FY2019 R&D Strategy Briefing

Oct. 25, 2019

Trust, Digital and Global
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Hirotaka Hara

CEO, FUJITSU LABORATORIES LTD.
Make. Trust

Lead. Digital

Act. Global
Achieving Digital Trust

Developing and providing cutting-edge technologies for ensuring “Trust” in the digital era
Achieving Digital Trust

Fujitsu Laboratories ensures “Trust” by technologies for solving various customer issues in the digital era.
Cyberspace

“Trust” in all kinds of transactions
Implementing cyberspace which can be used by all of stakeholders safely
People can handle their own personal data safely and securely

Aiming to create an integrated service for various businesses

IDYX

Providing a platform through which people can control their identity exchange and use

- ID setting has to be made for each case
- Fear of ID leakage and abuse

How to ensure trust in IDs?

IDYX platform

- Highly reliable identity exchange between businesses
- Improve trust in identity exchange and utilization

Each person can decide and control the range where their ID is used

Collaboration with JCB Co., Ltd.

Started joint research on digital identity handling
Connecting data for urban development

Providing safe/secure data exchange/utilization platform using blockchain

Co-creation with Mitsubishi Estate Co., Ltd.

Virtuora DX

Marunouchi Data Consortium

Creating new value and business for urban and social development through data utilization among participating companies

Data owned by companies

New business creation

Co-creation with Mitsubishi Estate Co., Ltd.

Data analysis

Transportation

Human flow

Environment (Weather, etc.)

Energy

Event

Hotel

Communication network

Building management

Commerce
Cutting-edge technologies for data management

Virtuora DX
Secure data exchange

Chain Data Lineage
Data origin and history management

Dracena
Digital twin IoT platform

IDYX
Decentralized ID authentication
Physical space

“Trust” that people are seeking

• Laws, Regulations, International rules
• Contracts, Code of Conducts
• Ethics, Moral, Religious values, etc.
How to address AI ethical problems

Collaboration with AI4People in Europe

Fujitsu Group AI Commitment

Nov. 2018
“Five ethical principles for AI”
Framework of European Commission’s AI ethics guideline

Mar. 2018
“Five principles to address AI ethical problems”

1. Provide value to customers and society with AI
2. Strive for Human Centric AI
3. Strive for a sustainable society with AI
4. Strive for AI that respects and supports people's decision making
5. As corporate social responsibility, emphasize transparency and accountability for AI
How to address AI ethical problems

Established the “Fujitsu Group External Advisory Committee on AI Ethics”

Aiming to reflect the objective opinions and ideas in the Fujitsu Group AI Commitment

Specialists from diverse fields are appointed

Junichi Tsujii
Fellow in Information Technology and Human Factors, and Director of the Artificial Intelligence Research Center at the National Institute of Advanced Industrial Science and Technology, with concurrent positions as professor emeritus at the University of Tokyo and professor at the University of Manchester

Yuko Kimijima
Professor (of Intellectual Property Law), Keio University Law School

Hiroko Kuniya
Independent Journalist, Trustee (Special Mission), Tokyo University of the Arts

Takanori Takebe
Professor, Institute of Research, Tokyo Medical and Dental University
Director, Communication Design Center, Yokohama City University
Deputy Director, Organoid Center, Cincinnati Children’s Hospital

Kumiko Bandou
President, Japan Legal Support Center

Takakazu Yumoto
Director, Primate Research Institute, Kyoto University
Also a professor in the area of ecosystem conservation in the field of Ecology and Social Behavior

Titles omitted
World’s top digital technology

Lead. Digital

Extensive technological insights
Technology value chain

Social implementation of research results
Business value chain
Technologies supporting DX

- Concentrating resources in 7 key technology fields

**Computing**
- Digital Annealer, HPC

**AI**
- Explainable AI, Wide Learning

**5G**
- Local 5G, network slicing

**Virtual world** (digital space)
- Multi-factor biometric authentication, Security by design
- Hybrid cloud and/ multi-cloud
- Virtuora DX, Data Lake, Chain Data Lineage

**Real world** (Physical space)
- Dracena, edge computing, real-time digital twin

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Cutting-edge computing technologies

🏆 Achieving World’s Highest Speed through Deep Learning Acceleration Technology (April, 2019)

Digital Annealer
New architecture for solving combinatorial optimization problems at high speed

Content-Aware Computing
World’s first technology to realize both tenfold higher speed and user-friendliness
Fujitsu and PeptiDream Inc. started joint research for drug discovery. Finding new drug candidate compounds tenfold faster than before

- Narrowing down the candidate compounds from several trillion kinds of peptides with Digital Annealer
- Reducing the search time from previous 3 months to about 10 days
- Aiming to accelerate the speed of drug discovery through joint research with leading pharmaceutical companies such as Novartis International AG in Switzerland

Receiving a high evaluation for the stable performance of Digital Annealer, we are promoting expansion of peptide drug discovery market which is drawing a lot of attention recently
Cutting-edge AI technologies

AI patent application ranking in Japan: 2nd
( Jul., 2019: JPO survey on patent applications for AI-related inventions)

XAI
- Technologies that enabled rapid commercialization of Explainable AI
- Breakthrough technology for proposing an appropriate action beyond prediction of a certain event

AI quality
World’s first technology for AI quality management

High Durability Learning
Issues of AI qualities presented by Fujitsu

- Grasping data characteristics
- Agreement on requirements
- Quality standard
- AI ethics
- Explainability
- Performance monitoring
- Data classification
- Security/Privacy
- Safety
- System performance indicator
- Functional adaptability
- Relearning

Promoting R&D for AI quality management
Prestigious global leading laboratory

Act. Global

Collaboration with Research institutes and universities
Enhancing research systems and expanding organizations

Open innovation & Borderless
True globalization

Promoting R&D globally under the best organizational structure

Fujitsu Laboratories of Europe
- DA (Digital Annealer) Enhancement
- Automatic formulation

Fujitsu R&D Center
- Blockchain
- Business support
- Ethereum, Smart contract

Fujitsu Laboratories
- AI quality
- AI ethics (AI4People, etc.)
- AI robustness evaluation
- High Durability Learning
- Scale-up (Bit extension)

Fujitsu Laboratories of America
- Expansion of application area, Problem division technology
- Hyperledger standardization

Commercialization (VPX, IDYX, etc.)
Open innovation

Collaborating with the best partner in each technology field
Representative examples of open innovation

**Exploring application fields of Digital Annealer through 11 joint projects**
- Optimization of doses in radiotherapy for cancer

**Aiming at realizing autonomously growing AI systems, conducting joint research on Life-long Learning**
- Set up a fund for Brain x AI research

**Joint research with the world’s leading institute for mathematical science about topological data analysis**
- Achieved the world’s highest accuracy* for detecting an irregular pulse through an electrocardiogram

* 1: Verified by using Physionet’s MIT-BIH and PTB Diagnostics datasets

**Joint research on high-speed/high-capacity database system using nonvolatile memory**
- Joint paper was selected at the leading international forum concerning database* 2

* 2: SIGMOD 2018

**Developed an AI facial expression recognition technology for detecting subtle changes in facial expression**
- Achieved the highest accuracy ever recorded in the international institute’s benchmark* 3

* 3: IERB2017

**Developing innovative platform technologies for robust machine learning**
- Received “Satomi award” from Japanese Society of Fetal Cardiology
Human resource management strategy specific to our laboratories

Key points

- Fostering highly skilled professionals (Setting unique incentives & Recruiting the world’s top-level researchers)
- Introducing a multi-career path for strengthening R&D capacity of company
- Human management system clarifying job description for promoting young researchers and vitalization of organization

Executives

Managers

Non-managers

Vitalizing the organization by raising employee morale for getting higher positions

Job definition

Highly skilled professionals

Setting incentives for highly skilled professionals

Remuneration, Research budget, discretion, etc.

External human resources

Career change
## Fujitsu’s top researchers around the world

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Technology</th>
<th>Additional Information</th>
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<tbody>
<tr>
<td>Akira Nakagawa</td>
<td>Associate Fellow, FLL</td>
<td>Video encoding technology</td>
<td>World's top researcher. Development of H.264/AVC. Received the Medal of Honor with Purple Ribbon award in 2016</td>
</tr>
<tr>
<td>Arnab Roy</td>
<td>Research Manager, FLA</td>
<td>Cryptographic technology</td>
<td>World's top researcher. Deputy chair of NIST Subgroup</td>
</tr>
<tr>
<td>Ahmed Al-Jarro</td>
<td>Principal Researcher, FLE</td>
<td>AI simulation technology</td>
<td>World's top researcher. Selected as a topic of Top Conferences: NVIDIA GTC 2019, Super Computing 2019</td>
</tr>
<tr>
<td>Jun Sun</td>
<td>Director of Information Processing Laboratory, FRDC</td>
<td>Character recognition technology</td>
<td>Invited to give a lecture at ICDAR, which is the most prestigious international conference of character recognition technology</td>
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Three researchers of Fujitsu Laboratories were selected, which is only nomination from private sector.

- Tomohiro Hayase: Research on Deep Learning based on free probability theory
- Yuichi Ike: Research on innovative data analysis through geometric approach
- Kanata Suzuki: Research on Deep Learning Robotics with model-based theory assurance

30 researchers were selected from among 170 applicants (Acceptance rate is 17%).
Make. Trust

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New technologies will be announced today
High Durability Learning

Paying attention to the operational systems with the largest number of issues, we have developed the world’s first technology to maintain AI quality.
Content-Aware Computing

Computing technology based on a new concept focusing on the content of processing target data
FUJITSU
shaping tomorrow with you