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Smart digitalization and automation solutions

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PROCESS INDUSTRY 4.0

THERE IS STILL SO MUCH UNTAPPED GROWTH POTENTIAL

Great strides are being made when it comes to digitalization in the process industry. Small and medium-sized plant operators, however, remain hesitant. Not even the digitalization push in the wake of the Corona pandemic has altered this attitude.

The opportunities presented by digitalization, especially for the process industry, are enormous – something that studies and surveys have repeatedly shown. Plants that are digitalized can be controlled more efficiently and effectively, because greater transparency is created with the help of data-supported methods and technologies, and better decisions can be made as a result. This is particularly true when plants are networked using the Industrial Internet of Things (IIoT).

The vast majority of industrial companies in Germany have long since begun taking advantage of the opportunities offered by digitalization in the context of Industry 4.0. According to a survey by the digital association Bitkom, almost two-thirds of companies are already using digital applications such as networked production facilities, real-time communication between machines or intelligent robots. Three years ago, only about half of them were doing so. Roughly 20 percent of companies are currently planning specific steps toward the implementation of Industry 4.0, and another 16 percent can at least imagine taking such steps in the future.

CORONA CRISIS LEADS TO DIGITALIZATION PUSH

As is the case in other sectors, the Corona crisis has accelerated the digitalization trend in the industrial sector: According to the Bitkom study, 95 percent of companies surveyed say that digitalization has also become more important in their business as a result of the pandemic. More than 60 percent of industrial companies say that digital technologies are helping them manage the consequences of the pandemic. And three-quarters have found that companies whose business model is already digitalized are weathering the crisis better.

"The reasons for this response behavior are not surprising," says Gerald Pilotto, Global Development Senior Vice President at Bilfinger. "After all, during the pandemic, there were often situations where access to operating facilities and production sites was limited. Many companies therefore started to make their facilities more crisis-proof – using digital solutions for remote monitoring, for example. This made it possible to control equipment and facilities from any location and at any time." In addition to gaining greater insight

> “Digital technologies not only increase productivity, they also generate new data-driven business models.”
>
> GERALD PILOTTO, GLOBAL DEVELOPMENT SENIOR VICE PRESIDENT BILFINGER SE

into machines and processes, plant operators achieve a reduction in unplanned downtime – in particular through remote monitoring and remote controlling. This was determined by industry studies, including the “Digitalization Index for SMEs 2020/2021” commissioned by Deutsche Telekom.

STAYING COMPETITIVE

Despite this progress, many small and medium-sized companies are still hesitant when it comes to digitalization. Excel lists are still used in many places for data exchange, for example, and paper forms are filled out for inspection and maintenance tasks. “The ‘if it ain’t broke, don’t fix it’ attitude is dangerous if the system works but soon becomes uncompetitive,” says Pilotto. “Moreover, digital technologies not only increase productivity, they also generate new data-driven business models. For this reason alone, even small and medium-sized operators of industrial plants should be taking a long, hard look at future-oriented digital applications.”

Industry experts agree that overcoming future challenges can only be achieved through a shift toward Process Industry 4.0. “The first step is to merge plant data with production data and thereby arrive at even better decisions in the control and maintenance of plants and components. Our experience across the board has been that this significantly increases the performance, availability and efficiency of the plants. The next step is to further expand the level of ‘collaboration’ between man and machine. In the not too distant future, plants, machines and components in the process industry will also independently exchange information online and thus continuously optimize themselves,” says Pilotto.

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INTERVIEW

“EVEN MORE EFFORT HAS TO BE PUT INTO DEVELOPING OPEN DATA STANDARDS AND DATA EXCHANGE FORMATS”

Prof. Julia C. Arlinghaus has been Director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg since 2019. She is also Chair of the Department of Production Systems and Automation at Otto von Guericke University Magdeburg.

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Prof. Arlinghaus, what will the process manufacturing industry look like in the year 2030 as regards digitalization and automation?

The transition to renewable energies and from linear to circular value creation will have to be brought about in the coming decade. Digitalization and automation are the key to this. Manufacturing facilities are becoming more and more autonomous. This means, for instance, that the continuous interpretation of process data with artificial intelligence will make it possible to prevent previously unpredictable process disruptions and to reduce maintenance expenditures at the same time. This will have a positive impact on productivity as well as process stability and thus on supply chains, too. Decarbonizing manufacturing processes will certainly be the biggest challenge. A step in this direction that all companies will have to take in the next three years at the latest is the establishment of end-to-end carbon footprints. And the German Supply Chain Due Diligence Act will require expanding this to include a sustainability footprint in the very short term.

> “The challenges facing the process manufacturing industry up until 2030 are complex and have to be considered from various viewpoints.“
> PROF. JULIA C. ARLINGHAUS

On which technologies and applications should the process industry capitalize as its digitalization proceeds? Where do you see the greatest potential?

We need power-to-X technologies to manage the transition to renewable energies, which is once again being accelerated politically. Demand-responsiveness of energy demands and temporary storage of energy in chemical resources hold major competitive potential for companies. But companies have to do their homework too: IT systems have to be updated and interfaces have to be harmonized. Standardization, using the so-called asset administration shell, for instance, – in other words, establishing the technical foundations for the digital process, equipment and factory twin – is perhaps the most important task: This standardization permits efficient modularization and data acquisition and is thus the basis for new digital business models, too.

Where do you see the biggest challenges on the road to a Process Manufacturing Industry 4.0?

Even more effort has to be put into developing open data standards and data exchange formats to tap efficiency and sustainability potentials throughout the value chain. In addition to standardizing and harmonizing IT systems, IT security will become the main activity. The challenge here is more than just establishing new technologies and software tools. The procedures and processes in companies and throughout supply chains also have to be adapted accordingly. This requires employee involvement at every level and in every area. Lifelong learning must actually be practiced.

What would help overcome these challenges?

The challenges facing the process manufacturing industry up until 2030 are complex and have to be considered from various viewpoints. We must thoroughly gear education and training toward interdisciplinarity and this also means we must invest in education and training just as much as in technology as such. We just completed a study of risks in smart manufacturing, the biggest risk being the human factor – people who do not know how to use technologies correctly or who flat out reject changes. Meeting the challenge of full standardization requires cross-industry and cross-organizational standardization initiatives. Here too, we have to think outside the box and in terms of value networks instead of industries.

To what extent is digitalization helping make the process manufacturing industry more sustainable?

Digitalization establishes transparency. It creates better process understanding and thus facilitates the optimization of processes and the reduction of resource consumption – not only in one company but in the entire value network. Digitalization can also resolve the seeming contradiction between efficiency, flexibility and sustainability. Future manufacturing facilities will be modular. That means they will be scalable and thus easily adaptable to changing conditions. This also pertains to their transformation toward the use of new raw materials just as much as renewable energies.

The Fraunhofer IFF sees itself as a technology and research partner for companies that want to make Industry 4.0 a reality and help shape the epochal transition to digitalization and automation.

DIGITAL TWIN

USING INTEGRATED DATA TO ACHIEVE INTELLIGENT CONTROL

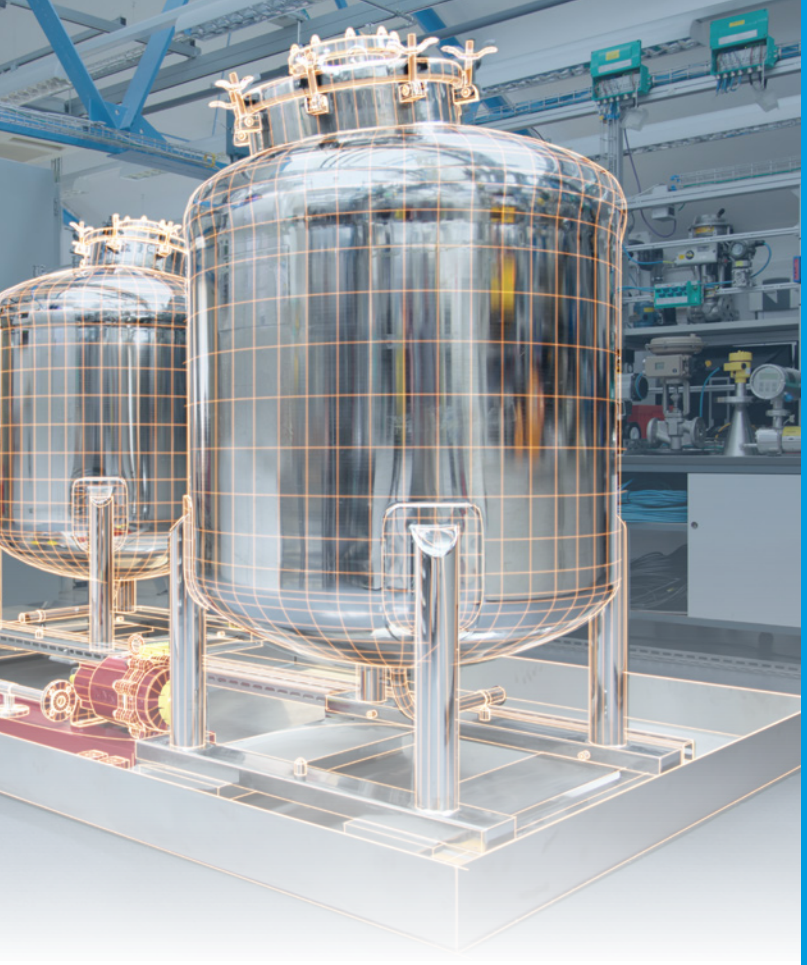
Digital twins are virtual replicas of existing or not yet developed industrial plants that reflect all of the circumstances, operating conditions and events of the actual plant. This allows for an optimized system design, predictive maintenance, improved industrial asset management as well as a general improvement in the performance of the plant and its systems.

To evaluate or estimate the current status of a plant, the process industry generally relies on historical and statistical analysis methods in addition to regular inspections. This has been the standard approach for years. With the increasing use of digital twins, however, this is about to undergo a fundamental change. Because virtual replication of actual plants means that even complex systems can be monitored and analyzed in near real-time – a development that is now possible with a digital platform that combines and evaluates production and maintenance data. Based on the data, potential defects can be detected even before they occur. It is also possible to identify potential for increasing the efficiency, effectiveness and availability of the plants.

DRAWING RELIABLE CONCLUSIONS ON PLANT PERFORMANCE

"A digital twin renders helpful services throughout the entire lifecycle of a plant," says Martin Bergmann, Director Product Management & Strategy Development at Bilfinger. "What this means specifically is that unproductive times are minimized, downtimes are eliminated and costs for maintenance and servicing are reduced thanks to intelligent system design. A digital twin also allows for predictive maintenance and optimizes plant and system management."

From a technical perspective, this virtual plant model is based partly on the Industrial Internet of Things (IIoT) and simulation software, and partly on the broad use of sensors that are used for continuous



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data collection – including temperature, pressure and flow rate. The digital twin thus experiences the same things as the real plant, but virtually on a computer. "Plant operators can better assess and exploit the possibilities of the plant. In addition, they no longer have to rely on their gut feelings or strict maintenance schedules based on time intervals when they make investment or maintenance decisions. Instead, they can plan necessary conversions or repairs according to actual needs," says Bergmann.

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PIDGRAPH

AI-BASED DOCUMENT RECOGNITION

Digitization of plant documents can be extremely time and cost-intensive. Just one reason why more and more plant operators are turning to Bilfinger's PIDGraph solution, which uses artificial intelligence to recognize analog piping and instrumentation diagrams (P&IDs). The more of these documents that are scanned, the better they can be considered in the context of other plant data and thus provide the data framework for a digital twin.

Before a digital twin of an industrial plant can be created, the plant's underlying piping and instrumentation diagrams (P&IDs) must first be digitized. Until now, the relevant P&IDs had to be created again manually. With PIDGraph, this is no longer necessary because the Bilfinger software can use the existing material as a basis. The self-learning program automatically migrates the plant documents into a format that is compatible with all commercially available CAE systems.

The automation of what would otherwise be a very time-consuming task is made possible through artificial intelligence: The software scans the P&IDs as an image or PDF file, for example, and then identifies the so-called nodes and edges. Neural networks trained to recognize patterns identify the symbols that are used and puts together an overall image of the diagram. PIDGraph also remembers corrections made by the user and continuously improves its own performance.

As the number of P&IDs added to the Bilfinger solution increases, they can also serve as a basis for contextualizing other data sources that are required to build a digital twin. This means that with the help of the structure of the P&IDs, transactional data (for example from a maintenance or quality assurance system) as well as data that tends to be unstructured (including maintenance reports and shift logs) can be linked and viewed in the overall context in addition to movement data (for example from a process control system or from individual sensors). This enables plant operators to quickly navigate vast amounts of data to find the relevant starting points for a particular situation. They can then use this information to improve plant safety, optimize operations or reduce costs.

VIRTUAL INDUSTRIAL SERVICES

CONTROL FROM A DISTANCE

VPN connections offer plant operators an entire range of new options for controlling and maintaining their plants: It is no longer necessary for employees and service providers to be on site in order to access plants, components and systems. The advantages offered are many.

> “In principle, a VPN connection is nothing more than a virtual extension of the cable that connects the computer to the IT systems of the plants.”
>
> JONATHAN GIEGERICH, BILFINGER GREYLOGIX

VPN (Virtual Private Network) connections have long been a reality in many industrial companies. The advantages such connections offer, however, are seldom taken advantage of in the control and monitoring of production facilities. This is because they require the digitalization of the corresponding plants, modules and systems. And they must meet high security requirements to prevent abuse by external parties.

Jonathan Giegerich from Bilfinger GreyLogix has already set up many VPN connections for industrial customers. “In principle, a VPN connection is nothing more than a virtual extension of the cable that connects the computer to the IT systems of the plants. The technology is now so sophisticated that this also meets the strictest security standards. There is therefore no reason not to use it to control digitalized plants in the process industry,” he says.

The advantages of virtual remote access to individual plants, components and systems are obvious: Employees do not necessarily have to be on site to initiate control and maintenance processes. They can perform their tasks from any computer that is suitable for this purpose. This saves time, money and effort.

“But the benefits are much greater than that if remote access is also used to regularly check plant data and detect irregularities,” says Giegerich. “Because that also makes the recording and storage of data possible. And the data can, in turn, be used to provide guidance on maintenance and plant reliability – thus improving plant performance and efficiency.”

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PROCESS AUTOMATION

USING SMART APPS TO MAKE PROCESSES LEANER

Among the daily tasks of employees in an industrial plant is the documentation of all procedures and processes, as well as the scheduling of work – in plant maintenance, for example. To ensure that no errors occur in the process, it is important that these tasks can be completed easily and without much effort. Smart apps help to ensure that this is the case.

They enable paperless record keeping, fast error reporting and lean processes without the need to do anything twice: mobile apps that can be operated on site at the plant and that can transfer information directly to the SAP system. Bilfinger Engineering & Maintenance GmbH has developed a number of such apps in its Digital Solutions business unit. The range includes apps for efficient documentation and scheduling of maintenance work as well as for improving documentation of occupational safety.

"With the help of the apps, we provide our customers with high-quality documentation of the work performed and of occupational safety measures," says Oliver Wichmann, Head of the Digital Solutions business unit. "The greatest advantage is that thanks to the digital solutions, all data is available quickly in high quality." When developing the apps, Bilfinger places particular emphasis on an intuitive design and ease of use. This approach reduces the amount of time employees need for documentation and saves the customer money. The needs of users are also a crucial factor: "The apps are used by our colleagues around the world – and they give us regular feedback," explains Wichmann. "This allows us to constantly develop and improve them."

→

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Bilfinger HSEQ App

With the Bilfinger HSEQ app, employees can quickly and easily document occupational safety or quality-related incidents including near misses, accidents or quality deviations. The app's intuitive operation helps ensure that incidents and suggestions for improvement are actually documented.

BMC@Note

BMC@Note is a web application that allows any customer or employee to generate a qualified SAP message – even if they have no prior SAP knowledge. The app also supports the management of notifications and includes an overview of the current status as well as an option for generating orders from a notification, for example.

BMC@Check

BMC@Check makes it easier to check equipment that is subject to mandatory inspection. The app allows users to create their own checklists, specify objects to be inspected, and set inspection intervals. Another advantage: Following the inspection, an inspection report is generated and sent directly to the customer, if desired.

BMC@Work

In BMC@Work, operating employees can view the jobs assigned to them and provide any necessary feedback. All relevant work safety functions are also available. The customer can view the work performed and accept the work directly on site.

BMC@Schedule

What workers are available? What work is pending? What is the current status of an order? The graphical planning tool BMC@Schedule ensures that supervisors are always on top of things. What is special about the tool is that it allows for the integration of the BMC@Work app so that the responsible craftsman can also see directly which orders he has been assigned.

“EXTREMELY SIMPLE AND INTUITIVE”

When Markus Schröder starts typing on his cell phone in the factory hall, it is still an unfamiliar image for many of those around him. “We really had to first convince some of our customers that entering data on a smartphone is not for private purposes, but part of our job,” says the master electrician at Bilfinger Maintenance’s Düren/Hoffsümmer site. “Documenting the work performed using a cell phone is, after all, relatively rare for many of our customers.”

Markus Schröder’s team relies on the BMC@Work app in particular. Here, pending jobs can be displayed and processed. To facilitate use of the app, all team members first received a cell phone where it was pre-installed in addition to training. “Using the app is extremely simple and intuitive”, says Schröder. “As a result, the orientation period was very short. Anyone who can handle a smartphone can also operate this app after some quick instructions.”

It was much more of a challenge to set up the corresponding processes. And since the goal is to work entirely without paper within a few years, not only the BMC@Work and BMC@Check cell phone apps were introduced at the Düren/Hoffsümmer site, but also the BMC@Note and BMC@Schedule web applications at the same time. “Our vision for the future is that the customer enters messages online via BMC@Note, we convert them into orders and then enter them into the scheduling process via BMC@Schedule. From there, the orders are sent to the employees, who process and document them using BMC@Work,” says Jörg Stieglitz, who supported the introduction of the digital solutions at Bilfinger Maintenance as Rollout and Change Manager. “And ideally, we would not only like to transfer the data generated in the process into our own SAP system fully automatically, but also create a direct interface to the customer’s system so that all the required documents can be exchanged digitally.”

Until that happens, some of the processes will still require paper documents to comply with quality management requirements. But the path to paperless collaboration has been clearly mapped out: “The app already enables electronic signatures – and from both the craftsman and the customer, so we’re already moving much faster, more efficiently and more sustainably in that regard,” says Jörg Stieglitz. “And the apps have a very flexible design, so that the reports can be precisely customized to the customer’s requirements.”

> “Anyone who can handle a smartphone can also operate this app after some quick instructions.”
>
> MARKUS SCHRÖDER, BILFINGER ENGINEERING & MAINTENANCE

Markus Schröder also appreciates the tremendous flexibility of the apps. Walkarounds and components newly-added for maintenance can be created or changed with little effort. Constant updating of the app ensures that all employees have access to the current status and are informed of changes in real time. “This increases transparency dramatically and significantly reduces errors and misunderstandings,” says Markus Schröder.

The many advantages of the apps have played a major role in making the members of Schröder’s team happy about using BMC@Work. Instead of tediously filling out paper forms, they now document their work with a few clicks and can also independently enter new orders into the system. “Most employees immediately recognize how much easier things are with the app,” says Jörg Stieglitz. “And the others sometimes still need a trial-and-error phase for an ‘aha’ effect to occur. Our experience with the introduction of apps, however, has shown time and again that if you explain to employees the broad spectrum of possibilities offered by the use of apps, they soon no longer want to do without the digital solutions.”

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IMPRESSUM PUBLISHER (V. i. S. d. P.) Bilfinger SE, Oskar-Meixner-Stradde 1, 68163 Mannheim, now@bilfinger.com
EDITORIAL RESPONSIBILITY Peter Stopfer, Head of Corporate Communications & Public Affairs **CONCEPT AND REALIZATION** COMMPARK GmbH **LAYOUT** ServiceDesign GmbH

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