INTERNATIONAL DATA SPACES ASSOCIATION

IDSA Executive Brief – Manufacturing data spaces and the role of IDSA

Why manufacturing needs data spaces

Manufacturing has always been a deeply interconnected domain. Products move through long and distributed value chains, involving suppliers, OEMs, logistics providers, equipment manufacturers, recyclers and regulators – each with its own systems, standards and constraints. As these networks have become more international, more digital and more interdependent, the question of how to share and govern data across organizational boundaries has become central. Companies need to exchange information without losing control over sensitive knowledge, without creating a new integration for every partner, and without facing inconsistencies in trust, identity or semantics.

Data spaces provide a response to this structural challenge. They are not platforms but governed environments in which organizations can share data under transparent and enforceable rules, while enabling collaboration. As regulatory requirements expand, particularly around sustainability, circularity, emissions reporting and due diligence, manufacturers increasingly depend on data that spans the entire lifecycle of a product. And as AI systems require diversified, high-quality training data, no individual company can meet these expectations alone. Data spaces, therefore, are becoming a form of industrial infrastructure: a way to make distributed production systems work as reliably and transparently as the physical supply chains they mirror.

Global context: A worldwide movement toward industrial data spaces

Industrial data spaces are emerging as a global phenomenon. In Europe, the development of cross-sector data spaces has accelerated through the Data Spaces Support Centre and large industrial initiatives that aim to harmonize trust, identity, and interoperability mechanisms. Similar activities can be observed worldwide. In China, large-scale industrial data ecosystems are being built across regions and sectors, and government-led initiatives frequently refer to the creation of more than one hundred domain-specific data spaces to support transparency, automation and digital product passports.

In Japan and South Korea, manufacturers use data-sharing frameworks to strengthen robotics innovation, advanced production systems and international supply-chain resilience. India focuses on digital public infrastructures that increasingly extend into industrial domains, while the United States explores data-exchange architectures in sectors such as aerospace, energy and advanced manufacturing, often linked to national competitiveness strategies. These efforts vary in maturity and governance, yet all aim to solve similar

problems: secure data flows, lifecycle transparency and compatibility across multi-tier value chains.

The International Manufacturing-X Council (IMX Council) provides a forum in which national and regional stakeholders can exchange insights on governance models, semantic alignment, certification concepts and operational principles. It brings together actors from Europe, Asia and North America who share an interest in ensuring that emerging data-space solutions do not evolve into incompatible islands but form a connected global environment.

The German Manufacturing-X program: public–private, evolving, and diverse

Within Germany, Manufacturing-X emerged as a public–private initiative anchored in Plattform Industrie 4.0. Its purpose is to enable companies to share production and product data securely across value chains, supporting the digital and sustainable transformation of manufacturing. The initiative addresses pressures related to supply-chain disruptions, climate change, and geopolitical instability, while strengthening competitiveness for companies of all sizes, including SMEs and startups.

However, Manufacturing-X is best understood not as a single coordinated program but as a funding framework from which many independent project families have emerged. Each project group brought its own partners, priorities and approaches, and as the funding phase ends, these clusters are evolving into a landscape of manufacturing data spaces. They share the same industrial motivation but were never fully synchronized. This diversity reflects the sector itself: heterogeneous, distributed and shaped by strong domain-specific communities.

The emerging landscape of MX industrial data spaces

As the project families mature, several sector-specific data spaces have come into clearer focus. They represent the practical continuation of the innovation efforts stimulated through Manufacturing-X and related programs. While they differ in scope, each addresses recurring challenges in its domain and builds on shared principles of trust and interoperability.

These initiatives include:

- **Factory-X**, which explores data-driven collaboration around production equipment, factory operations and industrial assets.
- **Rail-X**, which focuses on data exchange across mobility and rail systems.
- **Semiconductor-X**, addressing the extreme coordination needs of semiconductor supply chains.
- **Chem-X**, targeting chemical processes, materials and regulatory requirements.

Together with additional emerging efforts in electronics, furniture, materials, process industries and equipment manufacturing, they form a project family that illustrates the breadth of activity across the manufacturing domain. What connects them is the shared intention to build compatible data-sharing solutions that reduce fragmentation and support long-term interoperability.

Shared building blocks: governance and technical foundations

The landscape is diverse, but many initiatives increasingly draw on common governance and technical building blocks. European and German programs have produced a set of conceptual and operational elements that can be adapted across sectors. These include trust and identity mechanisms, usage-control principles, semantic alignment practices and operational functions such as onboarding, verification and certification.

These building blocks are essential because manufacturing domains evolve at different speeds and have different histories, standards and communities. Without shared foundations, the risk of creating incompatible ecosystems would be high. Instead, the Manufacturing-X project families increasingly reuse common components that support coherence without suppressing domain-specific needs. This approach reflects what many industry actors now see as the practical path forward: federated, not centralized; interoperable, not uniform; governed, not ad-hoc.

IDSA as a partner in a multi-actor environment

Within this landscape, the International Data Spaces Association contributes experience, concepts and frameworks that have matured over more than a decade of research and implementation. These contributions include the IDS Reference Architecture Model, the IDSA Rulebook, and the Dataspace Protocol, which is progressing through ISO/IEC standardization. They provide ways to design trust relationships, express usage rights, and support sovereign data exchange across varied technical environments.

IDSA collaborates with a wide range of actors, such as the OPC Foundation, the Industrial Digital Twin Association (IDTA), the VDMA, and specialized initiatives like Catena-X and Cofinity-X, whose work together forms the manufacturing data-space ecosystem.

This multi-actor stance is essential. Manufacturing-X can only succeed if domain-specific solutions remain compatible across sectors and if companies can participate without facing multiple incompatible governance regimes. IDSA helps align concepts and trust mechanisms, but always alongside, never above, the contributions of other organizations.

International links and the broader ecosystem

Manufacturing-X does not exist in isolation. As data spaces emerge in Europe, Asia and the Americas, interoperability questions become increasingly global. Several German initiatives are already engaging in international dialogues, and the IMX Council offers a platform for coordination across regions. IDSA's international network strengthens this position, helping ensure that German and European approaches remain compatible with wider global developments.

Data flows must align with real supply chains, not national boundaries. Ensuring compatibility across borders reduces integration burdens and supports the development of truly global data ecosystems.

The road ahead

As the MX project families move from funded innovation to operational structures, the core challenge becomes one of coherence and continuity. Building blocks exist, and many domain-specific initiatives are underway, but long-term success will depend on maintaining trust frameworks, ensuring interoperability, and aligning with regulatory expectations. Governance must evolve from project-based experimentation to stable organizational structures capable of supporting real industrial adoption.

This evolution will not be led by one organization alone. It will require partnerships, shared responsibilities and coordinated contributions from sector associations, standards bodies, research institutions, technology communities and industry stakeholders of all sizes.

IDSA contributes conceptual clarity, governance experience and international connectivity, helping ensure that Germany's manufacturing data spaces remain interoperable, trustworthy and aligned with broader European and global frameworks.