Improve quality and save time and money with digital engineering

Companies today are facing tremendous challenges. They have to meet short deadlines while remaining highly flexible in production. Digital models of plants that map complete operating sequences in real time give them a greater competitive edge.

Everyone's talking about Industrie 4.0 – not just the larger companies in the production industry but also medium-sized companies. In Industrie 4.0 factories, smart machines self-coordinate production processes and driverless vehicles autonomously handle logistics and material flows. The networking of humans, machines, and things is at the heart of the Internet of Things. Digital technologies can be used to create new production processes, business models, and products, thereby changing the demands placed on industrial production. Just one example: When an automobile manufacturer builds a highly automated production line with four system suppliers, interfaces are created. In particular, this means that the configuration of the data transfer between stations must be extremely complex and precise. Otherwise there could be costly downtime later on when the plant is in operation.

Real commissioning on the digital model

With the HeiVM "virtual machine," HEITEC helps companies meet the requirements of Industrie 4.0. During plant design, a key driver of productivity is software-based support of engineering processes through virtual modeling of machines, plants, robot applications, and material flows. "We're currently working on a pilot project with a medium-sized machine manufacturer that wants to be able to program standard machines faster using a virtual model," says Gerhard Stich, Sales Manager, Automation & Software at HEITEC, describing a potential application for HeiVM. It's crucial that the virtual models behave identically to their physical counterparts in terms of kinematics and interfaces.

The first step in creating a truly one-to-one model of a machine tool starts with the software. HEITEC has developed its own toolkit of technology objects that can be operated in software tools from different manufacturers, including Plant Simulation, Process Simulate, and MCD from Siemens, Vincent from the Fraunhofer Institute, Virtuos from ISG Industrielle Steuerungstechnik GmbH, and the 3D simulation software from machineering GmbH & Co. KG. However, the focus isn't on a specific tool but rather on the functioning of the plant. The machine and plant builders provide the corresponding CAD data and supply the circuit diagrams. As part of model development, this data is prepared so that the virtual model created can be controlled by the real SPS. To model the processes, HEITEC uses a comprehensive library of virtual components ranging from robots, presses, and conveyor belts to automation systems, sensors, and actuators. "The manufacturers supply us with the libraries, or we generate them ourselves. The stock grows from machine to machine," says Stich. The virtual plant is controlled by the real controller and functions according to the hardware-in-the-loop principle. For example, when a robot is required, it can be integrated directly into the system. "What's special about this concept of real commissioning on the virtual model is that the original automation software is used, and the operating sequences are mapped in real time," Stich explains. With HeiVM, automation concepts can be tested and process sequences optimized before the real plant exists. However, process owners can also use

HeiVM for early digital planning if the virtual model and the necessary technology objects are made available to them.

Faster commissioning, higher productivity

Creating a digital model when a plant is still in the planning phase makes it possible to avoid design errors that would later be costly to correct. For new developments, series machines, and special machines in particular, engineers can improve the quality of the plant configuration and reduce the risk of downtime. In the case of expansions and retrofits, plants can be tested on the digital model before commissioning. Parallel development processes significantly minimize the duration of the project and therefore changeover time, making it easier to meet agreed deadlines. According to estimates, virtual engineering reduces commissioning time by up to 80 percent and project lead time by up to 15 percent. With HeiVM, customers also save money through increased productivity on the virtual model. First, testing the process sequences helps prevent plant downtime. Second, production data can be evaluated digitally in the virtual model and optimizations performed. Trouble-free production is also guaranteed because software qualification has already taken place using the actual plant layout and workflows. Finally, employees can be trained more quickly and easily on the virtual model.

HeiVM in practice

An automotive manufacturer expanding an assembly line significantly reduced the conversion time using HeiVM. In the future, the assembly line will produce 4-cylinder and 6-cylinder engines in parallel. All the scenarios relevant to the conversion can be explored in the virtual model of the plant in order to achieve an optimal result: for example, to determine whether the buffer segments provided for the engines are sufficient or the robots' gripping motions are precise enough. The important interface tests – on the transfers from one station to the next and therefore the data transfers from one controller to the next – can also be conducted beforehand. Once everything has been checked, the programming is generated on the virtual model and real commissioning is performed in a minimum amount of time, preferably over the weekend. This allow the production outage caused by the conversion to be kept to a minimum. For a state-of-the-art labeling plant with a throughput of 1,200 glass bottles per minute, commissioning time was reduced to just four weeks using HeiVM. It typically takes months before this kind of plant – a highly complex mechanical and electronic system – can begin running smoothly. During the design phase, the plant was brought into the office as a digital model, optimized, and finally commissioned virtually. Thanks to the model's attention to detail, a highly precise drive configuration was realized that enabled glass breakage to be prevented. It was then possible to test the workflows and interactions between drives and simulate errors using the digital twin. In addition to saving time, this also prevented costly breakage.

Summary:

Experience has shown that the digital engineering methodology based on HeiVM reduces project and commissioning time for machine and plant builders and plant operators, thereby resulting in substantial cost savings.

A growing number of well-known medium-sized machine builders from the automotive industry, packaging industry, and logistics are willing to invest in Industrie 4.0 because they recognize the benefits of using digital methods. For example, last year a renowned German automaker incorporated HeiVM into its standard for creating plants and machines.