2. Smart management function: optimization of refresh intervals depending on memory status

*1 SSD 400Gbyte model supported by Hitachi Virtual Storage Platform (VSP)

*2 HDD 146Gbyte model supported by Hitachi VSP

High-speed data access platform: HADB Platform

Data access platform for high speed analysis of petabyte (PB)-order big data

- Approx. 100× faster than previous Hitachi model
- First registration as industry standard benchmark "TPC-H" 100 terabyte (TB) class (Oct. 2013)

Hitachi Advanced Data Binder (HADB) Platform



New line-up released
Oct. 2013



Masuda Prize
Best 10 New Products Award

Technology developed

Implementing "Out-of-Order Database Engine" principle proposed by Prof. Kitsuregawa^{†‡} and Project Assoc. Professor Goda[‡]

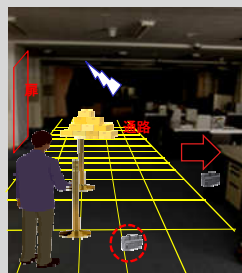
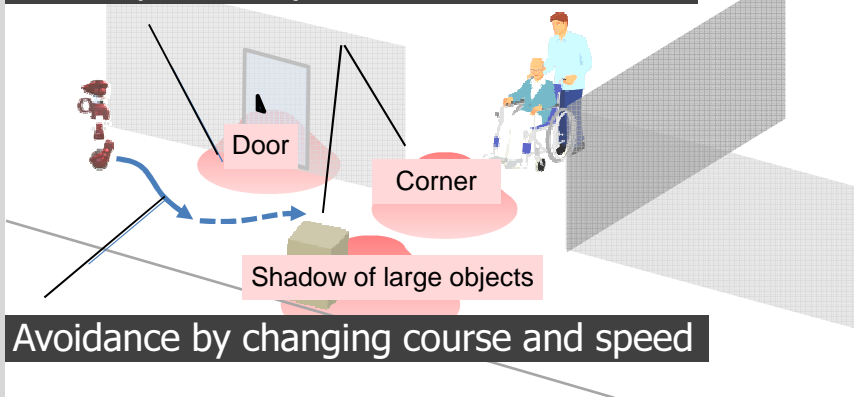
HADB uses the result of "Development of the Fastest Database Engine for the Era of Very Large Database and Experiment and Evaluation of Strategic Social Services Enabled by the Database Engine" (Principal Investigator: Prof. Masaru Kitsuregawa, which is supported by the Japanese Cabinet Office's FIRST Program (Funding Program for World-Leading Innovative R&D on Science and Technology)).

Leading technology development for automatic operation

Robotics technology to predict & avoid danger

Situation learning technology for robots to determine a safe path to avoid collision with people at intersections, corners and doors

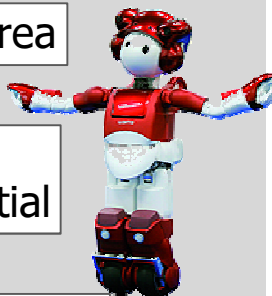
Predict probability of sudden encounter



Detect blind area

Predict danger potential

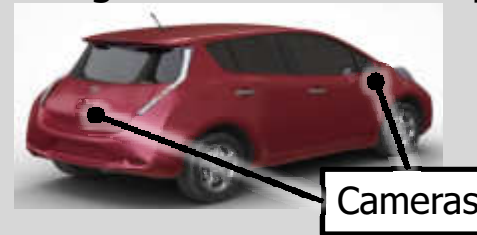
Change course/speed



Automatic driving technology

Surround view technology

Uses 4 cameras (front/rear/left/right) to recognize obstacles and parking spaces



Surround view

Auto-parking technology

Integrated control technology for steering, braking and acceleration



Auto-braking on detecting pedestrian or vehicle



Detect parking space and park automatically

3. Global R&D

3-1 R&D activities for One Hitachi

1. Build-up global R&D network

3-2

Big data

US Big Data Lab taking a central role in leading collaboration between research bases in Japan, Europe, India and Brazil

Automotive

US, Japan, Europe and China cooperating in the development of engines & chassis complying with regional regulations

2. Build-up regional value-chain

Railway

Established European Rail Research Centre (Oct. 2012)

3-3

Nuclear Power

Establish European Nuclear Research Centre (~Sept. 2014)

Healthcare

Established European Big Data Lab in the Innovation Centre of the Univ. of Manchester (Oct. 2013)

3. Global standardization of work

3-4

Design cloud

Globalization of the design environment using the cloud

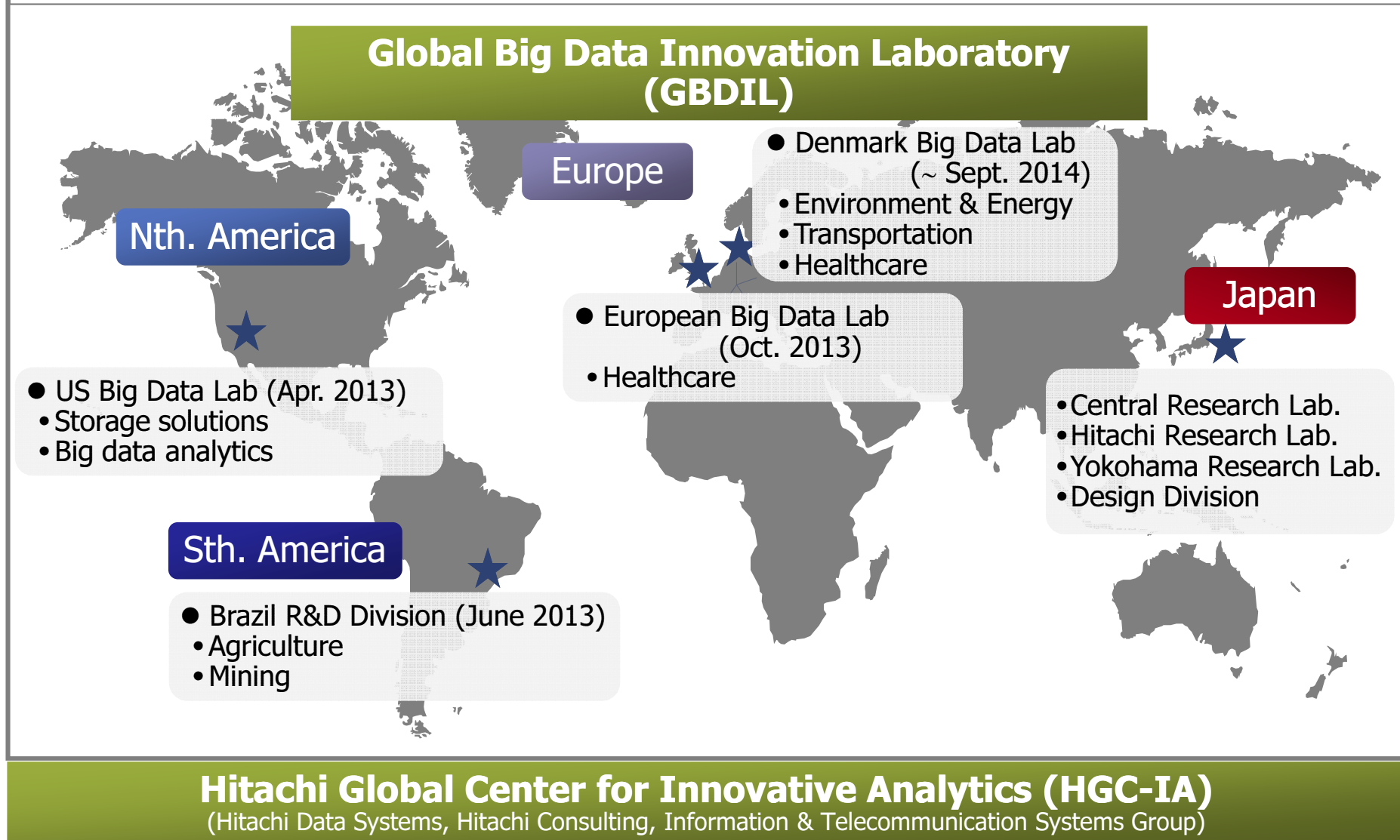
3-5

Materials procurement

Raise the local procurement of materials by Hitachi Group companies in China

3-2 Global collaboration in Big Data R&D

Overseas research bases leading the expansion of big data business



3-3 European Nuclear Power R&D Centre

(to be estab. by Sept. 2014)

Fusion of advanced European technology and Hitachi's ABWR technology

- To be established with HEU/ERD

European Nuclear Research Centre (ENRC)

- Introduce U.K. and European advanced technology
- Increase recognition of ABWR technology, and train technicians
- Identify local development needs

Joint research

U.K. universities

- Advanced plant maintenance technology
- Vast experience in decommissioning tech.

Safe & highly efficient nuclear power technology

- Raise plant utilization
- Reduce radiation exposure

Solutions for mid-to-long term issues

- Reduce waste volume
- Lower decommissioning costs

HEU: Hitachi Europe Ltd.

ENRC: European Nuclear Research Centre

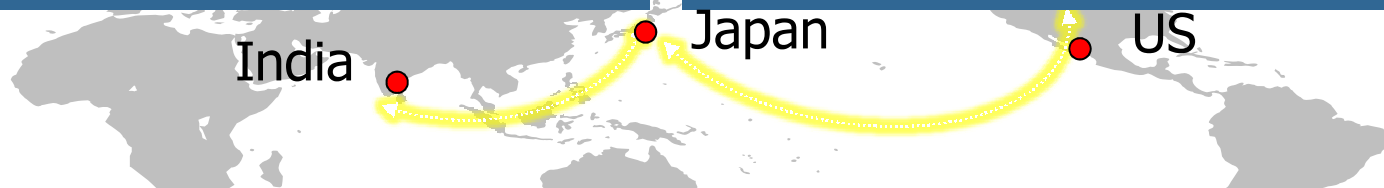
ERD: European R&D Centre

ABWR: Advanced Boiling Water Reactor

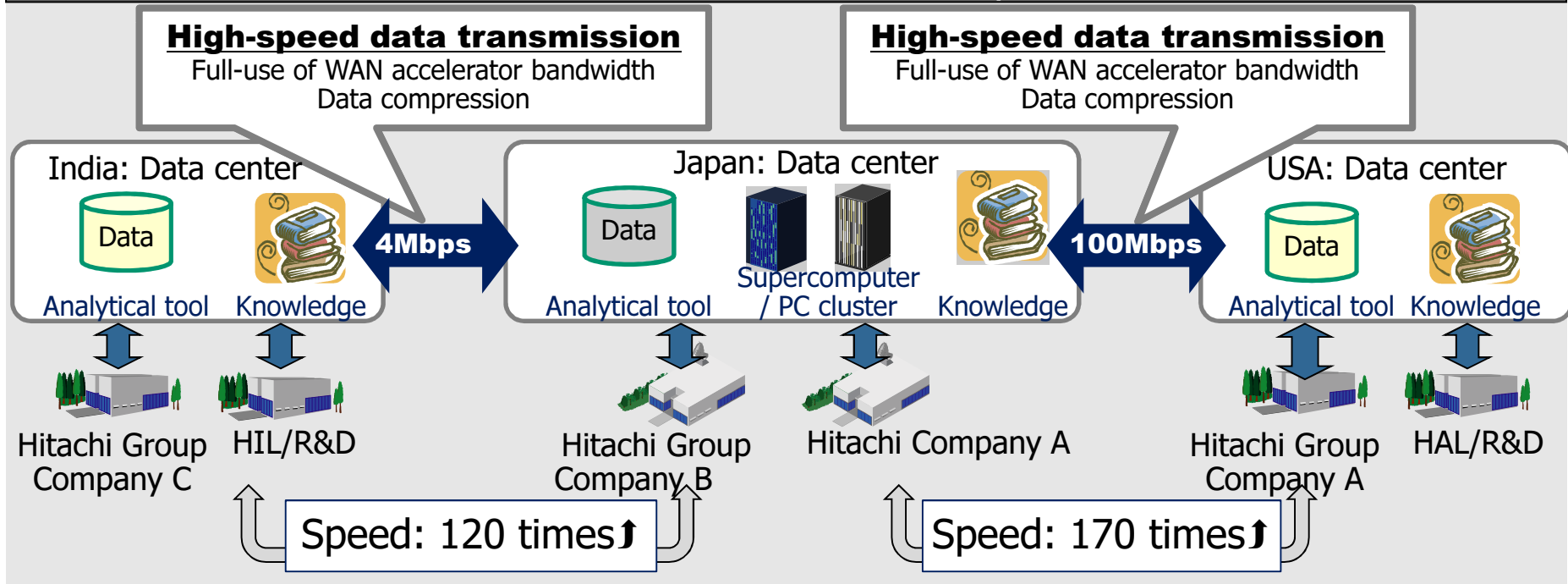
3-4 Global standardization of simulation-based design environ.

Realize an environment to access Japan's supercomputer from design & development bases worldwide

Raise global design & development efficiency Global use of most advanced facilities



Achieving over 100-fold increase in transmission speed with WAN* accelerator and data compression



3-5 Raising local procurement of materials in China

Promoting local procurement of materials in China to reduce product costs

Hitachi China Materials Innovation Technology Center

Established in the School of Materials Science and Engineering of Shanghai Jiao Tong University (April 2013)

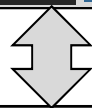


Exclusive Hitachi laboratory

Quality and characteristics assessment of Chinese materials

Development of manufacturing processes for Chinese materials and design support

FY2013 record
Approx. 20 cases



Joint research

SJTU Sch. of Materials Science & Engineering



Advanced analytical technology for Chinese materials

SJTU Sch.: Shanghai Jiao Tong University

Structure for construction machinery

Hitachi Construction Machinery China plant



Expand applications of Chinese material

High-pressure fuel pump component

Hitachi Automotive Systems China plant

Mass production of pump body at the Guangzhou Plant

4. Strategic steps for the future

4-1 Basic research for future Social Innovation Business



Solutions

Human symbiotic robot: EMIEW

Pursuing human functions such as predicting & avoiding danger, flexible communication with humans



Robotics

Business microscope

Optimizing organizational activity based on human behavioral data in association with business performance



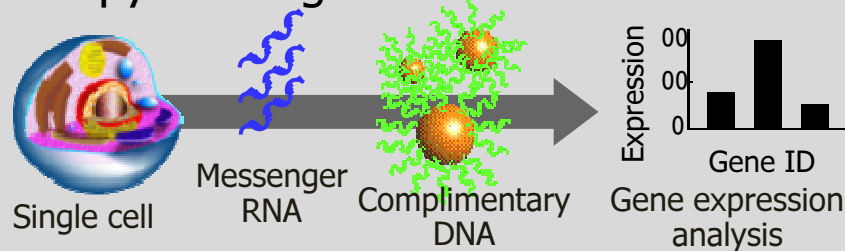
Name tag sensor node

Optimization of behavior

Creating new service

Single cell analysis

Analyze individual cells
To accelerate research in cancer therapy and regenerative medicine



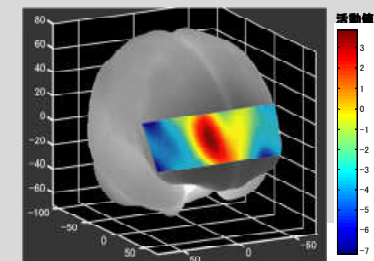
This work is supported in part by Research Program of Innovative Cell Biology by Innovative Technology grant from the MEXT.

Visualization of the body

Visualization of the brain

Optical topography

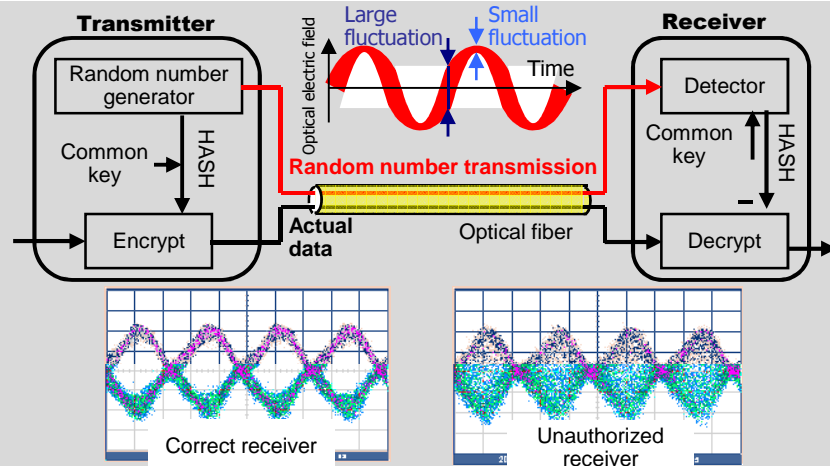
Measurement of brain functions in daily life



4-3 Information science

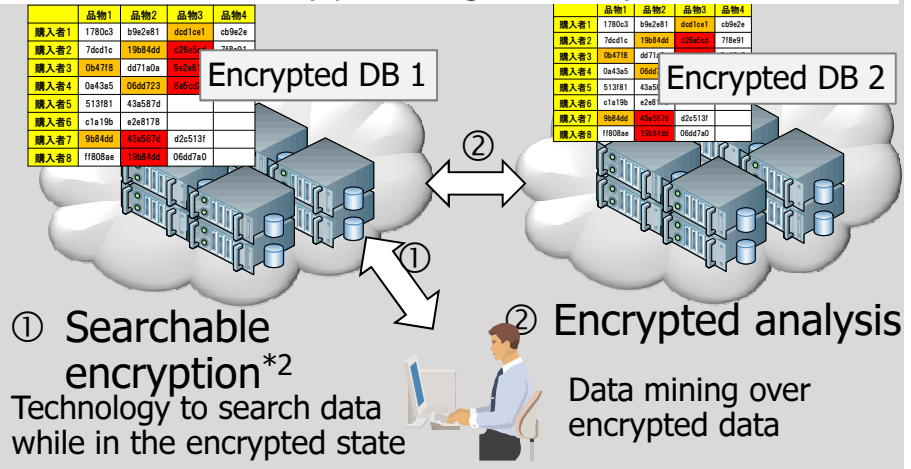
Secret data optical transmission*1

Secret communication technology developed using quantum fluctuation



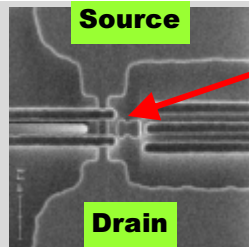
Encryption for the cloud

Search over encrypted data & Privacy preserving data analysis

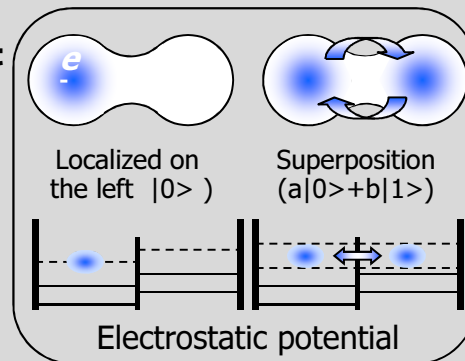


Si-qubit*1

Qubit – an elementary device in quantum computing - realized on silicon



Qubit



Si-qubit fabricated in a commercial CMOS line*2

Qubit: Quantum bit

Semi-perpetual storage

Fused silica storage with DVD comparable recording density & durability of a few hundred million years



Fused silica storage

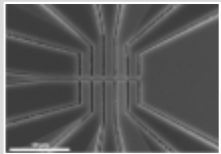
DVD comparable recording density (270MB/inch²)



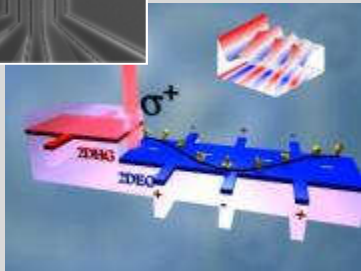
Few hundred million year durability (Heat resistance 1,000°C, 2 hrs.)

*1 This work was supported in part by the Project for Developing Innovation Systems of the Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.
*2 The searchable encryption method developed is part of research results from the 2010 project commissioned by the Ministry of Internal Affairs and Communications, for "R&D of technology for information security countermeasures in large-scale virtual server environments."

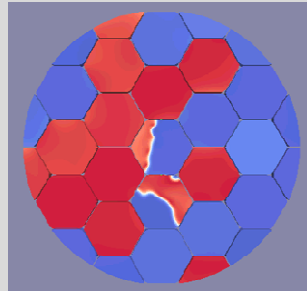
Theory & Simulation



(Grain boundary width 1nm, single side 50nm particle)



Spin current control



Simulation of magnetic flux reversal

Hitachi Cambridge Laboratory

Frontier measurement



SPring8

Advanced measurement using a synchrotron radiation facility (Non-destructive elemental analysis)



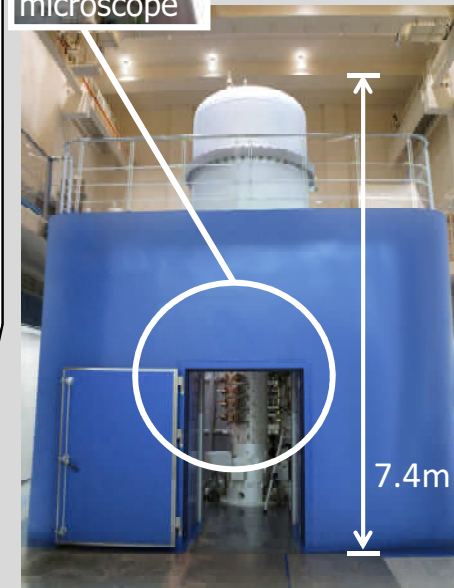
Atomic resolution electron holography microscope

Atomic resolution holography electron microscope



Main body of the electron microscope

Observation of electro-magnetic fields with atomic level resolution



7.4m

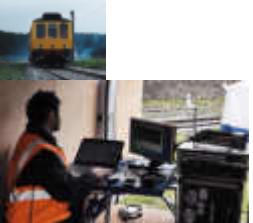
- New Materials
 - Magnetic materials
- Environmental technology
 - Battery materials
- Life sciences
 - Bio materials

External partners: RIKEN, Japan Science & Technology Agency (JST)

This research is granted by the Japan Society for the Promotion of Science (JSPS) through the "Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program) initiated by the Council for Science and Technology Policy (CSTP).

4-5 Open innovation led by overseas R&D centers


Univ. of Birmingham
(HEU/ERD)



Carriage abnormality detection using acoustics measurement

Railway maintenance

RWTH Aachen Univ.
(HEU/ERD)



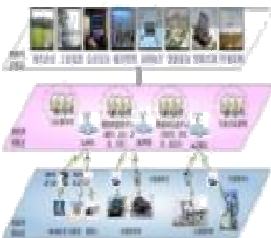
Map data linked chassis control

Technische Universität München
(HEU/ERD)

Engine combustion analysis & simulation

Automotive


Tsinghua Univ.
(HCR&D)



Internet of Things

Green ICT

EERC
(HAL/R&D)



Build-up solution portfolio for Oil & Gas business

Energy


IBM
(HAL/R&D SIR)



Joint research with leading consortium in adv.semiconductor measurement

Semiconductor measurement

IIT Hyderabad
(HIL/R&D)





Diesel generator (2 units)

Identify India's unique energy needs by analyzing energy demand curve within universities

Micro-grid


A*STAR/DSI
(HAS/R&D)

Practical verification of genome analytics platform

Genome analysis

Fudan Univ.
(HCR&D)



Joint project with Chinese business through partnership with university

Next-generation cloud

2014/2/28 News release

Univ. of Campinas
(HISA/Brazil R&D)



Study & preempt future market changes through discussion with university

Pioneer new markets

HCR&D: Hitachi (China) R&D Corporation
 SIR: Semiconductor Innovation Research Project
 EERC: Energy and Environmental Research Center
 HAS: Hitachi Asia Ltd.
 DSI: Data Storage Institute
 A*STAR: Agency for Science, Technology and Research
 HISA: Hitachi South America, Ltda.

4-6 Innovative R&D through industry-govt.– academia alliance

Promote mid-to-long term research aligned with national science & technology innovation strategy

2009-2013

FIRST* (Funding Program for World-Leading Innovative R&D on Science and Technology)

High-speed data access platform

Principle Investigator:
Prof. Kitsuregawa
(University of Tokyo)



Oct. 2013
New model released
Masuda Prize - Best Ten New Products Awards

Particle beam cancer therapy equipment

Principle Investigator:
Prof. Shirato
(Hokkaido University)



March 2014
Commenced therapy

Regenerative Medicine

Principle Investigator:
Prof. Okano
(Tokyo Women's Medical Univ.)



March 2014
Mass culturing prototype
Nikkan Kogyo Monodzukuri Renkei Prize

Atomic resolution electron holography microscope

Principle Investigator:
Dr. Osakabe
(Hitachi Central Research Lab.)



March 2014
Completed
1.2MeV Electron microscope

2014-

<Council for Science & Technology Policy>

Comprehensive Strategy on STI (June 2013)

Chairman & CEO NAKANISHI Hiroaki assumes appointed as member of the Council for Science & Technology Policy (Nov. 2013 ~)

ImPACT Program (Impulsing Paradigm Change through Disruptive Technologies)

High risk/high return 5 year project to generate disruptive technologies which will transform society. Budget: 55 billion. To be approved: July 2014.

SIP Program (Strategic Innovation Promotion)

Cross ministerial PJ to realize innovations in science & technology with CSTP acting as the control tower. (10 issues)

<MEXT>

COI Program (Center of Innovation)

Program to realize revolutionary innovations which cannot be achieved by industry alone through industry-academia collaboration; removing barriers in field and organization. 12 sites appointed.

*A Cabinet Office project to support 30 researchers in becoming world leaders in their fields by granting 1.5-6 billion JPY for 5-year projects (2009-2013)

5. Summary

R&D contributing to the global growth of Social Innovation Business

1. Leading Social Innovation Business

- Transform through a customer-driven R&D model
- Expand service business
- Enhance world No. 1 product business

2. Global R&D

- Build-up a global R&D network
- Build-up regional value-chains
- Global standardization of work

3. Strategic steps for the future

- Promote paradigm-shifting basic research
- Development of innovative technology through open innovation

END

2014 R&D strategy

R&D: A key driver in Hitachi's global growth

Solution-oriented R&D for Hitachi Global Business

10 April 2014

Keiji KOJIMA, Ph.D.

Vice President & Executive Officer

Chief Technology Officer

President & CEO, Research & Development Group

Hitachi, Ltd.

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