Semantic data layer based on digital twins

Comprehensive transparency in value chains is still a nice dream. Catena-X wants to make the dream come true – with standardized data structures and data descriptions via the Digital Twin.

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According to studies, nowadays most cars licensed in Europe reach the end of their life after 12 years, before taking their final trip to the scrapyard. In the past, it was easier – and less environmentally friendly – to just toss cars in the crusher, but now they are increasingly being taken apart and reused. Individual car parts are thereby finding a second lease of life as spare parts on some online platforms. But is it worthwhile for a dismantler to buy a scrap car of this type? And which parts contain certain harmful substances that recyclers need to bear in mind?

What's hidden within the car?

So far, recyclers have relied on self-compiled lists, databases, and a certain level of experience when deciding whether to make a purchase – often without knowing which parts and materials are exactly built in and whether it's worth it at the end of the day. The situation surrounding those dismantling and recycling cars at the end of their product life cycle clearly illustrates a shortcoming in the automotive value chain: nobody can say off the top of their head what is actually contained within a car.

Let's start with new cars: custom design, please!

For a better understanding of the problem, it's worth looking back at the point when a new car is ordered. Many people purchasing a new car expect a vehicle that meets their needs. They're no longer just choosing the color and engine type, but also wheel rims, seats, the entertainment system, GPS, driver assistance, and much more – there's a real focus on the customer. A customized new car has an almost unique combination of components.

Getting to grips with the configuration options is a skill not only for car manufacturers, but also for their supply chain. Therefore, to provide specific configurations for new cars, certain components need to be provided. These are taken from the car manufacturer's supplier ecosystem and are assembled into the finished product over several value-added steps.

Small-state mentality is the norm when it comes to data

Each supplier uses their own established methods, processes and IT systems, which are often incompatible with those of other companies. Components and parts in the various systems for Enterprise Resource Planning (ERP) and Product Data/Lifecycle Management (PDM/PLM) are given company-specific identifiers; different data formats are used, as well as unique nomenclature and terminology. ERP systems, for example, use the term "material", while PLM systems talk about "parts". Both "drivers" and "operators" are used to mean the same thing too.

One standard vs. data confusion

It's easy to understand that this established way of dealing with data without any sense of uniformity makes for an inefficient automotive value chain. A uniform standard could remedy this.


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Digitalization across the car recycling value chain can make the process more eco-friendly and economically viable.

guage for the automotive value chain and thereby eliminate the language confusion," explains Dr Tom Buchert from T-Systems. Dr Birgit Boss from Bosch adds, "At the end of the day, it's about turning raw data into information which is actually of use to everyone along the chain."

Semantic data models create structure

Computer scientists talk about semantic data models here. In more simple terms, they specify which format data needs to have and the importance of each type of data. The logical superstructure which enables the efficient exchange of data across the entire value chain is provided by a meta model, . The individual semantic models follow the rules prescribed by their meta model and cover the field of communication. As is always the case in Catena-X, the project uses open standards, such as the Asset Administration Shell of the Industrial Digital Twin Association (IDTA) and the BAMM Aspect Meta Model from the Open Manufacturing Platform. With its production and automotive expertise, Bosch is also playing a part in this.

However, this should also ensure that others (only) receive the data that is relevant to them. Companies should maintain control of their data – with improved transparency and efficiency along the value chain too. This is the vision of Catena-X, which aims to establish a global network that will enable consistent data exchange for everyone involved along the automotive value chain – from SMEs to large corporate groups. The path to a cross-company standard for the exchange of data is one of the key success factors for Catena-X and subsequently also in related industries.

But how is it possible to bring together the different worlds of information? Many companies (including Bosch and T-Systems) are working on the Catena-X project to find a solution. There is a close cooperation between information technology (semantic technologies) and expertise from the Catena-X use cases. "Our vision is to create a common lan-

Semantics was originally a sub-discipline of linguistics. The word stems from the Ancient Greek word σημαίνειν sēmaínein, which translates as "signify". Semantics describes the meaning of sentences, words, parts of words, and, in a figurative sense, signs. A semantic data model therefore assigns a certain meaning to certain data.

A digital twin as data administrator

But this then brings up another question. How can the concept of semantic data models be implemented? "This is where digital twins come into play," explains Tom Buchert from T-Systems. They create a sense of order and provide clarification for semantics. Buchert says: "At first it sounds complicated, but the idea behind it is simple. The digital twin becomes a kind of data container." Each digital twin has its own unique ID. This ID is linked to the semantic models and data associated with the twin.

In recent years, digital twins have caused a furore. Digital twins are virtual images of real things. They can be machines, but also software, people or – according to Gabler Wirtschaftslexikon – processes.

Every company involved in the value chain can use these models as a template, so they can provide or use the right data. However, interoperability is not guaranteed. In this case, the data and digital twins are provided by means of jointly defined interfaces, such as the PDM Web-Connector developed by T-Systems, a commercial integration solution that enables companies to extract information models and data from their back-end systems (ERP/PLM) and make them available to the applications according to the standardized Catena-X semantics.

This thereby creates a – company-owned – "container of data" in each value chain. These are currently registered on a central platform, which ensures a secure exchange of data. An app for end users, such as the recyclers or dismantlers, provides access to a combination of data relevant to them. In other words, the app answers their question about the components installed or any harmful substances that are present – without giving them access to other data.

In this way, the concept addresses data sovereignty for those involved, whereby the question of whether data is centralized or decentralized is a hot topic of discussion for Catena-X.

"Of course, digital twins with semantically enriched models for the data to be exchanged can be used in other ways – not just in the automotive industry," says Boss, explaining the idea's potential. "In this way, for example, the carbon footprint across the entire life cycle of a product can be recorded. The concept enables all kinds of collaborative collation of data, for any purpose."

Things are looking promising for the exchange of comprehensible data beyond company boundaries, as well as their preservation and legibility in cases of doubt even at the car scrapheap. ■

Twin

Digital