US-German supply chain resilience & carbon reporting demonstrator using AAS* and CESMII SMP*

Industrial business cases realized with international industrial standards

In recent years, supply chain resilience and carbon reporting have gained an increasing business importance on a global scale. Tackling these global challenges requires solutions that strengthen internationally coordinated efforts. Secured and managed industrial data interoperability among inter- and intra-company manufacturing platforms offers significant opportunities for improved, end-to-end industry process optimization in the fields of sustainability, supply chain processes and productivity.

Motivated by these global business needs, Plattform Industrie 4.0 and its US partner CESMII – The Smart Manufacturing Institute, along with Labs Network Industrie 4.0 and the ZVEI, developed a joint demonstrator to show international multi-vendor solutions for supply chain resilience and carbon reporting based on international industrial standards.

Demonstrator realizes several business cases based on AAS* and SMP*

The demonstrator is designed around the production of a ball-pen. The product (ball-pen) has several variants and is personalized. The supply chain of the product is configurable. The configuration enables transparent and educated business decisions. The demonstrator configuration options cover the following product lifecycle steps:

- Engineering and development (with personalization)
- Production
- Finishing
- Casing and shipment

The configuration options for the product (ball-pen) include:

- Material selection (aluminum or plastic ball-pen)
- Engraving of the pen (one-side or two-sided personalization)
- Finishing and casing of the pen (USA and/or Germany)
- Shipping (ship or air cargo)

* AAS: Asset Administration Shell
* SMP: CESMII Smart Manufacturing Profile

Joint Factsheet – in cooperation with

These options include the prediction of the expected carbon emissions. Therefore, the carbon transparency of the engineering process is ensured. International supply chain alternatives (including alternative components) strengthen the resilience of the production process. These configuration options are selected by the customer.

A closer look at the AAS and SMP implementation

The end-user product is more than just a ball-pen: It is the physical pen as well as its digital twin. As illustrated on the left-hand side of the figure below, the engineering and development step yields the instantiation of a new product AAS.

The data for this AAS instance of the product (ball-pen) has multiple sources and several interoperability technologies are involved:

- AAS Digital Nameplate sub-model (with the main information of the product and its manufacturer) provided by Industrial Digital Twin Association (IDTA)
- CESMII SMP profile data containing energy and carbon related information
- OPC UA time-series data collection of energy measurements per configuration step (live energy consumption measurements as well as offline measurements)
- AAS Time Series Data sub-model (energy measurements) provided by IDTA
- AAS Product Carbon Footprint sub-model to converge all carbon reporting data into the digital twin of the product provided by IDTA
- AAS Digital Nameplate for Laser Engraving Machine by project InterOpera [4]
- OPC UA 40501-1 companion specification for engraving (personalization process step)
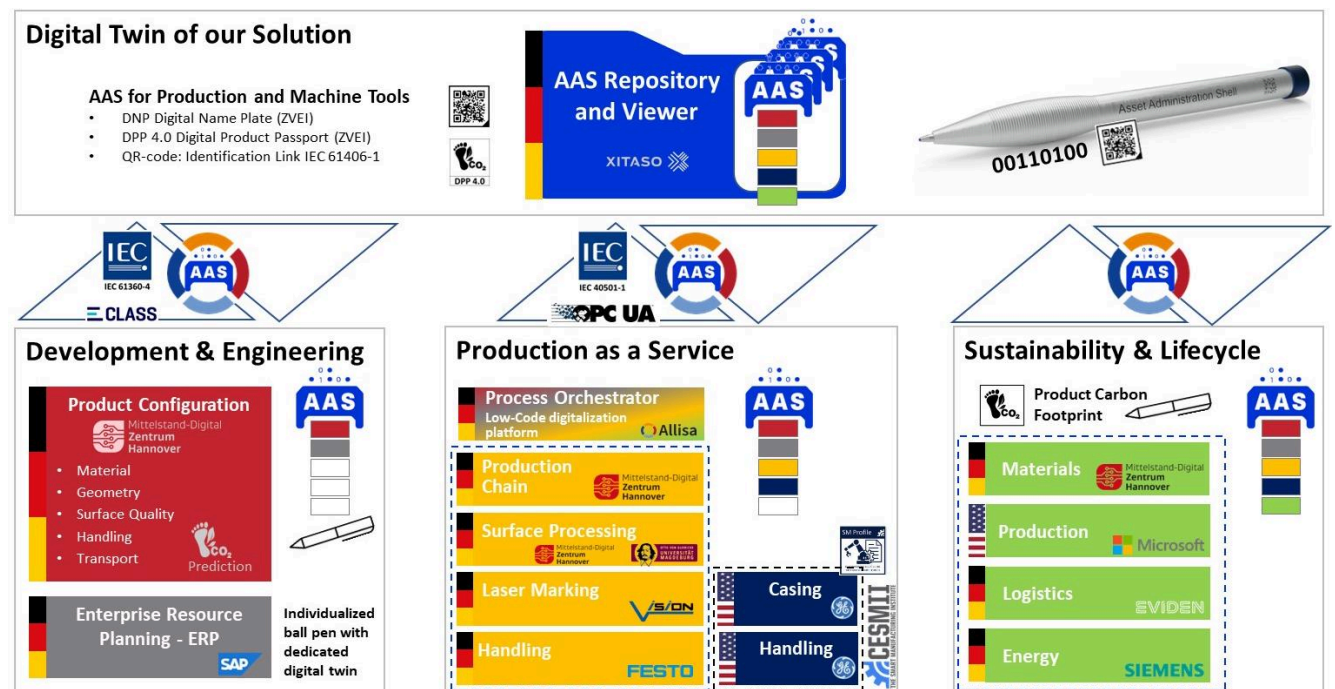- QR-code by Identification Link IEC 61406-1 for tracing the product pen over its life-cycle

Figure: Demonstrator Architecture

Conclusion and Outlook

The US-German demonstrator empowers business decisions along the value chain. It shows that industrial data can be measured, with the measured data the CO_{2e} consumption can be calculated and different choices in production and supply chain affect the CO_{2e} consumption. Furthermore, the configuration options ensure educated decisions in case of the supply chain disruption.

Through full transparency over the entire supply chain, the prerequisites to achieve resilience and carbon reporting goals are fulfilled. The demonstrator realizes the ambitious goals in an international setting based on global standards like AAS and SMP.

The demonstrated business cases have the potential to be fully integrated in future data space initiatives like the DPP 4.0 (Digital Product Passport) as well as Manufacturing-X. The consequent application of international standards ensures global cross-vendor interoperability of data.

References

[1] CESMII SMP
[2] OPC UA Companion Specifications
[3] IDTA
[4] Standardization Council Industrie 4.0 (SCI 4.0)
[5] ZVEI PCF and DPP 4.0
[6] LNI 4.0 AAS Demonstrator from Hannover Fair 2022

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