

RRI International Symposium 2022
October 13, 2022

Japan-Germany Standardization Collaboration in Industrie 4.0 and Industrial Internet of Things (IIoT)

- Joint work as a pre-standardization activity -

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Germany	Objective, Scope of activities First and second edition of Common Strategy Paper
Japan	Joint work as a pre-standardization activity Use case approach Examples of collaborations Future topics for collaboration How it works in Japan
Germany	PI4.0 standardization strategy Hot topics and Future pre-standardized topics from Germany
Japan	Session Summary

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Objective, Scope of activities

Situation:

- Japan and Germany are both world leaders in the field of manufacturing technology and production systems
- Both countries have made great efforts to promote smart manufacturing research, developments, and industrial implementations
- Standardization is a key issue for the success of a smart manufacturing vision
- Internet of Things (IoT)/Industry 4.0 requires an unprecedented degree of system integration across domain borders, hierarchy borders and life cycle phases

Approach: Japan and Germany agreed to cooperate on standardization in the field of smart manufacturing

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First and second edition of Common Strategy Paper

March 2017: Japan and German partners agreed to

- create a common future vision of smart manufacturing standardization
- establish a mechanism of proactive information exchange
- work transparently together

Since that time

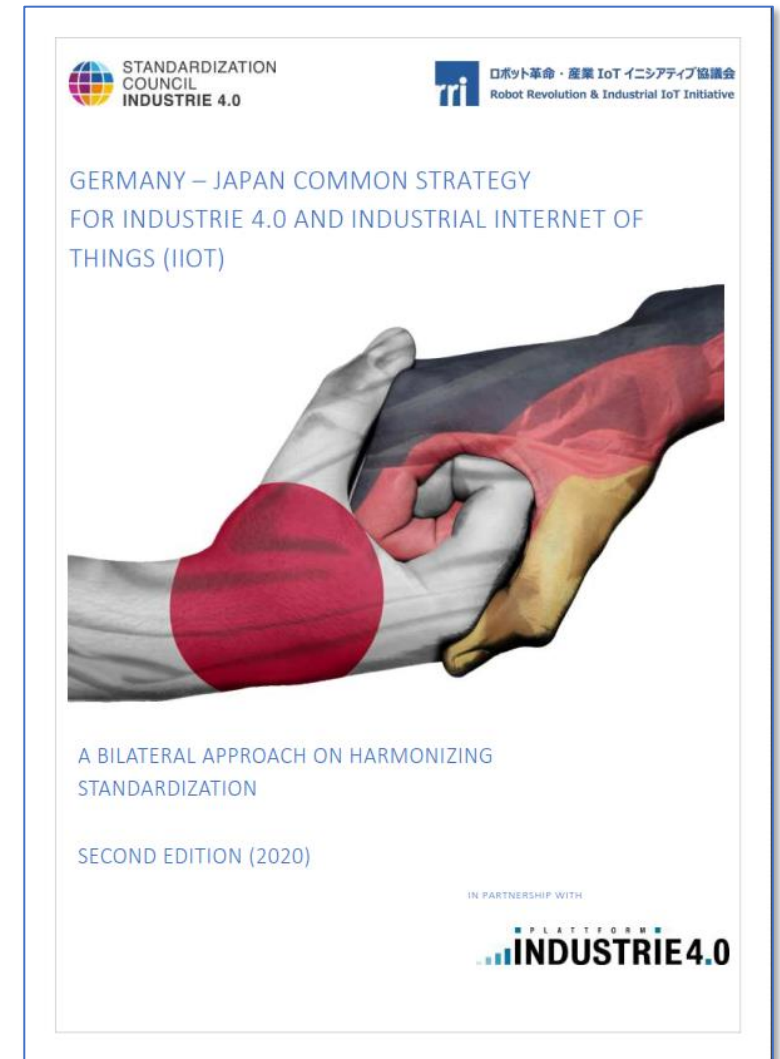
- 55 meetings of standardization experts
- 5 published discussion papers / white papers
- Presentations during
 - RRI-Forum
 - Industrie 4.0 Forum at Hannover Fair



First and second edition of Common Strategy Paper

October 2020: Update on the common strategy with more precise objectives and scope`:

- reaching a common understanding of standardization approaches and concepts
- continuation and establishment of constant and open information sharing
- supporting the adoption of national/international standards to harmonise the framework conditions
- identifying standardization requirements and providing input for several international standard activities
- prior study of the subject of standardization, and study for dissemination
- discussion and consideration of the future vision of standardization in smart manufacturing
- items related to standardization in problem solving future society such as Society 5.0 (Japan)



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Joint work as a pre-standardization activity

- Many urgent issues of sustainability, industrial innovation and social welfare for advancement of information society, e.g. Society 5.0
- Not only domestic but also international investigation mandatory
- Requirements and potential opportunities for international collaboration



- Standardization for smart manufacturing
- **Japan-Germany Standardization Collaboration:** deep and standing bilateral collaboration by experts
- **Pre-standardization activity:** identification of important potential standardization topics



- **Standardization activity:** ISO, IEC and other standardization organizations for clearly identified standardization topics based on international consensus

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Top-down Approach to Standardization

- Traditionally standardization work has been done, based on the “consensus” principle, assuming that technology is already known.
- In smart manufacturing era, standardization can not start from the existing standards or technology, but from the user’s high level vision and demand. Then detailed requirements are derived.
- Application scenario is a high level description for the future target.
- Requirements for standardization are derived from such high level user description in a top-down manner.
- Before going into the detailed technical discussion, it is important to agree on the requirements for target of standardization.

Top-down Approach to Standardization: Use Case

Top-down Approach

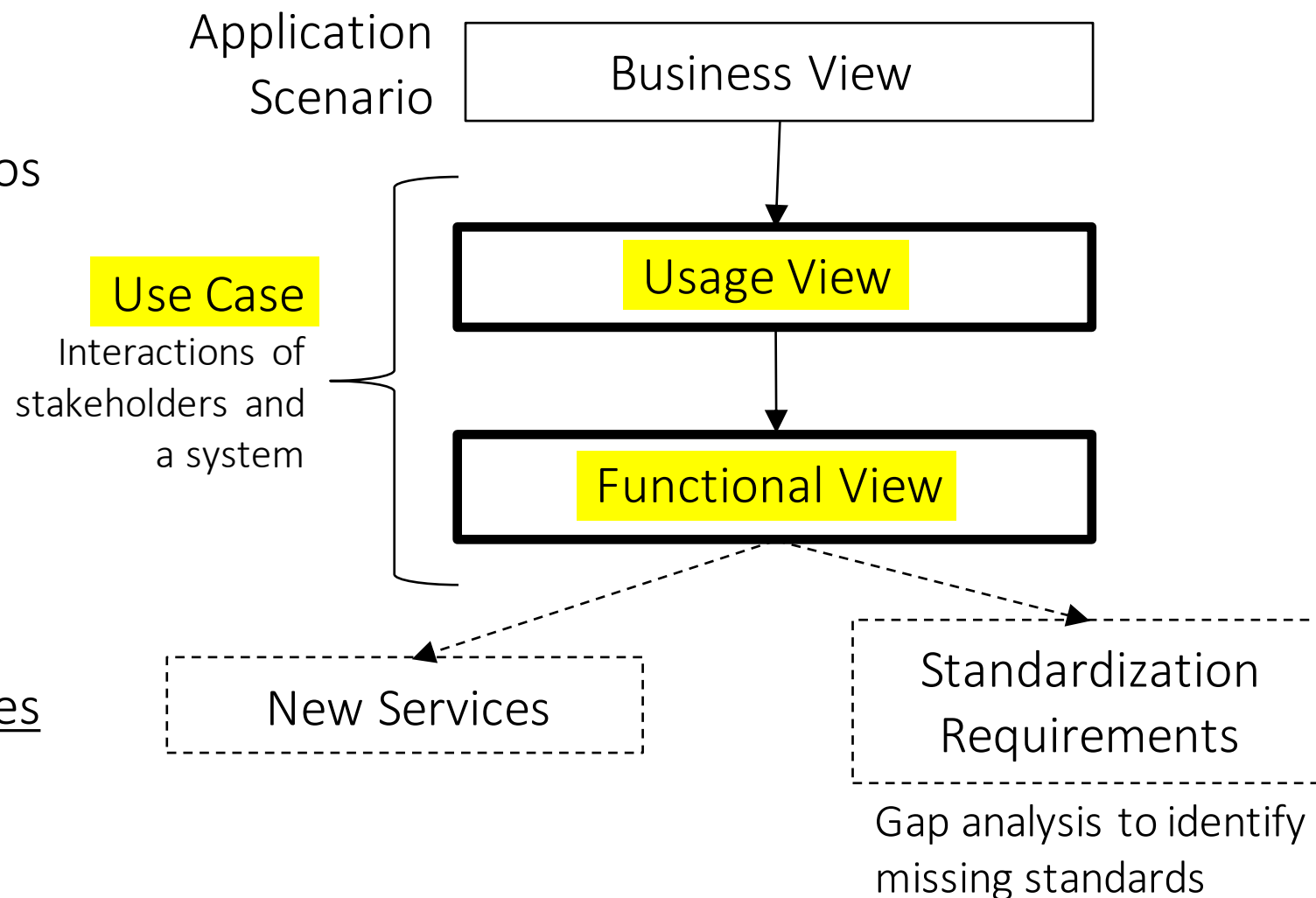
Possible future business scenarios



Technical **use cases**



New products, solutions, services
&
Standardization requirements

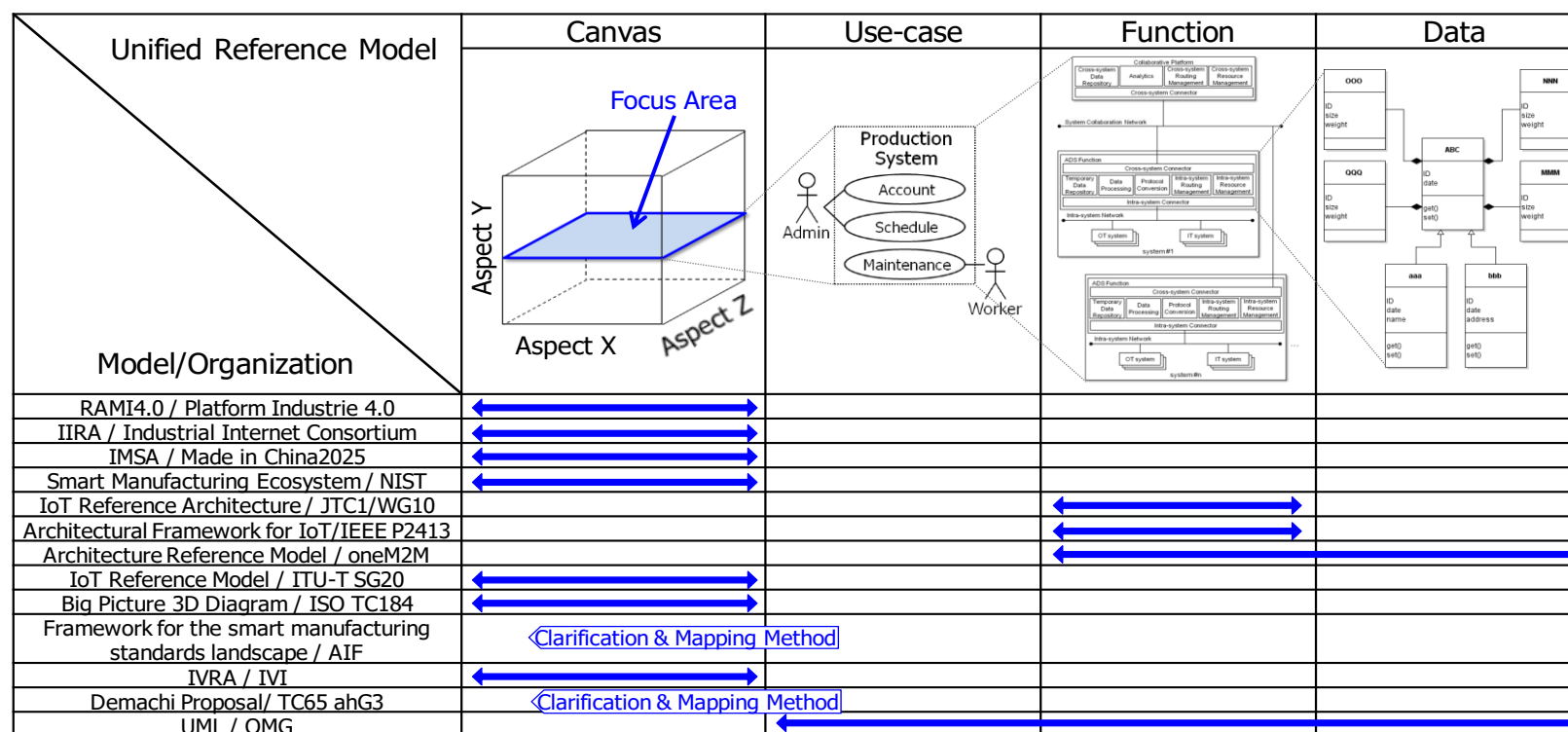


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URM-M: Unified Reference Model – Map and Methodology [2017]

Navigation tool for smart manufacturing system development

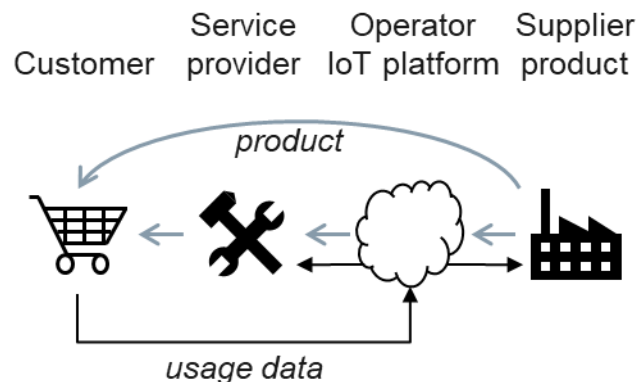
- URM-MM aims to provide map and methodology which show a procedural guide with relevant international standards and harmonize existing models to guarantee openness and interoperability at each development process.



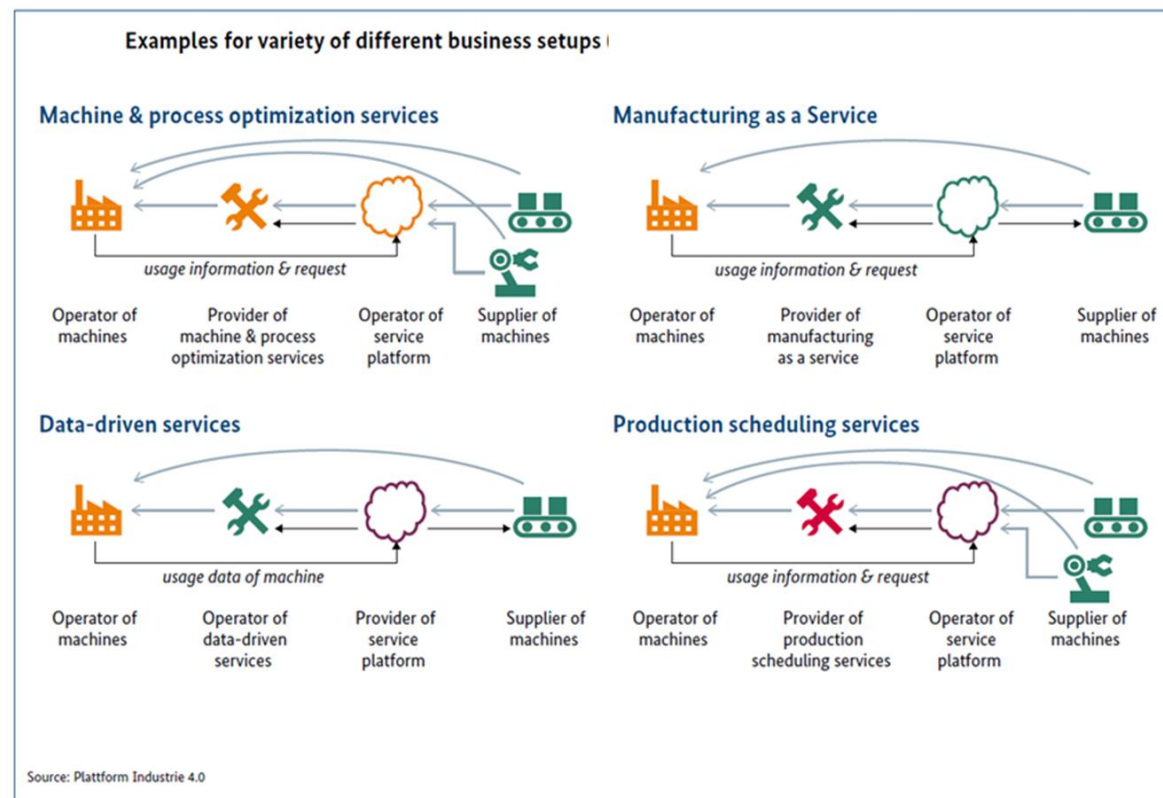
Today



Tomorrow



- New business roles: operator IoT platform and service provider
- Application scenario not focused on manufacturing industries and can be applied in other industries also



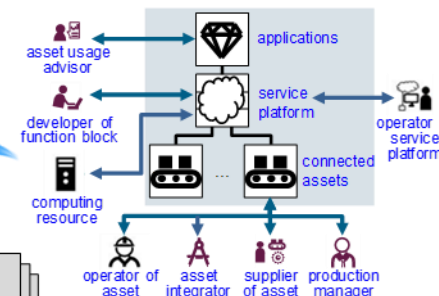
Objectives of Functional View analysis are;

- To be a reference for system designers who want to draw system architecture, function to work and information to share in the system, and necessary interactions between them for Value-based Service application
- To show hypothesis cases for standard developers who analyze requirements for future system and identify standards to be developed and promoted

Scenario name
Connection of an asset
Reconfiguration of an asset
Configuration of an application
Development of a library of function blocks
Development of a service platform
Collection of usage data of an asset
Analysis of usage data of an asset
Recording additional data on spontaneous request
Operation and maintenance of a service platform
Generation of recommendations resp. requests for action
Execution of recommendation resp. request for action
Benchmarking of assets
Continuous update of an asset model for improving usage data analysis of assets

Descriptions of Activities in Usage View are positioned as Scenarios and broken down into Steps between Actors following the form of IEC 62599-2

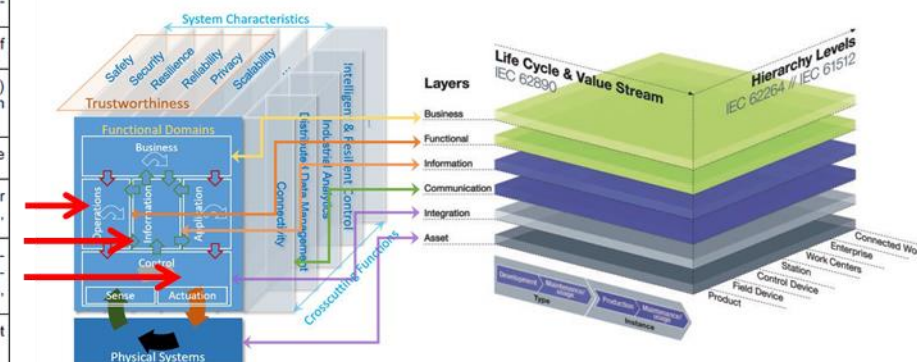
Step No.	Name	Description	Actors
SCN 06-1-	Collect usage data by asset	Asset monitors and records its own state (including results of operations performed by operator of asset)	Asset
SCN 06-2-	Collect usage data by operator of asset	Operator of asset records and observes the data of asset (without assuming specific application)	Asset and Operator of asset
SCN 06-3-	Collect usage data by service platform	Asset upload its data to service platform (by scheduled execution of the associated applications such as a data-collection algorithm)	Asset, Service platform and Computing resource



"What is done between which entities (Actors) ..."

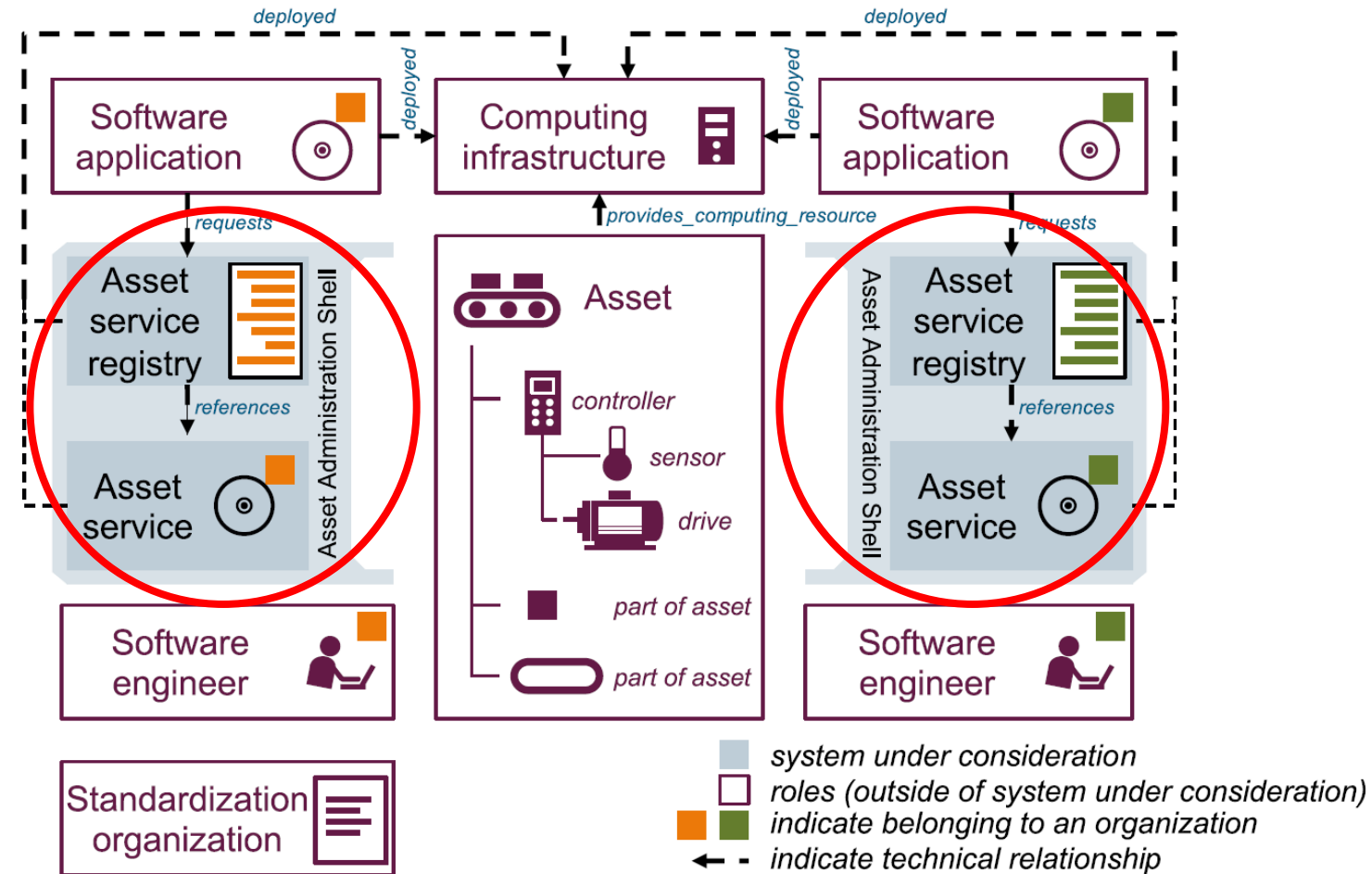
Functional domains	Requirement description
Asset management (Control)	Asset should disclose information about asset (e.g., transferable data types and available data transfer interface).
Communication (Control)	Asset should be able to (and allow service platform to) authorize and control data transfer from itself to specific actors and vice versa.
Communication (Control)	Asset should be capable of data transfer between itself and specific actors (with e.g., data transfer interface)
Asset management (Control)	Asset model (i.e., digital representative of asset) should be portable (so that the service platform can timely download and manage asset model).
Asset management (Control)	Asset and its model should be identifiable from service platform and applications.
APIs and UI (Application)	Asset should be able to receive external messages or commands sent by actors in various input modes (e.g., APIs, buttons)
Modeling (Control), Asset management (Control)	Asset and its model should be reconfigurable (in response to implicit change of environment (e.g., operation condition) and explicit messages sent by actors, service platform, and applications)
Data management (Information)	Consistency should be maintained between an asset and its digital representation in the service platform

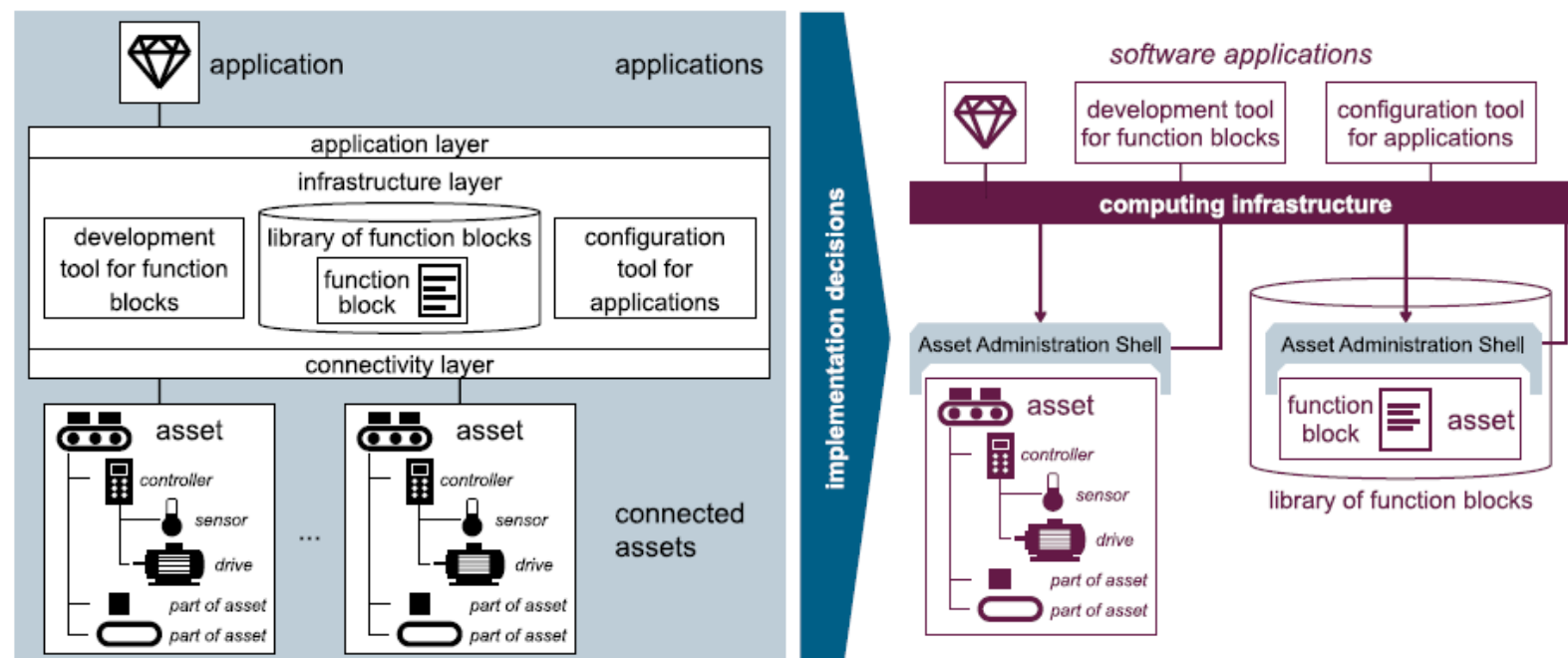
Requirements should be mapped on any of technology domains so that standard gap analysis can be made, finding what is missing in the current standard portfolio



Asset Administration Shell is digital representations of an asset:

- Structuring the information and functions of an asset in a uniform manner
- Decoupling an asset from the application specific interpretations
- Improving interoperability of an asset

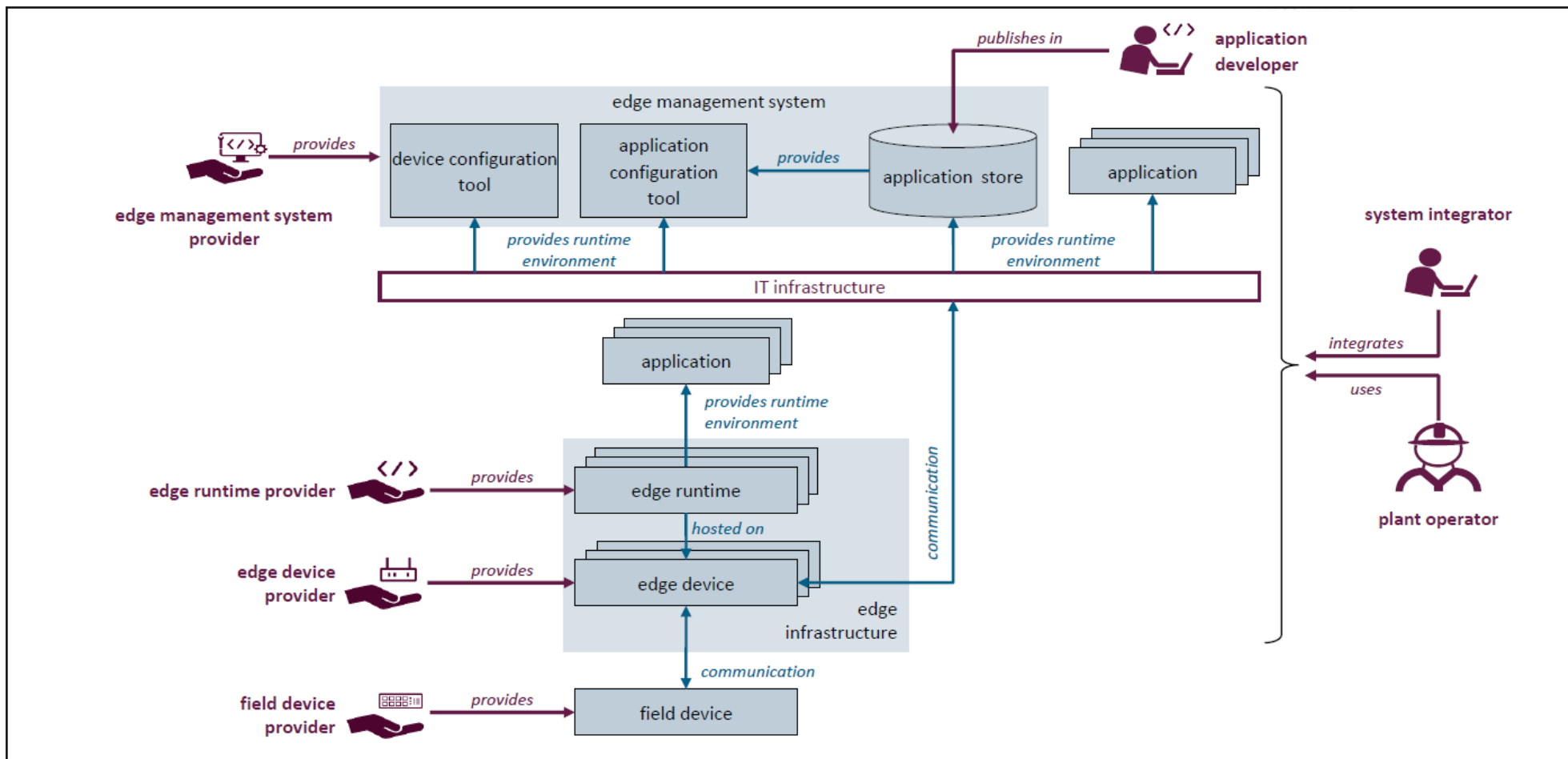




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Edge Management [2021]

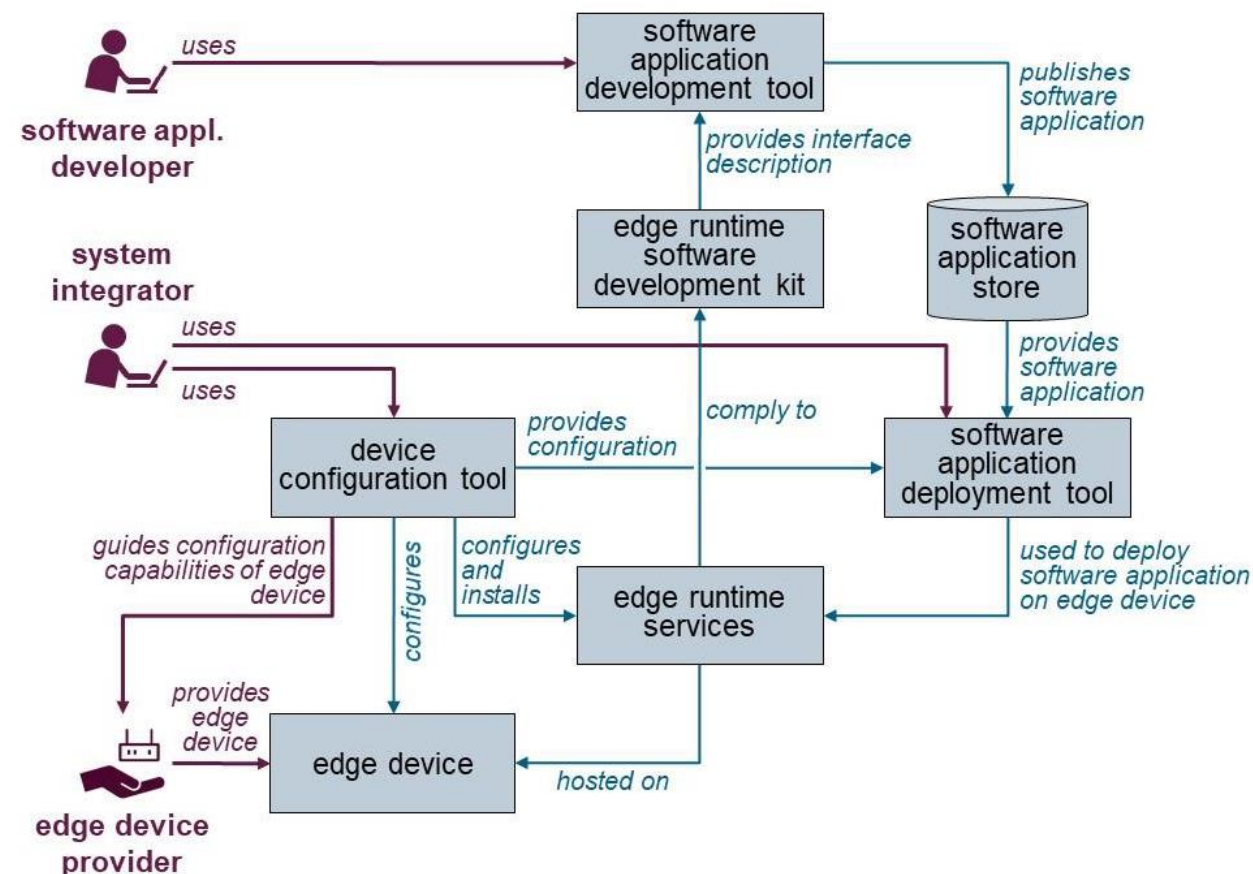
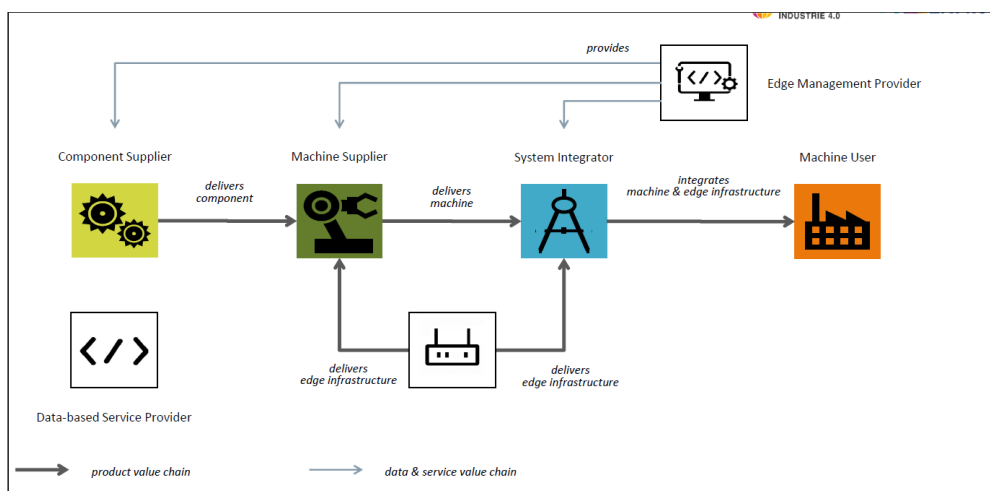
- Scope of Edge Management



Typical business cases

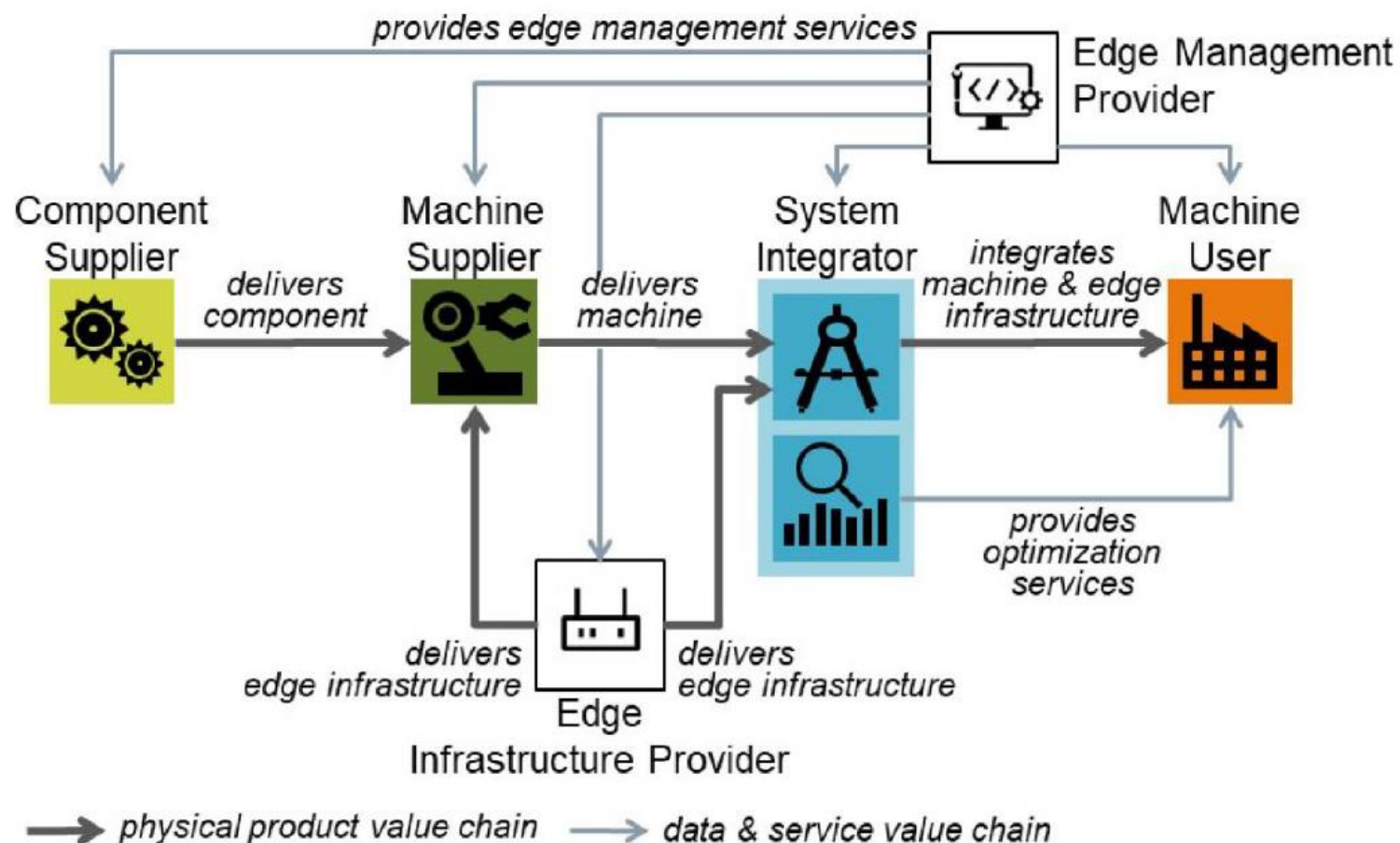
- Component supplier
 - New data-based services
- Machine supplier
 - Improved remote services
- System integrator
 - New, higher-value optimization services
- Machine user
 - Interested in all services above

Technical solution approach



New, higher-value optimization services

- Deliver optimization services based on gathered data
- New type of service is expected, as the “plug & operate” capabilities of machines and devices increase



- Basic technology is mature with the long history of related research and development.
- Intended concept of Digital Twin is not yet well understood: **bi-directional and dynamic cyber-physical integration throughout the whole life cycle.**
- Industrial implementation is in progress, but not yet satisfactory: superficial implementation based on simple tools.



- More systematic approach is mandatory for future sustainable evolution.
- Standardization is a basis for reducing the complexity and enhancing the interoperability.
- Critical review and knowledge sharing of the current status and identification of the gaps which hinder the practical usefulness are important.

Possible action items for Digital Twin

- Use case collection/review
 - Analysis based on scope/domain, viewpoint, maturity
 - Needs for standardization
- Comparative study of existing standardization activities
 - ISO, IEC, IEEE, Industrial consortia, etc.
 - Analysis based on scope/domain, viewpoint, etc.
- Future topics from industrial/social requirements
 - Reference architecture for industrial/social applications: usage/functional viewpoint
 - Example
 - Resilience across multiple industries/**social** infrastructure
 - **Environmental**/circular economy,
 - Long-term archiving,
 - Human-machine interaction/autonomy

Categorization of use cases for Digital Twin

- “Layer” dimension
 - Business – Usage – **Functional** – Implementation
 - Extended life cycle dimension
 - Process: **Supply chain** – Manufacturing management/execution – Maintenance – **Reuse/retirement**
 - Product: Material – **Parts** – **Assembly** – **Usage** – **Reuse/retirement**
 - Engineering: Engineering – Development – **Design** – Manufacturing preparation – **Redesign**
 - Hierarchy dimension
 - Inter-enterprises – Enterprise – **Work center** – **Device(control)** – **Device(physical)**
-
- Extended application domain
 - Manufacturing, Mobility, Food, Medical/welfare services, Logistics, Social infrastructure

Bold: already many examples

Red: still few examples -----> Huge potential benefit of utilizing Digital Twin concept

: Focus areas for the action items

Usage process for Digital Twin

- Interactions between cyber and physical world (to be elaborated)

	Cyber	Physical	static	dynamic
Supply chain	 → 		*	
Design/redesign	 →   ← 			*
Manufacturing execution	 ← 		*	
Use/reuse	 →   ← 			*
Extended <u>social</u> applications	 →   ← 			*

-  Models already existing or planned
-  Models affected or to be generated

- Missing characteristics
 - bi-directional and dynamic cyber-physical integration

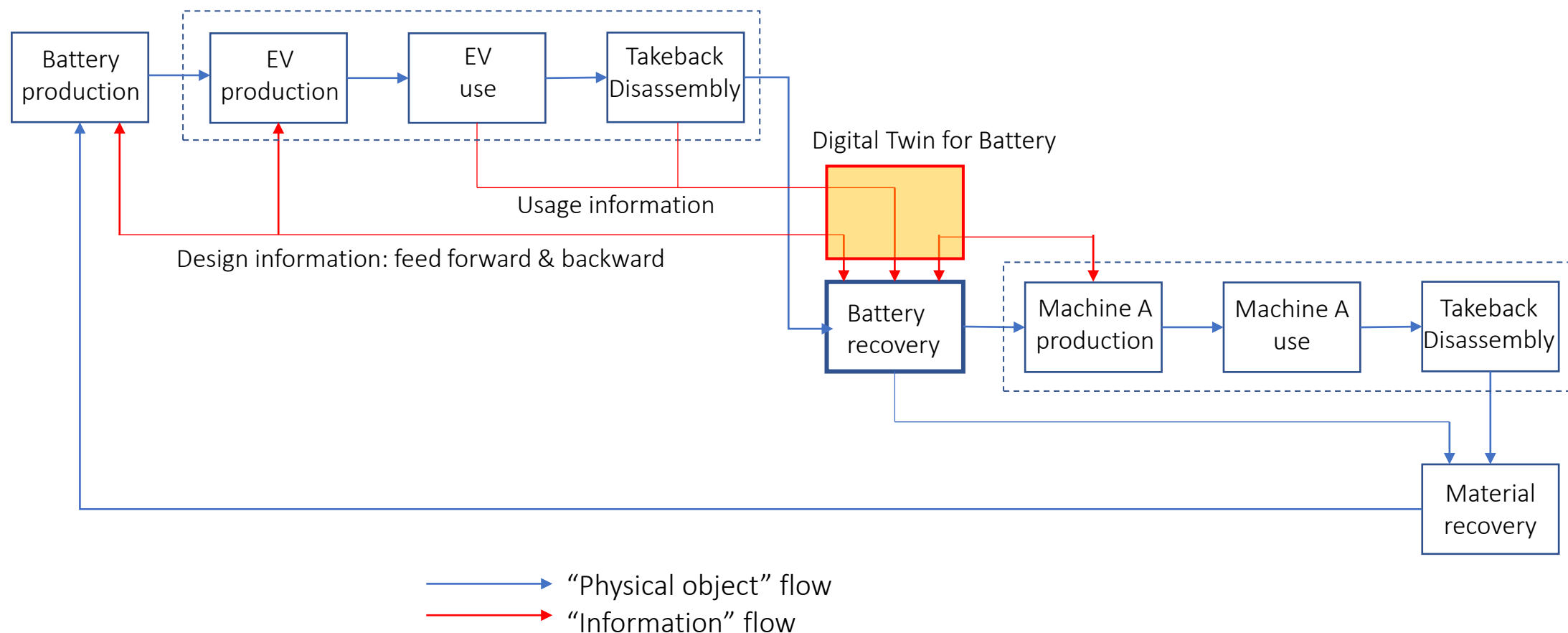
Use case: Reuse of products and production systems

Requirements for model contents

- Nominal product information
 - Functional/usage specification
 - Product configuration/assembly
 - Parts specification including materials for tracing environmental footprint
- Product usage information
 - Usage environment including dynamic changes
 - Usage history and associated data collected from physical world including environmental performance data (energy consumption, etc.)
- Used product information
 - Deterioration of product information including functionalities and materials, etc.
 - Evaluation of quality and reliability
- Product behaviour information
 - Dynamic behaviour including all aspects of physical/logical behaviour
- Redesign/reconfiguration information
 - Redefining functionalities based on product usage data
 - Updating related product information

Use case: Reuse of products and production systems

Example: EV battery reuse for multiple purposes



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How it works in Japan

- Diversified participants
 - Not focusing on standardization only
 - Necessity and benefit of standardization for future industry and society
 - Inclusion of various organizations, e.g., industrial/academic associations
 - Same technology with different context in Japan and Germany
 - Elaboration of different requirements and enablers for deep mutual understanding
 - IEC Syc SM and RRI/AG1, etc.
 - Horizontal interactions among standardization-focused organizations
- 
- Deep and standing bilateral collaboration by experts

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Standardizing Industrie 4.0

Triangle of Digital Transformation



- Strategic planning / recommendations
- International cooperation strategy
- SME integration



- | | |
|---|--|
| <ul style="list-style-type: none"> ▪ Initiation of cross sectoral standards ▪ Coordination of national and international standards ▪ Cooperation with international fora & consortia | <ul style="list-style-type: none"> ▪ Network of pilot projects ▪ Practical piloting and validation of concepts ▪ Validated return of results into standardization |
|---|--|



“Standardization roadmaps on Industrie 4.0 are important blueprints to shape the digital ecosystem.”

- Available in English and German at:
<https://www.sci40.com/english/german-roadmap/>
- Also available in 日本語
<https://www.jmfrri.gr.jp/document/library/1645.html>
- Reduce complexity, and to provide recommendations for uniform descriptions and specifications
- Over 60 Experts from Industry, Academia and Research involved
- Secretariat by SCI 4.0
- *“Door opener”* for SME into standardization of digital manufacturing

Standardizing Industrie 4.0

Progress Report 2022



- Available in English and German at: <https://www.sci40.com/sci-4-0/normungsroadmap/>
- Show the progress of the recommendations for standardization work
- Update the recommendations (if applicable)
- Input for new edition of standardization roadmap



- Edition 5 is scheduled for Hannover Fair 2023
 - 17. – 21. April 2023
 - <https://www.hannover.de/en/view/content/586447/full/0/672366>
- Update of existing chapters and recommendation for standardization work
- New or extended topics:
 - Sustainability
 - Data spaces

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Digital Product Passport a Concept from EU Commission

2022 March 30th:

EU KOM published draft of ESPR (**Ecodesign Requirement for Sustainable Products**)

→ Requirements for a Digital Product Passport (DPP)



The EU Digital Product Passport (DPP)



WHAT

*A structured collection of product related data with predefined scope and agreed data ownership and access rights conveyed through an **unique identifier***

HOW

***Decentralised** system with a central registry*

SCOPE

Information related to sustainability, circularity, value retention for re-use/remanufacturing/recycling

Digital Product Passport



Tracking of **raw materials extraction/production**, supporting due diligence efforts



Enable **manufacturers** to create products **digital twins**, embedding all the information required



Tracking the life story of a product, enabling services related to its **remanufacturing, reparability, re-use/re-sale/second-life, recyclability**, new business models



Benefit **market surveillance authorities and customs authorities**, by making available information they would need to carry out their tasks



Make available to **public authorities and policy makers** reliable information. Enable to link **incentives to sustainability performance**



Allow **citizens** to have access to **relevant and verified information** related to the characteristics of the products they own or are considering to buy/rent (e.g. using apps able to read the identifier)

International or European **Standards** will be needed at least in the following areas:

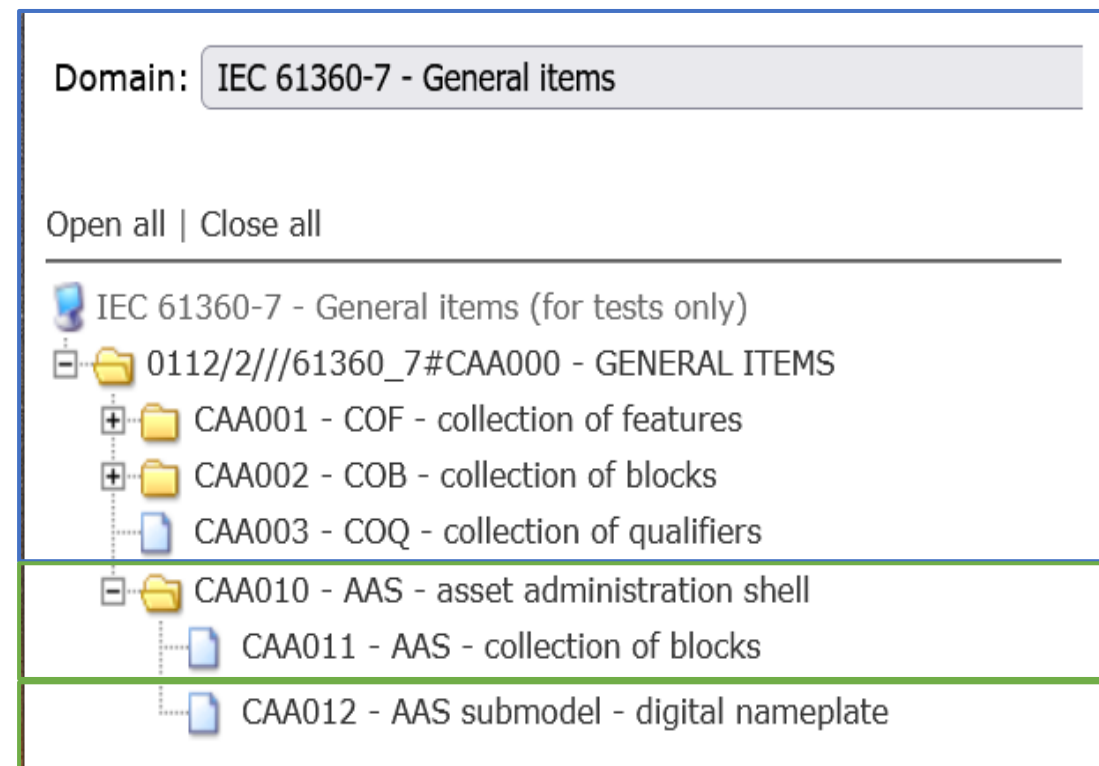
- Data carriers and unique identifiers
- Access rights management
- Interoperability (technical, semantic, organisation), including data exchange protocols and formats
- Data storage
- Data processing (introduction, modification, update)
- Data authentication, reliability, and integrity
- Data security and privacy

The Digital Product Passport

- ... is a concept from EU Commission
- ... could and should be based on technical concepts of industry → AAS
- ... requires definitions for the content of DPPs for specific product categories
 - ... This could be accomplished by submodels of AAS
 - ... Could and should be internationally standardized

AAS Submodels and the Support by IEC CDD

- The AAS shall become an international standard developed by IEC/TC 65/WG 24 in IEC 63278-series
- Selected AAS sub-model templates shall also become international standards
- Example: „Submodel Digital Nameplate“ (developed by IEC/SC 65E/WG 2)
- IEC/SC 3D proposes to develop such selected AAS sub-model-templates as “Database-standards” with publication in new IEC CDD domain IEC 61360-7



German approach in the area of standardization

- German standardization strategy (roadmap) is updated on a regular basis
 - New topics are added like sustainability and data spaces
- The AAS is a central element for digitizing German industry and data-based value chains
- The concept is very generic and can be applied to many use cases
- EU Commission aims for digital data exchange for sustainable products
- Concept of AAS could be applied to this use case



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- Standardization is important for realizing smart manufacturing towards global and sustainable developments.
- Germany and Japan have agreed to cooperate in the international standardization activities by sharing information and setting up consistent strategy and action plans. To widen the perspective, the cooperation seeks also to involve future visions of standardization related to smart manufacturing.
- The underlying aim and motivation for the collaboration is to maintain an open forum for timely information sharing and active discussion on any interesting issues of smart manufacturing and its standardization.

ありがとうございます
Vielen Dank

