Japan-Germany Standardisation Expert Meeting

Advancing semantic interoperability for the future of manufacturing transformation

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1. Overview of Germany - Japan collaboration

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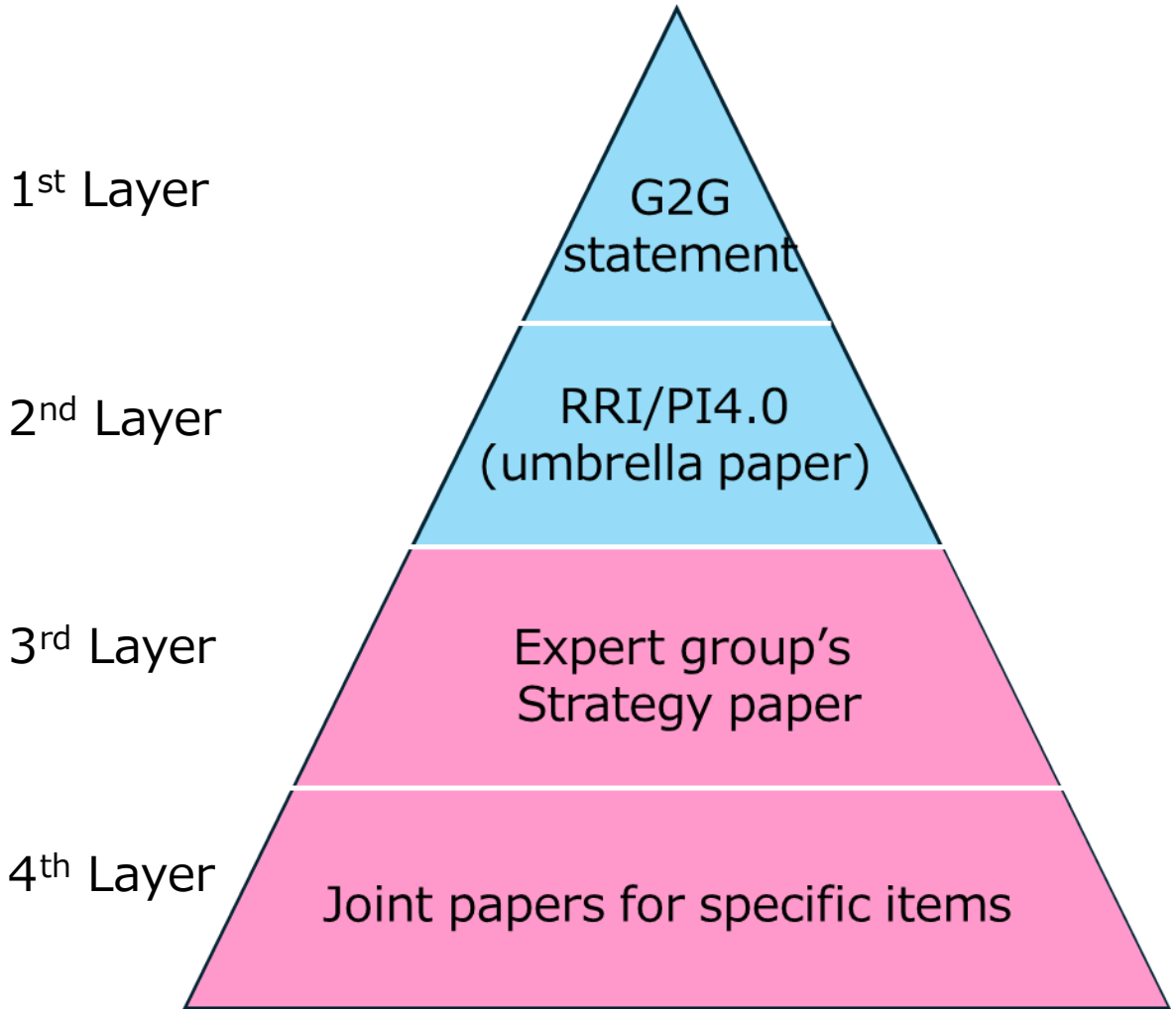

Four expert groups.

- Industrial Trustworthiness and Security
- Digital Platforms in Manufacturing Industries
- **International standardization**
- Manufacturing Dataspaces

2. History and Achievements

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2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026

Common strategy

The common strategy on international standardization in field of the Internet of Things/Industrie 4.0

Common strategy 2nd

White paper

[PROGRESS REPORT] Joint Use Case Development – Value Based Services

Usage Viewpoint / Functional Viewpoint of Application Scenario Value-Based Service

Usage View of Asset Administration Shell

Usage View "Seamless and Dynamic Engineering of Plants"

Edge Management – "Options for Implementation of Business Objectives"

Digital twin reference model and standardization to realize a sustainable industry

Joint Paper

ISO / IEC related TC, like JWG21, TC65, AAS, SyC SM …

3. Changes surrounding manufacturing industries

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Review of external conditions after 5 years of the last common strategy paper

Since 2020 the following technical and non-technical mega trends emerged in the area of manufacturing and industrial value chains (or gained importance):

1. Data spaces for industrial applications
2. Application of AI in general and GenAI and AI-agents in particular
3. Supply chain resilience
4. Circular Economy
5. Environmental reporting
6. Regulation on aspects of data economy (in addition to IT security)

For these mega trends important items for standardization have been identified

4. Identified items based on mega-trends

No.	Title
1	Semantic Interoperability aspects: The introduction of DPP and its impact on Industrial Implementation
2	Semantic Interoperability aspects: Technological basis for engineering data federation
3	Data Ecosystems / data spaces for industrial applications (including some use cases)
4	Digital twin reference model
5	Generative AI and multi agent AI for industrial applications
6	How to keep scalability with increasing number of data models and use cases
7	Common view on the role of standards to support society for new work (ageing society, young society, competitiveness, sustainability)
8	Open-source committee of manufacturing. Comparing the development of (international) Standards vs Open-Source development.

4. Identified items based on mega-trends

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Discussion process

Category 1: Near term theme

- Leading party to be identified (Germany or Japan)
- Problem statement and target outcome are identified and agreed with both parties

Category 2: Mid-long term theme

- Need more communication to narrow down the discussion points. Once both parties agree that the discussion points are meaningful, it will move to Category 1.

Category 3: Inventory

- The list of idea for future

4. Identified items based on mega-trends

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No.	Title	Note
1	**Semantic Interoperability aspects: The introduction of DPP and its impact on Industrial Implementation**	
2	**Semantic Interoperability aspects: Technological basis for engineering data federation**	Systematic approach of engineering data representation and hirachical dictionary from very meta level dictionary to individual dictionary.
3	Data Ecosystems / data spaces for industrial applications (including some use cases)	Review of different concepts for data spaces
4	Digital twin reference model	
5	Generative AI and multi agent AI for industrial applications	
6	How to keep scalability with increasing number of data models and use cases	Building blocks (AAS, OPC-UA, …) Requirements on data definitions
7	Common view on the role of standards to support society for new work (ageing society, young society, competitiveness, sustainability)	
8	Open-source committee of manufacturing. Comparing the development of (international) Standards vs Open-Source development.	

Near term theme

Mid-long term theme

Inventory

5. Near term collaboration items No. 1

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Item No. 1: Semantic Interoperability aspects – The introduction of DPP and its impact on Industrial Implementation

- DPP as a use case for a data space for industrial applications.
- This data space aproach should be applicable globally for global supply chains.
- Need for globally standardized
  - design principles
  - semantics
  - data models

Regulators will define requirements on
- DPP system and
- DPP data

Semantics should be based ideally on international standards

Upstream traceability is presumably not in the focus of (national/regional) DPP regulation

DPP as required by national/regional regulation

Raw Materials → Processed Materials → Sub-component Production → Component Production → Assembly → Market placement → Use → Repair Remanufacture Recycle

5. Near term collaboration items

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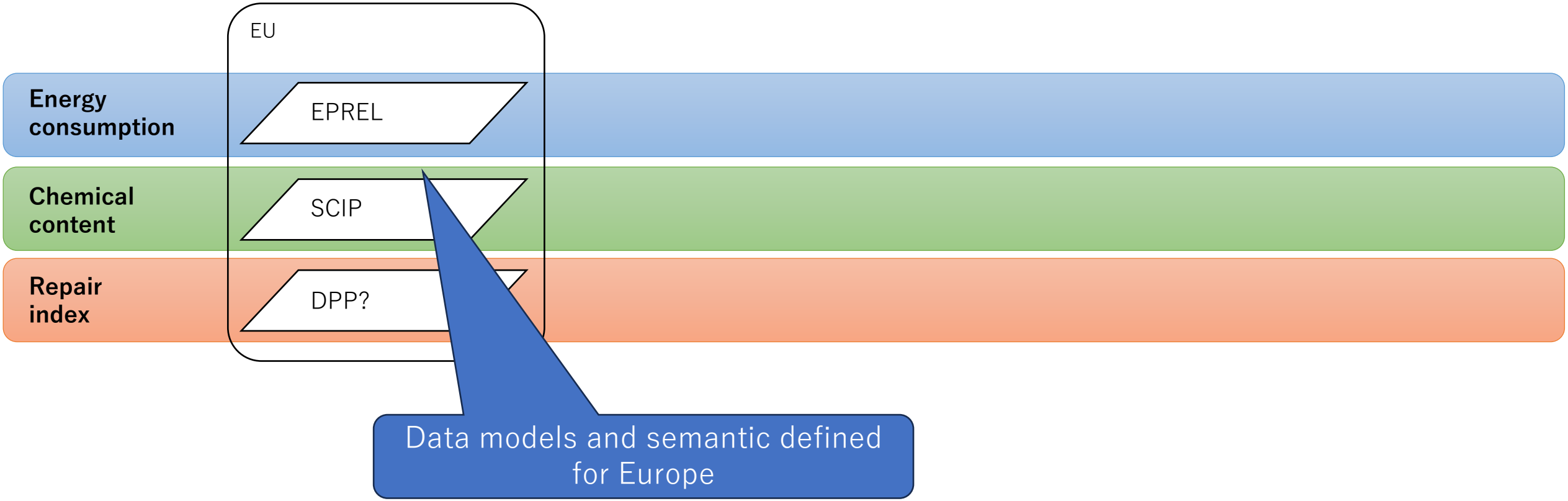
No. 1: Semantic Interoperability aspects – The introduction of DPP and its impact on Industrial Implementation

Today: Legally required product data models of different regions. e.g.



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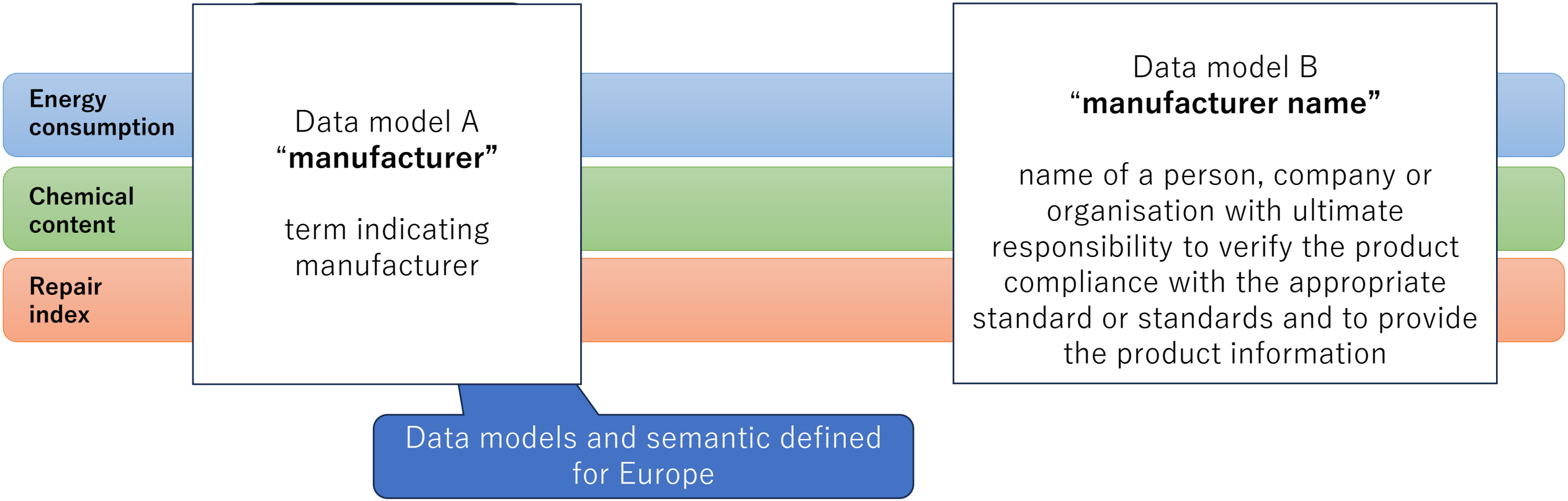

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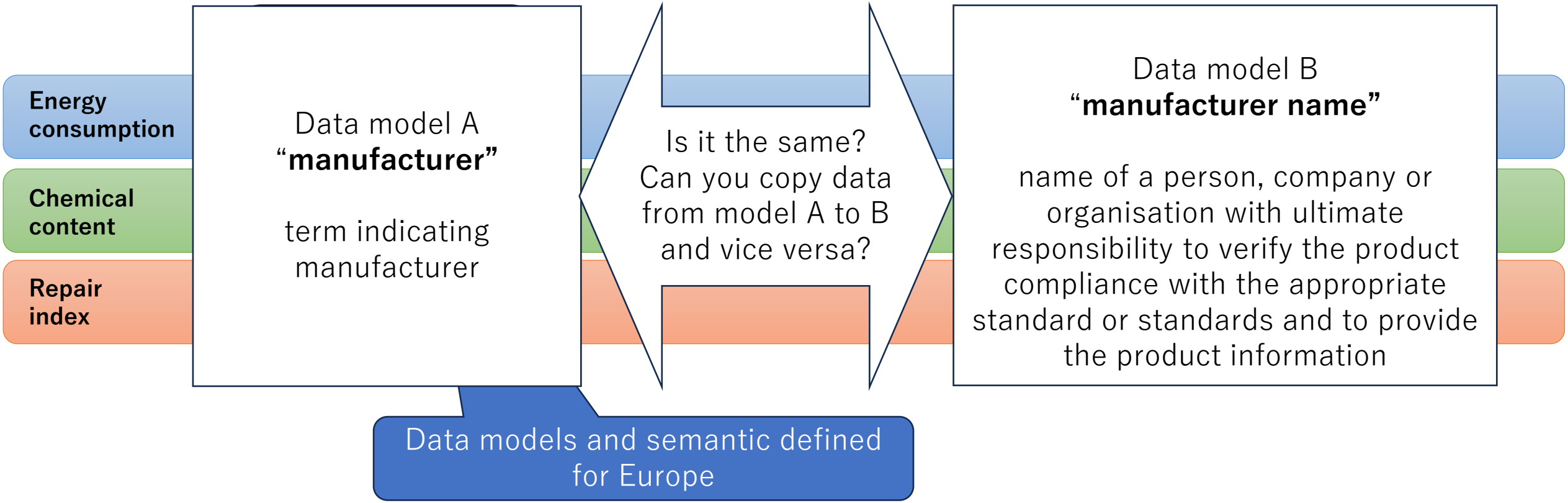

5. Near term collaboration items

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Item No. 1: Semantic Interoperability aspects – The introduction of DPP and its impact on Industrial Implementation

International standards describing requirements on the technological base layer (system). E.g.:

- IEC/TC 65/WG 24: IEC 63278-series on AAS
- IEC/SC 3D: IEC 61360-1 describing information model of Common Data Dictionary (CDD)
- ISO/IEC JTC1/SC 38: IDSA Data Connector
- IEC/TC 65/ JWG 29: Concept of Data Space – e.g. MX-Port
- IEC SyC SM/WG 8 „Data spaces for Smart Manufacturing”
- …

5. Near term collaboration items

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Item No. 1: Semantic Interoperability aspects – The introduction of DPP and its impact on Industrial Implementation

International standardized semantics for unambiguous description of data points.
This could be done at

- recognized standardization bodies → technology specific parts of IEC + ISO CDD, e.g.
  - IEC/TC 121 – IEC 62683 low voltage switchgear
  - IEC/TC 65 – IEC 61987 – Process automation
  - IEC/TC23 – IEC 63508 – circuit-breakers and similar equipment for household use
- consortia → e.g. ECLASS

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5. Near term collaboration items

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Collection of data points for application specific Use Cases
→ e.g. as submodel template for AAS

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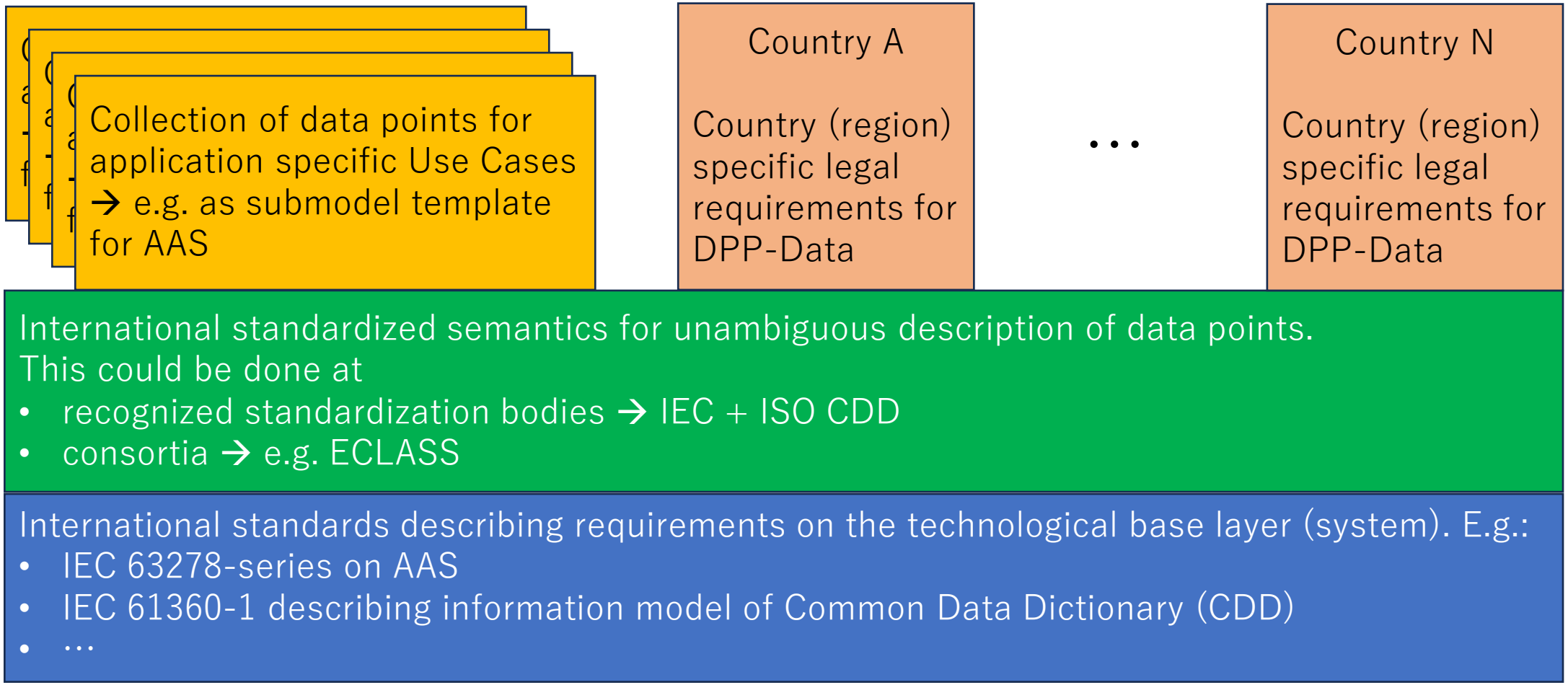

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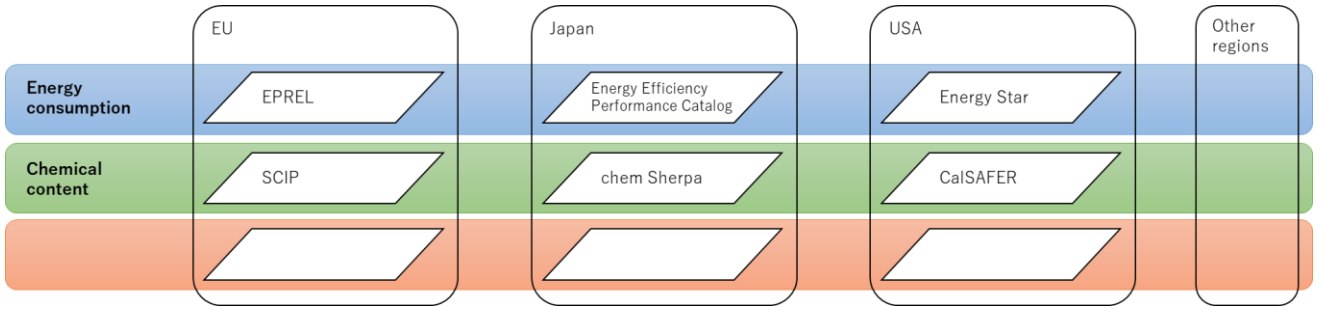
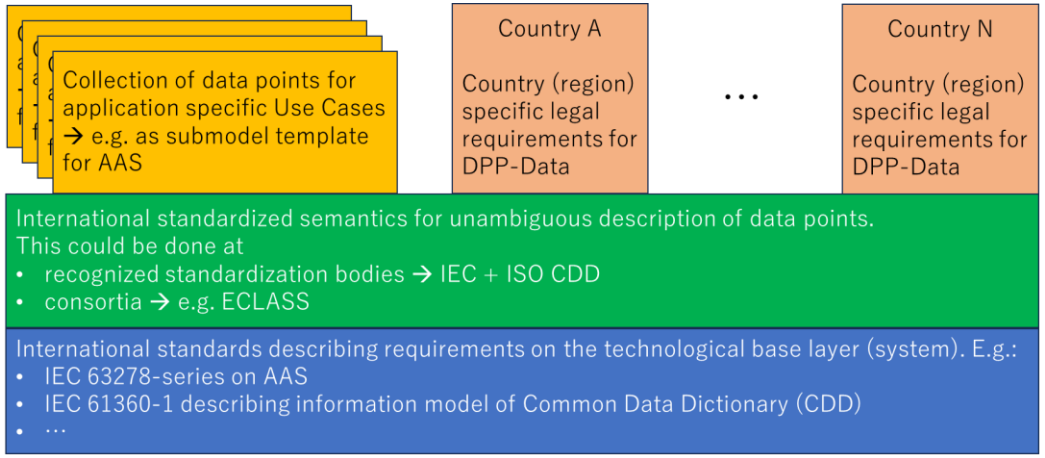


Can we establish a global single point of truth for globally interoperable data ecosystems?



5. Near term collaboration items

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Item No. 2: Semantic Interoperability aspects – Technological basis for engineering data federation

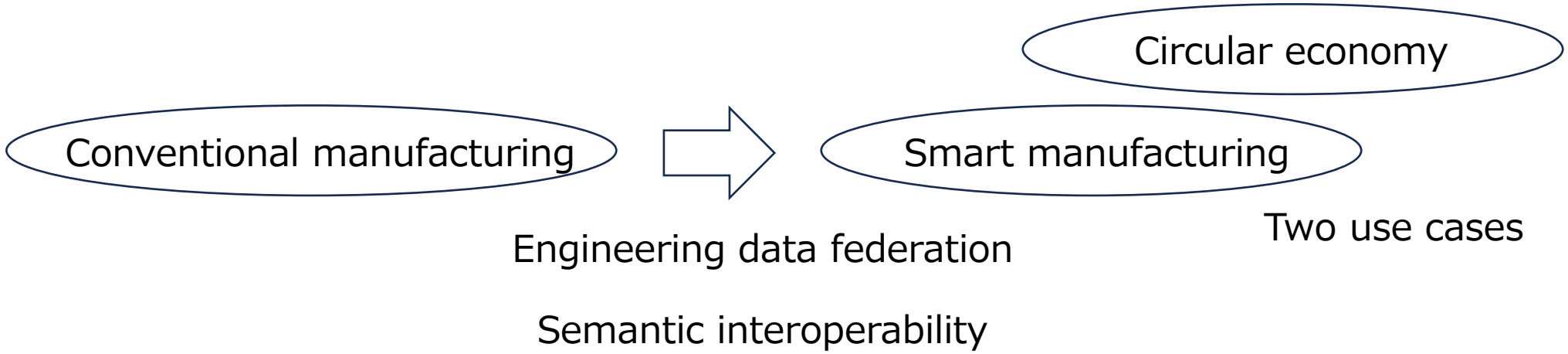
The Japanese team is exploring an aspect of semantic interoperability needed to drive a shift **from traditional manufacturing to smart manufacturing aligned with circular economy**, through **two practical use cases**.

Engineering data federation:

- The ability to utilize design, manufacturing, and operational data—managed separately by different organizations (factories)—without losing its informational value

Semantic interoperability:

- The technological basis for achieving this federation



5. Near term collaboration items

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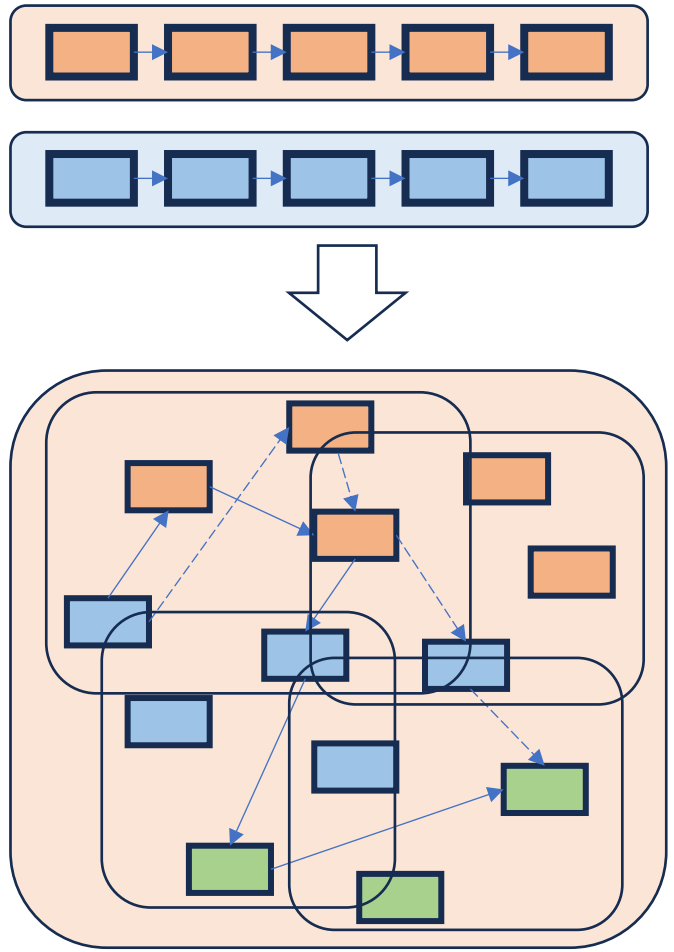
Item No. 2: Semantic Interoperability aspects – Technological basis for engineering data federation

Conventional manufacturing:

- Selection on physical resources (materials, equipment) as primary design variables of engineering activities (e.g., production planning)
- Data as their input/output and managed within organizational boundaries, with minimal cross-organizational sharing

Engineering data federation ensured by semantic interoperability



Smart manufacturing*:

- Data as another replicable resource.
- Generation – distribution - utilization of data as design variables for the optimization of globally distributed assets under geographic, economic, and environmental constraints.

*A view of smart manufacturing with a data-driven style

5. Near term collaboration items

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Item No. 2: Semantic Interoperability aspects – Technological basis for engineering data federation

1: AI-Based Predictive Maintenance*

Situation: Detecting equipment anomalies using vibration sensor time-series data

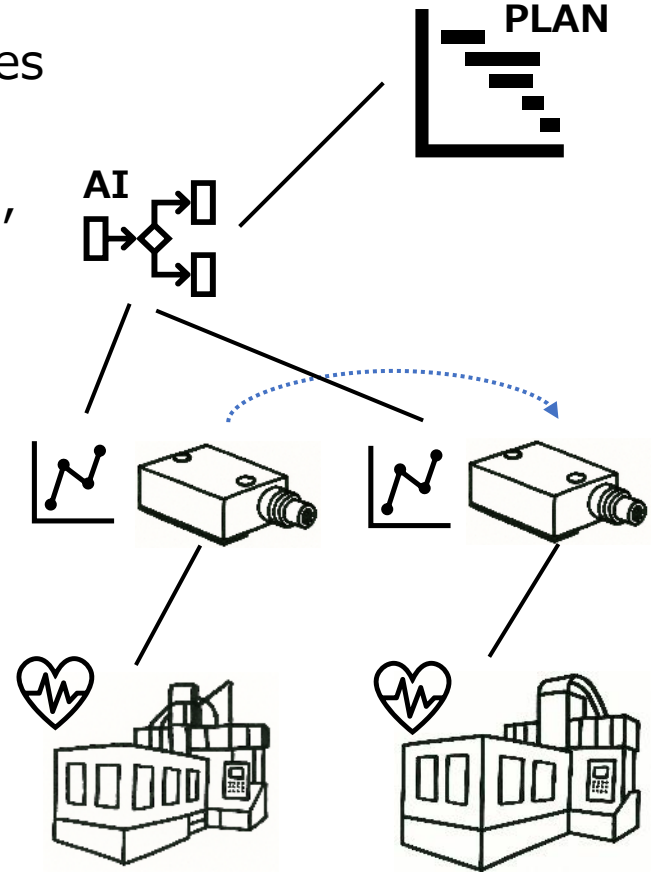
Key data elements: Machining conditions, NC programs, tools, workpieces, sensor mounting positions

Benefits in introducing semantics:

- Improved anomaly cause identification
- Flexible reconfiguration of machining – sensing – prediction systems

Benefits in introducing semantic interoperability:

- Integration with production planning and execution systems
- Accelerating AI model training with bigger datasets through shared semantic models



* Semantic interoperability among applications in Level 2 and Lebel 3 in IEC 62264

5. Near term collaboration items

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Item No. 2: Semantic Interoperability aspects – Technological basis for engineering data federation

2: Adaptive Manufacturing Supply Chain*

Situation: Transferring manufacturing processes to external partner facilities due to equipment failure

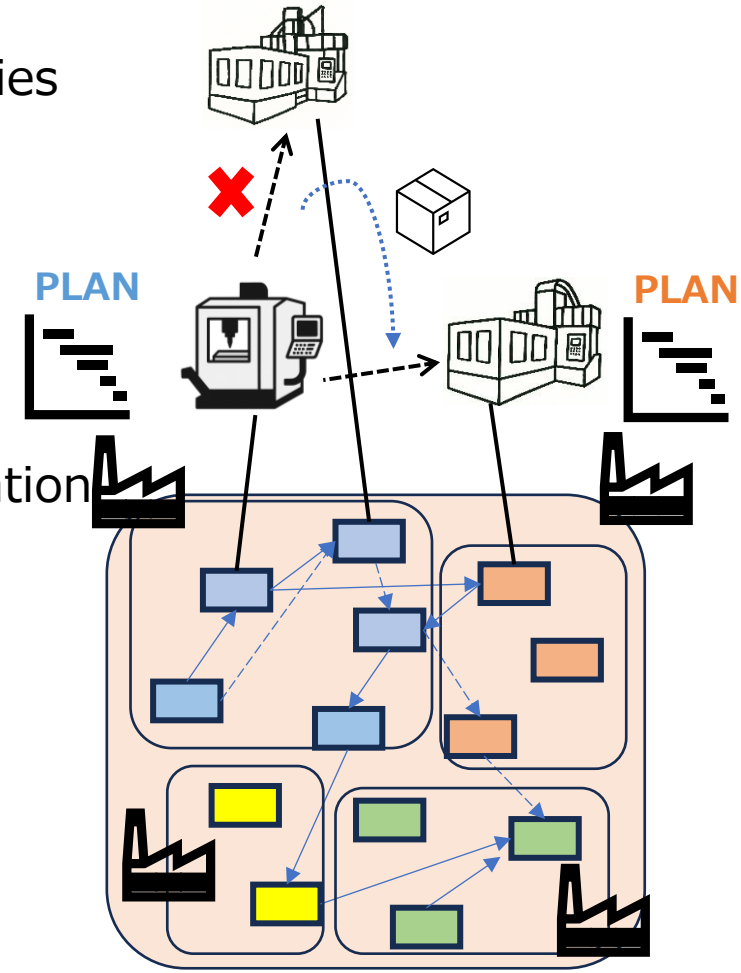
Key data elements: Equipment conditions, production planning data, production execution data

Benefits in introducing semantic interoperability:

- Accurate application of original manufacturing conditions with accurate understanding of partner equipment conditions, leading reduced preparation time and quality variability

Challenges:

- Building and running a containerized environment to absorb equipment-specific dependency** is not straight-forward due to physical interaction (e.g., vibration and human intervention)



*Semantic interoperability among applications in Level 3 and Lebel 4 in IEC 62264
**Concept from a software engineering practice

6. Summary

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Experts from Japan and Germany have collaboratively identified several appropriate topics related to international standardization in smart manufacturing. Among these, **two short-term topics related to semantic interoperability** are currently under consideration:

1. Implementation of Digital Product Passports (DPP) in industrial domains
2. Technological basis for engineering data federation

Interoperable digital infrastructure is necessary to achieve **circular economy through data traceability across product life cycles (via DPP)** with **data-driven technological innovation (via engineering data federation)** .

We look forward to continued collaboration!

Thank you for your attention

Danke für Ihre Aufmerksamkeit

ご清聴ありがとうございます