**Why there is no way around the digitalisation of the process industry - and what role process automation plays in this**

*More chemical production, but net zero emissions – this will not work without a sophisticated circular economy. For this to become reality, data must flow seamlessly in parallel to material flows. Process automation plays an important role in this – but it must be thought of in a larger and holistic way against this background.*

When twins enter puberty, growing pains are pre-programmed. The digital twin is no exception. For a little more than a decade, automation and digitalisation experts have been expecting great benefits from the representation of real plants in the digital world: scenarios and options can be simulated with it for process optimisation, prospective plant operators use it for training purposes, and maintenance personnel supplement the twin with analysis tools, in order to recognise maintenance needs at an early stage and to optimally plan maintenance.

However, the same applies to the digital twin in the chemical industry as to the digitisation of the industry as a whole: the process industry is still a long way from comprehensive use and continuous data streams. However, these are necessary if the goal of a climate-neutral chemical industry is to be achieved. After all, by 2050 – the year declared by most chemical nations as the year from which climate neutrality is to be achieved - the demand for chemicals will continue to rise. It will not be possible to produce these quantities in a climate-neutral way using the traditional methods of petroleum or natural gas. The chemical industry must and will embark on a transformation path that leads away from the linear economy (take-produce-dispose) and towards a circular economy in which products at the end of their life cycle become raw materials for new chemicals. But for this to happen, the digital twin must grow up and no longer revolve around the factory alone: The entire supply chain must become part of the virtual image.

**Circular economy needs transparent data**
In a circular economy, stakeholders across company boundaries are interested in which feedstocks are available where and in what quality. Disruptions in the supply chain must be taken into account as well as their consequences for production and the ability to deliver. If this data is transparent and available in real time, production processes can also be planned, retooled, or adapted to changed raw materials. Transparency is also important so that emissions can be accurately balanced for each product - this not only prevents competition-distorting greenwashing, but also makes it easier to draw up sustainability balances – on the basis of which the right decisions can be made to achieve the Net Zero goal.

In addition, there is another level of complexity: the transformation of the energy system is leading to more and more processes being switched from fossil fuels to electricity from renewable sources - the electrification of the chemical industry is already in full swing. But electricity from wind and solar energy is not continuously available. Where up to now plants have been planned for continuous operation on the basis of energy sources and raw materials available at all times, in future operators will gain economic advantages by flexibly aligning their processes to the energy and raw material supply. In addition, there is the overarching goal of linking energy management, industry, transport, and buildings in the sense of sector coupling and optimising them together. This dimension also makes the control of chemical production more complex. And here at the latest it becomes clear that humans alone are overtaxed in view of the abundance of optimisation goals and influencing variables: the key to holistic optimisation also therefore lies in digital tools.

**AI and MI require consistent data**
The industry expects great benefits and support in decision-making from new tools based on machine learning and artificial intelligence. These come into their own wherever large amounts of data are available - and this is where the crux lies: although chemical companies are already producing more data today than ever before, the data stock is often inconsistent and often lacks context - for example, about the relationships in material cycles. The problem is well known, and the industry has long been working on solutions: In the DEXPI initiative founded in 2011 by BASF, Bayer and Evonik, for example, a neutral data format was defined with which process information can be exchanged between software products from different engineering tool manufacturers. The current Manufacturing X initiative goes one step further: the stakeholders of the Industrie 4.0 platform have thus set themselves the goal of realising the Industrie 4.0 data space and the transformation to a digitally networked industry across the board. Ultimately, this is how a data-based economy is to be created.

But the same basic prerequisite applies to all these initiatives as to the circular economy: they require transparency about processes and resources used throughout the entire value chain; and they presuppose that data is also shared across company boundaries without this leading to a know-how drain at the companies. And often the benefits from digitalisation – for example in production – arise in a completely different place; without a holistic view, process operators often lack the business case and thus the motivation to invest in digitalisation. Even within companies, there are gaps in data: a now classic example is the information technology gap between plant planning and the operating phase: in digitisation projects, data often has to be painstakingly reconstructed that was already available digitally in the planning phase but was not passed on in a digitally readable format due to different responsibilities. In a future circular economy, information about a product must also be passed on throughout its life cycle – here, among other things, the use of blockchain solutions could ensure continuous information flows in the value chain. The examples show: Those responsible for digitalisation must focus on the entire value chain.

**The role of process automation is changing**
In this context, the role of process automators is also changing: on the one hand, they create the conditions for consistent data flows, on the other hand, they contribute to managing the data flows. The fact that the boundaries between IT (information technology) and OT (operational technology) are blurring can already be observed in numerous companies in the chemical industry – Industry 4.0 and the digital transformation are leading to an increased convergence of IT and OT and the integration and networking of systems. In the chemical industry, however, this must always take place against the background of high security requirements.

The current initiatives of the process automation companies are also part of the target picture of a digitalised chemistry: The Ethernet-based communication technology APL (Advanced Physical Layer) is intended to help the digitalisation of the field (sensors, actuators) achieve a breakthrough. With the Namur Open Architecture (NOA), data previously stranded in field devices can be used for optimisation applications - for example in cloud applications: for example, to detect anomalies or to reduce maintenance costs, energy and raw material consumption. The modular automation approach promises flexibility: the Module Type Package (MTP) is used to describe plant modules in a standardised way – this massively reduces the integration effort when assembling modular plant components. MTP is expected to save up to 70 % of the engineering time alone. And another acronym is important in this context: OPA-S. With the Open Process Automation Standard, a standardised and manufacturer-independent architecture for the automation of process plants is currently being created. Above all, the interoperability between devices and systems from different manufacturers is to be promoted in this way. This will enable plant operators to scale and expand their systems more easily and to better access data from different sources.

**Conclusion**
Without digitalisation, the chemical industry will not achieve its ambitious goals with regard to net zero emissions and the circular economy. So far, there is often a lack of end-to-end data consistency and a holistic view. Process automation and the digital twin are central building blocks of digitalisation, whereby their implementation must go far beyond pure plant automation in order to map the entire value chain. Current process automation initiatives and technologies such as APL, NOA, MTP and OPA-S offer promising approaches for implementation. However, they are only a small part of a holistic overall picture of digital business processes. To take full advantage of digitalisation, data must be shared and used fluently, consistently and in the right context. Only then will the digital twin really come of age.

*Author: Armin Scheuermann, chemical engineer and freelance trade journalist*

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Keywords in this article:
#processautomation #digitalisation #cycle economy #decarbonisation