Connected Industries Open Framework for manufacturing industry

utilizing Edge-AI + local-5G in Japan

Date: Sept 22nd, 2021

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Industrial Value Chain Initiative, Japan
Chair of Sensor-data Utilization Technology
for Data Distribution ASG

Agenda

1.Introduction to IVI &CIOF

2. Edge-AI Use Cases
・What’s Edge-AI ＆ Trend

3. Data flow between CIOF
（Edge-AI&local-5G PoC Use Cases）

4. Wrap up

＊CIOF：Connected Industries Open Framework

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IVI: Japan's Initiative in Smart Manufacturing

- **History:** Established in June 2015 mainly by 53 Japanese manufactures initiated by METI and JSME-MSD
- **President:** Prof. Yasuyuki NISHIOKA Hosei Univ., Japan
- **Committees:** General Planning & Strategy Business Cooperation Platform
  IP management and Diffusion (Promotion)
- **Members:** more than 700 members (as of April. 2020) from Corporate (Enterprises, SMEs) and Academia

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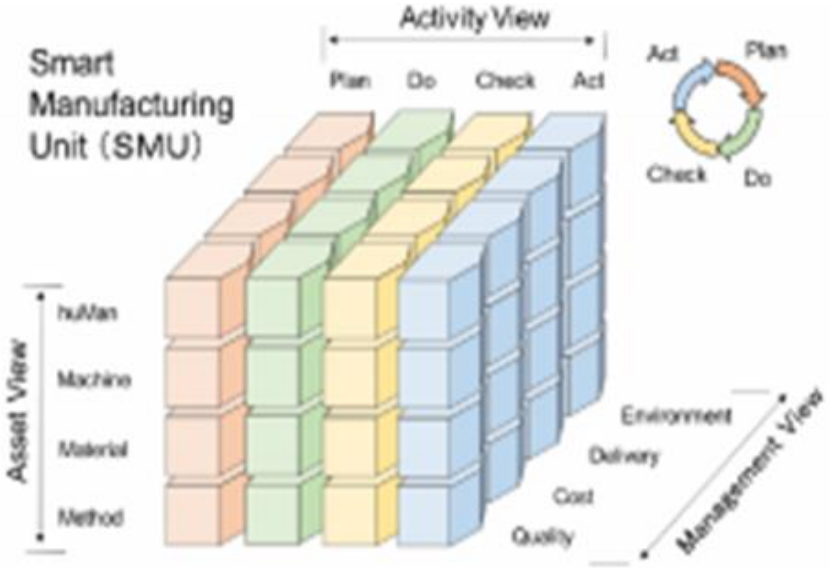
Indutrial Value Chain Initiative

Established in June 2015
262 companies, 758 members
(in March 2021)

https://iv-i.org/

VISION & MISSION

We will design a decentralized and bottom-up value formation mechanism centered on the manufacturing site, and provide a place for individual companies to collaborate across countries and regions in order to realize connected manufacturing.



Source: IVI Reference Architecture (2017)

Sustainable and inclusive production is available by

- bottom-up and human-centered approach by **smart thinking**
- knowledge sharing and cooperation on **loose standards**
- **data sovereignty** of factories in trustworthy networks

The IVI reference architecture released in 2017 is referenced by international standards such as ISO / IEC.

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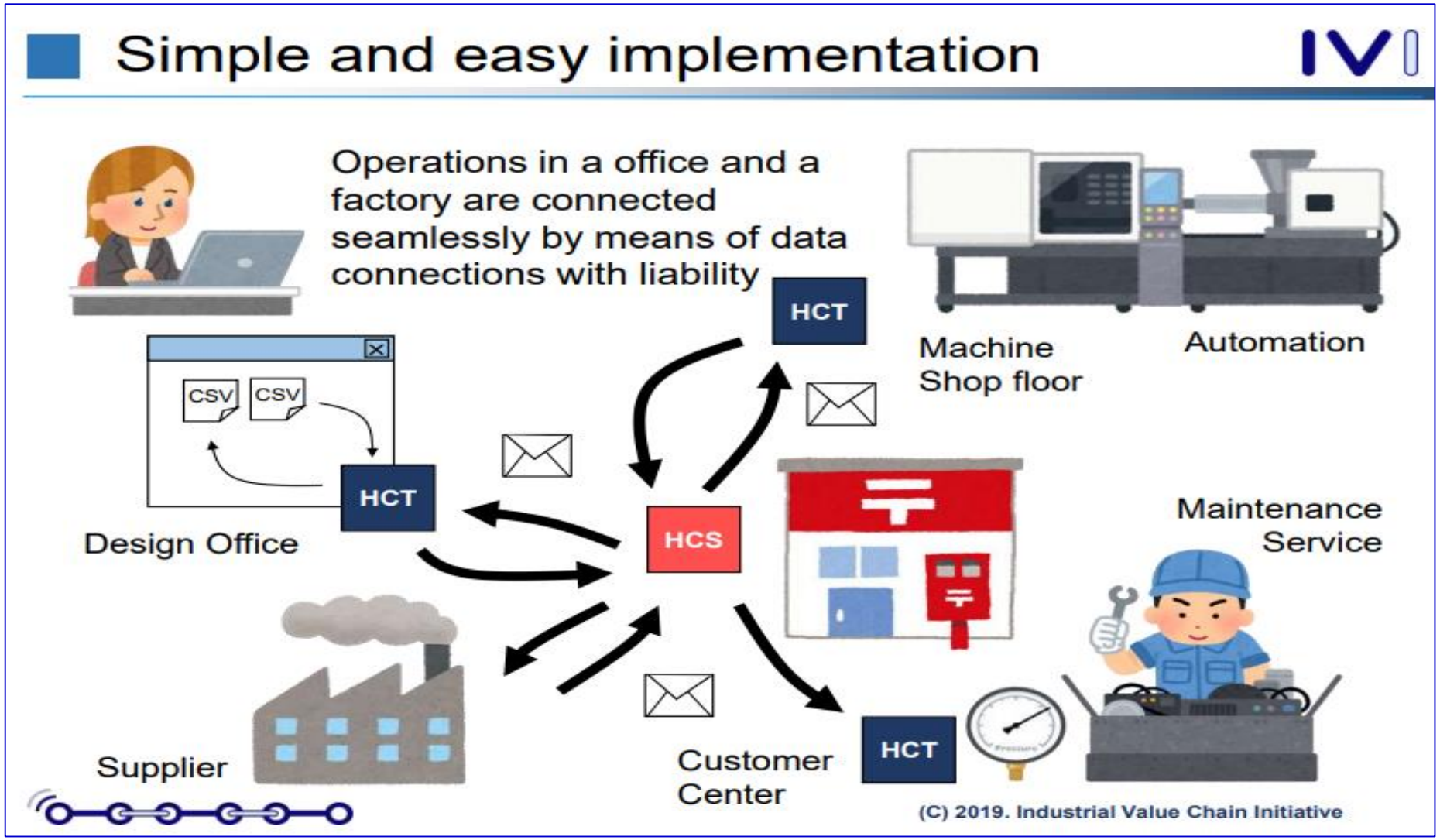
The concept of CIOF (As a review)



Excerpt from the presentation material of IVI evangelist Ms. Koroku of 2020 GIO

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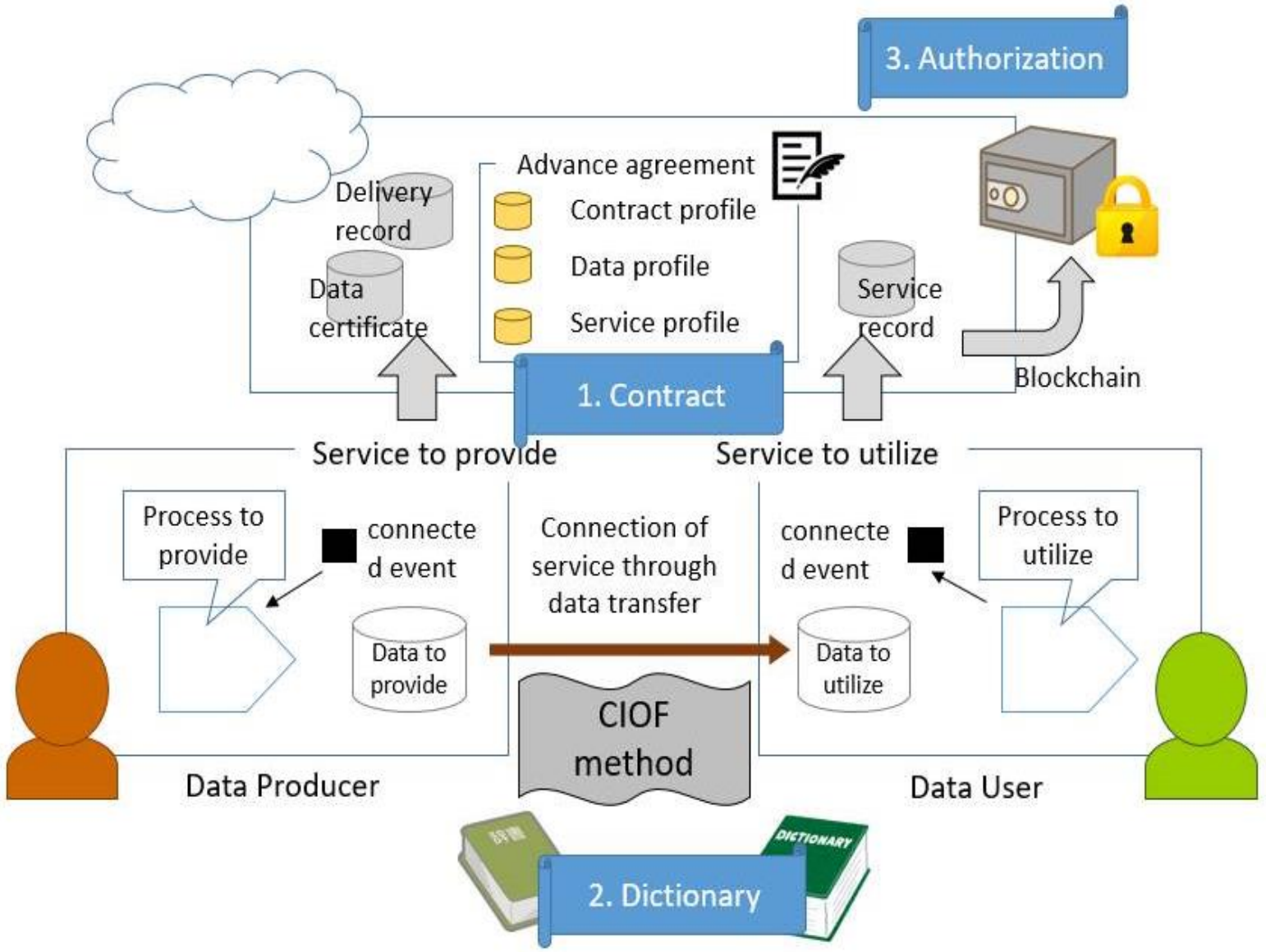
Distinctive Features of CIOF



1. Contract:
Usage of data and its restrictions must be defined by contract in advance.
CIOF system can trace the usage of data (event based monitor or record based inquiry, according to contract) and the status of data (kept, modified, deleted) when necessary.

2. Dictionary:
Multiple dictionaries (Specific dictionary and Actual dictionaries) are used for data conversion so that independence of implementation on site is guaranteed.

3. Authorization:
Data itself and related assets on site is managed by CIOF system to prevent data falsification. Data is encrypted and transferred on demand, not stored on cloud. Block chain technology will guarantee the communication security.

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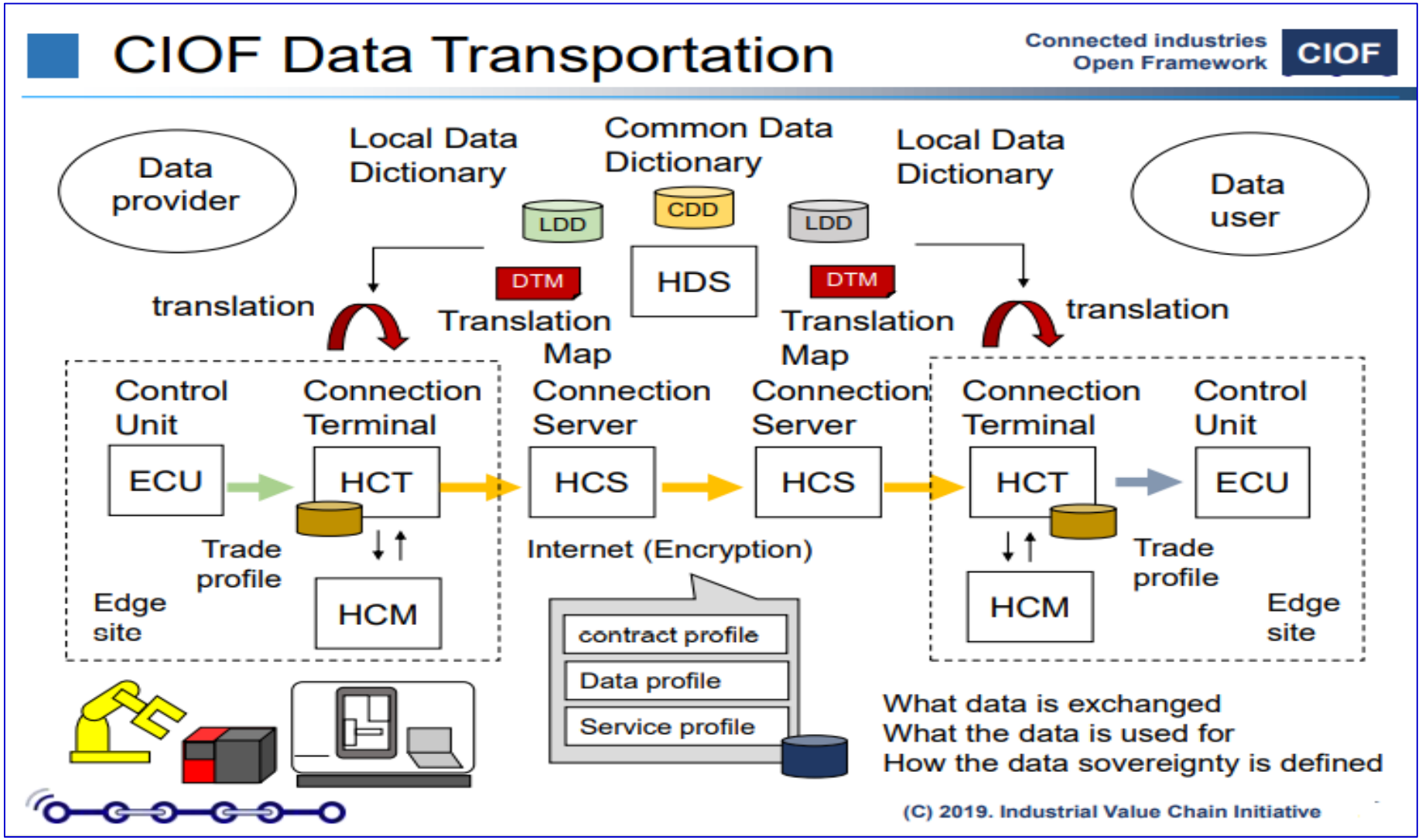
The concept of CIOF (As a review)



As a simple function, here is the overall view of the cooperation framework.

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CIOF Use Cases (1/2)

Connected Industries Open Framework CIOF

Data Ownership as Intellectual Property

Scenario 1

CNC data of machine tools are securely managed in a remote site and by decentralizing the remote site.

TOSHIBA

DMG MORI

Machine tool

Quality Assurance by Data Sharing

Scenario 2

Monitoring results of a inspection process and inquiring a image data of a particular NG lot.

FUJITSU

FANUC

Robot

Value Process Integration across SMEs

Scenario 3

Lot inspection at supplier SME directly by the customer and generating account payable

NEC

MITSUBISHI ELECTRIC

PLC

Excerpt from the presentation material of IVI evangelist Ms. Koroku of 2020 GIO

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CIOF Use Cases (2/2)

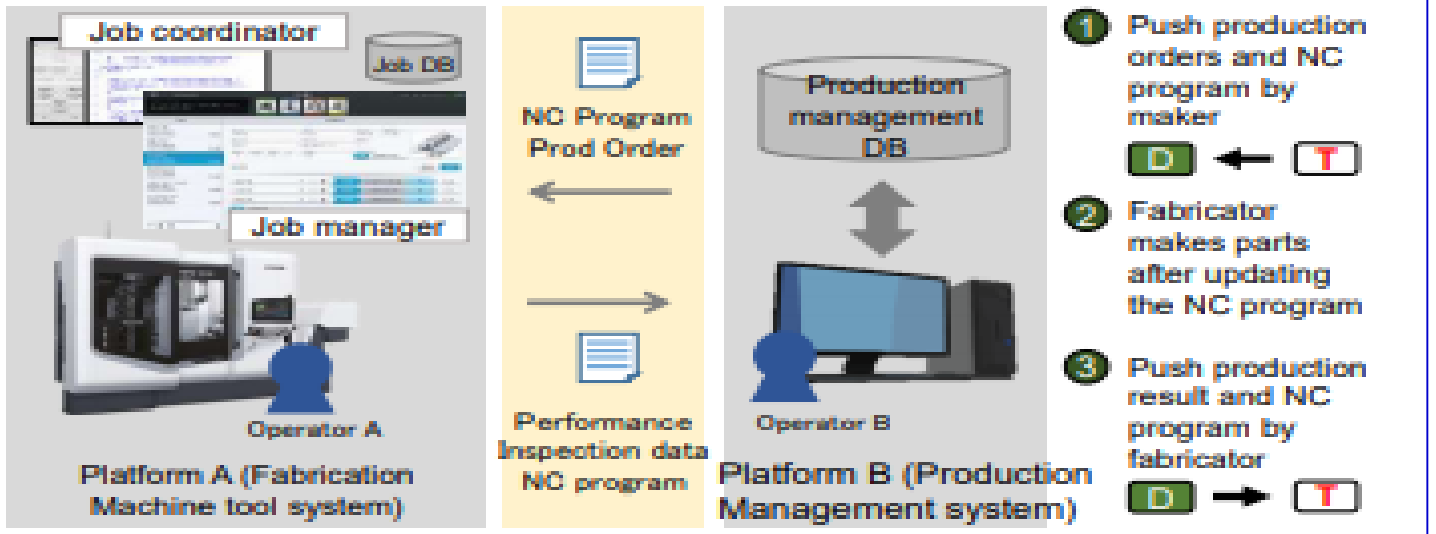
Connected Industries Open Framework CIOF

Data Ownership as Intellectual Property

DMG MORI CELOS ⇄ Meister TOSHIBA series

Scenario 1

CNC data of machine tools are securely managed in a remote site by decentralizing its data control.



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IVI has already signed Memorandum of Understanding with the International Data Space Association (IDSA) in Germany and the Alliance Industrial Internet (AII) in China.
We have agreed to promote the digitization of the manufacturing industry in an international collaborative effort.

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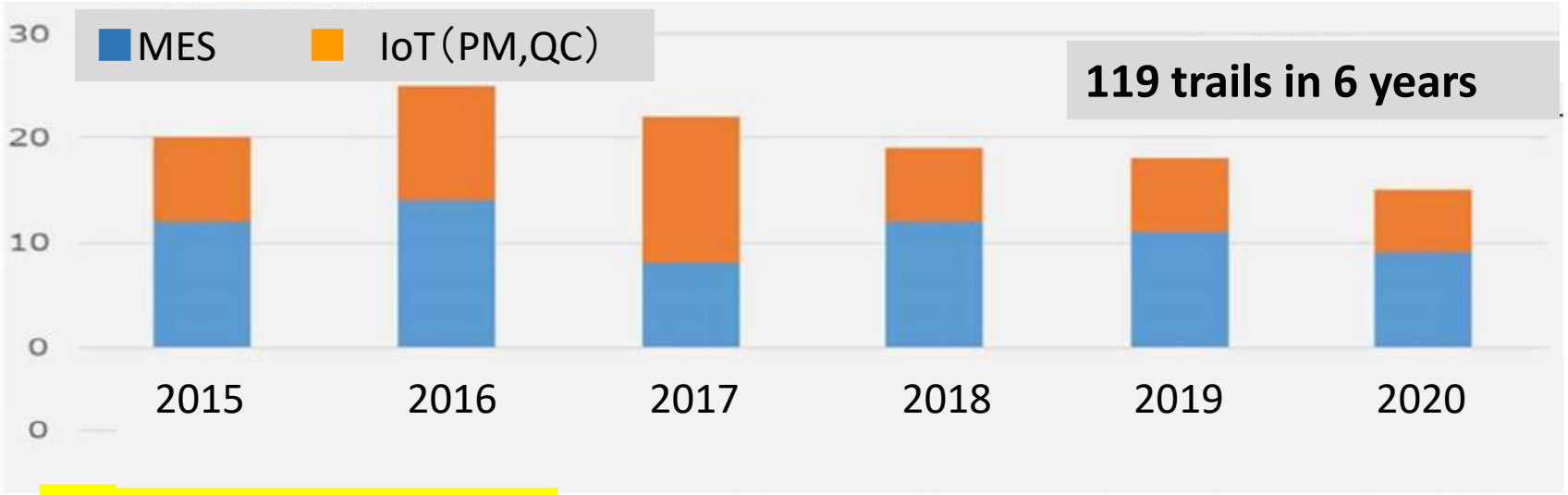
Use case study

(IVI Business Scenario WG　**list from 2015 to 2020**)



State of IVI activity

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(Overview) Equipment maintenance, quality control EdgeAI

Sensing | Collection | Accumulation | Exercise | Aim Goal

Process A
Facility A
Human
Cooperation people/equipment
Facility B
Additional sensor A
Additional sensor B
PLCdata
Real-time
Environmental data, etc.
Human

Collection

What to measure?
Linking data with failures
Abnormal threshold?
⇒ AI learning

Edge AI computer
(Supports dupe data)
(AI real time analysis function)
Pattern feature extraction, data rofile
IVI platform

How much
Do you want to sample?

Predictive maintenance
process Improvement
Data relationships
Time asset management)
Analysis
Parts change
Improved
ccuracy

【efficiency 】
Downtime = Zero
【Quality】
Product value・
Yield improvement

① Sensor data collection
Method / Arrangement
(Sensor selection, sampling rate, etc.)

Edge solution / platform area

② Temporary storage of big data
⇒ Real-time analysis
⇒ Implementation of predictive maintenance

③ Big data analysis
And product quality Improvement

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What's Edge-AI & Trend

High-speed, large-capacity, long-time storage function, and even AI function

波形

位置
振動
超音波
電流 etc

image information

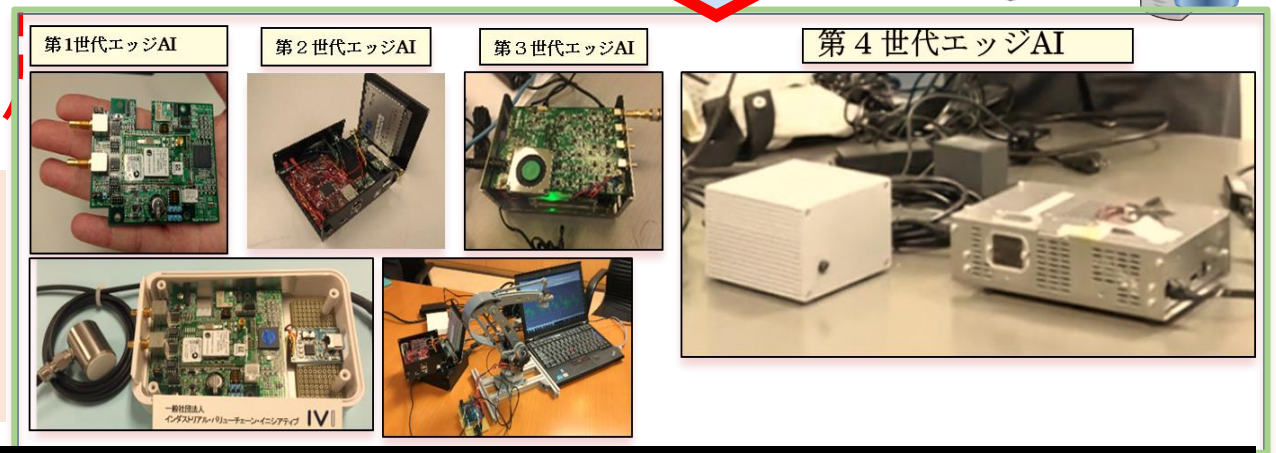
Triggers, recipes, CNCs, parts ...

10MHz ～100hz sampling 8c channel

Full time recording

≒160MB / Sec

≒0.6TB/hour



★ Various sensors, cameras, device triggers, etc. can be easily attached to the device with add-ons.

Prototyping an original edge computer for several years

The core is edge AI (300 million yen ⇒ 200,000 yen)
(light, thin, short and small, ultra-high functionality, low price)
IoT trends should be suppressed

Price is up to 1/150 in the last 7 years thanks to semiconductor ICs

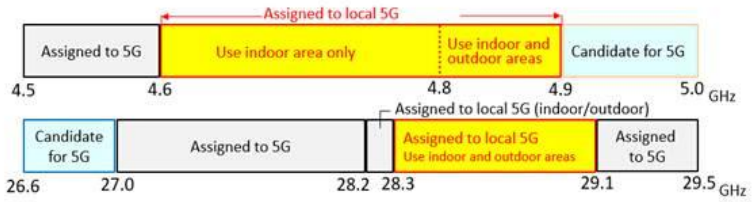
Edge-AI Use Cases　(2019 activities)

6E03-1 : In-house CMP equipment（Semiconductor silicon wafer : Market strategy）
★Demonstration company : Wafer polishing machine essential for semiconductor manufacturing: CMP equipment 2nd place in global share）

6E03-2 : high-speed press machine（Watch Precision Parts : Technology strategy & market expansion）
★Demonstration company : Ultra-precision mold processing technology is a growing company that holds top-level technology in Japan)

6E03-3 : In-house servo press sealed forging device（Bevel Gear : Market strategy）
★Demonstration company : A global company that can provide integrated supply from material cutting machines to servo press machines)

Make full use of edge AI and local 5G



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Edge-AI Use Cases

Implementation of IIoT and Edge_AI software
by Misuzu Industries and KS Tech

Misuzu Industries- continuous punch press processing of sheet metal

Impossible to detect scrap in the high speed process

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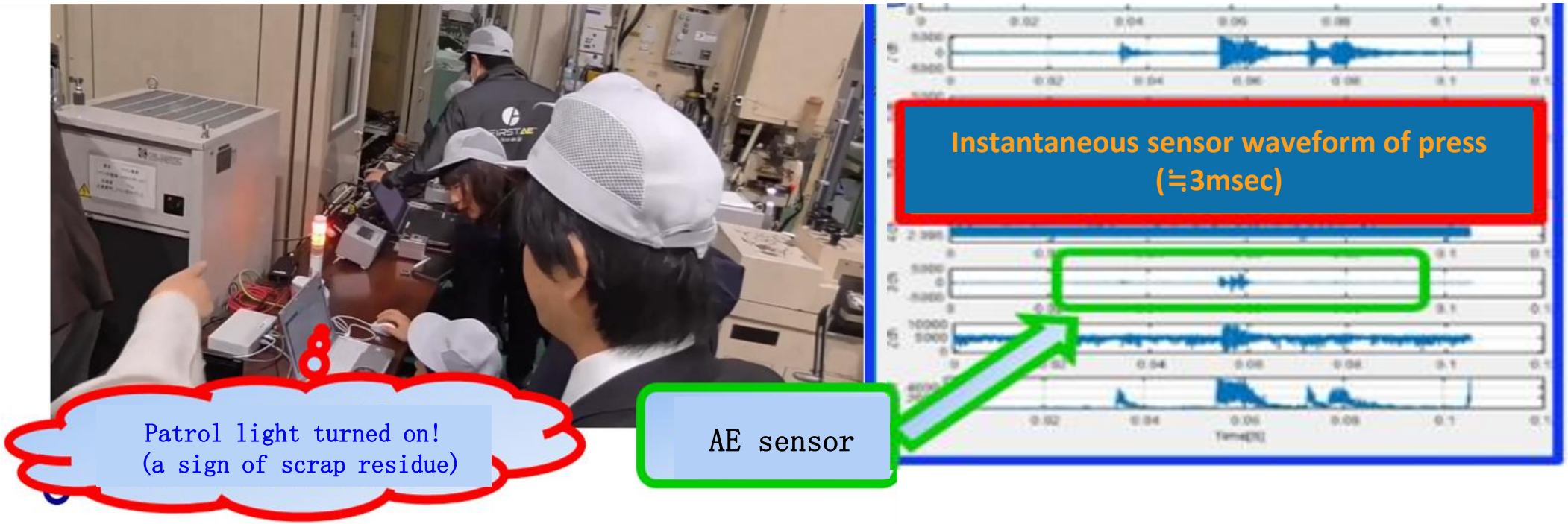
Edge-AI Use Cases

Adding a new signal to alert users on fault in equipment



During equipment operation

If patterns indicate scrap residue

A patrol light will be turned on

Allowing the users to pause the process and clean the equipment

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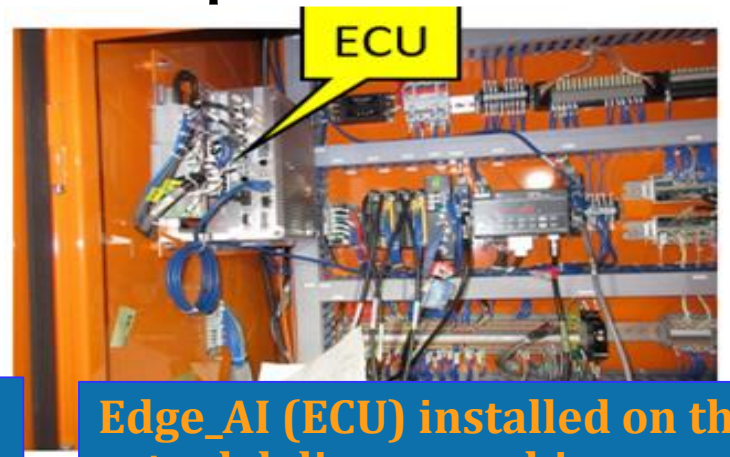
Edge-AI&local-5G PoC Use Cases

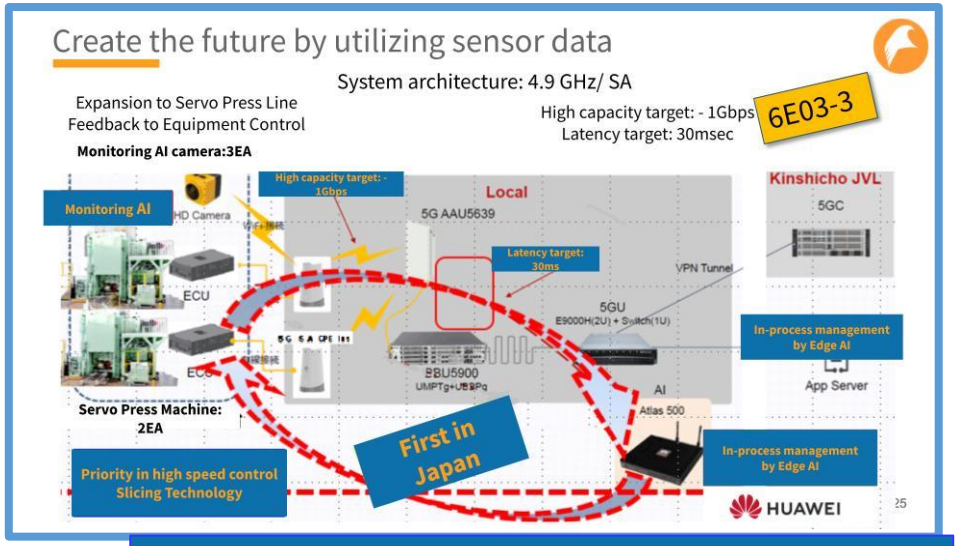
KS Tech- servo press machine

1200T servo press machine made by KS Tech

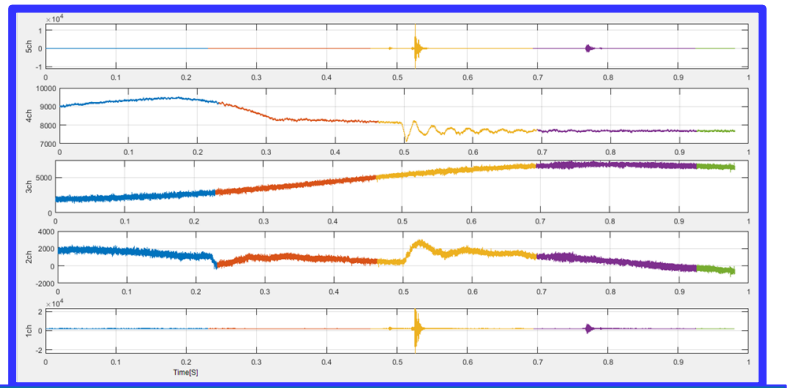


Edge_AI (ECU) installed on the actual delivery machine

Mounted on the actual device and started service



Japan’s first local 5G



Multi-sensor-Time series AI implementation (Edge_AI)

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Edge-AI Use Cases

Data flow between CIOF and edge AI (overall)

Data transfer from equipment to AI Vendor

Contractor at CIOF

Detector: AE sensor

AE wave

Crack propagation

AMP

ECU

CSV

Falkonry & AI vendors

Data analysis and pattern

Recognition

CSV

Asset control

Alert notification

Device adaptor for PLC

Control logic

Device adaptor for patrol light

OTLink(HP)

EL300

Analyzer

Analyzer

On-site API implementation

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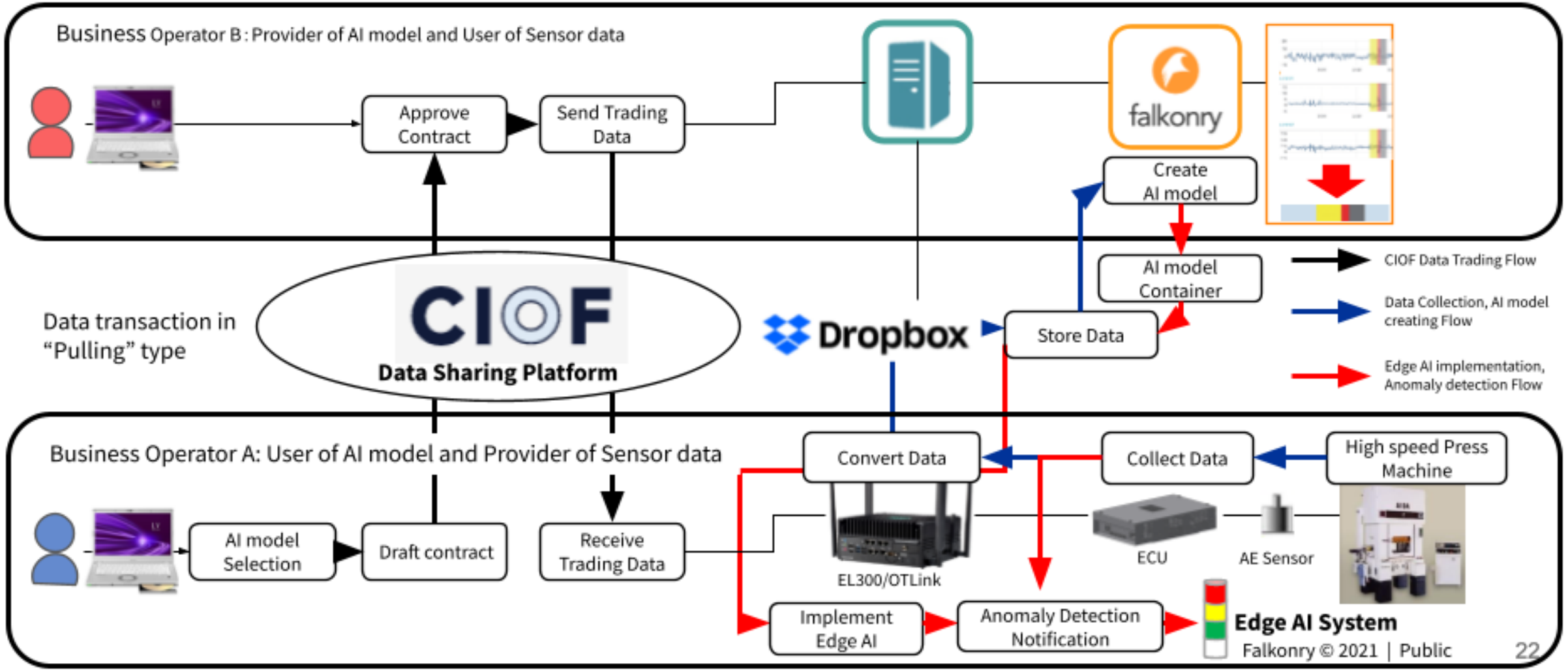
Edge AI system works with CIOF data infrastructure

By linking the implementation of **edge AI**, which can be called the core of the system, and **CIOF**, which enables secure data transaction, in manufacturing sites, we will develop data distribution among AI companies and related companies.



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Expected effect

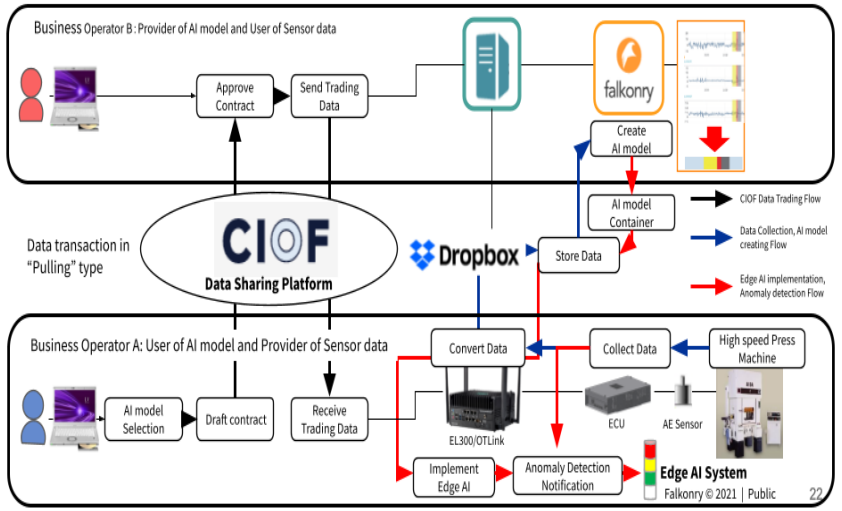
・A monetization model could be constructed by data distribution utilizing CIOF between companies.

Specific case:

・Through anomaly detection at the manufacturing site and abolition of visual inspection
・Expected effect of improving productivity of product development

Effect calculation (Misuzu Case)

1. Eradication of equipment defects and quality defects
   Productivity improvement: 10%
2. Scrap inspection efficiency
   30 people ➡ 15 people
3. Others
   ・You can improve your technical skills within SMEs
   ・DX conversion of on-site craftsmen
   ・Great return on investment



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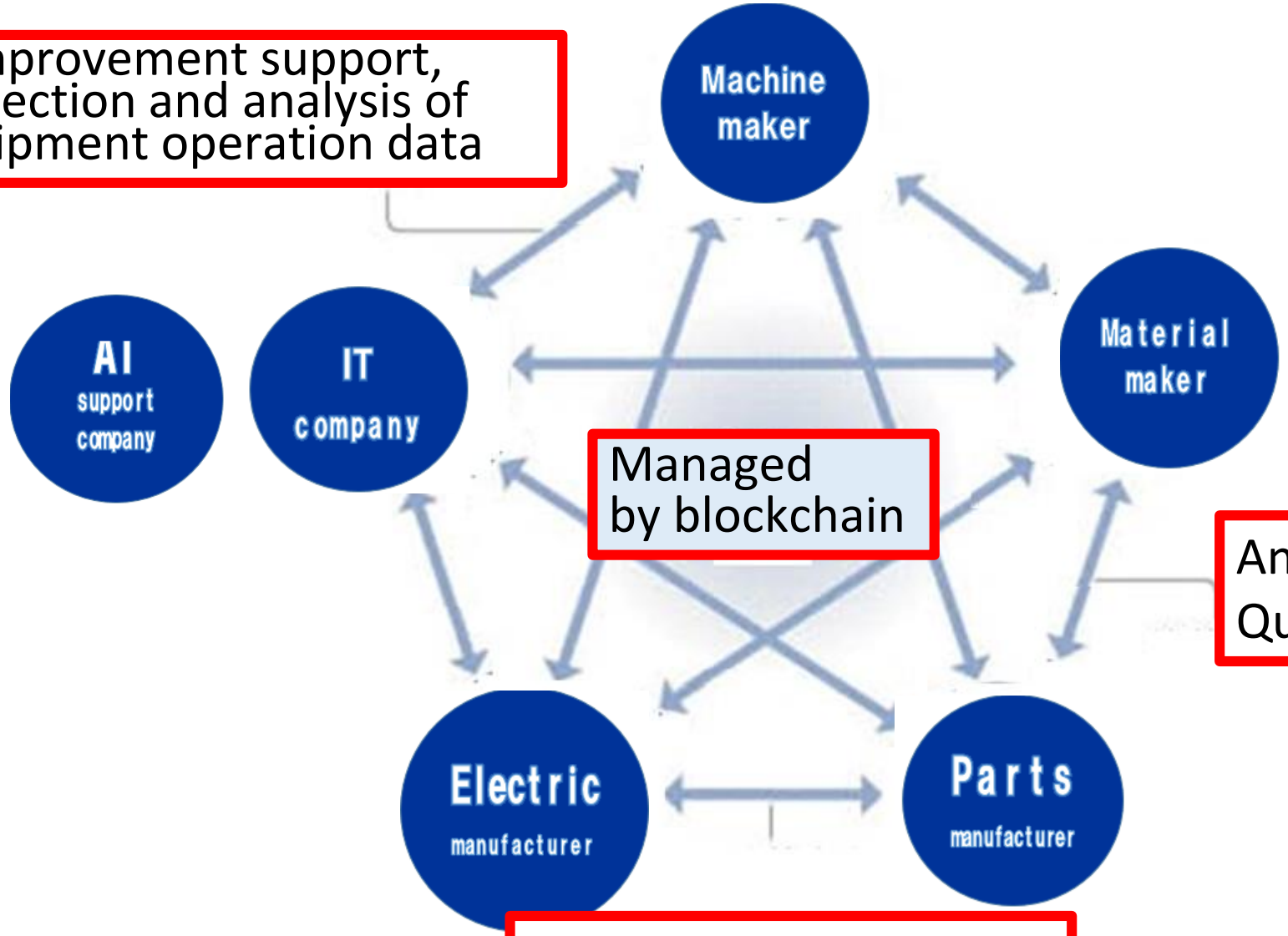
Manufacturing data transaction mechanism by CIOF

Improvement support, collection and analysis of equipment operation data



Anti-counter Feiting
Quality data sharing

Development efficiency

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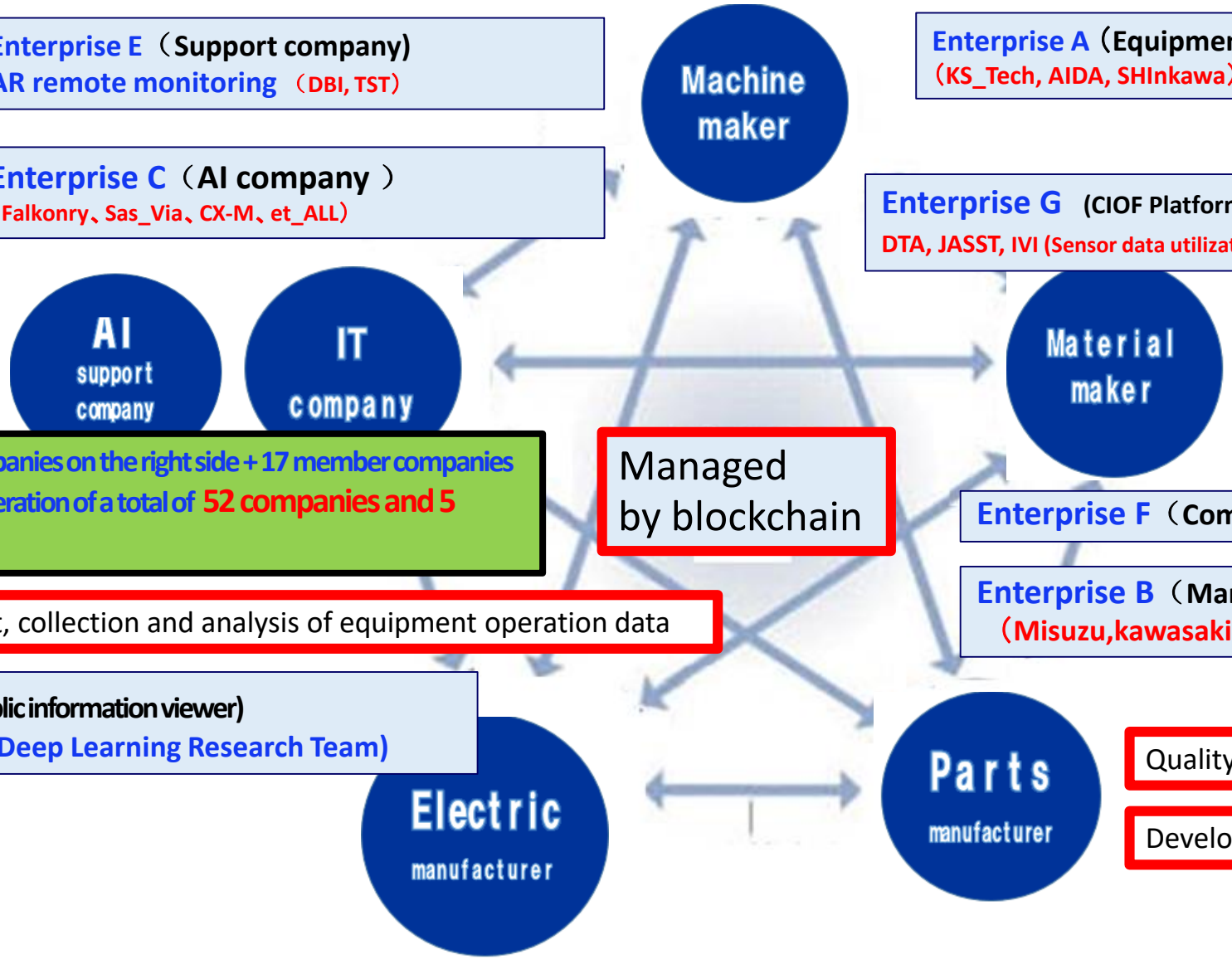
Manufacturing data transaction mechanism by CIOF

Enterprise E（**Support company)**
AR remote monitoring（DBI, TST）

Enterprise C（**AI company**）
（Falkonry、Sas_Via、CX-M、et_ALL）

Enterprise A（**Equipment manufacturer**）
（KS_Tech, AIDA, SHInkawa）

Enterprise G（**CIOF Platform**）
DTA, JASST, IVI (Sensor data utilization technology team）



- Cooperation of 18 companies on the right side + 17 member companies
- Activities with the cooperation of a total of 52 companies and 5 Consortium

Improvement support, collection and analysis of equipment operation data

Enterprise F（**Commercialization consulting company**）

Enterprise B（**Manufacturing plant**）
（Misuzu,kawasaki）_tanko

Enterprise D（**Public information viewer)**
Startup company (AI Deep Learning Research Team)

Quality day sharing

Development efficiency

. The word in red are the companies and organizations that cooperated in the evaluation this time

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Finally (Target plan for this year)

- **How far and what will we do?**
  - **CIOF verification: Try implementing CIOF in the Misuzu business case**

- **Pressing industry via CIOF and monetization case studies**
  - **Misuzu monetization: Joint order acceptance to secure large orders (HUB union)**
  - **Nichidai Monetization: Molding IoT Business Strategy**

Focus on monetization and data flow among companies rather than in-house organizations

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Thank you！

- **IVI General Inquiries：**https://iv-i.org/wp/ja/contacts/
- **ASG: Advanced Study Group) Details：**https://iv-i.org/wp/ja/activities/asg/
- **Speaker email address：**yasuo.matsuoka@Toshiba.co.jp

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