**Fortune favours the prepared: from modular plant construction to Shared Economy**

*Currently, all manufacturers in the chemical and pharmaceutical industries have their own multi-purpose systems, which are optimised in parallel. Modular plant engineering has set out to eliminate inefficiencies and accelerate processes. Can this be done? Where does the industry stand today and what are the driving forces at play?*

**A vision for the beginning: Efficiency and sustainability at the centre of attention**

The core idea of modular plant construction is similar to that of Lego. It provides the industry with functional process modules that can be linked via a standardised automation interface (Module Type Package, MTP) and quickly integrated into new processes. This would achieve a completely different level of efficiency by providing a large number of modules that could be used both within a company and across company boundaries. The goal of producing a molecule for an application in the fastest, most efficient and most sustainable way possible would then be within reach. In the field of personalised medicine, for example, it is not always necessary to produce large quantities, but rather small quantities of the highest purity. Modular plant construction can also contribute to the transformation of the chemical industry towards CO2-neutral processes: the replacement of conventional fossil-fuelled process steps with efficient and sustainably operated components e.g. for electrochemical transformations can be implemented just as elegantly with modular units as the integration of highly efficient heat pumps in existing systems.

**Going full steam ahead: Standardisation and conformance testing**

From the vision to the present – where does MTP currently stand as a central element for modular plant construction? Dr Frank Stenger, Chairman of the modularisation specialist group at DECHEMA and an Evonik employee, explains the importance of the modular automation interface MTP: “Making modules physically available is not a problem. To create a flexible system, you need automation technology that is modular as well.” Typically, the central control system is responsible for the control and regulation of a plant and its devices. When a component needs to be replaced, it is usually necessary to replace all cables as well. Instead, in order to work with a modular system that can be quickly integrated, the intelligence must be integrated into the module that controls and regulates "on site". All of the module's functions can then be transferred to a central control system via a single interface for orchestration with the other process modules.

"For this to work in practice and be of interest to manufacturers in the chemical or pharmaceutical industries," says Stenger, "this interface must be manufacturer-independent." A joint working group of NAMUR, ZVEI and, since summer 2023, PNO (Profibus User Organisation) has been working intensively on the details of the MTP standard, and the latest version is expected to be published in autumn 2024. Of the six properties and functions that MTP is intended to map as a PNO standard, the four most important ones have now been finalised. It is therefore possible to integrate a module into a system via the MTP interface and to address and control it.

"In fact, we have now reached the point where MTP is usable, but not everyone is using it yet," says Stenger. This is also confirmed by Dr Mathias Maurmaier, Committee Lead MTP of the joint working groups of NAMUR, ZVEI and PNO and SIEMENS employee: "We have opted for an incremental approach, which means that some things are covered so that the first projects can run - others are still under development. This also applies to the conformity tests, for which standardised specifications will come at the end of 2024, or early 2025 at the latest. This is an important step towards broad market deployment, as compatibility between different manufacturers can then be tested."

**From ability to action: When the transformation begins**

Fundamental change takes time and requires the active participation of all stakeholders. For the established control system manufacturers, the task used to be to develop a closed system and support it throughout its lifecycle - a large but relatively straightforward and predictable task. Modular plant engineering changes the parameters and the entire business model, as Maurmaier explains: "We are now dealing with an open system in which products from different players are integrated, sometimes with local control systems from several suppliers. We are no longer talking about the classic control system, but about the Process Orchestration Layer (POL). It can manage a whole pool of modules that are used in a first system today, are under maintenance tomorrow and will be used in another system the day after tomorrow".

For manufacturers of modules or PEA (Process Equipment Assembly), activities in Germany are currently being bundled in the REUNION funding project, which brings together module manufacturers, plant operators and approval authorities. The consortium leader of the funding project, Prof. Peter Pelz from the Technical University of Darmstadt, explains: "Our project includes many small and medium-sized companies that want to gain expertise in MTP as part of REUNION in order to be able to offer their customers appropriate products later on". The focus is on hardware, automation and documentation, with the Technical Universities of Dortmund, Dresden and Darmstadt working together with the partner companies.

"In the end, modularity can even be included in the portfolio as a product and offered to other sectors," says Pelz. " The motivation is great to help shaping the future in this way, to stop thinking in terms of modules and start thinking in terms of functions and services. For example, a new business model could be the sale of volume flow instead of pumps."

So while all market participants are tweaking the various parameters, beta tests by large companies are already serving to convince internal stakeholders to realise commercial systems. Sebastian Härtner, active in the DECHEMA modularisation specialist group and employed at Merck, is convinced that the effort is worthwhile: "In my view, modular plant engineering is the technology that will take us forward in the chemical and pharmaceutical industry. We now have two suppliers on the market who are creating the opportunity to use MTP with a commercial control system. By mid-2024, we will see the first qualified production infrastructure for active pharmaceutical ingredients in operation. These are the right and important steps into the future.

Härtner uses the comparison with car sharing to emphasise the potential of MTP. Today, everyone has their own car because car sharing is impractical. But if fully autonomous vehicles and intelligent control via an app ensured that every user had exactly the vehicle they needed within ten minutes, then they would no longer need to own a car. "This core idea of the shared economy can also be transferred to industry through modular plant construction. The more standardised processes are and the more interchangeable individual modules are to adapt production to demand, the more efficient and sustainable everything can be."

**A look at the legal situation and at the economic efficiency**

A potential barrier to many projects is the often lengthy and costly permitting process. This is another area where modular plant construction is providing a boost, as it offers great potential for efficiency gains. Stenger explains: "Every production plant needs a permit, of course. But if we can get approval for the modular system, we can move very quickly.”

There are therefore many clear advantages to modular plant construction - from the potential to create a shift towards efficient and CO2-neutral processes to the acceleration of approval processes. However, as things stand today, there will probably always be areas where a less flexible, long-lived plant based on the classic model is the right approach. Mauermeier comments: "If 24/7 availability and the ability to update during operation are the most important criteria, then a classic solution is the right choice. Many other applications will be modular in the future and we see a growing market share. This is evidenced, for example, by the fact that the first projects were initiated as part of an MTP show in Singapore in 2023, and the topic is becoming increasingly important in the biopharmaceutical sector in the USA.

As the number of projects grows, the question of how to assess the economic viability of a flexible, modular plant is becoming increasingly important. For this reason, the DECHEMA specialist groups MODA (Modular Plants) and COST (Cost Engineering) are currently working on a status report to provide clarity. Stenger summarises: "When I plan a conventional plant, the scope is clear and I know exactly what to expect in the coming years. If I plan a modular plant, I have a lot of flexibility and can expand or reduce capacity - with a higher initial investment. In the report we provide a basis for assessing what these benefits are worth in monetary terms and how to make an economically sound decision". The status report will be published at ACHEMA 2024.

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| **For data exchange: DEXPI**The integration of modules into a user's production environment requires extensive documentation. An important part of the documentation is the P&ID, the Piping and Instrumentation Diagram. It must be made available in standardised formats when the modules are delivered. DEXPI has developed a solution for this purpose. Michael Wiedau, Chairman of DEXPI e.V., who works at Evonik, explains: "Ultimately, we need an internationally standardised basis for data exchange in modular plant construction, and existing norms and standards must be incorporated". The ISO 15296 standard already contained a definition for the handling of "data integration, sharing, exchange and transfer between computer systems", but it was too broad for the needs of process engineering. Reiner Meyer-Rössl, vice chairman of DEXPI e.V. and an Autodesk employee, believes that networking is extremely important on the way to a new international standard: "We initiated the Process Industry Data Model Integration Congress PIDMIC at ACHEMA 2022. In doing so, we initiated a dialogue with standardisation bodies from VDMA and VDI to DIN and NAMUR. We will continue on this path at ACHEMA 2024."Both Meyer-Rössl and Wiedau are already experiencing a rise in demand. DEXPI has only been represented as an independent association since 2023, but the number of enquiries is already increasing significantly. As DEXPI is an open standard that is available free of charge, there are many research projects and start-ups working with it and developing solutions. "We are not allowed to talk about specific projects, but we know that a lot is in the pipeline and new systems are being built. However, nobody wants to let anyone look at their cards, lest they lose their edge.” |

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**About ACHEMA**

ACHEMA is the world forum for chemical engineering, process engineering and biotechnology. The world’s leading show for the process industry takes place every three years in Frankfurt. The spectrum ranges from laboratory equipment, pumps and analytical devices to packaging machinery, boilers and stirrers to safety technology, materials and software, thus covering all the needs of the chemical, pharmaceutical and food production industries. The accompanying congress, featuring scientific lectures and numerous guest and partner events, complements the wide range of exhibition themes. The next ACHEMA will take place from 10 to 14 June 2024 in Frankfurt am Main. [www.achema.de/en](http://www.achema.de/en)