

Tentative  
Translation

Supplementary Volume

## Compilation of Case Studies for “Safe, Secure, and Trustworthy Implementation of AI in Society”

### - Collection of Good Practices -

- AI ethics and governance
- AI development and utilization
- AI human resources development
- AI supply chains

July 25, 2022

The Conference toward AI Network Society

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\* Panasonic Holdings Corporation from April of 2022

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<sup>1</sup> See Section 1 below for the official names of business operators and others.

Following the adoption of the Council Recommendations including AI Principles by the OECD in May 2019 and the adoption of G20 AI Principles by the G20 in June of the same year, the focus on national efforts and international discussions on AI is likely to shift to how to comply with these principles and promote the social implementation of trustworthy AI.

This is true also for this Conference<sup>2</sup>, which compiled the "Draft AI R&D Guidelines for International Discussion" ("AI R&D Guidelines" hereafter) in July 2017 and the "AI Utilization Guidelines" in August 2019, and then conducted interviews with various stakeholders<sup>3</sup> including AI developers, service providers, business users, and consumers in order to promote the "Safe, Secure, and Trustworthy Implementation of AI in Society". These efforts are described in "Report 2020" (July 2020) and "Report 2021" (August 2021).

Based on interviews held by the Chair of this Conference from November 2021 to March 2022 ("interviews" hereafter) following the publication of "Report 2021", this collection of case studies introduces the efforts of business operators, experts, and relevant organizations ("business operators and others" hereafter).

## 1. Overview of interviews

After compiling "Report 2021", this Conference used these interviews as an opportunity to exchange opinions, based on presentations from business operators and others engaged in advanced or ambitious efforts to implement AI in society. The main points discussed during these interviews are based on the points discussed during interviews conducted for "Report 2020",<sup>4</sup> from the perspective of promoting the "Safe, Secure, and Trustworthy Implementation of AI in Society". Specifically, discussions focused on the following topics:

- What measures are developers and users (AI service providers and business users) taking to promote "Safe, Secure, and Trustworthy Implementation of AI in Society" or to increase acceptance of AI by society?
- What issues do business operators and others face in attempting to advance these measures, and what should be done to resolve these issues?
- What kind of environment should be created to increase acceptance of AI by society and promote "Safe, Secure, and Trustworthy Implementation of AI in Society"?

Opinions were exchanged on these topics in order to further discussion<sup>5</sup>.

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<sup>2</sup> The "The Conference toward AI Network Society" held by MIC. This collection of case studies was compiled as a supplementary volume of "Report 2022" released by The Conference toward AI Network Society. For more information, see "Report 2022". Many examples of initiatives can also be found in "Report 2021" (see Chapter 3 and Attachment 3 of "Report 2021").

<sup>3</sup> For information on stakeholder categories, see "AI Utilization Guidelines".

<sup>4</sup> The same points were used for discussion during the interviews conducted to compile the case studies provided in "Report 2021". For details on these discussion points, see the introduction to "Report 2020".

<sup>5</sup> More specifically, interviews were in some cases conducted from the perspectives of human resources development and AI supply chains (in particular, during the fifth interview conducted on March 24, 2022, opinions were exchanged to further discussion from the perspective of AI supply chains).

Details of these interviews are summarized below.

	Presented by	Title
2021		
First interview (November 24)	SoftBank Corp. [SoftBank]	Examples of AI use at SoftBank
	Panasonic Corporation [Panasonic]	Panasonic's approach to AI development and application examples
	Sharp Corporation, AloT Cloud Inc. [Sharp]	AI initiatives at the Sharp Group
Second interview (December 22)	Prof. Keiichi Nakayama (Medical Institute of Bioregulation, Kyushu University) [Prof. Keiichi Nakayama (Kyushu University)]	Application of artificial intelligence (AI) to medical biology
	Prof. Takuya Ueda (Clinical AI Human Resources Development Program, Tohoku University) [Prof. Ueda (Tohoku University)]	Clinical AI: An advanced AI R&D and human resources development center aiming to solve Global x Local medical issues
	Mercari, Inc. [Mercari]	Description of AI efforts by the Mercari Group
2022		
Third interview (January 25)	Japan Data Management Consortium [JDMC]	Ethics Framework for AI and Data use conceived by practitioners
	Mitsui Sumitomo Insurance Company, Limited [Mitsui Sumitomo Insurance]	Initiatives to promote digitalization at Mitsui Sumitomo Insurance
	DAIKIN INDUSTRIES, LTD. [DAIKIN INDUSTRIES]	AI human resources development efforts at Daikin Industries
Fourth interview (February 15)	West Japan Railway Company [JR West]	Data analytics initiatives at JR West
	KDDI CORPORATION [KDDI]	AI use cases and AI governance initiatives at KDDI
	KPMG AZSA LLC [KPMG AZSA]	Initiatives toward verifying the appropriateness of AI applications
Fifth interview (March 24)	NTT DATA Corporation [NTT DATA]	Supply chain risks associated with AI and NTT Data's responses
	FUJITSU LIMITED [FUJITSU]	Fujitsu's AI supply chain initiatives
	AI Data Consortium [AIDC]	Data use, issues, and initiatives

(Note): Names of business operators and others as of the time the interview was conducted. Names indicated in brackets ([ ]) represent abbreviations using in this text.



This collection of case studies should be of use to those who intend to start developing and utilizing AI, those who are currently developing and utilizing AI but are facing some challenges, and those who intend to further promote the development and utilization of AI, from the perspective of promoting the "Safe, Secure, and Trustworthy Implementation of AI in Society".

Note that the wording used in this collection of case studies is based on presentations and exchanges of opinions during actual interviews.

Although this collection of case studies has been compiled based on presentations and exchanges of opinions held during these interviews, business operators and others are also engaged in various initiatives other than those described herein. We plan to conduct interviews on these other initiatives as necessary, and hope to play a supporting role in promoting the "Safe, Secure, and Trustworthy Implementation of AI in Society".

## 2. Overview of initiatives by business operators and others

This section provides an overview of the activities of business operators and others, along with an overview of the presentations and exchanges of opinions provided during these interviews (presentation materials are available on the MIC website<sup>6</sup>). <sup>7</sup>

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<sup>6</sup> Presentation materials from business operators and others for which permission to disclose was granted are available at the following website.

< [https://www.soumu.go.jp/main\\_sosiki/kenkyu/ai\\_network/02iicp01\\_04000232.html](https://www.soumu.go.jp/main_sosiki/kenkyu/ai_network/02iicp01_04000232.html)>

<sup>7</sup> Terms used to refer to human resources development vary by business operator, and so the preferred terms for each business operator are used in this collection of case studies.

## SoftBank Corp.: Examples of AI use at SoftBank

Overview of major initiatives related to AI development and use

Initiative	Overview
Solutions by function:	People recognition, object recognition, natural language processing, structured data AI, other
Solutions by industry:	Restaurants, retail, commercial facilities; athletes (B2C); commercial facilities, offices; cities, construction, infrastructure
Chatbot	Automatically answers customer questions about SoftBank services and contracts (24 hours a day, 365 days a year).
Automated maintenance and inspection	Conducts image analysis for maintenance and inspection services using drones.
Automatic invoice reading	Automates accounting payment processes previously done using physical documents.
Vacancy counting, people tracking	Visualizes human movement for commercial facilities/offices.
Image processing (missing items detection)	Provides product shelf monitoring solutions for the retail industry.
Sign language recognition AI service	Uses AI movement recognition to convert sign language into text.
Use of AI in hiring new graduates	AI evaluates and judges applications when screening new graduates.
Human resources development	In May 2020, the company established the "Institute for AI and Beyond", a research center that brings together the world's best and brightest people.
	In April 2022, the company launched "AI Challenge", an educational program for high school students to develop skills in using AI.

### • AI solutions

- Solutions by function

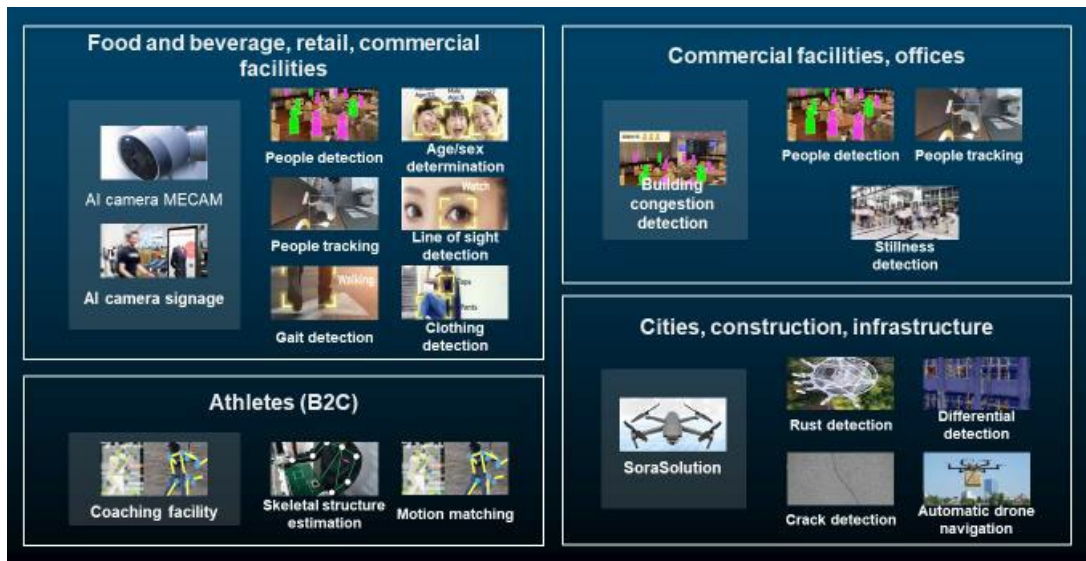
The infographic displays AI solutions categorized by function:

- People recognition:** People detection, Age/gender determination, Skillness detection, Facial image matching, People tracking, Line of sight detection, Skeletal structure estimation, Clothing detection, Motion matching, Gait detection.
- Object recognition:** Rust detection, River flood detection, Crack detection, Pipe recognition, Differential detection, Object recognition, OCR, Depth detection, Device damage detection, Object tracking.
- Natural language processing:** Text mining infrastructure, Chatbot.
- Other:** Population flow statistics, Automatic drone navigation.
- Structured data AI:** Irrecoverable debt prediction, Marketing prediction.

Legend:

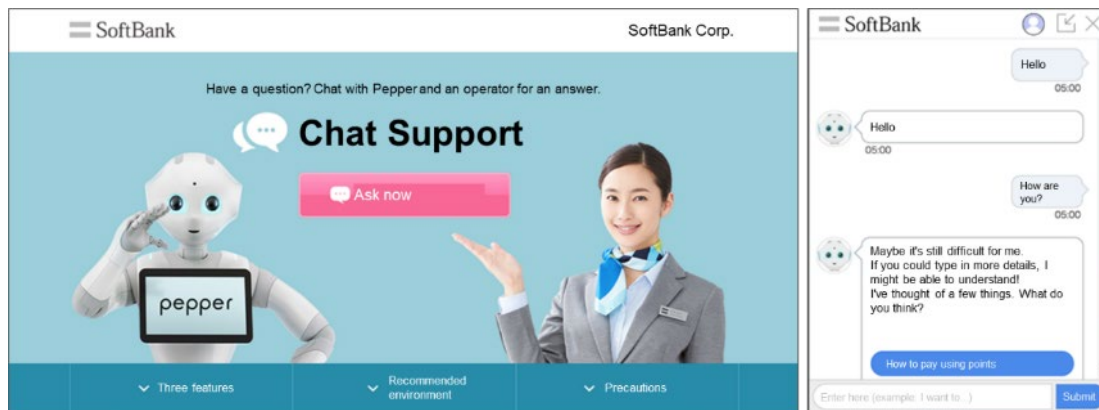
- Provided as a standalone service
- Provided as part of a solution

- Solutions by industry



**Initiative [1]: Chatbot**

- Implemented on the company's official website, this solution automatically answers customer questions about SoftBank services and contracts (24 hours a day, 365 days a year).  
=> Helps improve customer satisfaction and reduces the load on call center operators



**Initiative [2]: Automated maintenance and inspection**

- Conducts image analysis for maintenance and inspection services using drones.



Automatic rust level detection



### Initiative [3]: Automatic invoice reading

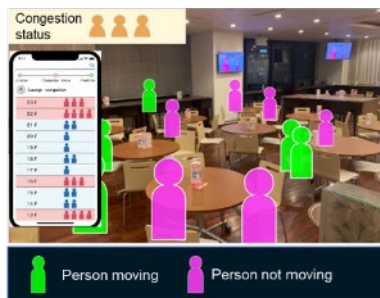
- Automatically reads invoices in the internal expense reimbursement system, in order to automate accounting payment processes previously done using physical documents.
- => Significantly reduces the workload on accounting department personnel in confirming and entering information



### Initiative [4]: Vacancy counting, people tracking

- Visualizes human movement for commercial facilities/offices.

Intuitive congestion visualization and stillness estimation



Congestion in restaurant, lounge, etc.

Congestion estimation based on entry/exit count

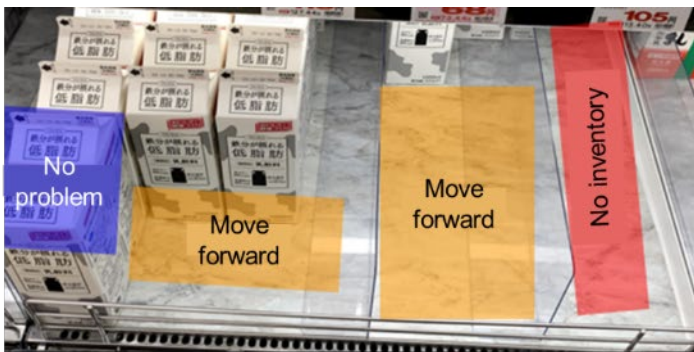


Cameras installed at entrance/exit

People tracked at entrance/exit, counted as they enter/exit

### Initiative [5]: Image processing (missing items detection)

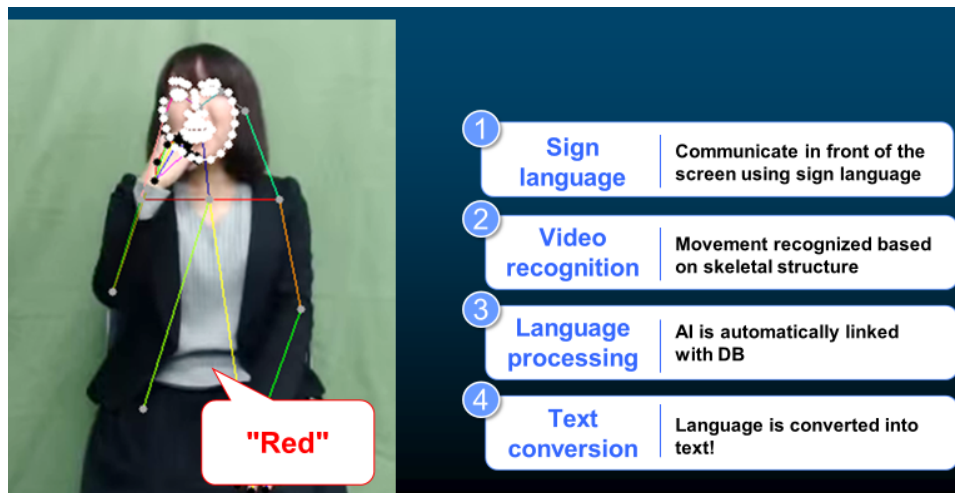
- Provides product shelf monitoring solutions for the retail industry.
- => Reduces opportunity loss by automatically detecting when there are no products on shelves and prompting employees to stock products





### Initiative [6]: Sign language recognition AI service

- Uses AI movement recognition to convert sign language into text (90% speech recognition rate).



### Initiative [7]: Use of AI in hiring new graduates

- AI evaluates and judges applications when screening new graduates.  
=> Dramatically reduces response times and labor costs, reduces variability during evaluations and keeps evaluations consistent



75% reduction (from 679 hours to 171 hours)

### Initiative [8]: Human resources development (Institute for AI and Beyond)

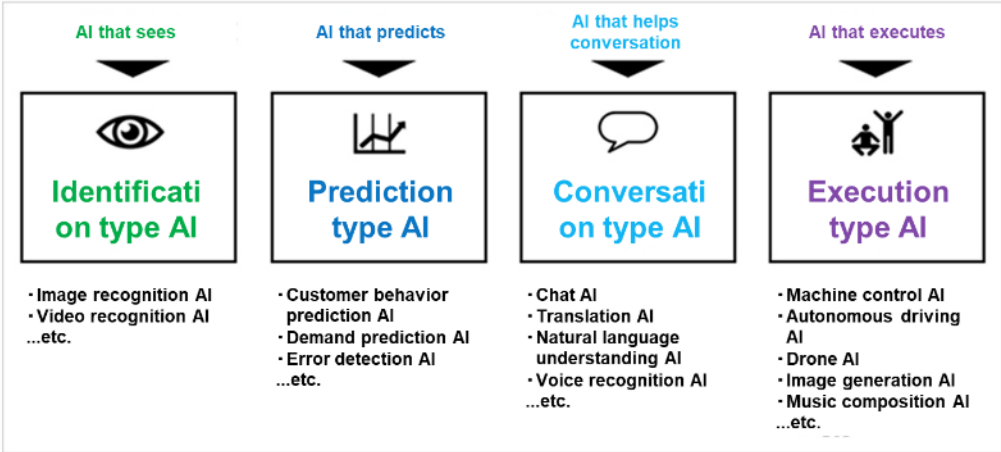
- Established the "Institute for AI and Beyond", a research center that brings together the world's best and brightest people (May 2020).



**Initiative [9]: Human resources development (AI Challenge)**

- Launched "AI Challenge," an educational program for high school students to develop skills in using AI (April 2022).

Four types of AI that can be learned about through AI Challenge



## ■ Overview of presentations and exchanges of opinions at interviews

- In a vacancy count to show congestion, in order to safeguard privacy the congestion is visualized by displaying icons to indicate the presence of people but prevent them from being identified. The technology can also be used to visualize office and conference room congestion as a countermeasure against COVID-19, and the company plans to begin offering it as a service.
- It is difficult to eliminate data bias completely, and so it is important to continue to make steady efforts to collect a wide range of data in large amounts to improve accuracy. The company is also engaged in technical efforts to prevent discrepancies based on factors such as race and gender. In areas where bias could be caused by AI, humans take over.
- When used for recruitment, the first countermeasure is to use it so that it does not have any direct impact on the decision to accept or reject. The goal is to reduce the amount of time humans spend reading applications, not to have AI accept or reject applications.
- When AI rejects an application during the selection process for new graduates, this decision is always checked by a human to ensure that no application is rejected based solely on a decision by AI. This is true also for interviews. Any interview rejected by AI must be confirmed by HR personnel, so that the decision of whether the interviewee passes is not made by AI alone.
- AI is best suited to operations that would require great time, cost, and labor for humans to perform, such as work consisting of many or repetitive tasks. However, it is difficult to use AI for operations where human judgment is important or where making a decision itself is difficult. When AI is used during these kinds of operations, final confirmation must be performed by a human.
- If performing an operation or task where any problem occurring during the process could not be tolerated, a human would have to take over. This requires a lot of work, but can make up for the imperfect accuracy of AI.
- The company is building a system that allows people to communicate using sign language and speech in real-time, so that hearing-impaired people and others can communicate naturally. This system uses AI to track body movements during video calls (from the hearing-impaired person to the other person), extract sign language characteristics and convert them into text, and automatically transcribe speech (from the other person to the hearing-impaired person), so that both people can communicate more naturally.
- The company is working to develop a wide range of AI human resources, and offers online training courses in data analysis and AI use. It offers a variety of AI training opportunities, including rewarding individuals who pass practical qualification exams (such as statistical exams and algorithmic practical exams), through its certification support system.
- In order to maintain sufficient AI human resources within the company, it is necessary to have a broad knowledge of computer science topics such as statistics. AI human resources are therefore mainly recruited from universities that provide education in such fields, or through mid-career recruitment. A wide range of OJT training is also provided so that employees can acquire practical knowledge and skills after joining the company.
- In May 2022, the company began running an education program for high school students to develop skills using AI for business purposes. It consists of an AI utilization literacy course and a practical AI utilization course. Students are expected to make use of learning data to create AI models and to incorporate AI into actual web services and the Pepper robot, in order to solve familiar problems within their schools and local communities.

## Panasonic Corporation: Panasonic's approach to AI development and application examples

### Overview of major initiatives related to AI ethics and governance

Type	Overview
Policies, guidelines, and principles	Formulated "AI Ethics Principles" in November 2019.
Organization and structure	Establish internal AI Ethics Committee.
Transparency and accountability	Jointly develop quality assurance processes to satisfy customers. Visualize basis used by AI to make decisions, using tools rather than the intuition and experience of experienced engineers.
Cooperation and collaboration with external parties	Collaborate with overseas universities and academic societies to acquire the world's most advanced AI technology.

### Overview of major initiatives related to AI development and use

Initiative	Overview
<b>Lifestyle domain</b>	
Air conditioners	Accurately control room temperature and energy consumption.
Cleaning robots	Autonomous control that allows for efficient movement.
Camera	Autofocusing based on subject recognition.
Support for the elderly (monitoring, walking support)	Detects body movement, heartbeat, breathing, etc., and monitors activity and sleep.
	Walking support robots assist during training while optimally adjusting the load.
<b>B2B domain</b>	
On-site CPS	Incorporates worksites within cyberspace and runs simulations, in order to discover work inefficiencies and make improvements.
Facial recognition authentication gates	Help streamline immigration and departure procedures at major airports nationwide.
Autonomously updated edge devices and services	Avoids issues with privacy by processing only on the edge and uploading only the resulting metadata to the cloud. AI update control is also possible.
<b>Mobility domain</b>	
Unmanned automatic valet parking system	Safely and automatically parks a vehicle once the passengers have exited.
Robot delivery service	Currently conducting verification experiments using small delivery robots for a delivery service in residential areas.
Battery usage service	Quantitatively determines and visualizes the status of batteries used for electric mobility products (electric vehicles, electric motorcycles, etc.) in real-time.
Human resources development	Employees are also allowed to work at universities, in order to develop a small number of elite employees who are well versed in cutting edge AI.
	Currently focusing on enhancing development programs to improve the quality of AI human resources (developing AI architects).



● **Panasonic strengths in AI**

**[1] Embedded AI**

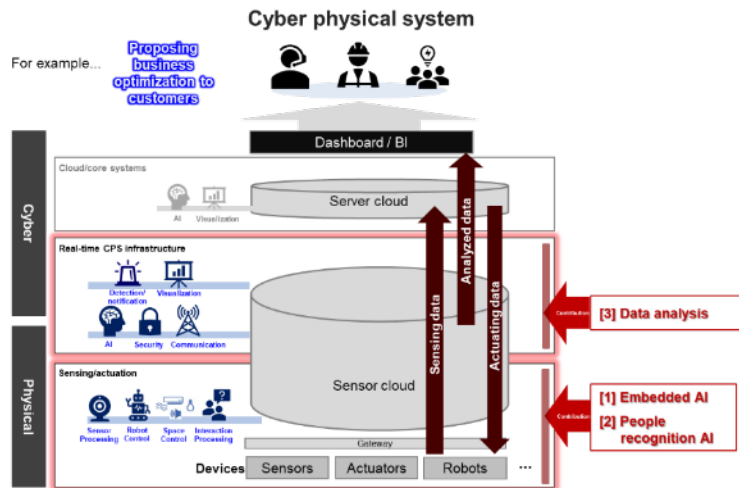
Knowledge of embedding high-speed, high-quality AI, developed through vehicle applications

**[2] People recognition AI**

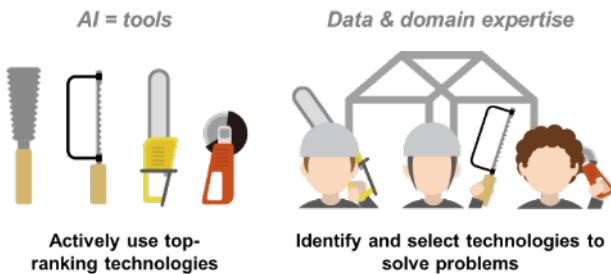
Knowledge of AI technologies for analyzing people, developed over many years

**[3] Data analysis**

Knowledge of using chronological analysis technology based on domain knowledge



- **Concept:** AI used by experts in domain knowledge

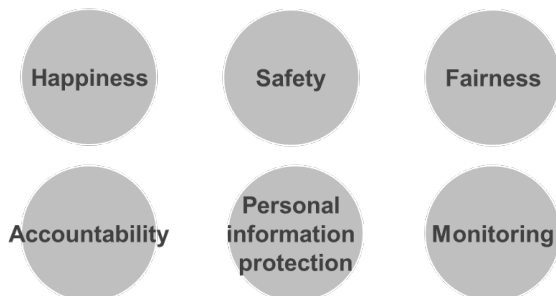


**Panasonic AI = DAICC**  
Data & AI for co-creation

**Initiative [1]: Formulation of AI Ethics Principles**

■ The company formulated its "AI Ethics Principles" as the minimum commitment required to deliver safety and security to customers (November 2019). The company also established its internal AI Ethics Committee, and promoted the establishment of a mechanism to thoroughly enforce and update AI ethics.

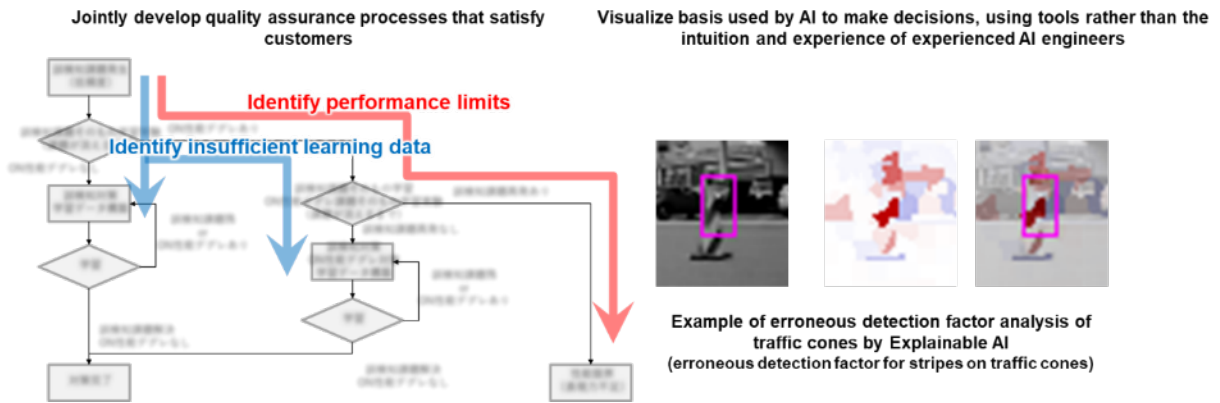
**AI Ethics Principles**



Use AI technology that is capable being a substitute for customer data and knowledge, in order to provide products and services directly linked with their lifestyles

## Initiative [2]: Quality assurance (black box elimination)

- Ensure the quality of AI (which functions as a black box).



## Initiative [3]: Cooperation with external parties

- The company collaborates with overseas universities and academic societies and engages with researchers to create frameworks, in order to acquire the world's most advanced AI technology.

### Partnership with academia



### Multimodal dataset for living spaces



Building and release of data in collaboration with Stanford University

### Movement recognition competition



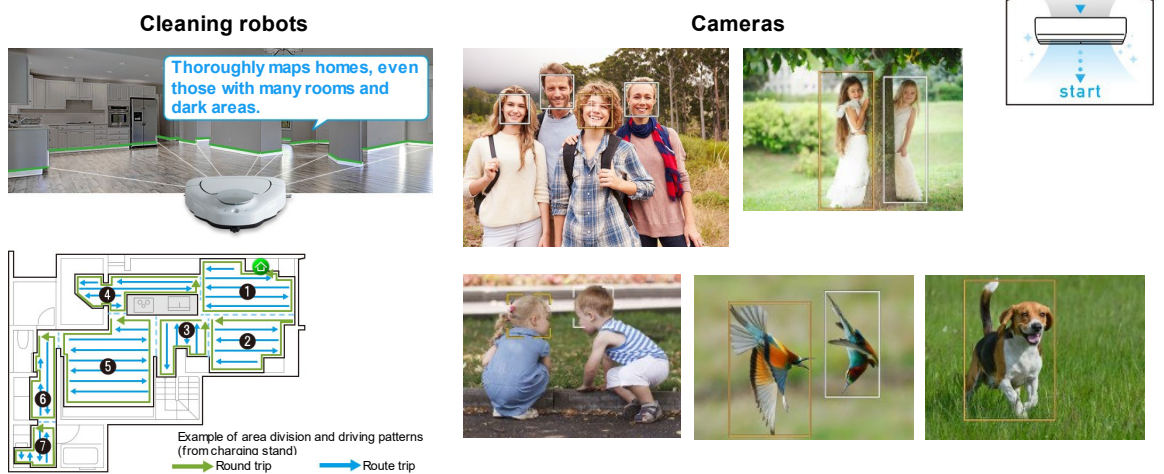
Development of AI models through work with leading AI academic societies



CVPR 2021

## Initiative [4]: Use and application of AI in the lifestyle domain

- Air conditioners: Accurately control room temperature and energy consumption.
- Cleaning robots: Autonomous control that allows for efficient movement.
- Camera: Autofocusing based on subject recognition.



- Support for the elderly: Monitor activity and sleep, and help with walking.



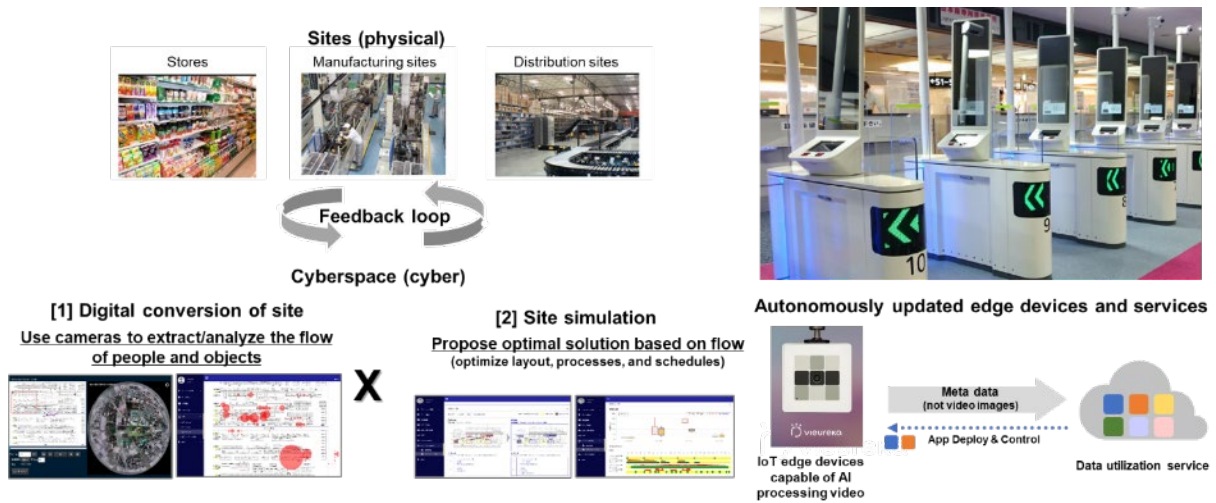
Condition detection such as sleep / lifestyle improvement



Walking support robot

**Initiative [4]: Use and application of AI in the B2B domain**

- On-site CPS: Incorporates worksites within cyberspace and runs simulations, in order to discover work inefficiencies and make improvements.
- Facial recognition authentication gates: Help streamline immigration and departure procedures at major airports nationwide.
- Autonomously updated edge devices and services: Allow for images to be processed only at the edge.



**Initiative [5]: Use and application of AI in the mobility domain**

- Unmanned automatic valet parking system: Safely and automatically parks a vehicle once the passengers have exited.
- Robot delivery service: Currently conducting verification experiments using small delivery robots for a delivery service in residential areas.  
=> Helps create an abundant and convenient lifestyle by reducing the time and effort required for shopping

**Unmanned automatic valet parking system**



Control server

Smartphone/tablet app used for vehicle entry/exit

Parking in extremely narrow spaces is possible without heading to open/line floors.

People detection using deep learning  
Emergency braking when someone steps in front of the vehicle, etc.

Designed to be used in in-vehicle ECUs, the lightweight AI can detect people in various positions and attitudes with a small amount of computation, including people that are partially concealed. The advanced emergency braking system can respond to people stepping in front of the vehicle.

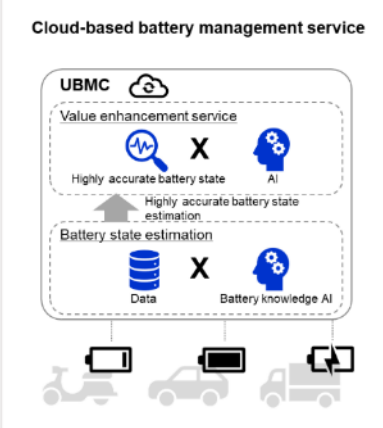
**Robot delivery service**



- Stopping, talking with people
- Safety**  
Human-coordinated robot
- Safety authentication, interaction
- Stable AV transmission, secure
- Secure**  
Remote monitoring, operation
- Communication band estimation, measures against hacking
- Danger prediction, delivery plans
- Efficiency**  
Operation management with less manpower
- AI detection, digital twin

- AI-powered battery usage service: Quantitatively determines and visualizes the status of batteries used for electric mobility products (electric vehicles, electric motorcycles, etc.) in real-time, helping to ensure that batteries are used safely and optimally.

**Cloud-based battery management service**



UBMC

Value enhancement service

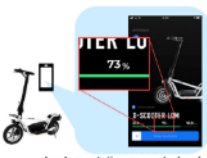


Highly accurate battery state

Highly accurate battery state estimation

Battery state estimation

Data

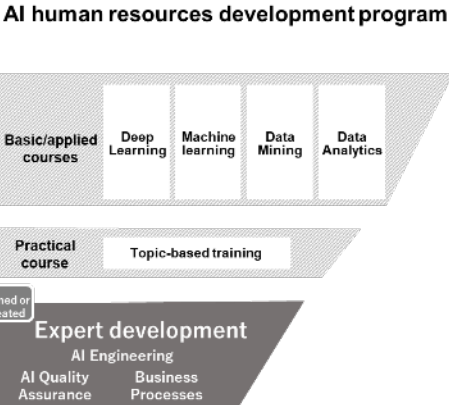
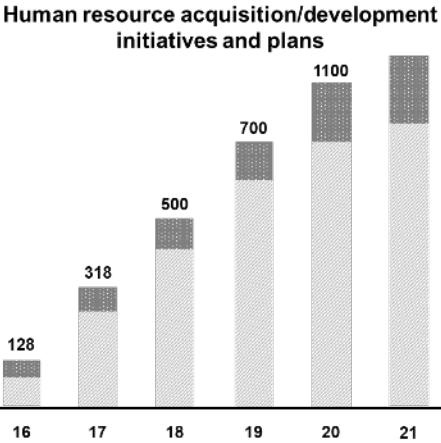
Battery knowledge AI

<p>No need to worry about charging</p> <p><b>Accurate battery state estimation</b></p>  <p>Implementation case study: glafit</p> <p><b>Battery knowledge and AI estimation</b></p>	<p>Battery replacement/charging notification</p> <p><b>Real-time remote monitoring</b></p>  <p>Implementation case study: glafit</p> <p><b>Highly efficient IoT system</b></p>	<p>Even more convenient with use</p> <p><b>Continuous feature updates</b></p>  <p>Travel range set</p> <p>Optimal route proposal</p> <p><b>Data analysis, OTA</b></p>
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**Initiative [6]: Human resources development**

- Increase "Data & AI for Co-Creation" (DAICC), train expert AI human resources, and implement measures to improve the quality of AI human resources.
  - Increase "Data & AI for Co-Creation" (DAICC): Develop software engineers to support the creation of digital products, as AI human resources
  - Train expert AI human resources: Develop a small number of elite employees who are well versed in cutting edge AI (cross-appointment system)
  - Improve the quality of AI human resources: Develop experts and train them to become AI architects



## ■ Overview of presentations and exchanges of opinions at interviews

- The company believes that AI is a tool to be actively utilized in promoting the implementation of AI in business, and that problems in the field are solved by identifying necessary technologies. Under the concept of DAICC (Data & AI for Co-Creation), engineers with data and domain knowledge use AI as a tool to solve problems.
- The field of AI continues to evolve at a rapid pace, so it is important to incorporate the most advanced and necessary technologies (especially those that have a clear path to practical application), and the company is increasing cooperation with world-class universities such as Stanford University and University of California, Berkeley.
- In the nursing care field at facilities for the elderly, the company is using non-contact room sensors to detect the movement, heart rate, respiration, etc. of residents, and to log and analyze life rhythms to improve life, sleep, etc., as a monitoring and peace of mind service. Walking support robots help the elderly during walking training while adjusting the optimum load according to the individual situation.
- Autonomously updated edge devices and services process images only on the edge side and upload only the resulting metadata to the cloud, avoiding issues with privacy and transmission volume.
- The company is conducting verification experiments using small and low-speed delivery robots for a delivery service in residential areas. In addition to the growing shortage of delivery personnel, there is a need to respond to new lifestyles, such as non-face-to-face and non-contact services. The company will accelerate its efforts to develop new delivery services by utilizing its accumulated knowledge in robot technology.
- Compared with normal software development, AI development requires an understanding of how to make good use of AI in the planning of services and products. It also may have a strong impact on social life, and must therefore be checked from an ethical perspective. AI operates based on learning data, so it can quickly become a black box and quality assurance often requires the application of special techniques.

With this in mind, the company is focusing on establishing AI ethics principles and a quality assurance concept, as well as on AI engineering from the perspective of the entire AI development process.

- The company has created its own guidelines on what must never be done with AI, and has established its "AI Ethics Principles" as the minimum commitment required to deliver safety and security to customers. The company has also established an internal AI Ethics Committee, and is promoting efforts to ensure thorough implementation of AI ethics and to establish a mechanism to update ethics as soon as possible.
- AI is a black box, so it must be developed in a way where customers are satisfied with the causal relationship between the learning data and results. Quality assurance processes must therefore be established jointly with customers.
- The company has introduced false detection countermeasures by visualizing the basis used by AI to make decisions, with a high level of accuracy. This allows causes of erroneous detection, which had previously been estimated based on intuition and experience, to now be identified instantly, reducing the time required for countermeasures by half.
- Since FY2016, the company has been working to enhance its AI human resources. In 2021, it was able to train more than 1,000 individuals capable of using AI technology. Each operating company of the Group has established an organization to investigate AI utilization.

- The company has introduced a system that allows its employees to also work at universities (cross-appointment system), in order to develop more expert employees. These employees continue to be adopted by notable academic societies, and continue to achieve excellent results in international competitions, and are leading the field of AI technology.
- In the area of human resources development, the company is focusing on improving the quality of its human resources based on the concept of retaining employees. Beginning with developing human resources who are experts in using AI, the company believes that the development of AI architects who excel in AI engineering and quality assurance will be a priority, and is therefore enhancing its development programs.

## Sharp Corporation: AI initiatives at the Sharp Group (AI education initiatives using RoBoHoN)

Overview of major initiatives related to AI human resources development

Initiative	Overview
Human resources development	Conduct technology education for elementary school students using the RoBoHoN communication robot. Arouse interest in AI technology through learning about AI technology.

### ● Thoughts on initiatives in the field of education

- The company wants more and more people to become interested in and be able to use new technologies.



### Initiative [1]: AI education initiatives utilizing RoBoHoN

- Conduct technology education for elementary school students using the RoBoHoN communication robot.

- RoBoHoN: The robot that makes you look forward to tomorrow

RoBoHoN learns by remembering your family member's faces, and what you care about. What's more, RoBoHoN will continue to learn new things as you download new songs/dances and other regularly added applications.



Talk to it to unwind.  
Smile at its funny posing.

You'll feel a little lonely when it's not around.  
It's a really strange thing.

You are a little excited about going home and going out.  
It makes you happy when you are alone, and it also gives you a chance to enjoy conversation with your family.



○ RoBoHoN programming education features, and examples of use in local public organizations

- [1] Cutting-edge, **tangible robot** can be moved at will.
- [2] Able to **design communication** such as conversations.
- [3] **Small** and easy to handle, so will not cause injuries to children.

Okayama Prefectural General Education Center



15 RoBoHoNs and PCs were loaned to public schools throughout the prefecture, along with the curriculum.

Nagaoka Board of Education (Niigata)



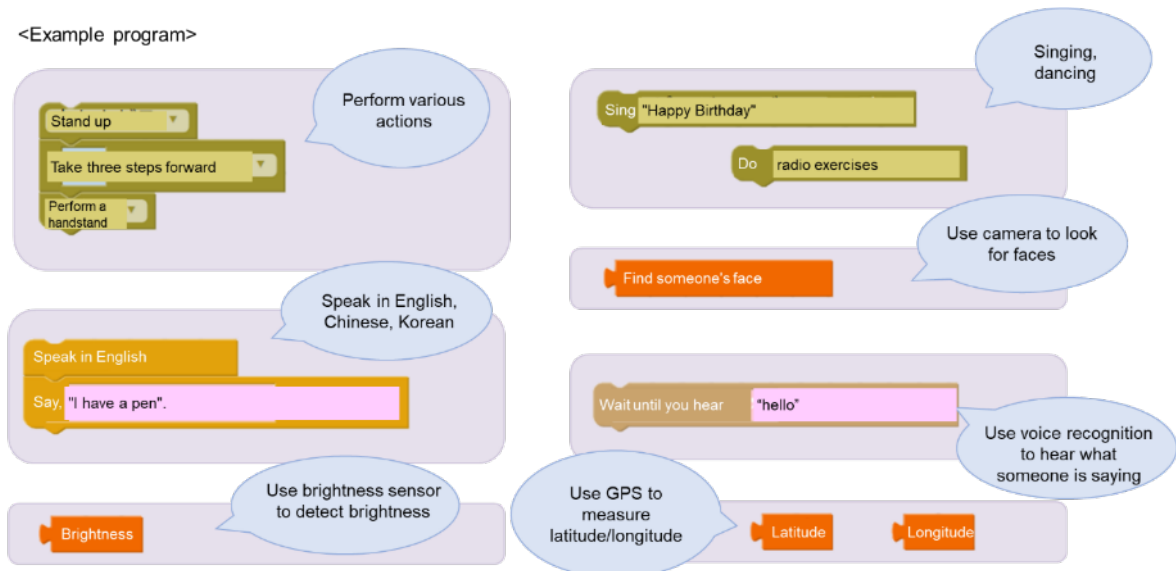
36 RoBoHoNs were provided for lessons at elementary schools throughout the city, for use by 3rd grade students and above.

Himeji Municipal General Education Center



74 RoBoHoNs were provided (one per elementary school in the city). The goal is to develop human resources with an awareness of the future.

<Example program>



○ The need for AI literacy education



- AI voice recognition
- AI image recognition
- AI interaction generation

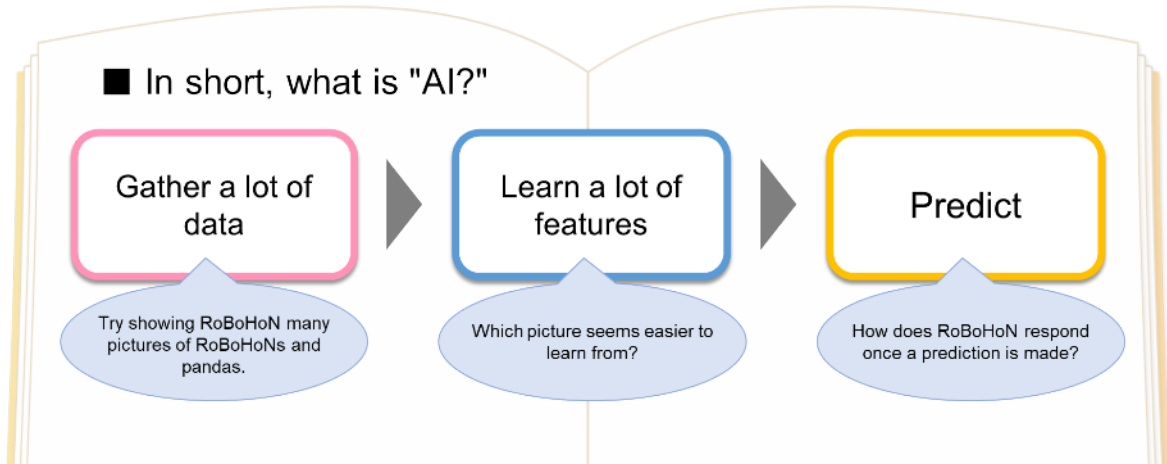
Children **use RoBoHoN to learn about AI technologies** used in familiar products, **get interested in AI technology**, and think about AI

○ Example curriculum

Tell the difference between RoBoHoN and a panda

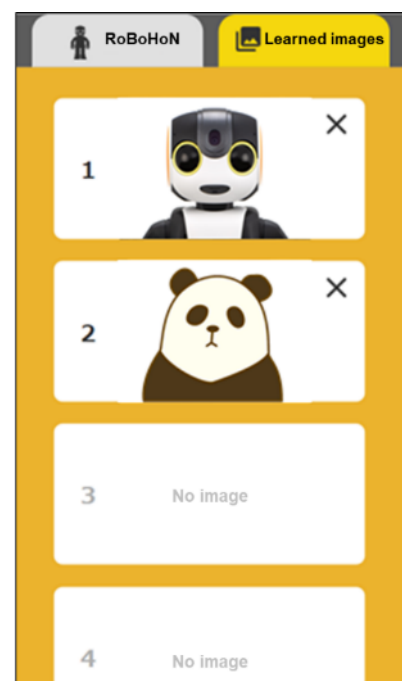


Cutting-edge technology is not magic!



```

Start
Say "Show me my picture! I'll remember it!"
Study No. 1 10 times
"Next, show me a panda!"
Study No. 2 10 times
Say "Okay! I'll figure it out now!"
Turn the AI camera ON
Repeat: Continue condition true
  Block If I thought No. 1 is probably right
    Block Say "It's me!"
  Else if I thought No. 2 is probably right
    Block Say "It's a panda!"
  
```



○ Photos from demonstration lessons



Let's try distinguishing between glasses, cellophane tape, and a stapler!



It's hard to recognize when the background is complicated!  
Let's try learning with it placed on a piece of white paper!



What about rock, paper, scissors?  
Let's try!

<Comments after the demonstration lesson>

I realized that AI has a high level of learning ability, and I felt that it will be necessary in the near future.

AI can distinguish products, even though computers in the past could not. Very useful. Now that we can do things that we couldn't do in the past, labor shortages shouldn't be a problem. AI can do the work of a receptionist, so aging of the population shouldn't be a problem.

We can learn from failure. I can learn from my teacher and make my own things.

With AI, even people who are alone can make friends quickly. No one will need to feel lonely, since they can talk with AI.

AI is very smart and was being used to do reception work at a cleaning company. I think AI will do all the work in the future, so there won't be a problem even if there are only a few people to carry on the business. I want to try living with AI now.

## ■ Overview of presentations and exchanges of opinions at interviews

- As a consumer electronics manufacturer, the company wants more and more people to become interested in and be able to use new technologies. With this in mind, it has been providing programming education solutions using the RoBoHoN communication robot, since 2018.
- Instead of merely looking at a screen, students can actually operate a robot using the programs they create, or design a conversation or other types of communication. Due to its small size and ease of handling, the robot has also been introduced to various local public organizations and is now being used nationwide.
- RoBoHoN is designed to control motion (such as cameras and sensors) in addition to movement and speech programs.
- Since February 2020, the company began engaging in AI literacy education initiatives in addition to programming education. The aim of AI literacy education is to increase the number of people who can develop AI technologies in order to realize a society where AI is increasingly utilized going forward. RoBoHoN is used to teach people about AI technologies used in everyday life, and to stimulate interest in AI technologies at an early age so that students will have an opportunity to think about AI.
- The purpose of the company's programming initiatives is to encourage children to interact with Sharp products (RoBoHoN) and use them to learn. It is not intended to feed back into other businesses.
- Programming topics are decided by the children. The goals are to teach children what they should be learning and how to make use of learning opportunities, and for them to learn what kinds of programs they can develop by having the robot recognize various things.
- RoBoHoN is capable of voice recognition, image recognition, and interaction, and these mechanisms are used to teach the curriculum.
- For example, one task would be to create a program that uses image recognition to distinguish between RoBoHoN and a panda. In addition to creating the program, students actually use the program to make the AI learn and make decisions, allowing them to learn not only by creating the task but also by experiencing how it works.
- During demonstration lessons, children study and experience the most efficient ways to learn as they go through a process of trial and error while creating actual programs and then having the robot learn and make decisions.

Students can be very creative and focused on their own solutions during demonstration lessons, and students have indicated after lessons that they are now more interested in AI.

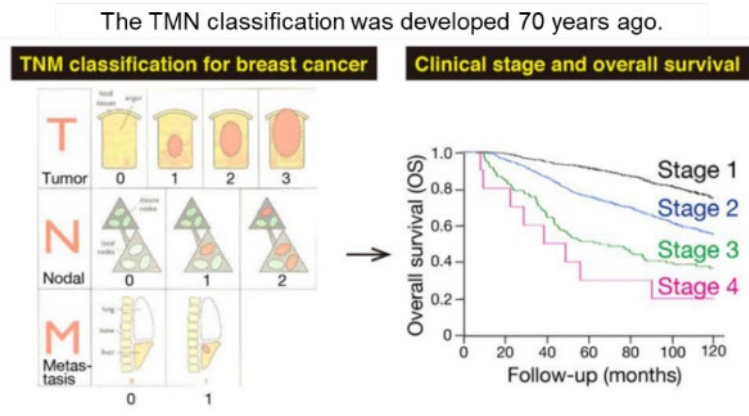
- Due to the spread of COVID-19, the company has not been able to provide lessons at schools, but hopes to offer more lessons and create more opportunities for children to experience AI.

Overview of major initiatives related to AI development and use

Initiative	Overview
Estimating cancer prognosis using AI	In order to accurately predict the prognosis of breast cancer patients, researchers selected 23 of approximately 20,000 genes, and then determined optimal parameters.
AI-based drug discovery revolution	Researchers quantified a protein with a three-dimensional structure (ball) using only one-dimensional structure (string) information, and then matched this against compounds to predict a score for binding (calculations can be performed accurately and quickly).

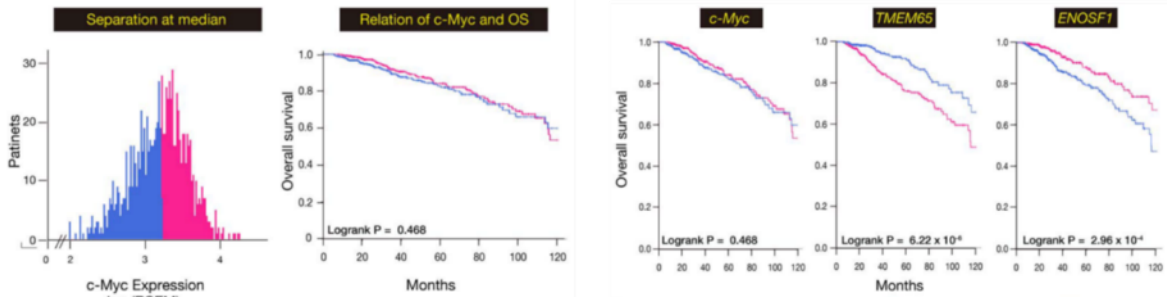
**Initiative [1]: Estimating cancer prognosis using AI**

- Researchers selected 184 of approximately 20,000 human genes thought to affect cancer prognosis (286 genes were initially selected, but then 184 genes unrelated to factors such as race or environment were selected from this number). Then 23 genes for which significant data can be obtained were selected, each gene was weighted, and optimal parameters were set. A molecular prognostic score (mPS) was assigned, patients were divided into six groups, and their prognoses were tracked. Each group matched the prognosis exactly.
- Traditionally, cancer prognosis is scored and determined using TNM classification based on past statistics (T: tumor size, N: lymph node metastasis, M: distant metastasis). TNM classification was developed 70 years ago (1952) and is still used today.
- > AI was used to develop an accurate prognosis system, in order to improve this situation





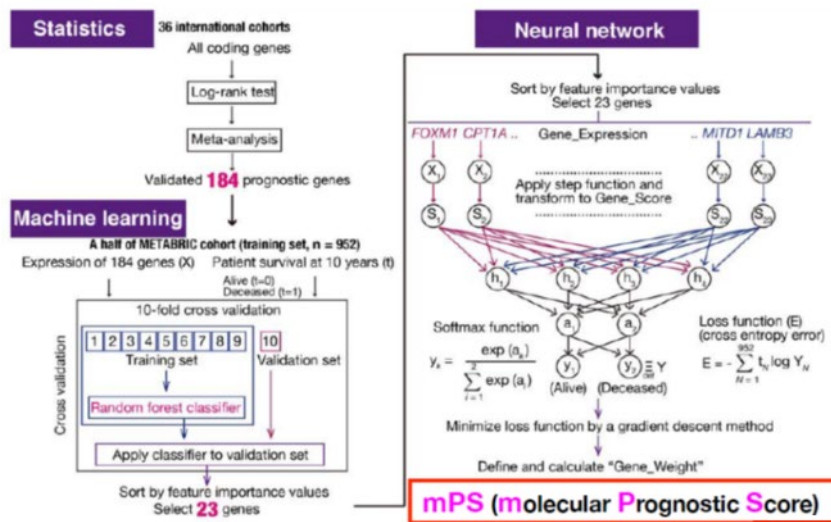
- Researchers tracked prognoses with gene expressions split into two values, and selected genes with an impact on cancer prognosis



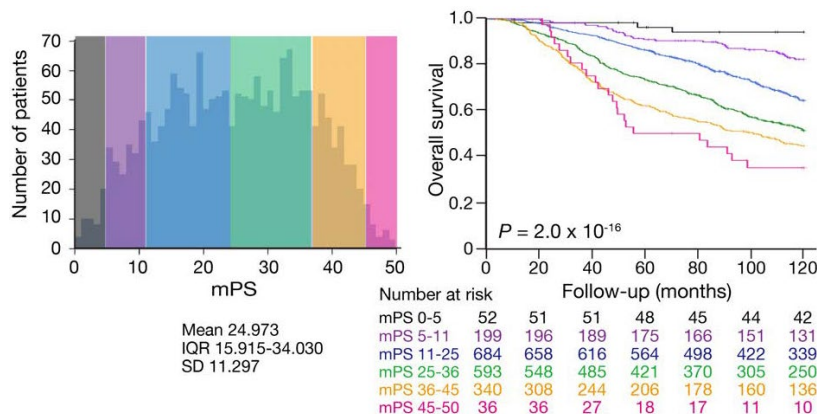
Prognosis tracked by high/low gene expression (blue: low, red: high)

There was little difference in most of the approximately 20,000 genes (left), but a difference was seen in 286 genes.  
 • 117 genes where prognosis is poor if expression is high (center)  
 • 169 genes where prognosis is poor if expression is low (right)

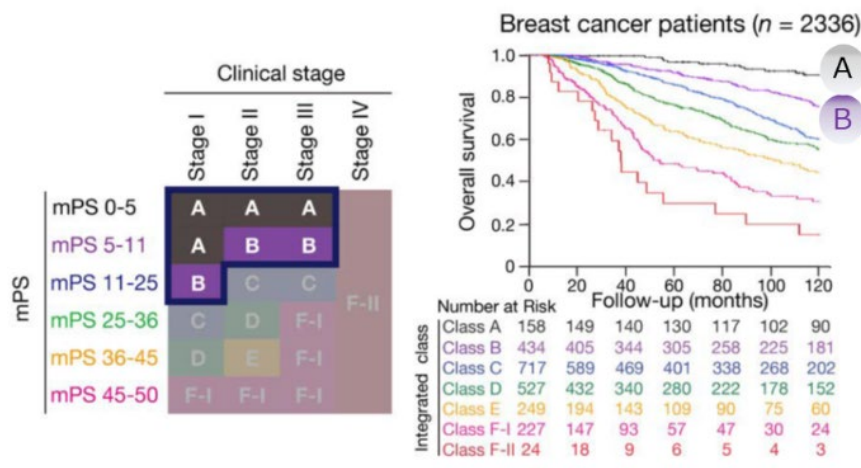
- Researchers selected 184 genes unrelated to factors such as race or environment, and then used AI to select 23 of these genes for which significant data could be obtained; each of these genes was then weighted to determine optimal parameters, and a molecular prognostic score (mPS) was created



- When researchers divided mPS into six groups and tracked prognoses, they found that the actual prognoses of all six groups matched closely with predictions  
 -> The mPS system was shown to accurately predict prognoses



- Combining mPS systems with TNM classification can result in even more accurate decisions
  - > For example, the mPS system can be further divided into six stages (A through F) even if a case is determined to be Stage 2 according to TNM classification, which can contribute toward investigating life plans and determining appropriate treatment (patients in groups A or B may not require chemotherapy or anticancer drugs)



- Many of the 23 genes had not been researched thoroughly, and if they had been researched under human biases, the results could also have been biased, leading to incorrect developments

Gene symbol	Gene name	Binary score		Weight	PubMed
		High	Low		
FOXM1	Forkhead box M1	1	0	3.424	130
CPT1A	Carnitine palmitoyltransferase 1A	1	0	3.399	0
GARS	Glycyl-tRNA synthetase	1	0	2.539	0
MARS	Methionyl-tRNA synthetase	1	0	2.312	14
UTP23	UTP23, small subunit processome component	1	0	2.311	0
ANLN	Anillin actin binding protein	1	0	2.225	6
HMGB3	High mobility group box 3	1	0	2.202	3
ATP5F1B	ATP synthase F1 subunit beta	1	0	1.934	0
APOOL	Apolipoprotein O like	1	0	1.754	0
CYB561	Cytochrome b561	1	0	1.594	0
GRHL2	Grainyhead like transcription factor 2	1	0	1.526	11
ESRP1	Epithelial splicing regulatory protein 1	1	0	1.485	17
EZR	Ezrin	1	0	1.372	3
RBBP8	RB binding protein 8, endonuclease	0	1	3.095	26
CIRBP	Cold inducible RNA binding protein	0	1	3.083	3
PTGER3	Prostaglandin E receptor 3	0	1	2.802	4
LAMA3	Laminin subunit alpha 3	0	1	2.601	1
OARD1	O-acyl-ADP-ribose deacylase 1	0	1	2.008	0
ANKRD29	Ankyrin repeat domain 29	0	1	1.886	0
EGR3	Early growth response 3	0	1	1.836	15
DIRAS3	DIRAS family GTPase 3	0	1	1.821	28
MITD1	Microtubule interacting and trafficking domain containing 1	0	1	1.425	0
LAMB3	Laminin subunit beta 3	0	1	1.366	5

Only 23 genes

## Initiative [2]: AI-based drug discovery revolution

- Researchers digitized and quantified proteins and compounds with three-dimensional structures using only one-dimensional structure information, and then performed matching in order to determine whether there is a connection between the therapeutic target and drug. Calculation is more accurate and faster than conventional methods (experimental matching or docking simulation [3D]).

=> Discoveries include drugs for treating many diseases such as promising anticancer drugs and drugs that reduce the risk of COVID-19 infections

(Note) Although the three-dimensional structures (balls) of many proteins are still unknown, all of their one-dimensional structures (strings) are already known.

- It has taken lot of time, effort, and money to research how proteins and compounds bind

■ **What are proteins?**

**Primary structure (string): All known**  
\*Stringy substance consisting of amino acids

**Secondary structure (string)**

**Tertiary structure (ball): Many unknown**  
\*Ball-like substance in which stringy substance is

- Protein = 20,000 types
- Low-molecular compounds =  $10^{60}$  types

**Protein** **Compound**

Imatinib ABL

Method for examining protein-compound bonds

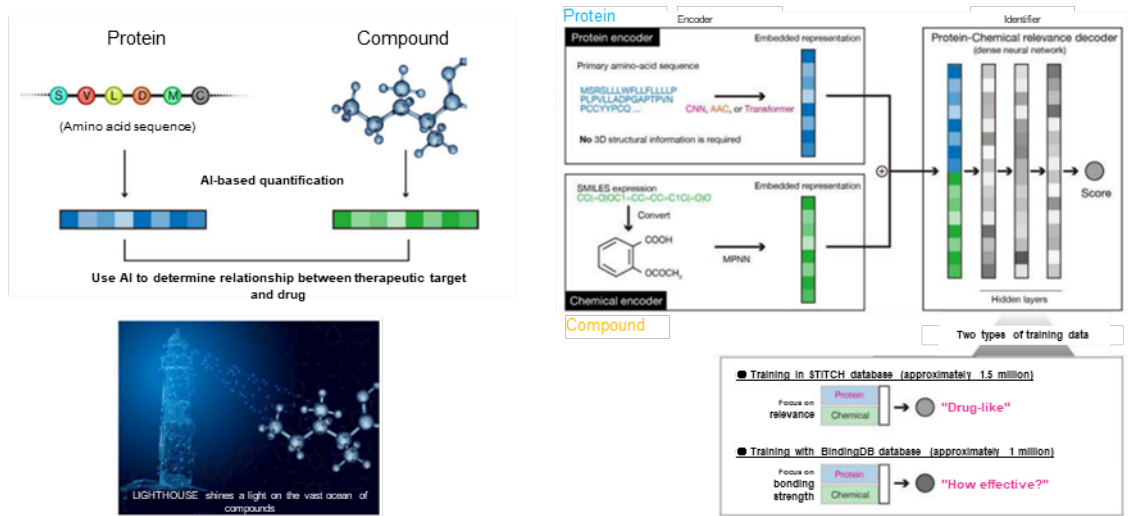
- [1] Experimentally combine proteins and compounds (current mainstream method)
  - > Only a small number of compounds can be examined, and doing so requires a great deal of time, effort, and cost
- [2] Docking simulation (3D)
  - > Many have unknown three-dimensional structures, and a large amount of time is required to calculate them

=> Develop new method: [3] **LIGHTHOUSE (one-dimensional)**

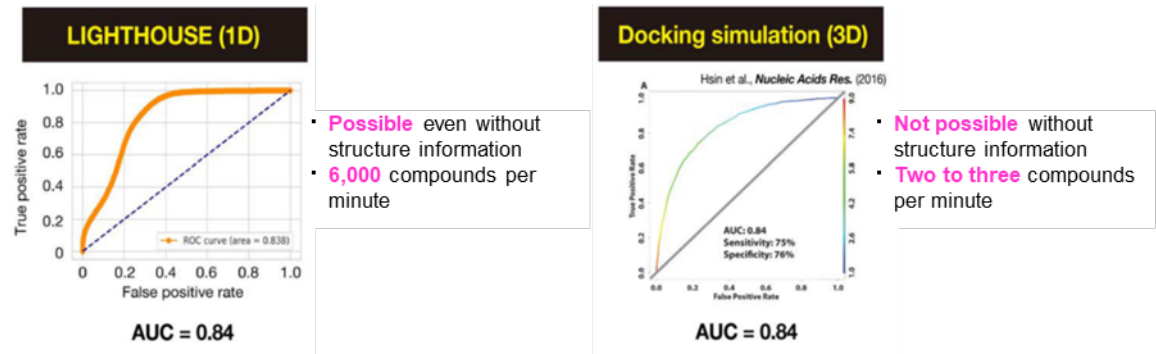


- LIGHTHOUSE: Matches proteins and compounds in a one-dimensional state to determine whether there is a connection between the therapeutic target and drug

**LIGHTHOUSE : Lead Identification with Graph-ensemble network for arbitrary Targets by Harnessing Only Underlying primary SEquence**



- LIGHTHOUSE is significantly faster than the docking simulation (3D) method



- LIGHTHOUSE can discover promising anticancer drugs and COVID-19 drugs

Discovery of drugs that strongly inhibit PPAT (cancer malignancy factor)  
(May be candidate for new cancer drug)

- Protein: PPAT (cancer malignancy factor)... Unknown structure (docking simulation not possible)
- Compounds: One billion... approximately 10,000 times the current drug discovery level

**Prediction of PPAT inhibitors using LIGHTHOUSE**

**Verification via experiments on discovered compounds**

Discovery of drugs that help prevent the spread of COVID-19

- Protein: COVID-19 receptor protein (ACE2)
- Compounds: 10,000 (existing drug only)

**Using LIGHTHOUSE to predict drugs to treat COVID-19**

**Verification via experiments on discovered compounds**

When ethoxzolamide is added, COVID-19 (green) is eliminated!

## ■ Overview of presentations and exchanges of opinions at interviews

- TNM classification (T: tumor size, N: lymph node metastasis, M: distant metastasis), which was created based on past statistics, is used to determine the prognosis of cancer. However, it was created about 70 years ago and lacks accuracy, so researchers used AI to create a more accurate cancer prognosis system.
- Researchers examined the expression of about 20,000 human genes and found that 286 genes had different prognoses depending on the amount of expression. As they continued their research, they found that 184 of these genes had an effect of prognosis regardless of factors such as race or environment.
- Researchers also discovered that they could obtain significant data if using 23 of these 184 genes, so they selected 23 genes and assigned weights to each to determine optimal parameters, in order to create a molecular prognostic score (mPS). They divided mPS into six groups (groups A to F) and then tracked the prognosis of each. The prognosis of each group matched closely with predictions.
- For example, this method is extremely useful if the TNM classification is determined to be Stage 2. mPS can be used to divide patients into groups with a good prognosis (groups A and B) and those with a bad prognosis (groups E and F).
- The ability to accurately estimate a cancer prognosis will [1] allow the patient to know exactly how many more years he or she can live, [2] help physicians to create treatment plans and eliminate unnecessary or excessive treatment (for example, patients in groups A and B do not need to receive strong anticancer drugs), and [3] allow life insurance companies to calculate accurate insurance premiums and create policies that better suit each individual patient.
- Many of the 23 genes that were ultimately selected are not well known or have not been thoroughly researched. If they were to be studied under human biases the results could also be biased, leading to incorrect developments. Shifting toward data-driven research that eliminates bias will likely reveal the true powers of AI.
- When creating a new drug, it is necessary to determine whether a protein binds to a compound and how strongly they bind. However, examining the approximately 20,000 types of human proteins and  $10^{60}$  types of low-molecular compounds would be extremely difficult.
- The main approach that is currently applied is to actually experimentally combine proteins and compounds. However, this is very time-consuming, labor-intensive, and expensive. Furthermore, pharmaceutical companies have only from 100,000 to 1,000,000 different types of compounds, which is only a fraction of the  $10^{60}$  types of compounds that exist, making it impossible to examine them all. Additionally, docking simulations (in which binding is simulated on a computer) cannot be used unless the three-dimensional structure is known, and there are many cases in which this is not the case. Calculation can also take an enormous amount of time.
- Based on the fact that a one-dimensional structure (string) will form a three-dimensional structure (ball) when folded, researchers considered whether there might be a correspondence relationship even with a one-dimensional structure. With this in mind, they created the "LIGHTHOUSE" software, which is used to replace proteins and compounds with one-dimensional numerical vectors and determine relationships with binding force.
- LIGHTHOUSE is capable of making decisions with almost the same accuracy as a three-dimensional docking simulation. It can even made decisions without three-dimensional structure information, making

it possible to screen an extremely wide range and large amount of information (LIGHTHOUSE: 6,000 types/min. [when using a PC], docking simulation: two to three types/min. [when using a supercomputer]).

- Researchers were able to use LIGHTHOUSE to discover candidate compounds for new anticancer drugs and drugs effective against COVID-19.
- The greatest strength of LIGHTHOUSE is that its operation is very light and it can calculate at several 1,000s of times the speed of a supercomputer when used on a standard PC.

Prof. Ueda (Tohoku University): Clinical AI: An advanced AI R&D and human resources development center aiming to solve Global x Local medical issues

Overview of major initiatives related to AI human resources development

Initiative	Overview
Human resources development	Established "Tohoku University Hospital AI Lab", a problem-solving verification space.
	Promote research and development of AI based on a design concept that incorporates perspectives from the medical field. -> Experience both general design concepts and unique medical biodesign processes
	Consistently develop medical AI human resources in three stages: university undergraduate education (medical school), initial hospital training, and graduate school education.
	Tohoku University, Hokkaido University, and Okayama University have teamed up to promote the "Clinical AI" project, which aims to solve GLOCAL (global and local) medical issues.
	Develop human resources who will work with hospital and medical departments and who are capable of connecting medical issues with technologies.

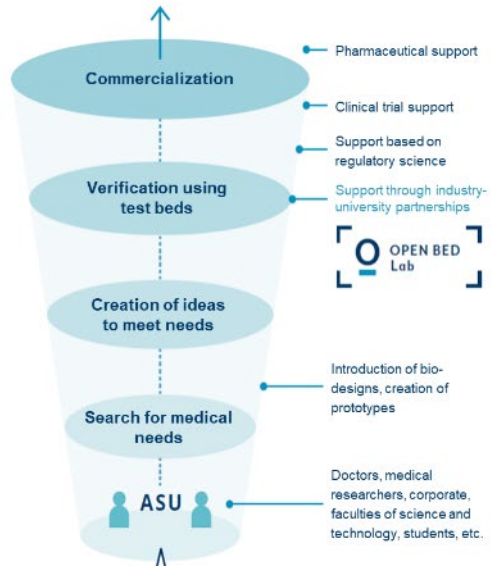
**Initiative [1]: Smart Hospital Project (Tohoku University Hospital AI Lab)**

- As one means of achieving the goal of "Comfortable for All", "Tohoku University Hospital AI Lab" is a problem-solving verification space that provides companies with old hospital beds for use in verifying research and development, and allows them to conduct joint research and development that incorporates various perspectives from the medical field. In addition, research and development of AI based on a design concept that incorporates perspectives from the medical field is also being promoted.

# Tohoku University Hospital AI Lab

## Function performed by OBL

Old hospital beds are loaned as test beds, in order to provide spaces to verify R&D and help develop new services for commercial use.

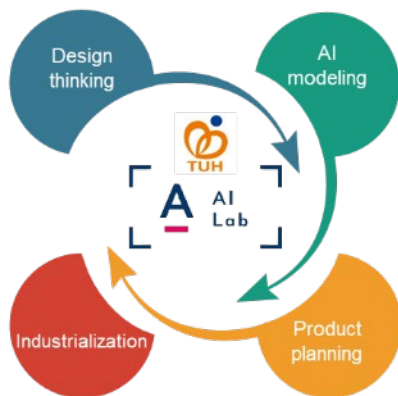


Issues facing AI research

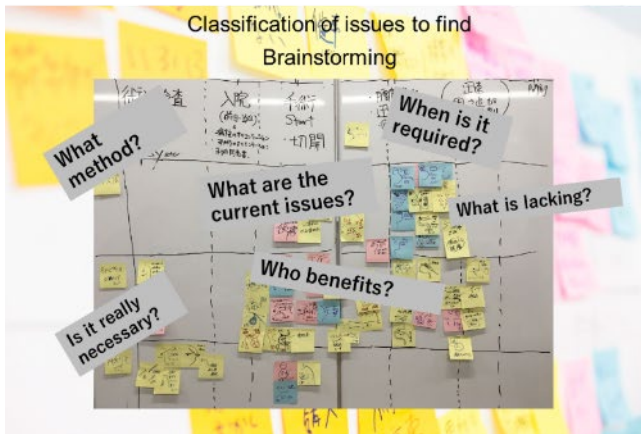
- There is little research on AI focused on medical value
- > In the future, it will be important to develop AI focused on clinical significance

- Research and development of AI based on a design concept that incorporates perspectives from the medical field is being promoted.

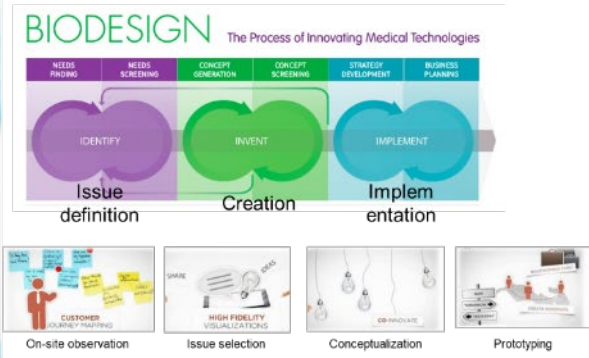
## What are design concepts?



Creative approach based on design concepts



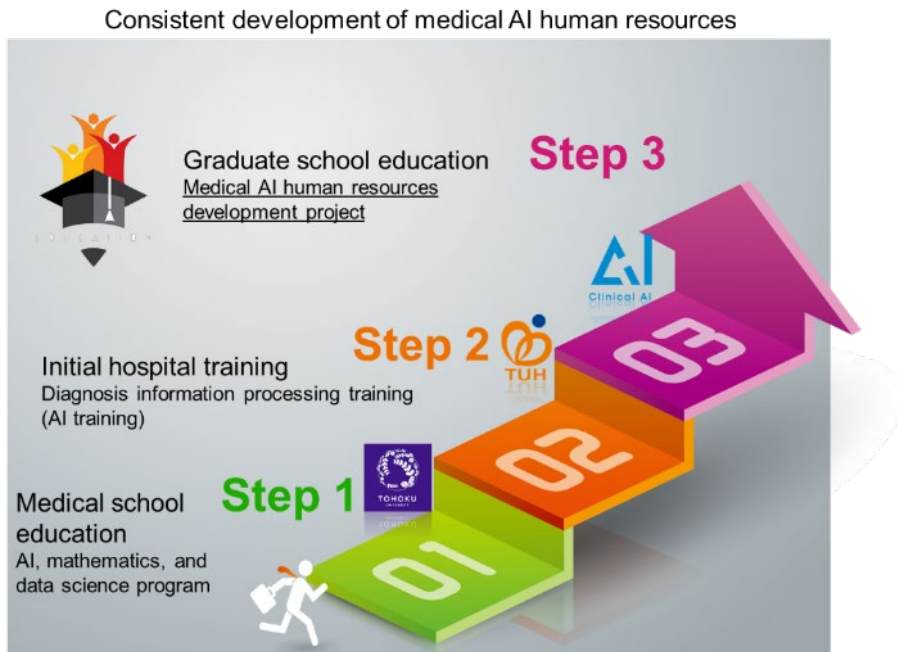
A creative approach based on defining issues rooted thoroughly in clinical needs





**Initiative [2]: Consistent development of medical AI human resources**

- The organization is engaged in consistently developing human resources capable of discovering areas where medicine comes together with data science, by providing consistent education in three stages: university undergraduate education (medical school), initial hospital training, and graduate school education.



- Step 1: University undergraduate education (medical school) (AI, mathematics, and data science program)

Liberal arts course (first and second years)  
Mathematics, data science, and AI education program  
(AIMD education program)

- Basics of Information (required)
  - Python and data literacy
- Practical Machine Learning 1 (optional)
- Practical Machine Learning 2 (optional)
- Introduction to Machine Learning Algorithms (optional)

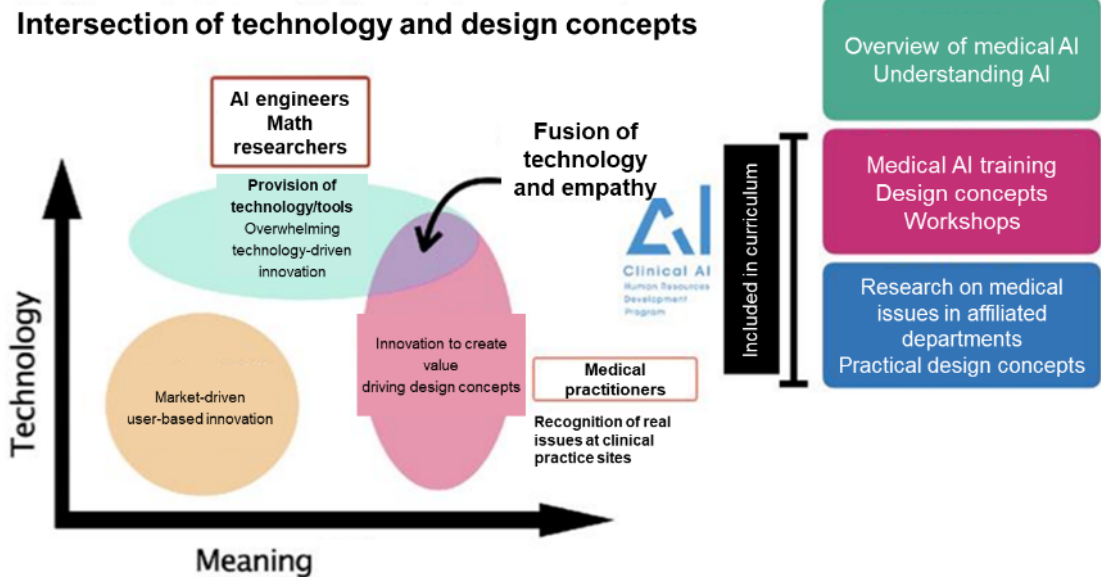
- Step 2: Initial hospital training (diagnosis information processing training [AI training])

Launched "Diagnosis Information Processing Training" program for trainees to learn about using AI technology for medical care, for initial clinical training at hospitals



- Step 3: Graduate school education (medical AI human resources development project)

## Clinical AI: A cutting-edge AI R&D and human resources development center aiming to solve "Global x Local" medical issues



### Initiative [3]: "Clinical AI" project

- Tohoku University, Hokkaido University, and Okayama University have teamed up to promote the "Clinical AI" project, which aims to solve GLOCAL (global and local) medical issues.

## GLOCAL: "Global × local" medical issues solutions

Core/partner schools	Cooperating schools
Tohoku University (core)	Yamagata University, Fukuoka Medical University
Hokkaido University	Hokkaido Institute of Health Sciences, Hokkaido University of Science
Okayama University	Tokushima University, Kagawa University, Yamaguchi University, Tohoku University, Kansai Medical School
Riken AIP Center	

RIKEN

### Adapting to global medical issues

Global conversion

Searching for solutions (AI) to problems in local areas based on finding medical issues in Japan, which is facing the issues of an aging population before any other advanced nation in the world

Uncertain future

Aging population

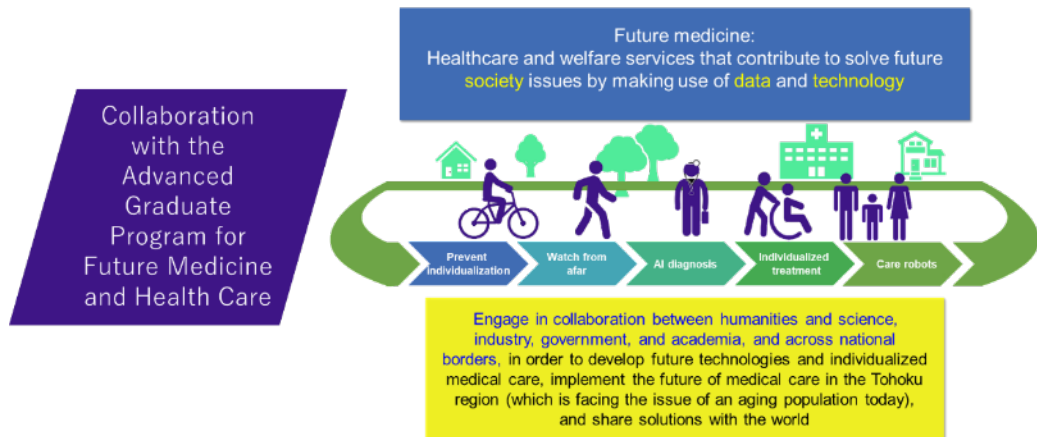
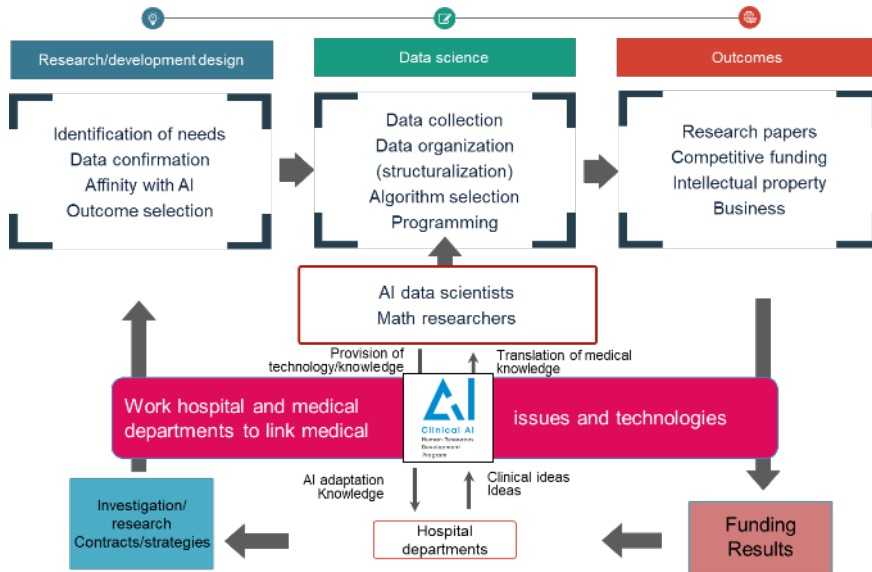
Shortage of medical workers  
Irregular distribution of doctors  
Work style reforms

Regional universities are the showcase for medical issues



## Initiative [4]: Ideal medical care and AI human resources development

- The organization is developing human resources who will work with hospital and medical departments and who are capable of connecting medical issues with technologies.



## ■ Overview of presentations and exchanges of opinions at interviews

- Tohoku University Hospital is promoting the "Smart Hospital Project" under the concept of "Comfortable for All," and is working to make the university hospital function as a framework for making both patients and medical staff happy. The concept of a "Smart Hospital" goes beyond simply installing digital devices, and places an importance on the concept of how patients and medical professionals approach medical care. It is important to maintain a concept of "matching technology" in introducing digital technologies that fit this concept, and of how to combine the value of medical care and the value of human life with technology.
- Research on AI has continued to make advances in the field of clinical medicine, but some individuals in the medical field believe that there has been little research on the true value of medicine. The problem here is that data science has yet to catch up with the needs of medical personnel. It will be important to develop AI with a greater focus on medical significance.
- "Tohoku University Hospital AI Lab" was created as a verification space in one floor of the hospital, so that data scientists could work with medical personnel to create value together. The focus here is on research and development of AI based on a design concept that incorporates various perspectives from the medical field.
- The design concept is to take an approach toward creating innovation with a focus on humans. Even in medicine, it is important to first incorporate design concepts and consider the medical value that doctors find important in the medical field rather than prior technology, and to discover "fusion points" with AI that match this.

It is important to develop human resources who can find these "fusion points", and the organization is attempting to develop human resources who are medical practitioners who also understand data science and can discover areas where these fields meet, within a consistent education program that consists of three stages: university undergraduate education (medical school), initial hospital training, and graduate school education.

- Tohoku University, Hokkaido University, and Okayama University have teamed up to promote the GLOCAL (global and local) "Clinical AI" project. Most issues in the medical field (including doctor shortages and increasingly aging populations) are not in urban areas but in rural areas, so universities in rural areas are working together to develop human resources who can match AI with solutions to solve these issues. Each university and hospital has its own characteristics, with Tohoku University focusing on hospitals and Okayama University focusing on pharmaceutical department work.
- The organization has incorporated programs to study design concepts. In addition to programs to study standard design concept processes (such as how to reduce waiting times at hospitals), there are also programs to study processes such as biodesign itself or what needs to be prepared in order to develop AI.
- Instructors also apply ingenuity, and all trainers and teachers are trained in coaching. Rather than "teachers", they are more like colleagues that consider topics together.
- Medical personnel are aware of medical value, while data science personnel are experts at algorithms. However, there are few people that are experts in both fields. The program is designed to develop human resources capable of bridging both fields, and the hope is to develop human resources who can conduct AI research utilizing design concepts while remaining sensitive to the needs of the medical field and with the

values of doctors.

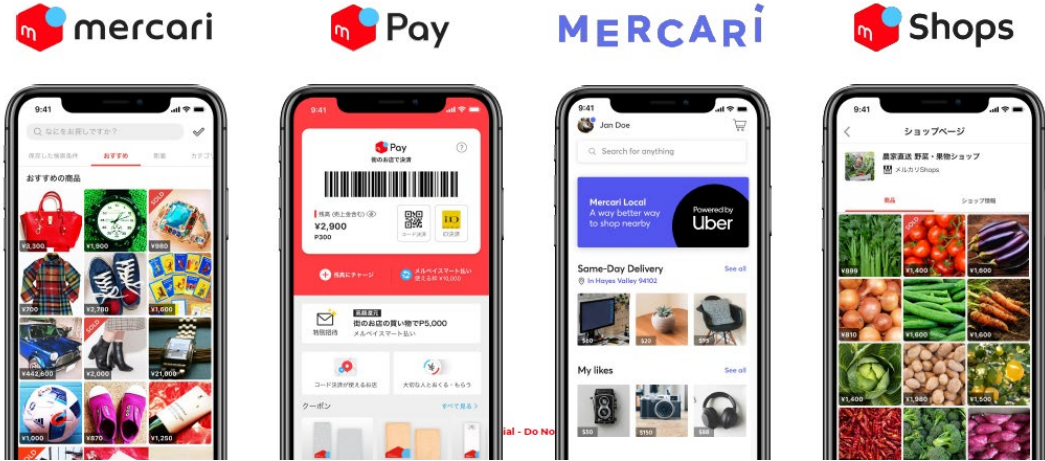
- Sharing patient data outside the hospital is currently very difficult. Although it would be best to share data with external organizations, we are not yet at that stage. The approach being used now is to keep data inside and share only analysis results and models.

Mercari, Inc.: Description of AI efforts by the Mercari Group

Overview of major initiatives related to AI development and use

Initiative	Overview
AI listing	Recognizes listing images, and suggest product titles and brands in real-time.
Personalization	Provides recommendations based on past purchases in the recommendations tab.
Credit Scoring	"Merpay Smart Payments" presents a spending range based on customer transaction information and "Merpay" payment history.
Fraud Prevention	Detects fraud and suspicious transactions.

• Business development




- "Mercari" flea market app

- Target marketplaces for Mercari



- ✓ Company announces "Marketplace Principles" formulated with external experts (January 2021)

Widely share basic concepts used to write terms of use and guides with everyone who participates in the marketplace, in order to increase marketplace transparency (such as future changes to rules or operating policies)

<p><b>Safe</b></p>  <p><b>Establish free trading enabled by safe environments</b></p>	<p><b>Trustworthy</b></p>  <p><b>Establish C2C marketplace based on mutual trust</b></p>	<p><b>Humane</b></p>  <p><b>The values and perspectives of each person must be respected, and transactions must be humane</b></p>
<p>[Examples of prohibited behaviors]</p> <ul style="list-style-type: none"> <li>Transactions of items which endanger the health and/or lives of individuals</li> <li>Transactions of items likely to lead to illegal/criminal acts</li> <li>In a state of emergency, transactions of items that are essential to protecting people's health and/or safety and which should be widely distributed as quickly as possible but are in notably short supply</li> </ul>	<ul style="list-style-type: none"> <li>Participating in transactions where item details are unknown or falsified</li> <li>Failing to comply with item returns even when there are problems with the item</li> <li>Listing items you do not actually have</li> <li>Listing items without the intent to actually sell anything</li> </ul>	<ul style="list-style-type: none"> <li>Items or behavior that promote discrimination based on race, ethnicity, religion, gender, etc</li> <li>Verbal abuse, threatening behavior, etc..</li> </ul>




Based on these three principles,  
**we aim to establish a diverse and free marketplace where everyone can participate with peace of mind**

- Merpay

➢ A smartphone payment service operated by Merpay, Inc., a Mercari group company



Use funds from selling things on Mercari or charged from a bank account, or "Merpay Smart Payments", to make purchases from "Mercari" or any of 2.06 million Merpay affiliates throughout Japan

<p>Can be used at stores throughout Japan</p> 	<p>Can use funds from Mercari sales</p> 	<p>Pay immediately using the Mercari app</p> 
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➢ "Merpay Smart Payments", a credit service based on "credit"

- Usage limits are determined based on usage history on "Mercari", and the purchase price can be paid later
- Users can set a maximum usage amount and check their own usage history
- Users are provided with flexible payment options, including "payments the following month", "installment payments", and the ability to change the payment amount whenever they want

	<p><b>利用上限金額を選択</b></p> <p>メルカリでの利用額と本店での利用額をあわせて上限です</p> <table border="1"> <tr><td>¥30,000</td></tr> <tr><td>¥28,000</td></tr> <tr><td>¥28,000</td></tr> <tr><td>¥27,000</td></tr> <tr><td>¥26,000</td></tr> <tr><td>¥25,000</td></tr> <tr><td>¥24,000</td></tr> <tr><td>¥23,000</td></tr> <tr><td>¥22,000</td></tr> </table>	¥30,000	¥28,000	¥28,000	¥27,000	¥26,000	¥25,000	¥24,000	¥23,000	¥22,000	<p><b>月々のお支払いイメージ</b></p> <p>設定する利用金額に応じて、各月の定額払い手数料と清算額が変化します</p> <p>月々の返済金額</p>  <p>清算完了予定 2022/05</p> <p>月々の返済イメージ</p> <table border="1"> <thead> <tr> <th>清算月</th> <th>元金</th> <th>手数料</th> </tr> </thead> <tbody> <tr><td>2020/11</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2020/12</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2021/01</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2021/02</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2021/03</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2021/04</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2021/05</td><td>¥10,000</td><td>¥1,000</td></tr> <tr><td>2021/06</td><td>¥10,000</td><td>¥1,000</td></tr> </tbody> </table>	清算月	元金	手数料	2020/11	¥10,000	¥1,000	2020/12	¥10,000	¥1,000	2021/01	¥10,000	¥1,000	2021/02	¥10,000	¥1,000	2021/03	¥10,000	¥1,000	2021/04	¥10,000	¥1,000	2021/05	¥10,000	¥1,000	2021/06	¥10,000	¥1,000
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● Status of AI utilization in the "Mercari" flea market app

	2017	2018	2019	2020
<b>Buy &amp; Sell</b>			- Coupon distribution optimization	- Personalization - Marketing Data Science
<b>Listing</b>	- Price estimation - AI listings	- AI listings (v2) - Barcode listings	- Price estimation (v2) - Automatic link with product catalog	- Mercari IME
<b>Safe</b>	- Violation detection (v1)		- Violation detection (v2)	
<b>Platform</b>		- ML Platform	- Similar image search - Edge AI	- ML Platform v2

**Initiative [1]: AI listing**

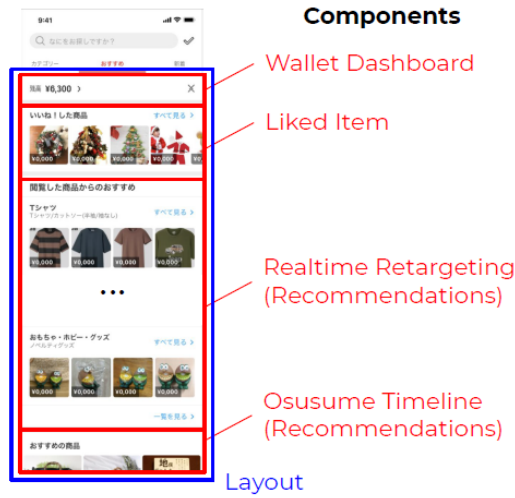
- Recognizes listing images, and suggests product titles and brands in real-time.





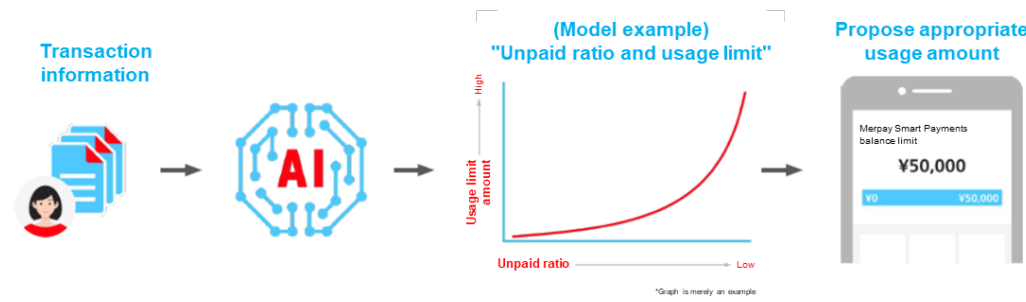
### Initiative [2]: Personalization

- Provides Mercari recommendations based on past purchases in the recommendations tab. Also provides an estimation of which recommendation components are best to present.



### Initiative [3]: Credit Scoring

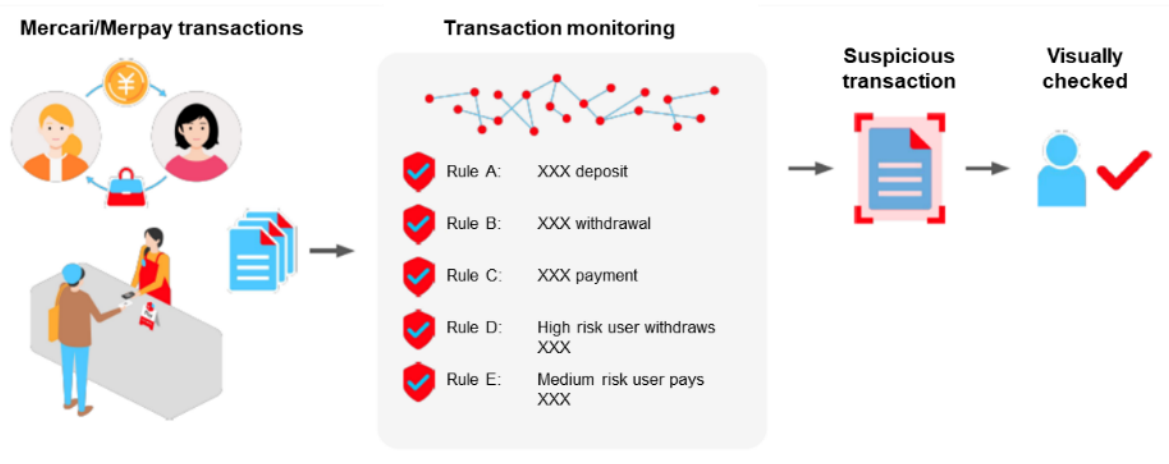
- "Merpay Smart Payments" presents a spending range for the customer, based on customer information registered in "Mercari", "Mercari" transaction (listings, sales, and purchases) information, "Merpay" payment history, and the identify confirmation status.



**AI technology based on credit model used** to set appropriate usage amounts

## Initiative [4]: Fraud Prevention

- Detects fraud and suspicious transactions in order to ensure safe and secure use of both "Mercari" and "Merpay".

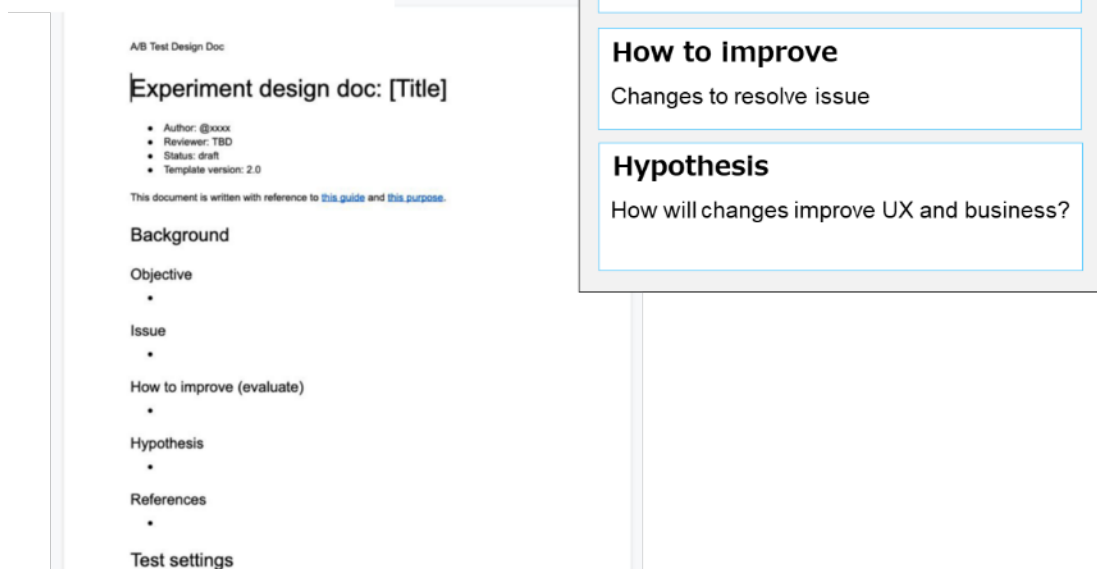


### • Preparation of the experimental design

- Experiments conducted in production during the development process of the AI system are prepared in an experimental design format, allowing anyone to view the purpose and method of experiments. Logs of past experiments can also be viewed to ensure transparency.

#### Contents:

- Background
- Test settings
- Description of indicators
- Evaluation method
- Action plan



## ■ Overview of presentations and exchanges of opinions at interviews

- The company defines "should be safe", "trustworthy", and "humane" in its Marketplace Principles, and aims to establish a diverse and free marketplace where everyone can participate with peace of mind.
- Merpay provides credit services on the Mercari app. Credit limits are determined based on actual Mercari usage, and a system is provided that allows users to set their own usage limits and manage their credit limits so as not to overuse services.
- Merpay has introduced its own credit scoring system. Unlike normal credit cards, which make use of user attribute information, Merpay does not use any attribute information. Instead, the credit limit scope is determined based on past transactions using Mercari/Merpay.
- The AI listing feature can recognize listing images and suggest titles or brands in real-time, and can even recommend listing prices.
- The Personalization service presents recommended products based on a user's purchasing information and products that they have "liked" on Mercari. Preference components will vary depending on the user (some are interested in recent purchases, and others want different brands), so the company is experimenting with optimizing recommendations by automatically estimating them according to preferences.
- The company needs to be able to detect transactions that violate its own rules or are fraudulent, and has therefore created a model that can identify potentially risky behavior from listings and deposit transactions. AI detects users engaging in risky behavior, and then a human manually checks for fraud.
- The company's approach to detecting counterfeit items is to identify them from images and descriptions. However, due to the possibility of erroneous detection and omissions occurring during the selection process, a human must also manually check what the AI detects to reach a final decision.
- The company takes a human-centered approach. Erroneous detection would result in the customer being penalized, so such cases must be checked to some degree by a human. However, there are issues of manpower and cost, and this will need to be investigated further.
- As for the accountability of decisions and predictions made by AI, the company has decided to prepare experimental designs and store information so that past situations can be traced.

Experimental designs will indicate the background, content, evaluation indicators, and evaluation methods. These experiments are open within the company, and comments from relevant departments and other engineers are welcomed, helping to prevent risks from being actualized.
- The company provides a sensitive service called the credit scoring model, and strictly scrutinizes model performance evaluations and feature results. The company is engaged in various efforts to establish conditions where the results of credit scoring can be explained.
- The company also believes that it is necessary to apply systems and regulations in each country, and continues to discuss this while exchanging opinions with group companies in the United States. The company is also closely monitoring developments in EU regulations, and believes that it will be necessary to consider whether to apply them to its own operations.
- This does not mean that the company will not respond unless strictly required by laws and regulations, both in Japan and overseas. Instead, the company believes that it is a prerequisite to respond appropriately even beyond the scope of laws and regulations, such as protecting consumers and platform sellers.

Japan Data Management Consortium (JDMC)

: Ethics Framework for AI and Data use conceived by practitioners

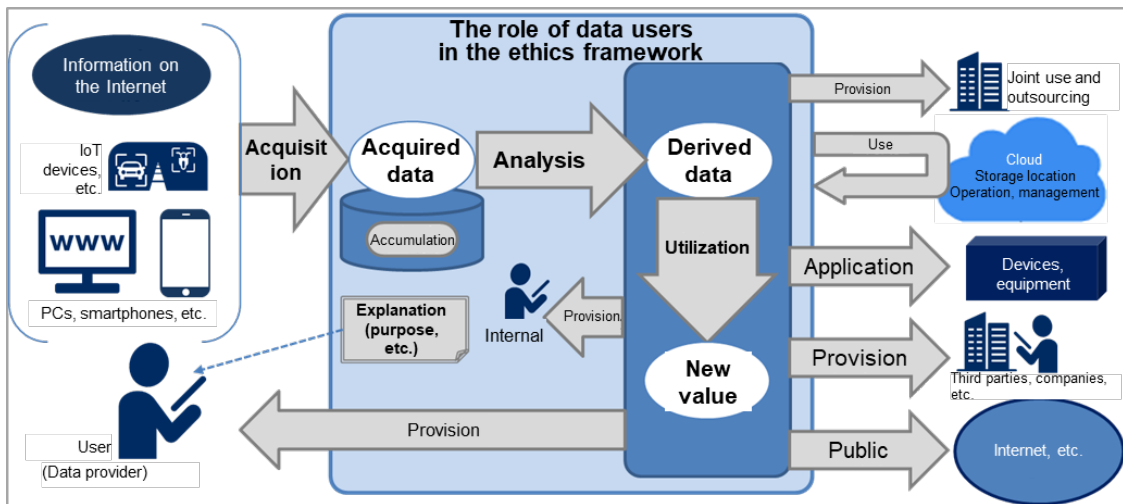
Overview of major initiatives related to AI ethics and governance

Type	Overview
Safety/security	Currently considering an ethics framework that summarizes important points to be considered to avoid problems when using data, from five perspectives: propriety, accountability, fairness, safety and security, and information protection.
Privacy	
Fairness	
Transparency and accountability	
Appropriate use	

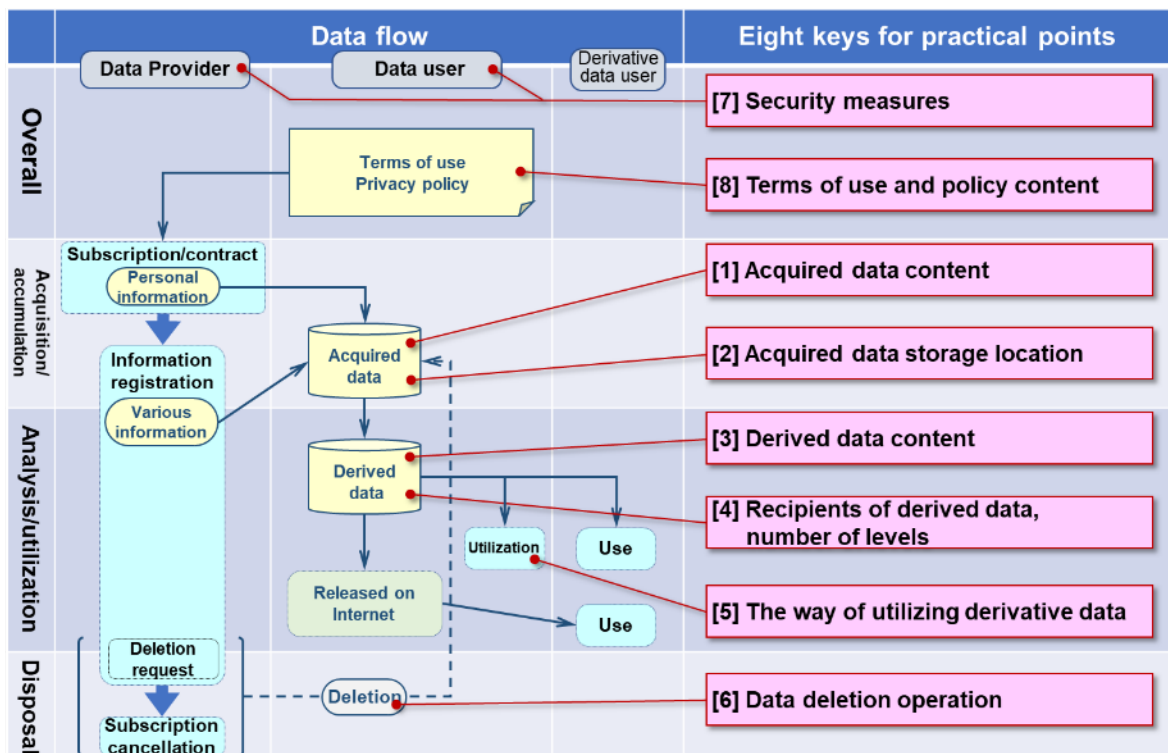
- Compliance Study Group on AI and Data Utilization
  - Main activities
    - Engaged in discussion from a compliance perspective on the challenges associated with an unprecedented increase of data volume and utilization due to the acceleration of the digital economy, as well as the key points for business expansion in the future
  - Concepts
    - Collecting data strategically and managing data appropriately will lead to full utilization of data
    - Mishandling data will pose major risks to management
    - In order to promote AI and data utilization, security, compliance, and personal information protection must be strictly handled in internal regulations and external contracts
    - Currently conducting research on contracts, compliance, personal information protection, as a foundation for companies to consider practical use and make strategic use of data

### Initiative [1]: Ethics framework

- Currently considering an ethics framework that summarizes important points to be considered to avoid problems when using data, from five perspectives: propriety, accountability, fairness, safety and security, and information protection.
  - Perspective during consideration
    - Although there are multiple parties/organizations involved in obtaining and utilizing data, the ethics framework is targeted at individuals/organizations who analyze and utilize data obtained from data providers
    - It is also assumed that derivative data created by users/organizations will be provided externally or disclosed



- Important points to be considered to avoid problems when using data



○ Ethics Framework to discover "stumbling points"

■ What are **stumbling points**?

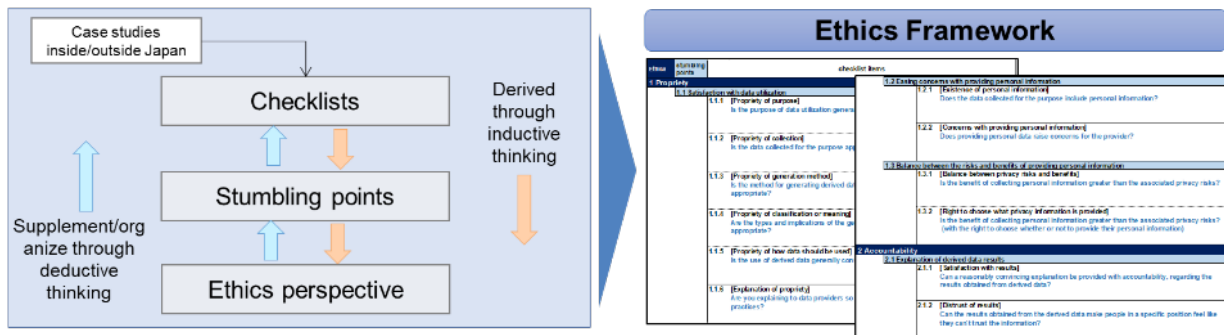
Factors that do not violate the law but may be problematic

■ **Goals**

- ✓ Engage in data utilization in checklist format  
**Allow use by practitioners themselves**
- ✓ Make it possible to identify not only past cases, **but also stumbling points that have not yet been identified**

■ **Approach for creating an ethics framework**

- ① Set "checklist" items to prevent incidents from occurring
  - ② Determine "stumbling points" by identifying common factors for multiple "checklist" items
  - ③ Derive the "ethical perspective" behind "stumbling points"
  - ④ Supplement "stumbling points" and "checklist" items through discussions based on actual experience
- These steps were repeated to brush up on knowledge and organize as "ethics framework"



○ Ethics Framework structure



- Data utilization requires a foundation of **"information protection"** as a prerequisite
- Establish **"safety and security"** on this foundation
- Establish data utilization methods that offer both **"fairness"** and **"accountability"**
- So that data can be used with **"propriety"**

Ethics	Stumbling points
<b>1. Propriety</b>	1.1 Satisfaction with data utilization 1.2 Easing concerns with providing personal information 1.3 Balance between the risks and benefits of providing personal information
<b>2. Accountability</b>	2.1 Explanation of derived data results 2.2 Potential for biases and errors in derived data
<b>3. Fairness</b>	3.1 Possibility of feelings of unfairness and discrimination based on derived data
<b>4. Safety and security</b>	4.1 Potential impact of derived data on individuals, organizations, and local communities 4.2 Potential for abuse 4.3 Data stored/managed in Japan
<b>5. Information protection</b>	5.1 Information security measures 5.2 Control at provision/publishing point 5.3 Appropriate deletion of collected data 5.4 Identification of individuals by matching with other data 5.5 Infringement of rights relating to data provided



- Items that can serve as list countermeasures to check for stumbling points

### [1] Propriety

Ethics	Stumbling points	Check overview
<b>1. Propriety</b>		
	1.1 Satisfaction with data utilization	1.1.1 Propriety of purpose 1.1.2 Propriety of collection 1.1.3 Propriety of generation method 1.1.4 Propriety of classification or meaning 1.1.5 Propriety of how data should be used 1.1.6 Explanation of propriety
	1.2 Easing concerns with providing personal information	1.2.1 Existence of personal information 1.2.2 Concerns with providing personal information
	1.3 Balance between the risks and benefits of providing personal information	1.3.1 Balance between privacy risks and benefits 1.3.2 Right to choose what privacy information is provided
<b>2. Accountability</b>		
	2.1 Explanation of derived data results	
	2.2 Potential for biases and errors in derived data	
<b>3. Fairness</b>		
	3.1 Possibility of feelings of unfairness and discrimination based on derived data	
<b>4. Safety and security</b>		
	4.1 Potential impact of derived data on individuals, organizations, and local communities	
	4.2 Potential for abuse	
	4.3 Data stored/managed in Japan	
<b>5. Information protection</b>		
	5.1 Information security measures	
	5.2 Control at provision/publishing point	
	5.3 Appropriate deletion of collected data	
	5.4 Identification of individuals by matching with other data	
	5.5 Infringement of rights relating to data provided	

	Problem	Risk factors	Measure for reducing risk
1.1	No users for the service  Service unable to launch	Not satisfied with the significance of the service or the need for personal information	Provide simple explanation (obtain consensus from many people)
1.2		Concerned about the impact of personal information leaks	Disclose security measures for personal information
1.3		Some people believe that the privacy risk is greater	Provide an explanation that takes into account the fact that different people perceive risks differently
		Minority opinion spreads and is highlighted as a problem	Provide the right to choose whether or not to provide personal information  Carefully explain measures for managing risk and the significance of the service

### [2] Accountability, fairness

Ethics	Stumbling points	Check overview
<b>1. Propriety</b>		
	1.1 Satisfaction with utilization	
	1.2 Easing concerns with providing personal information	
	1.3 Balance between the risks and benefits of providing personal information	
<b>2. Accountability</b>		
	2.1 Explanation of derived data results	2.1.1 Satisfaction with results 2.1.2 Distrust of results
	2.2 Potential for biases and errors in derived data	2.2.1 Biases and errors in results 2.2.2 Bias in generated data 2.2.3 Inclusion of fraudulent data 2.2.4 Limits on generation methods
<b>3. Fairness</b>		
	3.1 Possibility of feelings of unfairness and discrimination based on derived data	3.1.1 Expression of right and wrong 3.1.2 Unfair or discriminatory indicators 3.1.3 Provision disadvantageous to certain people
<b>4. Safety and security</b>		
	4.1 Potential impact of derived data on individuals, organizations, and local communities	
	4.2 Potential for abuse	
	4.3 Data stored/managed in Japan	
<b>5. Information protection</b>		
	5.1 Information security measures	
	5.2 Control at provision/publishing point	
	5.3 Appropriate deletion of collected data	
	5.4 Identification of individuals by matching with other data	
	5.5 Infringement of rights relating to data provided	

	Problem	Risk factors	Measure for reducing risk
2.1	Loss of social trust  Causing problems for users and society	People cannot understand AI analysis results, and applying them causes problems	Perform inference process visualization, answer matching verification, and human judgment
2.2		Inclusion of biases (including social biases) when collecting and creating learning data	Optimize procedures for selecting/creating ranges of learning data, and use bias detection tools
3.1		Some people will see discrimination or bias, even if classifications and categories are explained	Provide explanations that take various perspectives into account  Assign scores in a way that provides transparency for calculation factors and logic
		Criticism that the service is unavailable to some people and therefore unfair	Prepare multiple means of use as needed

### [3] Safety and security

Ethics	Stumbling points	Check overview
<b>1. Propriety</b>		
	1.1 Satisfaction with utilization	
	1.2 Easing concerns with providing personal information	
	1.3 Balance between the risks and benefits of providing personal information	
<b>2. Accountability</b>		
	2.1 Explanation of derived data results	
	2.2 Potential for biases and errors in derived data	
<b>3. Fairness</b>		
	3.1 Possibility of feelings of unfairness and discrimination based on derived data	
<b>4. Safety and security</b>		
	4.1 Potential impact of derived data on individuals, organizations, and local communities	4.1.1 Negative impact on individuals, organizations, and local communities 4.1.2 Changes to human thinking or behavior 4.1.3 Problems due to changes to human thinking or behavior
	4.2 Potential for abuse	4.2.1 Misuse through provision 4.2.2 Provision to the general public 4.2.3 Transmission overseas
	4.3 Data stored/managed in Japan	4.3.1 Storage overseas 4.3.2 Availability of cloud services in overseas regions 4.3.3 Entrustment of data management to overseas subsidiaries 4.3.4 Existence of information prohibited from storage overseas
<b>5. Information protection</b>		
	5.1 Information security measures	
	5.2 Control at provision/publishing point	
	5.3 Appropriate deletion of collected data	
	5.4 Identification of individuals by matching with other data	
	5.5 Infringement of rights relating to data provided	

	Problem	Risk factors	Measure for reducing risk
4.1	Loss of social trust	Disseminated information leads to harmful rumors	Consider wording with regard to individuals, organizations, and local communities
		Problems with decisions made and controls performed using AI results	Use caution when applying to social infrastructures, establish human-based decision processes
		Unprecedented new social problems	Verify impact on human behavior and activities
4.2	Inconveniencing individuals or organizations	Misuse as new means for committing crimes	Check for use for criminal purposes
		Personal information is easily misused	Stronger measures against personal information leaks
4.3	Personal information leaks overseas caused by overseas clouds	Use of overseas regions has high risk of leaks	Personal information must be used in Japan
		Provision of data in Japan when requested by overseas authorities on overseas cloud	Make use of anonymized information, separate use of domestic/overseas clouds

[4] Information protection

Ethics	Stumbling points	Check overview	Problem	Risk factors	Measure for reducing risk	
<b>1. Propriety</b>						
<b>2. Accountability</b>						
<b>3. Fairness</b>						
<b>4. Safety and security</b>						
<b>5. Information protection</b>						
	5.1 Information security measures	5.1.1 Confidentiality measures 5.1.2 Integrity measures 5.1.3 Availability measures 5.1.4 Existence of supported/acquired certification standards 5.1.5 Handling of supported/acquired certification standards	5.1 Secondary damage and loss of social trust due to personal information leak	General security risks	Implement security measures, obtain external certification	
	5.2 Control at provision/publishing point	5.2.1 External provision 5.2.2 Provision via the Internet 5.2.3 Restriction of data recipients 5.2.4 Agreements with data recipients on information protection 5.2.5 Existence of information prohibited from leaking overseas 5.2.6 Measures to prevent leaking overseas		Expanded scope of organization or system handling data	Restrict handling of personal information, make use of anonymized information	
	5.3 Appropriate deletion of collected data	5.3.1 Existence of information related to individuals, organizations, or local communities 5.3.2 Deletion rules and operations 5.3.3 Deletion policy disclosure		Personal information leaked due to a problem at a data recipient	Provide only anonymous/anonymized information to external organizations	
	5.4 Identification of individuals by matching with other data	5.4.1 Data granularity 5.4.2 Existence of characteristics that could be used to identify an individual 5.4.3 Existence of similar information on public sites 5.4.4 Existence of personal comments		Continued possession and use for data utilization	Delete personal information, and make use of anonymized information for data utilization	
	5.5 Infringement of rights relating to data provided	5.5.1 Existence of highly valuable information 5.5.2 Existence of values differing from acquired data		Problems with individuals due to personal identification	Can be matched against other information on the Internet	Consider how to use highly unique personal information
			5.4			
			5.5	Infringement claims received from data owners	Indication of infringement caused by derived data	Confirm uniqueness of source information and new value

o Usage after checking

- The checklist for stumbling points is designed to identify potential problems and ensure that services/business can be operated without issue. Once checking is completed, it must be shared with relevant parties to the degree that it is possible, in order to help resolve problems.
- Proposed utilization process
  - [1] Take a wide look at the current situation
    - Look at the checklist as a whole to determine which problems have the most stumbling points.
    - Check whether there is any significant impact on the services/business to be implemented.
    - If the organization has an internal AI policy, re-examine it to identify major issues.
  - [2] Determine risk factors
    - Organize risk factors for stumbling points that have become issues.
    - Identify which parties are involved with what stumbling points.
  - [3] Formulate measures to eliminate/reduce risk
    - Determine whether risks can be eliminated or reduced, and consider measures for doing so. There are many areas without clearly defined laws, and it can be difficult to completely eliminate risks. Therefore, work with parties concerned to devise measures for reducing risk to the extent possible.

## ■ Overview of presentations and exchanges of opinions at interviews

- The use of data is becoming essential for business as the volume of data increases in our current digital economy, and companies are now facing various compliance and ethical issues. With this in mind, the organization has been engaged in discussions since 2019 with the understanding that it would be necessary for businesses to conduct research on compliance and ethics as a basic effort to utilize data.
- The ethics framework is designed for businesses that want to acquire information and make actual use of data. The organization is compiling issues focusing on acquired data, the amount of derived data increasing due to the use of AI, and the fact that use of this data is being used in multiple stages and being provided externally.
- It is important for data to be practically useful, so the organization has been collecting case studies of actual problems occurring within Japan. Rather than deductively arriving at case studies from the concept of ethics, the organization first focused on collecting case studies inductively, abstracted these case studies, organized them by important points to check and ethical points of view, applied them to actual business cases, and repeatedly examined whether they were easy to use, in order to create a framework.
- The organization arranged the entire structure of the ethics framework into five ethics items. At the bottom of the structure is "information protection". Above this is ensuring "safety and security", realizing the use of data that in a manner that provides "fairness" and "accountability", and then using all of this to provide "propriety".
- The purpose of the ethics framework is to identify stumbling points by specifying problems, risk factors, and measures to reduce risks. However, it is also important to consider how to deal with these problems, and so the framework also considers whether it is possible to provide specific hints on how to deal with them.
- The organization believes that the five ethical points are universal, but that the stumbling points will change with time. It selected these five core ethical issues in order to make communication easier. In considering this framework, some similar keywords were eliminated (such as transparency, which is similar to accountability and fairness), resulting in just five keywords.
- When considering countermeasures, the organization believes that it may be difficult to find a one-size-fits-all solution because countermeasures vary from business to business. It has also categorized the framework into items that are mandatory to provide services, and those that are not. The organization continues to consider compiling a list of solution hints for use by businesses based on their priorities.
- The organization recognizes that the ethics framework is very comprehensive, and applying it to actual business would make it possible to include very detailed information. By using the framework, it should be possible to identify problems and issues that were not expected.
- In terms of actually using the framework, the organization is considering providing an overview of all risks identified through checking, determining each risk factor, and formulating how to reduce these risks.
- The organization is also collecting information related to ethics in other countries including in the EU. Rather than simply complying with regulations such as those in the EU, the organization believes that Japanese businesses could indicate that they are independently taking ethics into consideration and taking an active stance in using data appropriately, without any need for strict regulations.

Mitsui Sumitomo Insurance Company, Limited:

Initiatives to promote digitalization at Mitsui Sumitomo Insurance

Overview of major initiatives related to AI development and use

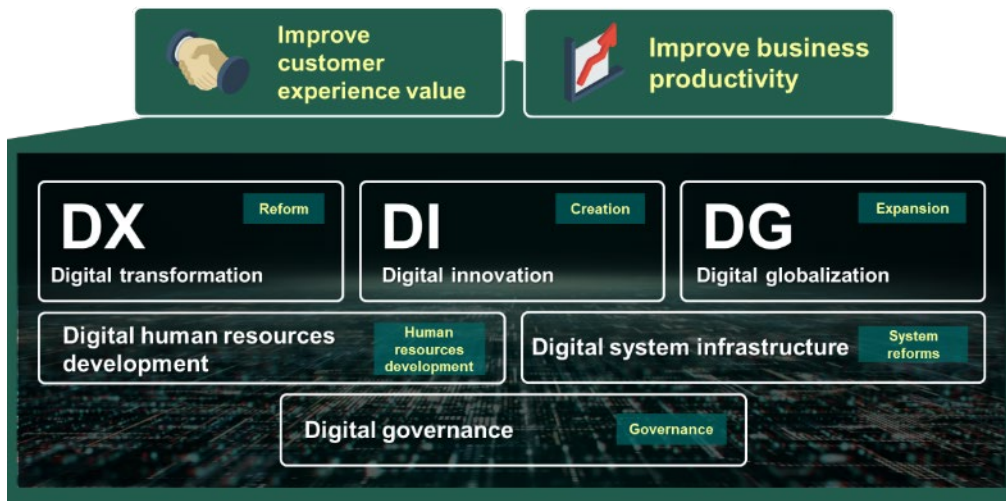
Initiative	Overview
<b>DX initiatives</b>	
Agent sales support system	Explains and proposes optimal products and plans derived from a needs prediction analysis, using simple videos. Capable of handling non-face-to-face processes, from insurance proposal to procedures.
Initiatives using dashboard cameras	If an impact is detected while a car is in motion, an image of the accident and location information are automatically sent to the insurance company, and AI analyzes the accident situation.
Initiatives in the event of a flood	Drones and AI are used to conduct a fluid analysis, predict flood height, and automatically calculate the degree of damage.
<b>Initiatives for "Creating Shared Value" (CSV)</b>	
Smart city initiatives	A dashboard camera mounted on a vehicle detects road damage, visualizes damaged areas, and determines whether repairs are necessary.
Measures against natural disaster risks	Accident data is used to visualize risks in the area, while real-time rainfall data and river water level data are used to identify hazardous locations. Population flow data is also used to monitor residents staying in or evacuating from dangerous areas.
Human resources development	A three-step curriculum has been prepared based on basic knowledge, skills, and background, in order to develop specialist human resources while broadening the company's base.
	A university partnership program and practical training program have been prepared, and an idea contest is held as an opportunity to demonstrate the results of these studies.

- **Digitalization**

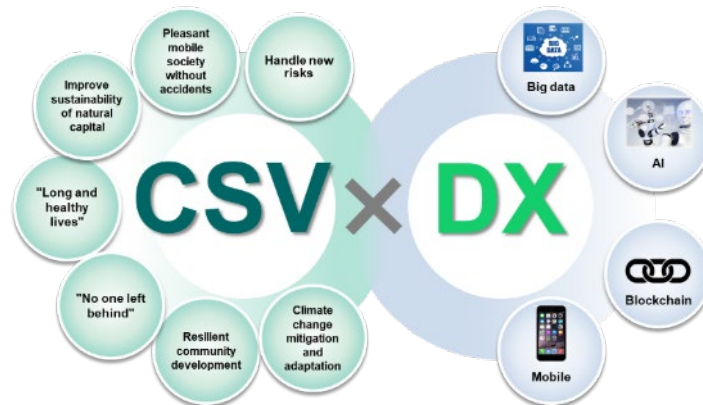
- Changes in social environments and risks surrounding the insurance industry



- > Digitalization needs to be promoted to address social issues

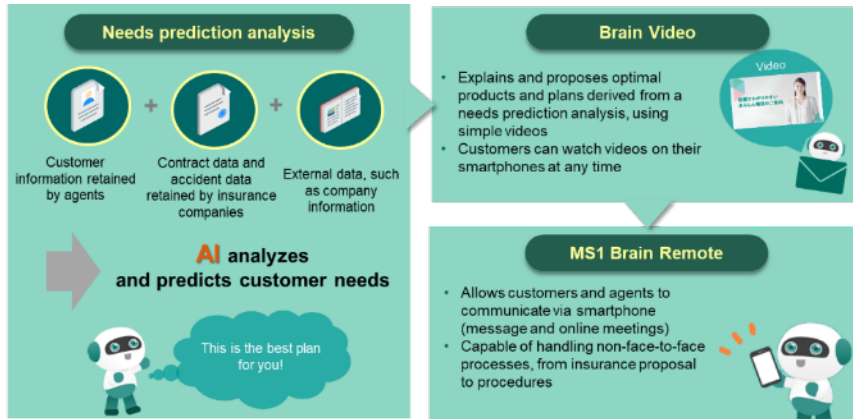


- CSV & DX: Solve customer and social issues with the power of DX, and aim for growth while realizing the concept of "Creating Shared Value" (CSV)



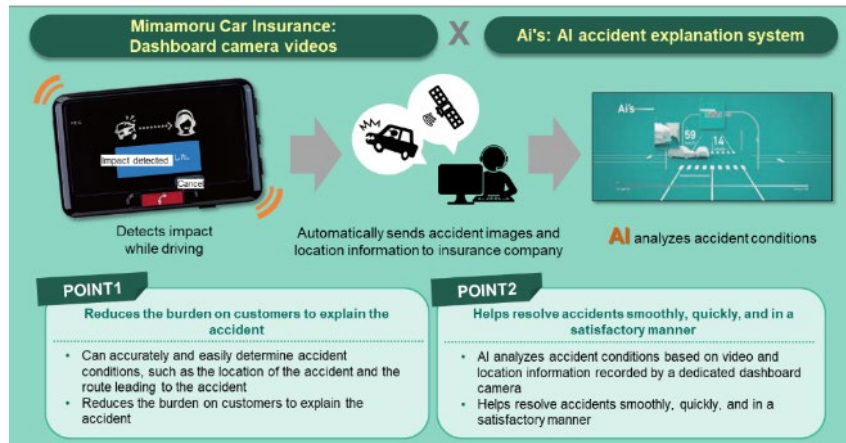
### Initiative [1]: Agent sales support system

- External data such as customer information retained by agents, contract data and accident data retained by insurance companies, and external data (such as company information) is used to predict customer needs and to explain/propose optimal products and plans using videos. Customers and agents can also communicate using their smartphones, allowing them to complete a series of non-face-to-face processes, from insurance proposals to procedures.



### Initiative [2]: Initiatives using dashboard cameras

- If an impact is detected while a car is in motion, an image of the accident and location information are automatically sent to the insurance company, and AI analyzes the accident situation. => Reduces the burden on customers to explain the accident and can help resolve the accident satisfactorily by responding smoothly and promptly

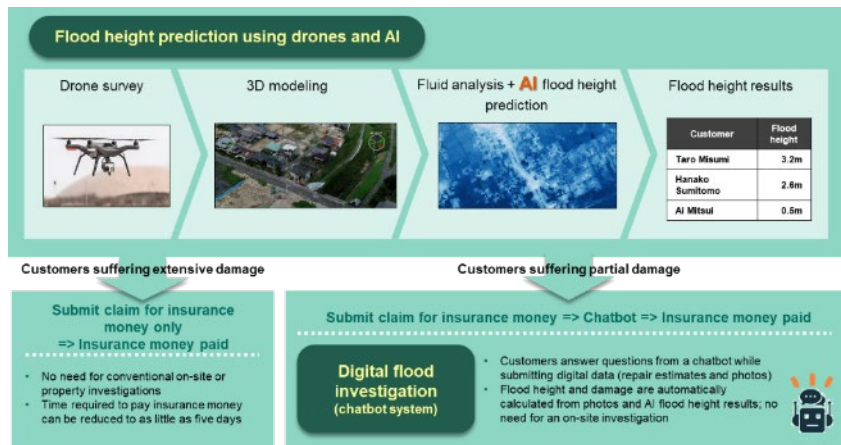




### Initiative [3]: Initiatives in the event of a flood

■ Drones are used to conduct surveys, and 3D models created based on this data are used to perform fluid analysis and predict flood height.

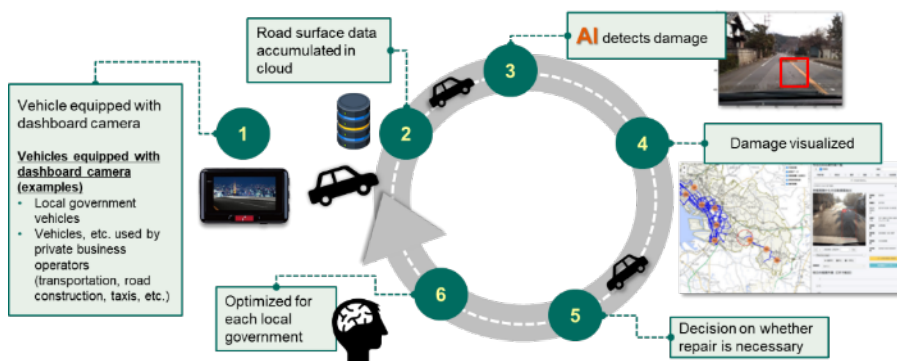
=> For customers who have suffered severe damage, there is no need to visit or inspect the property, and the period until payment of insurance money is reduced; for customers who have suffered partial damage, the degree of damage is calculated automatically based on the submitted photos and the predicted flood height (no need for on-site inspection)



### Initiative [4]: Smart city initiatives (Dashboard Camera Road Manager)

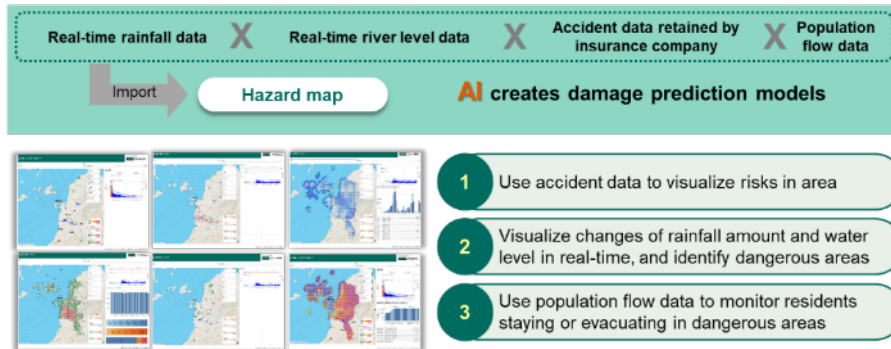
■ A dashboard camera mounted on a vehicle detects road damage, visualizes damaged areas, and determines whether repairs are necessary.

=> Expanding this service will help make it easier to inspect and maintain roads, bridges, and other facilities in cities, reducing the number of accidents





**Initiative [5]: Measures against natural disaster risks (disaster prevention information visualization system)**

- Accident data is used to visualize risks in the area, while real-time rainfall data and river water level data are used to identify hazardous locations. Population flow data is also used to monitor residents remaining in or evacuating from dangerous areas.
- => Can lead to a reduction in the effects of climate change



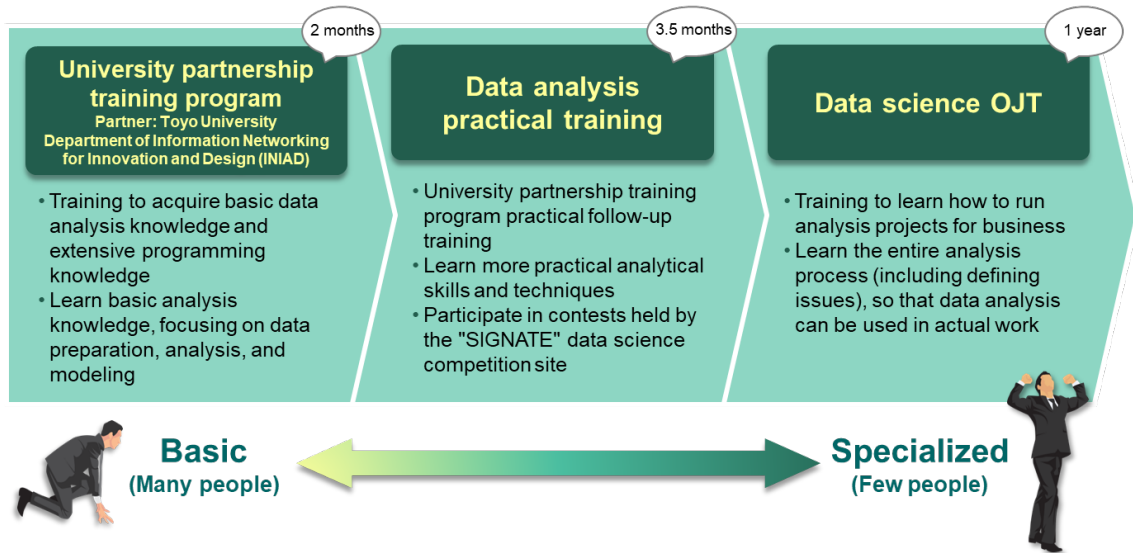
**Initiative [6]: Digital human resources development**

- Employees are trained split into two categories ("data analysis group" and "digital business group") in order to promote digitalization.

Data analysis group	Digital business group
<ul style="list-style-type: none"> <li>● Human resources who use BI tools and programming to analyze and propose use cases and hypotheses for problems</li> <li>● Human resources aiming to become "<b>data scientists</b>" in the future</li> </ul> 	<ul style="list-style-type: none"> <li>● Human resources who plan and develop new products and services using digital technology and data, and upgrade existing services</li> </ul> 

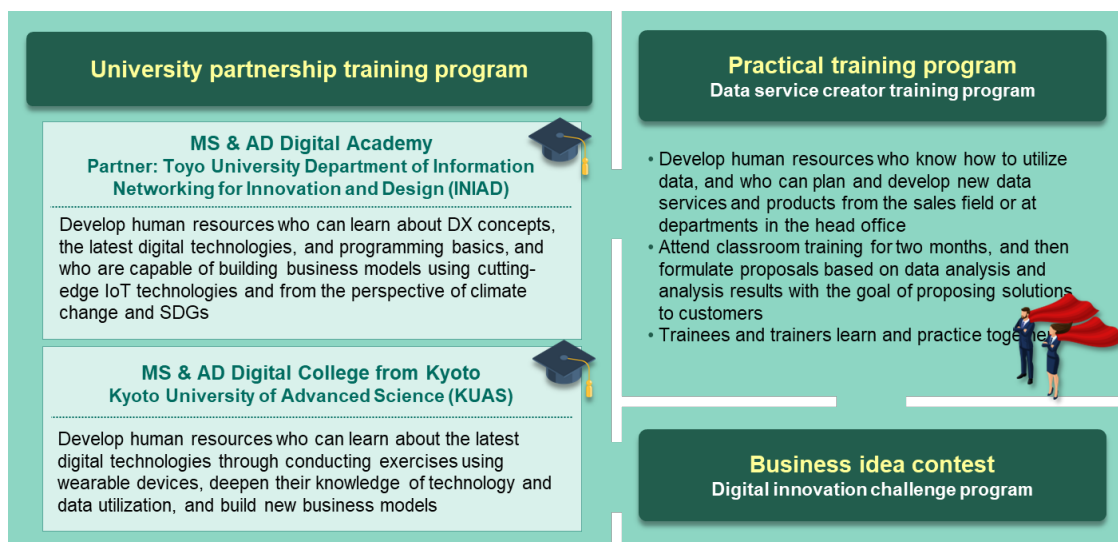
○ Data analysis group (data scientist) development

- A three-step curriculum has been prepared based on basic knowledge, skills, and background, in order to develop specialist human resources while broadening the company's base



○ Digital business group development

- A university partnership program and practical training program have been prepared, and an idea contest is held as an opportunity to demonstrate the results of these studies



## ■ Overview of presentations and exchanges of opinions at interviews

- Insurance companies are very closely connected with solving social issues. Society is facing new risks (including cyber-risks) arising with the spread of COVID-19, the increase in the number and scope of natural disasters, and the spread of advanced technologies. In order to respond to these social issues, the company believes it is necessary to promote digitalization.
- The purpose of digitalization is to enhance the value experienced by customers and improve business productivity. Toward that end, the company is promoting initiatives in three categories: reforming existing businesses (digital transformation [DX]), creating new businesses (digital innovation [DI]), and expanding efforts throughout Japan and overseas (digital globalization [DG]).
- In order to make digitalization easier to understand, the company has established the concept of "CSV & DX" to promote initiatives. In response to challenges such as coping with new risks and building resilient communities, the company is working toward realizing the concept of "Creating Shared Value" (CSV) by utilizing various DX tools such as big data, AI, and blockchain.
- The company obtains agreement on utilizing the data it collects, and has launched a service to identify damaged parts of roads from videos captured by dashboard cameras, and to provide local governments with information on whether repairs are necessary. In the future, this will help governments to inspect and repair not only roads, but also various facilities such as bridges and buildings, which can help to reduce the number of accidents.
- The number of floods (and victims of floods) is increasing in Japan, and there has been an increased focus recently on related efforts. It is important to make use of advanced technology to support reconstruction by paying insurance money to victims as soon as possible. Specifically, the company has launched initiatives to use drones to survey flooded areas, generate 3D models, and predict the depth of flooding by combining fluid analysis and AI technology.
- With regard to measures against natural disaster risks, it is important to make sure that customers can easily understand the risk of natural disasters. Toward that end, the company is promoting initiatives to not only create hazard maps, but also to visualize what kind of damage will occur and how many residents are remaining in the area.
- The company is also considering the issue of personal data affecting insurance products or insurance amounts. For example, with an automobile accident, it is necessary to verify not only the results of the accident, but also the causal relationship between driving behavior and the accident. For this reason, driving data alone is not sufficient when an insurance company reflects conditions to insurance premiums. In Japan, rates are calculated based on laws on rates used to calculate basic insurance premiums. The company believes that it is more important to reduce accidents all over the world.
- With regard to the organizational structure, insurance companies must promote innovation together with various stakeholders (such as external customers and business partners), rather than independently. The company has therefore established its Business Innovation Division, a new department aimed at forming alliances.
- The company has established a system for developing digital human resources within the company, and is working to develop them by dividing them into those who mainly analyze data and those who mainly conduct digital business.

For the data analysis group, the company has adopted a three-step curriculum in order to develop specialist human resources: [1] acquire basic knowledge within an information-related department at a partner university, [2] perform practical data analysis after returning to the workplace, and [3] implement analysis projects as business.

For the digital business group, the company has established a training program in which employees learn about various new business models using the latest digital technologies in courses taught at partner universities, while working alongside their managers (as managers would also need to understand these processes).

DAIKIN INDUSTRIES, LTD.: AI human resources development efforts at Daikin Industries

Overview of major initiatives related to AI development and use

Initiative	Overview
<b>Business innovation</b>	
Unmanned inspection of air conditioners	Use cameras to photograph the drain pans of indoor units and total heat exchangers, in order to visualize the degree of contamination.
Remote monitoring service for air conditioners	Proposes energy-saving operations tailored to each customer based on remote monitoring data, and uses high-performance controllers to automate energy-saving operation schedules.
Collaborative creation platform utilizing air and space data	Currently collecting various kinds of data from office spaces in order to build a new building management ecosystem centered on air conditioning, lighting, and security.
Personal Air Conditioning	Establishes multiple temperature variations to allow users to work in a comfortable environment.
Air Spot	Establishes rapid cooling/heating spots at entrances in order to quickly resolve problems of feeling too hot or too cold when entering from the outside.
Wind Creator (wind generator)	Generates natural wind that makes it feel as if one is in a natural environment, even indoors.
Linked Air (virtual window)	Devices installed in windowless rooms display scenery and generate wind.
<b>Process innovation</b>	
Establishment of technology for automatically measuring actual work time in factories	Use cameras to monitor workers, in order to perform automatic measurement, eliminate inefficiencies, and optimize actual work time.
Automation of external air conditioner inspections	Automate visual inspections for air conditioner (exterior) damage.
Automation of product noise inspections	Automate product noise inspections.
Visualization of proficiency	Visualize the proficiency level of trainees by standardizing knowledge data of skilled technicians.
<b>Human resources development</b>	Daikin Information and Communications Technology College was established for the purpose of quickly developing human resources who develop AI technologies in parallel with developing human resources who utilize AI and develop systems.
	Separate courses have been designed for new employees, existing employees, core management, management, and executives, in order to develop Π-type human resources that are experts in two or more different areas.



● **Air conditioner value chain**

- The company aims to create new value by not only providing air conditioning equipment, but also by utilizing data within the air conditioner value chain



**Initiative [1]: Unmanned inspection of air conditioners**

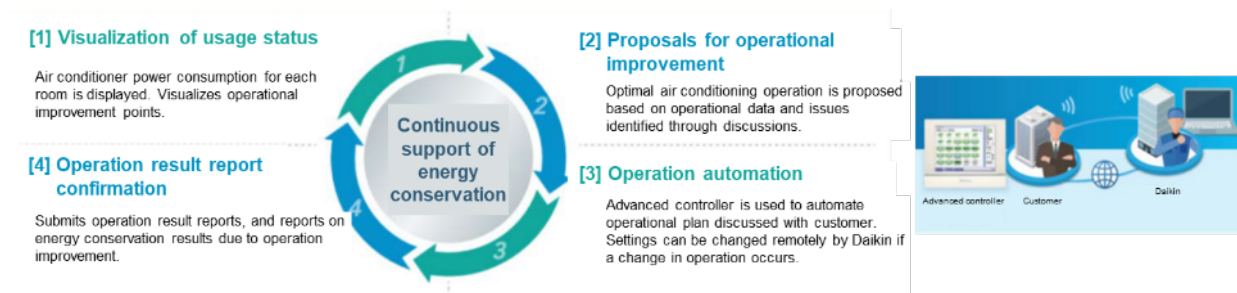
- Use cameras to photograph the drain pans of indoor units and total heat exchangers, in order to visualize the degree of contamination.

-> There is no longer any need for on-site visual inspections, which can help prevent the spread of COVID-19 and enable remote work



**Initiative [2]: Remote monitoring service for air conditioners**

- Proposes energy-saving operations tailored to each customer based on remote monitoring data, and uses high-performance controllers to automate energy-saving operation schedules.



### Initiative [3]: Collaborative creation platform utilizing air and space data

- Currently collecting various kinds of data from office spaces in order to build a new building management ecosystem centered on air conditioning, lighting, and security.



### Initiative [4]: Personal Air Conditioning

- Establishes multiple temperature variations to allow users to work in a comfortable environment.

### Initiative [5]: Air Spot

- Establishes cooling/heating spots at entrances in order to quickly resolve problems of feeling too hot or too cold when entering from the outside, without having to change the temperature indoors.

### Initiative [6]: Wind Creator (wind generator)

- Generates natural wind that makes it feel as if one is in a natural environment, even indoors.

**Initiative [7]: Linked Air (virtual window)**

- Devices installed in windowless rooms display scenery and generate wind, improving the value provided by the space and allowing individuals to refresh before meetings.



**Initiative [8]: Establishment of technology for automatically measuring actual work time in factories**

- Use cameras to monitor workers, in order to perform automatic measurement, eliminate inefficiencies, and optimize actual work time.

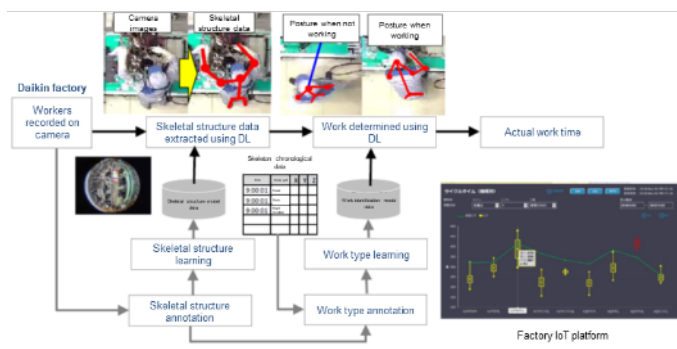
**Initiative [9]: Automation of external air conditioner inspections**

- Automate visual inspections for air conditioner (exterior) damage.

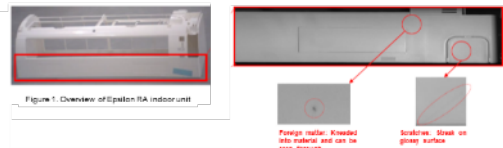
**Initiative [10]: Automation of product noise inspections**

- Automate product noise inspections.

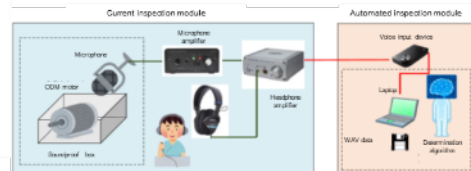
**[8] Establishment of technology to automatically measure actual work time in factories**



**[9] Automation of external quality inspections of air conditioner**

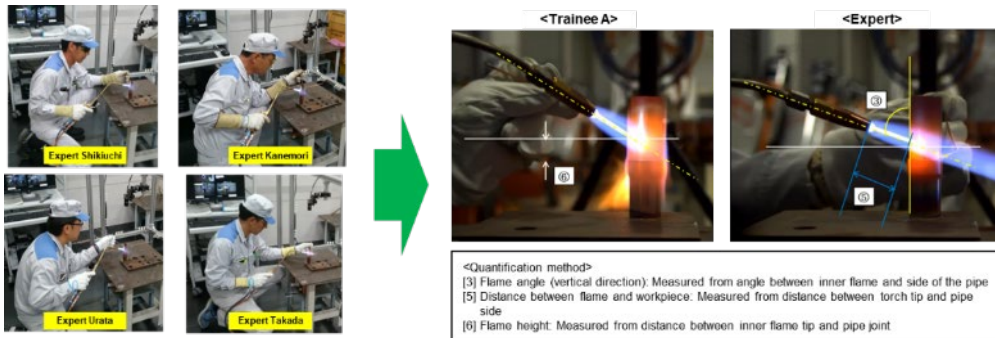


**[10] Automation of product noise inspections**



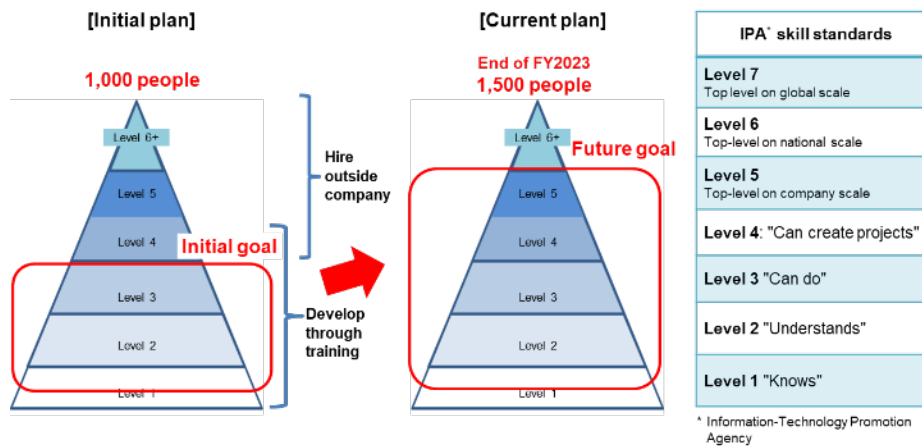
### Initiative [11]: Visualization of proficiency

- Convert knowledge collected from skilled technicians into standardized data and contrast this with work data from trainees, in order to visualize proficiency.



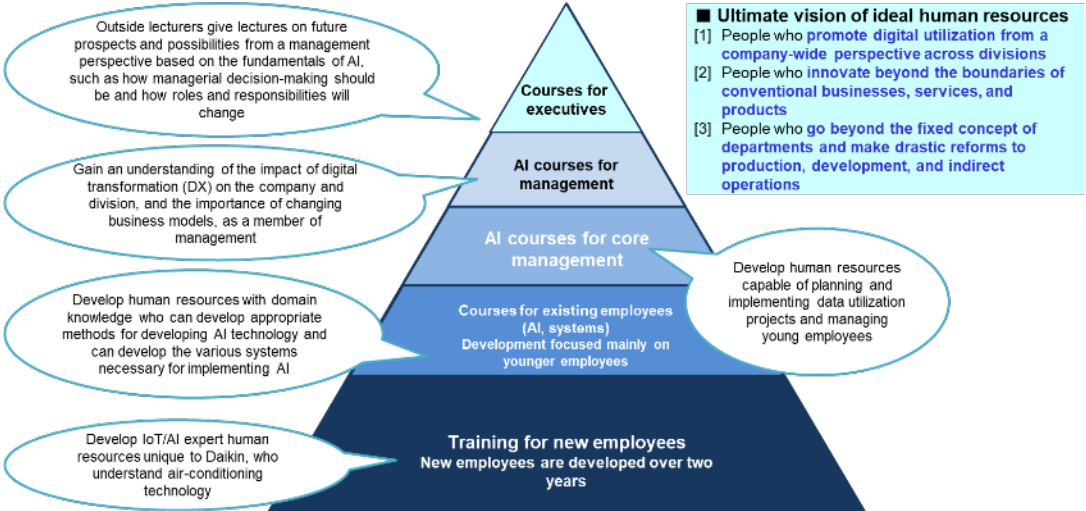
### Initiative [12]: Establishment of Daikin Information and Communications Technology College

- Daikin Information and Communications Technology College was established for the purpose of quickly developing human resources who develop AI technologies in parallel with developing human resources who utilize AI and develop systems (December 2017).
  - Over the four years since then, the company has made steady progress in developing capable human resources that understand digital technologies. In order for these human resources to play an active role in their divisions, the most important task will be to acquire and internally develop higher level human resources capable of planning and progressing themes.



**Initiative [12]: Development of Π-type human resources that are experts in two or more different areas**

- Separate courses have been designed for new employees, existing employees, core management, management, and executives, in order to develop Π-type human resources that are experts in two or more different areas.





## ■ Overview of presentations and exchanges of opinions at interviews

- The company previously only supplied air conditioners to customers (manufactured and delivered as products) and provided maintenance and upgrade services separately. However, under the concept of business innovation, it is now building a value chain that makes use of design and test run data to link adjacent processes, in an attempt to create new value.
- With regard to unmanned inspections of air conditioners, it is very difficult for humans to inspect the drain pan of indoor units and total heat exchangers, and so the company has developed a system that automatically determines contamination based on images taken with a camera, and sends cleaning alerts to customers. This also helps to prevent the spread of COVID-19, as work can be done remotely.
- With regard to remote monitoring services for air conditioners, the company has introduced a system to support energy-saving operations in buildings, that can be operated completely remotely. It automates energy-saving operation schedules and prompts customers to check operation reports to improve operation.
- The company had previously optimized internal processes such as product lifecycle management (PLM), customer relationship management (CRM), and its supply chain separately. In order to innovate processes, the company has adopted a concept of creating a data platform to improve business.
- With regard to automatically measuring actual work time in factories, the company has adopted a system that optimizes actual working times by using cameras to check for worker inefficiencies. The company is also promoting initiatives to automate processes for inspecting air conditioners (exterior) and abnormal noises, as these processes previously relied on humans inspecting products on-site.
- It is extremely important for skilled technicians (experts) to pass their knowledge and skills down to the next generation, and this was previously done from employee to employee. The company is now building a system to visualize proficiency levels and determine differences between trainees and experts, so that trainees will be able to learn automatically.
- The company's medium-term management plan for 2025 calls for the development of 1,500 digital human resources, mainly through Daikin Information and Communications Technology College, with a vision of promoting business innovation and process innovation.
- Originally, there were very few system personnel to develop and utilize technologies, and in-house training alone would not have been enough to meet the company's goal. Daikin Information and Communications Technology College was therefore established in December 2017. The company is working to reach a level where the company can become independent in three areas required of data scientists: topic execution, analysis, and data engineering.
- In addition to the technical expertise employees bring to the company, the company hopes to use this training to develop II-type human resources that are experts in two or more different areas including AI and IoT.
- The company provides separate training to new employees, existing employees, core management, management, and executives.

For example, during the first year of training for new employees, new hires learn in a classroom setting and are taught using problem-solving exercises (on topics such as building clouds), and take exams such as the Fundamental Information Technology Engineer Examination and Japan Statistical Society



Certificate. The company's pass rate exceeds the national average. During the second year, employees engage in project based learning (PBL), and conduct debriefings for the entire company. Two advantages of this initiative are that it provides the power of collective knowledge, and that employees have time to think carefully about their career over the two-year period. However, there is a barrier between learning the basics and putting them into practice, and the challenge now is how to overcome it.

- The company believes that it has made steady progress over the past four years. The number of students who want to join the company after hearing about these initiatives has increased significantly, and turnover is very low compared to the average, resulting in a sense of camaraderie among employees.

## West Japan Railway Company: Data analytics initiatives at JR West

### Overview of major initiatives related to AI development and use

Initiative	Overview
<b>Condition based maintenance (CBM)</b>	
Hokuriku Shinkansen snow accumulation prediction	Uses weather forecast data, snow depth gauge data, etc., to build a prediction model for train snow accumulation (especially around the threshold for snow removal).
Automatic ticket gate failure prediction	Uses operation data and failure history data of ticket gates to build an AI that outputs the probability of failure within three or seven days.
Surveillance camera AI	Currently building a system that automatically detects certain actions and objects (wheelchairs, canes held by the visually impaired, drunken passengers, lightheadedness, knives, etc.) from images taken by surveillance cameras, in order to notify staff.
Girder water level prediction	Predicts the girder water level of bridges from upstream river data (water level).
Turnout condition monitoring	Uses sensors installed in turnouts to detect signs of non-switchover, the state of contact/attachment, and the state of baseplate oil, in order to optimize inspections.
High-frequency track condition monitoring	Uses historical vehicle sway data to predict and visualize future swaying.
Track bed condition determination	Currently building a system that automatically detects track bed areas from images taken of railway tracks and classify their conditions into classes.
<b>Marketing</b>	
AI stamp collection events	Promote consumer behavior among visitors, such as making use of public transportation, sightseeing, and eating/drinking. This will be used as a new marketing tool using data analysis.
ICOCA data utilization	Currently applying data analysis in order to approach individual customers, identify travel patterns based on whether customers are moving or stationary, and analyze customer behavior through stamp collection events.

## ● Digital strategy

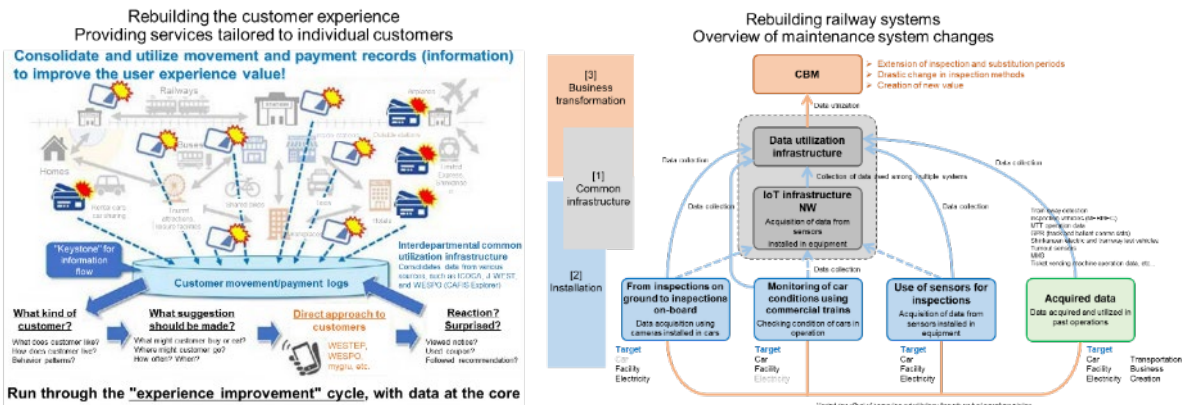
Create and continue to provide value, help revitalize the West Japan area, and use these processes to promote business transformation, by promoting the use of the abundant data the JR West Group has accumulated through digital technology, and linking this with real experiences at stations, stores, and in local communities

### <Digital strategy: Three reforms>

Utilization of digital technology and group data (Maintenance of data utilization infrastructure)	Group integration and external collaboration (Common membership and points)	Ability to respond to change and innovate (Culture & organization, structure & human resources)
<b>[1] Rebuilding the customer experience</b> (Seeking services that meet customer needs)	<b>■ Integrate all JR West Group services and collaborate with external partners</b> => Continue to provide new value tailored to each customer's needs => Expand services such as Maas App (WESTER, setowa), Mobile ICOCA (tentative name), and e5489	
<b>[2] Rebuilding railway systems</b> (Realization of technical vision)	<b>■ Build sustainable railway systems, improve safety, and pursue reliable transportation</b> => Attempt to transform operations and change maintenance system (CBM)	
<b>[3] Rebuilding the employee experience</b> (Work style reforms)	<b>■ Promote the use of digital technology and the use of ICT in working environments</b> => Implement employee work style reforms (create systems to improve motivation and produce results efficiently and frequently)	

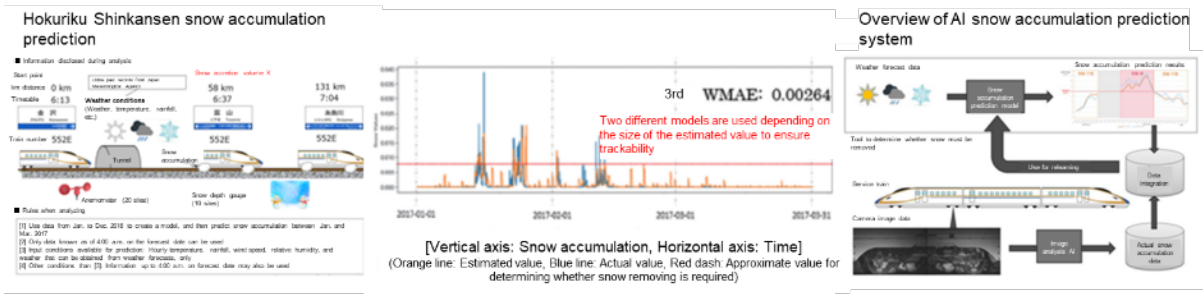
### <The future digital strategy of the JR West Group>

Establish a safe, prosperous, people connected, and happy society by applying digital technology to connect with groups and the outside world and create new value



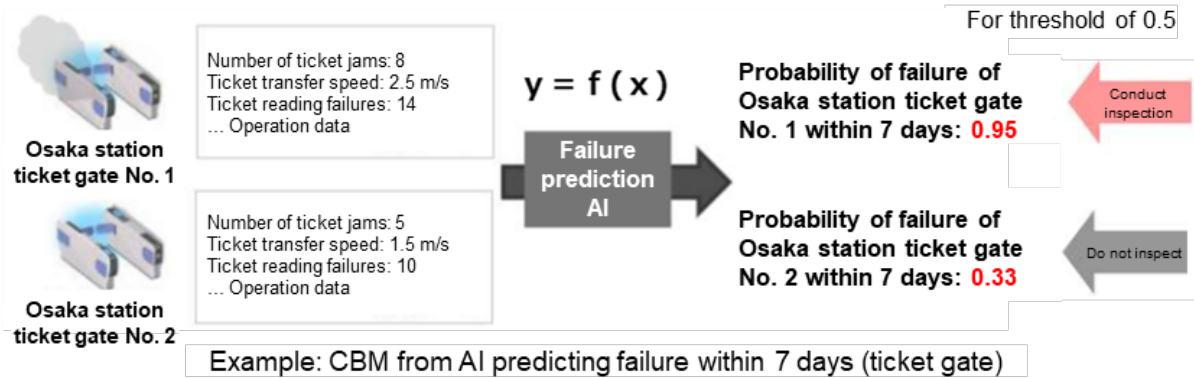
## Initiative [1]: Hokuriku Shinkansen snow accumulation prediction

- Uses weather forecast data, snow depth gauge data, etc., to predict train snow accumulation and build a model to retrain based on image analysis.
- => Helps to reduce of number of workers removing snow (making up for labor shortage), realize stable transportation, and further improve safety



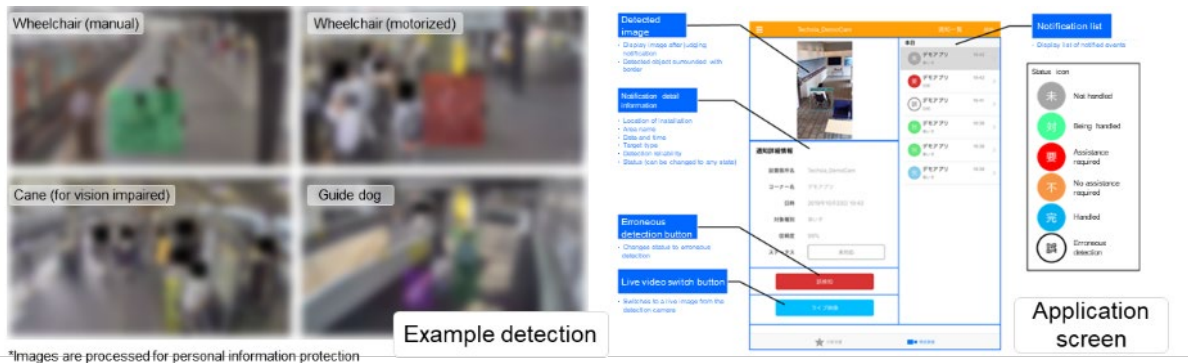
## Initiative [2]: Automatic ticket gate failure prediction

- Uses operation data and failure history data of ticket gates to build an AI that outputs the probability of failure within three or seven days.
  - => Helps to reduce the number of failures occurring as well as the total number of inspections, confirming that downtime can be reduced with fewer inspections



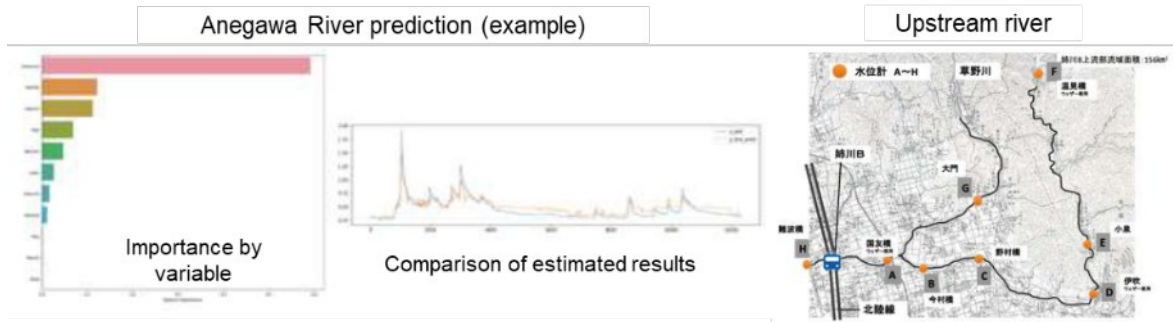
## Initiative [3]: Surveillance camera AI

- Currently building an AI that automatically detects certain actions and objects (wheelchairs, canes held by the visually impaired, drunken passengers, lightheadedness, knives, etc.) from images taken by surveillance cameras, and a system to notify staff.
  - => Helps to improve safety and CS by ensuring that dangerous behaviors and users requiring assistance are seen, and helps to reduce costs



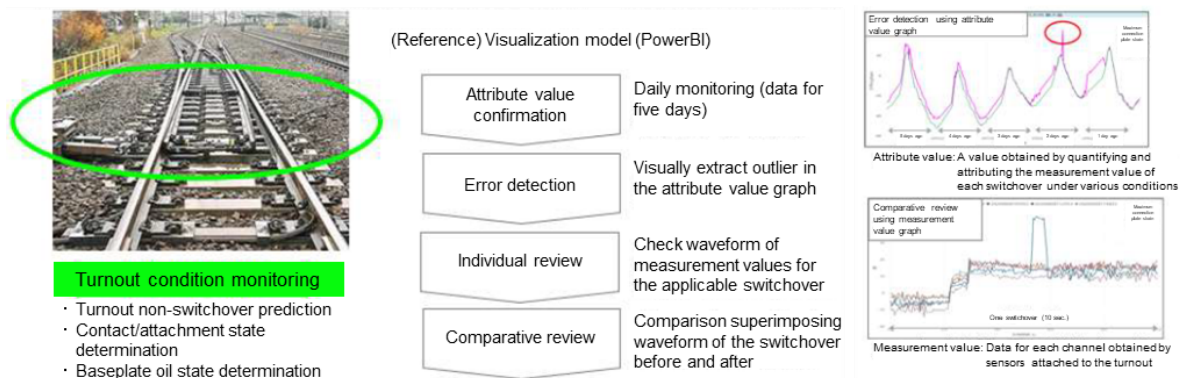
### Initiative [4]: Girder water level prediction

- Predicts the girder water level of bridges from upstream river data (water level).
- => Helps to improve safety through optimizing operation plans, etc.



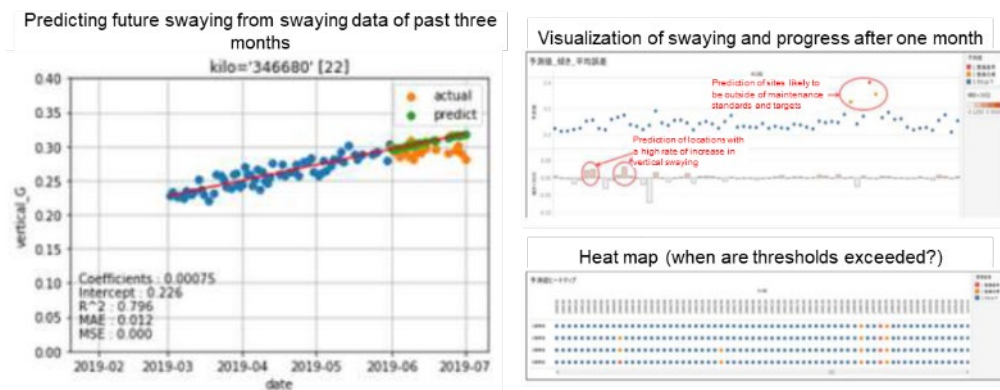
### Initiative [5]: Turnout condition monitoring

- Uses sensors installed in turnouts to detect signs of non-switchover, the state of contact/attachment, and the state of baseplate oil, in order to optimize inspections.
- => Helps to reduce of the amount of maintenance work (covering for labor shortages), realize stable transportation, and further improve safety



### Initiative [6]: High-frequency track condition monitoring

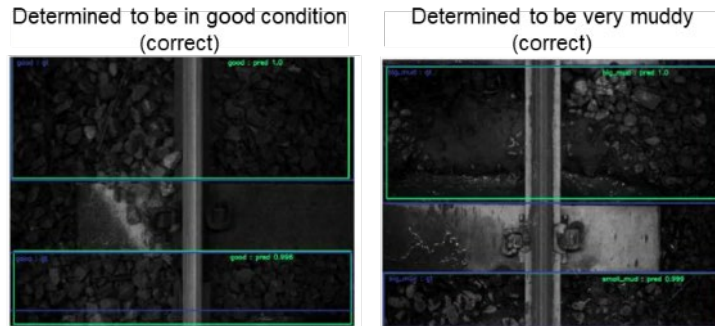
- Uses historical vehicle sway data to predict and visualize future swaying.
- => Helps to realize safe and stable transportation, streamline maintenance work, and extend inspection substitutions and periods





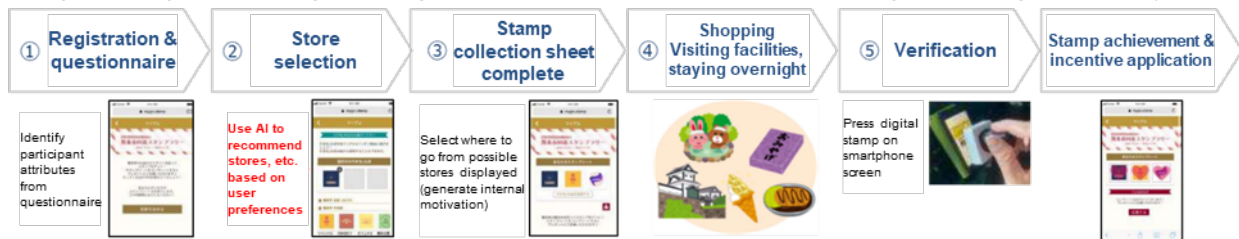
### Initiative [7]: Track bed condition determination

- Currently building a system that automatically detects track bed areas from images taken of railway tracks and classifies their conditions into classes.
- => Can improve work efficiency through enabling hybrid combinations with inspectors



### Initiative [8]: AI stamp collection events

- Promote consumer behavior among visitors, such as making use of public transportation, sightseeing, and eating/drinking. This will be used as a new marketing tool using data analysis.



### Initiative [9]: ICOCA data utilization

- Currently applying data analysis in order to approach individual customers, identify travel patterns based on whether customers are moving or stationary, and analyze customer behavior through stamp collection events.



## ■ Overview of presentations and exchanges of opinions at interviews

- Initially, initiatives were launched by a group consisting of only four people. After holding competitions and collaborating with other companies, the group now consists of 21 individuals including scientists and business personnel (as of the time the interview was conducted). 32 people have been active since June 2022, and it has taken a unique structure.
- Initiatives are divided into two fields (a technical field called "condition based maintenance" [CBM] and a marketing field), and are unique in that the data scientists in charge of business and analysis work as a team overseeing projects and deciding on issues to tackle.
- The company has three policies for promoting DX: identify areas for improvement through data collection and analysis ("measure"), use data to survey issues underlying internal and external needs ("survey"), and use data to plan for the creation of new value ("plan").
- The company's digital strategy is to promote initiatives and consider how to utilize digital, ICT, and data in three areas: rebuilding customer experiences, rebuilding railway systems, and rebuilding employee experiences.
- The company employs its own data scientists, but also has an open and closed strategy of not doing projects on their own or leaving them completely to others. The company has formed a capital and business alliance with a venture company engaged in data analysis. Depending on the nature of the project, the company works with the venture company on initiatives, and then feeds this knowledge back internally.
- The company has begun developing a system that quickly detects users who need assistance (such as individuals in wheelchairs, using canes, or accompanied by guide dogs), using images from surveillance cameras installed in stations. Note that AI looks only at the skeletal framework of individuals when making a decision, and that technologies such as facial recognition or movement tracking are not used to identify individuals, so that AI retains no personal information.
- The use of security cameras is a sensitive topic and of much concern. The purpose of use of personal information is explained on the company website, alongside information on technology development. In addition to contributing to the development of AI, the company does not collect and analyze individual behavior logs to determine individual characteristics and does not perform facial recognition, and instead uses AI in a way that does not include personal information.
- With regard to the balance between humans and AI, the company believes that it is still difficult to introduce AI into security devices and other devices where mistakes in judgment cannot be tolerated. Although there are some issues that human inspectors may miss or some cases where rules could be interpreted differently, using AI can provide an answer around 70% of the way. The company plans to replace tasks by obtaining data more often than humans can and increasing the number of decisions that are made.
- The company is using AI as a tool to help humans make final decisions.
- The company is currently considering introduction of AI to make determinations on HR and employee benefits. The data science field is a largely unexplored area in the railway industry, and the company's initiatives are truly industry-first efforts. They are worth pursuing for that reason. However, this will not be enough in the future, so wages, authorities, team organizations, and work styles/speeds will need to



change.

- There are two career paths for employees with data scientist knowledge. The first is to feed technology back into railway bodies as a member of an organization responsible for advanced data analysis. However, the company will also need to allow employees in the field to conduct data analysis in a more general manner. The other pattern is therefore to have an employee join a digital team for a certain period of time in order to acquire a background in data analysis, and then return to their business division and make improvements to work in the field.

## KDDI CORPORATION: AI use cases and AI governance initiatives at KDDI

### Overview of major initiatives related to AI ethics and governance

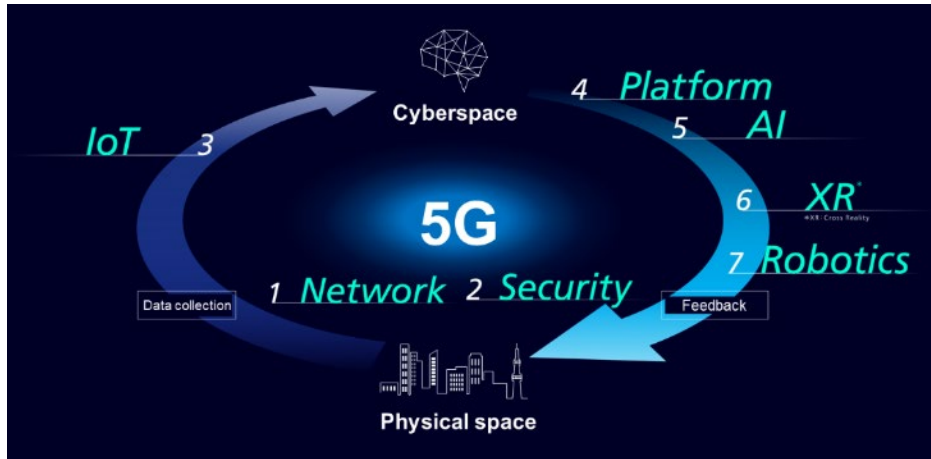
Type	Overview
Policies, guidelines, and principles	The "AI R&D and Utilization Principles for KDDI Group" were formulated and published in August 2021.
Transparency and accountability	Currently researching technologies related to the accountability of AI oriented for physical spaces and accountable AI that make use of knowledge graphs
Safety/security	The company is currently experimenting with hostile sample threats with regard to rogue circuits. It is also experimenting with technologies to counter data poisoning attacks and threats to malware detection technologies. It is also experimenting with technologies to counter data poisoning attacks and threats to recommendation systems.
Privacy	The company is currently researching technologies related to persona marketing AI in different industries with minimal ID linking. It is also conducting risk assessment and countermeasures prior to the launch of services through conducting the same privacy impact assessments (PIAs) as in the past even for AI-related services.

### Overview of major initiatives related to AI development and use

Initiative	Overview
Electricity bill prediction	Machine learning is performed on data such as past electricity bills, temperatures, and days of the week, in order to predict end-of-month electricity bills.
AI irrigation and fertilization system	Automates irrigation and fertilization based on information from soil and sun sensors.
Verification of network operation system	Automate certain process decisions by combining AI technologies according to operation log characteristics.
Verification of use in changing behavior	Verify whether psychological intervention can be used to encourage people to avoid road construction areas.
Human resources development	The company shares and disseminates the "AI R&D and Utilization Principles for KDDI Group" through employee community outreach activities and e-learning for all employees. It has launched a training program for developing DX core human resources, and includes courses on personal information protection and AI ethics in training.

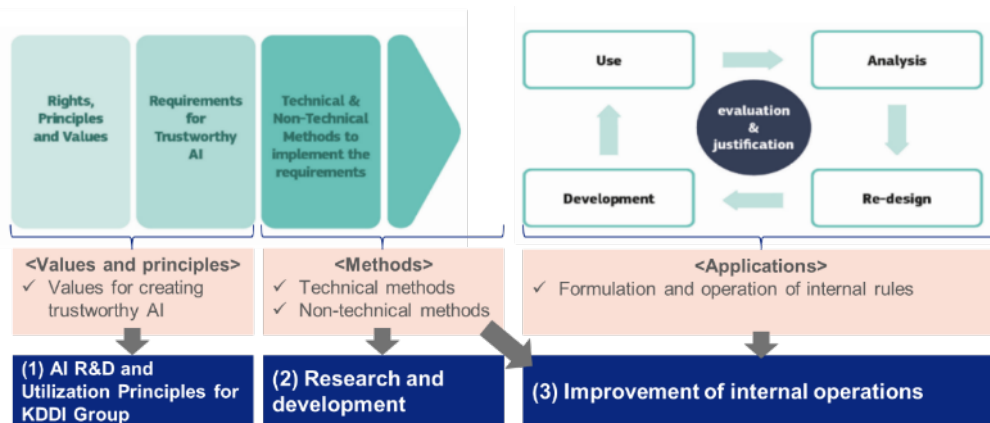
● **KDDI Accelerate 5.0**

- This concept aims to realize a sustainable, people-centered society ("Society 5.0"), that strikes a balance between economic development and solving social issues (next generation society concept: accelerate "Society 5.0" cycle using seven data-focused technologies including AI)



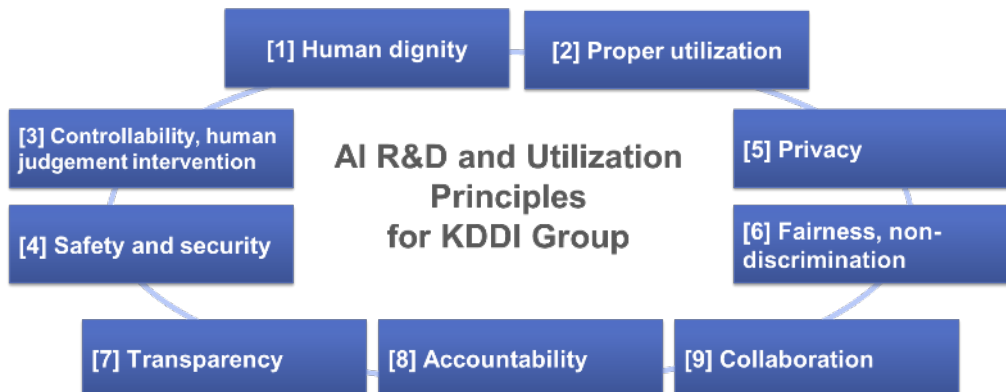
**Initiative [1]: "Trustworthy AI"**

- In order to provide "trustworthy AI", engage in initiatives to formulate and disclose principles, conduct research and development, and improve internal operations.

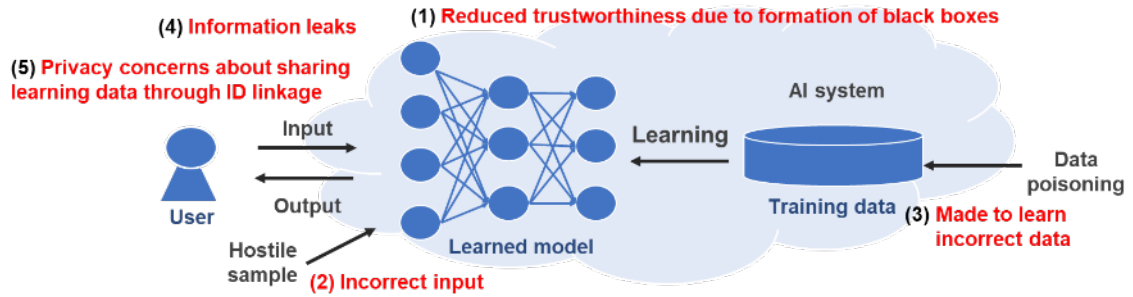


○ **AI R&D and Utilization Principles for KDDI Group**

- Formulated nine principles on appropriate AI development and utilization (published in August 2021)

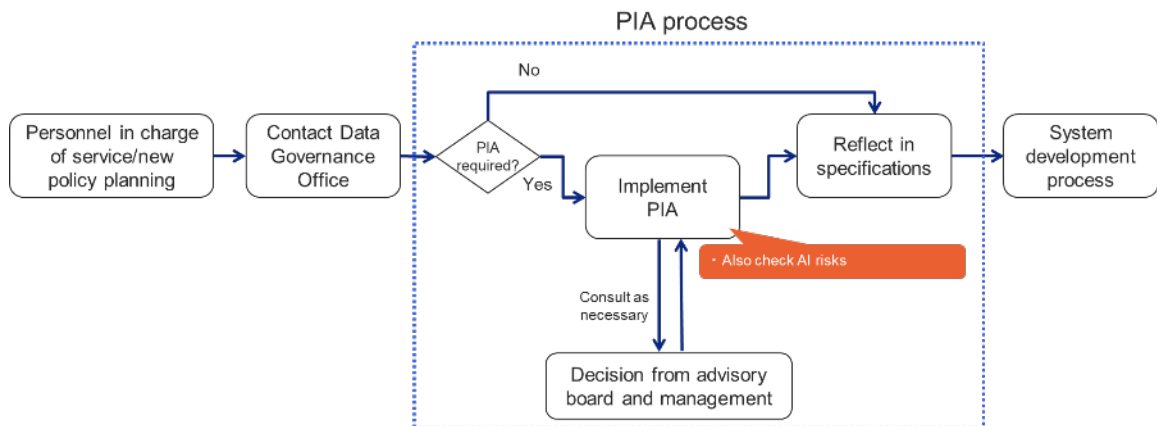


- Research and development
  - Currently researching technologies to address risks to AI



Classification	Risk	Current initiatives
Transparency	(1) Reduced trustworthiness due to formation of black boxes	<ul style="list-style-type: none"> <li>• Accountability of physical space-oriented AI</li> <li>• Accountable AI that utilizes knowledge graphs</li> </ul>
Safety and security	(2) Incorrect input	<ul style="list-style-type: none"> <li>• Currently experimenting with hostile sample threats with regard to rogue circuits * Entrusted to PRISM, Project of the Japanese Cabinet Office in FY2019</li> </ul>
	(3) Incorrect data learning	<ul style="list-style-type: none"> <li>• Experimenting with technologies to counter data poisoning attacks and threats against malware detection technologies</li> <li>• Experimenting with technologies to counter data poisoning attacks and threats against recommendation systems</li> </ul>
Privacy	(4) Information leaks	<ul style="list-style-type: none"> <li>• Examining and experimenting of model inversion attacks</li> </ul>
	(5) Privacy concerns about sharing learning data through ID linkage	<ul style="list-style-type: none"> <li>• Persona marketing AI in different industries with minimal ID linkage *Entrusted to JST CREST in FY2018</li> </ul>

- Improvement of internal operations
  - It is also conducting risk assessment and countermeasures prior to the launch of services through conducting privacy impact assessments (PIAs) even for AI-related services



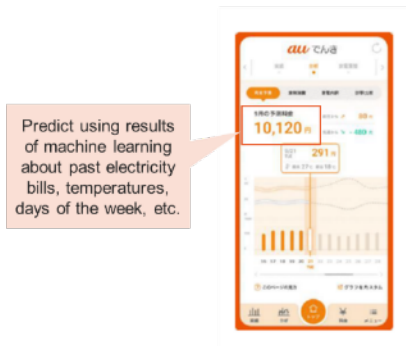
### Initiative [2]: Electricity bill prediction

- Machine learning is performed on data such as past electricity bills, temperatures, and days of the week, in order to predict end-of-month electricity bills.

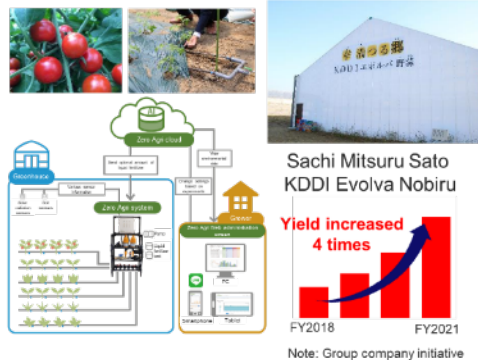
### Initiative [3]: AI irrigation and fertilization system

- Automates irrigation and fertilization based on information from soil and sun sensors.

[2] Electricity bill prediction



[3] AI irrigation and fertilization system



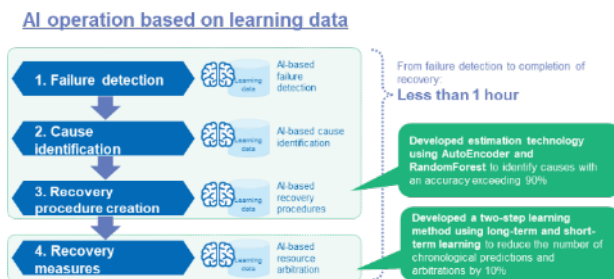
### Initiative [4]: Verification of network operation system

- Automate certain tasks within operation processes by combining AI technologies according to operation log characteristics.

### Initiative [5]: Verification of use in changing behavior

- Verify whether psychological intervention can be used to encourage people to avoid road construction areas.

[4] Demonstration of NW operation system using AI



[5] Verification of use in changing behavior



### Initiative [6]: Human resources development

- The company shares and disseminates the "AI R&D and Utilization Principles for KDDI Group" through employee community outreach activities and e-learning for all employees. It has also launched a training program for developing DX core human resources, and includes courses on personal information protection and AI ethics in training.

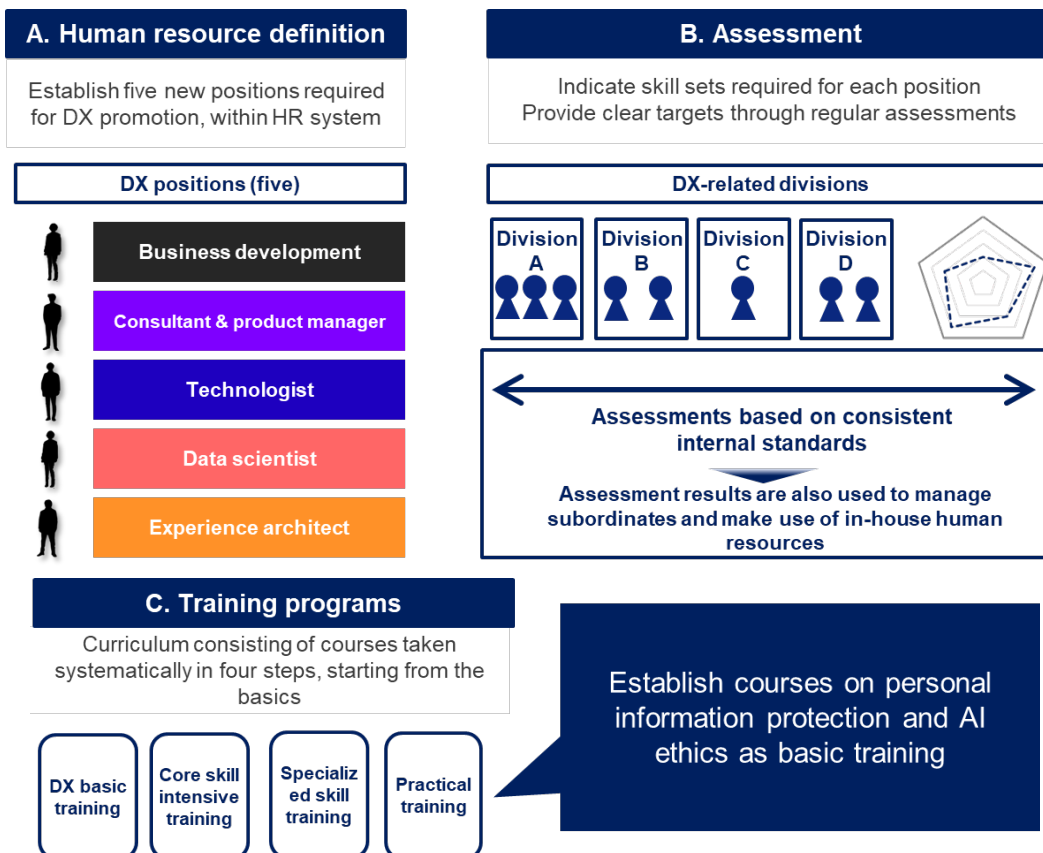
○ Short talks within the employee community



○ E-learning, internal public relations



○ Training program for developing DX core human resources



## ■ Overview of presentations and exchanges of opinions at interviews

- While utilizing various technologies including AI, the company is promoting its business with a view to striking a balance between solving social issues, economic development, and a prosperous digital society. The "KDDI Accelerate 5.0" concept was created in order to realize Society 5.0. This conceptualizes society in 2030, and shows the direction of technology development and business models that will support it. The concept includes seven important technology areas: network, security, IoT, platform, AI, XR, and robotics.
- Trustworthy AI is important as an element for achieving both AI utilization and governance. To this end, the company is implementing three initiatives: formulating and disclosing principles, conducting research and development, and improving internal operations.
- With regard to formulating and disclosing principles, in August 2021, the company formulated and disclosed nine principles considered important for the appropriate development and utilization of AI, having referred to the AI R&D Guidelines and AI Utilization Guidelines released by the Ministry of Internal Affairs and Communications.
- With regard to conducting research and development, the company is now researching accountable AI that can demonstrate why decisions are made (for example, how trustworthy AI can express accountability in order to prevent creating black boxes). With regard to security and safety, the company is researching how to detect inappropriate data learning. With regard to privacy, the company is researching how to protect privacy when using AI.
- With regard to accountable AI, the company is currently focusing its research efforts on explaining reasons for decisions to users after the fact. The company is currently engaged in research while using knowledge graphs as features for the reasons that decisions are made.
- With regard to improving internal operations, the company continues to conduct privacy impact assessments (PIAs) on how specifically to put policies into operation and how to protect privacy. In addition to privacy-related efforts, the company will likely begin checking items that require governance within PIAs, such as fairness and non-discrimination, accountability, transparency, and the intervention of human judgment. The company will then begin discussing what to do with regard to areas that cannot be checked.
- KDDI Evolva, Inc. (a group company) has installed existing applications and devices for an AI irrigation and fertilization system in Higashi Matsushima City in Miyagi Prefecture, and is working to support reconstruction and create jobs for the disabled through growing agricultural products. Although the experience and knowledge of growers are important with regard to when and how much to water and fertilize crops, the company is using AI to help people with disabilities establish stable crop cultivation environments without having to rely on agricultural experience. When tasks can be automated with AI, humans can focus on other tasks such as improving quality. The company is trying to improve both yield and quality by determining which tasks are best done by humans or by AI.
- With regard to verifying the use of AI in changing behavior, ethical issues are often involved in researching psychological intervention, and so the company has established an ethics committee to conduct external evaluations during planning stages prior to conducting experiments.
- It is often difficult to make employees aware of rules and principles that have been created. However,



employees working with AI have created a community to hold short talks discussing examples of using AI, and to promote the importance of governance (such as ethical guidelines). The company also conducts e-learning for all employees, and makes use of internal PR to disseminate information.

- Rather than developing AI human resources, the company is engaged in developing DX human resources. One example is that the company is creating courses on personal information protection and AI ethics. The company is promoting initiatives in a balanced manner by making its employees aware of the importance of privacy and AI ethics before engaging in related projects.

KPMG AZSA LLC: Initiatives toward verifying the appropriateness of AI applications

Overview of major initiatives related to AI ethics and governance

Type	Overview
AI model verification	It is important to verify AI models during all processes (from development to implementation, operation, and monitoring) from eight perspectives: fairness, accountability/interpretability, AI model accuracy, security/data protection, traceability/auditability, business continuity, data quality, and governance.
Organization and structure	Established the Digital Assurance Office and the AI Assurance Group (a group of experts in AI evaluation) in September 2021.

● **The need to verify the appropriateness of AI**

- Environmental changes associated with DX in corporate activities
  - As companies move towards DX, AI will be implemented in business and management/compliance processes, and this will ultimately impact society as a whole



- Responding to changing risks
  - Trends such as the European Commission's publication of a comprehensive set of AI regulations, and the development of AI charters by individual companies



● Opportunities to verify the appropriateness of AI

<b>Requests from management</b>	It is necessary to respond to questions from management about fairness, ethics, and interpretability of the developed AI model.
<b>Examples of problems at other companies</b>	Similar AI models are a problem for other companies, so it is necessary to verify whether there are any issues with the company's models.
<b>Compliance with internal and external regulations</b>	As internal and external regulations rapidly develop, internal audit departments must ensure that there are no problems in complying with regulations with regard to the many AI models developed and operated by internal business promotion departments.
<b>Reviews by internal audit departments</b>	Although AI has been developed for business promotion departments, stakeholders such as members of management and supervisory authorities are questioning the need for review by internal audit departments.
<b>Reviews of models developed by vendors</b>	When reviewing vendor-developed AI, it is necessary to enhance current in-house methods that assume traditional model verification.

● Initiatives toward verifying the appropriateness of AI applications (financial industry examples)

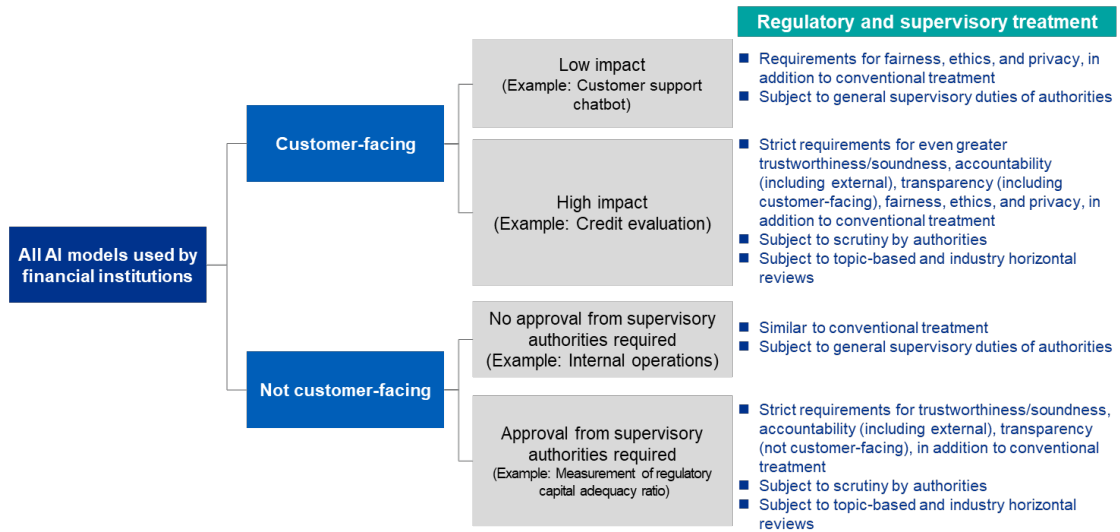
- Bank for International Settlements (BIS) Financial Stability Institute (FSI) report

■ Authorities' expectations related to common AI principles (summary)

Common AI principles	Regulatory expectations of authorities
Trustworthiness Soundness	<ul style="list-style-type: none"> <li>Expectations similar to traditional models (model verification, accuracy criteria, model updates, input data quality, etc.)</li> <li>For AI models, evaluate the trustworthiness and soundness of the results of the model in order to confirm them from the perspective that <b>consumers are not harmed</b></li> </ul>
Accountability	<ul style="list-style-type: none"> <li>Expectations similar to those described in general accountability or governance requirements (but with even more human involvement required)</li> <li>For AI models, <b>accountability also includes "external accountability"</b> to ensure that data subjects (potential and existing customers) provide channels for AI-based results, such as appeals and reexaminations</li> </ul>
Transparency	<ul style="list-style-type: none"> <li>Expectations similar to traditional models. Especially accountability and auditability.</li> <li>For AI models, there is also an expectation for <b>external disclosure</b> to data subjects (for example, the data used to make AI decisions and its impact on decision making)</li> </ul>
<b>Fairness</b>	<ul style="list-style-type: none"> <li><b>Principles emphasized in AI models</b> (although existing regulations cover this, <b>expectations for fairness are not explicitly applied to traditional models</b>)</li> <li>Authorities' expectations for fairness are related to addressing or suppressing bias in AI models that could have discriminatory consequences. "Fairness" is otherwise not generally defined.</li> </ul>
<b>Ethics</b>	<ul style="list-style-type: none"> <li><b>Principles emphasized in AI models</b> (although existing regulations cover this, <b>expectations for ethics are not explicitly applied to traditional models</b>)</li> <li>Authorities' expectations for ethics are more broadly defined than for "fairness" and it is necessary to ensure that customers are not exploited or harmed by bias, discrimination, or other causes (such as AI using illegally obtained information)</li> </ul>

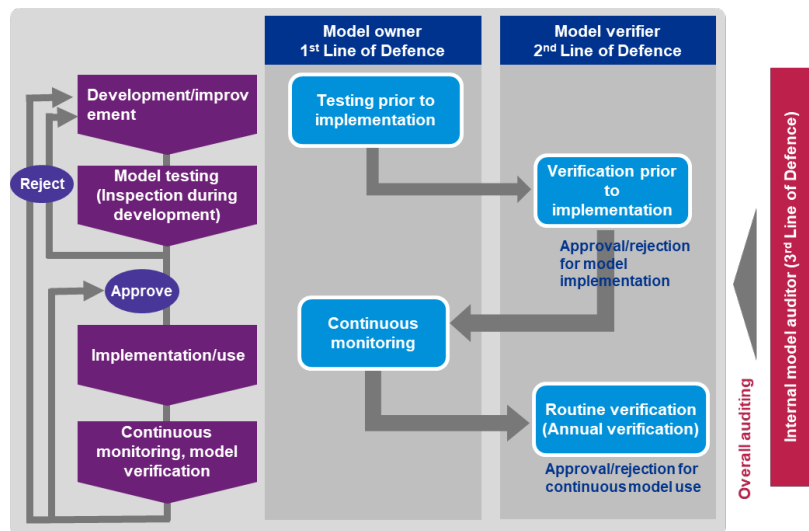
↳ In addition to these five principles, "privacy," "third-party dependency," and "resilience" have been specified, **but with the same expectations as in the traditional model**

■ Regulatory and supervisory frameworks for AI use cases



(Reference) Framework for model risk management in financial institutions

- Model lifecycle
  - Model definition
  - Inventory management
  - Risk assessment, risk rating
  - Model risk appetite setting
- Risk-based approach



- Important points in verifying AI models compared with traditional models\*1 (example)

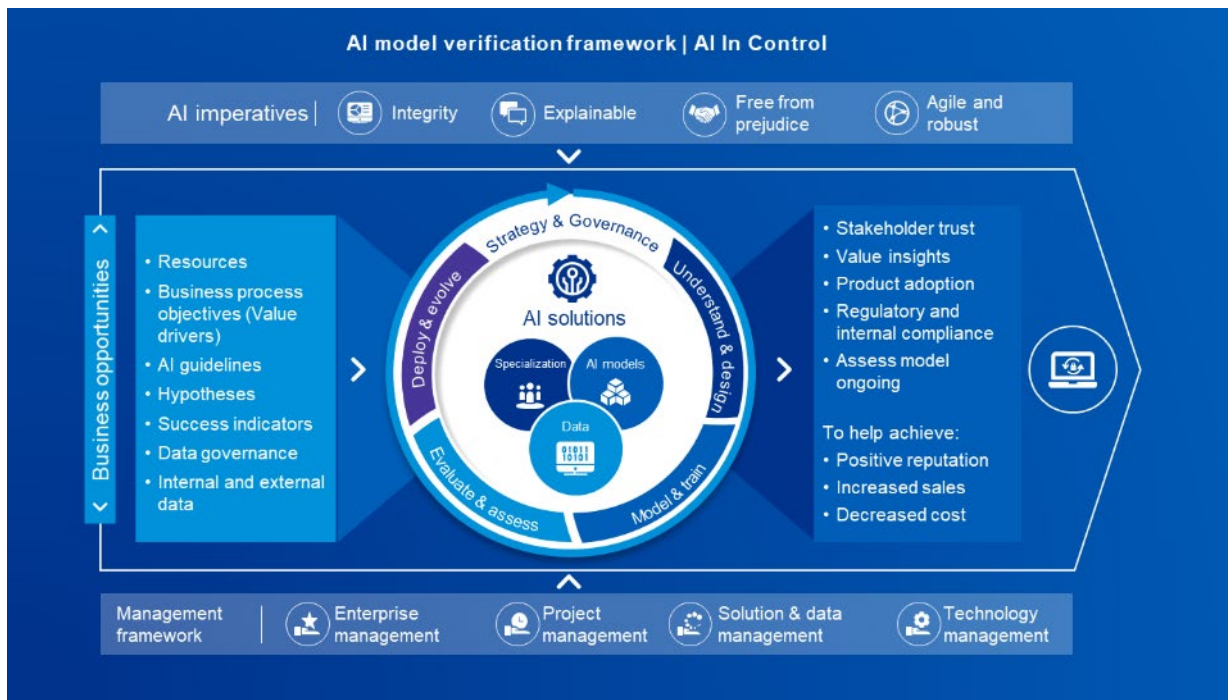
	Characteristics of AI models (comparison with traditional models) [Example]	Important points in verifying AI models [example] <sup>2</sup>
<b>Data</b>	<ul style="list-style-type: none"> <li>■ Use of large amounts of data (large quantity of data and explanatory variable candidates) and various types of data (unstructured data [text, images, etc.])</li> <li>■ Use of open data sources (including information on the Internet) ... etc.</li> </ul>	<ul style="list-style-type: none"> <li>■ <b>Data quality (particularly data bias)</b></li> <li>■ Suitability of the data cleansing process</li> <li>■ Compliance and privacy checks, such as data usage copyrights ... etc.</li> </ul>
<b>Models</b>	<ul style="list-style-type: none"> <li>■ Model development methods are complex (concerns about forming black boxes)</li> <li>■ Model development processes are complex (hyperparameter adjustment, etc.)</li> <li>■ Use of "learned models (including open AI)" (Rights and concerns about forming black boxes)</li> <li>■ Easy to overfit ... etc.</li> </ul>	<ul style="list-style-type: none"> <li>■ <b>Model fairness</b> (whether there is bias, prejudice, or discrimination, and whether there is excessive adaptation to special data, etc.)</li> <li>■ Model interpretability and verifiability</li> <li>■ Generalization of model accuracy</li> <li>■ Appropriateness of model development processes ... etc.</li> </ul>
<b>Implementation/operation</b>	<ul style="list-style-type: none"> <li>■ Model performance is likely to deteriorate</li> <li>■ Frequent relearning (model updates)</li> <li>■ Requires advanced human resources (must understand deep learning, etc.) ... etc.</li> </ul>	<ul style="list-style-type: none"> <li>■ Monitoring of I/O data and models</li> <li>■ Model updates, methods for verifying model updates, and eliminating negative feedback loops</li> <li>■ Ensuring reproducibility (model and data lifecycle management)</li> <li>■ Business continuity (including human resources) ... etc.</li> </ul>

\*1 In this document, "traditional model" refers to a model conventionally used by financial institutions (such as the multiple regression analysis model). "AI model" refers to models (random forest, deep learning model, etc.) that use machine learning and are more complicated than conventional methods.

\*2 Although there are also important points to note with regard to "traditional models", points that must be verified in depth compared to traditional models are summarized here for "AI models".

**Initiative [1]: Verification framework**

- It is important to verify AI models during all processes (from development to implementation, operation, and monitoring) from eight perspectives: fairness, accountability/interpretability, AI model accuracy, security/data protection, traceability/auditability, business continuity, data quality, and governance.
  - Verification framework



o Verification perspectives

**■ Eight perspectives for verifying AI models: Perspectives for verification compiled by KPMG and based on guidance from national authorities**

**1 Fairness**

Attention must be paid to the possibility of bias in AI decisions, and to ensure that individuals and groups are not unfairly discriminated against.

**2 Accountability/interpretability**

Must be able to provide basis (justify) for AI decisions in a form that humans can understand. If AI makes an abnormal judgment, a human must be able to detect it and correct the result.

**3 AI model accuracy**

Results output by AI must be correct (consistent with human expectations).

**4 Security/data protection**

A technical infrastructure must be in place as a measure for security risks such as information leaks and data loss, and the latest security attacks must be monitored using technology. It must also comply with current data protection regulations.

**5 Traceability/auditability**

All inputs and outputs in AI systems must be traceable through log output. The frequency and retention of logs must meet relevant regulation and operational requirements.

**6 Business continuity**

Functions for business continuity such as fallback in the event of a system failure or incident must be established. In the event of a system outage, business must continue using alternative methods.

**7 Data quality**

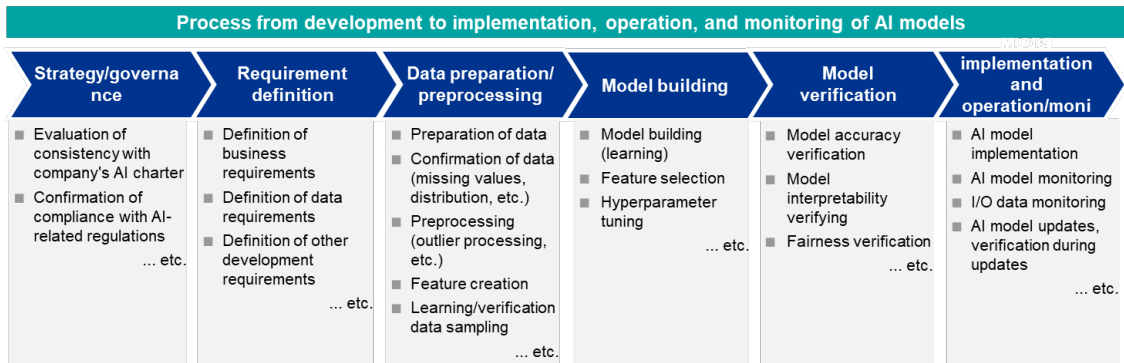
The quality of data input to AI systems must be regularly checked, including review and verification. In light of the characteristics and applications of AI, consideration must be given to suppressing unintended bias during learning, and individuals inputting data must be informed in advance that there is such a risk.

**8 Governance**

In light of the limitations and characteristics of AI, a governance framework that includes criteria for human verification of AI judgment results and criteria for evaluating the propriety of AI judgment results must be established.

o Verification processes

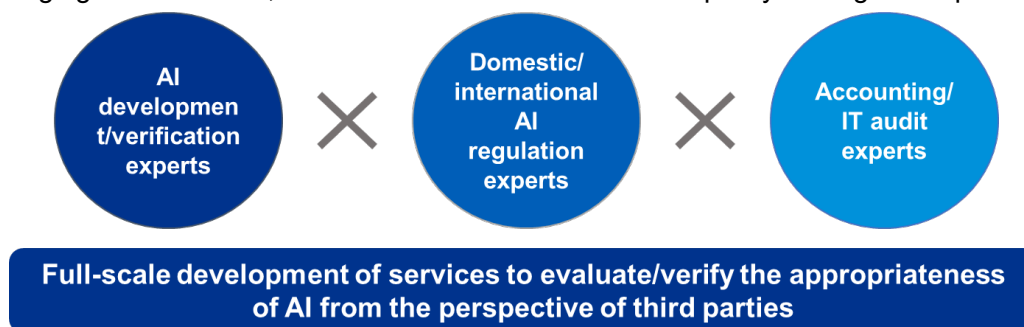
**■ Verification using the eight perspectives for verifying AI models (example)**



**It is essential to examine all aspects from "strategy/governance" to "model implementation and operation/monitoring" based on the eight perspectives for verifying AI models**

## Initiative [2]: Establishment of Digital Assurance Office and AI Assurance Group

- Established the Digital Assurance Office (within its Digital Innovation Division) and the AI Assurance Group (AAG, a group of experts in AI evaluation) in September 2021.
  - In addition to AI development and verification experts, and regulatory and guideline experts, from Japan and overseas, the organizations also include financial and IT audit experts with extensive experience in quality assurance work. The purpose of these organizations is to meet the needs of services to evaluate and verify the effectiveness of governance related to managing the risks of AI, as well as the effectiveness of AI quality management processes.





## ■ Overview of presentations and exchanges of opinions at interviews

- It is important to think carefully about what happens when an AI starts to adjust its parameters autonomously and perform unexpected actions, and the company believes that this perspective is very different from the verification framework traditionally used by audit firms.
- For example, a report published by the Bank for International Settlements (BIS) on case studies in the financial sector summarizes authorities' expectations for common AI principles. There was no focus on "fairness" and "ethics" as assumptions in traditional models. However, given the risks of AI, these are once again being given light and clearly stated in principles.
- The difference between traditional and AI models is in how much data is being handled. In traditional models, data and models could be considered separately. However, these are inseparable in AI models, and an AI autonomously analyzes data in all directions to arrive at optimal solutions. It is therefore necessary to note that the bias and quality of the data can have a large influence. It is also necessary to keep copyright and privacy in mind when using data.
- Traditionally, there has been no need to verify a model that has been created to any large degree, other than minor upgrades. For AI, however, the model continues to transform through continuous learning, and so the way it transforms must be verified with the issue of overfitting (over-learning) kept in mind.
- Since continuous learning is a feature of AI, the company believes that AI model verification requires a framework that includes an audit system for continuously monitoring the AI model, rather than once a year as in traditional audits.
- The AI verification framework would be used to check whether there are any problems with input (such as what AI should be made to do and how to prepare it) or output (such as confirming what AI produces and whether the result is as expected), in light of the elements required for AI (such as accuracy, accountability, elimination of discrimination, and speed/robustness).
- It is important for the management framework to verify not only solution and data management, but also project management (upon which this relies), enterprise management (for the entire business operator), and technology management (as a technical element), in a multi-layered manner.
- The company has defined eight perspectives for verification (fairness, accountability/interpretability, AI model accuracy, security/data protection, traceability/auditability, business continuity, data quality, and governance), but it will be necessary to confirm various elements together.
- The company believes that the eighth perspective (governance in terms of how AI is being created and implemented) is particularly important, and also believes that checking whether there are any discrepancies between what is being developed and what is being operated will carry much weight during verification.
- The verification process would work on multiple levels, starting with strategy and governance, and then proceeding on to requirement definition, data preparation/preprocessing, model building, model verification, and then model implementation and operation/monitoring. However, that does not mean that all of these processes must be performed; instead, areas with a greater focus shall be verified with certain frequency depending on risk sensitivity.

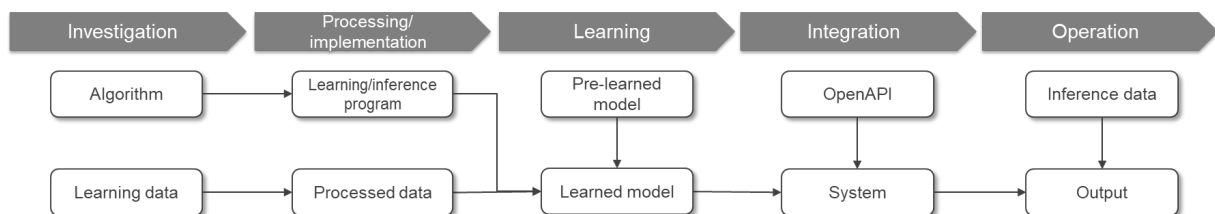
## NTT DATA Corporation: Supply chain risks associated with AI and NTT Data's responses

### Overview of major initiatives related to AI supply chains

Risk factor	Risk details	Response overview
Intellectual property and licensing	Suspension of publication or change in usage conditions	Thoroughly confirm licenses at the start of use and monitor license changes during operation.
	Fees incurred/increased during use	Find alternatives again, and change cost plans.
Privacy	Reuse of learning data and inference data	Check terms of use for any mention of reuse, and include any unintended use in terms of agreement, if anticipated.
Ethics	Use of data collected in legally and ethically questionable ways	Check whether there are any legal or ethical problems with suppliers or procurement methods, depending on the sensitivity of the data handled.
	Inferences lacking fairness	Assess whether parameters related to universal human attributes affect output, and correct if necessary.
Quality	AI accuracy not suitable for usage case	Design and maintain evaluation data suitable for use cases, and verify accuracy in PoC processes.
Security	Possibility of backdoors	Review source code each time.
	Embedded data plagiarism routes	There is no effective means of detection, and decisions are based on the trustworthiness of the provider.

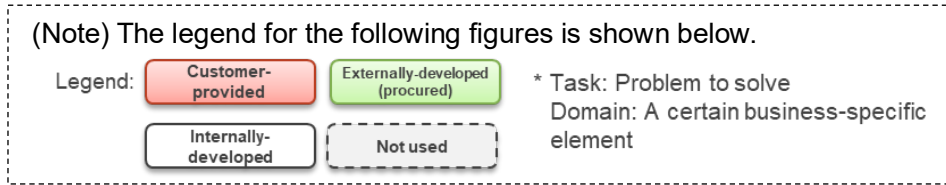
### • Supply chain unique to AI development

- Data and software are intangible and are neither warehoused nor transported, so the risk for these is whether the services, data, and products the user wants can be used when and on the terms and conditions they want, in terms of intellectual property and licensing, privacy, ethics, quality, and security.

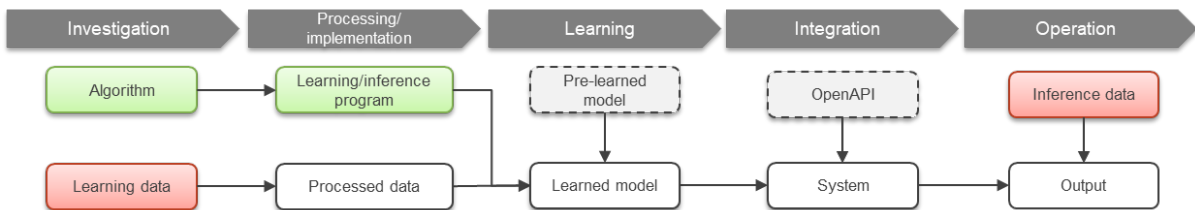


Risk perspective	Risk examples
Intellectual property, licensing	Suspension of publication, suspension of continued use, transition to paid model, business constraints
Privacy	Use of personal information outside of intended purposes, distribution outside specific regions
Ethics	Discrimination, unfairness
Quality	Unable to achieve desired results
Security	Data/model plagiarism, inference tampering, implicit reuse

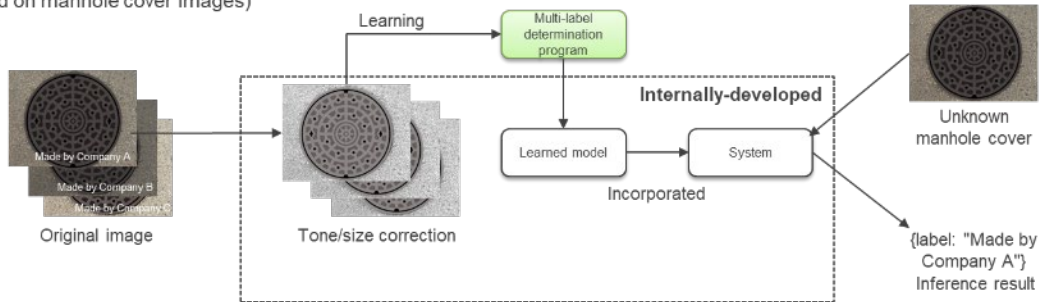
- Each element of the supply chain (such as data and algorithms) can be made internally or externally, but typical patterns are classified into four categories: [1] domestic in-house production, [2] in-house production for global use, [3] large-scale model tuning, and [4] open API utilization.



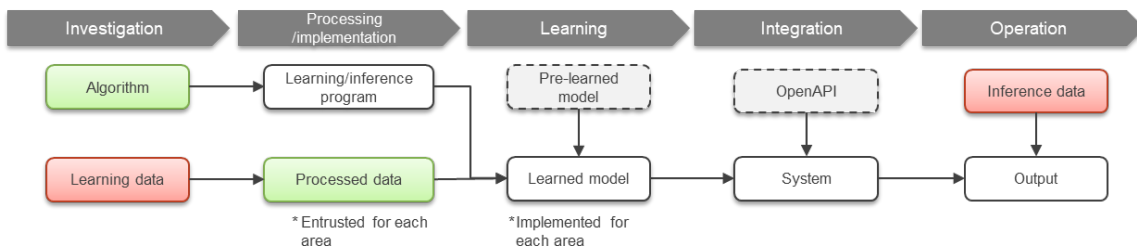
[1] Domestic in-house production: There are no products or data suitable for the task and domain in the market



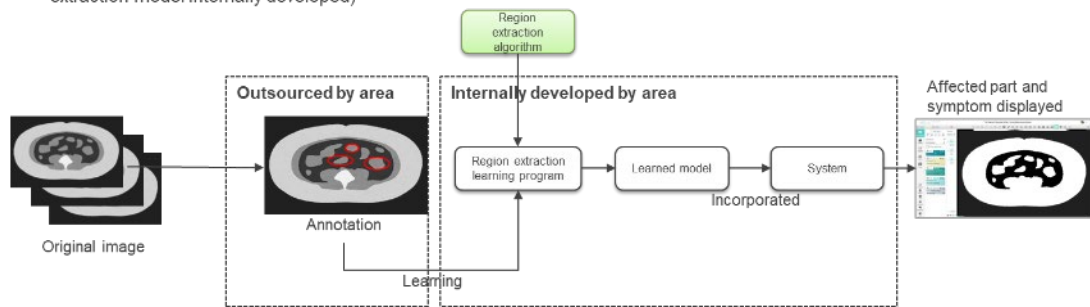
Example: Determining the type of manhole cover (multi-label determination model internally developed, based on manhole cover images)



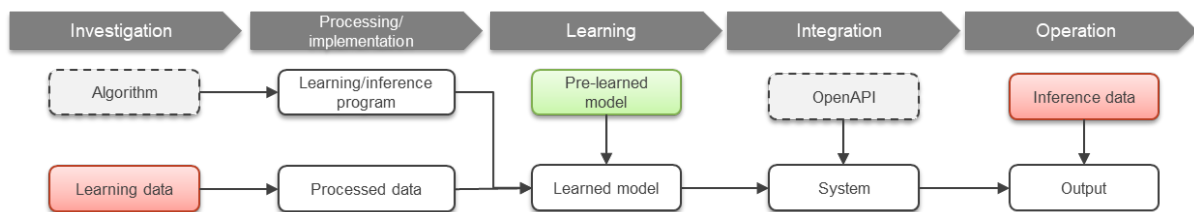
[2] In-house production for global use: There are no products or data suitable for the task/domain in the market, and data in each area must be available within appropriate areas



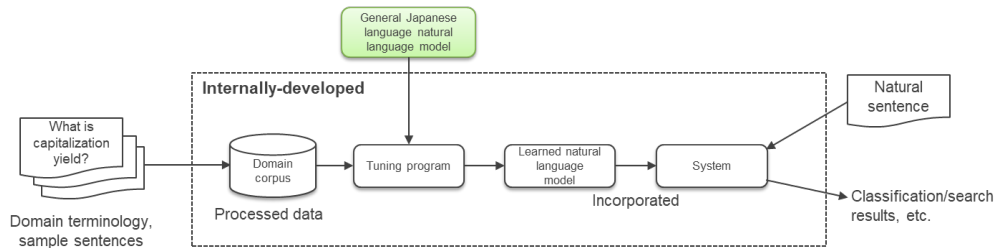
Example: Extraction of affected parts and symptoms from medical images (data processing entrusted closed to each area, region extraction model internally developed)



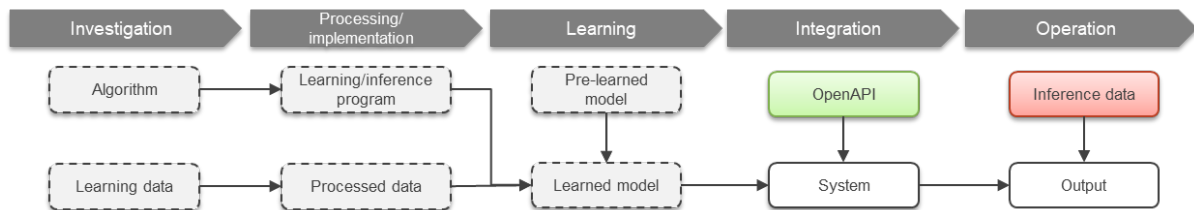
[3] Large-scale model tuning: There are pre-trained models suitable for the task in the market, but there is no data suitable for the domain



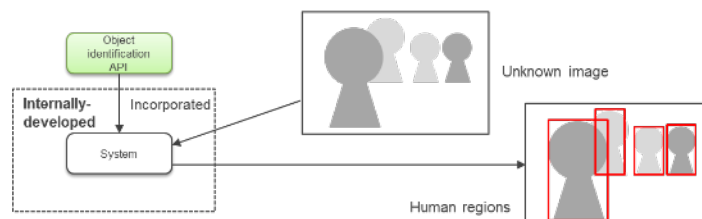
Example: Document classification/searching for industry/business-specific terminology (extension of large-scale natural language model)



[4] Open API utilization: There are products suitable for the task/domain in the market, and require only to be embedded in a system



Example: Extraction of humans from images (using object identification OpenAPI)



## Initiative [1]: Responding to AI supply chain risks

- Summarize risk factors in AI supply chains in terms of risks and responses that may occur when a product is produced (procured) externally.

- Intellectual property and licensing: Risk of license changes

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
<div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">Learning/inference program</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">(Including in advance) Learned model</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px;">OpenAPI</div>	Suspension of publication due to policy of relevant authority, change in usage conditions	Thoroughly confirm licenses at the start of use and monitor license changes during operation (on the assumption that no retroactive change will be made)	
	Commercial fees/charges incurred/increased during use	Research alternative means Change cost plan	

- Privacy and intellectual property: Risk of unintended use

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
<div style="border: 1px solid green; border-radius: 5px; padding: 2px; width: fit-content; margin: auto;">OpenAPI</div>	Learning data and inference data input through an API are reused by the API provider	Check terms of use for any mention of reuse, and include any unintended use in terms of agreement	

- Ethics [1]: Ethical risks in acquiring data

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
<div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">Learning data</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">(Including in advance) Learned model</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px;">OpenAPI</div>	Use of data collected in legally and ethically questionable ways	Check whether there are any legal or ethical problems with suppliers or procurement methods, depending on the sensitivity of the data handled	It would be best to have a third party evaluate and certify the data governance (ethical considerations and compliance measures) of the provider

- Ethics [2]: Equity risk due to data bias

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
<div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">Learning data</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">(Including in advance) Learned model</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px;">OpenAPI</div>	Bias in labels results in inferences that lack fairness	Assess whether parameters related to universal human attributes affect output, and correct if necessary	

- Quality: Risk of model functions and non-functions differing from expectations

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
<div style="border: 1px solid green; border-radius: 5px; padding: 2px; margin-bottom: 2px;">(Including in advance) Learned model</div> <div style="border: 1px solid green; border-radius: 5px; padding: 2px;">OpenAPI</div>	Disclosed processing accuracy does not suit use case	Design and maintain evaluation data suitable for usage case, and verify accuracy in PoC processes	Quality standards for AI are established, and indicators published by each company have been standardized

○ Security [1]: Risk of inference guided through backdoor

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
Learning/inference program	Risk of including <b>backdoor</b> (a process that produces the intended output for a particular input; see next page for details)	Review source code each time	For dominant products, should work toward obtaining certification by official organizations
(Including in advance) Learned model		There is no effective means of detection, and decisions are based on the trustworthiness of the provider	
OpenAPI			

○ Security [2]: Risk of data plagiarism through backdoor

Externally developed	Risk details	NTT Data response (current)	Ideal (proposed)
Learning/inference program	Data plagiarism pathway planted (bypassing unintended pathways)	Review source code each time	For dominant products, should work toward obtaining certification by official organizations

(Reference) Backdoors in AI

- Unlike program code (where processes and communication are visualized), internal processing is unclear in models and APIs, so it is impossible to detect whether these might contain a backdoor.
- > It is not possible to discover backdoor processes that obtain intended inference results using certain input.



## ■ Overview of presentations and exchanges of opinions at interviews

- Data and software (both components of AI) are intangible assets that are neither warehoused nor transported like traditional goods, so the risk in AI supply chains is whether the services, data, and software products the user wants can be used when and on the terms and conditions they want.
- First, the company creates a learning/inference program similar to OSS based on published papers and innovative algorithms, processes data from the field or society (original data), and then creates data for learning (processed data). Next, the company creates a trained model based on the learning/inference program and the processed data, and incorporates it into actual software and systems. Ultimately, the entire AI supply chain would likely operate software and systems to obtain output.
- Within such a process, risks related to intellectual property and licensing, risks related to data privacy, ethical risks such as data bias (for example, whether biased data is used), risks related to quality such as whether the expected benefits are obtained, and risks related to security such as data leaks and unintended output results (leading to inferences) would be considered risk factors in AI supply chains.
- There will likely be four typical patterns used in AI supply chains: domestic in-house production, in-house production for global use, large-scale model tuning, and open API utilization. The company summarized risks at points within each pattern where elements are procured externally.
- With regard to intellectual property and licenses, there is a risk that they may become unusable due to changes in provision or disclosure policies, or that additional fees may be required due to a change in pricing policy, even if a product was previously available for free.
- With regard to privacy and intellectual property, there is a risk that products may be used for purposes other than the intended purposes, and that data provided through APIs may be reused. For this, it is important to carefully check the terms of use.
- With regard to ethics, there is a risk regarding whether data is obtained legally and ethically. For this, it is important to check whether there are any problems with individual suppliers and procurement specifications according to the sensitivity of the data being handled. The company also believes that establishing a mechanism for obtaining third-party endorsements of the provider's data governance concept and methods could allow for data to be used with peace of mind.

There is also a risk of data bias, as bias in labels can lead AI to make inferences lacking fairness. For this, it is important to determine the extent to which parameters related to universal human attributes (such as gender) affect output.

- With respect to quality, there is a risk regarding whether the accuracy of an externally procured product matches the required task. For this, there is currently no choice but to verify accuracy using a PoC based on the task. However, it would be preferable to establish AI quality standards to achieve certain guidelines.
- With regard to security, there is a risk of products containing backdoors as there is no way of knowing what was used as a base for creating models and programs procured externally. For this, there is no choice but to check source code and make judgments based on the trustworthiness of the provider. The company believes that conducting thorough legal investigations/reviews would be a realistic approach for companies to take.

There is also a risk of data being stolen through backdoors. For this, the company believes some kind of public endorsement of dominant components or products would bring peace of mind to users.

## FUJITSU LIMITED: Fujitsu’s AI supply chain initiatives

### Overview of major initiatives related to AI ethics and governance

Type	Overview
Organization and structure	The AI Ethics and Governance Office was established in February 2022 as an organization directly under the company president to further strengthen company-wide and comprehensive efforts related to AI ethics and governance.
Cooperation and collaboration with external parties	Promote and strengthen domestic and overseas cooperation in the field of AI.

### Overview of major initiatives related to AI supply chains

Initiative	Overview
Contractual measures	
Distribution of algorithms	Represent and warrant the legitimate authority, etc. of data collectors in contracts, and conduct audits as necessary. Present technical limitations and ethical issues of AI, and respond in cooperation with users.
Distribution of data	
AI supply chain examples	
Provision of AI components	Automatically and accurately analyze mass spectrometer measurement data.
Provision of AI services	Begin using AI translation services.
Provision of AI algorithms	Automatically optimize nursery school admissions.

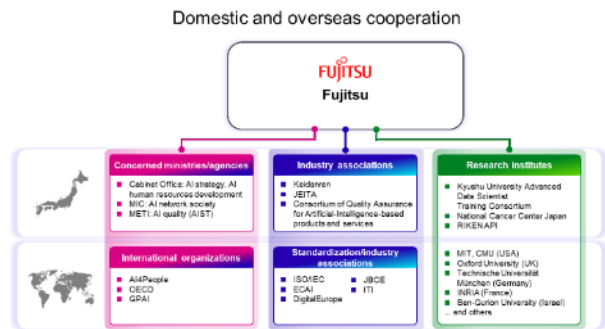
Challenge	Response
Ensuring quality when using AI	
Obsolete AI models (reduced accuracy)	Accuracy must be monitored through periodic labeling.
Reduced accuracy or overlooked abnormal conditions	Track change trends in input data, and automatically estimate AI accuracy.
Frequent maintenance required to maintain high accuracy	Prevent reduced accuracy by not additional labeling existing models.
Enormous cost of retraining	Reduce amount of data requiring relabeling through automatic label estimation.

#### **Initiative [1]: Establishment of AI Ethics and Governance Office**

- The AI Ethics and Governance Office was established as an organization directly under the company president to further strengthen company-wide and comprehensive efforts related to AI ethics and governance (February 2022).

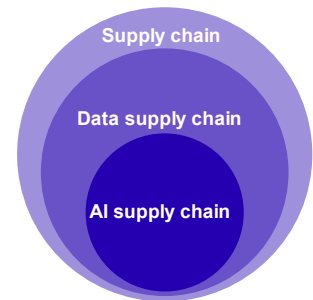
## Initiative [2]: Cooperation and collaboration with external parties

- Promote and strengthen cooperation with relevant ministries, international organizations, industrial groups, and standardization organizations throughout the world.



### AI supply chains

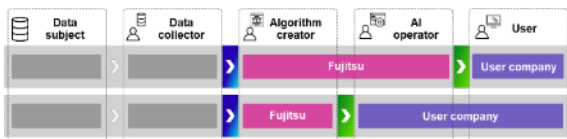
- An AI supply chain is a data supply chain with elements to enable AI
  - Emulates existing supply chain and data supply chain laws, guidelines, standards, and technologies
  - Unique elements of AI supply chains: Supply chain patterns include AI, technologies are unique to AI supply chains



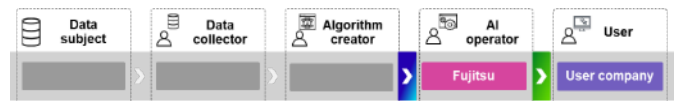
### - Typical AI supply chain patterns

- Pattern [1] (distribution of algorithms)

<Company provides AI algorithm to another company>

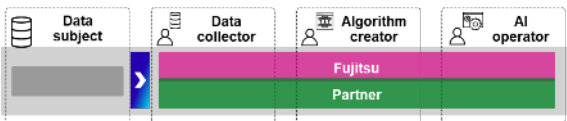


<Company purchases AI algorithm from another company>



- Pattern [2] (distribution of data)

<Joint research>

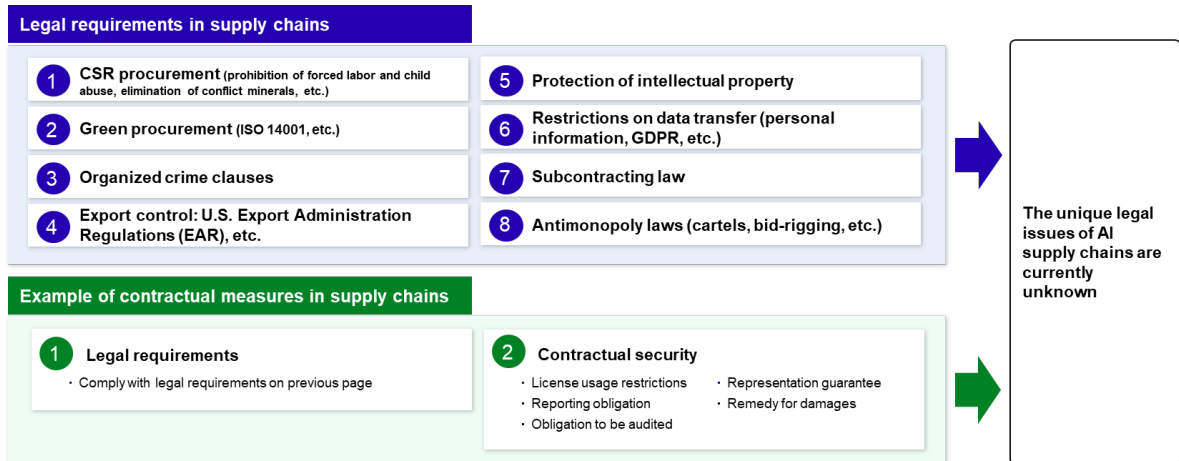


<Data purchased and resold to users>



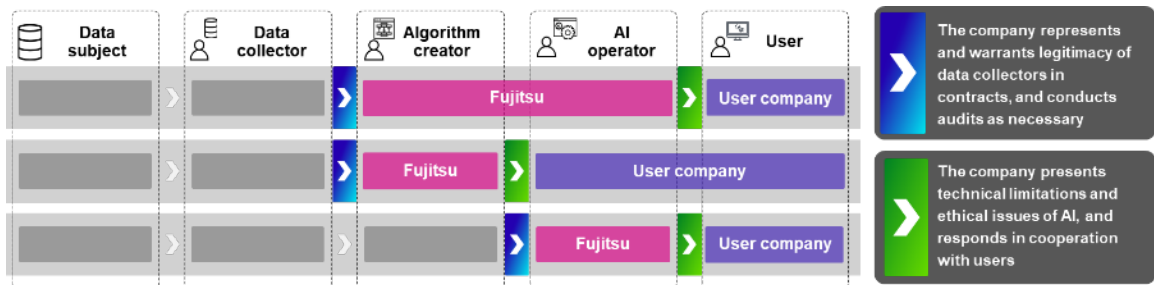
● AI supply chain laws and contracts

- A supply chain for AI must still follow existing legal systems



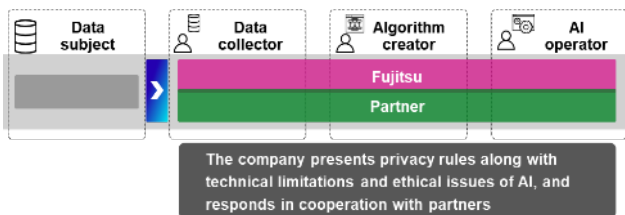
- Contractual measures

➢ Pattern [1] (distribution of algorithms)

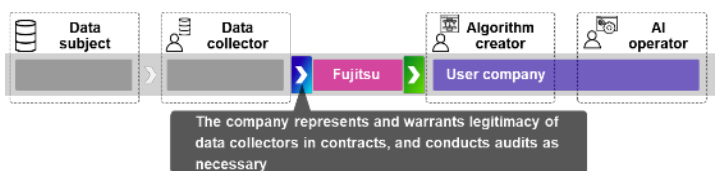


➢ Pattern [2] (distribution of data)

<Joint research>

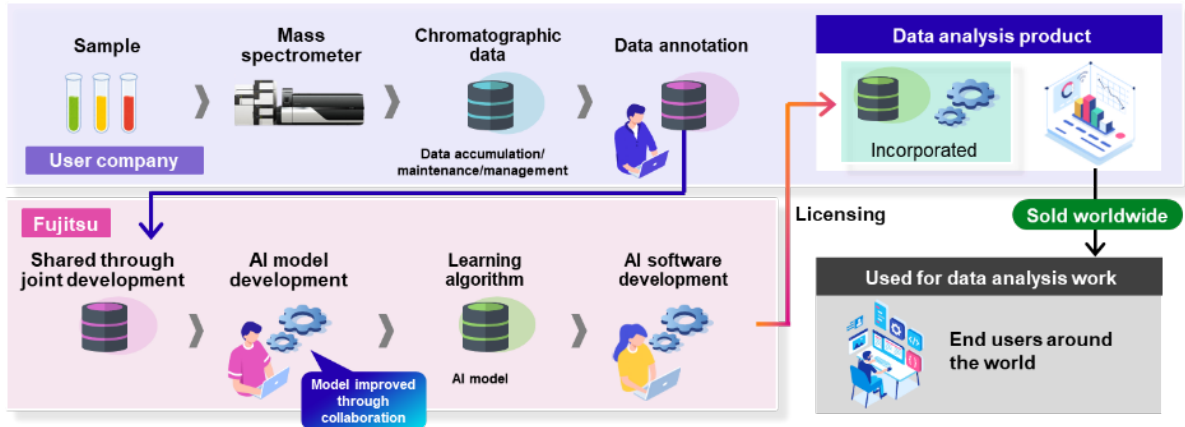
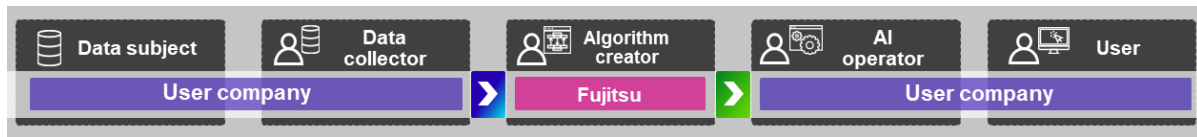


<Data purchased and resold to users>



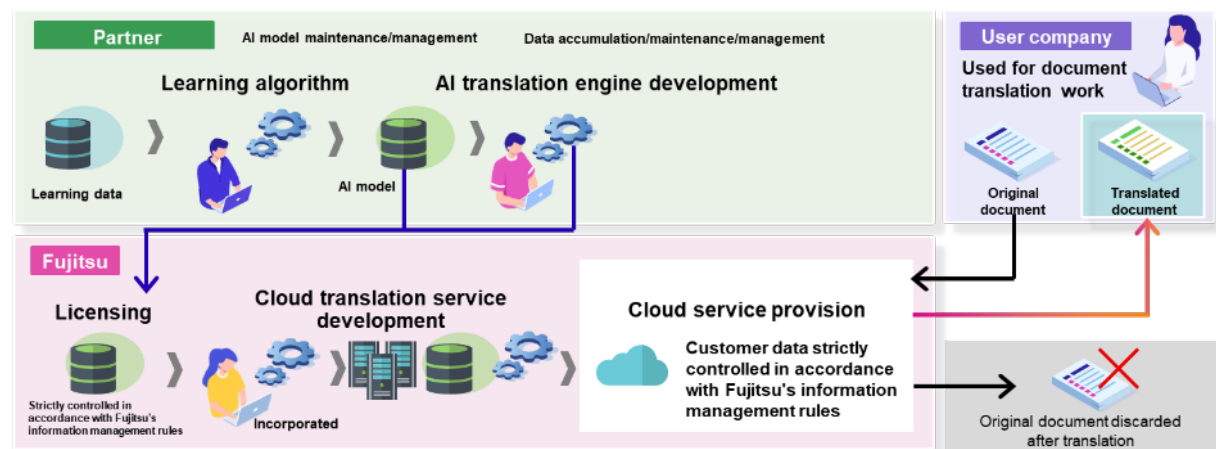
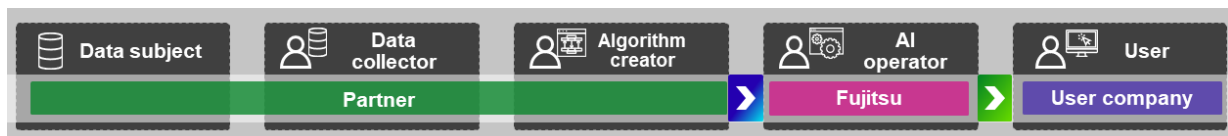
## Initiative [1]: AI supply chain examples

- Provision of AI components: Automatically and accurately analyze mass spectrometer measurement data.



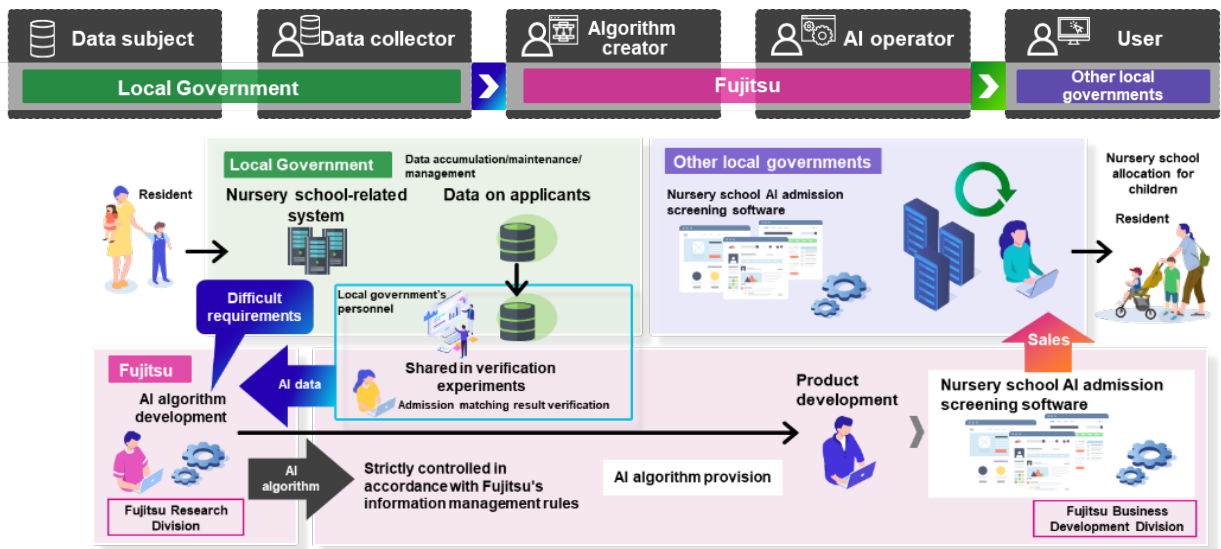
Issues, technologies, results	AI supply chain
<p><b>Issue:</b> It takes time to analyze measurement results obtained from measuring instruments Analysis accuracy varies between workers</p> <p><b>Technology:</b> Perform analysis at the same level as an expert, by training the AI with analysis results from experts AI automatically optimizes parameter adjustments that workers would make in conventional algorithms</p> <p><b>Result:</b> Time required to perform work is reduced to about 1/3rd compared with conventional algorithms, and analysis can be performed even by non-experts with no variation between individuals</p>	<p><b>Data perspective</b></p> <ul style="list-style-type: none"> <li>· User company collects data for the development of this product.</li> <li>· Performs procedure up to annotating data for AI development</li> <li>· Shares data with Fujitsu under joint research and development agreements</li> </ul> <p><b>System development perspective</b></p> <ul style="list-style-type: none"> <li>· Fujitsu develops AI model using User company's data</li> <li>· Fujitsu develops AI software incorporating this model and provides it to User company</li> <li>· User company develops data analysis software incorporating Fujitsu AI</li> </ul> <p><b>Provision of AI software and AI models to end users</b></p> <ul style="list-style-type: none"> <li>· User company sells data analysis software worldwide</li> <li>· For customers requiring a custom response, a separate custom AI model is built and offered as a separate option for the product</li> </ul>

- Provision of AI services : Begin using AI translation services.



Issues, technologies, results		AI supply chain	
Issue:	Due to an increase in the number of foreign students and overseas partner schools, there is a growing number of signs and agreements to translate. Issues include increased workload and translation quality problems.	<b>Data perspective</b>	<ul style="list-style-type: none"> <li>The partner uses learning data during product development</li> <li>End users upload files to translate to Fujitsu's cloud service</li> <li>End users download the translated data</li> <li>Once translation is completed, data uploaded by end users and translation results are deleted</li> </ul>
Technology:	High-precision translation using a neural machine translation engine* (Japanese to/from English, Japanese to/from Chinese). Files are translated without requiring preparation (PowerPoint, Word, Excel, PDF). Efficient verification of translation accuracy using reverse translation function.	<b>System development perspective</b>	<ul style="list-style-type: none"> <li>Fujitsu provides its own services incorporating the partner's services.</li> <li>Translation quality is guaranteed by the partner</li> </ul>
Result:	Reduced translation workload and improved translation quality. Around 800 nouns and technical terms unique to Meiji University registered in dictionary to standardize expressions.	<b>Provision of AI software and AI models to end users</b>	<ul style="list-style-type: none"> <li>End users only use this as a cloud service, and are not directly exposed to AI software or AI models</li> </ul>

■ Provision of AI algorithms: Automatically optimize nursery school admissions.



Issues, technologies, results		AI supply chain	
Issue:	Time is required to perform allocation in a way that meets diverse needs, such as wanting to keep siblings at the same nursery school, or avoiding situations where only one sibling can be admitted.	<b>Data perspective</b>	<ul style="list-style-type: none"> <li>In order to verify the effectiveness of this algorithm, share data with the local government for the purpose of conducting verification experiments</li> <li>The solution uses a mathematical optimization AI algorithm (instead of a statistical machine learning AI), so it contains no models built from resident data</li> </ul>
Technology:	Unique matching technology based on game theory realizes allocation that meets applicants' needs to the maximum extent possible.	<b>System development perspective</b>	<ul style="list-style-type: none"> <li>Algorithms whose effectiveness was confirmed through verification experiments are transferred from the Research Division to the Business Development Division</li> <li>The Business Development Division incorporates the algorithm concerned into the product.</li> <li>It then develops and provides logic to meet the difficult requirements of the local government (ensuring fairness, protecting privacy, etc.)</li> </ul>
Result:	Able to finish allocation work that would normally take 20 to 30 people days to complete, in only a few seconds.	<b>Provision of AI software and AI models to end users</b>	<ul style="list-style-type: none"> <li>Fujitsu sells nursery school AI admission screening software containing AI functionality to the local government</li> <li>The local government personnel use the software to derive admission screening results based on the diverse wishes of applicants (for example, keeping siblings at the same school, or prioritizing the admission of the older sibling)</li> </ul>

- (Future vision) Unique AI supply chain elements
  - AI-specific audits will be required for elements involving the boundaries between each stakeholder
  - The role of AI operators will become important, as changes during operation will become an issue
  - Handling of lifecycles (iterative processes) will become important (for example, whether a contract allows for data to be reacquired)

● Quality assurance issues during AI operation

Issue	Response
Obsolete of AI models due to trends in input data during operation and changes in external environments (reduced model accuracy)	Accuracy must be monitored through periodic labeling
Reduced accuracy or overlooked abnormal conditions	Track change trends in input data, and automatically estimate AI accuracy (accuracy monitoring)
Frequent maintenance required to maintain high accuracy	Prevent reduced accuracy by not additional labeling existing models (automatic restoration)
Enormous cost of retraining	Reduce amount of data requiring relabeling through automatic label estimation (relearning support)

## ■ Overview of presentations and exchanges of opinions at interviews

- In order to promote AI ethics, the company believes that it is important to follow its own rules appropriately and to engage in continuous efforts to disseminate AI ethics both inside and outside the company. Toward that end, the company established its "AI Ethics and Governance Office" directly under the company president, in February 2022.
- It is difficult for a single business operator to act independently with regard to AI, and it is important to collaborate with a large number of stakeholders. The company sees AI supply chains as similar to conventional supply chains, just with added unique elements to enable AI.
- The company believes that discussions of AI supply chain practices can be limited to those typical of major transactions. With regard to the distribution of algorithms, there are cases where the company provides these to other companies, and cases where the company receives these from other companies. With regard to the distribution of data, in most cases data is prepared by the company's users or joint research partners. In some cases, the company purchases data and resells it to other companies, but this is rare.
- Legal requirements in AI supply chains are mostly the same as those in conventional supply chains. The company is not currently aware of any special legal requirements required for AI, due to the limited nature of transaction patterns. With regard to contractual measures, if the data subject is an individual, procedures such as obtaining consent are already being carried out within existing frameworks. However, technical limitations and ethical issues must be addressed jointly with users. When the company obtains data from data collectors, it guarantees the data by representing and warranting the legitimate authority, etc. of the data collectors in contracts, and conducting audits as necessary.
- As an example of the company providing an algorithm to another company (automatic analysis of measurement data), the user company collects and annotates data, shares this data with the company based on a joint research contract, and then the company develops an AI model. From a system development perspective, the company uses data from the user company to develop an AI model and AI software with this model embedded, and then provides a license to the user company. The user company develops software with the provided AI software embedded, and then sells this to its end users.
- As an example of the company receiving an algorithm provided by another company and using it to provide a service (translation service) to other users, during the product development stage the partner company uses its own data (which cannot be accessed by the company), and end users of the service upload files to the company's cloud and download the created translations, after which the uploaded data and translations are deleted. From a system development perspective, the company provides its own service incorporating the service of a partner company, with quality guaranteed by the partner company.
- As an example of the company developing an algorithm (for nursery school admissions) and providing it to other parties (local governments), data is shared in order to verify the algorithm and its effectiveness during verification experiments. However, the model does not incorporate resident data because it uses a mathematical optimization algorithm rather than a machine learning algorithm. From a system development perspective, the company transfers algorithms (with effectiveness verified during verification experiments) from the Research Division to the Business Division, and sells the software with embedded AI functionality for use by the end user.



- The company believes that it is important to apply technology in addressing challenges unique to AI supply chains. As for issues such as reduced accuracy, the operator has an important role in performing monitoring and correction, and this requires supporting technology. For example, the company is developing technology related to quality assurance in order to help prevent performance degradation during operation. The company believes that applying this technology throughout the supply chain will be a step toward resolving the unique challenges of AI.

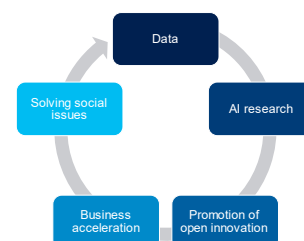
## AI Data Consortium (AIDC): Data use, issues, and initiatives

Overview of major initiatives related to AI supply chains

Initiative	Overview
Importance of taking responsibility	It is necessary to respond to issues such as changes in the value of data, the increasing complexity of data transactions and contracts, the increasing complexity of sales channels and rights, and the increasing importance of responsibility in software development, by promoting the use of AI.
Data and intellectual property	It is important to remain aware of intellectual property rights protected by laws and regulations (Copyright Act and Unfair Competition Prevention Act), and to protect one's own rights with contracts.
Construction of a data distribution platform	In March 2022, the organization established a data distribution platform called "AIDC Data Cloud", and developed data transaction mechanisms (contract templates for various sales channels, data catalogs for historical information, and flexible billing models [duration-based, one-time, volume, and revenue sharing]).

### ● Issues surrounding AI and data

- There are many issues to resolve with AI research, open innovation, and solution development (commercialization), including fragmented data providers, different licensing concepts, personal information, and linking with computational resources
  - Standardize contract processes for providing and utilizing data and establish a foundation for sharing data
  - Develop data utilization models that take personal information and privacy into consideration
  - Develop a sustainable data utilization foundation by developing diverse data stores and data business transactions



=> Promote solutions to social issues through trouble-free data distribution

- Help solve social issues with AI
  - Link AI research with efforts to solve social issues by providing various kinds of data and establishing a foundation for sharing data

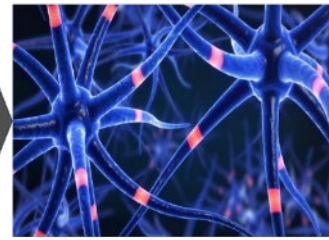
**Example: Improving communication between people with disabilities and people without**



There is no automatic speech recognition (ASR) engine that can recognize the speech of people with cerebral palsy or hearing impairment



Many supporters feel that the speech of people with speech difficulties has something in common.



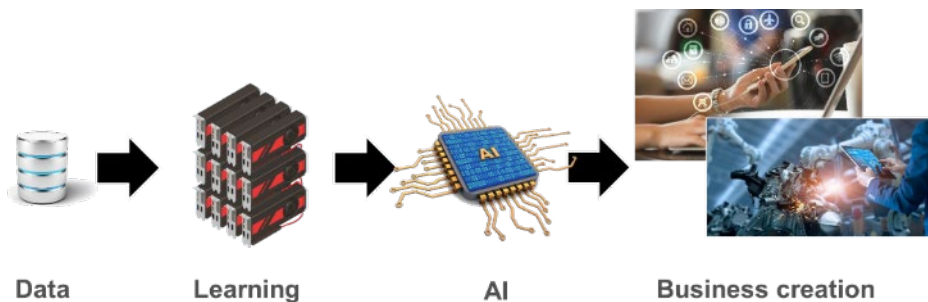
The goal is to collect conversation data and use the latest AI research to support the communication and social participation of disabled persons with speech difficulties

• Collaborative partners/observers

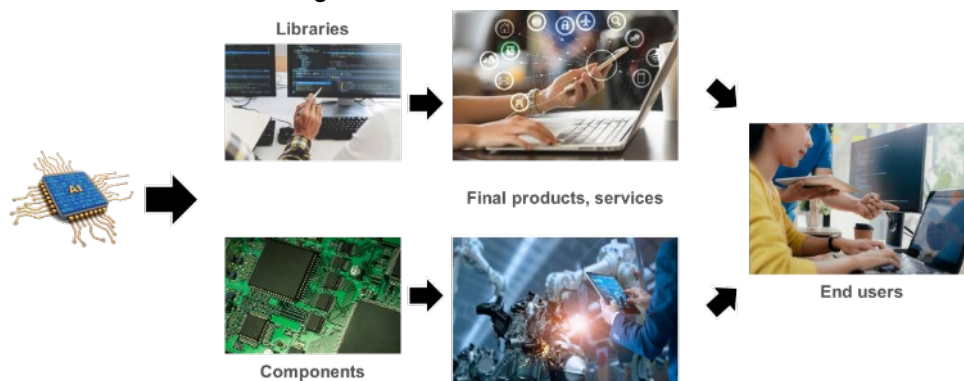


• Increased importance of taking responsibility: Data, responsibility, and intellectual property

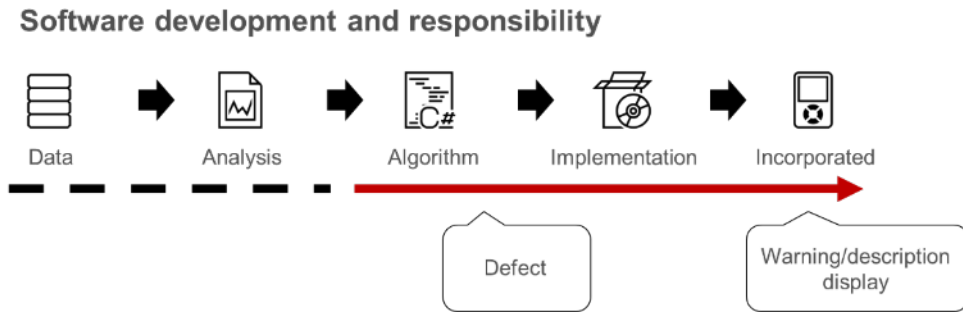
- Data sales contracts changed by AI (data transactions and contracts becoming more complicated due to the value of data being changed through business use of AI)



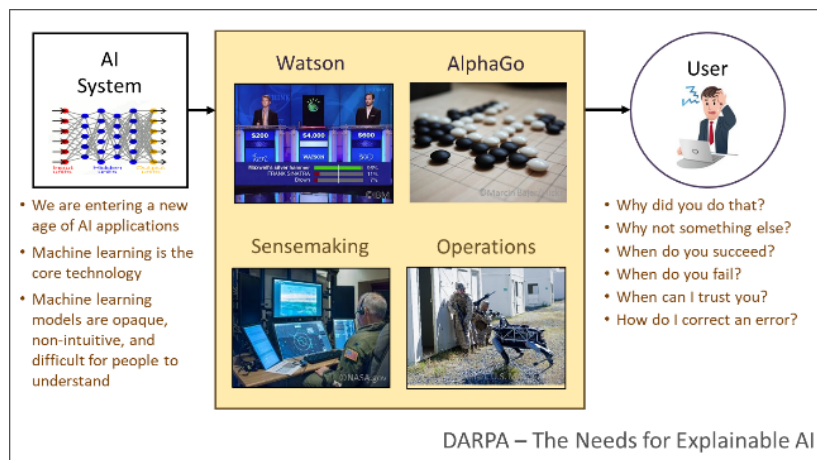
- Complex sales channels and rights



- Clear products and responsibilities



- AI business utilization and accountability



- Data history management changed by AI
  - Work history requiring traceability
  - Annotations due to errors and malice, which are difficult to eliminate

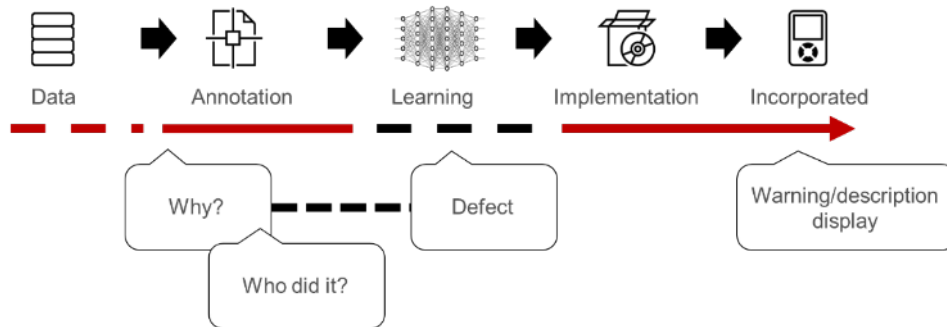


Worker **identification** and **assurance** is becoming increasingly important





- Responsibility required for data changed by AI

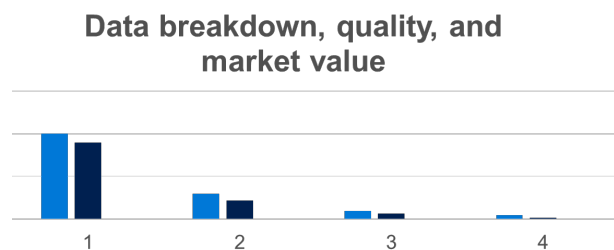
### Responsibility and systems using AI



- AI utilization, assurance, and data
  - Assurance levels required for data that varies by application

Level 1	Level 2	Level 3
		
The impact of using AI can be surmised, and it is allowable only for users.	The impact of using AI can be surmised, and it can be compensated for or recovered.	The use of AI may impact health or social rights, or it is difficult to compensate for or recover.

- Value evaluation of data changed by AI
  - Value that changes over time
  - Value that differs by distribution



- Data and intellectual property
  - Important points for AI vendors and engineers to keep in mind
    - For data provided on platforms, if the data is categorized as a "database" as defined under the Copyright Act or as "shared data with limited access" under the Unfair Competition Prevention Act, then the intellectual property rights exist in the provided data
    - Protection method other than legal protection
      - ✓ It is important to protect one's own rights by establishing rules on rights and obligations in contracts
      - ✓ It is important to distribute annotation and cleansing data based on certain rules, on certain trusted platforms

**Initiative [1]: Construction of a data distribution platform**

- Controlling the use of external data is becoming increasingly important. In response, the organization established a data distribution platform called "AIDC Data Cloud" in order to develop data transaction mechanisms that assume the use of AI (March 2022).
  - Control of external data utilization becoming increasingly important



- "AIDC Data Cloud" data distribution platform



Framework for data transactions assuming required AI use



**Data sales contracts that differ by sales channel**



**History and assurance required for data**



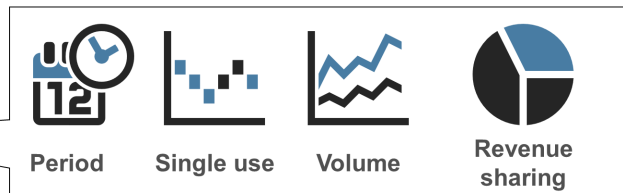
**Value of data varies by time and breakdown**

Data distribution realizing "AIDC DataCloud"

 **Contract templates for various sales channels**

 **Data catalogs for history information**

 **Flexible billing model**





## ■ Overview of presentations and exchanges of opinions at interviews

- Outside of Japan, an extremely high amount of data is being distributed, and solutions are being provided to solve social issues in various areas. However, this is not the case in Japan, where progress has yet to be made in the distribution and utilization of data. The organization is working to solve social issues by utilizing data and AI.

For example, it can be difficult for people other than supporters to understand what is being said by individuals with cerebral palsy or hearing impairment. The organization is interested in using AI to solve such issues, under the assumption that there must be some common points or correlations.

- The organization is engaged in work related to research on intellectual property and AI, data collection, and the construction of a data platform, and is promoting these initiatives in cooperation with various universities, research institutes, and government organizations.
- Traditionally, transactions have been based on the assumption that data is simply consumed. However, with AI and machine learning, models trained using data are incorporated into components, libraries, and services, etc., which are then included in solutions to create new businesses. How data is distributed and the value of data are therefore likely to change from assumed patterns as more organizations make use of AI and machine learning.
- There are various sales channels for technology patents, such as introducing a particular technology into a component or library for use in a final product, or selling this to another manufacturer for use in a final product. The contract process would become very complicated in such cases, depending on conditions such as the unit price of the final product and the number of units sold. Sales channels and contracts for data assumed for use in AI and machine learning have characteristics similar to those of technology patents, and so they face similar issues. However, there is no appropriate contract model in this area.
- Product responsibilities are similar to those for software in some respects. However, unlike with software, the issue of model accountability has yet to be solved for AI and machine learning.
- Biases in the quality of AI and machine learning are often caused by data. However, if data annotation (labelling) is outsourced, one cannot rule out the possibility of a malicious operator. The organization has examined how to take responsibility and how data transaction contracts should be written, if such an issue should occur.
- With regard to data distribution, the value of data often changes depending on the degree of data bias and the passage of time. For example, natural language processing requires dialect data and data on the elderly, on a daily basis. However, this data is difficult to obtain, and is therefore valuable in the data distribution market.
- Data is generally subject to general controls in information systems. However, as more organizations begin applying AI and machine learning solutions, it will become important to ensure control and accountability.
- There is a need for a data distribution transaction platform to meet these needs, and the organization has been promoted initiatives to build a platform for data transactions and contracts. In March 2022, the organization built a platform for data transactions (AIDC Data Cloud) and began providing services. There is a wide variety of usage cases with respect to contracts and billing models, so the organization is currently working with others to implement mechanisms for tasks such as creating dynamic contract templates. The data platform can also be used to what was used as a basis for labelling data, as well as the historical trail of development data.