FACTORY-X

Factory-X

Customer Sounding Board
June 24, 2025

PART OF MANUFACTURING-X

Supported by:
Federal Ministry for Economic Affairs and Energy
Funded by the European Union
NextGenerationEU
on the basis of a decision by the German Bundestag

Agenda
Topics and Presenters

Topic	Presenter
Welcome, Introduction & Moderation	Silke Huesmann Roland Rosen 
Factory-X Use Case Overview and MX-Port	Ulrich Löwen 
TP 2.05 Modular Production	Dominik Dahlmann Markus Lieret 
TP 2.06 Manufacturing-as-a-Service	Birgit Obst 
Discussion & Closing	All

After each part of presentation we have time for questions

FACTORY-X

Factory-X

The Digital Ecosystem for Factory Outfitters and Operators

Factory-X is a Lighthouse Project for Manufacturing-X

- Building the **open** and **collaborative digital ecosystem** for Factory Outfitters and Operators upon Catena-X and concepts of Platform Industry 4.0
- Focus on **11 dedicated use cases** to extend the existing horizontal supply chain-oriented use cases and add vertical use cases to integrate the operation of shop floors
- Under the leadership of Siemens and SAP, **47 partners** are working together in this strong consortium, supplemented by **10 associated partners**
  (companies, associations and research institutions)
- **Manufacturing-X wide coordination** and establishment of an **international Manufacturing-X network**
- Project started on February 1st, 2024
- Completion of Project by June 2026

Factory-X Partners

- August Wilhelm Scheer Institut
- Arvato Systems Digital
- BASF
- Berger Holding
- Catena-X e.V.
- Codewerk
- DMG MORI
- Empolis
- EPLAN
- Estainium
- Festo
- Fraunhofer
- German Edge Cloud
- Hilscher
- ifm diagnostic
- IFW - Leibniz Universität Hannover
- igus
- inovex
- InstaWerk
- ISW - Universität Stuttgart
- Lenze
- LNI e.V.
- Matchory
- MT Analytics
- Open Industry 4.0 Alliance
- Pakic
- Phoenix Contact
- prenode
- proALPHA
- RIF Engineering & Consulting
- Ruhr-Universität Bochum
- SAP
- Scheer GmbH
- SCHUNK
- SDFS Smarte Demonstrations-fabrik Siegen
- SICK
- Siemens
- SmartFactory-KL e.V.
- soffico
- Software GmbH
- TRUMPF
- T-Systems
- TÜV SÜD Chemie Service
- Uhlmann Group
- VDMA e.V.
- WITTENSTEIN
- ZVEI e.V. (FE)

Factory-X Associated Partners

- ARENA2036 e.V.
- Bayern Innovativ
- Beckhoff Automation
- Digital Data Chain
- Eviden
- IDTA e.V.
- Robert Bosch
- Sharecat Solutions
- VDE e.V.
- ZVEI e.V.

Factory-X goes public
Registration over https://factory-x.org/

Manufacturing-X Technical Council

What is the Manufacturing-X Technical Council?

- Factory-X aims to create an IT/SW technical basis (the „Factory-X Kernel“) for software solutions in Manufacturing-X using results from Catena-X.
- In the M-X Technical Council, the approaches are presented – depending on the project progress – and feedback is invited.

Who is it for?

- The Manufacturing-X Technical Council is aimed at anyone who is interested in the application of the IT/SW technical “Factory-X Kernel”, e.g., for the implementation of their own software solutions within the framework of Manufacturing-X.

When? #4 is on June 26, 2025

Customer Sounding Board

What is the Customer Sounding Board?

- In Factory-X, various so-called business applications (software solutions) are designed, developed as prototypes and validated for 11 use cases.
- In the Customer Sounding Board, these are presented – depending on the project progress – and feedback is invited.

Who is it for?

- The Customer Sounding Board is aimed at anyone who is interested in using, e.g. validation, the business applications of the use cases or who wants to create their own software applications that are interoperable with Factory-X.

When? #4 Now!

What‘s next?

Further MX TC und CSB will follow and we aim for direct exchange! If necessary, via NDAs.

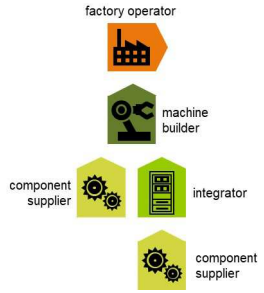
Factory-X Use Case Overview and MX-Port

Factory-X Use Cases Generate Business Benefits For Participating Companies Through Cross-Company Data Sharing

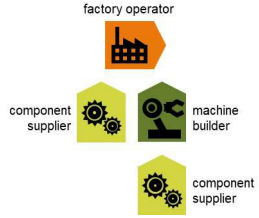
FACTORY-X

11 Use Cases for data transfer along product and production system supply chain

Int. Toolchains & Collab. Engineer.



Inform. Update and Change Service



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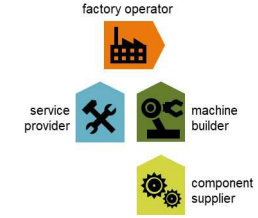
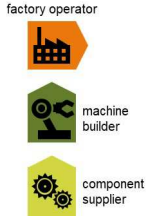
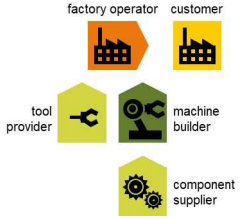


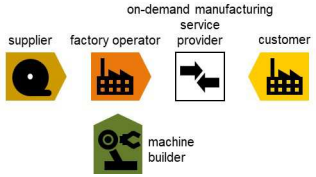
Condition Monitoring led Services



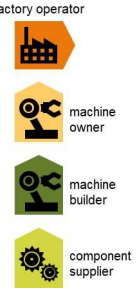
Modular Production



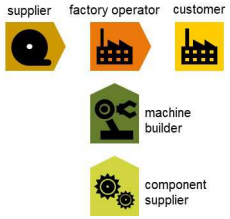
Manufacturing as a Service



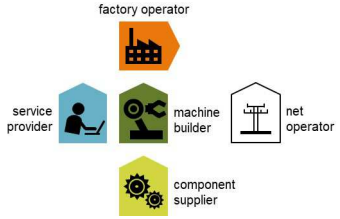
Autonomous Operation aaS



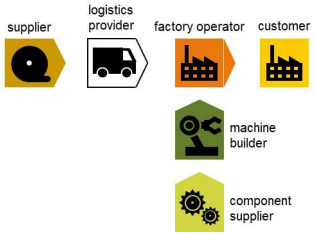
Traceability



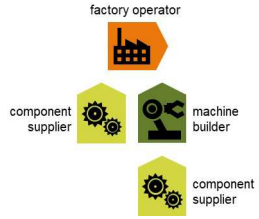
Energy-Consump. & Load Mgmt.



Carbon Footprint Management



Circular Economy



Factory-X Use Cases Generate Business Benefits For Participating Companies Through Cross-Company Data Sharing

11 Use Cases for data transfer along product and production system supply chain

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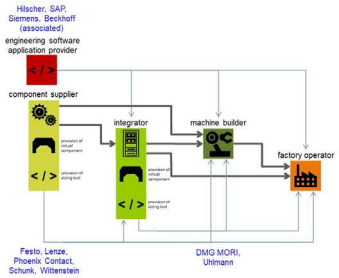

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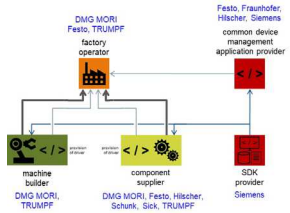
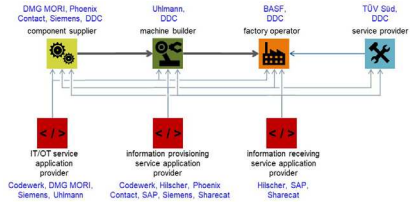
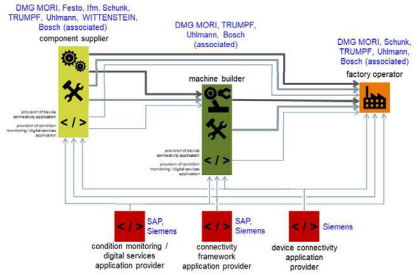


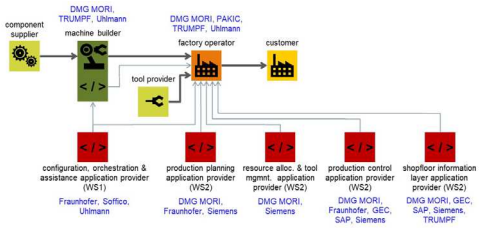
Collaborative Information Logistics



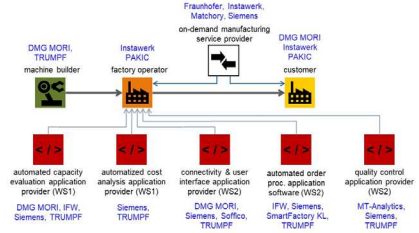
Condition Monitoring led Services



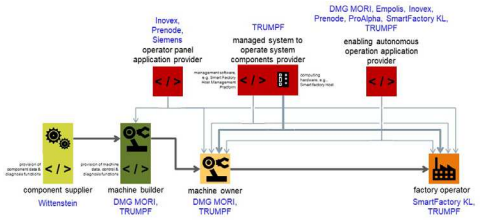
Modular Production



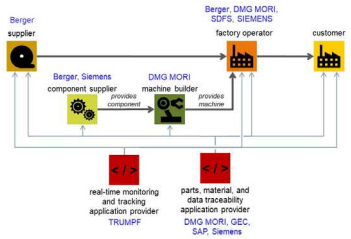
Manufacturing as a Service



Autonomous Operation aaS



Traceability



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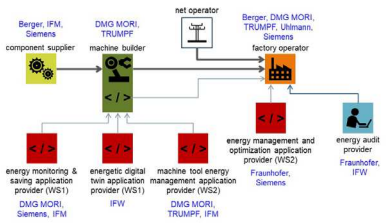
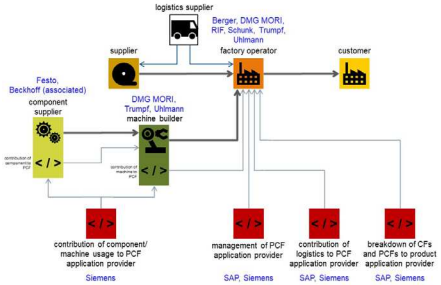
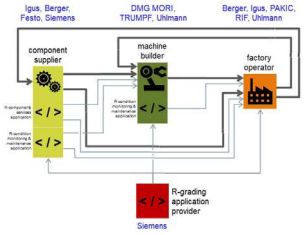


Carbon Footprint Management



Circular Economy



Factory-X Use Cases Develop Overarching Requirements For Shared Services From An Application Point Of View

FACTORY-X

11 Use Cases for data transfer along product and production system supply chain

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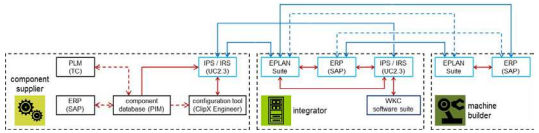

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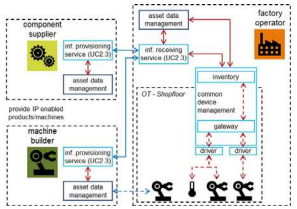

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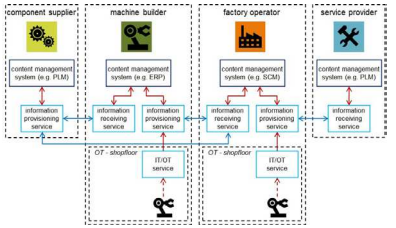

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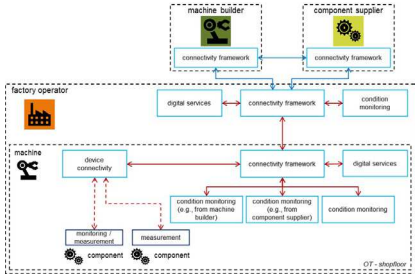
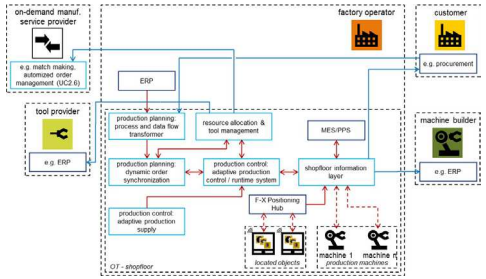


Modular Production



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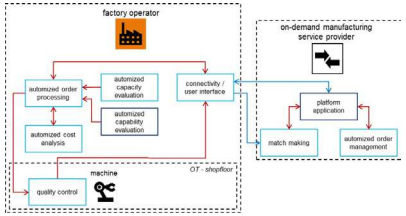
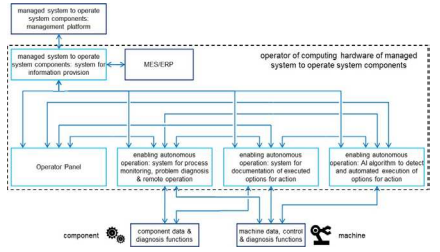


Autonomous Operation aaS



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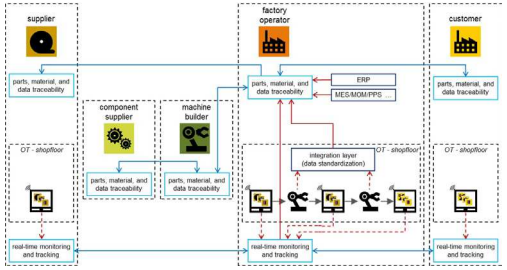

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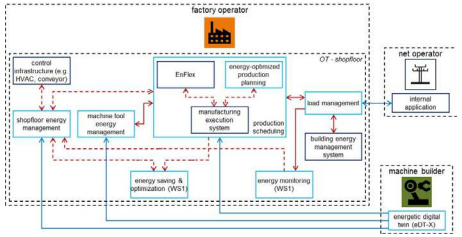
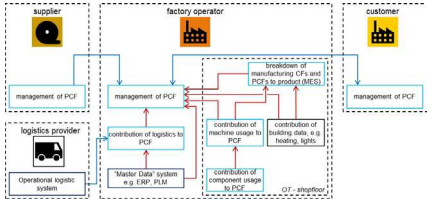
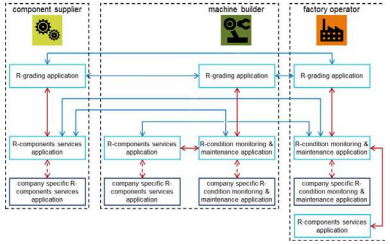


Carbon Footprint Management

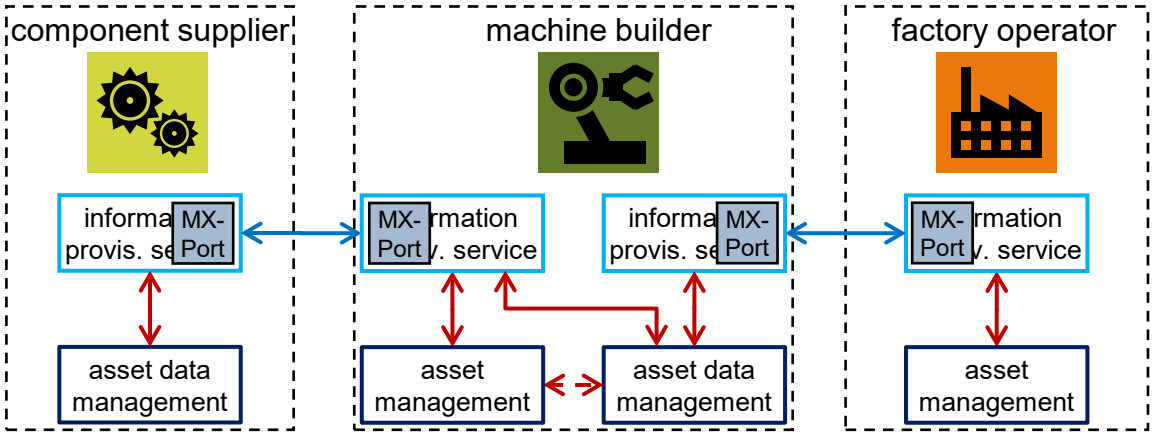


Circular Economy

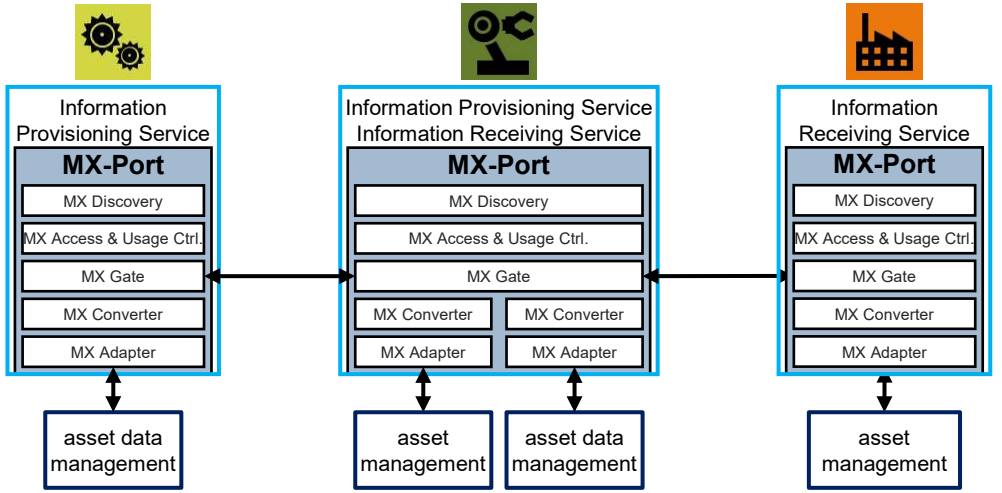


Factory-X Use Cases Have Agreed To Implement Interactions Between Software Applications In A Uniform Manner (MX-Port)

Usage View (Illustration)



Technical View (Illustration)



Interaction between TP2 and TP4

- Based on the requirements, TP4 specifies MX-Port and provides prototype implementations
- The use cases build demonstrators and decide whether to use the MX-Port provided by TP4 or develop the required MX-Port themselves – but **in compliance** with the TP4 specification

Using the MX-Port in a first step we realize two MX-Port configurations[1]

Generic structure of MX-Port

- Layered structure with different functional manifestations per layer
- Use case can configure specific MX-Port according to its needs

Layer	Components for configurations
MX Discovery	A1 A2
MX Access & Usage Ctrl.	B1 B2
MX Gate	C1 C2
MX Converter	D1 D2 D3
MX Adapter	application specific

options

individual configuration

Configuration “Leo”

- IEC 63278 / IDTA compliant; AAS as integration technology for cross-company data sharing

Layer	MX-Port “Leo”[4]
MX Discovery	ID-Link
MX Access & Usage Ctrl.	AAS security[2]
MX Gate	AAS-REST
MX Converter	AAS sub model
MX Adapter	application specific

Configuration “Hercules”

- Using DSP/DCP for cross-company data sharing

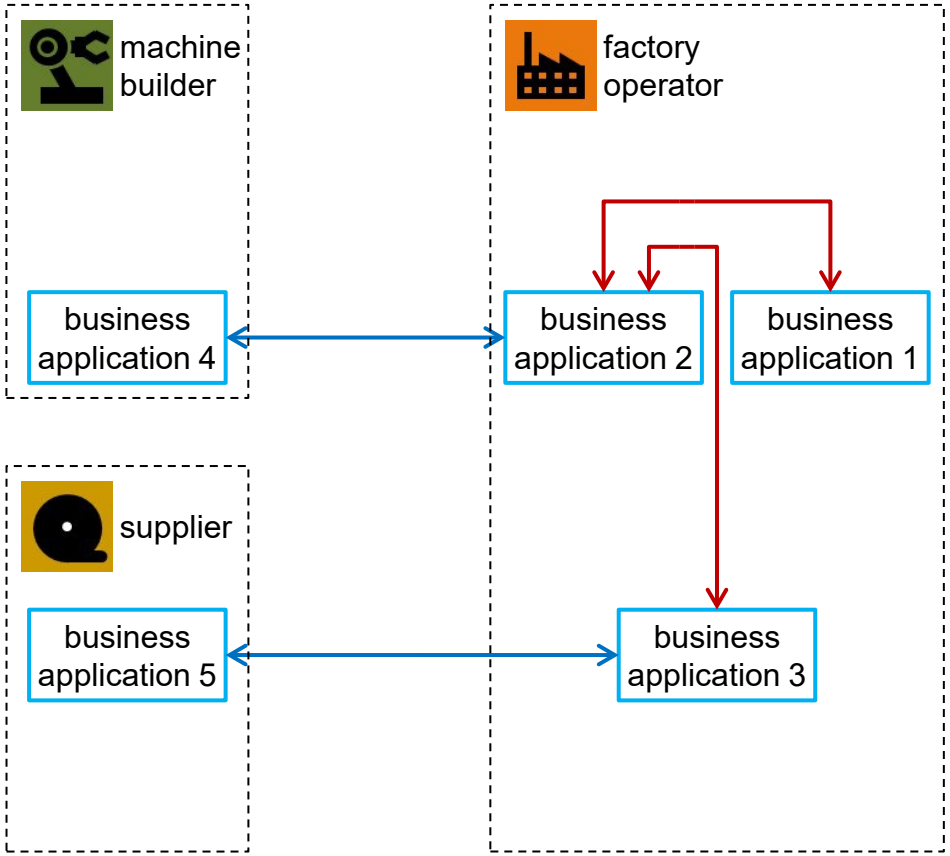
Layer	MX-Port “Hercules”[4]
MX Discovery	Data Space Protocol / Decentral Claims Protocol[3]
MX Access & Usage Ctrl.	
MX Gate	AAS-REST
MX Converter	AAS sub model
MX Adapter	application specific

1) Factory-X is using constellations name for MX-Port configurations
2) For example, reference to IDTA-01004-3-0 and IEC63278-3
3) Concrete implementation by Factory-X will be an EDC adaption (realized as open source)
4) **Other configurations can use different technologies / standards like OPC UA, OPC object model, Automation ML …**

Example how to combine “Leo” and “Hercules”
Opposite MX-Ports must be configured the same

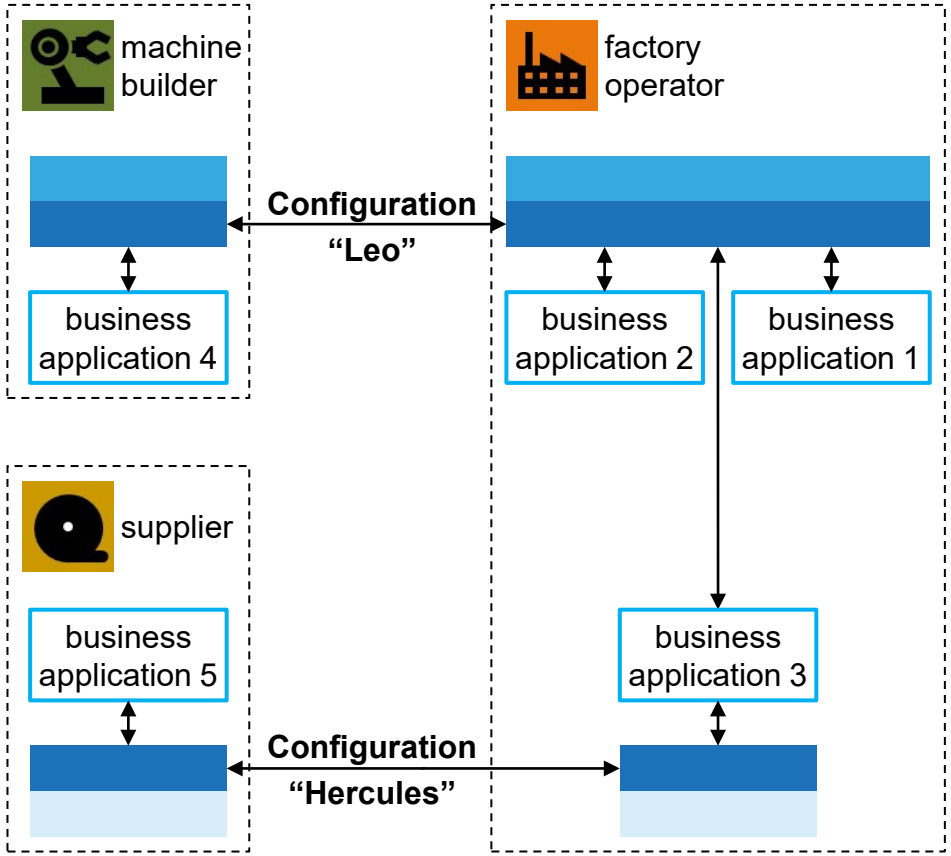
FACTORY-X

Usage View



design decision of use case

Technical View



FX Gate, FX Converter, FX Adapter: AAS-REST / OPC UA etc.
FX Discovery, FX Access & Usage Ctrl.: ID-Link, AAS security / OPC UA Part 2
FX Discovery, FX Access & Usage Ctrl.: DSP/DCP

Factory-X Use Cases Aim To Attract Many Interested Parties From Outside The Factory-X Consortium For Their Use Case

FACTORY-X

It is important to keep the entry barrier for data sharing as low as possible

- Example 1: To share publicly available data, no provision of access control measures shall be required
- Example 2: If a data provider wants to protect its data with a mechanism appropriate to its business environment, the data provider shall not be forced to implement a different mechanism

Therefore, the use cases require different MX-Port configurations; expressed very simply:

- **MX-Port configuration Leo:** a data provider provides data via an AAS server in accordance with IDTA guidelines without having to meet additional requirements
- **MX-Port configuration Hercules:** a data provider and data consumer can only share data if **both** meet the requirements of “Catena-X”

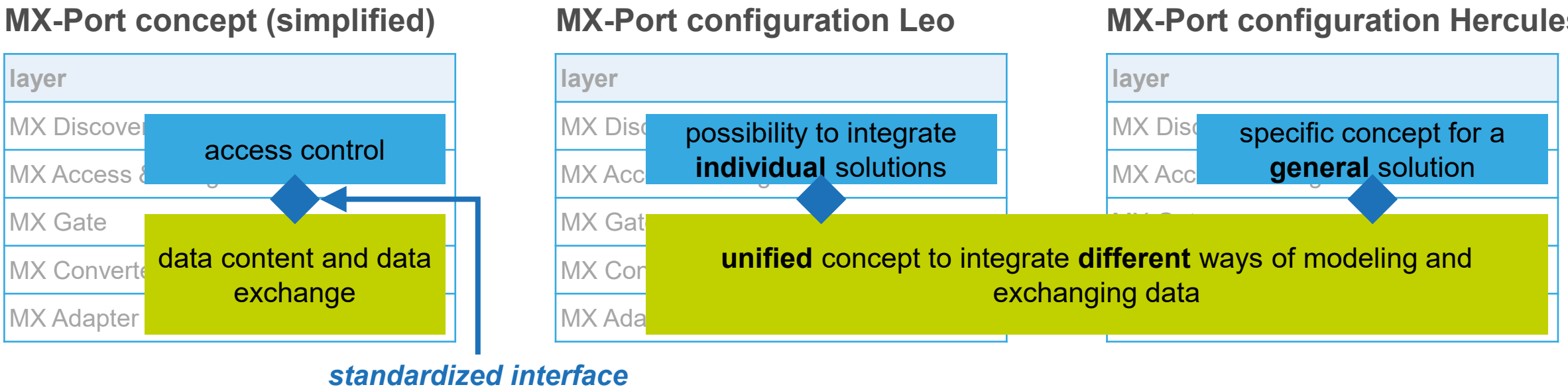
The use cases are fully aware of the following trade-off

- The greater freedom with Leo **increases** the complexity of data sharing, but **accelerates** the scaling of the ecosystem (low barriers to data provider participation)
- The greater restriction with Hercules **simplifies** the complexity of data sharing, but **hinders** the scaling of the ecosystem (increased barriers to data provider participation)

Factory-X Use Cases Promote The Coexistence Of “Leo” And “Hercules”

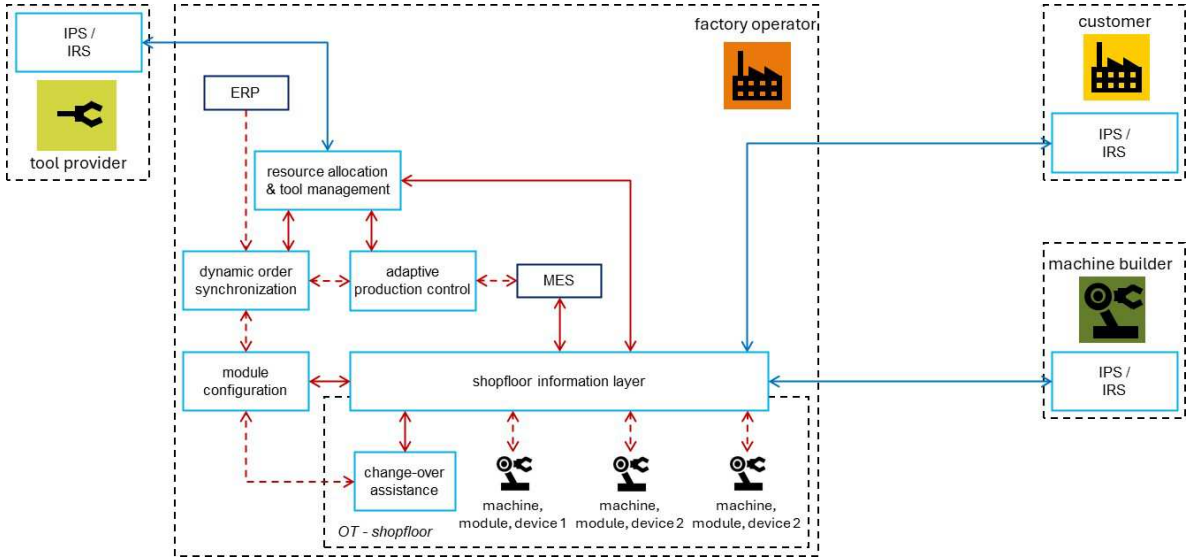
A core value of Factory-X is the content standardization of internal data of a data provider, combined with a standardized exchange mechanism for this data

- Essential **prerequisite** for making internal data understandable, accessible, and usable (for oneself and then, if necessary, for others)
- Another value of Factory-X is standardized access control for shared data; for many use cases, this value proposition is currently secondary to data standardization

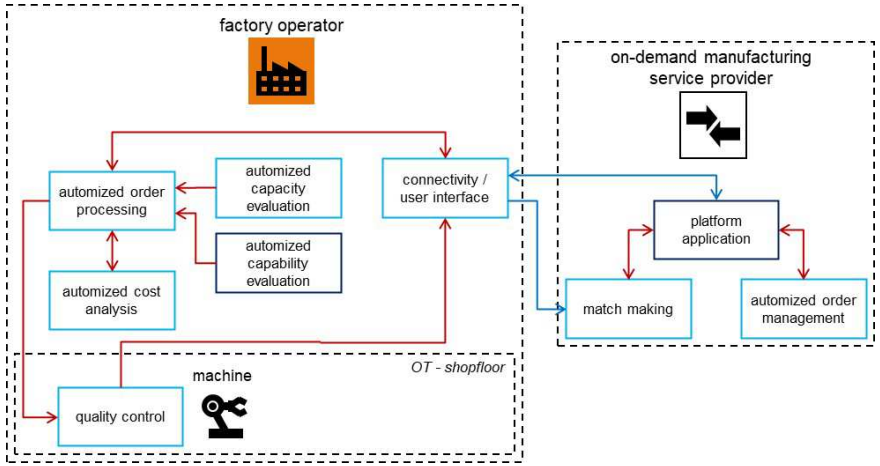


Presentation Of Selected Use Cases

UC5

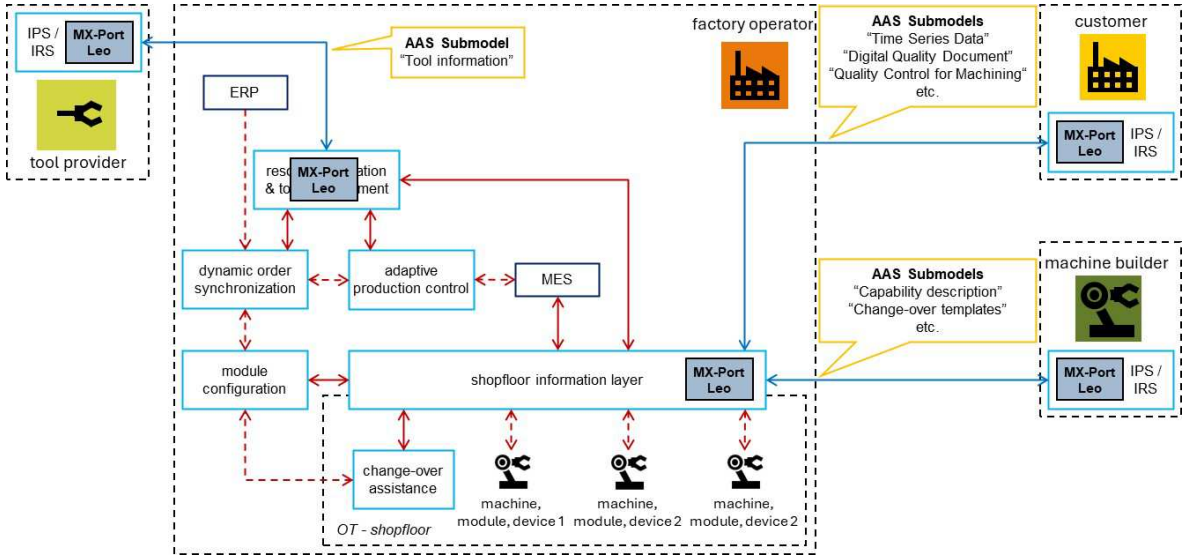


UC6

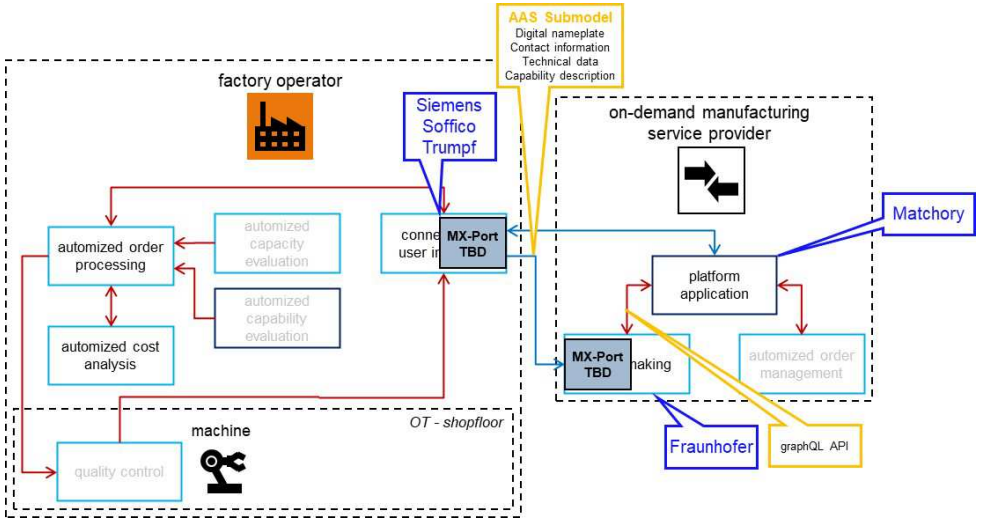


Presentation Of Selected Use Cases

UC5



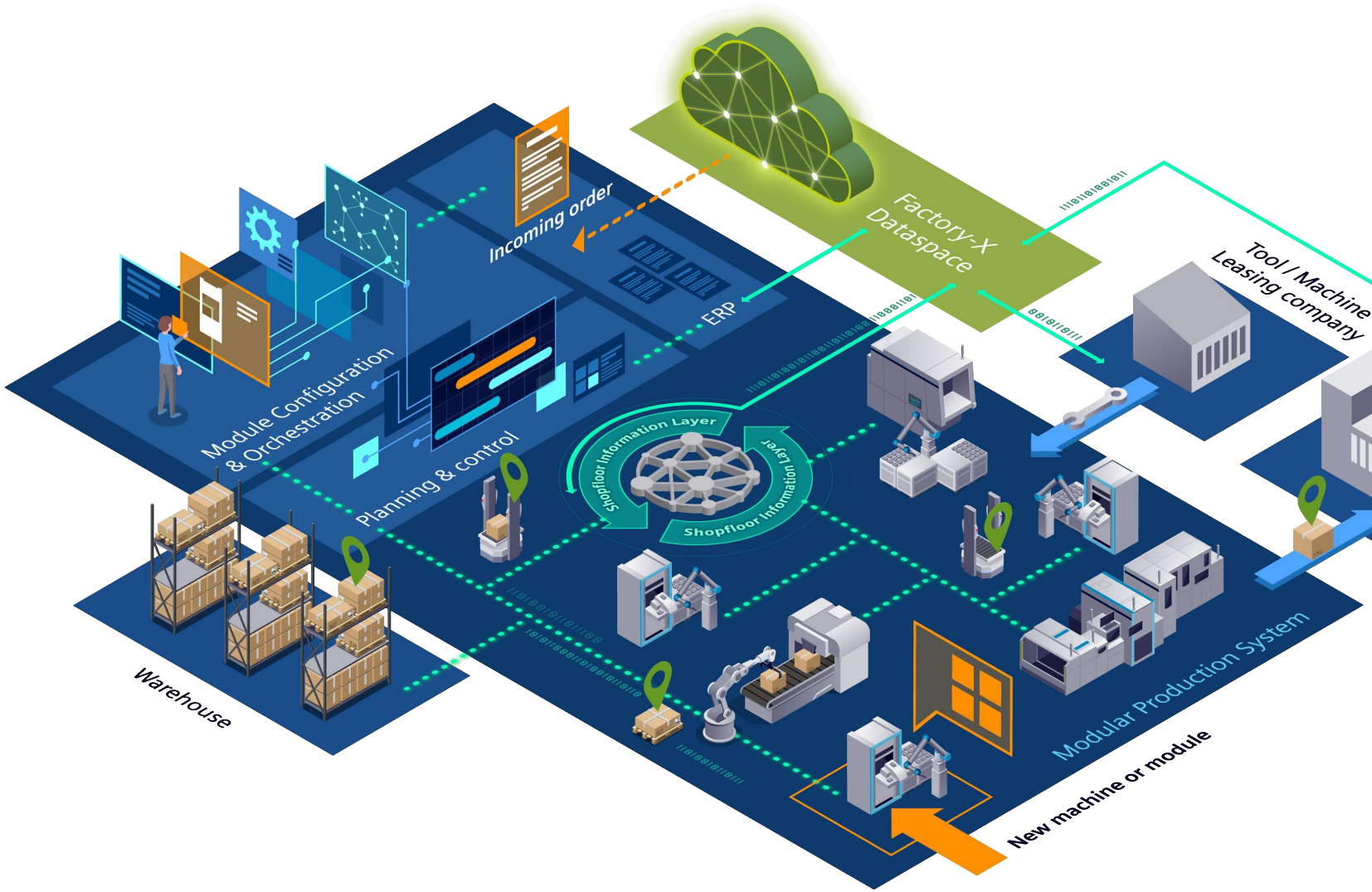
UC6



FACTORY-X

TP 2.05
Modular Production

Modular production systems need to capabilities and flexibility to adapt to new production requirements or unforeseen events.



Analyze incoming orders to determine suitable target machines and configurations

Determine optimal machine configuration / shopfloor setup to fulfill a set of orders

Consider (re-)configuration and provisioning times as well as machines states during scheduling

Create specific operator guidance to bring machine from configuration A to B

Receive and provide all relevant information via FX dataspace in interoperable and sovereign way

TP2.5 - Modular Production provides solutions to simplify and optimize both production set-up and control.

FACTORY-X

Identified pain points

- High costs for data integration and IT/OT convergence limit production flexibility (especially for brownfield systems)
- Commissioning, maintenance and change-over are time-consuming and require a high level of technical expertise
- Modular machine setup is not yet mapped in software and requires redundant user input
- Missing flexibility during re-scheduling in the case of short-term or unforeseen events and no insights of the implications
- Shopfloor data and machine feedback is not / only partially considered during planning and production control
- Missing / immature planning tools for machine configuration: Which modules are suitable for a task? How long does the change-over take?

FX solution in detail

- Usage of interoperable, semantic self-description for shopfloor assets and standardized interfaces and information models
- Requirement-based, (semi-)automated configuration of machines and modules and generation of operator guidance
- Continuous integration of shopfloor events for adaptive production planning and short-term re-scheduling in case of unforeseen events

Benefits of the FX dataspace

- The FX data space enables the sovereign and interoperable exchange of order information, module descriptions, configuration information and shopfloor data.
- Reyling on common standards and protocols in the data space allows the automated adaption of production resources and ensures flexibility to increase resilience and competitiveness.

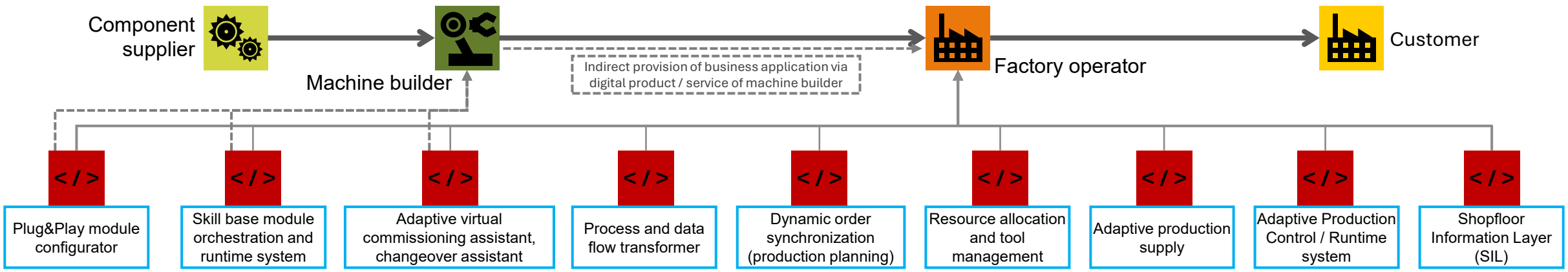
TP2.5 - Modular Production provides solutions to simplify and optimize both production set-up and control.

FACTORY-X

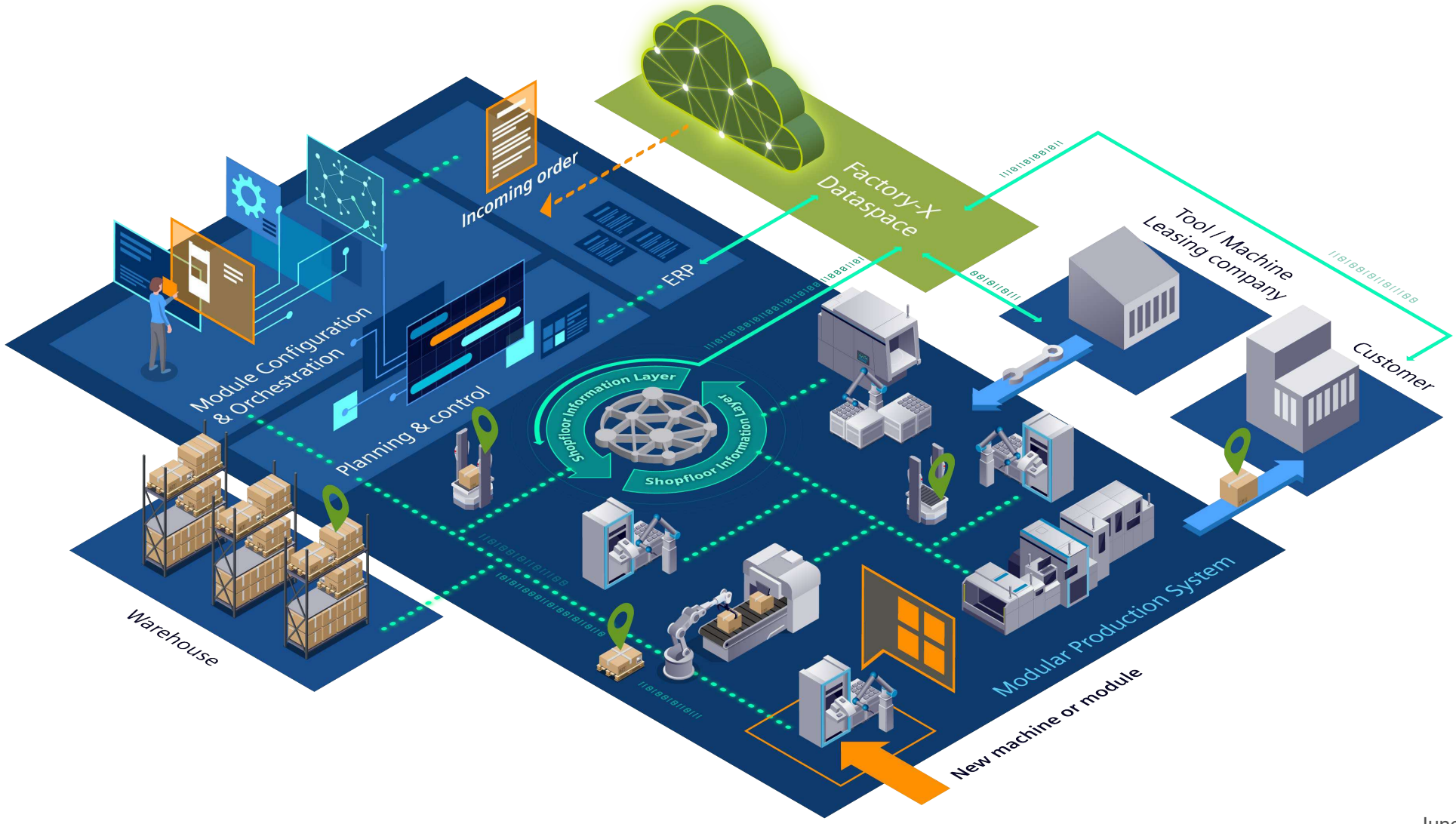
- Optimize your production with automated configuration of machines and workstations. Reduce setup and downtime while minimizing potential sources of errors.
- Achieve flexibility and adaptability of production resources to increase resilience and competitiveness
- Maintain stable and high-performing production even during a shortage of skilled workers, enabling greater flexibility and adaptability.

Involved partners

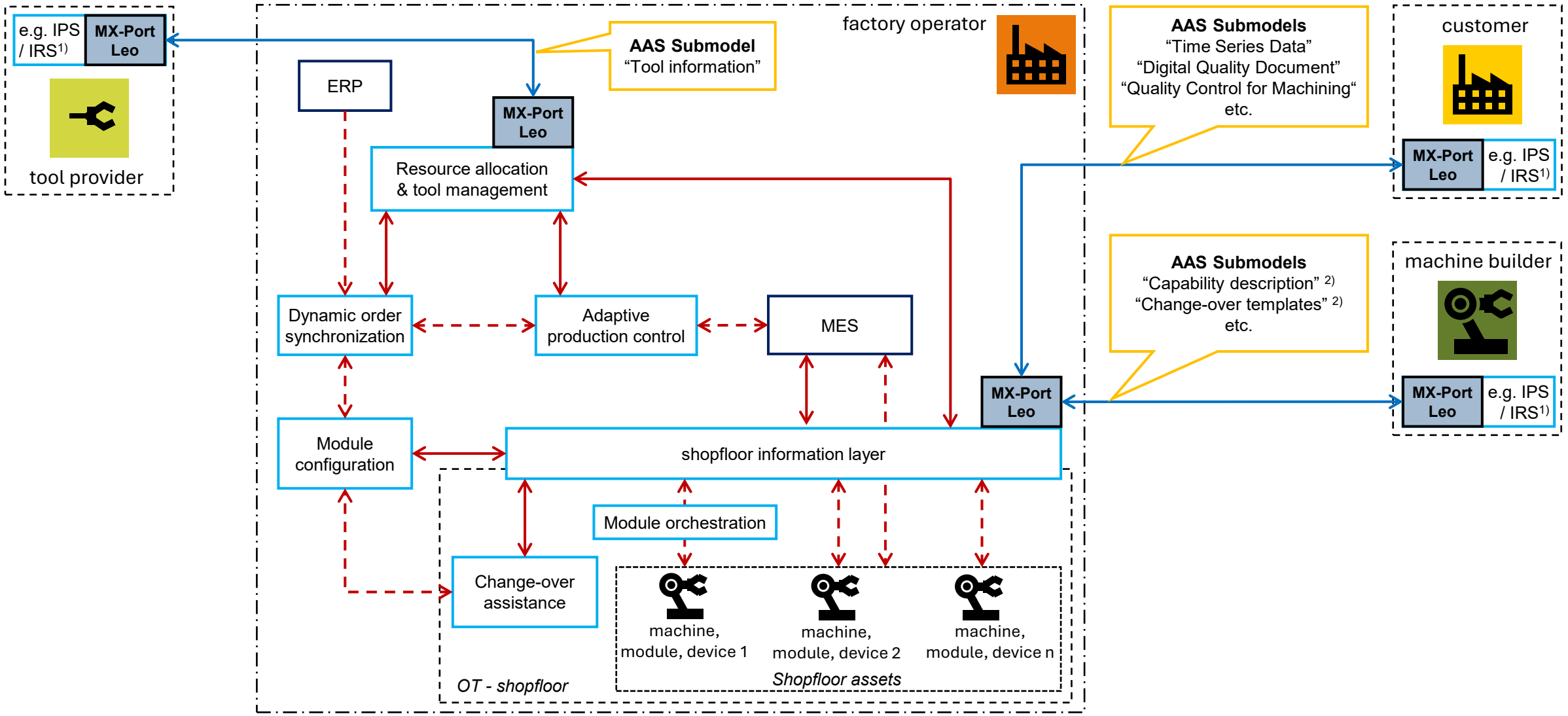
DMG MORI, Fraunhofer, GEC, PAKIC, SAP, SIEMENS, soffico, TRUMPF, UHLMANN GROUP



Modular production systems need to capabilities and flexibility to adapt to new production requirements or unforeseen events.



The usage of FX Port Leo allows the efficient and interoperable exchange of asset data, module descriptions or shopfloor data.

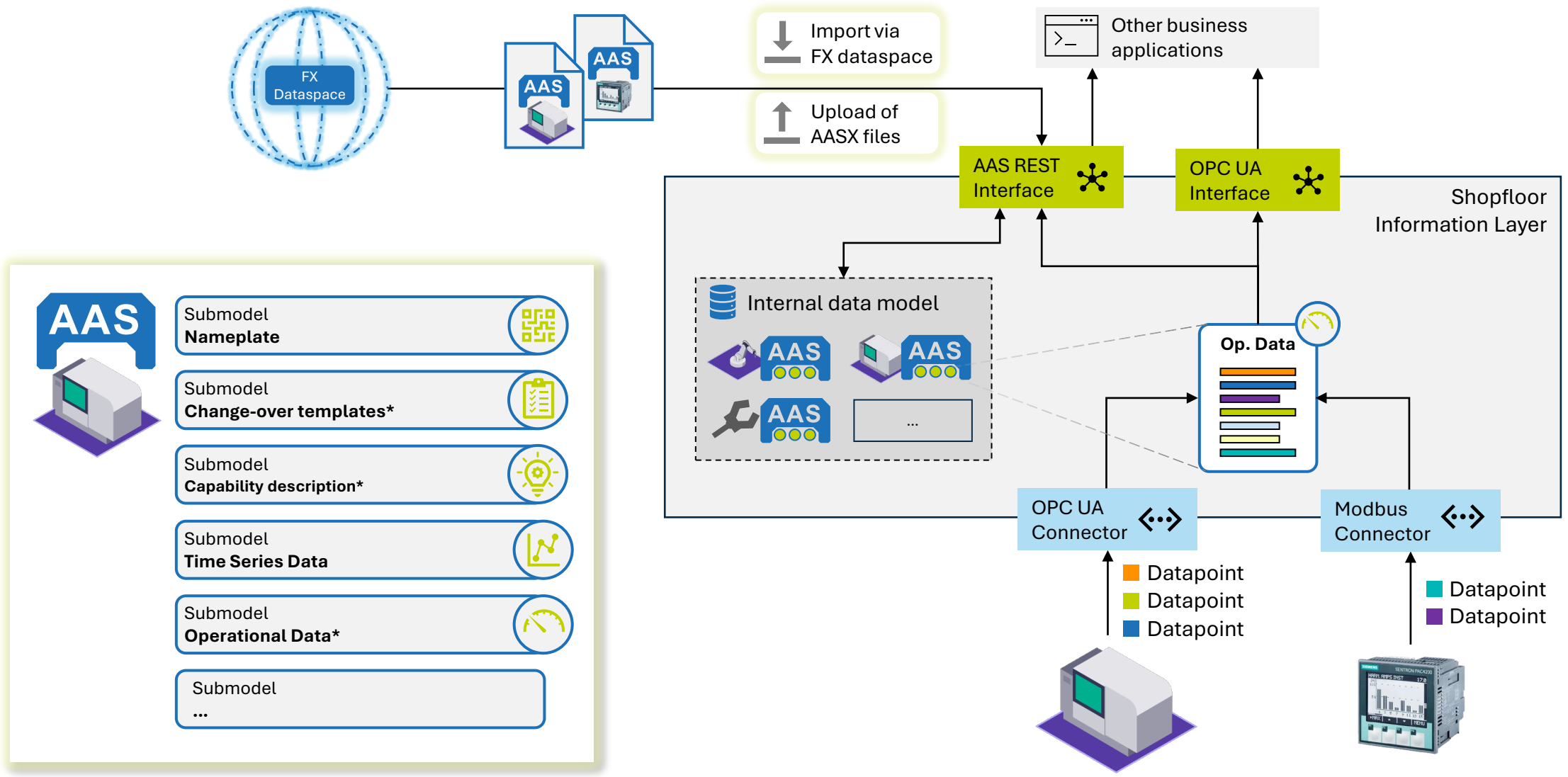


* For simplification not all business applications are shown

1) Information Provisioning/Receiving Service

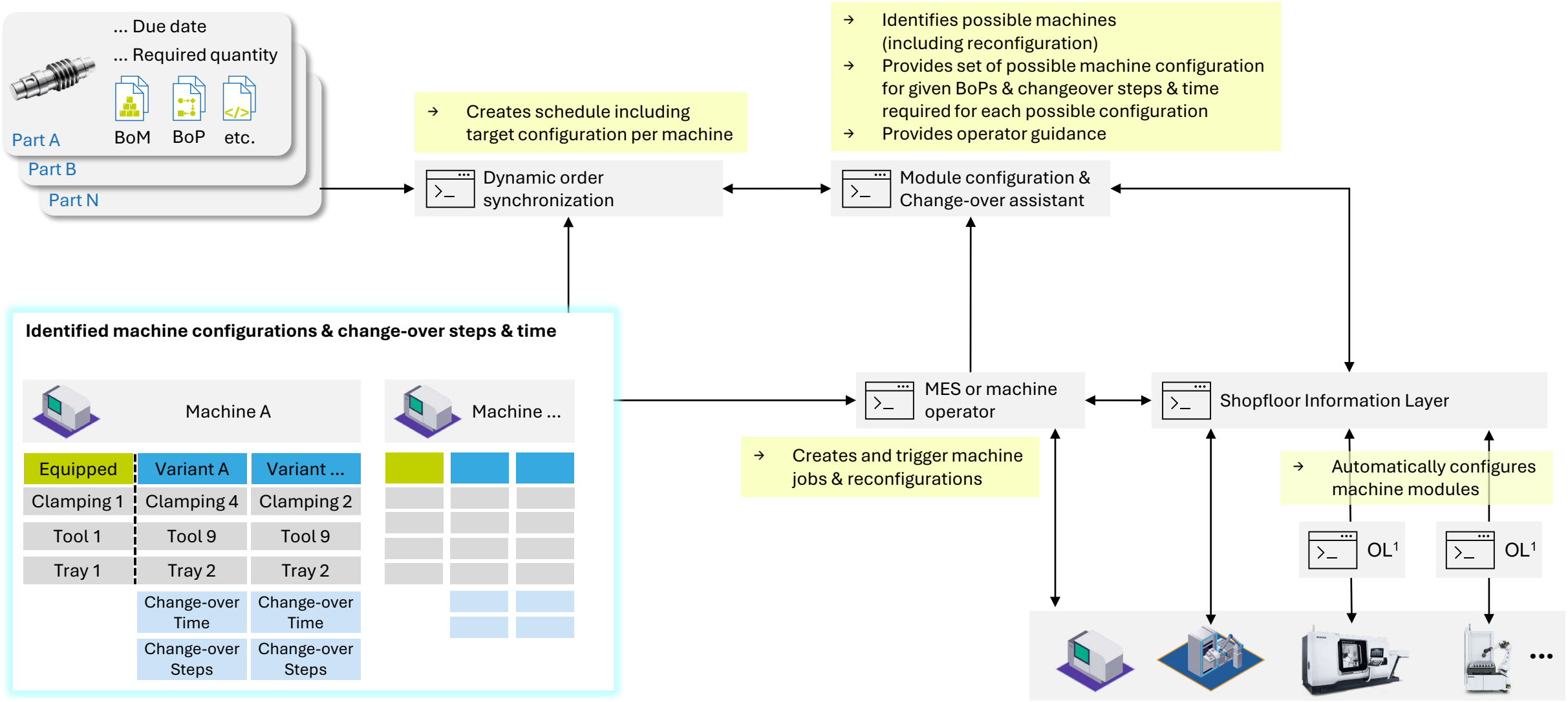
2) Custom AAS submodel, no provided by IDTA

Relevant asset information can be accessed via the FX dataspace and provided to other BA via the Shopfloor Information Layer (SIL).



* Custom AAS submodel, no provided by IDTA

Machine configurations, schedules and operator guidance is are generated based on order data, digital twins and shopfloor data.



* Simplified process, not showing all inter- or transactions as well as involved business applications

[1] Orchestration Layer

Machine configurations, schedules and operator guidance is are generated based on order data, digital twins and shopfloor data.

FACTORY-X

Part A
... Due date
... Required quantity
BoM BoP etc.
Part B
Part N

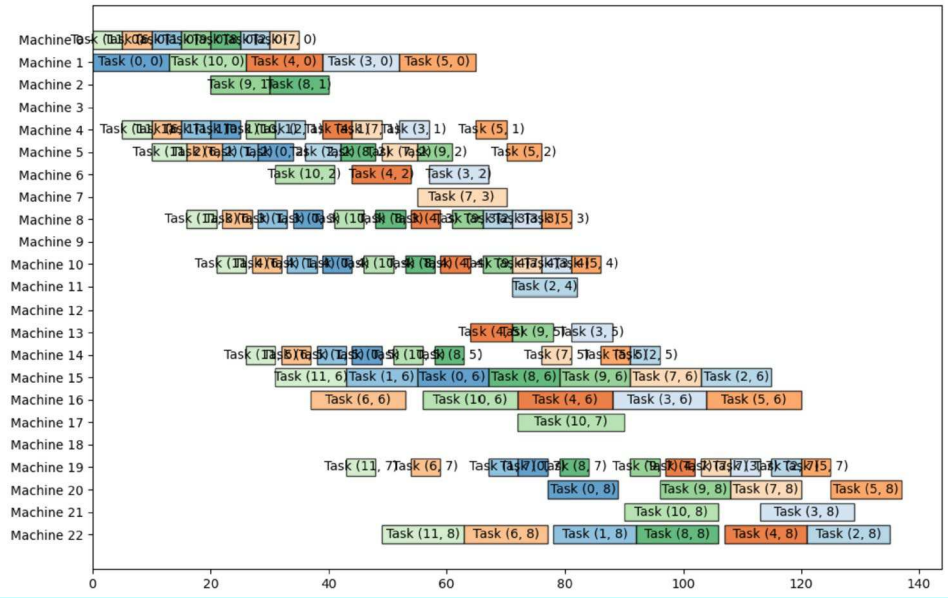
→ Creates schedule including target configuration per machine

→ Identifies possible machines (including reconfiguration)
→ Provides set of possible machine configuration for given BoPs & changeover steps & time required for each possible configuration
→ Provides operator guidance

Dynamic order synchronization

Module configuration & Change-over assistant

Resulting schedule



MES or machine operator

Shopfloor Information Layer

→ Creates and trigger machine jobs & reconfigurations

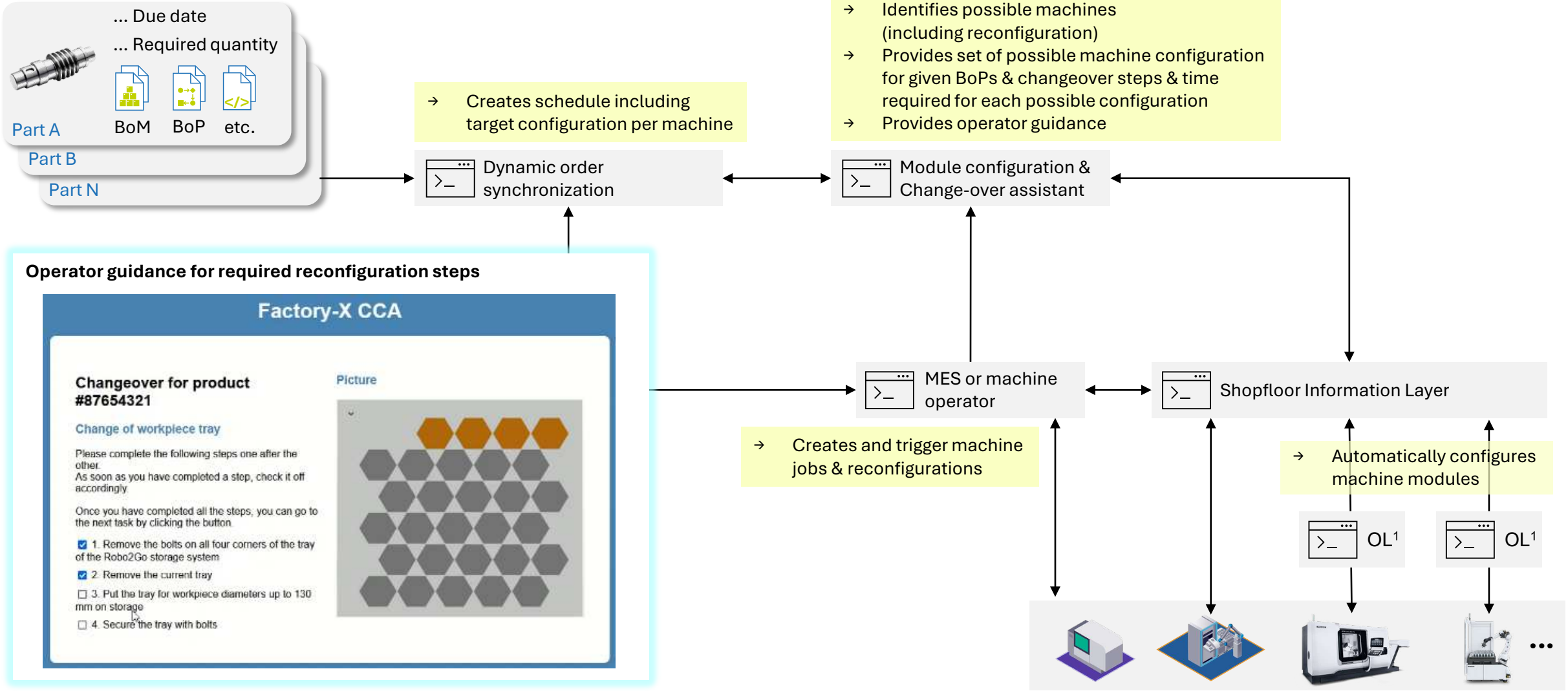
→ Automatically configures machine modules

OL[1] OL[1]

* Simplified process, not showing all inter- or transactions as well as involved business applications

[1] Orchestration Layer

Machine configurations, schedules and operator guidance is are generated based on order data, digital twins and shopfloor data.



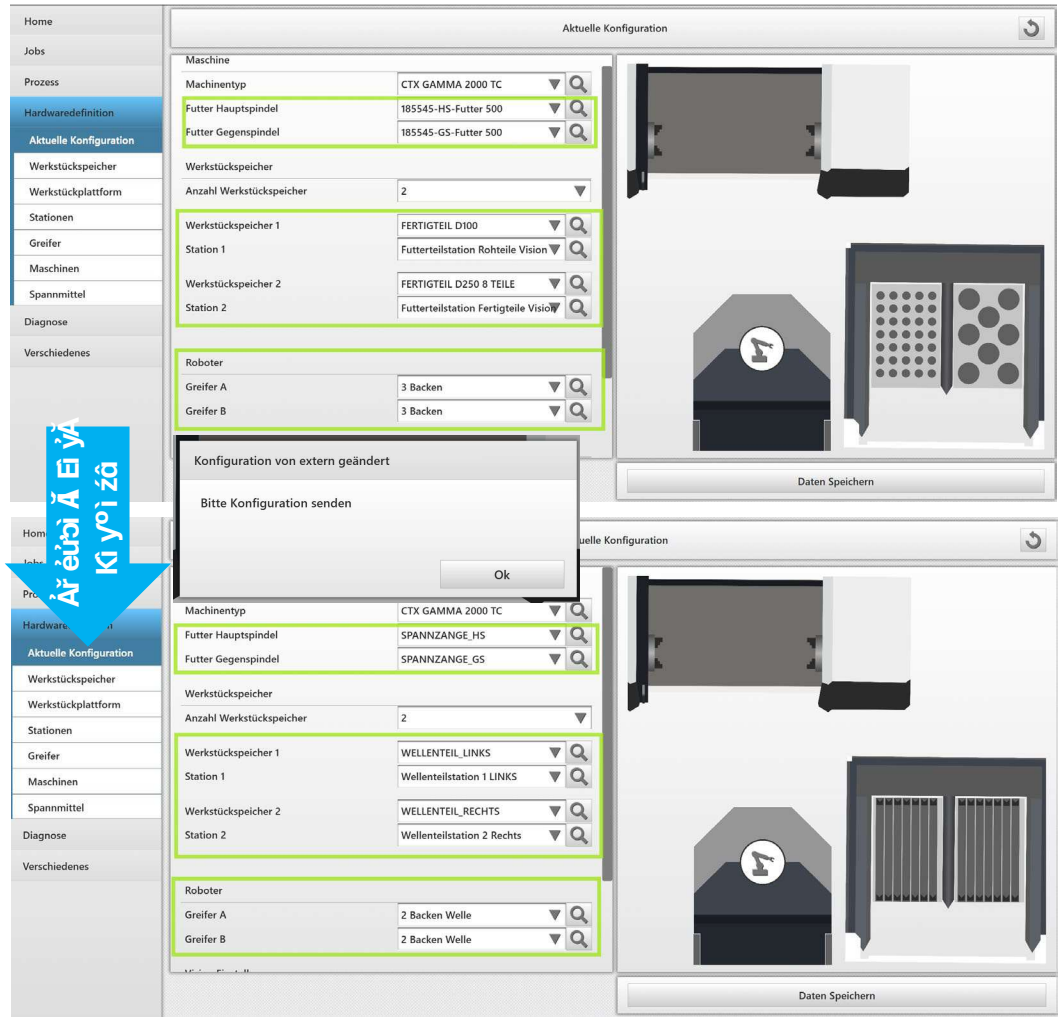
* Simplified process, not showing all inter- or transactions as well as involved business applications

[1] Orchestration Layer

Machine configurations, schedules and operator guidance is are generated based on order data, digital twins and shopfloor data.

FACTORY-X

Automated module configuration



→ Identifies possible machines (including reconfiguration)
→ Provides set of possible machine configuration for given BoPs & changeover steps & time required for each possible configuration
→ Provides operator guidance

Module configuration & Change-over assistant

MES or machine operator

Shopfloor Information Layer

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OL[1]

OL[1]

* Simplified process, not showing all inter- or transactions as well as involved business applications

[1)] Orchestration Layer

FACTORY-X

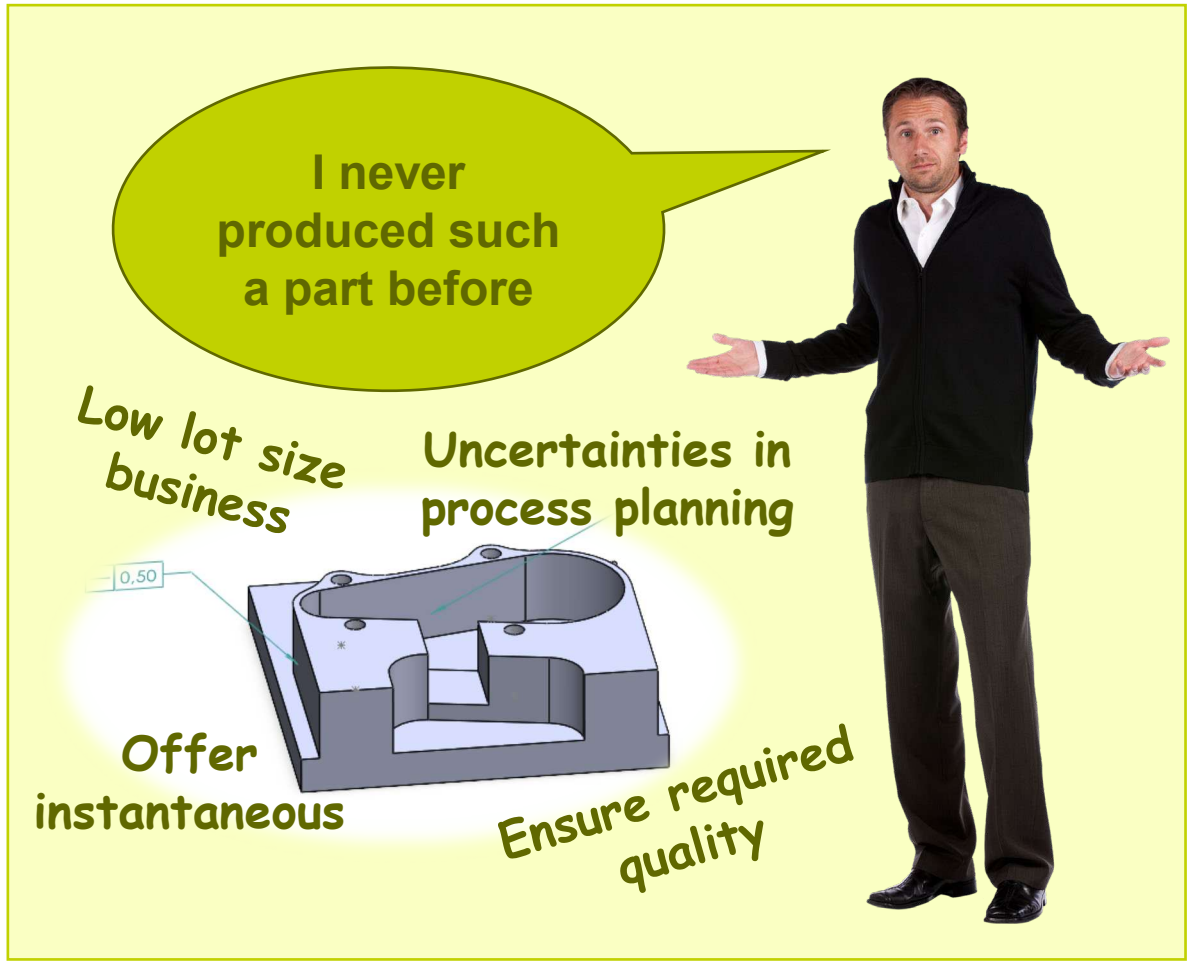
TP 2.06
Manufacturing-as-a-Service

Manufacturing as a Service

Digital transformation for on-demand manufacturing

FACTORY-X

⇨ Easy entry to digital manufacturing marketplaces



⇨ Switch from manual to automated processes

Benefits

Factory operator

- ✓ Acquiring new customers and increase order entry
- ✓ Easy entry to digital network through standardized machine connectors
- ✓ Competitive from inquiry to delivery through automized processes

Manufacturer networks & service provider

- ✓ Users with higher diversity and capacity
- ✓ Easier onboarding of new suppliers
- ✓ Standardized description of manufacturer’s information

Manufacturing as a Service

Digital transformation for on-demand manufacturing

FACTORY-X

Technical Solutions

- Standardized connectors to machines, factory sites, and services (MX-Port Adapter, Converter, Gate)
- Standardized description of manufacturer's information, manufacturing requests, and quality control in AAS data models
- Generalized capability notification for scalability
- Automated machining feature recognition and quoting

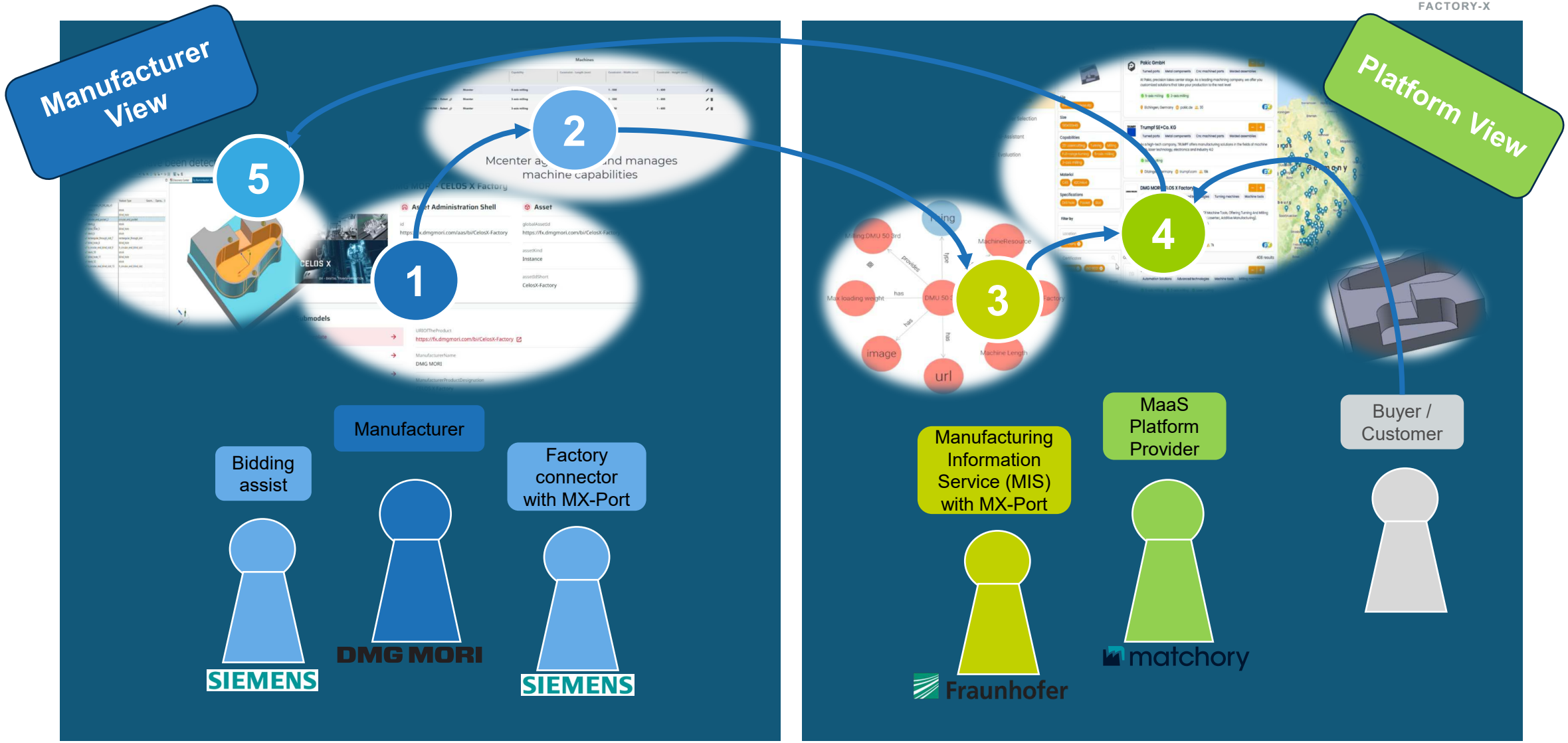
Next Steps

- MX-Port configuration (Access & Usage Control, Discovery)
- Automated generation of manufacturers capabilities
- Seamless workflow for quality control over all levels from IT to OT to IT

Manufacturing as a Service

Digital transformation for on-demand manufacturing

FACTORY-X



Demonstrator by group members

Manufacturing as a Service

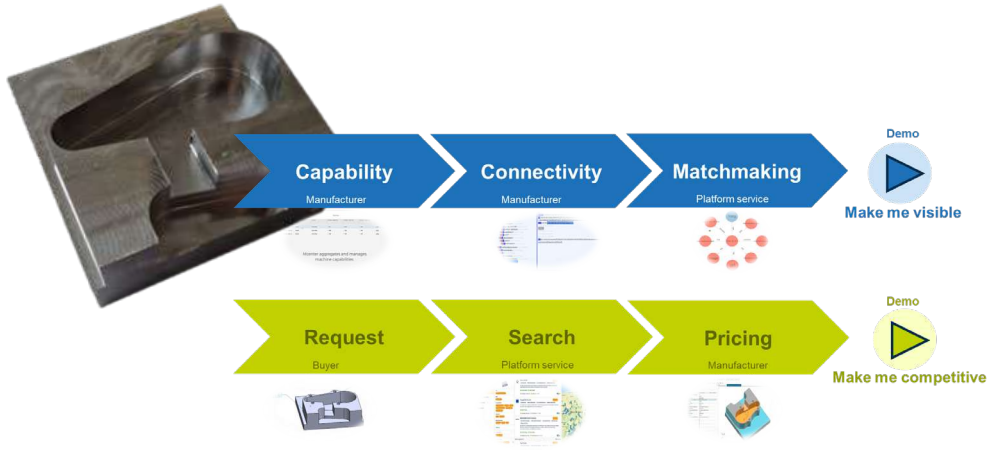
Digital transformation for on-demand manufacturing

FACTORY-X

Value Contribution

- **Reduced effort** with single notification of manufacturer information for **scalable visibility** ends in **manageable increased order entry** enabled by **connectivity**

- Best fitting order entry and **competitiveness** supported by **automated processes** enabled by **standardized data formats and interoperability**



Data space

- Development of Factory-X Ports for on-demand manufacturing

- Employment of AAS data models for seaming less connectivity between different domains

FACTORY-X

Q & A

Thank you

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