Advancing Manufacturing Industry by Artificial Intelligence
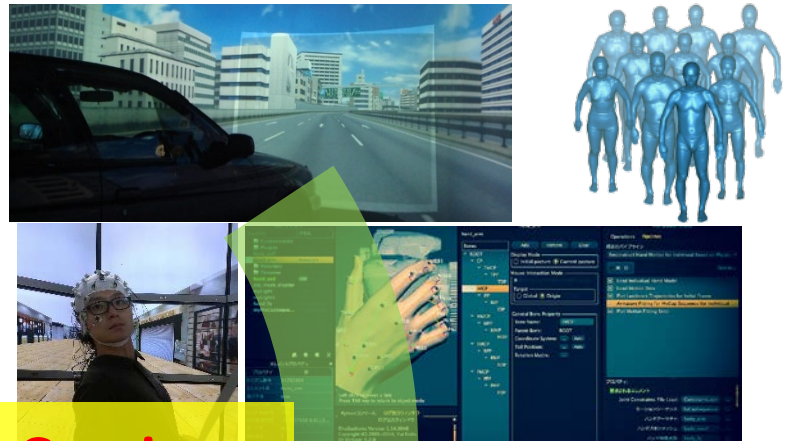
Satoshi Sekiguchi, Ph.D.

Director General,

Department of Information Technology and Human Factors,

National Institute of Advanced Industrial Science and Technology (AIST)

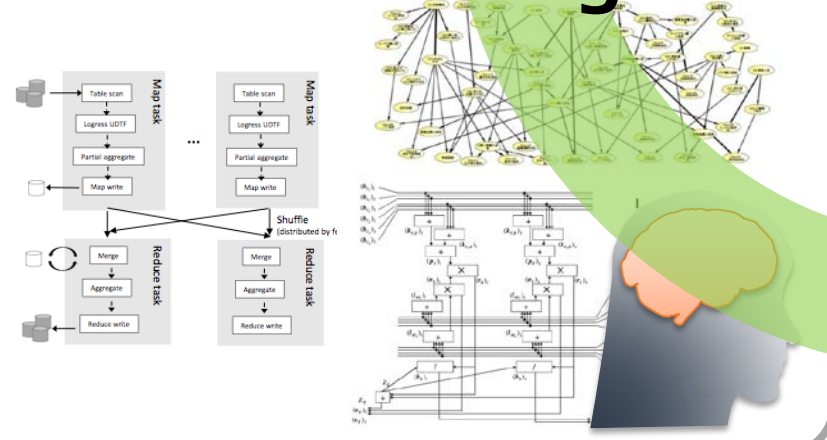# WhoAmI: Information Technology and Human Factors at AIST

Robotics

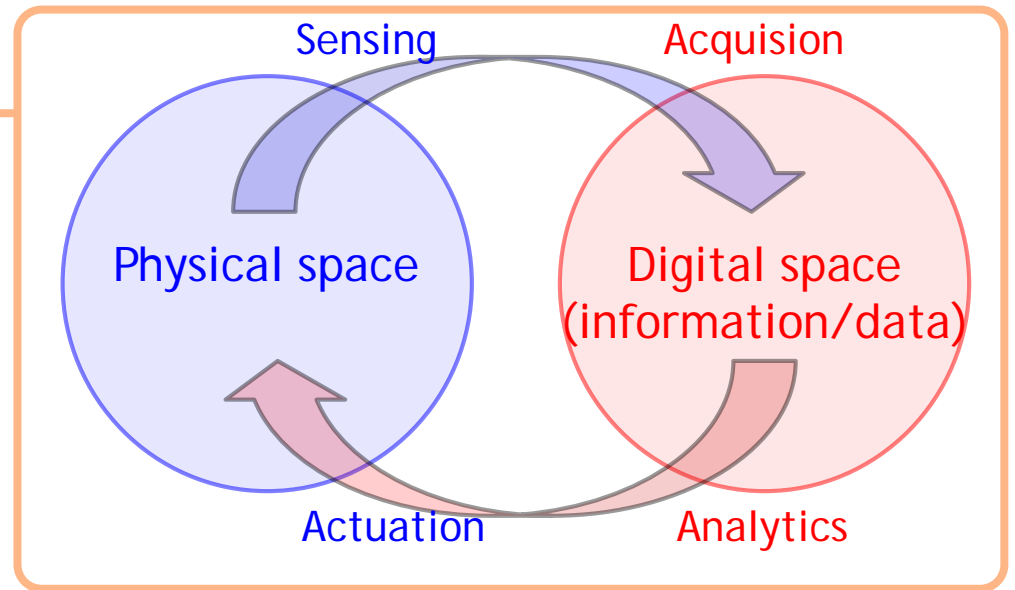## Computational Human Models

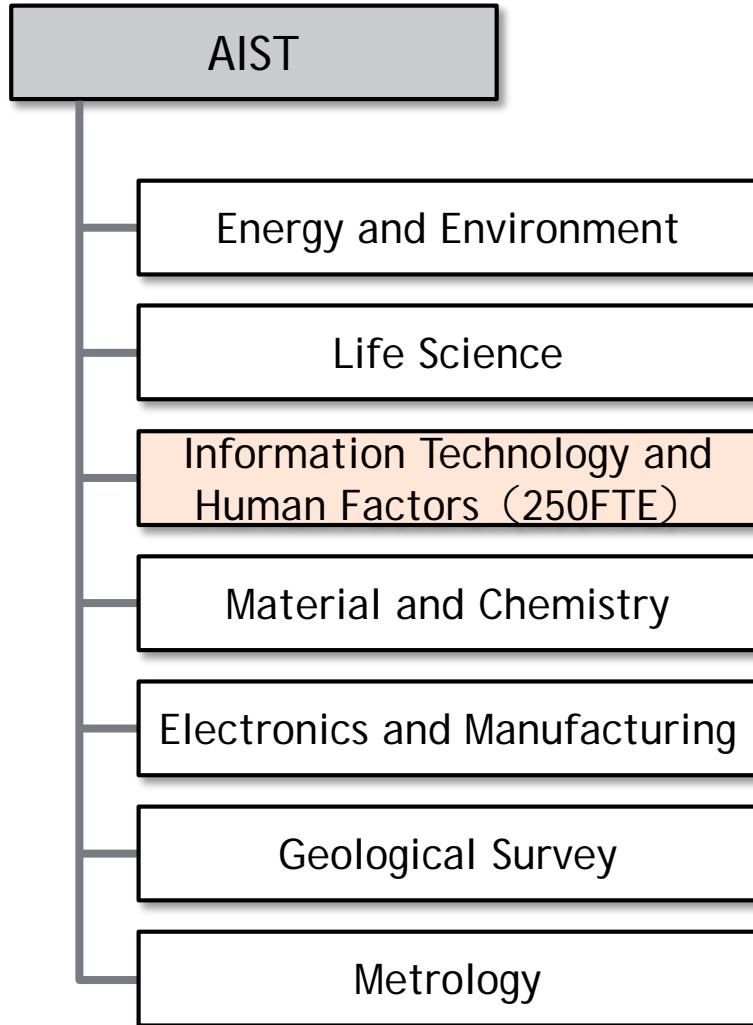**Super Smart Society**

Artificial Intelligence

IoT security

National Institute of Advanced Industrial Science and Technology, JAPAN

- AIST
  - Energy and Environment
  - Life Science
  - Information Technology and Human Factors（250FTE）
  - Material and Chemistry
  - Electronics and Manufacturing
  - Geological Survey
  - Metrology

Sensing — Acquision

Physical space — Digital space (information/data)

Actuation — Analytics

AIST: Expected mission for innovation

TRL（Technology Readiness Level）

Basic Study | Applied Research and Development | Feasibility Study | mass production Market in

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

- basic principles observed
- technology concept formulated
- experimental proof of concept
- technology validated in lab
- technology validated in relevant environment
- technology demonstrated in relevant environment
- system prototype demonstration in operational environment
- system complete and qualified
- actual system proven in operational environment

Basic Science

Universities

AIST
（Bridging chasm）

Market

Business partners

The Trinity – IoT, Big Data, CPS changes the paradigm

Analytics (AI+Simulation)

Applications (cloud/service)

Big Data
Digital copy of physical world

IoT
Transforming physical world computable
sensors: smart phone, wearable, vehicle, building, transportation
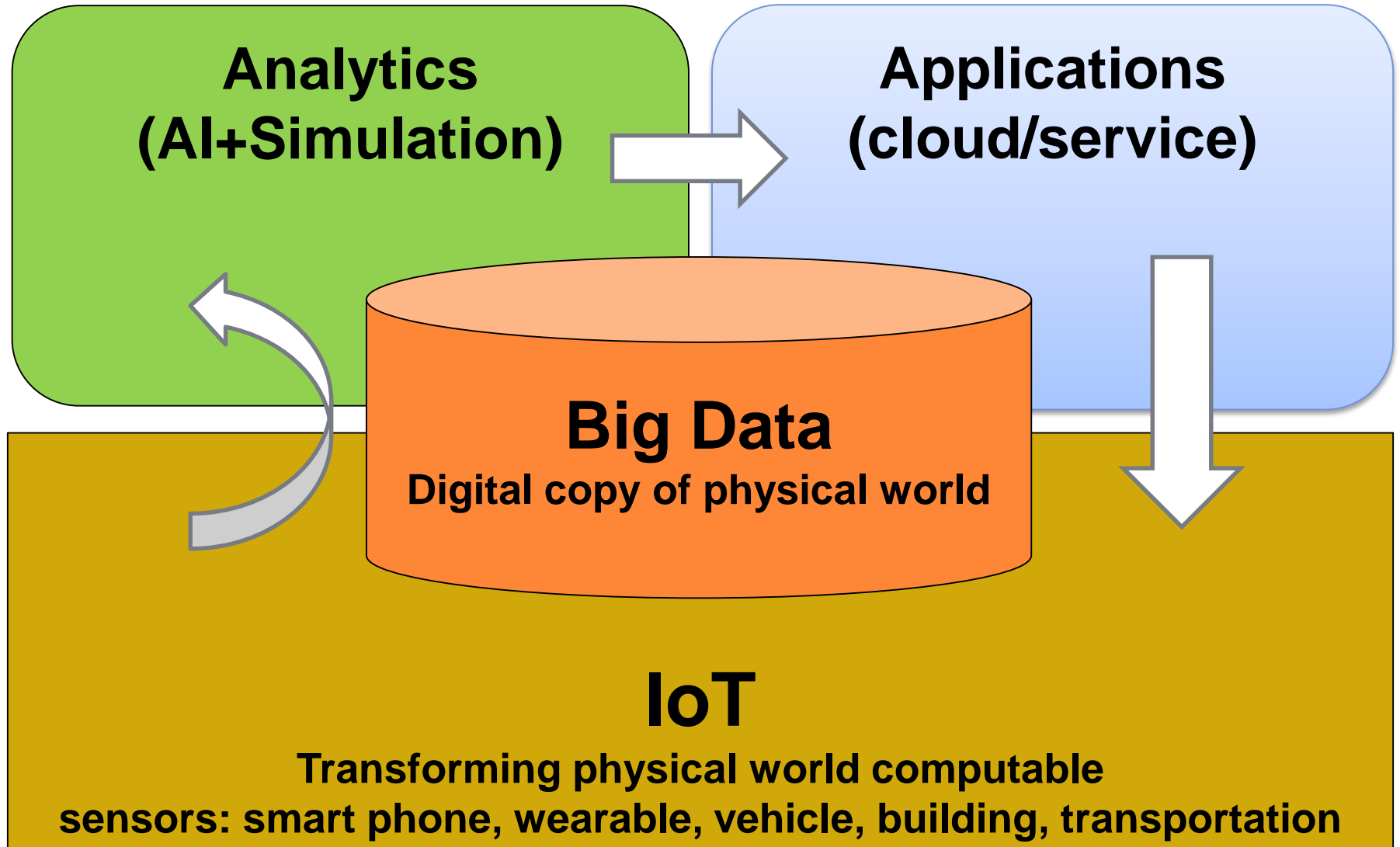
AI for Manufacturing

How many of you feel a reality of
receiving benefit from IoT ?

Enquête: how much making use of big data in biz
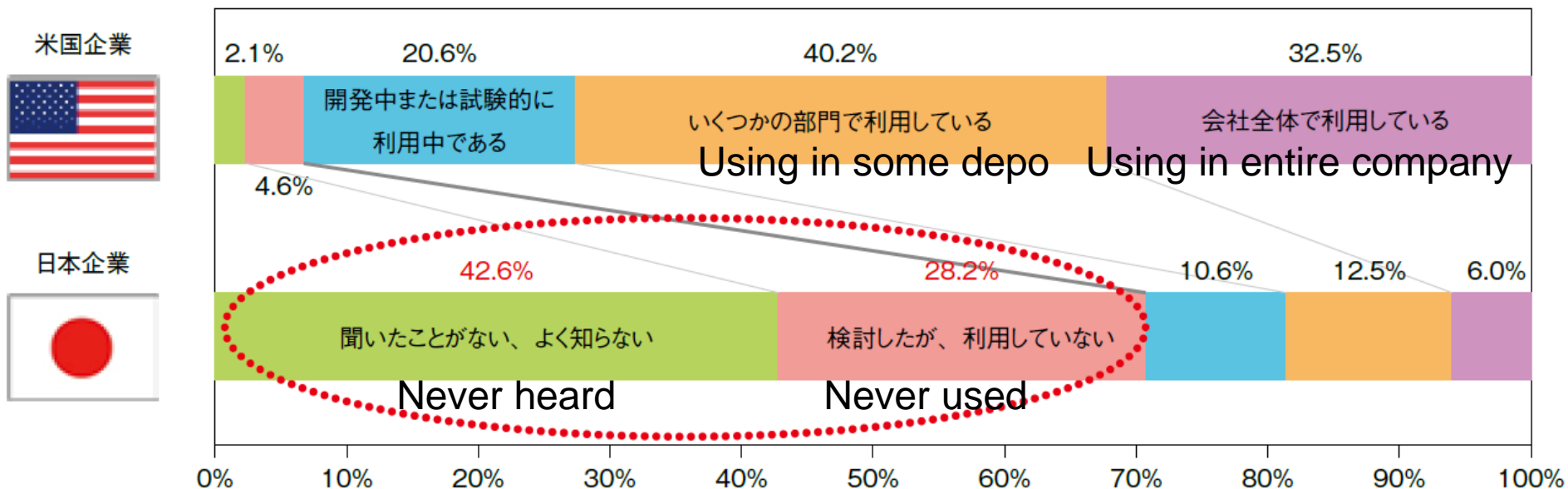
	米国企業	日本企業

米国企業

2.1%	20.6%	40.2%	32.5%
	開発中または試験的に利用中である	いくつかの部門で利用している / Using in some depo	会社全体で利用している / Using in entire company

4.6%

日本企業

42.6%	28.2%	10.6%	12.5%	6.0%
聞いたことがない、よく知らない / Never heard	検討したが、利用していない / Never used			

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2015年版ものづくり白書

佐々木内閣府参与

Smart Factory

Industry 4.0 production system

Supply Chain
Management

Product Life Cycle
Management

Order

process

| Product design | Process design | Process management | Sales/ Maintenance service |

delivery
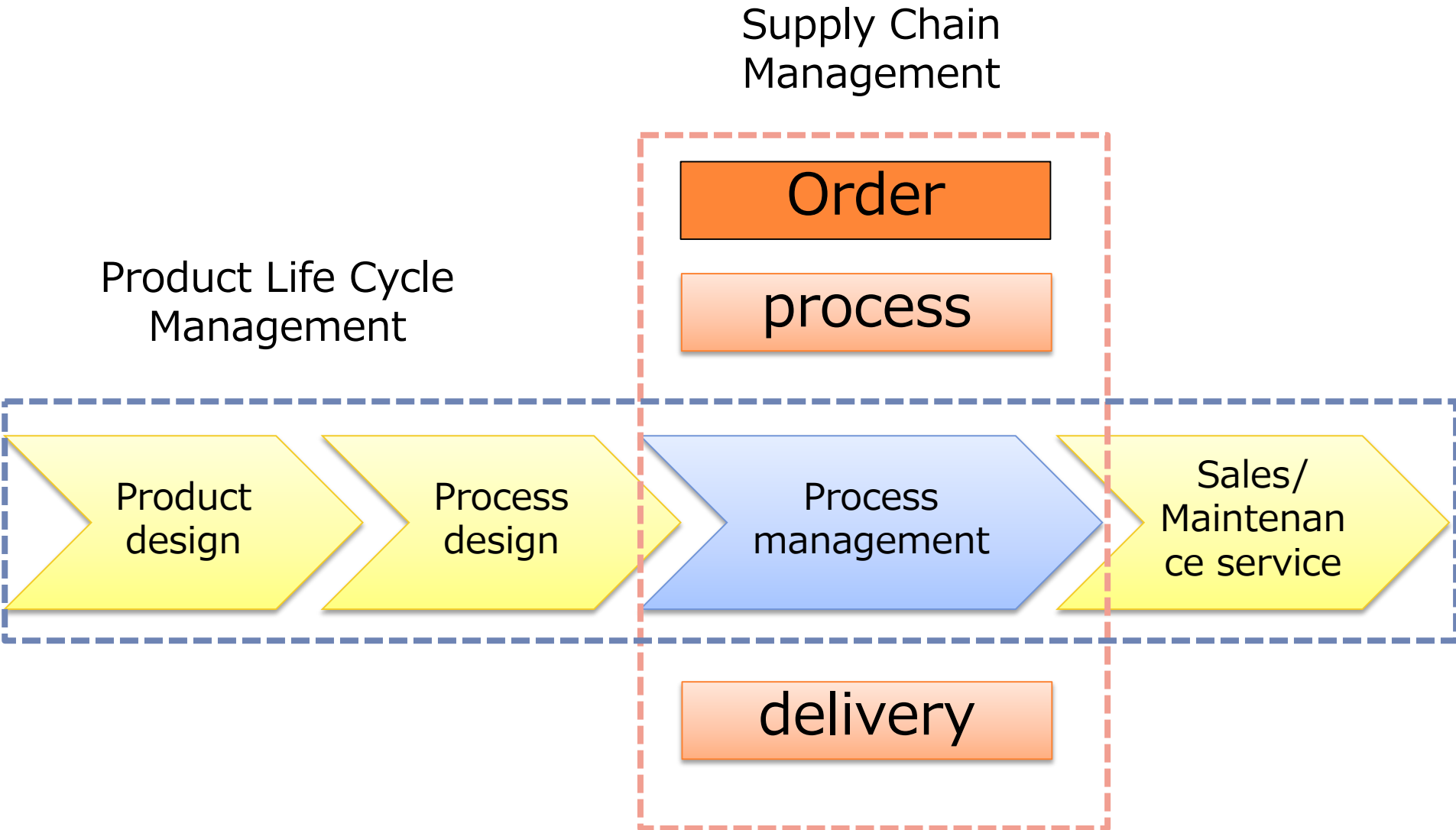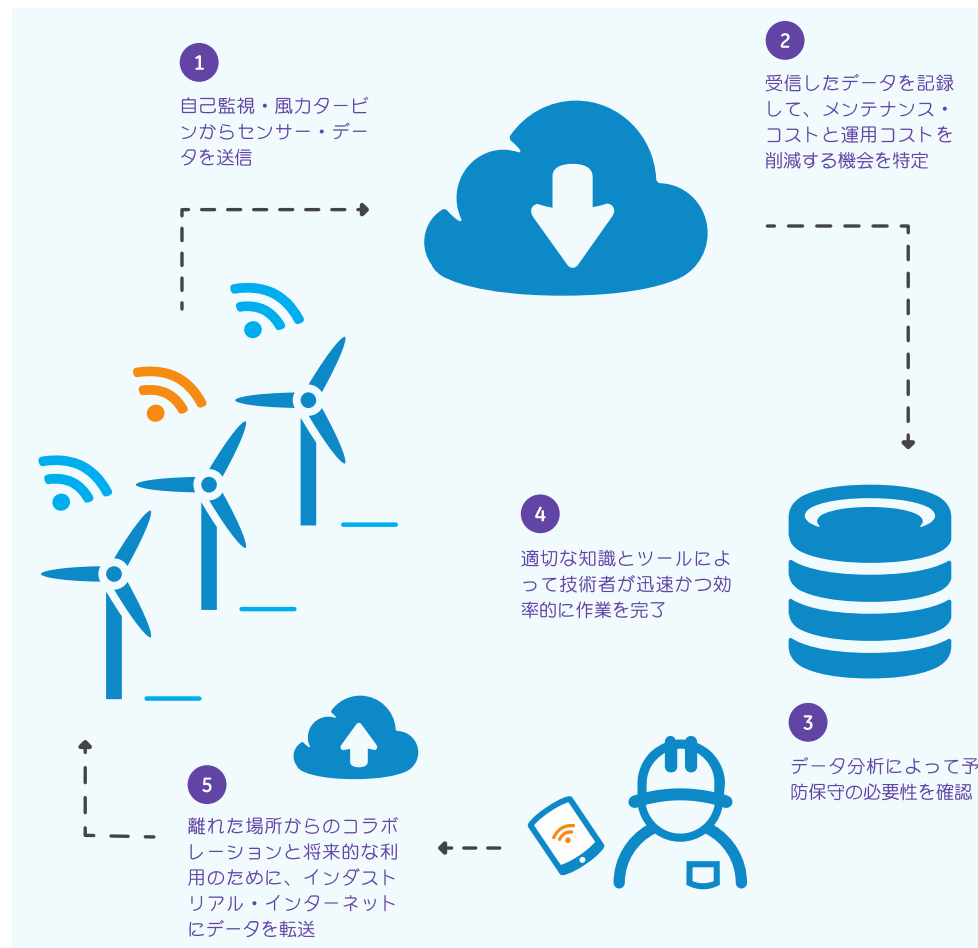
Industrie 4.0

Industrial Internet

AI Platform

AI Platforms

- **Close interaction between research and deployment**
  - Speed of Deployment: If we have an idea that actually works, within a month it can be in front of 1.5 billion people (by LeCan, Facebook)
- **AI for AI → AI for Smart Society, Sciences, and Manufacturing**
  - Partnerships between research institutes and institutes using the technology
- **Technology and Data as Commodities**
  - AI Platforms
  - Tension between Commons and their Monetarization

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State of Affairs
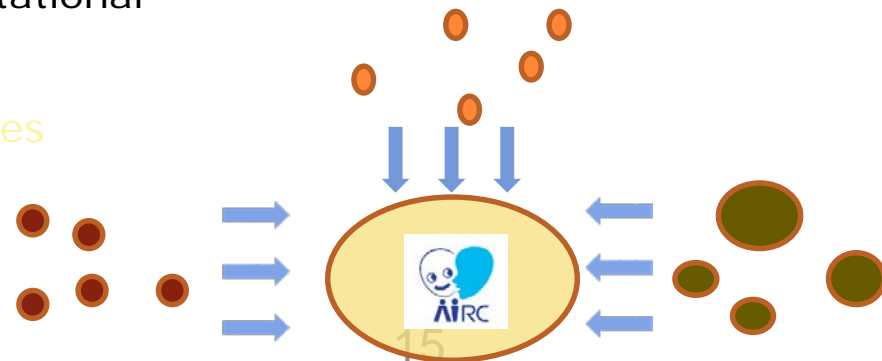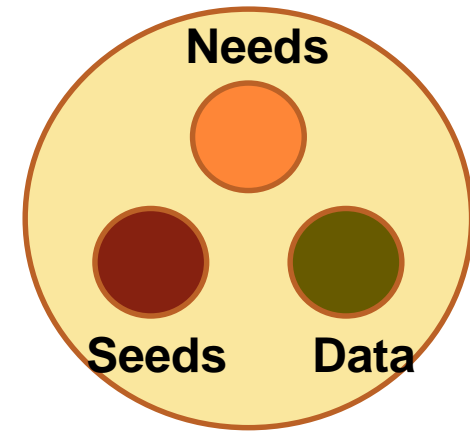# AI Research/Deployment

Giant IT Companies (G,M,...

- **Giant IT Companies in the US**
  - **Data, Seeds and Needs** in Single Organizations
    - **Data** -- Data gathered by them
    - **Seeds --** Researchers/Engineers and Computational Resources
    - **Needs --** Clear Business Models
  - **Closed eco-system**
  - Transition from internal big data to scattered and/or more specialized data
  - M&A of Start-ups
- **Japan, Europe and Academia**
  - **Fragmentation** of Data owners, Researchers/Engineers, Smaller computational resources, lack of business models
  - Open Alliance of stakeholders
  - Cooperation with Start-ups and industries

Needs

Seeds   **Data**

15

AI Platforms

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State of Affairs
AI Research/Deployment

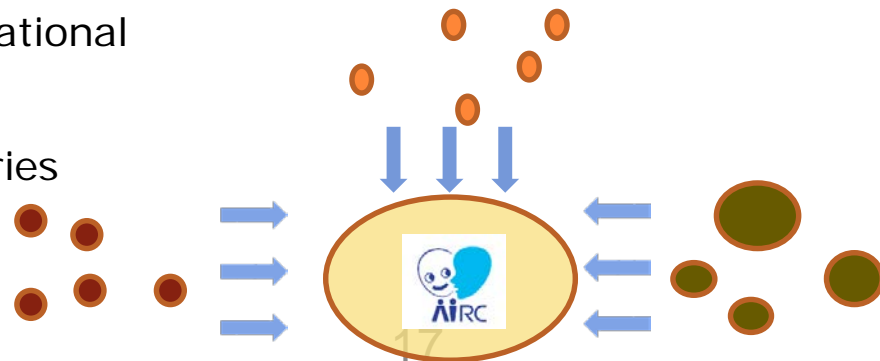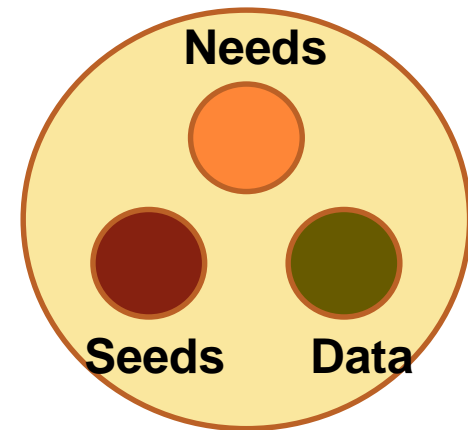**Giant IT Companies （G,M,**

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  - ▶ **M&A** of Start-ups, **Lock-in** of users in their eco-systems
- ● **Japan, Europe and Academia**
  - ▶ **Fragmentation** of Data owners, Researchers/Engineers, Smaller computational resources, lack of business models
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Needs

Seeds   **Data**

17

AI Platforms

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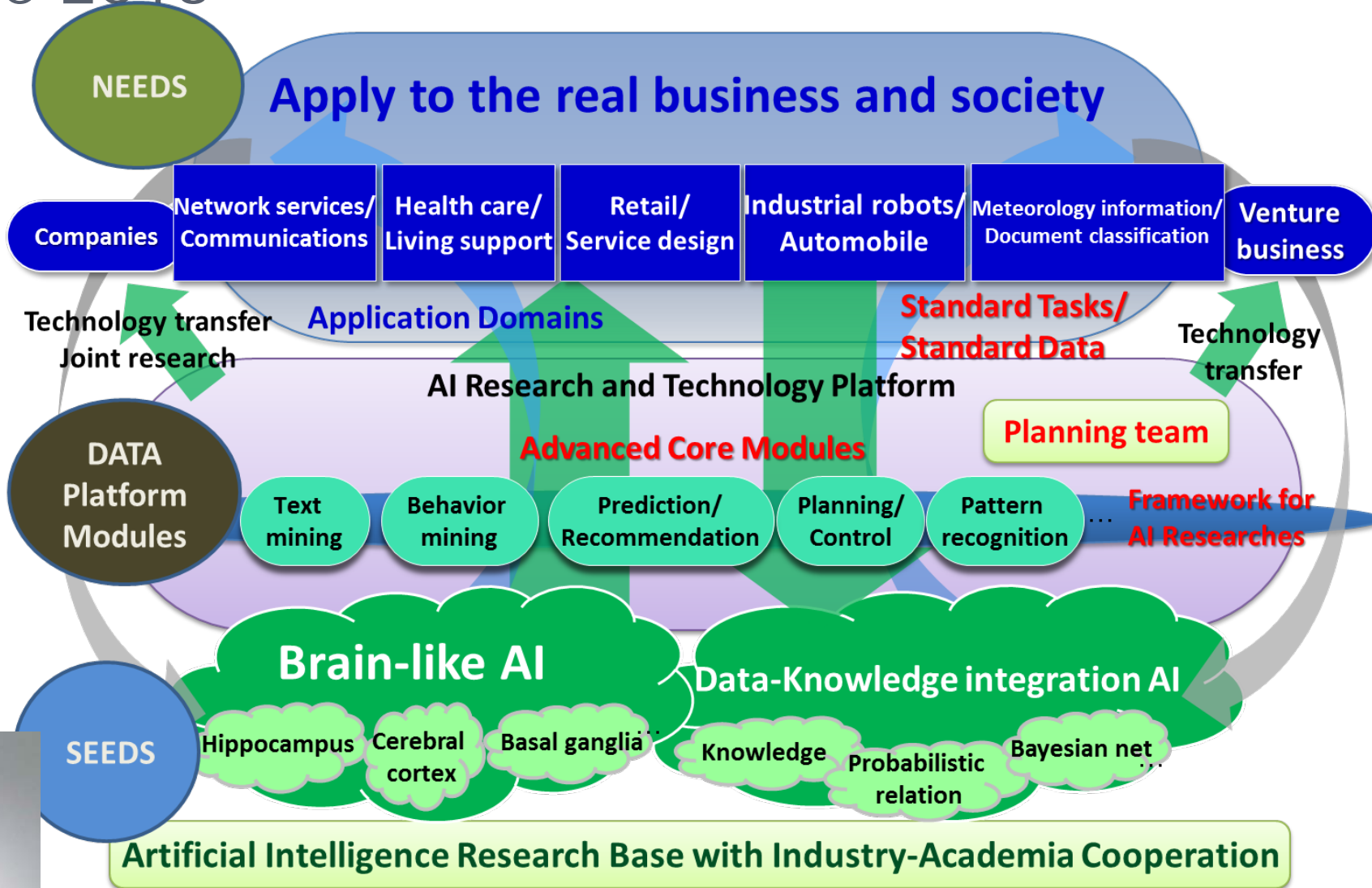- **AI for AI → AI for Smart Society, Sciences, and Manufacturing**
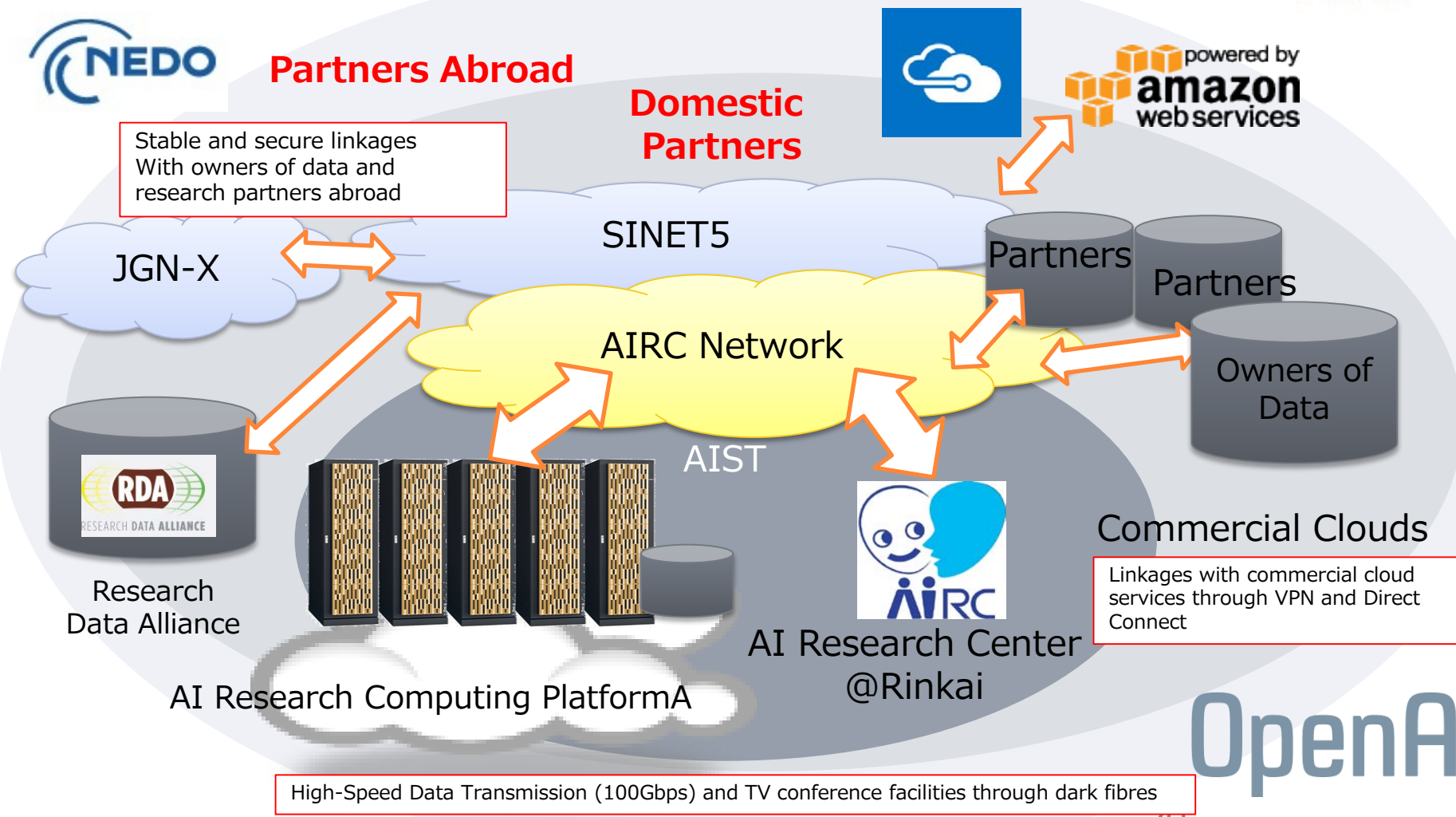 - Partnerships between research institutes and institutes using the technology
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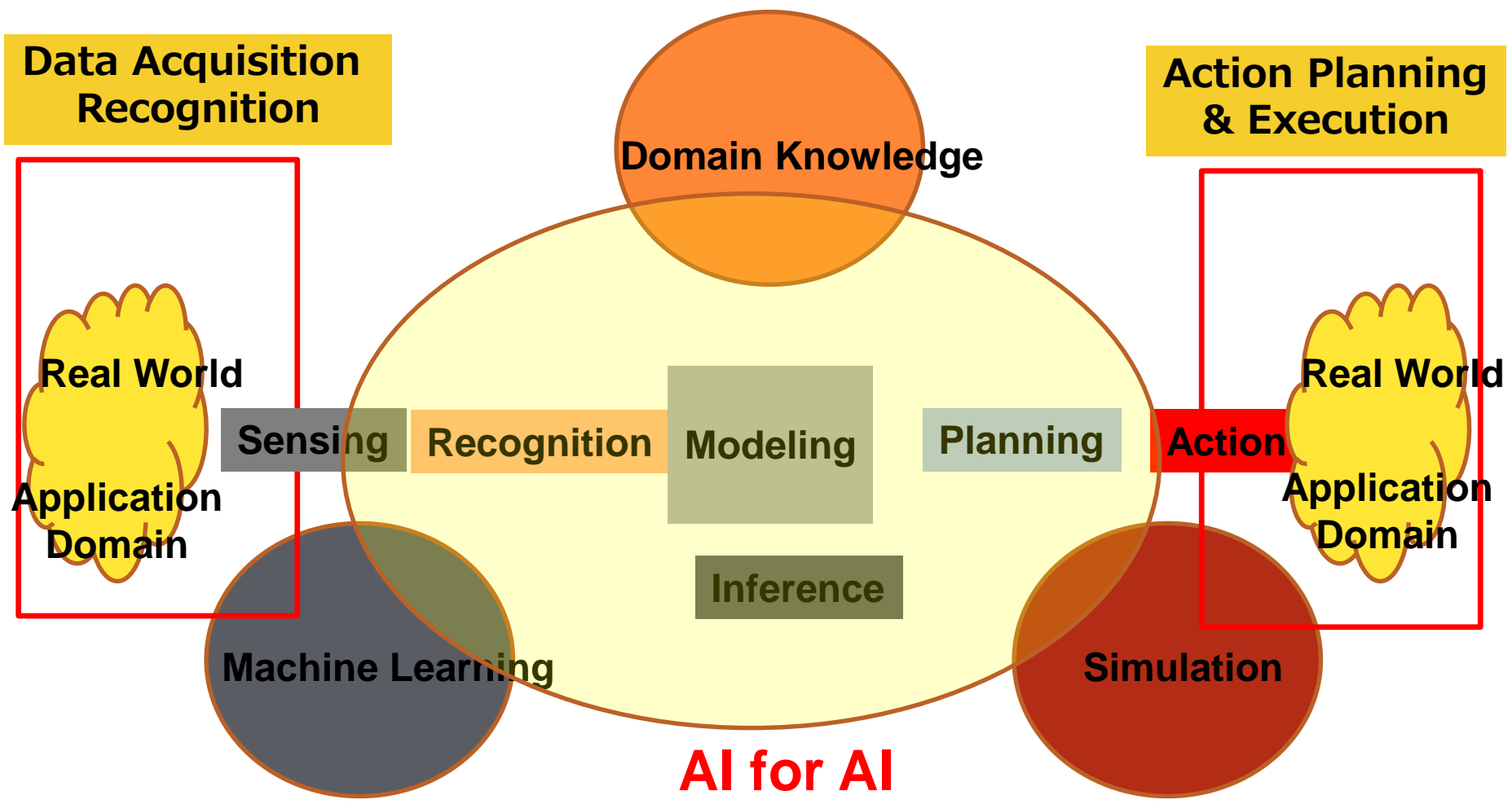# Artificial Intelligence Research Center, AIST since 2015

NEEDS

Apply to the real business and society

| Companies | Network services/ Communications | Health care/ Living support | Retail/ Service design | Industrial robots/ Automobile | Meteorology information/ Document classification | Venture business |

Application Domains

Standard Tasks/ Standard Data

Technology transfer Joint research

Technology transfer

AI Research and Technology Platform

DATA Platform Modules

Advanced Core Modules

Planning team

| Text mining | Behavior mining | Prediction/ Recommendation | Planning/ Control | Pattern recognition | … |

Framework for AI Researches

Brain-like AI

Data-Knowledge integration AI

SEEDS

Hippocampus | Cerebral cortex | Basal ganglia …

Knowledge | Probabilistic relation | Bayesian net …

Artificial Intelligence Research Base with Industry-Academia Cooperation

Big Data/AI computing platform

Partners Abroad

Domestic Partners

Stable and secure linkages With owners of data and research partners abroad

JGN-X

SINET5

AIRC Network

Partners

Partners

Owners of Data

AIST

Research Data Alliance

Commercial Clouds

Linkages with commercial cloud services through VPN and Direct Connect

AI Research Center @Rinkai

AI Research Computing PlatformA

High-Speed Data Transmission (100Gbps) and TV conference facilities through dark fibres

20

AI Embedded in the Real World

AI which cooperates with Human

Basic Components and Technologies in AI

Data Acquisition Recognition

Action Planning & Execution

Domain Knowledge

Real World Application Domain

Real World Application Domain

Sensing Recognition Modeling Planning Action

Inference

Machine Learning

Simulation

AI for AI

AI embedded in the real world—Partnerships

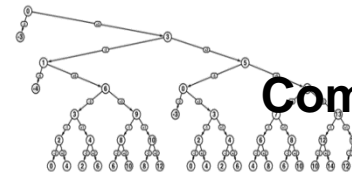# Machine Learning and Simulation

A game of perfect information

DNN

v(s)

Database of Games in the past

Training Data

p(a|s)
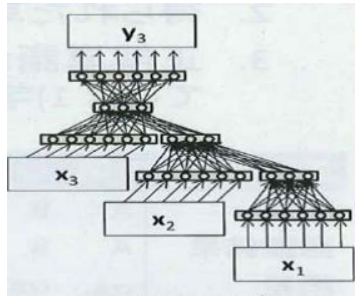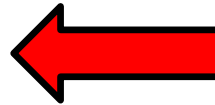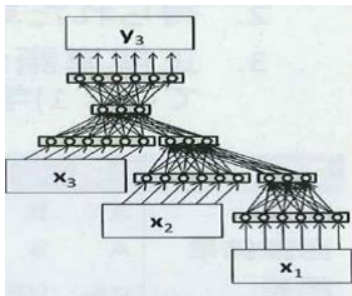
Complete Simulation

Simulation and Machine Learning

DNN

v(s)

p(a|s)
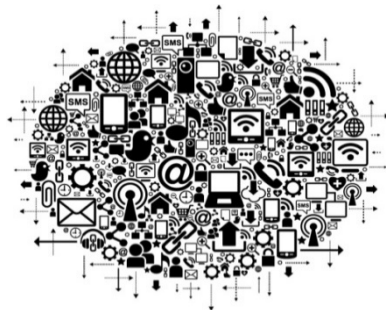
Partially Known

A game of perfect information

Diverse databases
Of
Omics
Database of
Games in the past
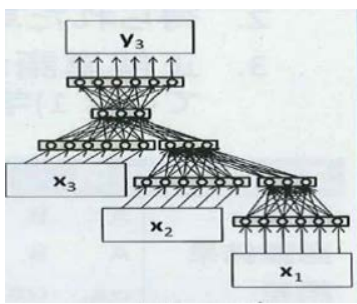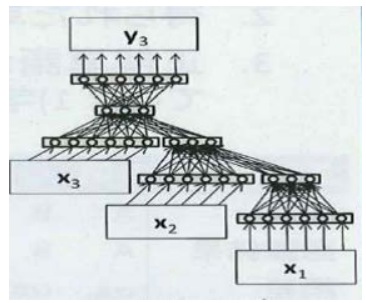
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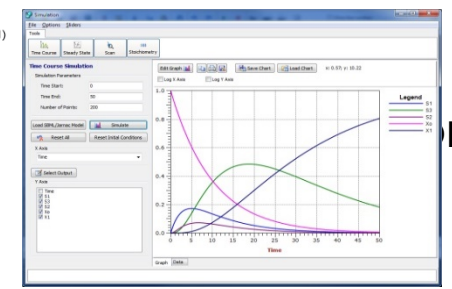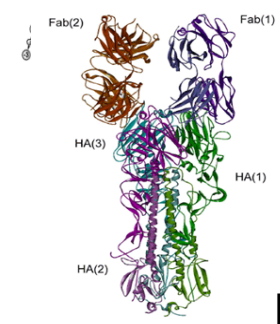
Incomplete and Partial Simulation

Thank you !