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Discussion Paper

# The Asset Administration Shell (AAS) and common misunderstandings

# IMPRINT

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# Introduction

The Asset Administration Shell is - as of Q1/2024 - much more than “just another trend” – the overall concept has a similar power for Industry 4.0 as the HyperText Markup Language (HTML) had for the world wide web mid of the 1990s. The world wide web consortium W3C founded by “godfather” Tim Berners-Lee was for the today’s capabilities of the Internet as important as the Industrial Digital Twin Association IDTA is and will be for the future of efficient and sustainable manufacturing and automation processes. This document focuses on discussing some popular misconceptions and explain whether there is anything tangible.

"AAS digital twin" is the concept of creating virtual representations of physical assets or systems in the context of Industry 4.0. "AAS" stands for "Asset Administration Shell", a standardized description of an asset's behavior and capabilities for communication and interaction. The digital twin replicates the physical asset, including its properties, behavior, and performance. It helps simulate and optimize operations, monitor real-time conditions, and predict and prevent failures. The Asset Administration Shell is a standard for integrating data from various sources into the digital twin, enabling efficient interoperability and collaboration among businesses. It's crucial for processes like replenishment, maintenance notifications, and compliance with regulations like the digital product passport (DPP) or battery passport.

Now, let’s clear some common misconceptions.

## "AAS is a clone of data!"

Well, not necessarily. If a customer prefers and implements submodels with their own persistence, that's a valid approach. However, for many scenarios, it's often more advantageous if the AAS retrieves data "ad-hoc"/"on-demand" from a system of records (e.g., SAP S/4, MES, maintenance- or asset management applications, ...). In this context, the client makes use of the AAS "APIs". The AAS, respectively its APIs enable/act as a proxy for accessing the system of records.

Alternatively, there is the possibility of persisting certain submodels and/or properties, while others are retrieved on demand. The mechanisms can be employed to keep them in sync with the corresponding system of records.

## "AAS is just an exchange format"

Within Catena-X the AAS is (as of today) pretty much "just" the means/format to exchange asset specific information among companies.

But it is also true, that the overall concept of AAS allows much more, e.g., to act as a trigger for business process (e.g., create maintenance notification in a plant maintenance system).

## "AAS is just a static format"

Yes and no. You can use an XML file with a semantic definition of structured elements to reflect an asset. This is called "AAS Type 1". But there is also "AAS Type 2", which is using a normalized API over a service-oriented approach (REST/ JSON). Additionally, there is "AAS Type 3", which represents a machine-based communication, again using standardized API.

As a conclusion: a combination of different AAS types is valid. If you're just using XML files, or archiving XML files: this is just the beginning. Think of it as an external output format. Once your AAS systems are in place, you can choose an output format of your choice. The content is still the same, but the kind of output format may vary on your needs. We recommend using "AAS Type 2" whenever possible.

## "AAS only works with the submodels, standardized by the IDTA"

The more submodels the IDTA (Industrial Digital Twin Association e.V.) standardizes, the better. But the standardized submodels are only one pillar of the whole concept. The AAS metamodel and the AAS APIs are independent from standardized or IDTA-approved

submodels. By the way, there is a parallel between an OPC UA companion specification and an AAS IDTA submodel: similar to OPC UA companion specifications, AAS IDTA submodels do not encompass all the data that a machine can provide. There remains room for a machine builder to provide additional information, particularly to articulate individual capabilities or characteristics.

It's likely that specific submodels will be developed for interacting with or integrating into specific business systems, also known as systems of records. For instance, there might be submodels designed for seamless interaction with a system like ERP, PLM or MES, plant, client, process, and customizing-specific codes to align with the APIs of the legacy system.

## "AAS manages to complete business processes and serves as a long-term replacement for ERP or asset management systems"

We operate on the assumption that we leverage and integrate existing systems, each with its distinct "focus areas". The AAS digital twin functions as the cohesive link between these systems. While some autonomous processes, especially from an asset perspective, may be managed by AAS logic (assuming there is a state-machine, rule-engine, runtime, etc., to process the necessary logic), it's essential to note that certain tasks, such as determining the priority of maintenance or repair requests among numerous AAS, may require traditional list-processing and complex coded processes found in systems like ERP, PLM or MES.

Looking ahead, enterprise applications embracing AAS concepts may establish interfaces for data exchange with AAS-based digital twins, while retaining their business logic within their respective applications and domains. The seamless integration of AAS into such applications will significantly contribute to the widespread adoption of AAS principles.

## "AAS is just a concept and at an academic stage"

As of Q4/2023, there is substantial evidence that the adoption of AAS has gained momentum in the market. Companies are launching practical and valuable projects, and the support for AAS is steadily increasing. Entities such as Catena-X, Manufacturing-X, the OI4 Alliance, and the diverse narratives/demonstrators showcased at Hannover Fair and SPS 2023 should be taken seriously. Moreover, there is a multitude of projects in collaboration with various partners, actively evaluating and testing AAS concepts. These initiatives focus on interoperability through the execution of pilots, demonstrators, and initial implementations tailored to specific use cases.

## “AAS is a German-only exercise and not a worldwide initiative”

Certainly, the fact that AAS originated in Germany and is currently mainly driven by German stakeholders poses a challenge. However, its global presence is growing daily. contributions from many international/Fortune500 companies, adoption by companies in Norway, the Netherlands, South Korea, Japan, and various other countries are making AAS increasingly international.

Moreover, AAS is in the process of being standardized as an international standard under IEC 63278.

## “AAS is just about master data”

The exchange of master data from the manufacturer to the operator or engineering partner serves as a foundational use case, crucial for enabling more intricate scenarios for digital twins. In certain industries, addressing this aspect is pivotal to filling a gap and reducing systematic errors, manual data management, and enhancing the overall quality of master data.

Interacting with AAS, such as retrieving the phone number of the last service technician who worked on the machine, is just as essential as obtaining or maintaining the planned schedule (for maintenance or production) for the machine in the coming week. AAS, along with its corresponding submodels, establishes connections to asset information through protocols like Modbus, MQTT, OPC UA, enabling representation of the most recently updated values that reflect the current state of a machine.

## “AAS does not add value, it is just a superfluous initiative … all processes work already today”

Looking at the picture below, the processes technically work already today. Though, AAS helps to bring asset-related, product-related, process-related or system-related data in a more structured manner which helps stakeholders to make processes within the life cycle more efficient.

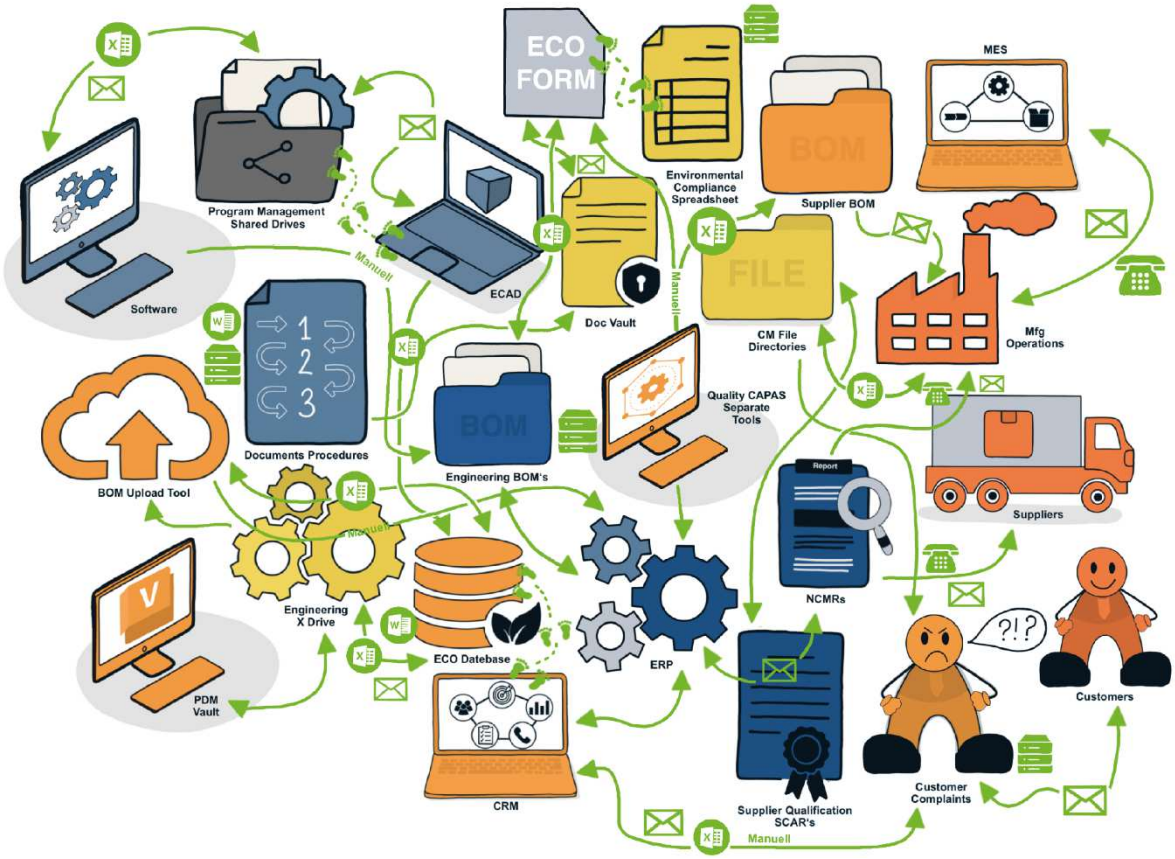


*Figure 1: What's “working” today - disconnected silos*

The Internet of Things (IoT) is inherently complex due to the vast number of interconnected devices, diverse communication protocols, and the need for seamless integration across various domains. Managing and maintaining this intricate network poses challenges in terms of data interoperability, security, and real-time decision-making. A digital twin, by creating a virtual replica of the physical IoT environment, offers a solution by providing a comprehensive, real-time representation of the system. This enables simulation, analysis, and optimization, facilitating efficient monitoring, control, and predictive maintenance, ultimately addressing the intricacies, and enhancing the overall performance of the IoT ecosystem.

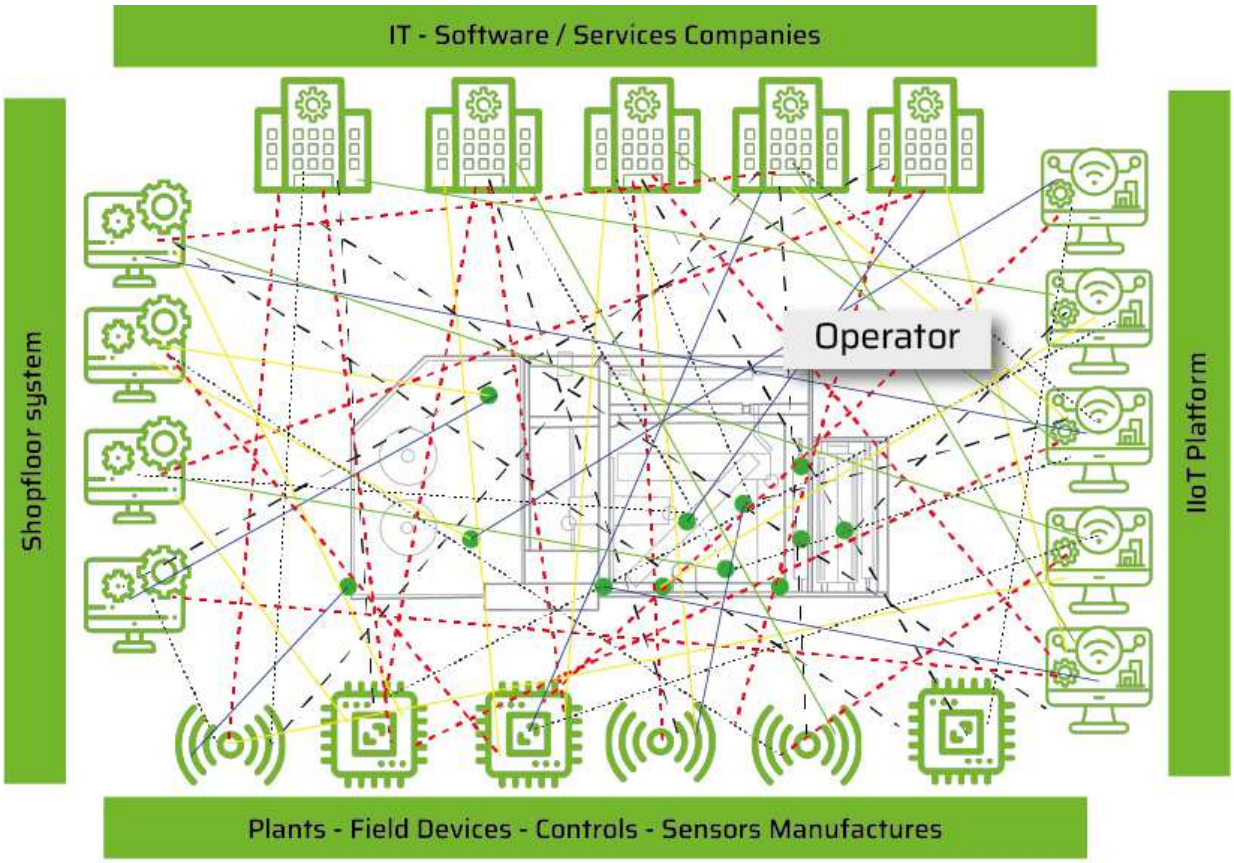


*Figure 2: IIoT is complex*

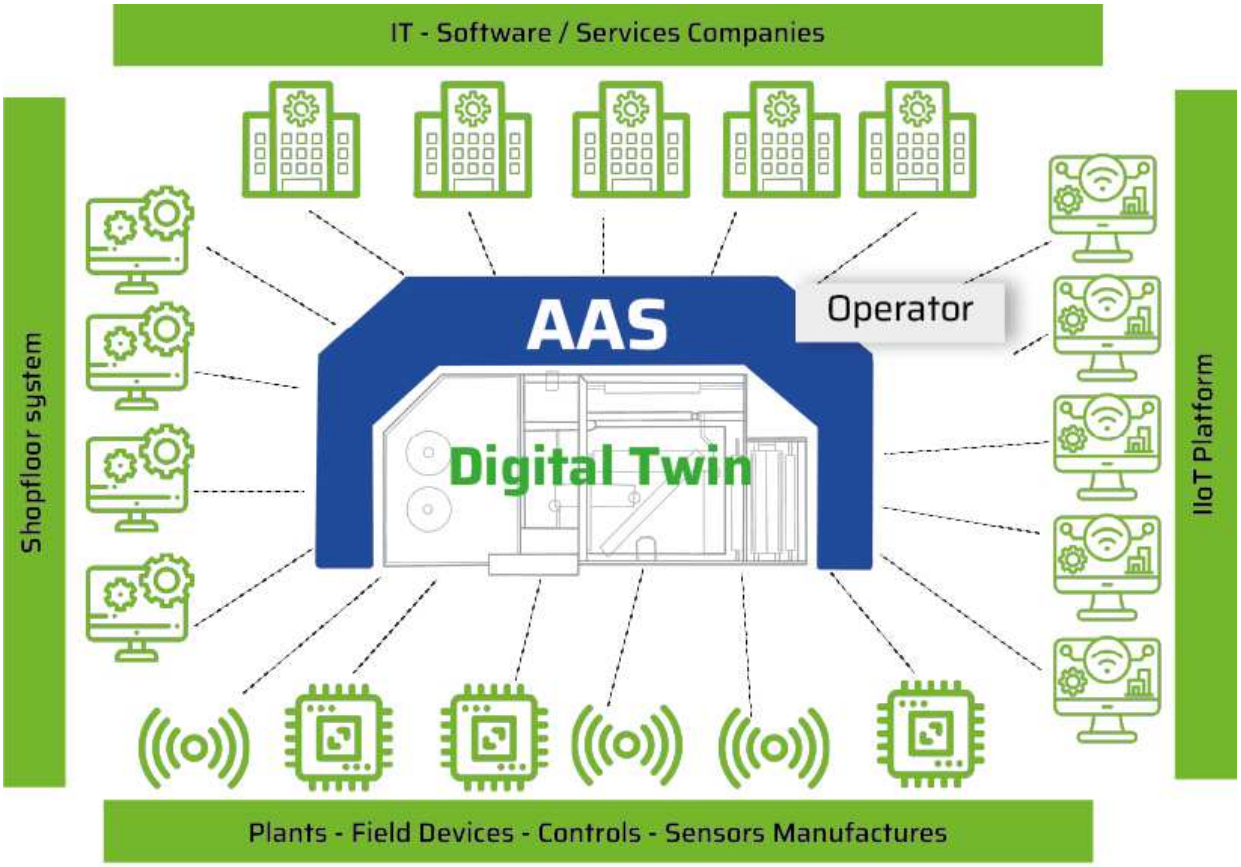


*Figure 3: Standardized digital twin as the key to interoperability*

## “AAS is just about engineering and simulation”

A key value of AAS is its ability to provide a comprehensive view of an asset, as illustrated by examples such as immediate access to the last service technician's phone number, the "digital product passport", "dismantling instructions", "handover documentation" and "calibration certificate." Moreover, AAS serves as a standardized data exchange for use cases in engineering and simulation. This capability facilitates efficient end-to-end solutions in these domains.

## “AAS = digital twin”

The digital twin can be seen as the aggregation of all AAS with the same global asset ID. It incorporates features like Web3 for data requiring clearance or proof of truth. For instance, consider two AAS for a single asset - one managed by the manufacturer, the other by the operator. Both may have a "current location" submodel, but the manufacturer's submodel becomes outdated after the goods issue. The operator's "current location" submodel now holds the accurate information. Web3 technology, in conjunction with AAS, can potentially resolve such discrepancies. AAS offers a comprehensive perspective on various aspects of a digital twin throughout the entire asset lifecycle.

## “There is only one AAS for an asset”

Multiple AAS can exist for the same asset, both within a company and across different companies. The unifying factor is the presence of a unique "global asset ID," with all AAS referencing this identifier. However, the content, composition, and ownership of each AAS can vary.

Throughout an asset's lifecycle, ownership may change, affecting the digital twin. This change typically involves copying or sharing the digital twin. Nonetheless, a trace of the digital twin may persist with the manufacturer. This imprint, for instance, can support tasks like updating master data from the manufacturer to the customer or facilitating data exchange between the customer and the manufacturer (as seen in cross-enterprise data exchange based on data spaces).

## “AAS only works on a centralized infrastructure”

The AAS registry concept is established to pinpoint the endpoint for accessing an AAS or its submodels. Therefore, by nature, AAS can be considered a "distributed document." Furthermore, the AAS serves as a standardized exchange format for asset data, offering well-defined semantics. This characteristic promotes its utilization in decentralized environments, among various other functions.