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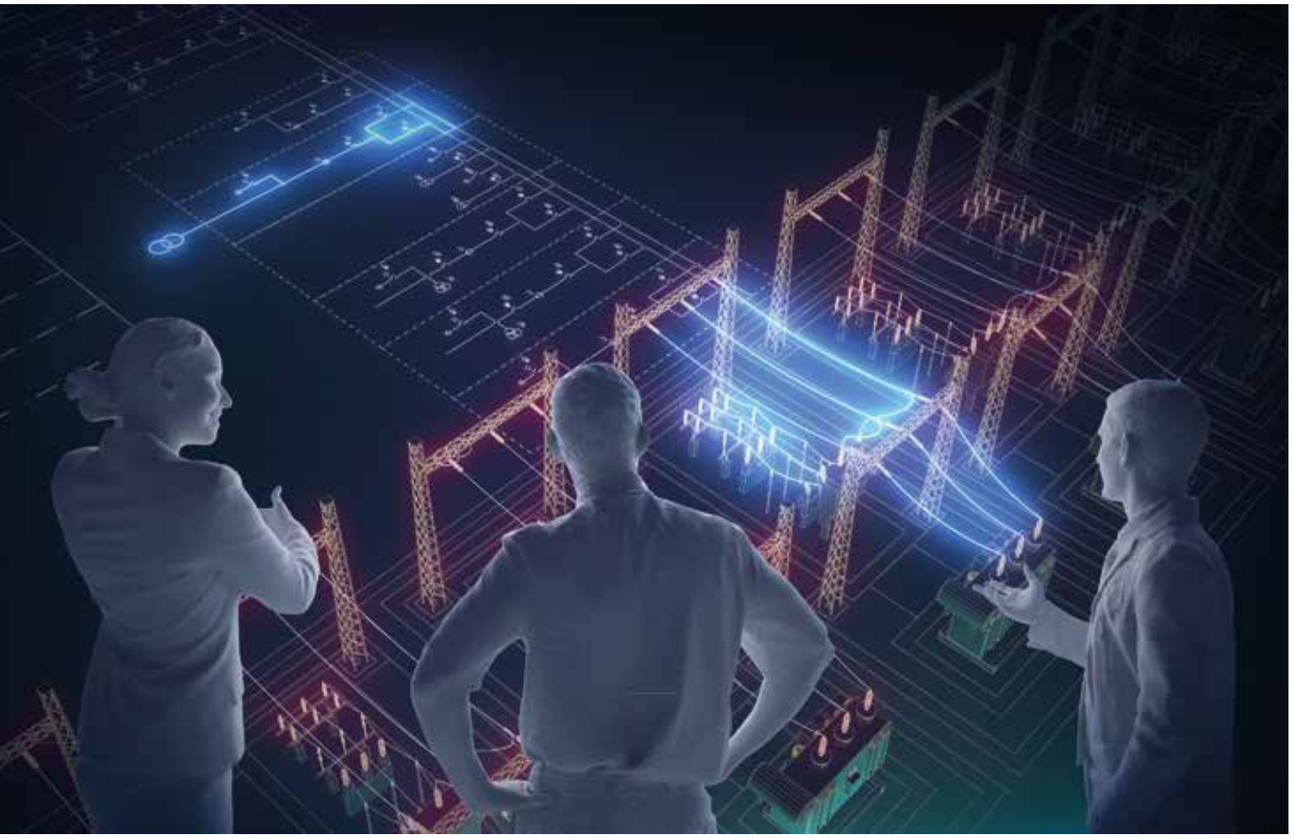
Modularization and standardization ensure climate neutrality

Whether in energy distribution, industrial plant erection or the mobility sector, the demand for more and more decarbonization is putting enormous pressure on industry to innovate. But there has long been a solution for this. AUCOTEC's Engineering Base bridges the gap between modularization and standardization for more sustainability.



"Ignaz Schiffermüller: Versuch eines Farbensystems (Vienna, 1772), plate I — color wheels can be used to create pleasing color schemes, and to explain the dirt associated with the production of hydrogen *Source: Wikipedia*

Climate change is challenging our economies. Clearly, we have an obligation to lead a more environmentally friendly lifestyle than before. Therefore, more sustainable products must be brought onto the market (faster than before), which of course entails producing them as climate-neutrally as possible. Restructuring of the network infrastructure, power generation, and the entire transport system is also pending. After all, a study from 2019 proves the technological feasibility for steel, cement, ethylene, ammonia, and glass production, for example. It assumes that by 2050 it will be possible to reduce greenhouse gas emissions in the areas mentioned by a remarkable 80 to 95 percent compared to 1990 (1,2).

But despite all efforts towards climate neutrality, breaking even on the balance sheet cannot be the goal. From a technical point of view alone, this is not enough for the c-level that was previously geared towards growth even in the double-digit range: Economic success must still be guaranteed despite the major technical challenges. How can we clear the stage for that? Especially since the complexity will continue to increase rapidly.

Color theory with hydrogen

Hydrogen is the energy carrier of the future, but only if it is 'green'. A quick reminder: Green hydrogen is split into H_2 and O_2 by the breaking down of H_2 with electric current and by means of electrolytes — if the electricity required for electrolysis comes exclusively from CO_2 free sources, the entire production process is completely free of this greenhouse gas. Blue hydrogen, meanwhile, is obtained from fossil fuels. Here, the resulting CO_2 can be separated and stored or reused. Well-known methods are Carbon Capture and Storage (CCS) or also Carbon Capture Usage (CCU). At this point, we prefer not to say anything about gray hydrogen obtained from fossil fuels.

Many innovations are of course still necessary in industrial plants for the production of green hydrogen (e.g. the still young PEM electrolysis process) on industrial scale, while the existing gas network in Germany can be used for its supply (3).

It depends on the right digitalization strategy

Whether it is the supply of green hydrogen, electromobility and the associated expansion of the power grid infrastructure and renewable energy sources, or the expansion of the circular economy — the time pressure is high everywhere and the goals are ambitious. And AUCOTEC's Engineering Base (EB) platform and its scalable data model are involved in a lot of business cases.

Sustainable solutions under the provision that they comply with regulations and at the same time meet the economic framework conditions call for a digital twin and an expandable data model. This is exactly what EB is known for. Let's take an industrial plant from the process industry as an example and ask a recognized expert how all this is connected. "In the first step, a new process is designed on the basis of functional requirements. Reactions have to take place, reaction products have to be separated and distilled. In a conventional procedure, the second step is to think about what the physical shape of the plant should look like: For example, a tubular reactor with a distillation column. This is how the plant model with its spatial characteristics is created," says Dr Wilhelm Otten, who is responsible for

Grid operators urgently need more capacity for the transport of regenerative energy *Picture: AUCOTEC*

the harmonization of activities relating to standardization and the ISO standard for the process industry at the non-profit organization DEXPI. “But what we need is an approach that combines both perspectives,” emphasizes the expert[1], who, as Head of the Process Technology & Engineering business line, pushed ahead with large-scale digitalization worldwide at EVONIK for more than 30 years.

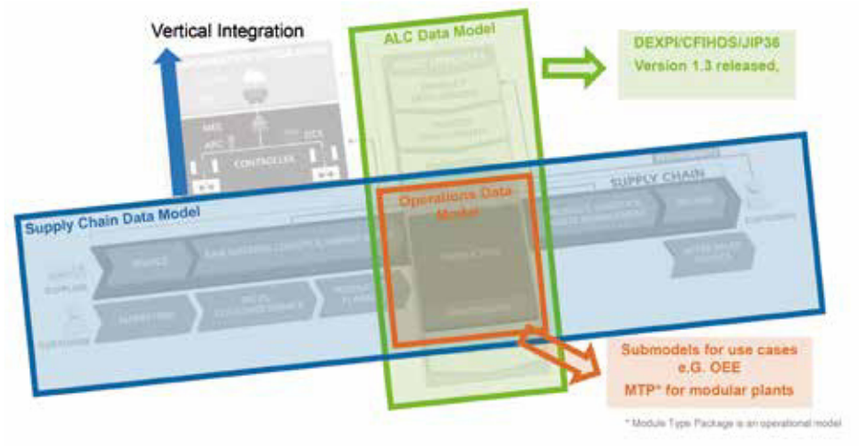
In the process industry, core processes and the associated data models relate to the supply chain and the product or asset lifecycle. The latter results from the fact that product development in the process industry is always accompanied by a new or further development of a process. There are no reusable manufacturing islands (e.g. robot cells) as known in the discrete manufacturing industry. In addition, there is an ‘operations data model’ that reflects the automation of the system from the point of view of IT.

The digital twin has many fathers

For the digital twin in the process industry, the ‘asset model’ (of all the components operated and their specifications) is necessary, the said operations model (the target/actual values for operation or specifications for maintenance measures are stored there for e.g. the reactors), and the supply chain model (4). Of course, these models should not be viewed separately from one another, as together they reflect all the business processes. “A behavioral model is also required for the digital twin. It is created through simulations and artificial intelligence applications,and it is used to design the system in terms of virtual commissioning. As part of advanced process control approaches, simulation models are used to control the system,” explains Dr , and makes an important point: “The digital twin must always be based on the business processes. Therefore, an entire system is never digitalized at once for no reason.”

The add-on of modularization to sustainability

Dr works as a senior consultant for the implementation of the ‘Low Carbon Transitional Testbed’ pilot plant in Singapore. The goal is to produce methanol and downstream products using CO_2 from exhaust gases along with green hydrogen. A complete digital twin is to be created from the pilot plant,and comprehensive modularization (also of the automation technology) is to be implemented. When planning, he relies on EB, “because the tool not only develops and maps the core of the digital twin, with master data, structure, and asset information. Since you need this data for simulations as well as in operation, we wanted to go further and use an integrated system that not only combines all disciplines from flow diagrams to pipe planning and detailing to automation.” EB can also communicate with the simulation, 3D, and other tools via open interfaces. Of course, it is very important to Dr that EB supports international standards such as ISO and DEXPI. “It was also very important to us that the system enables modular data management in the data model because we are building a modular system. That’s how we came to EB. It can be integrated into the entire lifecycle of the plant, the interface effort is significantly reduced and, more importantly, we have a consistent database instead of



The basis of any digitalization strategy is an appropriate data / information model *Source: WOtten Consulting 2023*

[1]) See also the interview on the following pages.

Houston-based Modular Plant Solutions (MPS), a global engineering firm specializing in process modularization and project implementation, announced April last year its contract to support Arbor Renewable Gas in the construction of the first-of-its-kind modularized green gasoline plant

Source: Business Wire 2022

distributed tools for drawings or spreadsheets. This is the only way that the modules with all their aspects can be presented as a unit, and change management is made significantly easier.”

So can the entire system be mapped with EB? Process, plant structure, and asset model yes — i.e. the entire CAE part — but not the 3D CAD part. However, interfaces to the leading 3D CAD systems such as Smartplant 3D, CADISON, or AVEVA E3D also help here in order to create the spatial context, for example for the isometric creation or steel construction.

Turning 24 into 6

But how do you bridge the gap between digitalization and sustainability? The fact is that modularization and digitalization are just methods to make the system more efficient. “Modularization with the help of EB ensures that processes can be configured quickly. The modules, as we have mapped them in the pilot plant in Singapore, are able to map 30 reference processes of the process industry in the sense of an 80:20 rule. Of course, a new module will always have to be developed,” says Dr Otten.

In this way, the creation of a pilot plant is reduced from two years to about six months. The shortening of the time-to-market corresponds to the economic aspect of sustainability. The expert also has another aspect of sustainability in mind with the pilot plant in Singapore: “Clients rent our modules for six months. The pilot plant is not thrown away afterwards, but reused in a different form by another client.”

In addition, consistent digitalization helps to get to the bottom of the potential of design options with intuition and creativity and to continue to pursue the chosen option until successful implementation. Increased efficiency in communication with team members is achieved through the use of calculation models because, in contrast to pure data exchange, they already contain the design context. EB with its scalable data model also stands for such lean communication. (bv)

References

(1) de.wikipedia.org/wiki/Dekarbonisierung

(2) www.isi.fraunhofer.de/de/presse/2019/presseinfo-08-2019-dekarbonisierung-industrie.html

(3) Adam, P. et al., „Wasserstoffinfrastruktur – tragende Säule der Energiewende“, Whitepaper von Siemens Energy, Gascade Gastransport und Nowega, 2020

(4) See for instance: www.gep.com/blog/strategy/types-of-supply-chain-models-explained

For more about elegant tool support for modularization and standardization visit *www.aucotec.com*