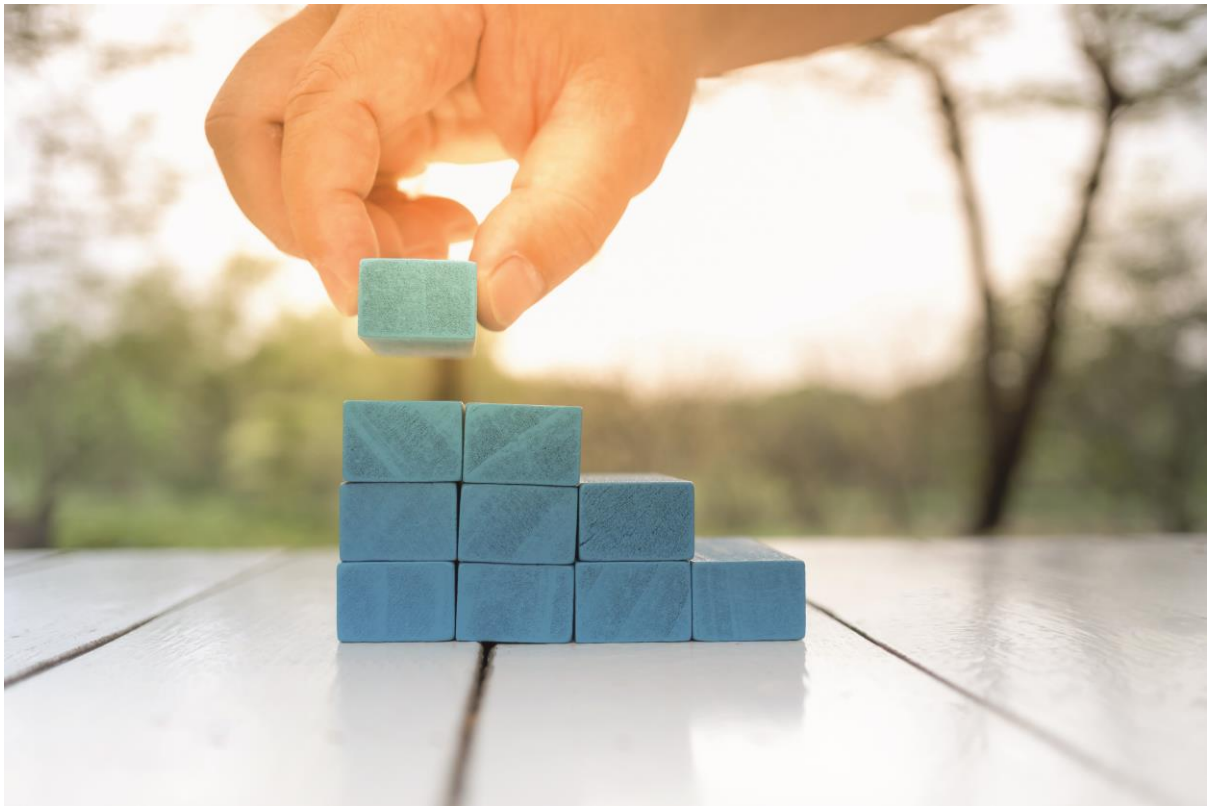
Modular automation in the chemical industry

Clear advantages for both systems manufacturers and operators

Flexible products that can be designed individually are the goal of the fourth industrial revolution. Many people therefore imagine a scenario in which they can choose the painting, the type of seats, and the rims of their new car and still adjust them during production. However, most of the time they do not take into account where the variety of single versions comes from – namely from the chemical industry (lead image).



Lead Image - (image source: Shutterstock)

In the chemical industry, we have numerous examples of products that are only of interest during a specific period of time and in a limited quantity. This applies, for example, to trend colours that also have a special structure. This colour is only produced for one season and then withdrawn from the range. Of course, the supplier does not dispose the system that has produced the colour – it is converted and then used for producing other products. That's why a system nowadays can be seen as something like a spare parts storeroom. In addition, engineering costs for the newly assembled system will not reduce.

With that in mind, it is important that the modular approach of a flexible production, implemented in factory automation, is also taken by the process industry. Thanks to the modularity, system operators are now able to work with process flow diagrams; they do not

have to deal with the automation components again and again. There rather is a central pool of different system modules that can be lent to further companies if necessary. This way, system operators are provided with an increased transparency and dedicate greater attention to using their own system. The modularisation of systems also opens up new fields of business in the process industry: apart from borrowing, modules can be rented for a certain period as well. Lower engineering costs and less effort in terms of time-to-market (image 1) are additional benefits.

Figure 1 - Modularisation provides increased transparency to system operators so that they can dedicate greater attention to the use of their own system (image source: Shutterstock)

Faster response to malfunctions and an increased demand

Some manufacturers of subsystems are already providing their solutions as completely automated modules. The single subsystems can then be assembled to a complete system by the operator. The most demonstrative modules are those equipped with a container-like frame. Similar to a children's box of building blocks, those modules can be combined to form a system and, in case of a malfunction, be replaced by a replacement module. In addition, this way of designing a system facilitates logistics, as containers do not have to be treated as bulky goods. The scalability of production is another benefit: In case of a great demand for the manufactured product, the production volume increases by simply multiplying the respective module (image 2).

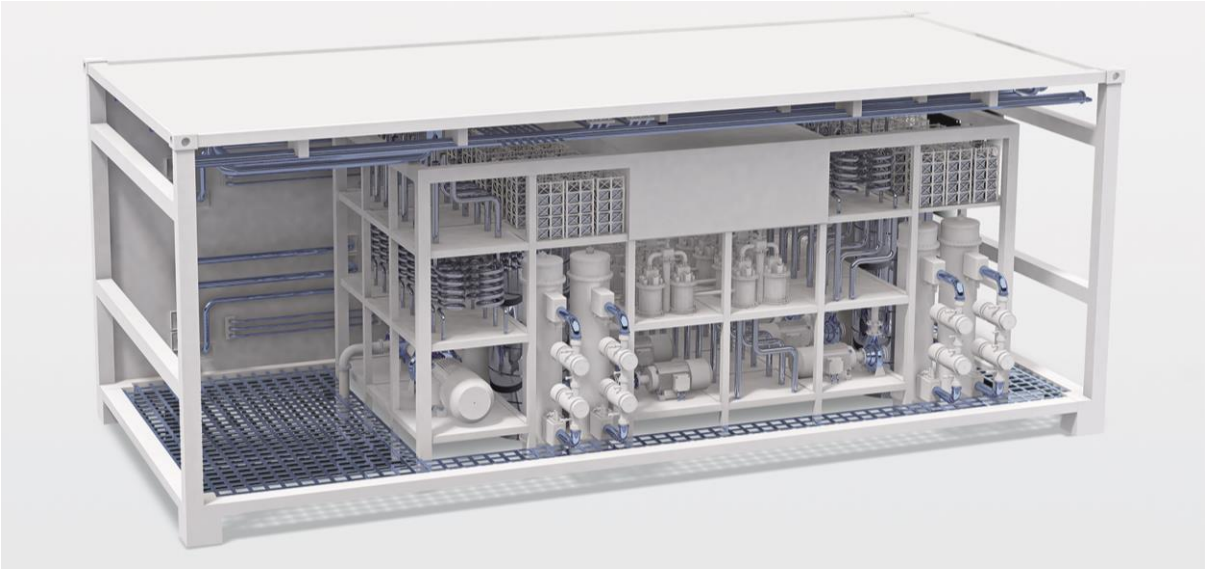


Figure 2 - Regarding transportation and assembly, the “container-design” provides clear advantages

For several years now, different working groups from NAMUR and the ZVEI are dealing with the question of how these modules can be interconnected to one system and how they can be controlled. The working groups are not only exchanging ideas actively. Apart from this, new project groups have been established that deal intensively with particular technological problems – for example the modeling of control displays and the process control. As a result, different white papers are available that are standardised under directive 2658 by VDI/VDE and NAMUR. In addition, the results were presented at a joint booth at the Hannover Messe and the Achema. Discussions with trade fair visitors made clear that both systems manufacturers and operators deal with the modularisation of systems and that they partially realise their ideas in demonstration systems. The single working groups also work on topics like communication, alarm management, and functional safety.

Easy integration into the complete system

One of the working groups has decided that an exchange file will be needed for integrating modules into the process control level. The format of the exchange file is called Module Type Package (MTP) and builds upon the XML-based Automation Markup Language (AutomationML). The file comprises all the relevant information that is required for the integration of data in a distributed control system. The formalised description via MTP file generates a mobile automation module that can be integrated into the process system in an easy and flexible way. Data points do not have to be created and connected with visualisation objects by hand anymore. This happens automatically when a file is imported.

Manufacturers of programmable logic controllers (PLC) will only ensure that the MTP description file is created in parallel with the PLC program. After that, DCS vendors implement the import function. Since OPC UA is used as an interface for data exchange, combining several modules, which were automated with control technology of different manufacturers, to one system is not a problem anymore. At the moment, the system module has a programmable logic controller that controls the module and communicates with the respective distributed control system. However, the further development of automation technology and the integration of OPC UA servers into I/O modules does not exclude the possibility that the controlling of module groups is moved to the central PLC or directly to the distributed control system.

So, what kinds of demand does automation technology that is installed in system modules like this have to meet? As the modules need to be small, the narrow design of the automation components plays an important role. The compact product families from Phoenix Contact therefore provide space-savings of up to 70 percent.

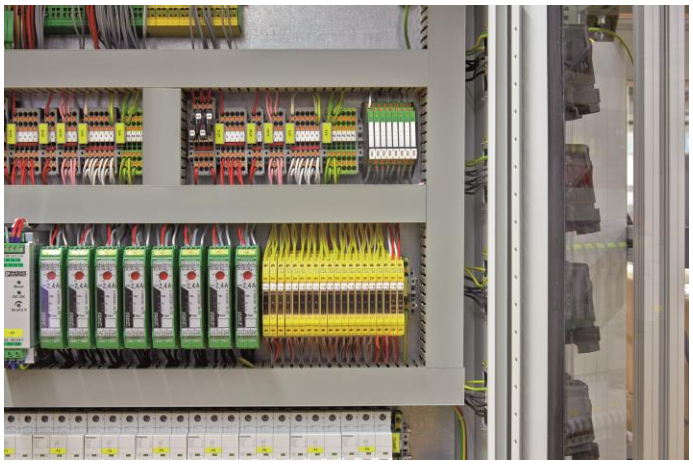


Figure 3 - The narrow devices of Phoenix Contact save up to 70% space in the control cabinet

Among other things, the portfolio comprises measuring transducers, isolators, and intrinsically safe relay modules. The company declared itself in favour of intrinsically safe devices here, safety aspects are therefore solved in the module itself. The safety devices that have a width of only six or twelve millimetres will provide for the proven safety (image 3).

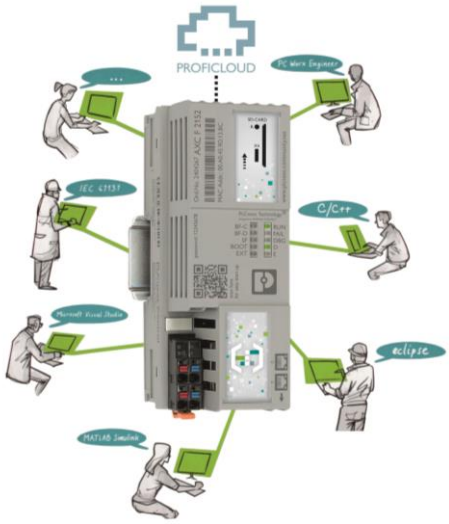


Figure 4 - Using the AXC F 2152 PLCnext Control, you can implement compact and intelligent system modules at the same time

The white papers created within the working groups determine how a PLC program should look like, how units are to be controlled, how measuring points have to be read, and which additional parameters, apart from the real value, they need to provide. The services got a data structure and can be controlled from the distributed control system. In addition, they can support different operation modes and cover a thought-out state machine. In order to implement all this, the PLCnext Technology open control platform from Phoenix Contact proves helpful. This way, the user can realise complex functions in high-level language and then integrate the program into the automation system of Phoenix Contact. Development times are thereby reduced and production processes can be adjusted to changing demands very quickly. Just as the I/O modules that go with it, the AXC F 2152 PLCnext Control features a slim design which enables compact and intelligent system modules at the same time (image 4).

Reducing engineering efforts and manufacturing costs

The modularisation of chemical systems opens up clear advantages that have been recognised by manufacturers of subsystems as well as system operators. The reduction of engineering efforts also reduces the manufacturing costs of the final product which increases the provider's competitiveness. So it is probable that modularisation will also enter the process technology.

More information:
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Open platform for limitless automation

Processes need to become more flexible and automation solutions need to become more communicative and adaptable to remain competitive on the market in the long term. That is why Phoenix Contact has developed the PLCnext Technology open control platform that meets every demand of the IoT world.

The new technology makes it easy to work in parallel with different software tools – such as Visual Studio, Eclipse, Matlab Simulink, and PLCnext Engineer – as well as to create programming code both in IEC 61131-3 and C/C++ and C#. The task-handling enables program routines to run as a classic IEC-61131 PLC code, so that high-level language programs become automatically deterministic. The platform also ensures consistent data exchange and synchronous execution of the program code.

In addition, it is also easily possible to integrate functions from other manufacturers or the open source community into the Phoenix Contact automation system and to fuse them into an overall solution. Besides, the integration of current and future interfaces and protocols is possible. New IoT-based business models can be realised through the direct connection to cloud-based services and databases (image 5).

Figure 5 - With PLCnext Technology, current and future interfaces, as well as cloud-based services and databases can be integrated into the solution