PROJECT "DIMA" – NEW PATHS IN PROCESS AUTOMATION:

Modular Applications for Customizable Production

Individuality, modularity, simplicity and efficiency need not be contradictory. In the "Decentralized Intelligence for Modular Applications" (DIMA) project, WAGO, together with COPA-DATA and other partners, prove how automated engineering and re-engineering can revolutionize process automation.

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Fluctuating procurement and sales markets, flexible relocation of production sites and the increasing need for customer-specific individualization of a product range are leading to ever-shorter product and innovation cycles in the process industry. Conventionally-constructed process technology equipment in the areas of chemical processing, food and beverages, cosmetics and pharmaceuticals are usually not flexible enough and cannot efficiently master the introduction of new products or amended production quantities. Companies in the process industry often introduce new technologies with significant delay. The requirements are increasing: machines and equipment must allow for quick adaptation, in a modular manner and with minimal effort; production processes must be as flexible as possible in order to remain competitive. As part of the Industry 4.0 concept, the call for increased individualization, down to a batch size of 1, is getting louder.

DIMA – PROJECT AND OBJECTIVES

"DIMA – Decentralized Intelligence for Modular Applications" was initiated by WAGO, a global provider of electrical connection and automation systems. The project meets the demand for individualization of process equipment and a high degree of modularity in the automation of production processes.

DIMA was first presented at the annual general meeting of NAMUR in 2014. NAMUR, the international User Association of Automation Technology in Process Industries was founded more than 65 years ago. The DIMA concept is based on a standardized approach of NAMUR's 1.12 working group. The committees of NAMUR and the German Electrical and Electronic Manufacturers' Association (ZVEI) have now taken on this approach in order to further specify it. The objective of the cooperation is the development of an international standard. WAGO was looking for partners to help position the concept on the market and to secure high acceptance and wide market penetration with providers and customers. There are now more than 20 companies involved in the project – including COPA-DATA with zenon as process control system. Further partners are, among others, Emerson, Yokogawa and Endress+Hauser as manufacturers, as well as BASF, Bayer and Sanofi Aventis as users. Higher education partners are the Dresden University of Technology, the Helmut Schmidt University Hamburg and the RWTH Aachen University.

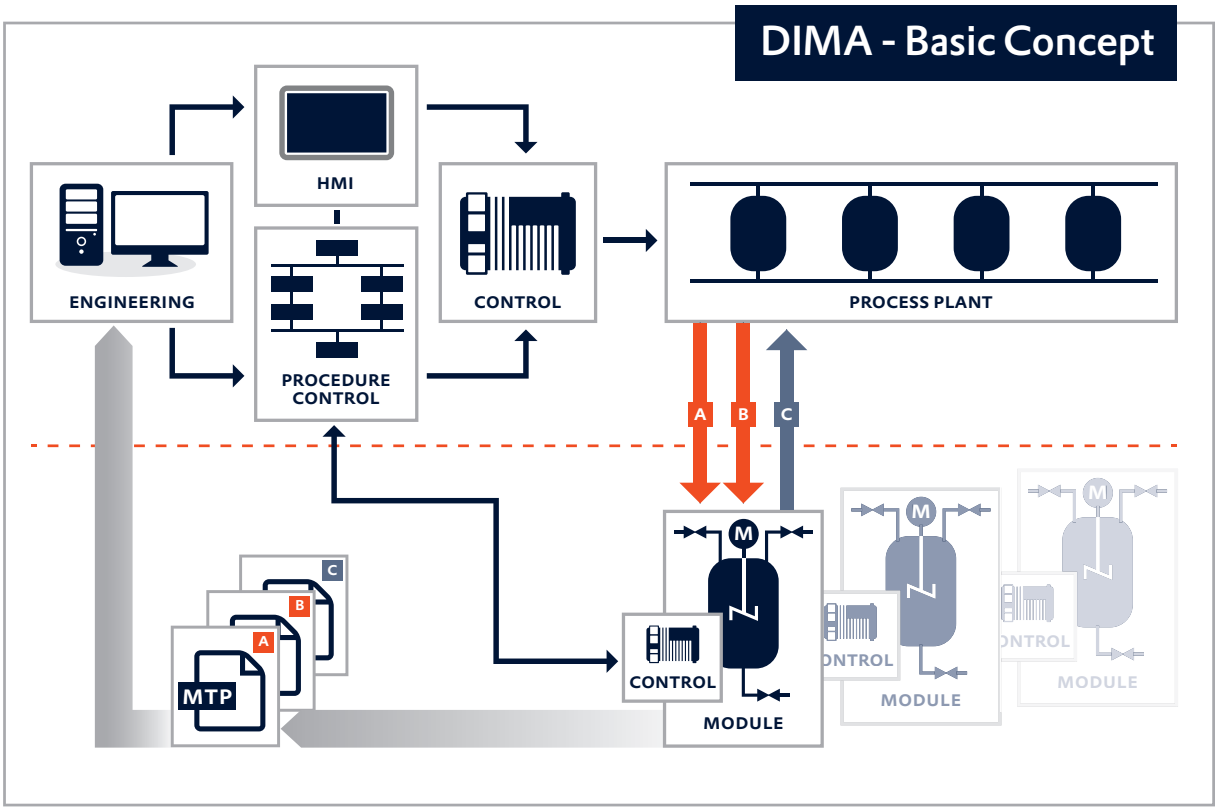
SERVICE-ORIENTATED ARCHITECTURE WITH SMART EQUIPMENT MODULES

Conventional process technology equipment is controlled by a process control system that includes process control, HMI and engineering. Part-modularized, process technology equipment often consists of a central communication and automation architecture (central intelligence), as well as process technology modules, such as centrifuges, agitators, filling machines, tempering or fermenting equipment. The idea of the DIMA concept is to compile an entire plant consisting of several autonomous equipment modules. An equipment module displays one or more standardized process steps, carries out procedures, operations or functions and thus provides a so-called service. The module manufacturer defines whether a service creates an interim product in a complex module, for example, or whether a service operates two valves and a pump. A module provides its process-technology function as a service to the higher-level process control system – it takes on the role of a service provider. The process control system can call up the service offered by the module – it acts as a service user. DIMA consequently uses the paradigm of service-orientated architecture (SOA), which is proven in the IT field. The modules have their own "intelligence" in the DIMA concept. Each module is equipped with its own controller, which executes services and monitors the module status.

The engineering of the overall equipment is based on two independent engineering processes: the module supplier first configures the module (module engineering)

"Our aim is to considerably shorten the time between product approval and market availability. We estimate that 60 percent of the development time of process equipment can be saved. But this can only happen if the equipment is created in a modular manner and we give the company the possibility to act more quickly and flexibly."

ULRICH HEMPEN, MANAGER OF INDUSTRY & PROCESS MARKET MANAGEMENT AT WAGO



and provides a description. The equipment operator uses this description in the integration engineering and configures the entire plant.

If companies wish to amend a production process, they only need to exchange one or more modules. The production quantity can be increased by means of numbering-up, i.e. adding modules of the same type. The major benefit of the modularization of equipment is the reduction in engineering work. Manufacturers can plan and construct modular equipment more efficiently, because a large part of the engineering can already take place in the module engineering phase. The modules that are already fully automated only need to be integrated into the process control system.

TECHNICAL MODEL AND STRUCTURE

The technical implementation of the DIMA method requires a new definition for the description of process equipment modules: the "Module Type Package" (MTP). The following information is stored in this MTP: communication parameters for easy integration of the module into the equipment; services, i.e. the description of the process performance characteristics of the module, as well as graphics information for operation and observation. In addition, there are further descriptions, such as information on status, diagnosis, history and archiving.

In order to design the complete engineering or re-engineering process as efficiently as possible, WAGO and COPA-DATA have developed an MTP handling and management system. With this system, companies can read in the MTPs and trace which artifacts in zenon have been created by which MTP. This allows the connection of the modules required in the process, even in ongoing operation. zenon also gives customers the possibility to select and export customized services and operating screens. This way, companies can set out a concept for reuse and reduce project-related costs.

UNIFORM VISUALIZATION

As part of DIMA, the MTPs are not provided with any graphics data, but only the information that something (such as a temperature for example) must be displayed. The process, distributed over several modules, is to remain operable and observable. zenon is used for this. The central challenges in the process are the automatic creation of operating screens and the implementation of

a uniform look and feel of the modular equipment. The module manufacturer is responsible for the planning, the construction and the programming of the module, and therefore creates the operating screen of the module. At this time, the creator still lacks the knowledge of the operating screen library of the higher-level system. However, a function (such as the display of a temperature) must always be displayed identically in the control system. To translate the module-specific operating screens into a uniform look and feel in the project, the operating screens must be available in a display-independent specification form. This contains information regarding the operating screen element, as well as its location and size. An algorithm sets the project-dependent operating screen elements in the desired display and location on the operating screen of the target system and links them to the corresponding variables for communication with the PLC of the module. The use of this role-based library concept means that the library is present in both the engineering tool of the module manufacturer as well as in the target system. A corresponding library is currently being developed by NAMUR and ZVEI.

THE INTERACTION OF THE SERVICES

To process the individual production steps, the services of the modules must initially be put into an ordered sequence. A continually-operated reaction process requires, for example, coordinating the start-up of the reactor with the provision of the initial products. In order to orchestrate services throughout modules, companies must be aware of the current status (such as run, stop or error) or status transitions. The decentralized intelligence of each module determines the corresponding information and transfers it using a communication interface. In order to bring the services of the connected modules into the desired sequence, DIMA envisages the use of batch functionalities (zenon Batch Control module). The range of functions of a production plant is visualized in the batch tool with the help of several models. The module communicates with Batch Control directly and receives the command to execute a service from there. If the module has completed the execution of the service correctly, it reports this as a status.

FIRST PROTOTYPE EQUIPMENT

At the SPS IPC Drives 2015 trade fair in Nuremberg, WAGO presented equipment that meets all requirements of NE 148 and similar standards for the first time. The prototype DIMA equipment consists of four modules that each form a typical process technology step: mixing, distilling, filtering and bottling. In the process, two reactants are mixed in the mixing station, their product is then separated by distillation and the distillate is then filtered when coagulation occurs and then filled into manageable vessels. All four modules are equipped with their own intelligence – the PFC200 controller from WAGO. Each have an MTP and are connected to a backbone in a star shape. This supplies the modules with electrical energy and compressed air to operate the actuators. In the integration engineering, the MTP is integrated into zenon with the help of a wizard, which displays all MTPs that have been read in and deletes them again if required. The operating screens are then created automatically. The production process is shown as a recipe and the individual recipe stages include possibilities to set parameters.

WAGO – together with COPA-DATA and other partner companies – are using DIMA to forge new paths in process automation. Users will thus be in a position to implement flexible process equipment in a short time, reduce product cycles, react more quickly to new market conditions and individualize their production.

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