Federal Ministry
for Economic Affairs
and Climate Action

MANUFACTURING-X

Manufacturing-X – Funding Scheme for a Competitive, Resilient and Sustainable Industry

Funding measures of the Federal Ministry for Economic Affairs and Climate Action (BMWK) for the development, establishment, and scale-up of a cross-industry data ecosystem for the digitalization of industrial supply chains

bmwk.de

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NextGenerationEU

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Content

The Manufacturing-X Initiative

Development of the open, decentralized data ecosystem Manufacturing-X as a basis for resilience, sustainability, and competitive strength of our industry

Vision: a globally connected, sustainable and resilient industry

Companies of all sectors and sizes are cooperating in federated interoperable data ecosystems to boost efficiency, increase the sustainability and resilience of supply chains, safeguard existing businesses, and create new innovative businesses.

Mission: creating a federated digital ecosystem

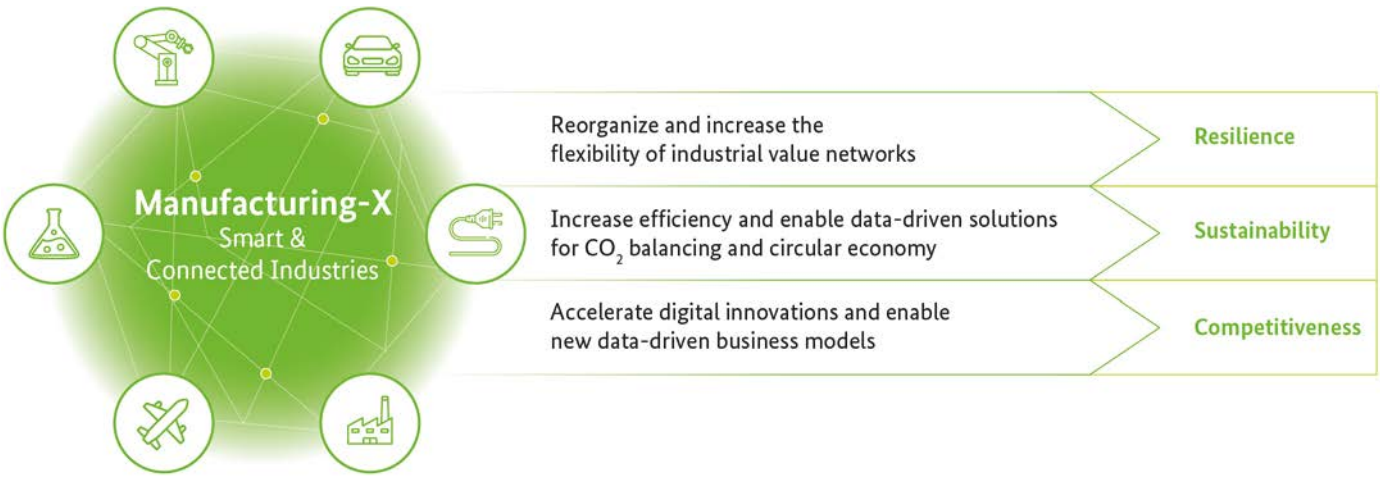
Expanding upon existing building blocks and proven technologies, the Manufacturing-X community is jointly developing interoperable solutions for the seamless, secure, and sovereign data exchange in industrial production and across supply chains. These are based on common rules and standards and ensure that companies retain control over their data and digital assets. At the same time, the Manufacturing-X community is implementing and operating high-value use cases, creating tangible benefits for their value networks. The initiative is also cooperating with partners from across the world to align approaches, find common solutions, and realize a shared vision of interoperable industrial digital ecosystems.

Value proposition: added value through digital cooperation

The Manufacturing-X ecosystem will strengthen companies in the face of global competition, increasing digitalization, and growing regulatory requirements while securing their digital sovereignty. It will enable companies to

- increase their process efficiency by leveraging standardized data exchange and compatible operating models, e.g. for their business partner data management
- leverage synergies and optimize the efficiency of value networks, e.g. with demand and capacity management or energy load management solutions
- set up new data-driven business models and create value through intelligent products and digital services, e.g. with manufacturing-as-a-service or collaborative condition monitoring solutions
- innovate together with customers and suppliers, e.g. for collaborative engineering
- retain control over their data and securely exchange data across entire supply chains, e.g. for Digital Product Passport exchange or for PCF reporting
- scale digital solutions more efficiently, e.g. for tools feeding their unique data into large-scale AI models without losing their digital sovereignty

Figure 1: Plattform Industrie 4.0: Manufacturing-X. Smart & Connected Industries



Companies of all sizes and especially SMEs and startups will be able to participate in the digital ecosystem and equally share these benefits. Beyond that, Manufacturing-X will also allow small companies and startups to develop entirely new products and digital services, expand their customer base, and scale faster in the common digital ecosystem.

What has already been achieved

Manufacturing-X is rapidly evolving and gaining more and more traction. Initial successful implementations such as Catena-X for the automotive industry prove the value realized in data ecosystems for all participants. Other key industries such as machinery and plant engineering, aerospace, semiconductor, and many more are following suit and are developing interoperable solutions for their respective industries while building upon the shared technological foundation. Important building blocks and core technologies for the common data ecosystem are available as open-source assets and ready for industrial adoption. Additionally, the initiative is already receiving a great deal of positive international attention, and international participation is growing: The International Manufacturing-X Council brings together stakeholders that are all working towards the common goal of creating a federated, decentralized, and collaborative data ecosystem for a globally connected industry. Integration into European and international processes and activities relating to the development of data ecosystems is firmly planned and the exchange of information has already begun. Supply chains are international – this understanding is firmly anchored in the Manufacturing-X initiative.

How industrial data ecosystems work

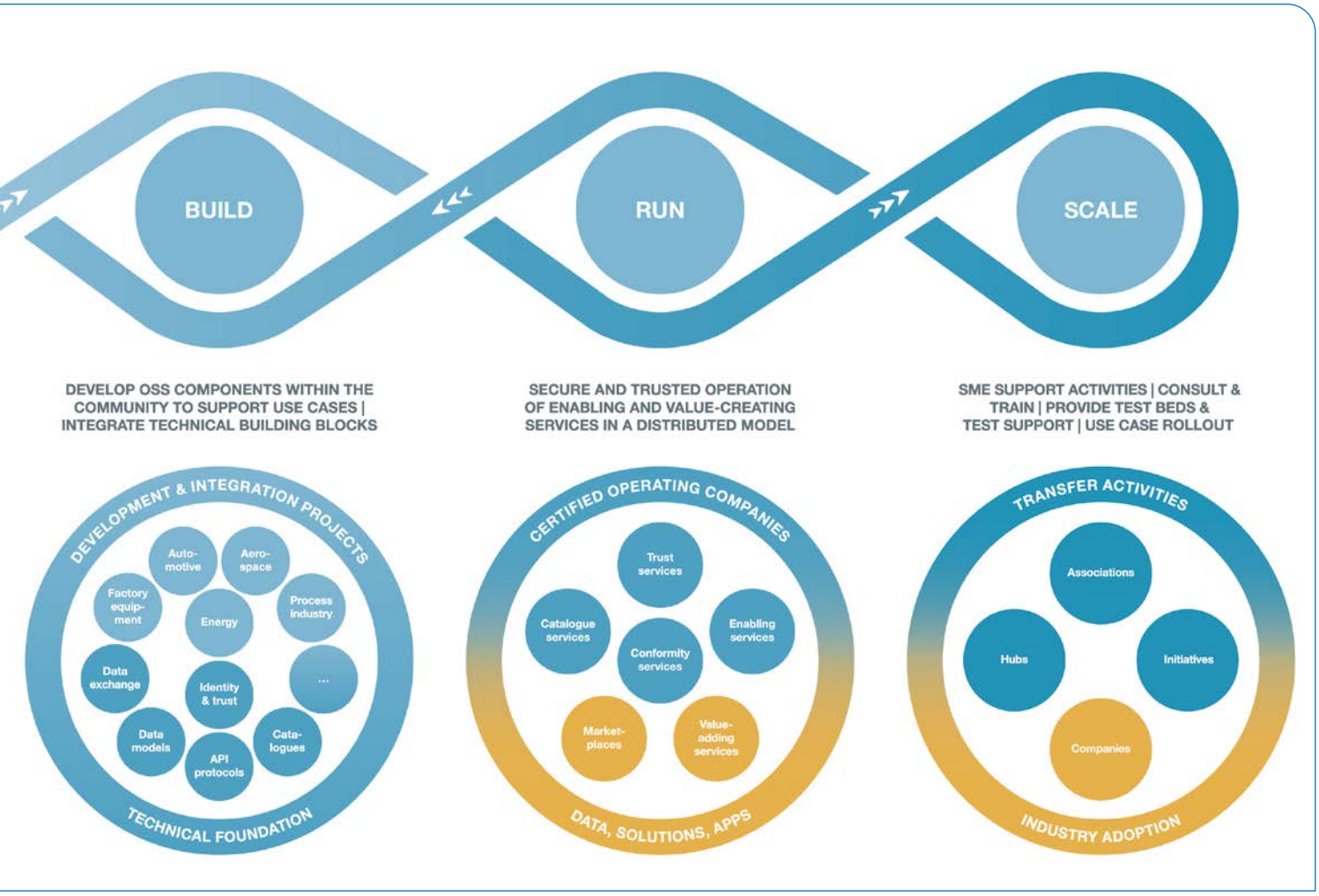
The Manufacturing-X Initiative has developed and put into practice an integrated end-to-end blueprint for the development, operation, and scaling of data ecosystems along the main pillars of *Influence, Build, Run*, and *Scale*. The roles and activities

Figure 2:
How industrial data ecosystems work: Influence, Build, Run, Scale.

subsumed under *Influence, Build, Run*, and *Scale* need to be intertwined and harmonized to realize the shared vision of interoperable industrial data ecosystems. While the approach origins with the creation of data ecosystems for the manufacturing industry, it is also applicable to data ecosystems in any other field. The initiative Manufacturing-X is already underway to branch out from the manufacturing industry into all other industrial sectors.

Influence

Starting point for the creation of interoperable data ecosystems is a shared vision with common goals and objectives that are mutually agreed upon by all involved stakeholders and initiatives. Jointly working towards these common goals necessitates a high level of transparency of all participants. Different stakeholders and initiatives need to coordinate to align their activities and find common



ground on central design concepts and principles. They take responsibility for the integration of all building blocks to establish an interoperable system that can be relied upon by all participants. Stakeholders include companies, research organizations, development projects and communities, standardization bodies, and governmental agencies.

On a global scale, several national Smart Manufacturing initiatives have started the International Manufacturing-X Initiative (IMX). They form the International Manufacturing-X Council (IMXC), which guides and orchestrates global activities to transition from seperate data ecosystems into an overall “system of systems” of trusted, interoperable data ecosystems. The IMXC formulates a common vision and roadmap to identify and implement use cases with global reach and ensures mutual alignment and harmonization. It establishes the necessary structures and supports local players and initiatives.

At a regional or domain-specific level, various actors establish initiatives and develop concepts tailored to their distinct requirements, in line with the overall vision. These initiatives are oftentimes closely interlinked with practical implementation projects as part of the pillar *Build*. The Manufacturing-X community establishes common structures and bodies that take responsibility for the realization of the overall system. They ensure that there is a regular exchange between international and national initiatives, that activities on a national level are aligned with the overall vision, and that overarching concepts are implemented consistently. Important aspects of alignment are approaches to standardization and concepts for the interoperable operation, certification, and governance of data ecosystems and their components.

Build

The pillar *Build* subsumes all activities related to the technical development and implementation of all building blocks and use cases of data ecosystems. Usually, this development is organized in dedicated projects led by the industry, most commonly by industry consortia.

Technical foundation

All industrial data ecosystems benefit from a joint basic infrastructure that includes, e.g. common approaches to data connectivity, interoperable data models, a compatible trust framework, and shared core services. These building blocks can be used across use cases and across industries. Open-source development communities are established to develop and provide central software components and support the various industry-specific requirements.

Implementation of use cases

Most industry projects focus on the creation of industry- and application-specific elements for their respective value networks, e.g. for industrial manufacturing, the automotive value chain, or the process industry. Building and expanding upon the common technical foundation, the projects are implementing high-value use cases that create tangible benefits for their value networks. The implementation of use cases is harmonized between projects and initiatives, ensuring interoperability across industries. As part of the open-source development, reference implementations and software development kits for use cases are made available to be adopted, maintained, improved, and expanded upon by the open-source development community.

All elements of both categories must be developed in accordance with the intended operating models to ensure that they are interoperable with the overall system and can be put into lasting operation.

Run

By operating all software solutions in a live system that allows the real interaction between network players, the data ecosystem is brought to life. The components that need to be operated encompass enabling services for the data exchange, business applications that realize specific use cases, and common services e.g. for the onboarding and certification of new partners.

Core services and onboarding

Certified operating entities guarantee the operation of core services in accordance with an agreed-upon legal framework. They set up corresponding technical and process landscapes and make them available to the ecosystem in a secure and trustworthy manner. They provide services guaranteeing the conformity, security, and trustworthiness of data exchange, for data publishing and discovery, and for uniform contract management in multilateral data sharing processes. Ultimately, operating entities enable the exchange of data between network players and thus the actual value creation in the data ecosystem.

The goal of Manufacturing-X is to provide an interoperable operating environment for many such operating units being able to offer services.

Onboarding services, which can be provided by either operating entities or third parties, enable the participation of new partners in the network. Partners can then freely interact with network players within the entire “system of systems” of interoperable data ecosystems. As such, the onboarding process only needs to be performed once to interact with partners across many different industries. User-friendly onboarding processes are a basic requirement for the subsequent scaling of the data ecosystem.

Market activities

Within the operational data ecosystem, providers then offer a wide range of applications and services to users across industries. The actual business value of the data ecosystem for each respective user is realized in these business applications. All applications can be based on software development kits and always conform to the common standards, ensuring their interoperability with the overall system. Providers compete in offering innovative solutions that generate the most value for their customers. For ease of access and visibility, applications are aggregated on common marketplaces that act as "app stores" for the data ecosystem.

Scale

The scaling of industrial data ecosystems is driven both by pre-competitive transfer initiatives as well as by free-market activities of industry players that promote their innovative solutions and expand their value networks.

Transfer activities

National and global players promote the knowledge transfer between initiatives and to industries and companies which are not yet part of the data ecosystem. To ensure easy access to technology and knowledge, associations, initiatives, and dedicated transfer projects work hand in hand to disseminate vision, concepts, and ideas to the engaged countries and industries. Publicly funded transfer initiatives can play an important role in the coordination and implementation of these transfer activities and in enabling new partners, especially SMEs, to become part of the network.

Industrial adoption

The global network is expanded via multipliers such as leading industry players, consulting companies, and service providers that promote their innovative solutions and activate and expand their respective value networks. Large companies promote the access to the data ecosystem in their respective supply chains while service providers offer innovative, value-adding applications and expand their customer base. Consulting companies worldwide support the connection of companies to the data ecosystem and open new business opportunities for their customers. Ultimately, free market forces drive companies to become part of the data ecosystem in order to partake in the sovereign, secure, and efficient data exchange with their value network and to benefit from the value realized in the offered business applications.

Collaboration needs moderation: The national and international coordination structure for Manufacturing-X

Collaboration is crucial to drive the development and implementation of interoperable data ecosystems. However, successful collaboration requires not only the right technology, but also suitable coordination bodies and structures as well as a continuous progress monitoring. The national and international coordination structure of Manufacturing-X aims to ensure that different projects work together efficiently, learn from each other and that there is an alignment and exchange of knowledge and ideas on an international level. This coordinated approach is essential to support the scaling and success of the initiative in global and cross-industrial value networks.

Manufacturing-X funding projects

Funded projects as part of the Manufacturing-X funding scheme advance the development of data ecosystems for various industrial sectors. They further develop the common technological foundations and implement high-value use cases that generate tangible benefits for their value networks.

Manufacturing-X Guidance Board and Topic Groups

The Manufacturing-X Guidance Board consists of representatives from all funded projects that contribute to the development of the Manufacturing-X ecosystem, most of them as part of the Manufacturing-X funding scheme. The Guidance Board is moderated and led by the project Factory-X and the funding agency VDI Technologiezentrum GmbH.

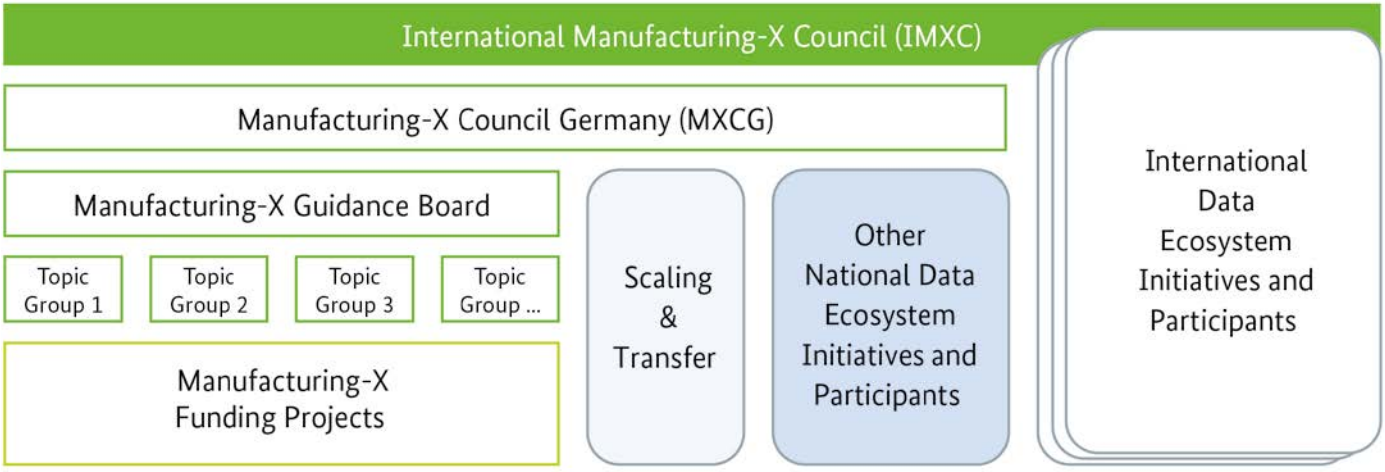
With its dedicated members, the MX Guidance Board ensures that

1. all participating projects are contributing to the creation of one compatible and interoperable digital ecosystem across industries,

2. participating projects are free of overlap, and that

3. the resulting ecosystem shall be operated by one or more interoperable operating entities.

Figure 3: Plattform Industrie 4.0: Coordination structure Manufacturing-X



Manufacturing-X Council Germany

Since 2023, the Manufacturing-X Council Germany is responsible for the overall strategy of the Manufacturing-X initiative in Germany and serves as its representative in the International Manufacturing-X Council. Its tasks include bundling the results of national project activities, creating transparency, and coordinating and moderating the development of common approaches and design principles.

International Manufacturing-X Council

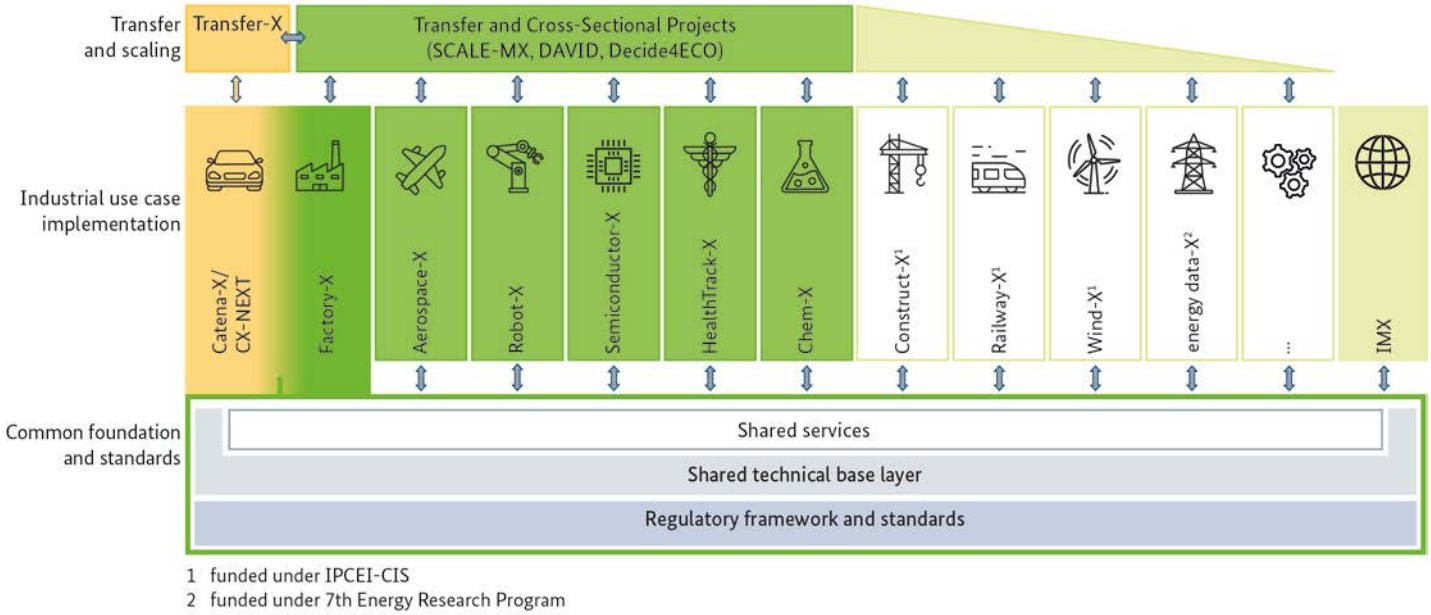
The International Manufacturing-X Council was initiated by several industrial nations in July 2023. The committee identifies relevant topics on a global level, organizes the cross-border exchange of experience, and coordinates a joint approach to implementing a global, interoperable data ecosystem. It also promotes the global harmonization of national regulations and shapes international standards.

One framework for all: Manufacturing-X as a cross-sector data infrastructure for the industry

"Manufacturing-X: Make Data Work" is the guiding principle for the cross-industry digitalization of industrial production. The basis for the shared use of federated and independent data ecosystems is the creation of a common, sovereign infrastructure. Manufacturing-X deals with cross-sector use cases for the collaborative use of data in order to leverage economic and ecological potential.

To this end, uniform standards must be defined, which must be implemented and operated as part of a joint technical infrastructure in order to ensure interoperability and sovereignty. Manufacturing-X is thus based on a common technical, organizational, and legal framework and is continuously further developed by the international Manufacturing-X community.

Figure 4: Federal Ministry of Economics and Climate Action: Framework Manufacturing-X



1 funded under IPCEI-CIS
2 funded under 7th Energy Research Program

Four core elements ensure interoperable data exchange between industries

A comprehensive technical architecture for Manufacturing-X is the key to achieving interoperability. To this end, common central elements of the technical and organizational architecture are being developed that guarantee interoperability not only within an industry, but also across industries. The architecture is aimed at the technical integration of existing and future systems within manufacturing data ecosystems.

The requirements for these four core elements, the so-called building blocks, for the industry-specific use cases show certain similarities. Therefore, these four core elements can be developed across industries using a cooperative approach.

Identity & Trust concerns security aspects of data-sharing processes. Data is only shared between partners who trust each other and where the sender and recipient can be clearly identified.

Visibility & Access comprises standardized technologies for data sharing, e.g. through the use of interoperable interfaces to enable a high level of efficiency in the use of shared data.

Service & Sharing includes the provision of central services for the efficient design and implementation of data sharing processes, e.g. a standardized registry service for searching and locating decentrally distributed data records.

Agreements provide the basis of central services for standardized contract management in the multilateral sharing of data. Among other things, the focus is on establishing legal certainty in multilateral data sharing and aspects of monetizing data flows.

The Manufacturing-X community is thus driving forward the development of a common technological basis that can be used across all industries to enable the design of individual solutions.

Structural analysis of the project portfolio: key findings on the shared technical base layer

As shown in figure 5 on page 11, the Manufacturing-X foundation is based on common technical building blocks that enable cross-industry interoperability. To get an in-depth view into how the technological basis is being driven forward by funding projects, a total of 23 projects from various funding schemes were analyzed in August 2024. The aim was to classify the funded projects of the relevant funding schemes with regard to their contributions to core building blocks of an overarching data ecosystem architecture. A particular focus was placed on enablement services, as they play a key role in the implementation of an interoperable architecture. Four core aspects are of particular relevance:

- Connectors / APIs
- Information models
- Digital twins
- Shop floor connectivity

The results are summarized in the following info box. A key finding is that all elements of the shared technical base layer are addressed by the funding projects. In addition, the Eclipse Dataspace Components (EDC) is frequently used as a framework. The Asset Administration Shell (AAS) also plays a central role as an information model in most projects. In particular, projects for the development of digital twins rely on the AAS and complementary technologies.

Figure 5: Structural analysis of the project portfolio: key findings on the shared technical base layer

- **Almost all projects** deal with **APIs**.
- **Most projects** use or plan to use **EDC** and **AAS**.
- Some **projects** use **other solutions** also ensuring interoperability.

- **Fewer projects** have already determined how they will implement **contract management**.
- The **projects** that have **already defined** contract management will use/ are using solutions from the **EDC context**.

- Projects that have defined how they implement **identity verification** rely on solutions from the **Catena-X / Tractus-X** context.
- **Projects** where this is **unclear** also test **solutions from Catena-X**.

- The **IDS / IDSA or AAS information model** is usually used as the **information model** or at least its use is planned.
- **Some projects also** use other semantic web standards such as **RDF** and **RDFS**.

- AAS, Common Data Model (CDM), and VHT are used as technical solutions for the implementation of digital twins.
- The **use of AAS is dominant**, with some projects using other solutions as a supplement.

- Projects that plan to connect the shop floor use **common market standards (OPC UA, MQTT, Umati)** or are planning to do so.
- Other industry-specific standards, such as SECS/ GEM, are also taken into account.

Funding scheme for Manufacturing-X

Supporting the development of the data ecosystem for an intelligently connected industry

Fostering structural change for the digitalization of the industry

BMWK is supporting the Manufacturing-X initiative with an accompanying funding scheme to support cross-industry, pre-commercial research and development projects. The goal is the further development of basic technologies, and the implementation of priority use cases for the cross-industry Manufacturing-X data ecosystem.

The Manufacturing-X funding scheme creates necessary structures for pre-commercial collaboration which would not unfold under purely market-based conditions. Moreover, it promotes the transfer of project results to the broader industry, especially SMEs, as well as internationalization. The first projects within the funding scheme were launched at the beginning of 2024 and will run until 2026. The initiative is a lighthouse project as part of the German government's digital strategy.

Funding objectives

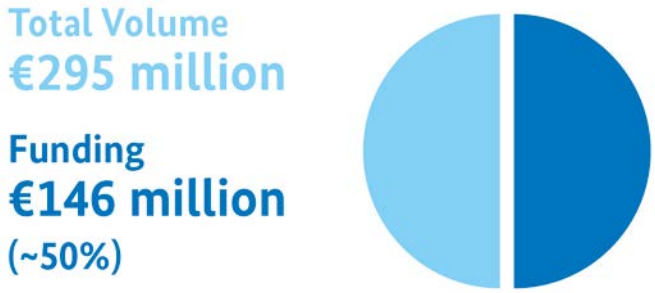
The overarching objective of the measure is to secure and strengthen the digital sovereignty of Germany and the EU. To this end, the funded projects will create federated, interoperable structures and solutions that foster a significantly more resilient and ecologically sustainable design of industrial value networks as well as supply chains.

As part of the 2020 economic stimulus and future package ("Konjunkturpaket"), the BMWK has already initiated and implemented a funding scheme for the digitalization of the automotive industry and its suppliers. Experience from this program has shown that the success of cross-system digital infrastructures depends above all on a binding technical architecture and clear coordination. This applies both at the operational and decision-making levels, ensuring the moderation and management of tasks related to internationalization and transfer.

Facts, figures and data: overview of funded sectors, projects and funding volumes

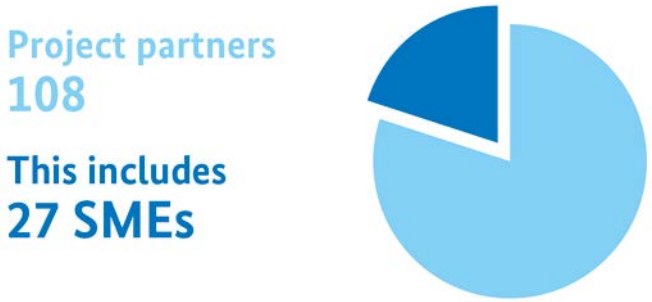
Funded projects

Of the 89 project proposals received, ten consortia were selected for funding by the BMWK. The project Factory-X was the first collaborative project to start on February 2, 2024, with a volume of approx. 153 million euros. By December 2024, nine additional collaborative projects have commenced work in multiple phases. A total of 129 sub-projects with a volume of around €295 million and state funding of around €146 million have thus been approved within the funding framework.



The project partners

Among the organizations conducting a total of 129 sub-projects (companies, universities, research institutions, and associations), 21 partners are collaborating in more than one project. The declared aim of strongly involving small and medium-sized enterprises was also successfully implemented.



Industries and use cases in Manufacturing-X

The Manufacturing-X program achieves a broad impact on most important manufacturing industries (see p. 14) and thus creates an important prerequisite for the successive participation of other companies involved in the value chains.

The aim is to have one overarching joint project per sector to ensure the highest possible degree of efficiency in the respective industry ecosystem. As cross-sectional suppliers, machine and plant manufacturers, and factory equipment suppliers have the greatest bandwidth in the collaborative projects. The use cases (see p. 16) also show that the identified potential is effective in all sectors. The cross-sectional projects SCALE-MX and DAVID, which focus on transfer and technical harmonization respectively, naturally do not have a use case as such.

Detailed information on the project content, the partners involved, and the most important key figures can be found in the project profiles on the following pages.

Figure 6: Overview – Industries involved in Manufacturing-X

Projects[1]	Indu					
	Machinery & Plant Engineering	Factory Equipment Supplier	Automotive[5]	Aerospace	Electrical Engineering	Chemical Industry
Aerospace-X						
Chem-X						
CX-NEXT						
Decide4ECO						
Factory-X						
HealthTrack-X						
Robot-X						
Semiconductor-X						
Antrieb 4.0[2]						
Construct-X[3]						
DIAMOND[2]						
energy data-X[4]						
Fluid 4.0[2]						
GrowING[3]						
Railway-X[3]						
RoX[3]						
Wind-X[3]						

1 Cross-sectional projects DAVID and SCALE-MX are not listed
2 Projects funded under KoPa 35c a2
3 Projects funded under IPCEI-CIS (8ra)
4 Projects funded under the 7th Energy Research Program
5 Includes road, rail and water transportation

stries

Defence	Energy	Pharmacy Healthcare	Logistics	Construction	Materials

Project focus
Considered in aspects

Figure 7: Overview – Use cases in Manufacturing-X

Projects[1]	Business Data Management	Traceability	Digital Product Passport	Product Carbon Footprint	Circular Manufacturing	Quality Management	Collaborative Condition Monitoring
Aerospace-X							
Chem-X							
CX-NEXT							
Decide4ECO							
Factory-X							
HealthTrack-X							
Robot-X							
Semiconductor-X							
Antrieb 4.0[2]							
Construct-X[3]							
DIAMOND[2]							
energy data-X[4]							
Fluid 4.0[2]							
GrowING[3]							
Railway-X[3]							
RoX[3]							
Wind-X[3]							

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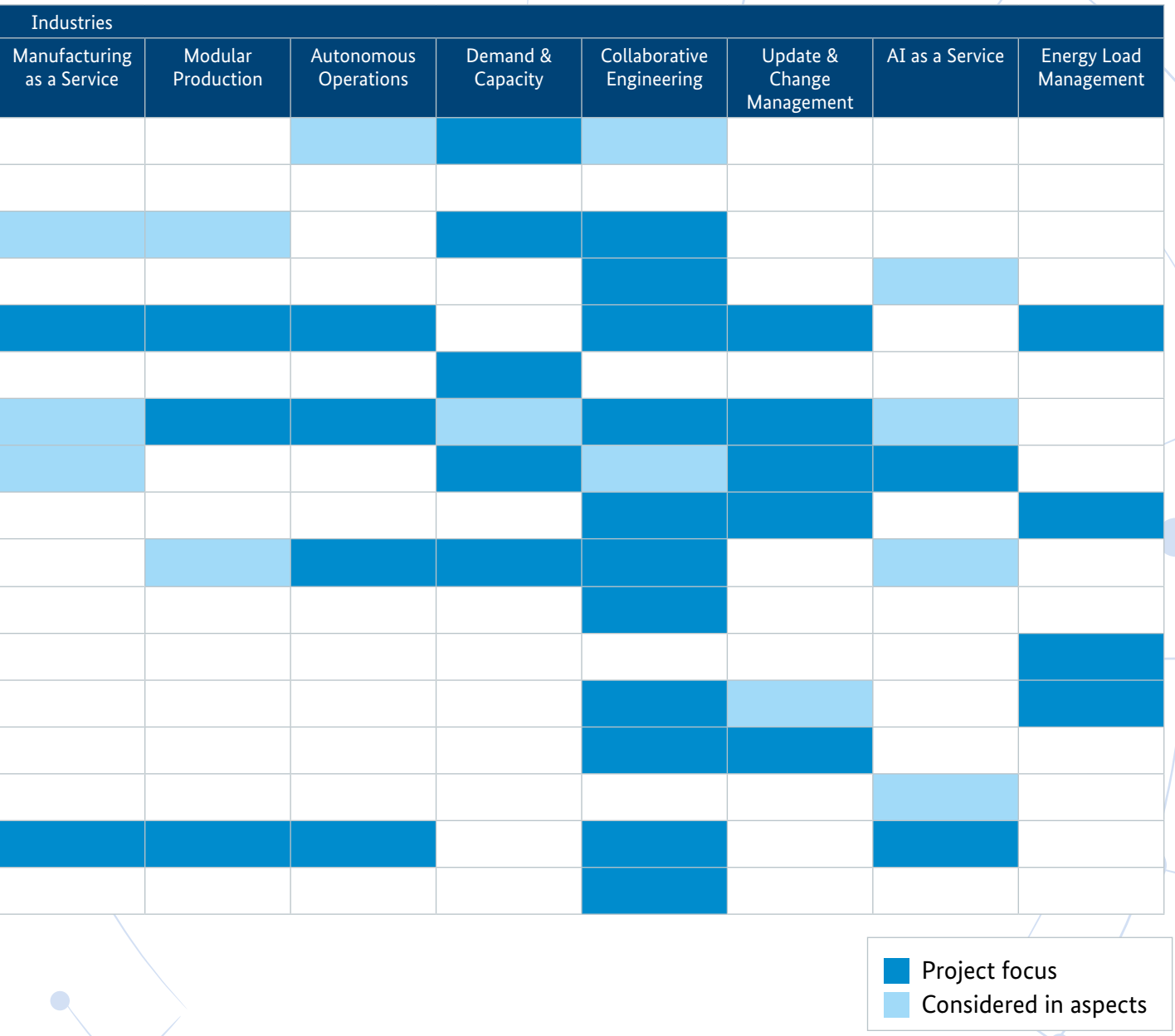

Industries
Manufacturing as a Service
Modular Production
Autonomous Operations
Demand & Capacity
Collaborative Engineering
Update & Change Management
AI as a Service
Energy Load Management
Project focus
Considered in aspects

Project Profiles

AEROSPACE-X

CHEM-X

Catena-X NEXT
Your Automotive Network

Decide ECO

FACTORY-X

HTX
HealthTrack-X

ROBOT-X

SEMICONDUCTOR-X

DAVID

scale-MX

Click on a project logo to go directly to the project summary

Visit the Manufacturing-X website:
www.manufacturing-x.com


antrieb 4.0
Construct-X
DIAMOND
energy data-X
FLUID 4.0
growING
Railway X
ROX
Enabling AI Robotics
WIND-X
Adding value to data

Aerospace-X

Ecosystem for an efficient and sustainable Aerospace Supply Chain

Project coordinator
Karl Richert | Airbus Operations GmbH

Project duration
04/2024 – 06/2026

Project volume
€40.2M (Funding share BMWK: 48.3%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Under the leadership of Airbus, the „Aerospace-X“ consortium has been formed from 31 companies and research institutes. The project drives the digital transformation of aerospace supply chains. The project develops basic capabilities to enable transparent data usage, enhance efficiency and ensure open-source, cross-industry collaboration. By developing important building blocks of a sovereign data space, Aerospace-X paves the way for a collaborative data ecosystem for the aerospace industry.

Based on the value streams for fuselage, cabin and propulsion, the basic capabilities for cross-company digital collaboration with regard to basic technologies, data infrastructure, software services and regulation are to be further developed. The focus is on the use cases of demand and capacity management, product carbon footprint & digital product passport, circular economy and end-to-end quality management.

Consortium

Consortium lead

AIRBUS

DLR, Capgemini, DIEHL Aviation, SAP, Fraunhofer IPK, gemineers, T Systems, toolcraft, PRÄWEST, ZAL Zentrum für Angewandte Luftfahrtforschung, SYNERGETICON, SUPPLYON

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

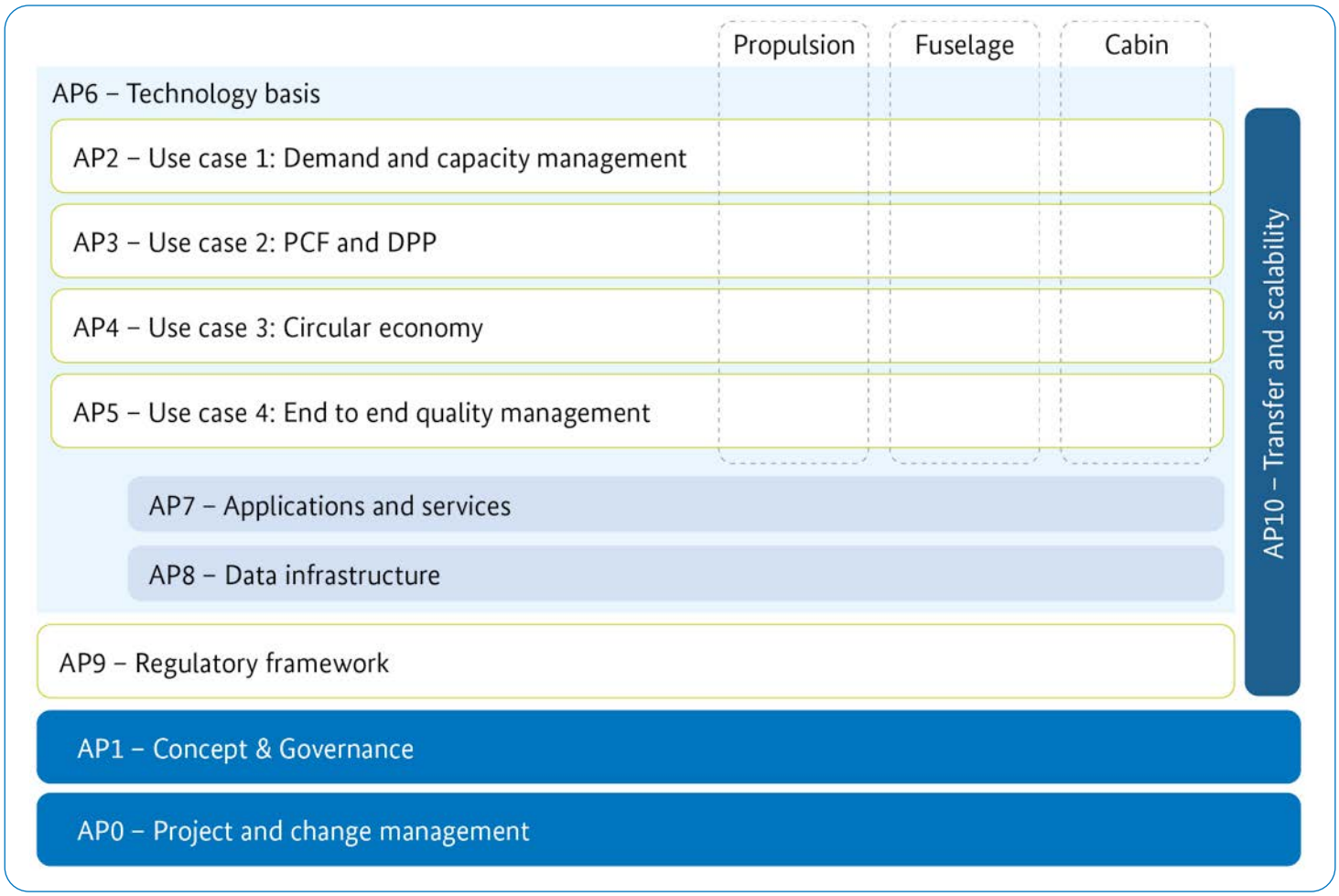
Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



Chem-X

Development of a data space for the chemical industry and interfaces of the associated value chains using the example of the digital product passport

Project coordinator
Andreas Wollny | BASF SE

Project duration
12/2024 – 11/2026

Project volume
€19.5M (Funding share BMWK: 45.3%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The chemical industry and raw materials sector face significant challenges, including rising costs, stricter regulations, and increasing international competition. These factors make advanced digitalization and a shift toward CO_2-neutral production essential. The transition to a sustainable circular economy, alongside the implementation of the European Green Deal and the EU Chemicals Strategy, requires substantial investments. Furthermore, it imposes expanded reporting obligations and heightened liability risks, placing additional pressure on competitiveness.

The Chem-X project focuses on three fundamental pillars to support the industry in overcoming these challenges:

1. Enhancing competitiveness by defining chemistry-specific data points and establishing technical standards, Chem-X aims to improve interoperability and efficiency across the supply chain.

2. Advancing sustainability by defining an open-source data model for chemicals to enable transparent, cross-value-chain communication of sustainability characteristics, such as the Product Carbon Footprint (PCF) or recycled content.

3. Increasing Resilience through the use of digital technologies, including digital material twins and standardized material data exchange, to enhance the industry's ability to respond swiftly and flexibly to market fluctuations.

Consortium

Consortium lead

BASF
Cofinity-X
covestro
Henkel
DAW
MERCK
SAP
SIEMENS
SPHERITY
WACKER

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

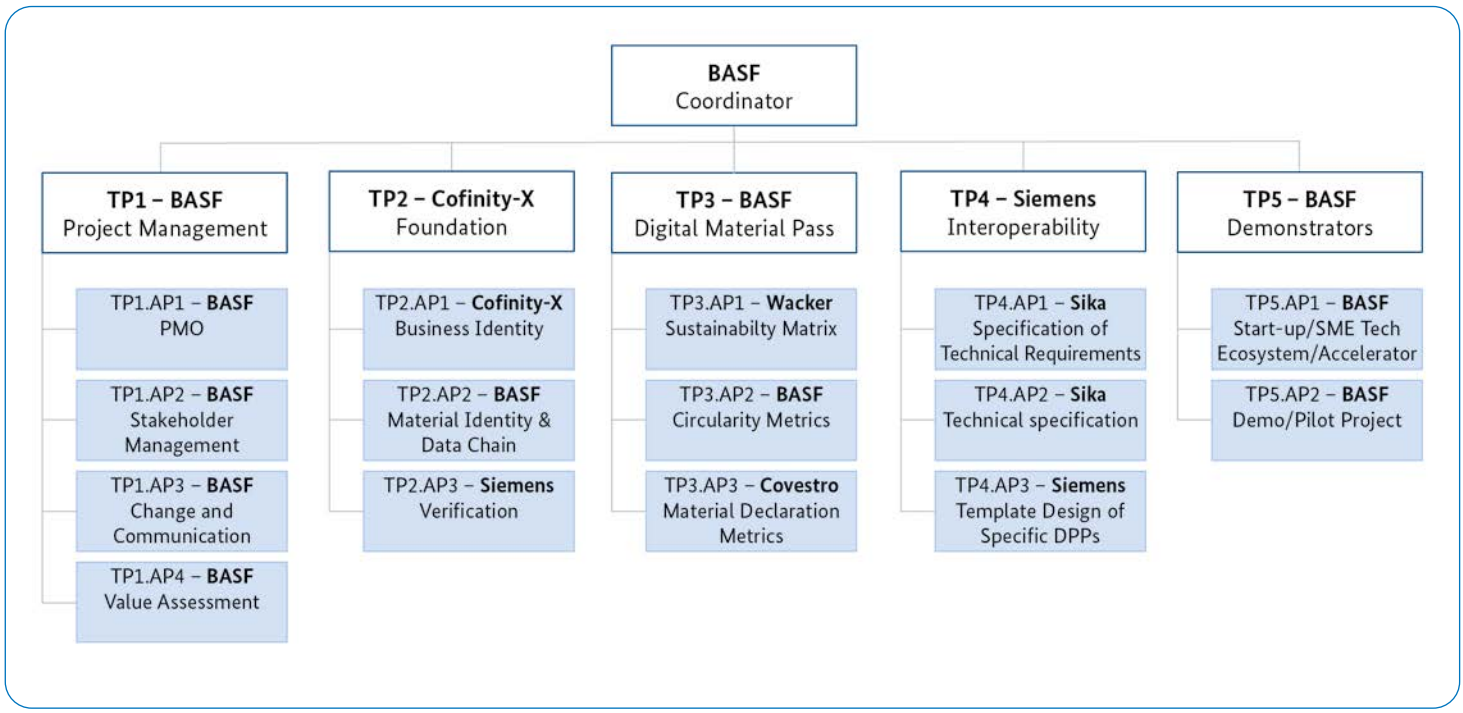
Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



CX-NEXT

Catena-X NEXT – Your Automotive Network

Project coordinator
Oliver Ganser and Anja Lang | BMW Group

Project duration
08/2024 – 09/2026

Project volume
€25.2M (Funding share BMWK: 44.3%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Catena-X has pioneered the creation of the first open and collaborative data ecosystem specifically designed for the automotive industry. This innovative initiative has set a new standard for data sharing and collaboration among industry stakeholders. Building on this foundation, the successor project, CX-NEXT, aims to further enhance and expand the capabilities of the Catena-X data ecosystem. The primary objective is to fortify the existing infrastructure to address the increasingly complex challenges faced by global supply chains. To achieve this, CX-NEXT is focused on three core objectives:

- **Enhanced Core Services** – Improving the essential services of Catena-X to ensure smoother operations and seamless integration, including, initiatives like Manufacturing-X.
- **Global Reach** – Scaling Catena-X on an international level to connect more partners worldwide more quickly, thereby increasing the resilience of supply chains.
- **Open-Source-First** – Further developing the Eclipse Tractus-X project to foster a community centered around collaboration and continuous improvement.

Consortium

Consortium lead

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

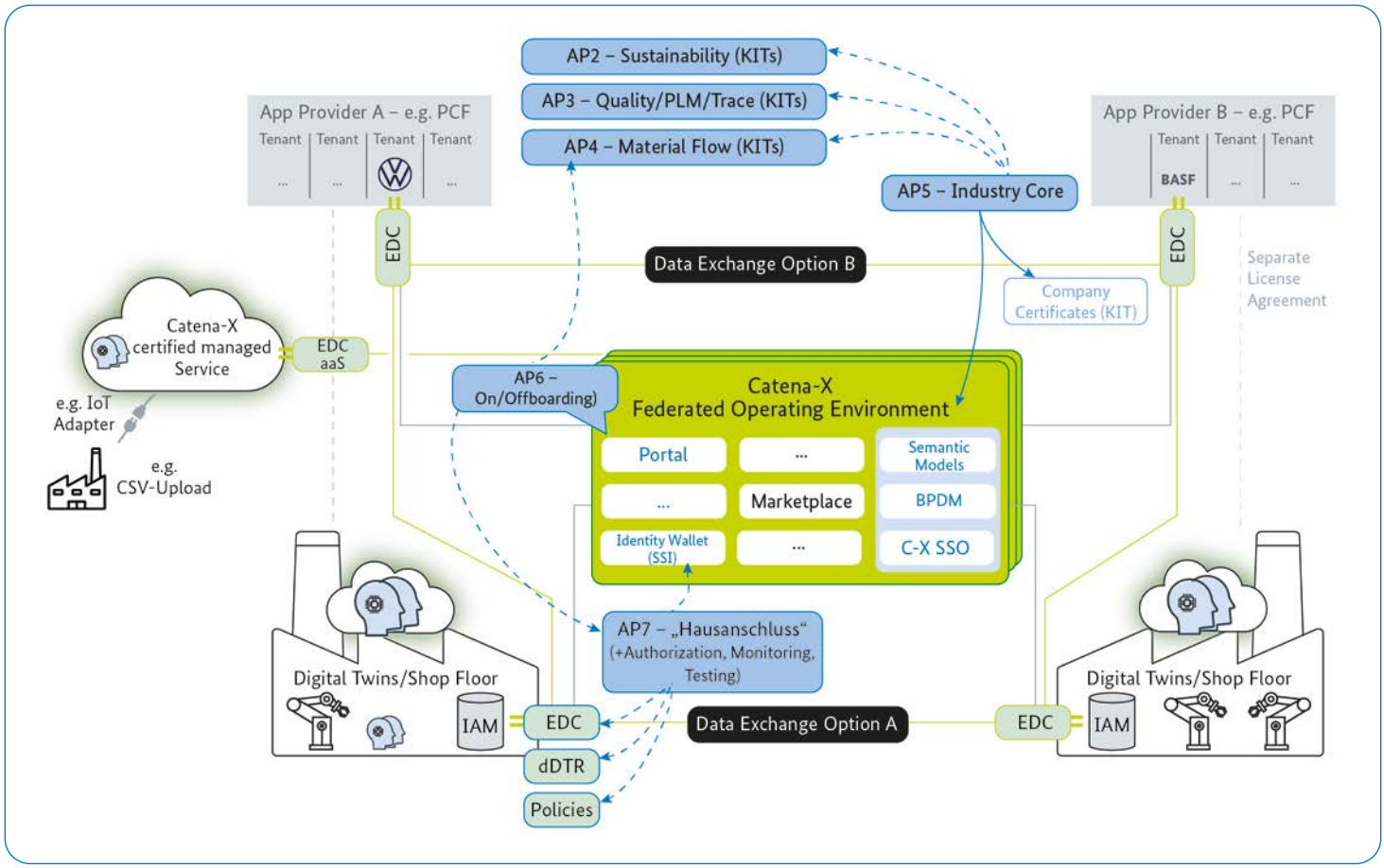
Project focus | Considered in aspects | Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



Decide4ECO

Model-based, predictive and flexible decision support in the development of ecological, circular value creation through data ecosystems

Project coordinator
Dr. Martin Holland | PROSTEP AGp

Project duration
04/2024 – 09/2026

Project volume
€6M (Funding share BMWK: 52.8%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The Decide4ECO project focuses on analyzing and assessing sustainability requirements and achieving sustainability goals. As resource consumption is largely determined in the early stages of product planning and development, the project focuses on this by developing digital solutions for decision support in product development and production with a focus on sustainability criteria.

The assessment aims to consider the entire value chain and product life cycle. The data required for sustainability analysis must be collected across the entire manufacturing and supply chain. To facilitate this, data exchange along supply chains will be implemented based on common standards. As part of the project, open interfaces and standards will be developed to support this approach.

Within the shared data ecosystem, a standardized Digital Product Passport will be created and enriched with additional information. The resulting software solutions for sustainability assessment will integrate all relevant upstream and downstream processes and will be further enhanced with predictive, AI-based impact analyses.

Consortium

Consortium lead

PROSTEP

BOS | CONTACT Software | Hadi-Plast | NEXPIRIT | sonova | HEINZ NIXDORF INSTITUT UNIVERSITÄT PADERBORN

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

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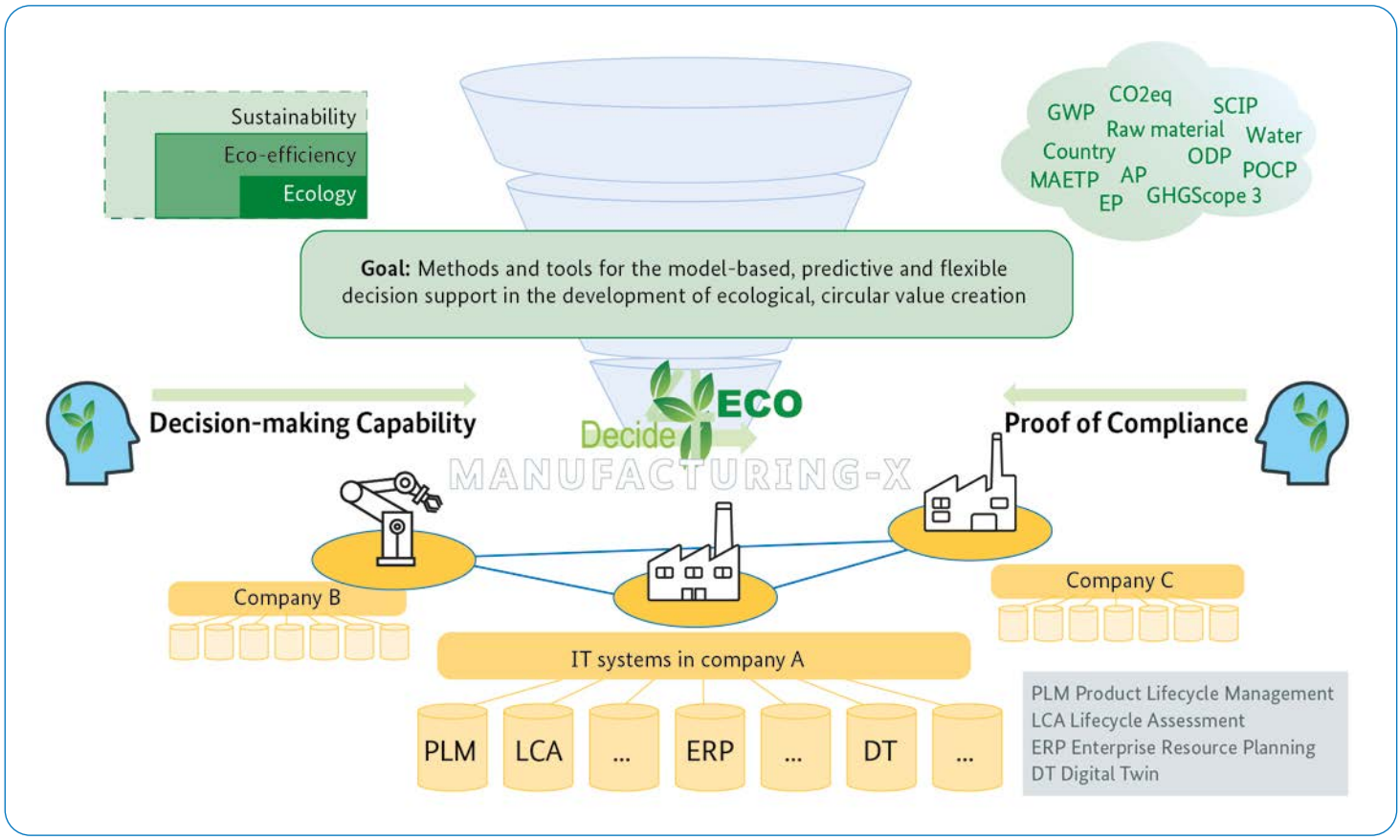

Factory-X

The Digital Ecosystem for Factory Outfitters and Operators

Project coordinator
Roland Rosen | Siemens AG

Project duration
02/2024 – 06/2026

Project volume
€153M (Funding share BMWK: 47.9%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

In the “Factory-X” lighthouse project, 46 partners are collaborating under the leadership of Siemens and SAP. The primary objective is to establish an open and collaborative data ecosystem for factory equipment suppliers and operators, based on technologies of Catena-X and concepts developed by the Industrie 4.0 community. The project will implement eleven use cases that are particularly relevant to the manufacturing industry.

The project focuses on three main aspects:

- **Cross-manufacturer data consistency** for engineering, device information and condition monitoring
- **Contribution to sustainability** through carbon footprint and energy management applications, as well as digital solutions to support a circular economy
- **Provision of digital solutions** for “as a service” business models (e.g. marketplace/pay-per-part, remote control/monitoring)

In addition to technical development, the consortium plays a central role in the cross-project coordination of development activities and in building an international Manufacturing-X community.

Consortium

Consortium lead

SIEMENS

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus | Considered in aspects | Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
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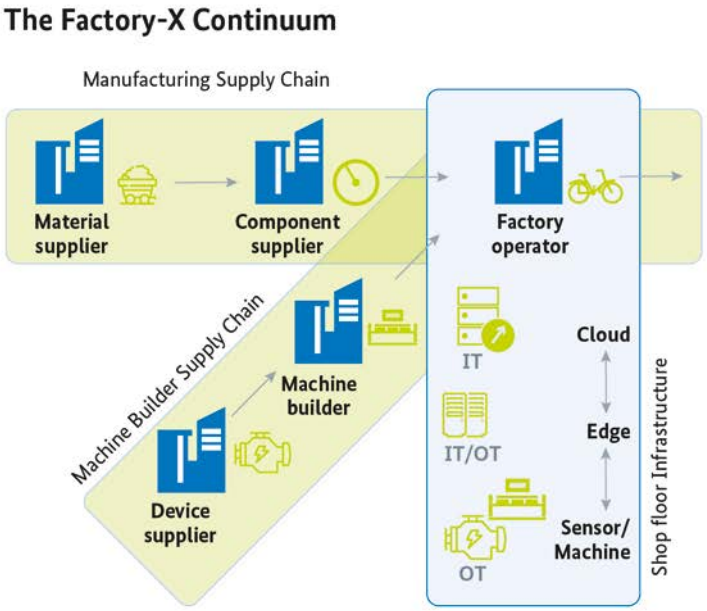

From the perspective of a manufacturing company, there are two different supply chains:

Supply chain regarding the **product** of the manufacturing company

- All deliveries from suppliers that are **integrated** into the manufacturing company's product
- Application scope of Catena-X

Supply chain regarding the **production system** of the manufacturing company

- All deliveries from suppliers that are needed to **build** and **operate** the manufacturing company's production system
- Expansion of application scope of Catena-X by Factory-X

HealthTrack-X

Digitalization of the production and supply chain of the healthcare sector

Project coordinator
Maro Bader | ROCHE PHARMA AG

Project duration
05/2024 – 07/2026

Project volume
€5.3M (Funding share BMWK: 57.3%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The HealthTrack-X (HT-X) project aims to digitalize the production and supply chain of the healthcare sector. The industrial healthcare sector is a leading and future-oriented industry with a high intensity of research and innovation. Nevertheless, digitalization is not advanced in many areas: for example, there is no interoperable infrastructure between companies along the healthcare supply chain – data format and quality are decisive factors, but they vary. This is where HT-X comes in and creates interoperable interfaces.

HT-X was created by a group of companies involved in sphin-X to realize the vision of a collaborative data ecosystem for the healthcare system. sphin-X promotes use cases in the areas of research and development, supply chain, product life cycle, and collaboration. HT-X is implementing the vision by establishing a technical infrastructure to fit the use cases, committing to building a data ecosystem, achieving technical readiness for data exchange, connecting the first participants to the data ecosystem, and completing initial use cases in the data ecosystem.

Consortium

Consortium lead

Roche

adesso | BDI | Fraunhofer ISST | GESUNDHEITS-FOREN | ROTE LISTE | SIEMENS Healthineers | W2 healthcare

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

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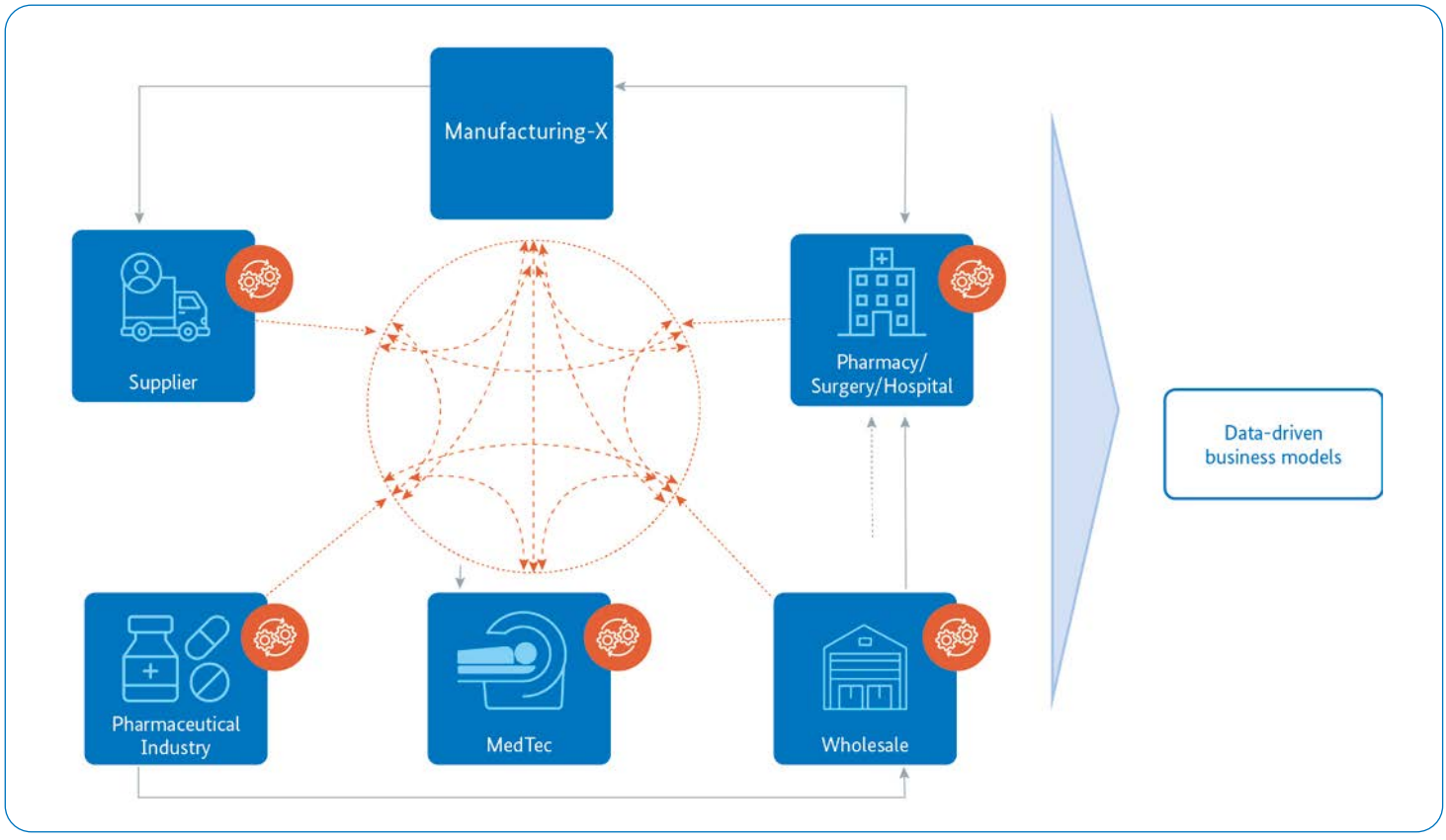

Robot-X

Connected model-based development and operation of robots for industry and SMEs using Catena-X and AI

Project coordinator
Dr. Alexander Dettmann | YardStick Robotics GmbH

Project duration
04/2024 – 06/2026

Project volume
€9.9M (Funding share BMWK: 46%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Robot-X aims to digitalize the product lifecycle of robotic systems, connect stakeholders, and optimize interaction processes. The project seeks to lower entry barriers for small and medium-sized enterprises (SMEs), making it easier for them to access customized robots and automation solutions. This will be achieved through model-based systems engineering (MBSE) and artificial intelligence (AI).

At the project's core is the development of a connected data space for exchanging digital twins of robotic components, enabling data- and model-driven systems engineering using AI. The approach focuses on automating the configuration of robotic systems based on a modular design principle.

To demonstrate this, three cross-industry application scenarios are being implemented:

- **Drone Port** – a drone takeoff and landing system for defense and agriculture.
- **Industrial Packaging** – a packaging solution for irregularly shaped industrial components.
- **Composites Processing** – an autonomous precision grinding system for the aviation industry.

Consortium

Consortium lead

YARDSTICK ROBOTICS

RHEINMETALL · PIERBURG · GalvanoPro · ifak · synaptic

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
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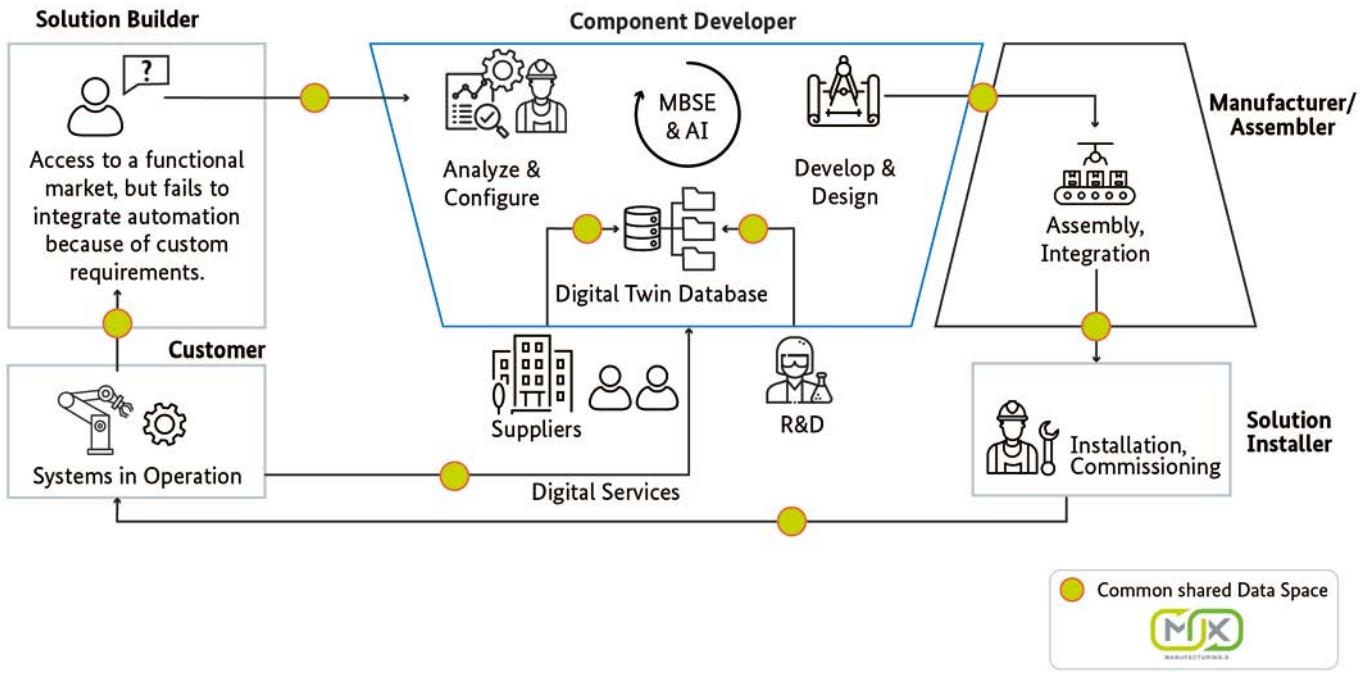

Semiconductor-X

Initiative for the digitalization of supply chains in the semiconductor industry

Project coordinator
Dr. Harald Gossner | Intel Deutschland

Project duration
05/2024 – 09/2026

Project volume
€28.6M (Funding share BMWK: 54.7%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Semiconductor-X aims to create a sovereign data ecosystem for the semiconductor industry while developing advanced digital twin technologies to digitally represent critical planning segments of the semiconductor supply and value chain.

The project generates digital tools to enable efficient, sustainable, and resilient operations in the semiconductor industry through industry-wide digitization and dataspaces for improved traceability in the value chain, e.g. through tracking and tracing of chiplets, anomaly detection, and life cycle assessment data.

Utilizing semantic data models and open-source software approaches, Semiconductor-X facilitates the implementation of proactive digital process twins, transaction twins, and fragmented twins, as well as their provision and aggregation within the orchestrated data ecosystem.

During the course of the project, integrated demonstrators will be developed to foster a swift implementation and transfer of project results – Semiconductor-X ensures the availability of semiconductors for European key technologies and industries.

Consortium

Consortium lead

intel

Fraunhofer IFF · Infineon · elmos · MERCK · SAP · BOSCH

Environmental Experts DAS · HQ-Dielectrics · EXPO21XX online exhibitions · OptWare · SYSTEMA Art of Automation

HTWD · SIEMENS

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
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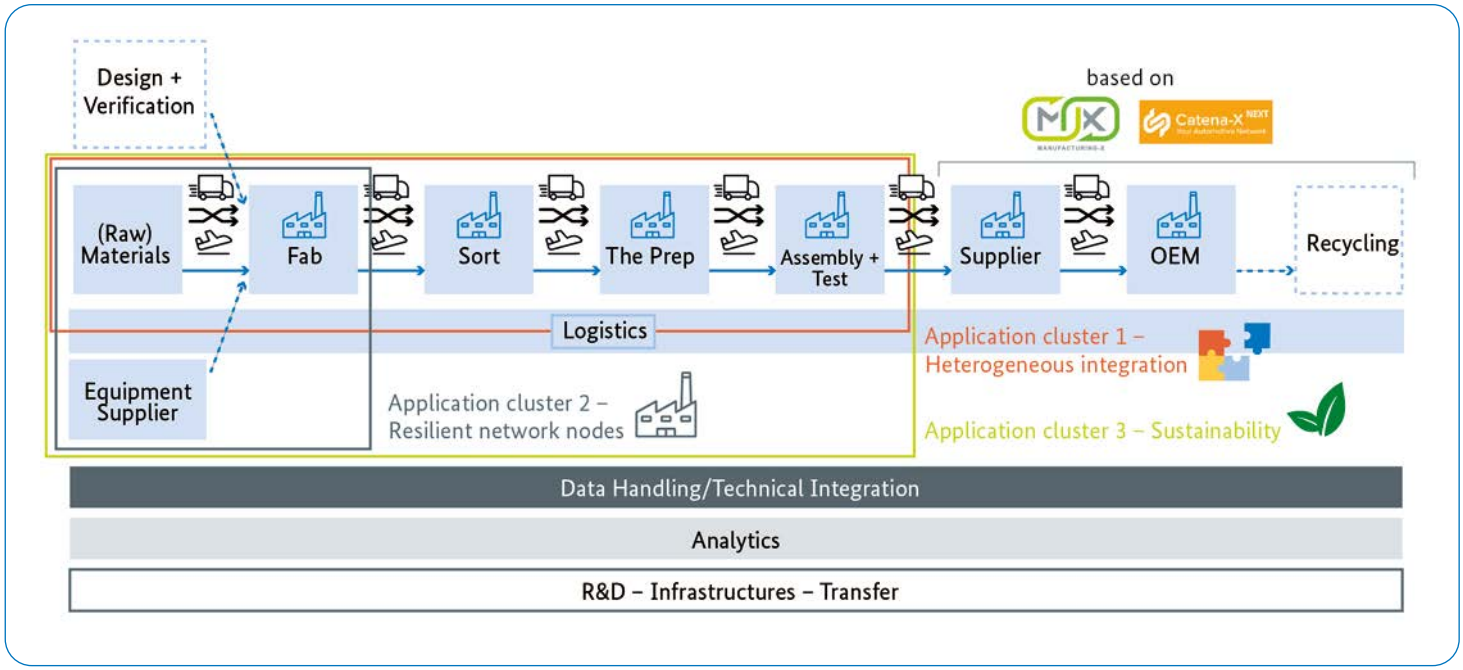
1 Collaborative Condition Monitoring

Infographic/Architecture



DAVID

Direct support for the application of the Asset Administration Shell within the Industry 4.0 data space

Project coordinator
Dr. Christian Mosch | Industrial Digital Twin Association e.V.

Project volume
€3M (Funding share BMWK: 93.3%)

Project duration
05/2024 – 07/2026

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

DAVID, set up as a cross-sectional project within the Manufacturing-X Initiative, aims to ensure digital interoperability based on the Asset Administration Shell (AAS). It contributes to the development of open data ecosystems in the industry by providing processes and resources to validate the technological and semantic interoperability of the MX-projects, which is a basic prerequisite for cross-industry use cases. Within the framework of DAVID, Manufacturing-X projects are supported both content-wise and methodologically, particularly in terms of using the AAS.

In addition, projects funded under the scheme "KoPa 35c Modul a2 – Digitalization of vehicle manufacturers and the supplier industry" are eligible for support as well. DAVID coordinates the use of the AAS within Manufacturing-X, validates intermediate project results, and ensures their standardization. Moreover, the project develops an SME adapter to enable SMEs to connect to the Industry 4.0 data ecosystem.

Consortium

Consortium lead

IDTA

HKA · Hochschule Kempten · ifak · Fraunhofer IESE

SCALE-MX

Scaling technology transfer for Manufacturing-X

Project coordinator
Dr. Marc Hüske | VDMA

Project duration
10/2024 – 09/2026

Project volume
€4.4M (Funding share BMWK: 84.9%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

SCALE-MX, as a transfer initiative of Manufacturing-X, aims to sustainably increase the participation of companies, especially SMEs, in the Manufacturing-X data ecosystem through targeted outreach. The focus of SCALE-MX is the systematic preparation and user-friendly presentation of transfer content from Manufacturing-X funded projects, as well as the coordination, conception and implementation of cross-industry and sector-specific transfer measures. A concrete example is the practical demonstration of applications developed in R&D projects for exchanging emissions data, with the specific aim of addressing SME users and making the benefits tangible. In this way, SCALE-MX makes a significant contribution to successfully transferring Manufacturing-X content into practice.

Consortium

Consortium lead

VDMA

bayern innovativ

Niedersachsen.next

DIHK Service GmbH

WIK

zvei

Beyond Manufacturing-X: leveraging synergies and expanding upon a common technical foundation

Manufacturing-X is the central initiative for the German economy to jointly develop industrial data ecosystems; however, it does not exist by itself but is closely aligned with other relevant initiatives. Manufacturing-X builds upon developments in recent years and is the logical evolution and an anchor point for current related activities.

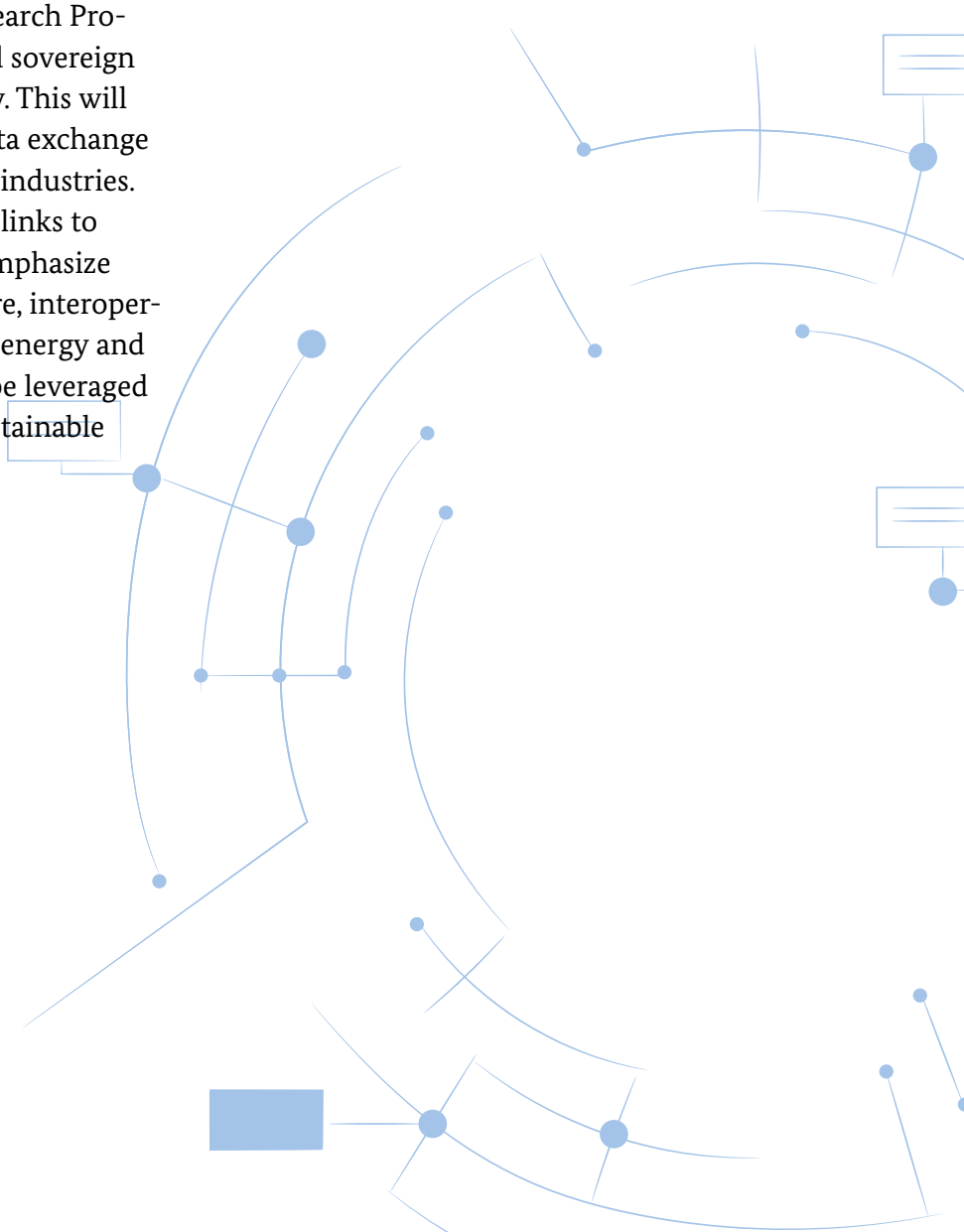
The interoperable standards for various industries that are being defined in the context of Manufacturing-X are largely based on the foundations laid by the Catena-X project. This lighthouse project has taken up the concepts of the European Gaia-X initiative and has put them into practice: A decentralized, federated, and interoperable digital infrastructure in which all users retain complete sovereignty over their data. Catena-X, the world's first true industrial data ecosystem – for the automotive industry – was created on this basis. The BMWK has supported Catena-X as part of the funding scheme "Digitalization of Vehicle Manufacturers and the Supplier Industry". Within the same funding framework, other important projects have developed solutions and technological building blocks that are valuable not only for the automotive industry. These projects are presented on the following pages.

Moreover, Manufacturing-X is also connected to other BMWK-funded initiatives, such as the 8ra Initiative. Based on IPCEI-CIS (Important Project of Common European Interest – Next Generation Cloud Infrastructure and Services), 8ra is the key digital initiative for Europe, driven by more than 100 companies and research organizations from twelve EU Member States aiming to establish the first-ever "Multi-Provider Cloud-Edge Continuum". The main objective is the creation of an entirely new decentralized environment which will enable software infrastructure for the advanced use of data processing resources from Cloud to Edge. This novel open ecosystem operated by multiple providers will reduce technological dependencies as well as lock-in effects. Moreover, it will enable a whole new dimension of data-driven business models, e.g. AI- and

IoT-related, for a broad spectrum of domains and industries. Several projects within the 8ra Initiative will also contribute significantly to Manufacturing-X, bringing together the Cloud-Edge Continuum approach of 8ra and the federated data-ecosystem approach of Manufacturing-X.

The core research and innovation strategy in the energy sector also includes BMWK-funded projects related to Manufacturing-X. One such initiative, the energy data-X project, is supported under the German government's 7th Energy Research Program and aims to develop a secure and sovereign data ecosystem for the energy industry. This will facilitate efficient and standardized data exchange between the energy sector and related industries. This cross-sector approach establishes links to Manufacturing-X, as both initiatives emphasize data-driven business models and secure, interoperable data exchange. By connecting the energy and manufacturing sectors, synergies can be leveraged to enhance efficiency and promote sustainable production processes.

The necessary bridging between these programs and initiatives will be achieved through projects that are presented on the following pages. The stakeholders are involved in the coordination structures and bodies of both Manufacturing-X and IPCEI-CIS, where they communicate needs, specifications, and requirements directly.



Antrieb 4.0

Experimental lab for industrial electric drive systems within the Industry 4.0 data space

Project coordinator
Dr. Falk Eckert | ZVEI e.V.

Project duration
01/2023 – 12/2025

Project volume
€4.3M (Funding share BMWK: 94.7 %)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Antrieb 4.0 is developing interoperable, cross-vendor solutions for industrial drive systems, leveraging a shared database to facilitate seamless interaction among value chain participants and establish the necessary technical framework. The precompetitive, manufacturer-neutral approach to addressing common challenges within this industry sector can significantly enhance data availability, transparency, interoperability, and access.

Central to this endeavor is the establishment of a Gaia-X-compatible data space, the definition of technical communication standards, and the application of artificial intelligence for targeted data analysis. This strategic approach shifts the focus from individual electric drive systems to the implementation of cross-vendor solutions, fostering interactive and co-creative value creation among market participants.

Collaborating with several industrial companies, Antrieb 4.0 is developing several use cases to demonstrate the added benefits for the entire value chain. By generalizing data analytics and AI methodologies, the project enables a manufacturer-independent utilization and transfer of learned models between electric drive systems. This is supported by a standardized integration between electric drive systems, using uniform data transmission technology and a common language from the central control system to the electric drive and sensor, along with corresponding safety concepts.

The practical application of these use cases and smart services will be showcased through a demonstrator. This demonstrator features both horizontal and vertical integration and a modular hardware concept, allowing cooperative operation across different locations, akin to an electric wave spanning multiple sites.

Consortium

Consortium lead

zvei electrifying ideas

Fraunhofer

Technische Universität Darmstadt

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

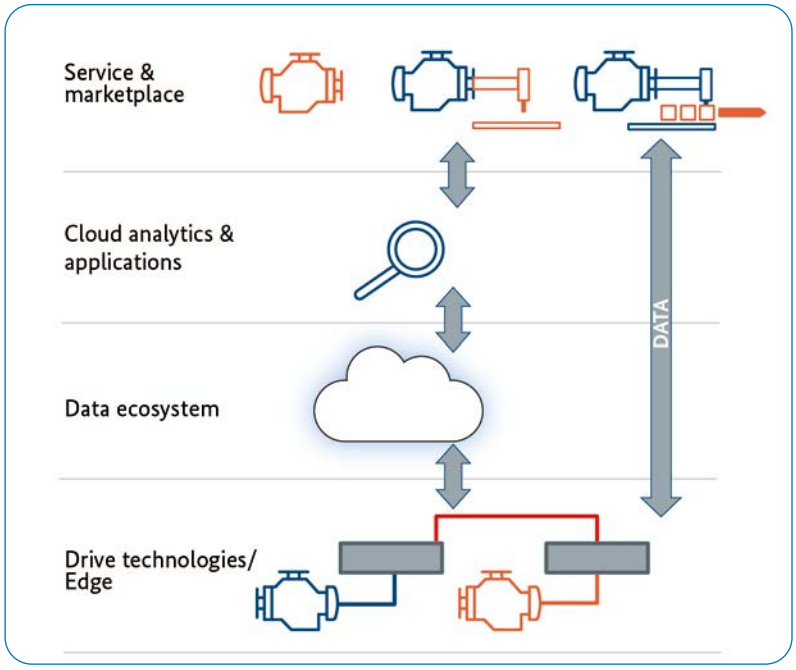
Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



Construct-X

Digital, trust-based collaboration in temporary value creation networks in the construction industry and industrial and plant engineering sector

Project coordinator
Martina Sandau | HOCHTIEF ViCon

Project duration
03/2025 – 02/2028

Project volume
€43.9M (Funding share BMWK: 66.1%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Construct-X aims to create digital standards, tools and methods to enable digital and trust-based collaboration in temporary value creation networks of the construction industry, plant engineering and the skilled trades. To this end, the project develops a cloud-based open-source reference architecture and implements various cloud-edge applications relevant to the construction sector.

These solutions will be integrated into the Multi-Provider Cloud-Edge Continuum developed by the 8ra Initiative. This enables latency-free and secure/loss-free processing of data on construction sites and a reduction in the bandwidth required.

The aim of Construct-X is to increase productivity, efficiency and transparency in the construction industry and in construction projects. It will also minimize the environmental impact of construction projects and contribute to the sector achieving its sustainability goals. The consistent use of data is essential to achieve these goals. Project data has so far only been used partially and in a less collaborative form in the diverse and heterogeneously organized construction industry. Construct-X will lay the foundation for the development of a federated data ecosystem with common rules and standards for the multi-lateral data exchange, drawing on experience already gained in other sectors, e.g. with projects such as Catena-X and the Manufacturing-X Initiative.

Consortium

Consortium lead

HOCHTIEF ViCon

CONTRANS Logistik GmbH · ARENA2036 · Fraunhofer IML · LS CARGO · HOTTGENROTH SOFTWARE · HFK RECHTSANWÄLTE · Lindner
LIEBHERR · [LogProIT] · PREDICTIVE INTELLIGENCE · MATERNA · STRABAG · tabyal
UNIBERG · VIA IMC · MAKADAM LABOR SCHWABEN · PSI · sit.institute GmbH · softbauware
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buildingSMART

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

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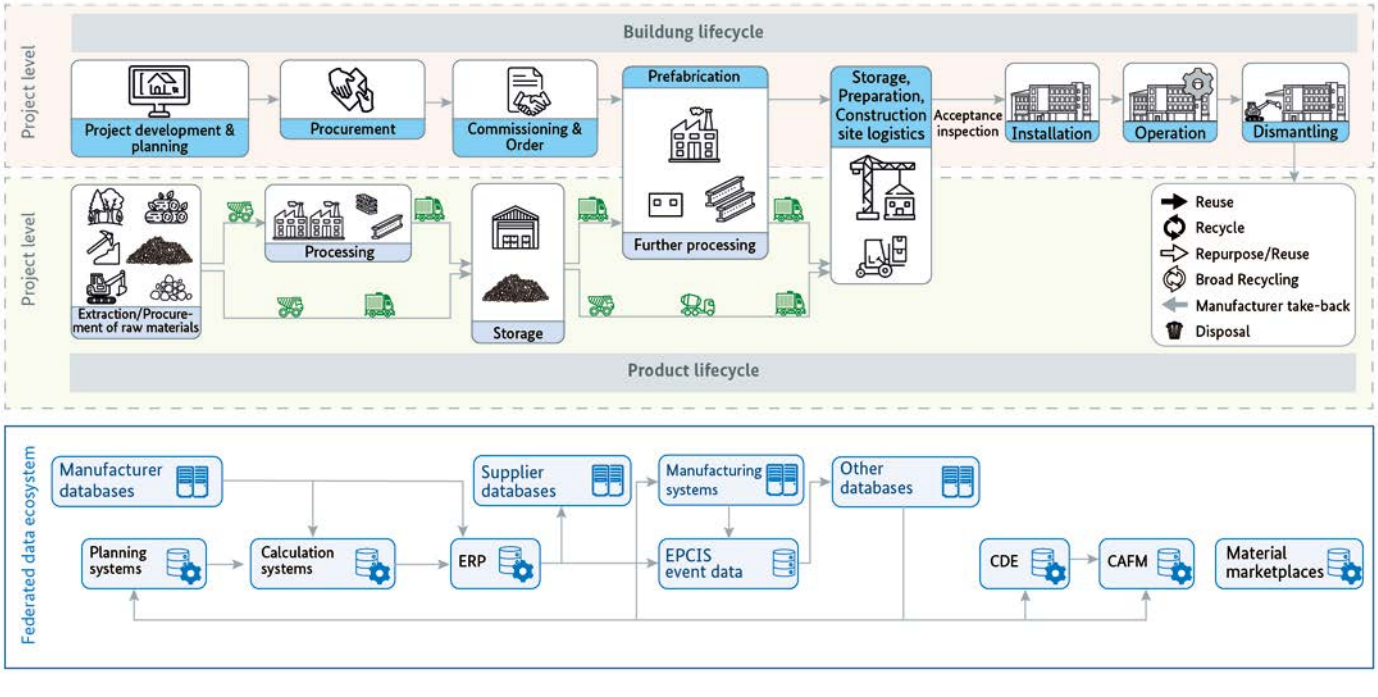

DIAMOND

Digital plant modeling with neutral data formats

Project coordinator
Michael Ach | BMW Group

Project duration
11/2022 – 10/2025

Project volume
€26.5M (Funding share BMWK: 47.3%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

DIAMOND is at the forefront of developing a comprehensive data model tailored for the digital engineering of production facilities. The objective is to significantly reduce project timelines, thereby facilitating the swift integration of new vehicles as well as drive technologies into manufacturing plants. To expedite the digital transformation of various use cases, it is imperative to devise innovative concepts for data exchange and reuse, digitization, and the creation of new business models. The success of these endeavors relies heavily on their economic viability across the entire ecosystem. This requires not only advanced technical solutions but also the evolution of organizational structures and the development of personnel within the companies involved. The project is divided into four closely coordinated workstreams:

1. Identifying information needs based on the planning and engineering processes
2. Developing demonstrators for modern data exchange/transformation leveraging streaming technologies
3. Testing and utilizing a complex example within the BMW production system to validate the concept
4. Creating training and migration concepts

Consortium

Consortium lead

BMW

MURR ELEKTRONIK, CADENAS, Mercedes-Benz Tech Motion, EKS, FESTO, FFT, inpro, LET'S DEV, LuArtX, WiMOD, Universität Magdeburg, LPS, SIEMENS, SIMPLAN, SOLAR COMPUTER, SYNERGETICON, tarakos

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
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Project focus · Considered in aspects · Out of scope

Use cases

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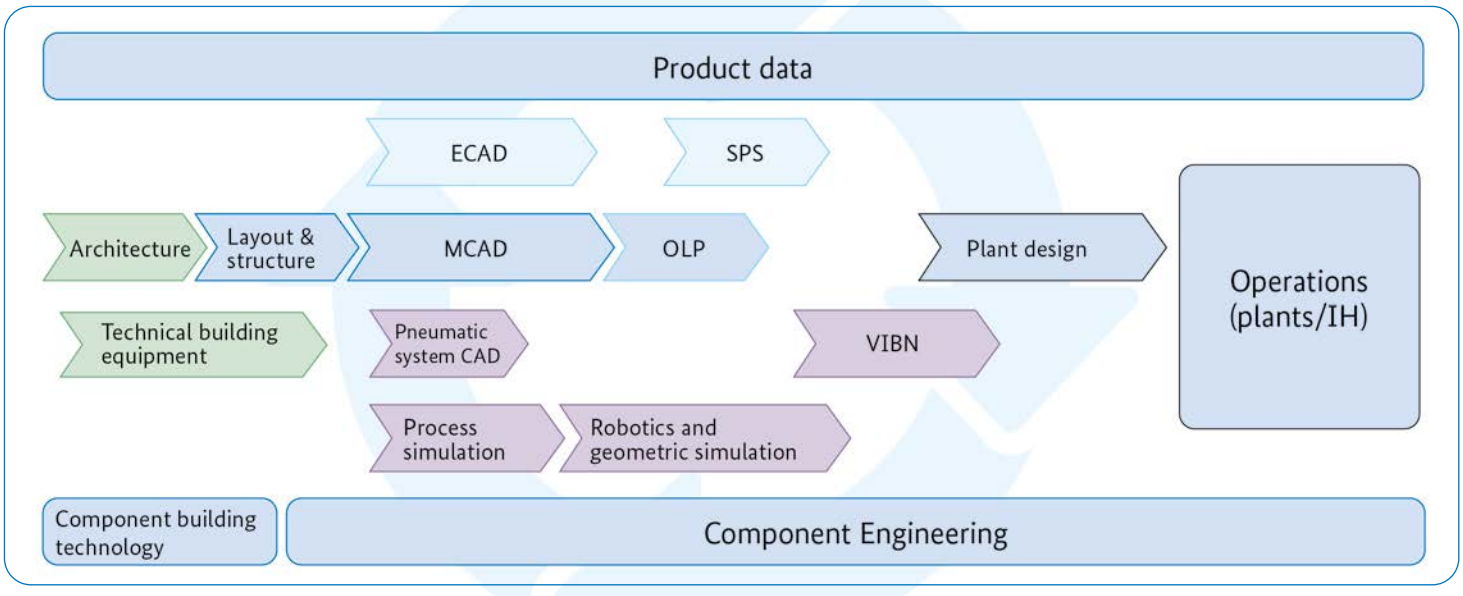

energy data-X

Energy data space for data exchange in Gaia-X

Project coordinator
Steffen Hofer | TenneT TSO

Project duration
10/2023 – 09/2026

Project volume
€9.5M (Funding share BMWK: 60%)

Funding agency
PT Jülich
PTJ-ESX-EFP@fz-juelich.de

Project description

energy data-X is developing a cross-sector data ecosystem, contributing to the realization of national and European energy and climate protection goals. The digitalization of the power supply is a major key to achieving the energy transition and climate neutrality. The exponential increase in renewable energy generation plants and energy storage systems (esp. wind, photovoltaic and home storage systems) as well as flexible energy consumers (esp. heat pumps and electric vehicles) requires a particularly powerful, cross-sector data ecosystem in order to manage energy loads and ensure the stability of energy grids.

The project's goal is the creation of a shared data ecosystem for innovative, data-driven business models as well as standardized, efficient data exchange. To this end, the project consortia builds a future-proof data ecosystem connecting all market players digitally. The application of the European Gaia-X principles and standards will guarantee security and sovereignty of data exchange. The energy data-X consortium is setting up this prototype for all market partners in the energy sector and all sectors related to energy, thereby enabling an increase in innovation and competitiveness through secure, self-determined and standardized exchange of data.

Consortium

Consortium lead

TenneT

50hertz | amprion | ARGE NETZ | Bundesanzeiger Verlag | DKE | e·on
EVIDEN | EWEnetz | Fraunhofer | International Data Spaces Association | Microsoft | PPC
Schneider Electric | SPHERITY | TRANSNET BW

Industry coverage

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Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture

Fluid 4.0

Implementing digitalization within the cross-industry and cross-manufacturer data space using Asset Administration Shells (AAS), submodels, and demonstrators.

Project coordinator
Martin Hankel | Bosch Rexroth AG

Project duration
01/2024 – 07/2026

Project volume
€13.4M (Funding share BMWK: 60.0%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

Fluid 4.0 brings together fluid technology manufacturers, machine and plant builders, operators, and service providers in one joint project. Together, the project consortium focuses on the development of digital twins for the management of fluid technology systems and components. Specific solutions for connected digital twins will be implemented for the following four highly-relevant use cases:

- Development of machine control systems
- Energy monitoring of fluid technology systems
- Cross-industry CO_2 accounting
- Circular Economy

The objectives of Fluid 4.0 include the creation of sub-models for Asset Administration Shells (AAS) tailored to the system management of the respective use cases and their exchange within a cross-industry data ecosystem.

In order to substantially improve product lifecycle management, this data ecosystem is set up to be legally compliant, trustworthy, and role-based. To this end, Fluid 4.0 will build on existing infrastructure for the digitalization of fluid technology components (AAS, ECLASS models, OPC UA Companion Specifications) as well as on data space components developed by other industries (e.g. Catena-X).

Consortium

Consortium lead

rexroth A Bosch Company

CF LAB future of construction
em engineering methods AG
AVENTICS
FLUIDON
Fraunhofer IIS
HAWE HYDRAULIK
IQSTRUCT ENGINEERING
KERN TECHNIK
RÖCHER
RWTH AACHEN UNIVERSITY
TECHNISCHE UNIVERSITÄT DRESDEN
VDMA
Danfoss Power Solutions
HYDAC

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

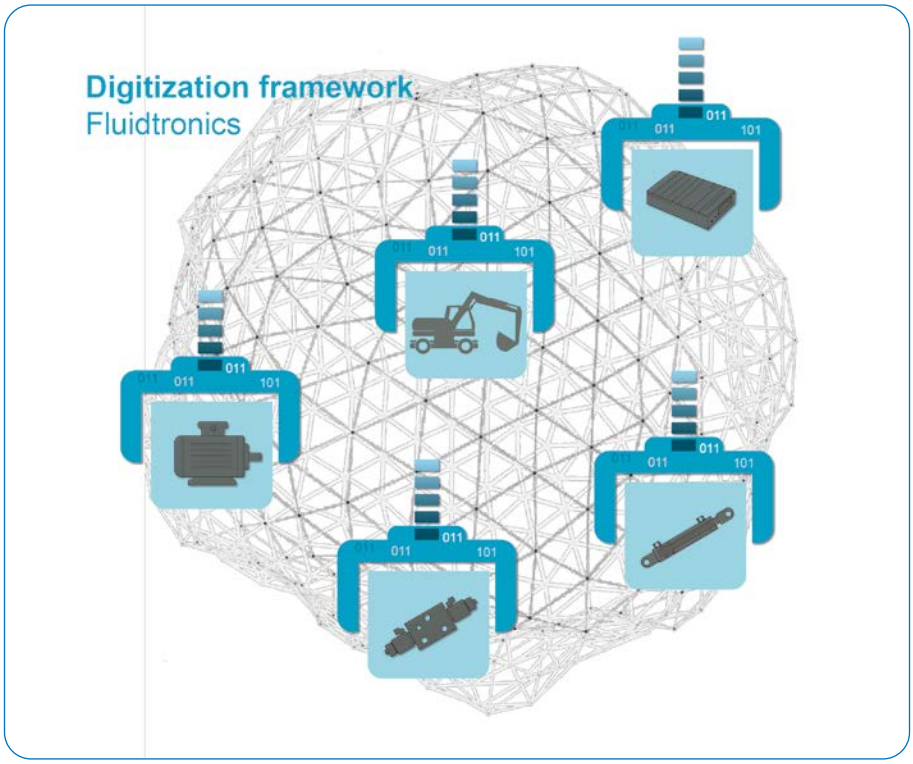
Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



growING

Growing digital twins for integrated co-creation

Project coordinator
Dr. Johannes Fisel | Robert Bosch GmbH

Project duration
11/2024 – 01/2027

Project volume
€12.8M (Funding share BMWK: 47.2%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The growING project aims to transform collaboration in the special-purpose machinery sector by advancing the development of digital twins.
Its goal is to enable seamless, digital, and cross-enterprise cooperation, significantly reducing the time-to-market for new machinery. By leveraging interoperable technologies such as the Asset Administration Shell and the Eclipse Dataspace Connector, growING ensures compatibility across diverse tool and process landscapes.

To validate the efficiency and practicality of the solutions, demonstrators and pilot systems are being implemented in real-world scenarios.

The project plays a critical role in shaping the Multi-Provider Cloud-Edge Continuum by providing essential requirements and testing the applications and technologies developed within this ecosystem.

growING takes the concept of digital twins to the next level by progressively enriching their capabilities, making them adaptable to increasingly complex scenarios. In doing so, the project strengthens digital sovereignty in Germany and Europe, reduces technological dependencies, and fosters the education and upskilling of professionals in digital technologies.

Consortium

Consortium lead

BOSCH

Flexis

KLOTZ

ruhlamat

SimPlan

Universität Stuttgart ISW

Industry coverage

Machinery & Plant Engineering	**Supplier**	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

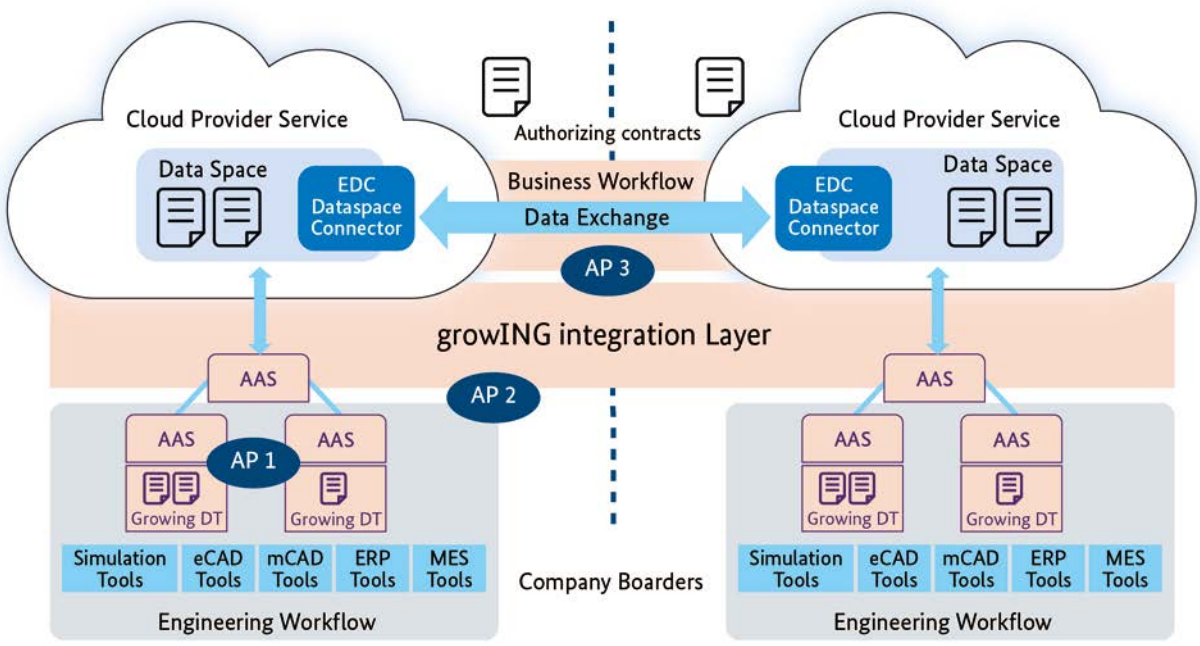
Project focus | Considered in aspects | Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	**Collaborative Engineering**
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



Railway-X

Development of a data room in the international rail industry using cloud-edge technology for data collection and processing

Project coordinator
Stefan Kleindienst | Siemens Mobility GmbH

Project duration
01/2025 – 12/2026

Project volume
€12.1M (Funding share BMWK: 45.9%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The Railway-X project consortium aims to create a federated data ecosystem for the railway industry. This is done in close coordination with other Manufacturing-X projects, while industry-specific initiatives are integrated in order to develop solutions that fulfill all requirements of end users in the industry.

The rail industry faces similar challenges to other sectors in terms of digital and sustainable transformation. Just like in all other sectors, the consistent availability of standardized data is an essential requirement for efficient and scalable digital solutions that address these challenges. Railway-X will therefore develop a federated digital infrastructure for the efficient exchange of standardized data in the value networks of the railway industry.

Several use cases to be implemented by the project will demonstrate the benefits of this data ecosystem. For example, regulatory product passports for batteries will be implemented by the project. On this basis, the recording and aggregation of PCF values can thus not only be simplified, but also recorded in a comparable manner across all OEMs. This is of particular importance in the industry, especially against the background of public procurement regulations.

Consortium

Consortium lead

SIEMENS

dfki

FKM ELEMENTE

HARTING

HOPPECKE

WAGO

Capgemini

SALZGITTER MANNESMANN FORSCHUNG

Technische Universität Braunschweig

Industry coverage

Machinery & Plant Engineering	Supplier	**Automotive**
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

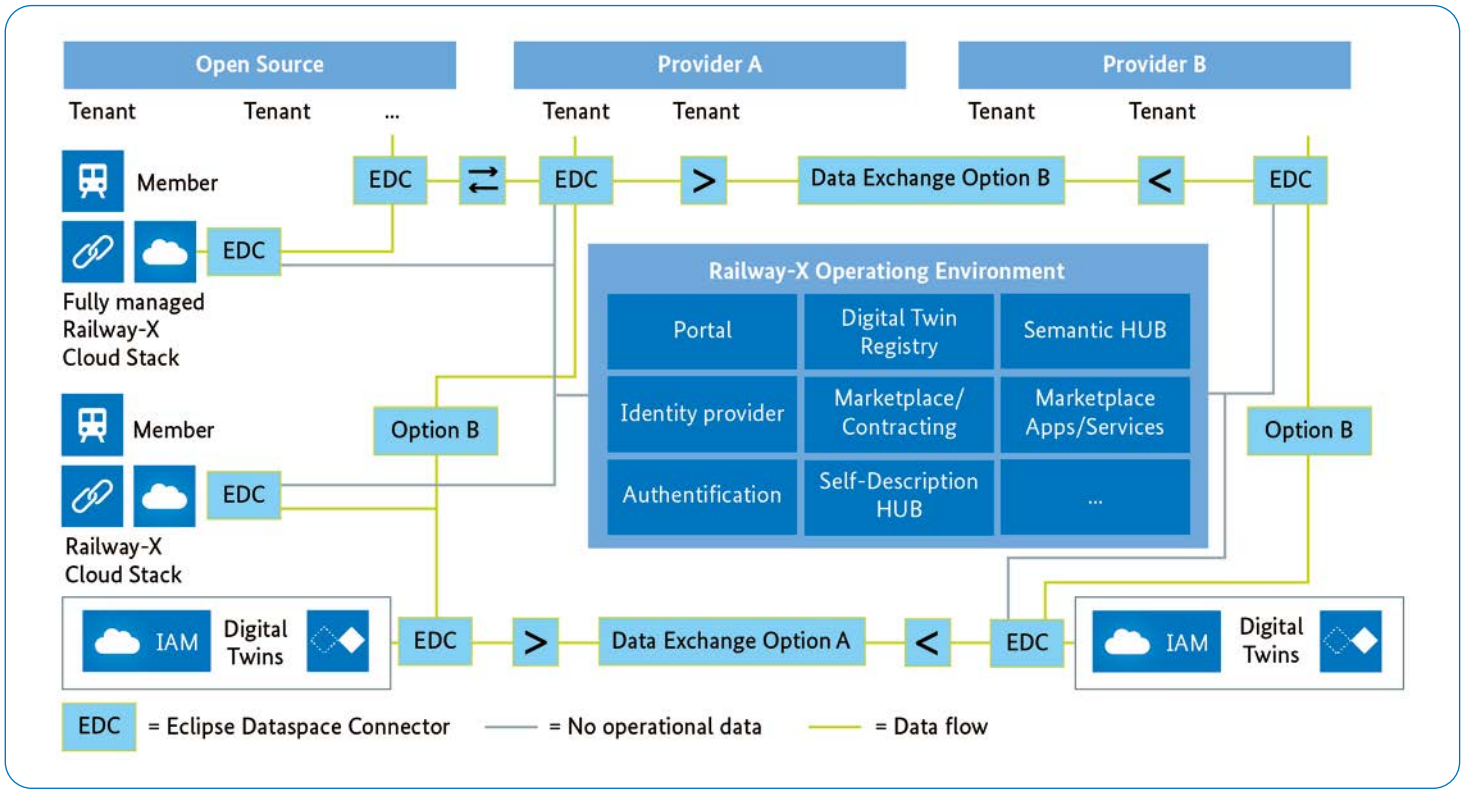
Project focus | Considered in aspects | Out of scope

Use cases

Business Data Management	**Traceability**	**Digital Product Passport**
Product Carbon Footprint	**Circular Manufacturing**	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
Autonomous Operations	Demand & Capacity	Collaborative Engineering
Update & Change Mgmt.	AI as a Service	Energy Load Mgmt.

1 Collaborative Condition Monitoring

Infographic/Architecture



RoX

Digital Ecosystem for AI-based Robotics

Project coordinator
Bernd Kuhlenkötter | ABB AG

Project duration
09/2024 – 02/2027

Project volume
€52M (Funding share BMWK: 52%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The RoX project consortium, in which 24 partners from industry and research work together, aims to develop and establish a digital ecosystem for AI-based robotics that is realized in the cloud-edge continuum. The ecosystem is intended to improve collaboration between parties from different life cycle phases, e.g. between equipment manufacturers, system integrators, and operators.

An important part of the project is the creation of generic software modules that are to be made available via the ecosystem. A compatible design of all modules will make it possible to draw on solutions from different providers and thus create an individually optimized overall solution. Existing concepts, technologies and standards are used as a basis for the technical implementation in order to ensure technical interoperability of the project results.

A total of twelve use cases from four application domains will be implemented to validate the practical suitability of the ecosystem. These domains encompass robotic systems for loading and unloading, for picking and kitting, for commissioning, and for the autonomous production.

Consortium

Consortium lead

ABB

Boehringer Ingelheim, DÜRR, FIEGE, Gluth System Technik, dfki ai, DLR, Fraunhofer IPA, intrinsic, invite, Mercedes-Benz, RHEINMETALL, RIF, roboception, robomotion, SAFELOG, SCHUNK, SIEMENS, SOTEC, T Systems, VDMA, WACKER, WÜRTH, YARDSTICK ROBOTICS

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
Product Carbon Footprint	Circular Manufacturing	Quality Management
CCM[1]	Manufacturing as a Service	Modular Production
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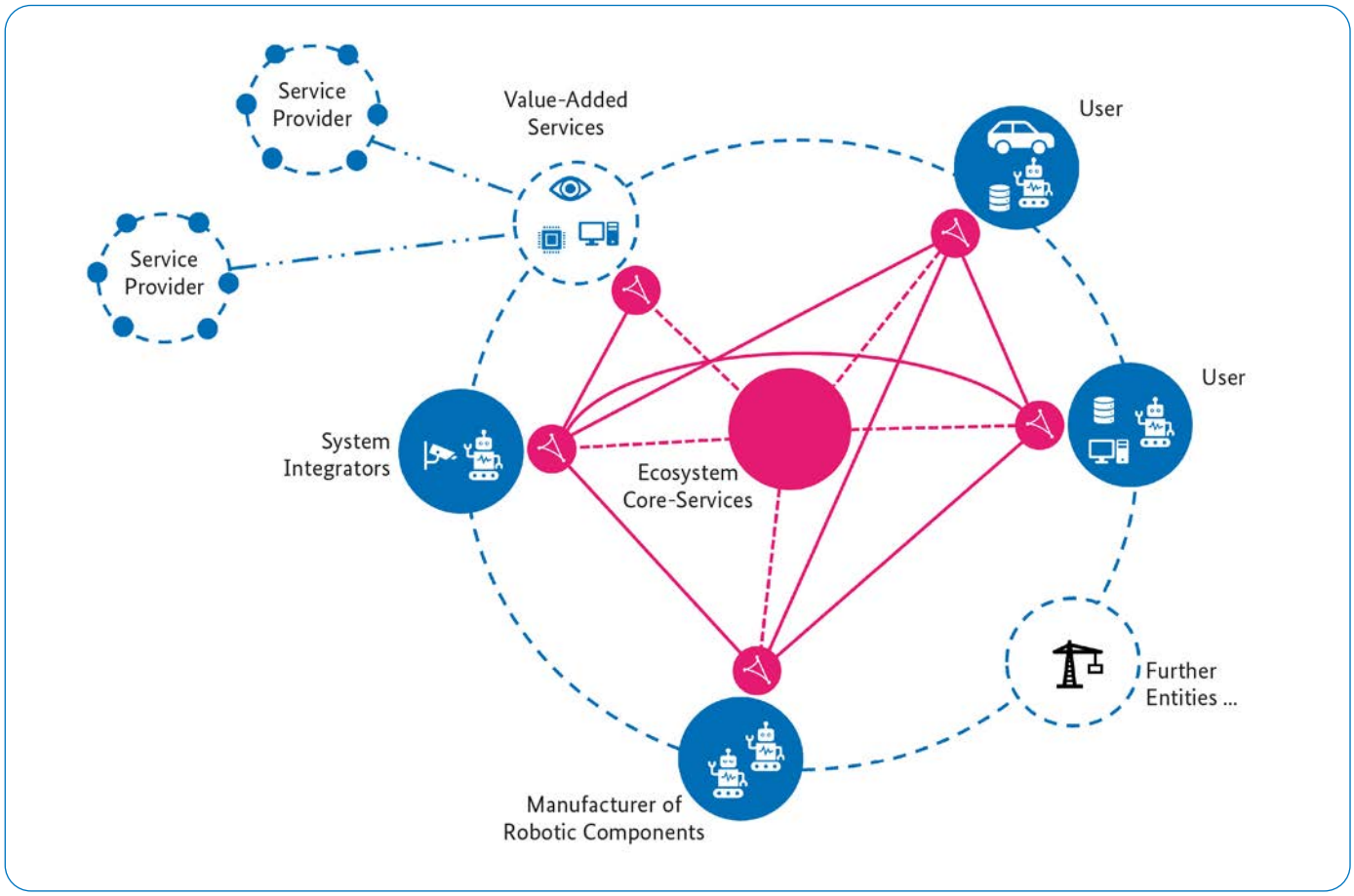

Wind-X

Cloud-edge based data space for the wind industry

Project coordinator
Henning Klinke | WRD Wobben R&D GmbH

Project duration
11/2024 – 07/2027

Project volume
€5M (Funding share BMWK: 60.2%)

Funding agency
VDI Technologiezentrum
manufacturing-x@vdi.de

Project description

The Wind-X project aims to enhance digital collaboration in the wind industry by establishing a federated, decentralized data ecosystem that enables more efficient data exchange across the sector. By leveraging cloud and edge computing, Wind-X facilitates seamless and secure data sharing between manufacturers, suppliers, and wind farm operators without compromising data sovereignty.

One of the major technical challenges in the wind industry is the fragmentation of data, which limits innovation and operational efficiency. Companies rely on diverse and incompatible data systems, making cross-organizational collaboration difficult. Wind-X addresses this by standardizing data formats and enabling interoperable digital services. Economically, the project tackles high maintenance and lifecycle costs of wind turbines by introducing predictive maintenance and digital twin technology to optimize performance and reduce downtime.

The solutions and technology assets to be developed in this project will be demonstrated through two use cases. The first use case will address traceability for sustainability and logistics, while the second will focus on the digital twin in production and field.

Consortium

Consortium lead

ENERCON
HAHN PROJECTS
mews
SWMS
BIBA
RWTH AACHEN
VDMA

Industry coverage

Machinery & Plant Engineering	Supplier	Automotive
Aerospace	Electrical Engineering	Chemistry
Defense	Energy	Pharmacy/ Health
Logistics	Construction	Materials

Project focus · Considered in aspects · Out of scope

Use cases

Business Data Management	Traceability	Digital Product Passport
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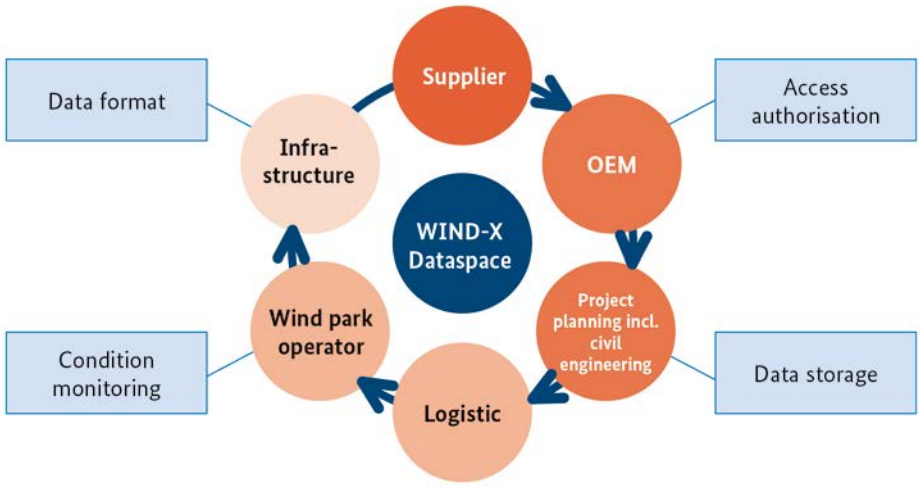

The data space will be tested and validated in the following Use Cases:

Use Case 1: Traceability (for Sustainability and Logistic)

Use Case 2: Digital Twin (in Production and in the Field)

Community development and transfer in Manufacturing-X

Collaboration for a connected industry

Successful scaling of data ecosystems requires close cooperation between industry, academia, and all relevant associations.

As part of Manufacturing-X, the funding projects SCALE-MX and Transfer-X will drive the scaling of digital ecosystems in a targeted manner. In addition, the Next Level Mittelstand initiative supports SMEs in the practical use and implementation of digital technologies. Together, these initiatives are creating a sustainable infrastructure for the widespread use of data-driven business models within the industry.

SCALE-MX – The transfer initiative for Manufacturing-X

SCALE-MX is the central transfer project for Manufacturing-X and empowers companies and multipliers on regional and national level to exploit the potential of data ecosystems and their added value. The aim is to facilitate access to data-driven value creation networks and provide companies and multipliers with practical information about the use and integration of data ecosystems.

Communication activities focus on specific best practices and practical use cases. With direct access to all relevant user industries and "X projects", SCALE-MX aims to significantly increase the participation of German industrial companies in the Manufacturing-X data ecosystem. This initiative supports companies in engaging with the data economy and securing their long-term competitiveness.

Transfer-X – Transfer knowledge, enable digitalization

The BMWK-funded Transfer-X project strengthens the competitiveness of SMEs through the structured transfer of knowledge on data ecosystems and digitalization technologies. Transfer-X is a publicly accessible knowledge platform with practical training materials, hybrid transfer modules, and specific application scenarios. Companies receive targeted support in training their employees to make efficient use of data-driven value creation potential.

Next Level Mittelstand – Innovative strength for SMEs

Next Level Mittelstand is an initiative of the Plattform Industrie 4.0, which was founded to promote digitalization for SMEs on the way to becoming a digital champion in 2030 and to strengthen competitiveness.

In order to promote cooperation and exploit synergies, special emphasis is placed on bringing SMEs together. Being the backbone of the German economy and a driver of digital transformation, strong networks among SMEs need to be established. In consequence, companies can benefit from efficiency gains and innovation ecosystems that enable data-driven business models and unlock new value
creation potential in data ecosystems.

In dedicated workstreams, practical solutions are collaboratively developed and implemented. These workstreams generate specific best practices for companies, facilitating knowledge transfer and accelerating digital adoption across industries.

Working together for strong data ecosystems

All three initiatives work closely together to support companies in the use of data ecosystems in a practical way. Through the targeted transfer of knowledge, they promote the industrial application of data ecosystems and strengthen the data-driven economy.