Connected Industries Open Framework for Industrial Value Chain Transformation

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Prof. Dr. Yasuyuki Nishioka
Industrial Value Chain Initiative
Hosei University
Outline

1. Overview of Industrial Value Chain Initiative

2. Smart Manufacturing Scenarios in 2018

3. What is Connected Industries Open Framework?

4. Result of Use Cases Development in the Project

5. Road Map of Digital Transformation of Manufacturing
Loosely defined standard for connected manufacturing

Interface is adjusted to the standard

Specification is adjusted to the interface

Loosely defined standard

Terminal

Specific dictionaries

Connected operations in site A

Connected operations in site B

Connected operations in site A

Connected operations in site B

Reference model

Specific For Connection

Interface

Interface
Smart Manufacturing Reference Architecture

Reference Architecture
Model Industrie 4.0

Industrial Value Chain Reference Architecture

Industrial Data Space Reference Architecture

Industrial Internet Reference Architecture

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Members of IVI

250+ companies, 600+ individuals

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Regular Members of IVI

250+ companies, 600+ individuals
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## Smart Manufacturing Scenarios in 2018

<table>
<thead>
<tr>
<th>No</th>
<th>Title</th>
<th>Facilitator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Key performance Index for connectable factory floors and management</td>
<td>Yamazaki Mazak Corporation</td>
</tr>
<tr>
<td>2</td>
<td>Secure and large-scale data distribution services</td>
<td>Toshiba Corporation</td>
</tr>
<tr>
<td>3</td>
<td>Visualization of decision making based on risks and losses in applying condition-based maintenance</td>
<td>Daikin Industries, Ltd.</td>
</tr>
<tr>
<td>4</td>
<td>Improving quality, productivity and automation of production lines with Artificial Intelligence</td>
<td>Mazda Industries Corp.</td>
</tr>
<tr>
<td>5</td>
<td>Predictive maintenance and quality control anyone can use by using sensor data</td>
<td>Misuzu Industries Corporation</td>
</tr>
<tr>
<td>6</td>
<td>Developing of quality according operator uniqueness utilizing BOP</td>
<td>Brother Industries, ltd.</td>
</tr>
<tr>
<td>7</td>
<td>Simplification and efficiency improvement in the operation phase of robot equipment</td>
<td>Yaskawa Electric Corporation</td>
</tr>
<tr>
<td>8</td>
<td>Visualization of achievements of people / goods / behavior analysis and optimization</td>
<td>Mazda Motor Corporation</td>
</tr>
<tr>
<td>9</td>
<td>Evolution to high-efficiency manufacturing by autonomization</td>
<td>Nikon Corporation</td>
</tr>
<tr>
<td>10</td>
<td>Visualization of kaizen status at remote manufacturing sites</td>
<td>Ricoh Co., Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Visualization and optimization of energy consumption and productivity of manufacturing facilities</td>
<td>Panasonic Industrial Devices SUNX Co., Ltd.</td>
</tr>
<tr>
<td>12</td>
<td>Optimization by tracking the actual time and location of parts transportation trucks</td>
<td>Mazda Motor Corporation</td>
</tr>
<tr>
<td>13</td>
<td>Progress announcement service for small and medium enterprises</td>
<td>Fujitsu Limited</td>
</tr>
<tr>
<td>14</td>
<td>Real-time data collection and utilization between factory processes by extended MES</td>
<td>Kojima Industries Corporation</td>
</tr>
<tr>
<td>15</td>
<td>Construction of small parts management system using digital tag</td>
<td>DMW Corporation</td>
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<tr>
<td>16</td>
<td>Quality control for each worker - Secure real-time management of quality KPI -</td>
<td>IHI Corporation</td>
</tr>
<tr>
<td>17</td>
<td>Stabilization of product quality by using AI on edge of production</td>
<td>Mitsubishi Electric Corporation</td>
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<tr>
<td>18</td>
<td>Improvement of quality in forging production line</td>
<td>Mitsubishi Electric Corporation</td>
</tr>
<tr>
<td>19</td>
<td>Constructive and continuous data collection and analysis</td>
<td>CKD Corporation</td>
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</tbody>
</table>

2015 : 20 scenarios  
2016 : 25 scenarios  
2017 : 22 scenarios  
2018 : 19 scenarios
Selected Outputs of 2018 scenario WGs

Developing of quality according operator uniqueness utilizing BOP (4A01)

Quality control for each worker - Secure real-time management of quality KPI (4A04)

Visualization of achievements of people / goods / behavior analysis and optimization (4C03)

Evolution to high-efficiency manufacturing by autonomization (4C04)

Predictive maintenance and quality control anyone can use by using sensor data (4B01)

Improvement of quality in forging production line (4A03)

Simplification and efficiency improvement in the operation phase of robot equipment (4C01)
Selected Outputs of 2018 scenario WGs

Secure and large-scale data distribution services (4E04)

Visualization of decision making based on risks and losses in applying condition-based maintenance (4D02)

Key performance Index for connectable factory floors and management (4D01)

Visualization of kaizen status at remote manufacturing sites (4C05)

Improving quality, productivity and automation of production lines with Artificial Intelligence (4C02)

Real-time data collection and utilization between factory processes by extended MES (4E02)

Optimization by tracking the actual time and location of parts transportation trucks (4E01)
16 Digital tools for Smart Thinking Organization

- Fact
- Summary
- Work Set
- Concern
- Actor
- Organization
- Activity
- Machine
- Information
- Thing

◆ Concern chart
◆ causal structure chart
◆ goal planning chart
◆ organization chart

◆ work flow chart
◆ collaboration chart
◆ work structure chart
◆ visualization chart

◆ device function chart
◆ logic chart
◆ allocation chart
◆ condition chart

◆ process chart
◆ data relation chart
◆ component chart
◆ layout chart

- Stage
- Logic
- Area
- Event
- Scene
- Process
- Function
- Data
- Unit
- State
- Component
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Simple and Easy to implement a connected world

Operations in a office and a factory are connected seamlessly by means of data connections with liability.

**Batch transfer**
Data is distributed in a form of encrypted file. This is not real-time basis, but reliable.

**Simple protocol**
Same as a post office, data is sent without handshake process.

**peer to peer**
Data is not stored is the Internet, so that security management is feasible.
Double stages translation by adaptable dictionaries

Common dictionaries are selected to adjust the local dictionaries for each side.

**AS-IS approach**

A common single dictionary is defined and both side adjusts the local words to it.

Undefined local words are out of control and difficult to maintenance them.

**TO-BE approach**

Each side can define the local words of its dictionary and prepare the translation map.

Local site can flexibly choose the words to adjust the system to the reality.
Trade profiles for data distribution and delivery

Process of Providing the Data

Contract Profile shows the rights of obligations of the parties that shall be agreed between them

- What data is used?
- Who is the user?
- Where is this used?
- When is this used?
- How often is this used?

Template

Service Profile | Data Profile | Contract Profile

Prior agreement

Contents of distribution

HCT | ECU | EDU

HCT | ECU | EDU

Process of Using the Data

Contract History

Template

Service Profile | Data Profile | Contract Profile

HDS | HCS

Contract clauses

- Expire date
- Num of use
- Local storing
- History interval
- Reporting
- Monitoring

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System Architecture

In a distributed site (edge)

Hyper Dictionary Server
Hyper Connection Server
F/W
Hyper Connection Terminal
Hyper Connection Manager

HCS
HDS

F/W
HCT

HCS

Edge Control Unit
ECU

EDU

Edge device unit

System Integration Phase
Register parties, controller and devices, and dictionaries.

Trade contract setup phase
Agree the contract to distribute data using document templates

System execution phase
Distribute an actual data and use it in accordance with the contract

Monitoring and Evaluation Phase
confirm the transaction history of the data transfer and use

System Integrator,
Production Line builders
Marketer,
accountant and Data base engineer
Field operator
and practitioner of the daily works
Quality assurance staff,
accountant and managers

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Use case categories of platform data distribution

✓ Open and/or closed business model implementation regarding **data as intellectual properties**

Scenario 1  CNC data of machine tools are securely managed in a remote site and by decentralizing the remote site.

✓ **Enhance of quality assurance** by sharing the result of testing data among supply chain

Scenario 2  Monitoring results of an inspection process and inquiring an image data of a particular NG lot.

✓ **Accounting integration** with manufacturing operations by confirming the performance data

Scenario 3  Lot inspection at supplier SME directly by the customer and generating account payable
Open and/or closed business model implementation regarding **data as intellectual properties**

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

The CNC program that interactively modified by the field operator according to individual order items or prototypes, is disassembled into additional conditions and parameters, and is shared among the company. Actual orders are managed between sites considering cost, quality, and delivery time by associating them with the job characteristics.

**Meister** series

DMG MORI ↔ TOSHIBA

(A) fabricator  (B) maker

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**Scenario 1**

1) Push production orders and NC program by maker (A << B)
2) Fabricator makes parts after updating the NC program
3) Push production result and NC program by fabricator (A >> B)
Enhance of quality assurance by sharing the result of testing data among supply chain.

- Monitoring results of a inspection process, and inquiring a image data of a particular problematic lot.

The results of workpiece loading, unloading and quality inspection (image inspection) after processing are linked with external data. Then the system externally acquires data necessary for quality control inside the edge. When an incident occurs, managers identify the cause and improve it from the data inside and outside the edge.

FIELD system

FANUC

(A) fabricator

COLMINA

FUJITSU

(B) maker

Scenario 2

1) Push production order by maker (A << B)
2) Push production result by fabricator (A >> B)
3) Push shipping result by fabricator (A >> B)
4) Pull quality data (pictures) by maker (A >> B)

- Real time reporting of production line status
- Quality data distribution by push/pull procedures

Purchas order panel of customer (maker)
Sales order panel of supplier
Production line of supplier
**Accounting integration** with manufacturing operations by confirming the performance data

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

Order is automatically accepted when supply parts from the manufacturer arrive at the supplier side. IoT gateway at the point of passage of materials in the factory monitors and logs there, and necessary inspection data is checked at each station. In the maker side, account payable is generated when the parts complete and ready to ship. The maker or 3PL goes and pick up them.

1) Push purchase order by maker (A << B)
2) Push production progress by supplier (A >> B)
3) Pull direct acceptance by maker (A >> B)

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(A) supplier SME  (B) maker

**IFS Applications 10**

**Edgecross**

**MITSUBISHI ELECTRIC**

**NEC**

**Production line**

**PLC**

**IPC**

**HMI**

Factory manager at maker site
Trade contract setup phase

- HDS: Hyper Dictionary Server
- HCT: Hyper Connection Terminal
- HCM: Hyper Connection Manager

Local dictionary

Common dictionary

Mapping data

Local dictionary

Common dictionary

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<tr>
<th>Year</th>
<th>Goals of Activities</th>
<th>Technical Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY2019</td>
<td>Implement all the functions of the minimum executable model, and start services by stable operation and support.</td>
<td>Collect words and relations of dictionaries for preliminary study on developing a self-organizing common dictionary</td>
</tr>
<tr>
<td>FY2020</td>
<td>Solution partners start their service operation so that users can choose and implement with a little integration cost</td>
<td>Design an additional function of dictionaries that recommends the correct words and mapping for the local users</td>
</tr>
<tr>
<td>FY2021</td>
<td>For scaling up and security improvement, implementation architecture and infrastructure are redesigned and rebuilt</td>
<td>Apply the technology of AI-based automatic translation between the local and common dictionaries</td>
</tr>
<tr>
<td>FY2022</td>
<td>Develop a strong authentication system both on hardware and software, so that proof of delivery is available</td>
<td>Optimize the rules and processes of translation and delivery on data trade using context depending historical data.</td>
</tr>
<tr>
<td>FY2023</td>
<td>Expand the system in open-basis, and contribute to developing international rules and standard of the data economy</td>
<td>Data trade is monitored by AI and it detects unauthorized use, as well as ranking and rating of the parties</td>
</tr>
</tbody>
</table>
Why don’t you join us?

Danke schön.

https://www.iv-i.org/en/