Data Exchange and Collaboration with Standards

Bernd Feldvoss - Airbus

Presenters Bio

Bernd Feldvoss
PLM Interoperability Standards Specialist

Engineering Tools Architecture and Roadmap

AIRBUS

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Bernd Feldvoss is a Product Data Interoperability Standards Specialist within Airbus Commercial Aircraft, based in Hamburg, Germany.

Bernd joined Airbus in 1998 and worked as a Systems Engineer where he was involved in the development of Data Exchange Methods and operating Data Exchange (DMU & Product Structure) and did several movements until joining in 2022 engineering Process, Methods, Tools & Data.

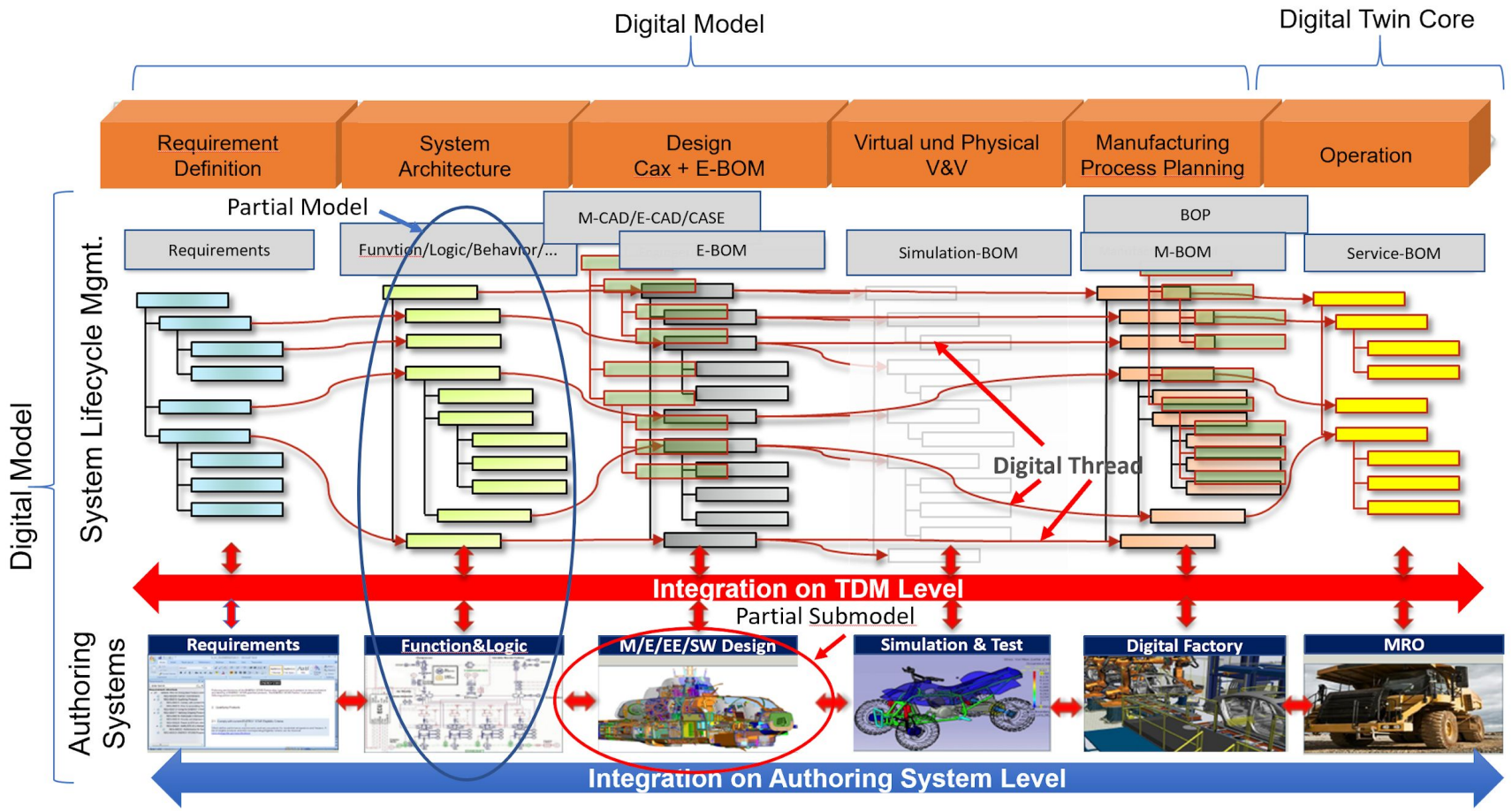
Bernd represents Airbus in numerous working groups and committees including; prostep ivip Technical Steering Committee and the JT Open Technical Review Board. He is also a member of the Global Collaboration Working Group in the CIMdata managed PLM Aerospace & Defense Action Group.

Bernd studied Computer Science at the University of Hamburg, where his focus was on Computer Aided Engineering.

Challenges

- **Data Spaces**
  - **Data Centric**
  - **Federation/Data Linking**
- **Gaia-X, Aerospace-X, NextErA**
- **US DoD Digital Engineering, MOSA**
- **Collaboration**
  - **MBE, MBSE, SW, …**
  - **Supply Chain**
  - **Toolsets (CAD, PLM, ERP, etc.)**
- **Export Control, ITAR, etc.**
- **Metaverse**
  - **Digital Twins, VR/AR, OpenUSD, etc.**
- **Standards**
  - **SDO's: ISO, AIA, SAE, OMG, W3C, INCOSE, NAFEMS, OPC, Modelica,VDA, ….**
  - **STEP, JT, SysML, IPS Series, AAS, RDS, χMCF, …**
- **Simplification**
- **Bureaucracy**
- **Regulations**
  - **EU AI Act, EU Cyber Resilience Act, EU Data Act, Ecodesign for Sustainable Products Regulation (ESPR) incl. Digital Product Passport (DPP)**

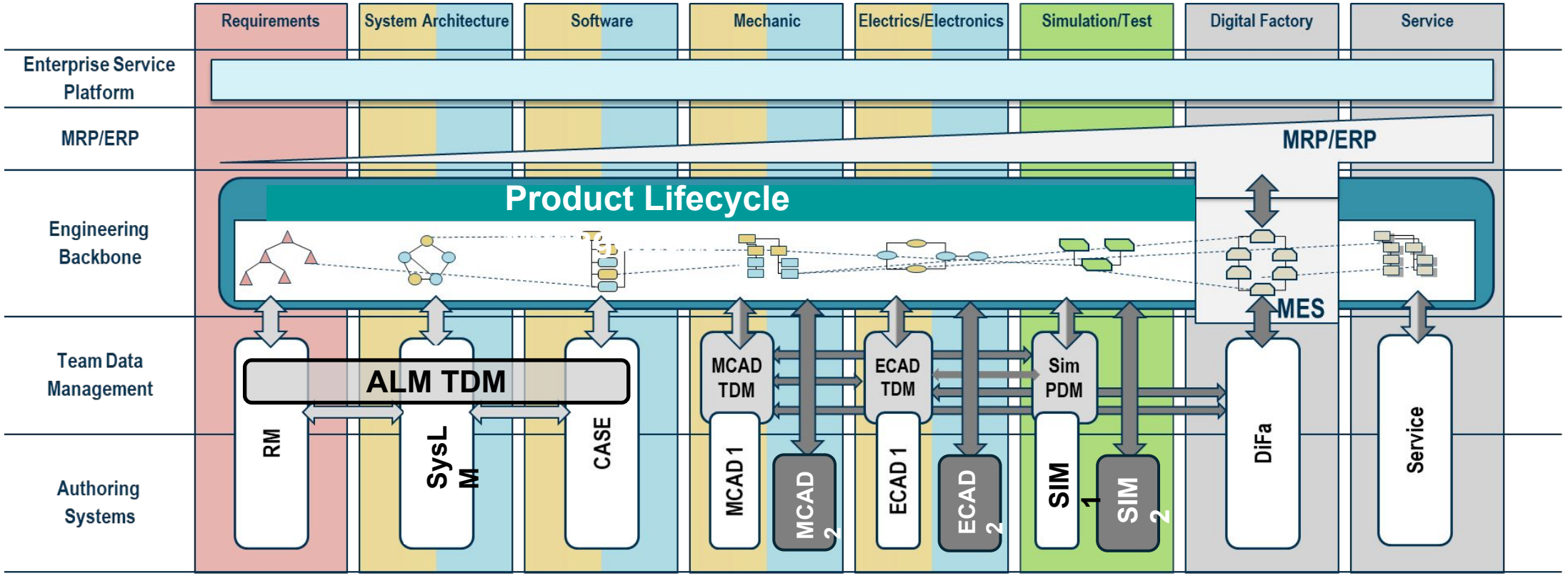
Product Life Cycle - Model Landscape



BOM Bill of Material, E-BOM/M-BOM Engineering/Manufacturing BOM, BOP Bill of Processes, MRO Maintenance Repair and Overhaul, Cax CA-Application

Source: Prof. Dr. Martin Eigner

Product Life Cycle - System Landscape



Source: Prof. Dr. Martin Eigner

OMG - Model-Based Acquisition (MBAcq)

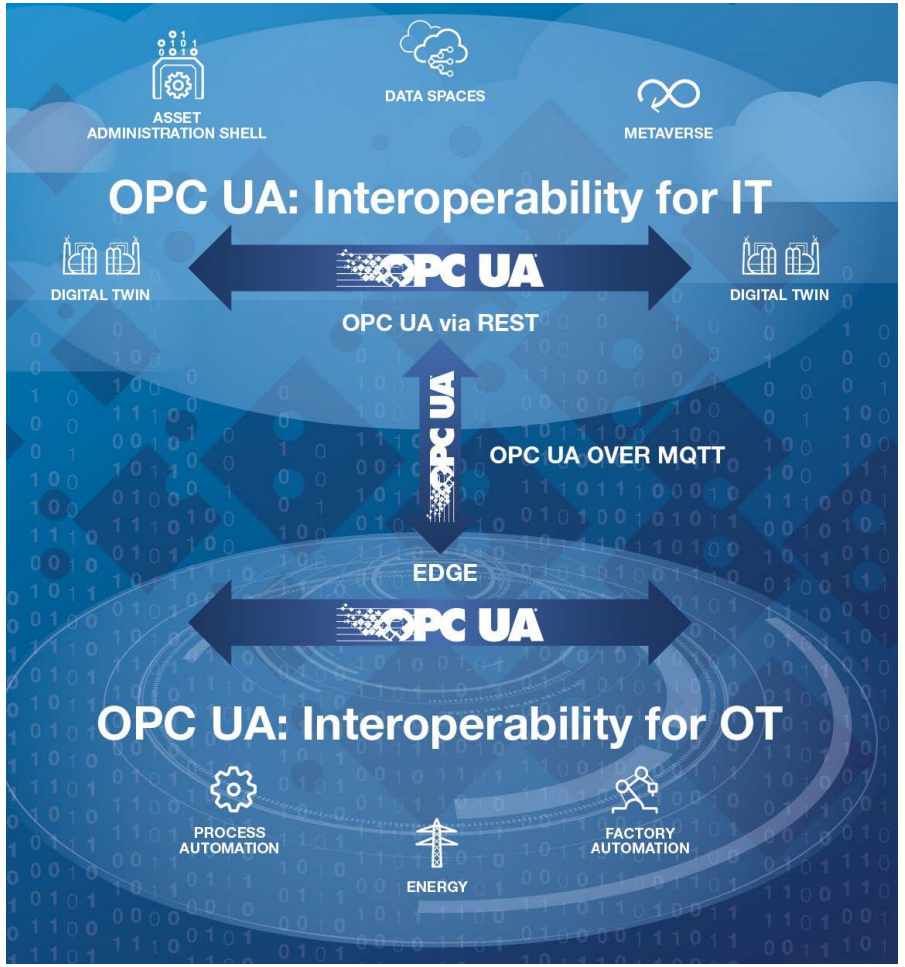
The **Model-Based Acquisition** User Group Community (MBAcq) will enable participating members to access a wealth of cutting-edge insights at the forefront of the industry, working on projects shaping the future of MBSE specifications and reference architectures. MBAcq members will obtain value through networking and participation in developing community products, giving them a competitive advantage.

MBAcq Community Purpose
The purpose of this community is to serve as a forum where end users from various industries, government entities, academia, and tool vendors come together to collaborate on the creation and advancement of standardized patterns, reference architectures, and guidance for advancing the progress of Model-Based Systems Engineering (MBSE) standards during acquisition.

MBCollab

https://www.omg.org/communities/model-based-acquisition-user-community.htm

OPC Unified Architecture - Interoperability for Industrie 4.0 and the Internet of Things



OPC UA: Industrial Interoperability

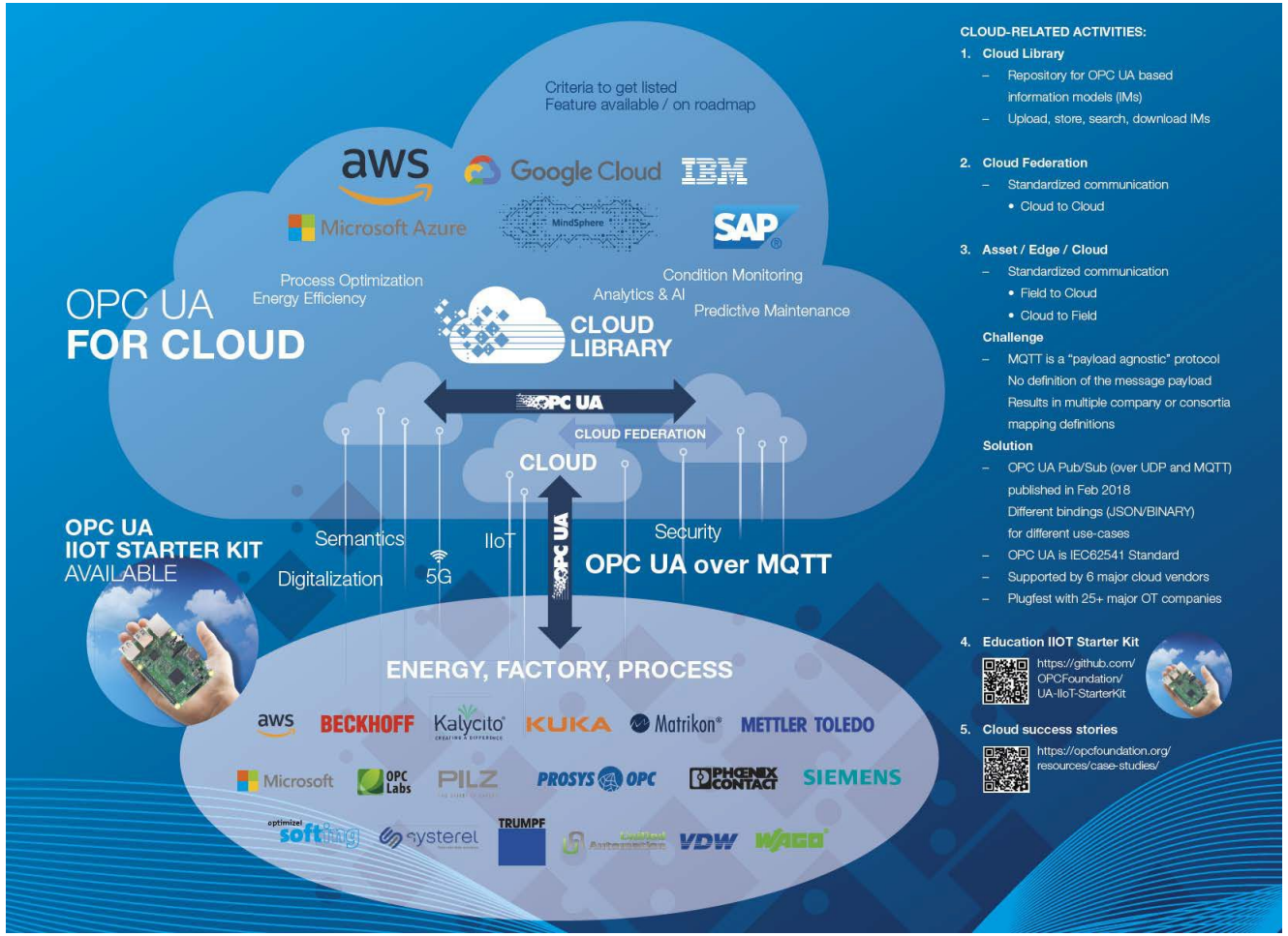
One harmonized solution for OT and IT
Including:
… rich modeling language
- complex data
- inheritance

… flexible transport
- TCP/IP, UDP, MQTT
- File Transfer (since 2013)
- REST interface (since 2016)

… security
- for accessing information
- for transport of information
- onboarding
- infrastructure certificate management

https://opcfoundation.org/

OPC Unified Architecture - Interoperability for Industrie 4.0 and the Internet of Things



Transport (Status 2023) „OPC UA over MQTT“
Information exchange

- 53 OT companies
- 2 IT companies Microsoft, AWS

Cloud Library

World largest online Repository of Information models

- Association standardized
- Companies standardized

Free of charge

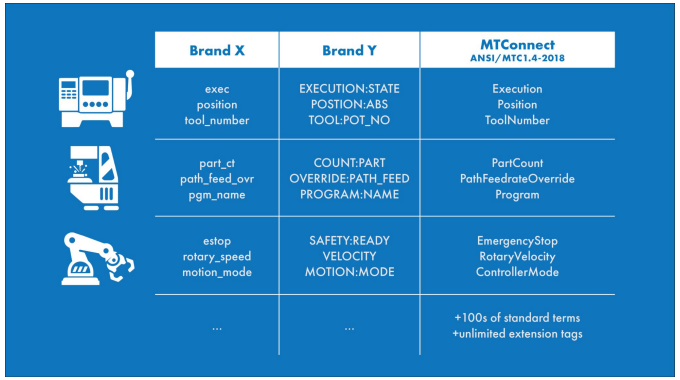
MTCONNECT
POWERED BY AMT

THE ASSOCIATION FOR MANUFACTURING TECHNOLOGY

MTConnect standardizes factory device data.

The MTConnect standard (ANSI/MTC1.4-2018) is a domain specific semantic vocabulary for manufacturing equipment. Developers and system integrators use this information model to provide structured, contextualized data with no proprietary format. This reduces translation costs and lets users focus on useful, productive manufacturing applications rather than low level data wrangling. MTConnect data sources include things like production equipment, sensor packages, and other hardware. Applications using MTConnect data provide more efficient operations, improved production optimization, and increased productivity.

Scalable system architectures depend on standards. MTConnect provides domain-specific vocabulary and data models, is extensible, and integrates with other standards by design



Quality Information Framework (QIF)

The **Quality Information Framework** (QIF) is a unified XML framework standard for computer-aided quality QIF systems, available free to all implementers.

QIF enables the capture, use, and re-use of metrology-related information throughout the Product Lifecycle Management (PLM) and Product Data Management (PDM) domains.

In August 2020, the DMSC announced the QIF 3.0 metrology standard was harvested, approved, and published by ISO as the new ISO Standard ISO 23952:2020; click to read more on this important status change.

QIF was created by The **Digital Metrology Standards Consortium** (DMSC TM). DMSC is responsible for the development, maintenance and support of the QIF standard, as well as the Dimensional Measuring Interface Standard (DMIS). The DMSC is an ANSI accredited Standards Developing Organization as well as an A-Liaison to ISO. The DMSC invites participation within the consortium of other standards groups and activities that seek to resolve technological inefficiencies and other issues related to digital metrology.

Industrial Digital Twin Association (IDTA)

Asset Administration Shell (AAS)

AAS Specification in Version 3.0

- Part 1: Metamodel
- Part 2: Application Programming Interfaces
- Part 3: Data Specification
- Part 4: Security
- Part 5: Package File Format (AASX)

IDTA

https://industrialdigitaltwin.org/en/

IEC

IEC 63278-x

EU Digital Product Passport (DDP)

ID Link
(IEC 61406)

+

AAS
(IEC 63278)

=

With open standards
free to use

EU Ecodesign

Ecodesign for Sustainable Products Regulation (ESPR)

The Ecodesign for Sustainable Products Regulation (ESPR), which entered into force on 18 July 2024, is the cornerstone of the Commission's approach to more environmentally sustainable and circular products.

Products and the way we use them can have a significant impact on the environment. Consumption in the EU can therefore be a major cause of climate change and pollution.

The ESPR is part of a package of measures that are central to achieving the objectives of the 2020 Circular Economy Action Plan. They will contribute to helping the EU reach its environmental and climate goals, doubling its circularity rate of material use and to achieving its energy efficiency targets by 2030.

A sustainable product is likely to display one or more of the following characteristics:-

- Uses less energy
- Lasts longer
- Can be easily repaired
- Parts can be easily disassembled and put to further use
- Contains fewer substances of concern
- Can be easily recycled
- Contains more recycled content
- Has a lower carbon and environmental footprint over its lifecycle

Digital Product Passport (DPP)

The ESPR will introduce a Digital Product Passport (DPP), a digital identity card for products, components, and materials, which will store relevant information to support products' sustainability, promote their circularity and strengthen legal compliance.

This information will be accessible electronically, making it easier for consumers, manufacturers, and authorities to make more informed decisions related to sustainability, circularity and regulatory compliance. It will allow custom authorities to perform automatic checks on the existence and authenticity of the DPPs of imported products.

Information to be included in the DPP will be identified by the Commission, in close consultation with all relevant stakeholders, and will depend on the specific product in question. This information can include:

- Product's technical performance
- Materials and their origins
- Repair activities
- Recycling capabilities
- Life Cycle environmental impacts

DPP4.0 – The Digital Product Passport for Industry 4.0

EU Cyber Resilience Act (CRA)

The Cyber Resilience Act introduces mandatory cybersecurity requirements for hardware and software products, throughout their whole lifecycle.

The problem addressed by the Regulation is two-fold.

https://digital-strategy.ec.europa.eu/en/policies/cyber-resilience-act

First is the inadequate level of cybersecurity inherent in many products, or inadequate security updates to such products and software.

Fact Sheet

Second is the inability of consumers and businesses to currently determine which products are cybersecure, or to set them up in a way that ensures their cybersecurity is protected.

The Cyber Resilience Act will guarantee:

- harmonised rules when bringing to market products or software with a digital component;
- a framework of cybersecurity requirements governing the planning, design, development and maintenance of such products, with obligations to be met at every stage of the value chain;
- an obligation to provide duty of care for the entire lifecycle of such products.

EU Data Act

https://digital-strategy.ec.europa.eu/en/policies/data-act

The Data Act is a comprehensive initiative to address the challenges and unleash the opportunities presented by data in the European Union, emphasising fair access and user rights, while ensuring the protection of personal data.

Fact Sheet

The Regulation on harmonised rules on fair access to and use of data — also known as the Data Act — entered into force on **11 January 2024**. The Act is a key pillar of the European data strategy and it will make a significant contribution to the Digital Decade's objective of advancing digital transformation. For more in depth explanation, please see the Data Act explained.

The new measures complement the Data Governance Act, which was the first deliverable under the European strategy for data and became applicable in September 2023. While the Data Governance Act regulates processes and structures that facilitate voluntary data sharing, the Data Act clarifies who can create value from data and under which conditions. Together, these two acts will facilitate reliable and secure access to data, fostering its use in key economic sectors and areas of public interest. They will also contribute to the establishment of an EU single market for data, ultimately benefiting both the European economy and society at large.

The Data Act will enable a fair distribution of the value of data by establishing clear and fair rules for accessing and using data within the European data economy, a necessity heightened by the growing prevalence of the Internet of Things (IoT). Thanks to this regulation, connected products will have to be designed and manufactured in a way that empowers users (businesses or consumers) to easily and securely access, use and share the generated data.

The Data Act is a cross-sectoral piece of legislation (i.e. it lays out principles and guidelines that apply to all sectors). It does not modify existing data access obligations, however any forthcoming legislation should align with its principles.

VDMA Quick Guide "Interoperability Interface Standards for Applying the EU Data Act Successfully"

EU AI Act

The AI Act is the first-ever legal framework on AI, which addresses the risks of AI and positions Europe to play a leading role globally.

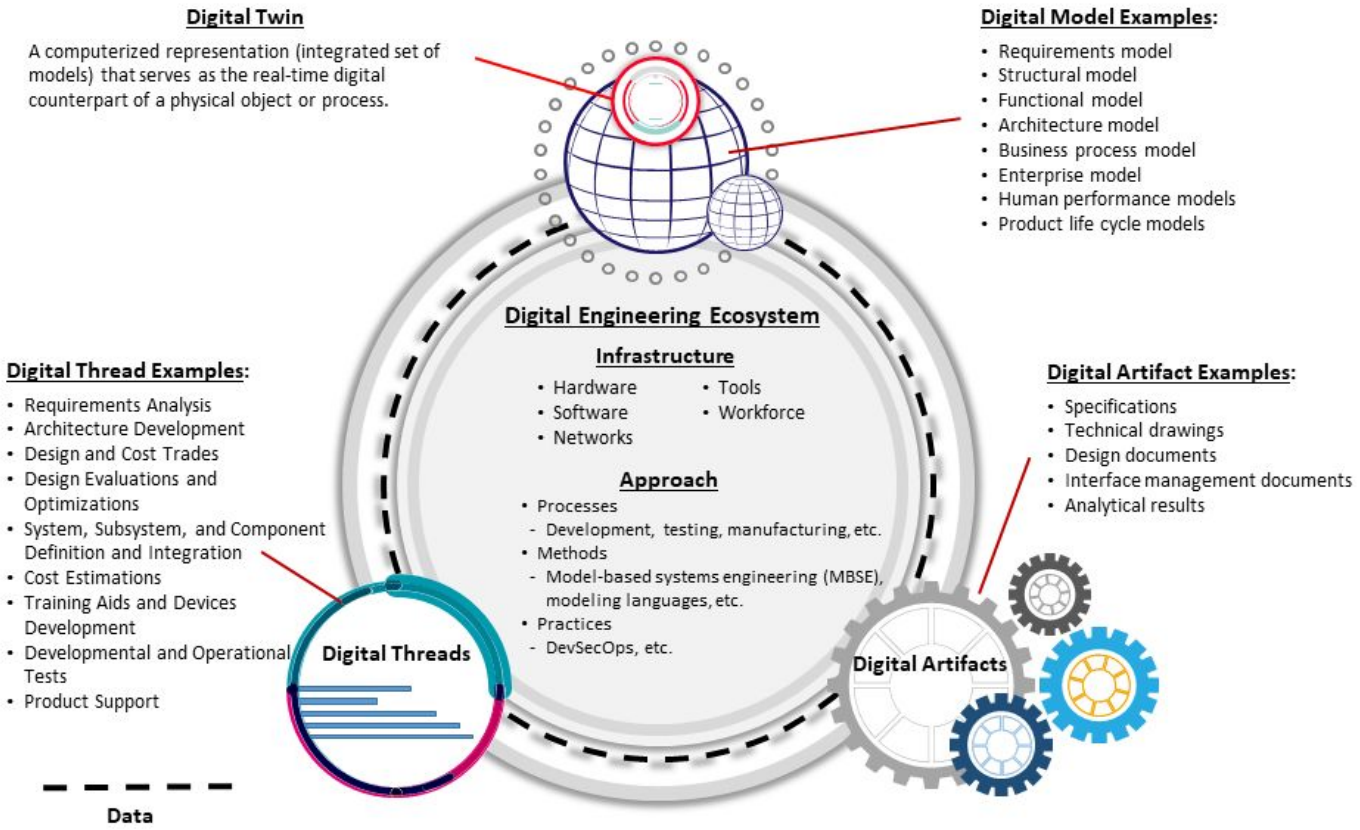
https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai

The AI Act (Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence) provides AI developers and deployers with clear requirements and obligations regarding specific uses of AI. At the same time, the regulation seeks to reduce administrative and financial burdens for business, in particular small and medium-sized enterprises (SMEs).

The AI Act is part of a wider package of policy measures to support the development of trustworthy AI, which also includes the AI Innovation Package and the Coordinated Plan on AI. Together, these measures guarantee the safety and fundamental rights of people and businesses when it comes to AI. They also strengthen uptake, investment and innovation in AI across the EU.

The AI Act is the first-ever comprehensive legal framework on AI worldwide. The aim of the new rules is to foster trustworthy AI in Europe and beyond, by ensuring that AI systems respect fundamental rights, safety, and ethical principles and by addressing risks of very powerful and impactful AI models.

US DoD - Digital Engineering Directive



Data management should adhere to DoD Data Strategy goals – make data visible, accessible, understandable, linked, trustworthy, interoperable, and secure

21st December 2023

June 2

DoD INSTRUCTION 5000.97

DIGITAL ENGINEERING

DEPARTMENT OF DEFENSE

DIGITAL ENGINEERING STRATEGY

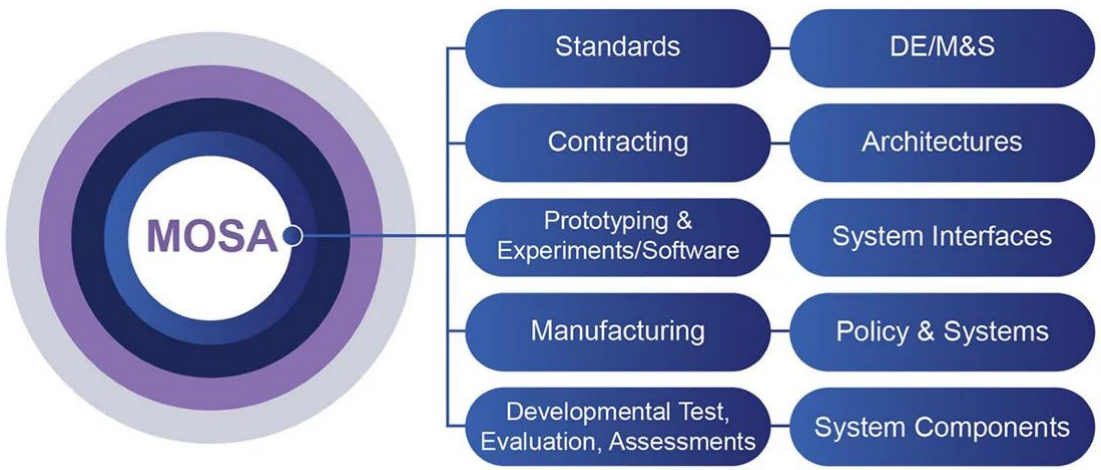
JUNE 2018

Modular Open Systems Approach (MOSA)

DEFENSE STANDARDIZATION PROGRAM
MAKING SYSTEMS WORK TOGETHER

https://www.dsp.dla.mil/Programs/MOSA/

https://www.cto.mil/sea/mosa/



Modelica

fmi Functional Mock-up Interface

https://fmi-standard.org/

Modelica

https://modelica.org/

ssp System Structure & Parameterization

https://ssp-standard.org/

dcp Distributed Co-Simulation Protocol

https://dcp-standard.org/

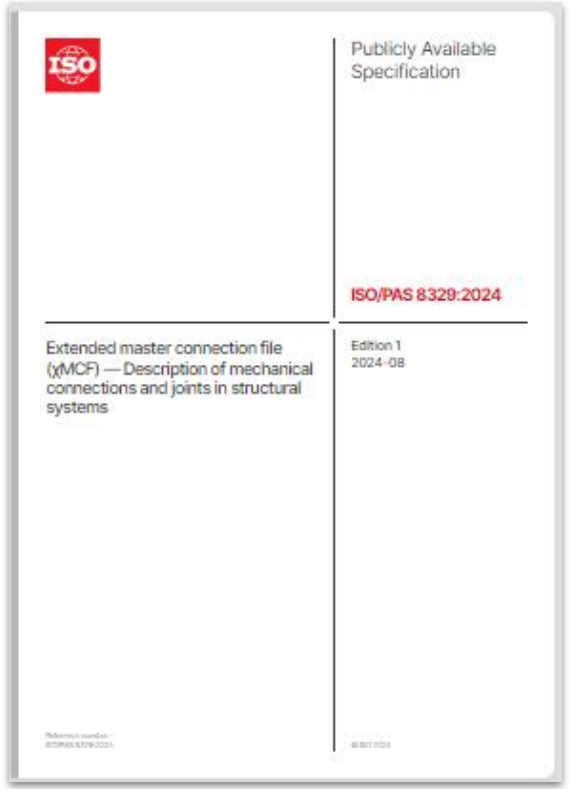
efmi Functional Mock-up Interface for embedded systems

https://www.efmi-standard.org/

Extended Master Connection File χMCF (xMCF)

A Standard for Describing Connections and Joints in the Automotive Industry

ISO/PAS 8329:2024: Extended master connection file (χMCF) — Description of mechanical connections and joints in structural systems



A Federated and Secure Data Infrastructure
Gaia-X strives for innovation through digital sovereignty.

gaia-x
https://gaia-x.eu/

Our goal is to establish an ecosystem, whereby data is shared and made available in a trustworthy environment.

Our intention is that we give the control back to the users by retaining sovereignty over their data.

Our outcome will not be a cloud. It is a federated system linking many cloud service providers and users together in a transparent environment that will drive the European data economy of tomorrow.

Gaia-X is an initiative that develops, based on European values, a digital governance that can be applied to any existing cloud/ edge technology stack to obtain transparency, controllability, portability and interoperability across data and services.

Gaia-X is not a market operator, nor will it operate directly or exclusively any of the services required by the governance.

Gaia-X Federation Services (GXFS)

https://www.gxfs.eu/

Shaping the future data infrastructure together - secure, open and transparent

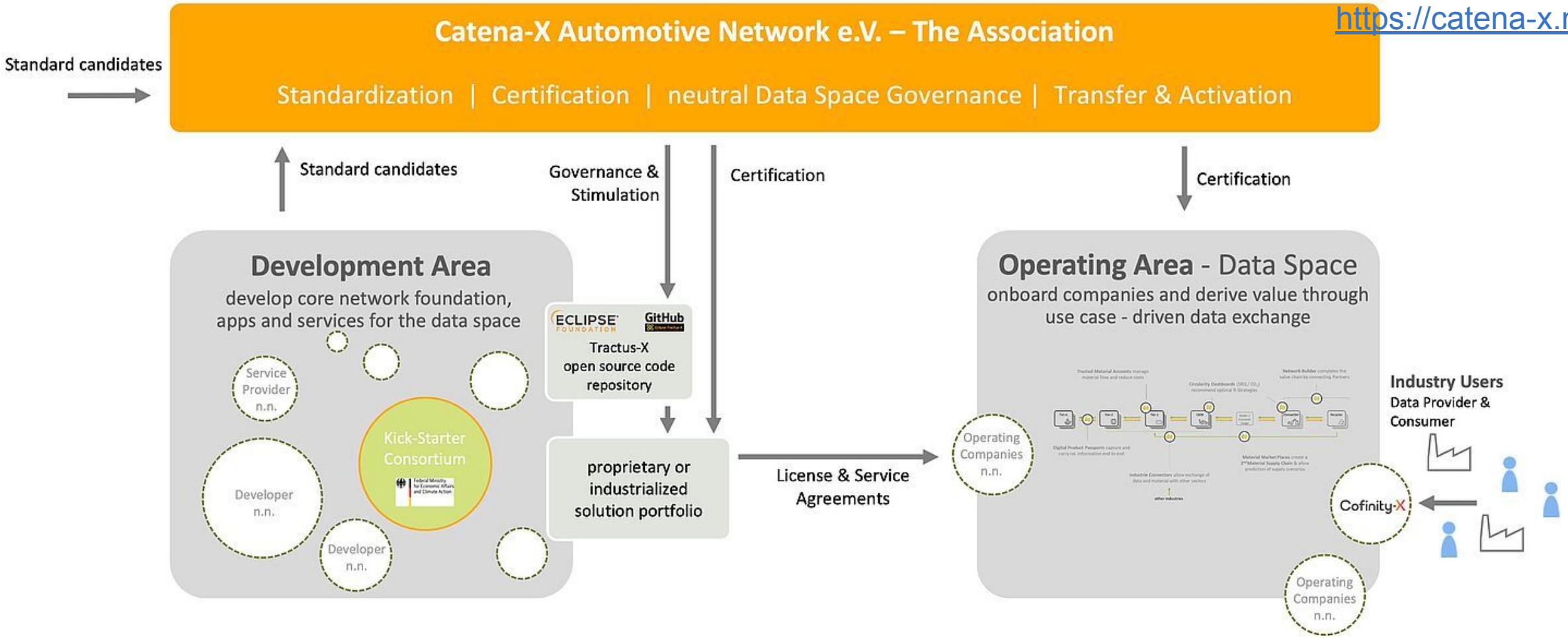
Innovation through digital sovereignty - that's the goal of Gaia-X. This is achieved by establishing an ecosystem in which data is made available, collated and shared in a trustworthy environment where users always retain sovereignty over their data. What emerges is not a cloud, but a **federated system** that links many cloud service providers and users together.

The Gaia-X Federation Services (GXFS) provides a set of OSS software components that assist in operationalizing a Gaia-X compliant federated ecosystem of infrastructure and data. GXFS is, so speaking, a toolbox that extends the Gaia-X framework and provides a reference implementation for some of the components necessary to support the inclusion of a participant in the Gaia-X ecosystem and the creation of a Gaia-X compliant federation.

Catena-X

Catena-X
Your Automotive Network

https://catena-x.net/en/



Initiative to digitalize supply chains in the industry

https://www.plattform-i40.de/IP/Navigation/EN/Manufacturing-X/Manufacturing-X.html

The stakeholders of Plattform Industrie 4.0 have a major goal: to implement the DataSpace Industrie 4.0 and the transformation to a digitally networked industry across the board. Business, politics and academia have started the joint initiative Manufacturing-X. Companies will become able to autonomously and jointly use data across the entire production and supply chain. This makes digital innovations possible for more resilience, sustainability and competitiveness. The initiative must be developed on a European and global level right from the start – just like our value creation networks are organized.

Industry creates prosperity and jobs. Germany is the world leader in Industrie 4.0. However, changing geopolitical conditions, climate change and global crises pose major challenges for companies. For example, industry must be able to react to disruptions in supply chains or in energy supply. It must consistently use the possibilities of a data-based economy. The digital and sustainable transformation of the entire German industry is more important than ever. The basic requirement for this transformation is transparency about processes and resources used in the entire value chain. Digital ecosystems and the sharing of data create the necessary foundations for this.

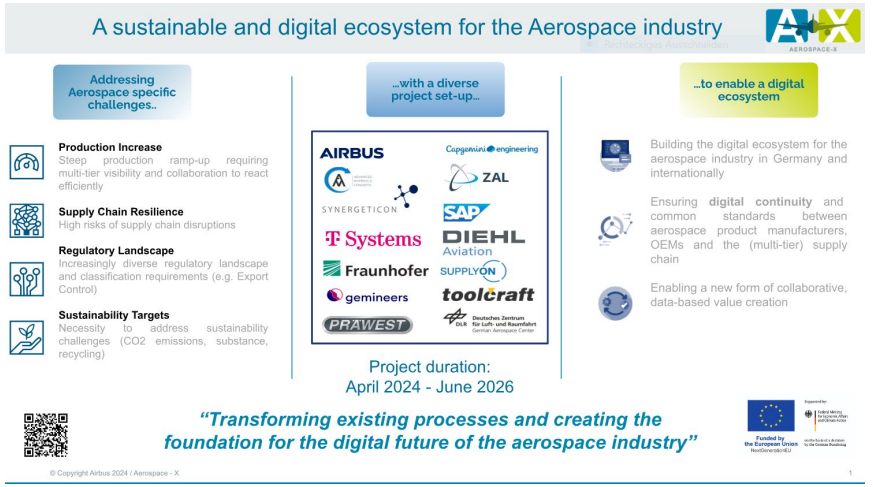
Aerospace-X

AEROSPACE-X

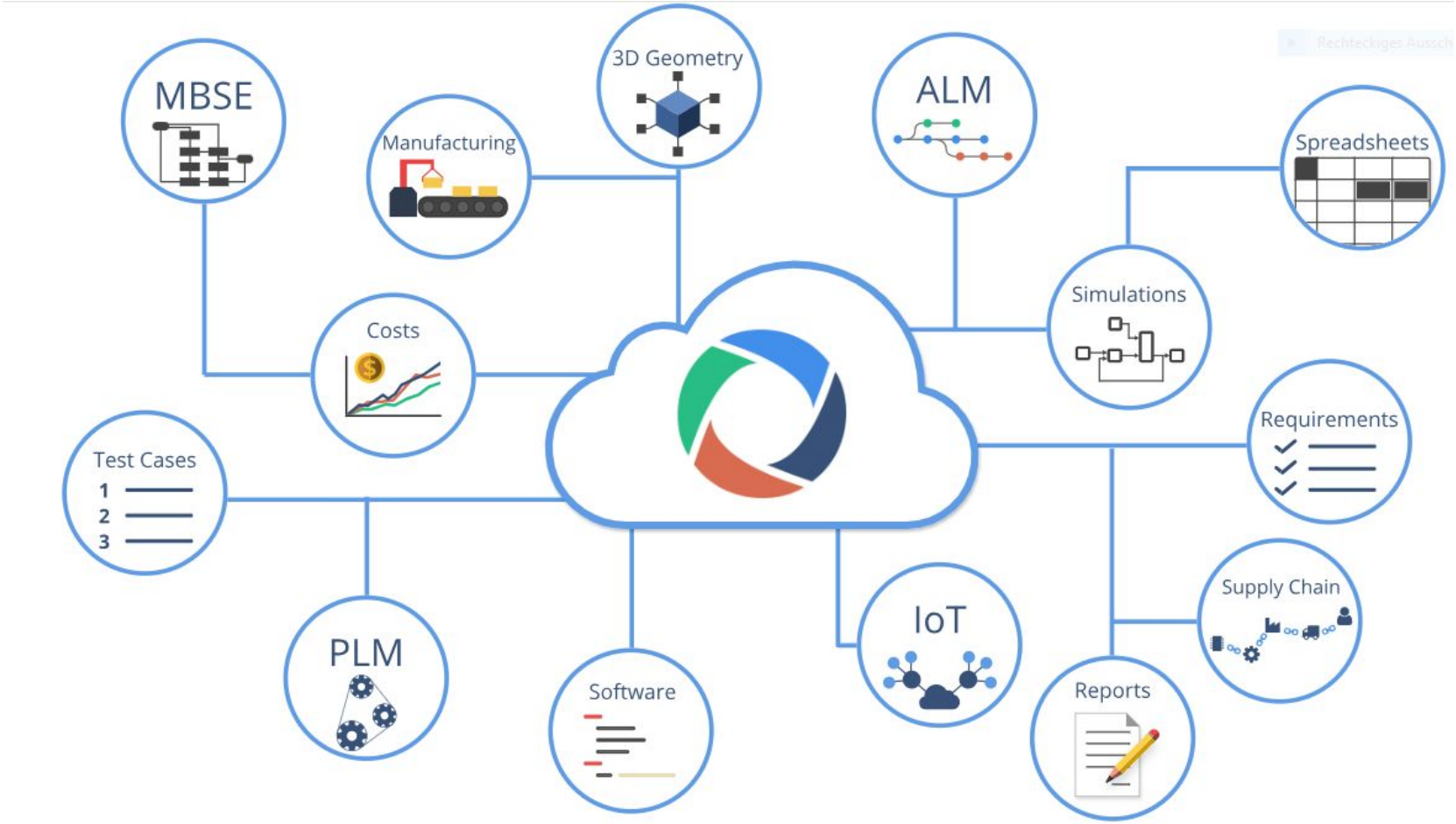
[Aerospace-X] is a research project to develop the foundation for a data ecosystem for the aerospace industry.

The project is run as a consortium composed of suppliers and manufactures, representing big Tier1 suppliers but also Tier-x SMEs, scientific partners and technology providers. Airbus acts as consortium and project leader.

Aerospace-X works very closely with the initiative **NextErA** and will provide input into the NextErA releases to build and operate the future decentralized data space for Aerospace and Defence industry.



Open Services for Lifecycle Collaboration (OSLC)



OSLC

https://open-services.net/

IPS S-Series Specifications

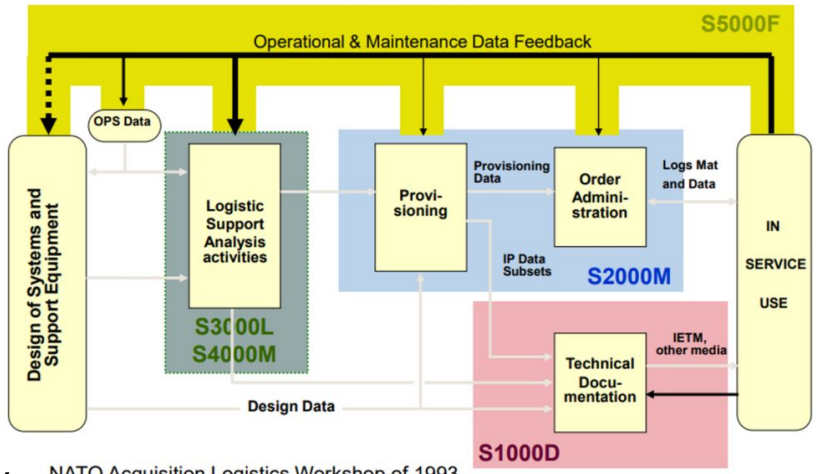
S-Series Specifications Summary

In 1993, the allied nations of the North Atlantic Treaty Organization (NATO) introduced the need for developing a fully integrated suite of Integrated Logistics Support (ILS) specifications that would exchange technical and product support data digitally across an interoperable common source data exchange medium. Below is the ILS data exchange ideology share during the 1993 NATO Acquisition Logistics workshop.

The S-Series Specifications of Integrated Product Support (IPS) are a set of guidelines developed by ASD, alongside our partners at Aerospace Industries Association in the US (and Airlines for America for S1000D) to ensure effective and efficient support for defence and civilian systems throughout their life cycle. These specifications provide a framework for implementing IPS across the entire system life cycle, from requirements development to disposal.

The S-Series specifications cover a range of topics related to IPS, including logistics, maintenance planning, supply-chain management, training and technical data, reliability and maintainability, and sustainment. They provide guidance on how to effectively manage and support complex systems, with an emphasis on maximizing system availability and readiness while reducing life cycle costs.

ILS Overall Business Process and the S-Series



NATO Acquisition Logistics Workshop of 1993

IPS S-Series

The S-Series suite is comprised of the following specifications:

SX000i: International specification for Integrated Product Support (IPS)
S1000D: International specification for technical publications using a common source database
S2000M: International specification for material management
S3000L: International procedure specification for Logistics Support Analysis (LSA)
S4000P: International specification for developing and continuously improving preventive mainten
S5000F: International specification for in-service data feedback
S6000T: International procedure specification for training analysis and design

Data Modeling & Exchange Working Group (DMEWG)

The Data Modeling & Exchange Working Group is a sister committee to the SX000i committee. While the SX000i defines common logistics processes t across all S-Series specifications and the interactions between the respective S-Series ILS Specification logistic processes, the DMEWG ensures the technical details so as to ensure that such processes are properly implemented across the different specifications. In particular, the DMEWG is responsible for:

- The SX001G Glossary for the S-Series ILS Specifications, which covers the definition of all terms used across the S-Series ILS specifications.
- The SX002 Common Data Model for the S-Series ILS Specifications, which covers the core model shared by at least two different specifications.
- The SX004G, UML model readers guidance, which provides a guide how to read the UML models for all specifications.
- The SX005G, S-Series ILS specifications XML schema implementation guidance, which provides guide about how tu use the XML schemas of the S-Series of ILS specifications

https://www.gartner.com/en/articles/what-is-a-metaverse

What is a metaverse?

Technically, a metaverse is a collective virtual shared space, created by the convergence of virtually enhanced physical and digital reality. For simplicity's sake, think of a metaverse as the next iteration of the internet, which started as individual bulletin boards and independent online destinations. Eventually these destinations became sites on a virtual shared space — similar to how a metaverse will develop.

A metaverse is not device-independent, nor owned by a single vendor. It is an independent virtual economy, enabled by digital currencies and non-fungible tokens (NFTs).

As a combinatorial innovation, metaverses require multiple technologies and trends to function. Contributing trends include virtual reality (VR), augmented reality (AR), flexible work styles, head-mounted displays (HMDs), an AR cloud, the Internet of Things (IoT), 5G, artificial intelligence (AI) and spatial computing.

https://www.gartner.com/en/articles/what-is-a-metaverse

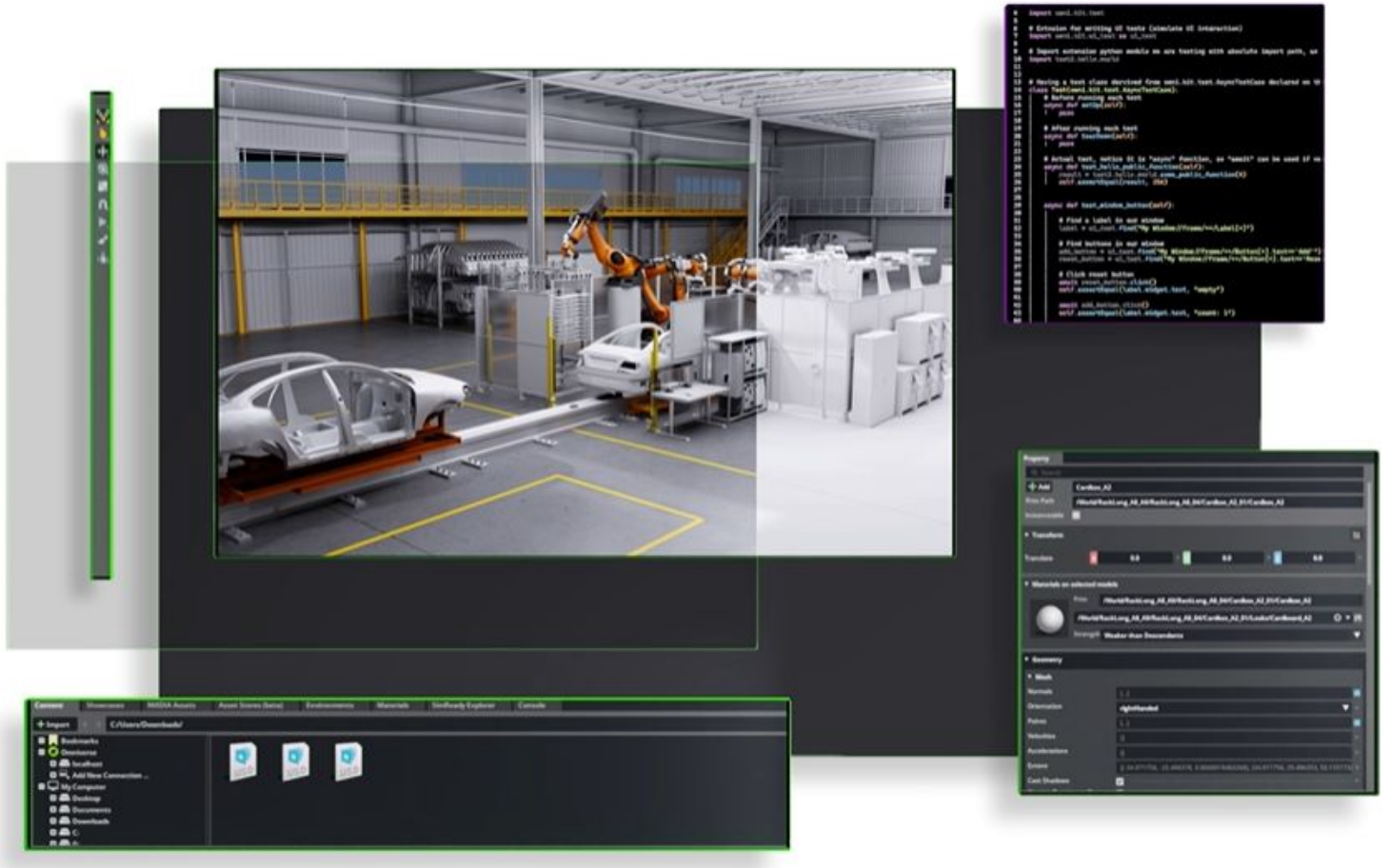
4 key innovations make metaverse a strategic technology trend:

- Innovation No. 1: **Web3**, which is a new stack of technologies for the development of decentralized web applications that enable users to control their own identity and data. Web3 and metaverse complement each in a community or ecosystem where value in some form is exchanged between people or organizations — or a combination.
- Innovation No. 2: **Spatial computing**, which can be defined as a three-tiered technology stack through which users experience the intersection of the physical and digital worlds.
- Innovation No. 3: **Digital twin of a person** (DToP) not only mirrors a unique individual, but is also a near-real-time synchronized multipresence, with the ability to be present in multiple places at the same time in both digital and physical spaces.
- Innovation No. 4: **Digital twin of a customer** (DToC), a subset of DToP, is a dynamic virtual representation of a customer that simulates and learns to emulate and anticipate behavior. Customers can be individuals, personas, groups of people or machines.

Omniverse

https://www.nvidia.com/en-us/omniverse/

NVIDIA Omniverse™ is a platform of APIs, SDKs, and services that enable developers to easily integrate Universal Scene Description (OpenUSD) and RTX rendering technologies into existing software tools and simulation workflows for building AI systems.

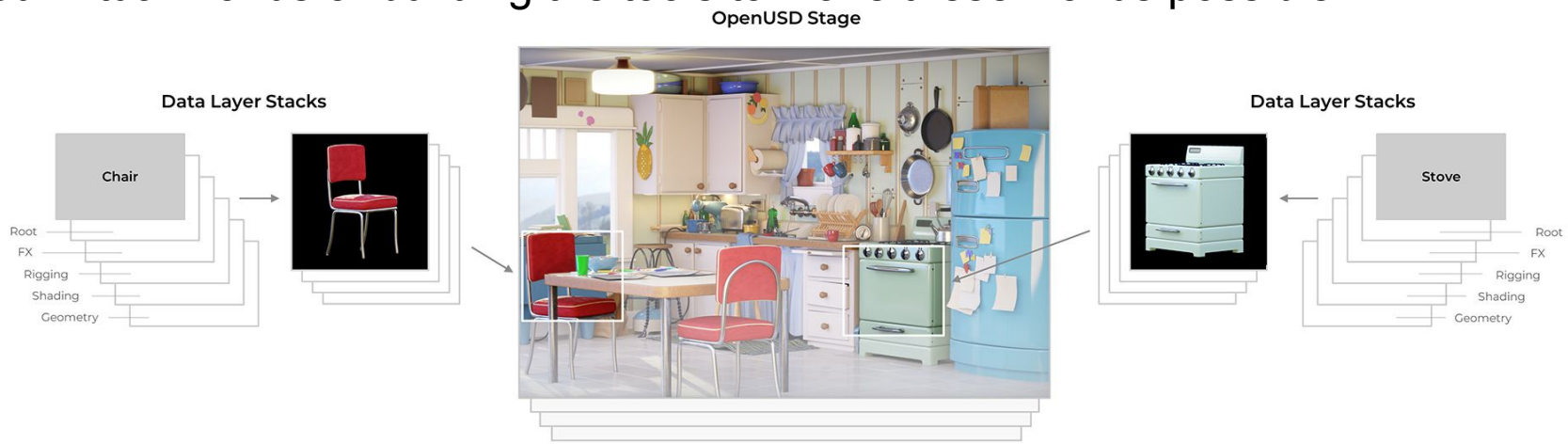


https://www.nvidia.com/en-us/omniverse/usd/

Building Interoperable 3D Workflows With OpenUSD

Universal Scene Description (OpenUSD) is more than just a file format. It's an open and extensible ecosystem for describing, composing, simulating, and collaborating within 3D worlds.

Invented by Pixar Animation Studio, OpenUSD encompasses a collection of fundamental tools and capabilities that accelerate workflows, teams, and projects, whether you're creating assets and environments for large-scale, AI-enabled virtual worlds or building the tools to make these worlds possible.



Alliance for OpenUSD

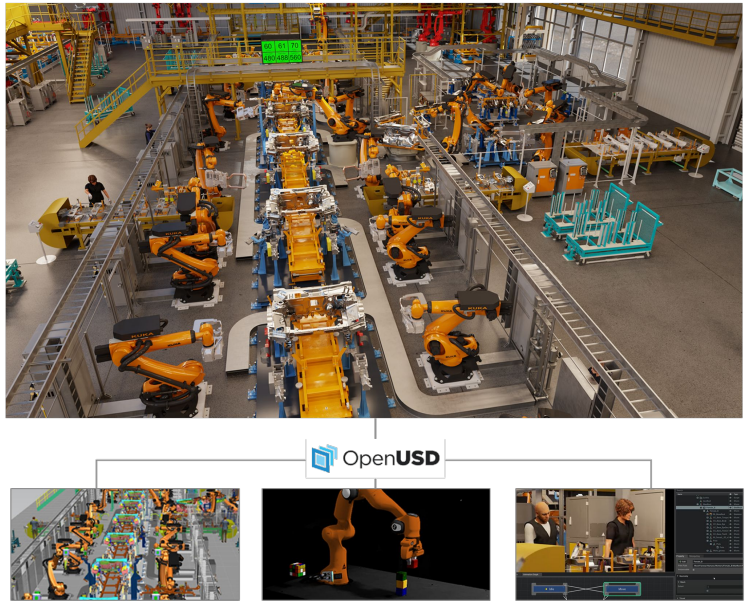
AOUSD
Alliance for OpenUSD

https://aousd.org/

To foster the standardization, development, evolution, and growth of OpenUSD.
The Alliance for OpenUSD (AOUSD) is an open, non-profit organization dedicated to promoting the interoperability of 3D content through OpenUSD (Universal Scene Description). Standardizing the 3D ecosystem will enable developers and content creators to describe, compose, and simulate large-scale 3D projects and build an ever-widening range of 3D-enabled products and services. Part of the Joint Development Foundation, the Alliance brings together a diverse and inclusive community of participants to provide an open forum for collaborative development and discussion around OpenUSD.

General Members

Ansys, Bright Machines, CESIUM, chaos, digitalfish, EPIC GAMES, Sunvega 三维家, HEXAGON, FOXCONN HON HAI TECHNOLOGY GROUP, 芒果融创科技 INNOCREATIVE MANGO, intel, IKEA, LOWE'S, MAXON A NEMETSCHEK COMPANY, Meta, Microsoft, otoy, Pickford.ai, shutterstock, SideFX, SIEMENS, SONY, SPATIAL, FOUNDRY, Trimble, worley, WPP



Challenges - Summary

Completeness/Conversion Errors
Consistency
Cybersecurity
Trust/Counterfeit
Who need what? What to do with such information
Easy usage
Customization of Tools

Federated Systems

- **Identify Management (User ID's)?**
- **What happens with data in case of merger/bankruptcy?**
- **Avoid redundancy/Uniqueness**
- **Libraries (e.g standard parts. material, …)**

Many thanks for your attention