POSITION PAPER

Interoperability – Our vision for Industrie 4.0: Interoperable communication between machines within networked digital ecosystems

In the industrial world, new forms of cooperation have replaced rigid value chains. The borders between countries, industry sectors and companies are becoming increasingly blurred. Machines, products and plants are able to communicate autonomously in digital, globally networked → ecosystems that are dynamic, self-optimising and composed of multiple decentralised stakeholders.

Working together, we are bringing the established strengths of German industry – heterogeneity, diversity and specialisation – into the era of the digital economy, which is chiefly characterised by openness, pluralism and fair competition. In this way, we are laying the groundwork to secure the future of German small and medium-sized companies and Germany's position as a leading international industrial location.

Our position: Interoperability is the basis of Industrie 4.0 and guarantees open and pluralistic markets

Only through interoperability can we design the complex, decentrally organised structures required, grant unlimited access to all industrial stakeholders and ensure open and pluralistic markets. The term describes the ability of systems, devices and applications to communicate with one another and work together seamlessly. Open standards are essential components for interoperability, since the following considerations apply to digital ecosystems:

- All relevant → assets must be integrated in the Industrie 4.0 environments in order to be able to interact with each other. Anything that is necessary and useful for value creation networks is mapped digitally and uniformly and is therefore transparent along the entire value stream.

- Central controller instances are replaced by multiple → decentralised combined "modules".

- Artificial intelligence plays a key role in terms of enabling assets to exchange data and information directly with one another and to make decisions autonomously.

- The systems are open and none of the stakeholders is allowed to have a monopoly. To this end, we need to define interoperable interfaces, establish legal frameworks and provide access to basic information.

Our approach: Open standards

Germany has carried out intensive development work for many years and is a world leader in the area of integrating Industrie 4.0 individual and system solutions. Drawing on this core competence, we are jointly developing open standards that meet the requirements of digital ecosystems:

- **Connectivity:** assets use common communication protocols and the same "connector" between the analogue and virtual world.

- **Data integrity and cyber security:** the processed data remain complete and unchanged, while appropriate integration and protection measures prevent data from being damaged or changed unexpectedly.

- **Clear semantics:** assets uniformly understand the meaning and content of information. They use the same vocabulary, clearly understand the messages that they exchange digitally and can communicate in such a way that they interact autonomously and complete the tasks to be performed.

- **Inclusion of AI:** all stakeholders can use and interconnect machine and user data cooperatively. In addition, they can use artificial intelligence to arrive at new solutions and business models.

- **Rules on governance and data security/sovereignty:** all stakeholders operate under fair and equal conditions in the open ecosystems at a national, European and international level.

The → Asset Administration Shell – AAS meets these requirements and thus forms an essential basis for the interoperability required: It allows for the digital integration of assets, provides the technical requirements for a decentrally organised Industrie 4.0 and, as a freely accessible and interoperable interface, is the implementation of the digital twin. It is also suitable for cloud-to-cloud communication.

Our implementation: Pioneers put the Asset Administration Shell into practice

Plattform Industrie 4.0 is continuing to develop the Asset Administration Shell for practical use in business while promoting international standardisation of the concept. The Asset Administration Shell is being further developed in five application-oriented research projects (to be expanded to eleven in the near future), tested in ten testbeds and implemented in (at least) two pilot projects. Several initiatives have joined the Open Source Project → "AASX Package Explorer" with their own projects.
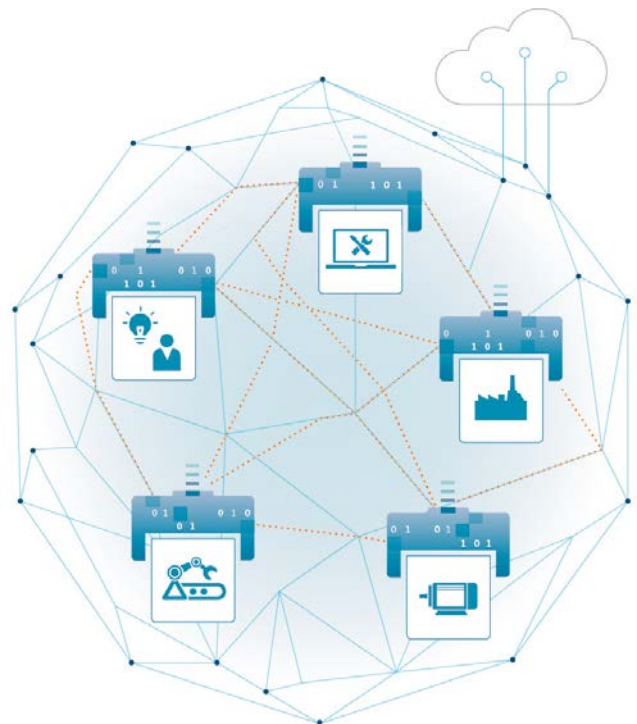
Source: Plattform Industrie 4.0/Salari

Our aim: The Asset Administration Shell should become a central "integration connector" for digital ecosystems

The concept behind the Asset Administration Shell is a practical one, as proven by the numerous successful projects. We are now close to achieving widespread commercial application of the concept. Different levers must be set in motion for this purpose: existing research projects must be coordinated and further research carried out. A transfer concept needs to be developed, while educational measures are also required.

Background

Asset: An asset is an entity that has a perceived or actual value for an organisation and either belongs to or is managed by the organisation. For example, assets can be products, devices, machines, plans or orders.

The **AASX Package Explorer** is a software tool that companies can use to create and edit their own Asset Administration Shell based on their own business use case. This is an open source implementation that can be downloaded by companies.

Decentralisation: In the Industrie 4.0 context, decentralisation means that many different approaches and modules can network freely, independently and dynamically as required. Decentralised, autonomous systems with embedded intelligence play an important role in the digital ecosystems of industrial value creation (B2B). The cooperative and transparent use and interconnection of standardised machine and user data allows new solutions and business models to be developed using artificial intelligence. In relation to the beneficial use of AI at various levels of industrial practice (edge, premises, cloud), the collection and use of Smart Data plays a crucial role alongside Big Data.

Ecosystem: In Industrie 4.0, flexible machines, plants and functions are distributed across the ecosystem. With this configuration, the ecosystem can span company, industry and country boundaries. All assets are networked and communicate with each other. Products also form part of the ecosystem.
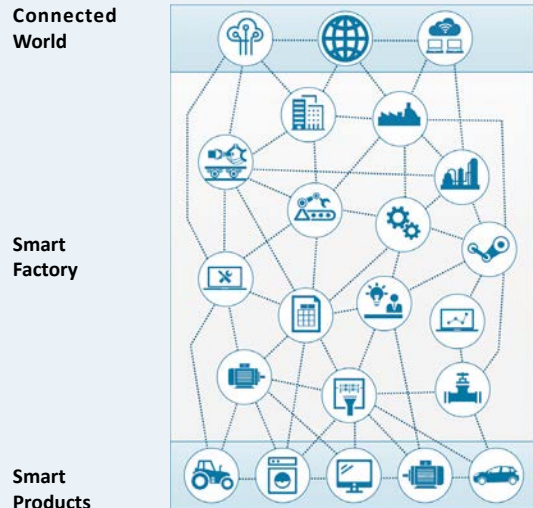
Source: Plattform Industrie 4.0/Salari

Asset Administration Shell – AAS: As part of the concept behind the Industrie 4.0 component, the Asset Administration Shell was developed within the Plattform Industrie 4.0 (working group "Reference Architectures, Standards and Norms"). All of the relevant data for a hardware or software component in production, e.g. of a machine, are summarised to provide a virtual image of the component, which is then stored in the Asset Administration Shell.

The Asset Administration Shell is open to various communication channels and applications and thus acts as the "connector" between I4.0 objects and the networked, digital, decentralised world. With the Asset Administration Shell, Industrie 4.0 application scenarios are transformed into reality: it enables all relevant assets to communicate using a common language.

For more information on Asset Administration Shells, see the Plattform Industrie 4.0 website.

The Plattform Industrie 4.0 online library includes an introduction to the Asset Administration Shell.