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The Magazine

for the Digital Enterprise

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In focus
Industrie 4.0 is becoming a reality

Industry software
Packaging –
custom made

Special
Automotive industry
in the fast lane

Contents

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Digitalization and Industrie 4.0 in practice

Dear customers and those interested in the digital factory,

At Hannover Messe 2016, Siemens will not only be showcasing new products. We will demonstrate how our core products for the digital transformation of industry, such as our Digital Enterprise Software Suite, are growing and coalescing. In this context, I would like to draw your attention to three solutions in particular.

One of the greatest challenges for industry remains that of uniting all the specialist disciplines in parallel in the same data model for each mechatronic product. At Hannover Messe, we will be presenting Integrated Mechatronics Engineering. Mechanics, electrical systems, and software, supplied by a library with mechatronics components, provide data for automation, simulation, and virtual commissioning – if required, combined with the Mechatronics Concept Designer.

The second challenge is merging product and production system development with the world of production planning and control – in other words, Manufacturing Operations Management (MOM) – in a single data model. Often, when we speak of integration we are referring to PLM (product lifecycle management) and MES (manufacturing execution system). And indeed that is another of our highlights at Hannover Messe: Closed Loop Manufacturing.

The third topic is one we had in the pipeline last year, and now its moment has arrived. With MindSphere – Siemens Cloud for Industry, we are providing the first cloud infrastructure that will allow our customers to offer services using worldwide data collated from their applications. The Internet of Things is becoming a reality.

Digitalization and Industrie 4.0 in practice: In recent years, we have invested billions and hundreds of engineers have literally worked around the clock – and now, for the first time, you can see for yourself the whole picture.

Anton S. Huber,
Chief Executive Officer of Siemens AG
Digital Factory Division

Success with sustainability

For decades, surfboards have essentially been made out of one material: polyurethane (PU). PU is a nonrecyclable material that is produced and processed using noxious, time-consuming methods. In addition, boards made of PU are not biodegradable and therefore do not decompose when they go to landfill sites. And there is evidence to show that PU boards leach into waters when they are used.

For this reason, in 2005 a group of surfers decided to completely reinvent surfboards. They changed the position of the stringers in the board, and instead of PU they used the recyclable material polystyrene (PS), which is easier and safer to process. As a result, they ended up with nimble, stable, and durable boards.

This marked the birth of Firewire Surfboards. The Carlsbad-based company's innovative boards quickly became so popular that the manufacturer could no longer keep up with the high demand. That is when they turned to Siemens and its NX design software. With the help of NX, Firewire has increased its production capacity by 20 times – while maintaining maximum flexibility to satisfy the individual needs of its customers.

Kelly Slater, the 11-time world surfing champion from the United States (photo), became such a big fan of Firewire that he acquired a majority share in the company in 2015.

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Firewire / Todd Glasser

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The future began yesterday

The digital revolution in industry is unstoppable. Companies in the manufacturing and processing industries benefit from increased productivity and flexibility and shorter times to market, thereby increasing their competitiveness. Their customers benefit from more personalized, high-quality products. And end users can order their very own merchandise, tailored to their needs. Batch sizes of one are becoming the new normal.

Technology people" – that is the nickname that Schwäbische Werkzeugmaschinen GmbH (SW) has given to its employees. This refers to people who enjoy exploring processes, manufacturing solutions, and technologies in the broader sense – not only individual machines. The term reflects a fundamental attitude: It is no longer enough to sell technologically flawless products. Customers now want maximum flexibility, short innovation cycles, and innovative business models that give them true added value.

SW has fully embraced this mind-set – and this is evident not only in the term it uses to describe its approximately 500 employees. In addition to providing personal customer advice and technologically outstanding multispindle processing centers and automation and assembly solutions, the Swabian company has won the appreciation of customers all over the world for its online services in particular.

A couple of years ago, SW also introduced an online solution to analyze machine statuses in its PULSE (Productivity and Lifecycle Services) portfolio. This allows experts from the SW headquarters in Baden-Württemberg or the subsidiaries in the United States and China to identify and solve problems online, for example, meaning that service technicians are usually not required. And if spare parts are needed, shipment can be arranged immediately. Even maintenance work can be planned with this technology according to actual needs. This significantly reduces unplanned downtime and enables maintenance work to be carried out at suitable times.

Moreover, the online tool offers an additional valuable benefit to the customer: SW can assess the productivity of its machines at the customer's site online at any time, compare it to the target figures, and, taking this as a basis, provide recommendations on how to optimize maintenance, servicing, and production processes. "Without the transparency guaranteed by such a tool, it is almost impossible to find out why the production output volume is too low or fluctuates and eliminate the cause, especially when it comes to networked machines," says Jochen Heinz, head of industrial data services at SW. "Here the cause might just as well be found in an individual machine as in the workpiece feed, for example."

The technological foundation for PULSE is the Siemens online solution Machine Tools Analytics Services. With this solution, customers can benefit from innovative services based on the digitalization of all processes and from the development of new business models.

Core components for the Digital Enterprise

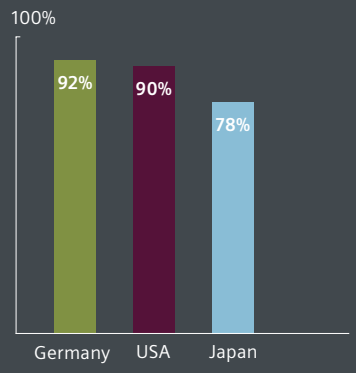
Such companies include four core areas: First, a Digital Enterprise requires industrial software solutions for end-to-end processes, from development to production and services (see page 11). Moreover, it needs an efficient communications infrastructure for networked data exchange. A Digital Enterprise also needs reliable security solutions to ensure protection of trade secrets in this networked, online world. Finally, a Digital Enterprise must offer industrial services that increase its own real net output ratio by means of digitalization.

Digitalization makes it possible to merge all stages of the value chain. The first attempts to do so occurred as early as the 1980s, in the form of computer-integrated manufacturing (CIM). At the time, however, the planned integration of computer-aided design (CAD) and computer-aided manufacturing (CAM) could not be fully carried out. "The technology simply wasn't far enough advanced for that yet," says Uwe Grundmann, European chief executive officer of the American market research company ARC Advisory Group, headquartered in Düsseldorf. "Back then, only 56 kbit/s could be transmitted over the telephone lines, which was much too slow." Today, ›

Higher turnover, lower costs

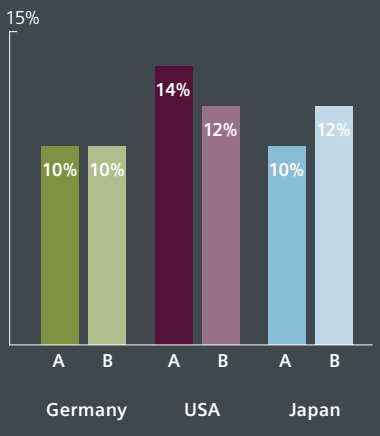
Companies expect a great deal from digitalization, as was confirmed by a recent survey of 300 companies conducted by McKinsey & Company, a global management consulting company.

"Industrie 4.0 is more of an opportunity than it is a risk"



A How much increase in turnover do you expect from Industrie 4.0?

B How much cost savings do you expect from Industrie 4.0?



Source: McKinsey & Company

speeds of up to 10 Gbits/s are possible – about 180,000 times as much! In addition, today we have much more powerful methods of capturing, transferring, storing, and evaluating large quantities of data. The technological advances have an effect not only on the volume of data (Big Data) but also on its analysis and practical application (Smart Data).

Customers drive progress

Technological progress, however, is not the only thing that drives the development of the Digital Enterprise. "Customers are instrumental in this development. They want to be supported on their path toward the Digital Enterprise and ask for the corresponding solutions and products," states Peter Weckesser, chief operating officer of the Siemens Product Lifecycle Management business unit in the Digital Factory Division.

»Plant availability is a main priority when it comes to security issues.«

Uwe Grundmann,
ARC Advisory Group

So it comes as no surprise: "Short time to market is becoming increasingly important," affirms Weckesser. Achieving this requires holistic, digitalized processes. Furthermore, customer needs are becoming more individual and have to be met flexibly. "Our target is a batch size of one. At Nike, for example, customers can have their names stitched onto their athletic shoes in the factory," Weckesser reports. In the end, it is about increasing productivity, making more efficient use of human resources and machines, and reducing the consumption of energy and raw materials.

3D printing is gaining ground

The new possibilities offered by 3D printing will make a significant contribution toward more individualized, flexible production. 3D printing, based on CAD files, can create components out of metal, plastic, or ceramics that, in the past, were not possible to make or could only be manufactured with great effort. This printing method will be particularly successful in creating small batches of products that need to be light but very strong and that must be delivered quickly because their design undergoes constant changes – for example, in the aerospace or automotive industries.

For the Porsche 919's steering system, for example, components will be printed and subsequently finished in the same machine by the supplier. From concept to manufacturing, it used to take several weeks to produce such components. Today, this can be done in only a few hours. Airbus uses 3D printing to produce supporting components out of titanium for its A350 model. In the past, these parts had been milled out of aluminum and weighted 30% more.

Because factory digitalization inevitably goes hand in hand with powerful communications infrastructures, IT architectures need to change as well. From a bilateral, hierarchical exchange of information, the trend is moving toward broadly networked, distributed systems.

The five stages of the Digital Enterprise

Digital Enterprise operations can be subdivided into five stages: product development, production planning, production engineering, production execution, and services. But unlike in traditional approaches, these stages are seen as a holistic, fully integrated system instead of a chain of processes in chronological order. All the relevant data are captured, transmitted, and analyzed in each stage, and also in all interactions among the stages.

Already from the very beginning, during product development, innovations must be designed, tested, and modified digitally. Long before the first physical product comes into being, the developers have already created a digital twin. With this twin, virtual tests can be performed to determine whether and how the product works. Ideally, designers will not need to make any further changes to the real end product. "The goal is that the first prototype built is already fit for sale," explains Weckesser.

This digital approach also stretches to production planning and production engineering, because even production can be completely planned with digital means – all the way to the virtual ›

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Schwäbische Werkzeugmaschinen GmbH (SW) is developing a digitalization strategy. Jochen Heinz (left), head of industrial data services, and Peter Siegel, initiator of online services at SW, belong to the digitalization team.

»Industrie 4.0 opens up possibilities for new customer relationships«

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Interview with Peter Weckesser, chief operating officer of the Siemens Product Lifecycle Management business unit in the Digital Factory Division.

The vision of Industrie 4.0 is based on a digital value chain – from product development, production planning, and production plant design to production and customer service. Is the data stream aligned to these stages of the value chain?
Peter Weckesser: The value chain has many interactions between all stages – the data stream is not aligned to them. Customer service passes customer requests on to development. Production planning receives information on improvements in the production sequences. Production collects data that help increase the precision of production planning and production efficiency.

Does the digital value chain go beyond the company itself?
Weckesser: Industrie 4.0 enables completely new customer relationships. Here, Siemens offers Lifecycle Analytics, an analysis software solution for predictive remote maintenance. With this software, manufacturers can access and evaluate operational data that can help them improve their products.

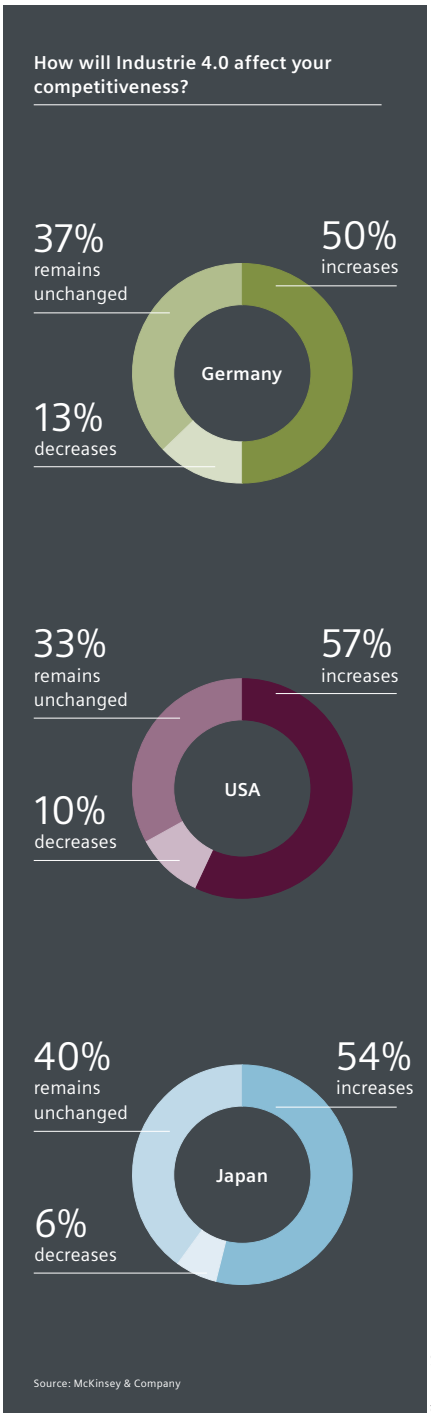
Development, production, and service often work with very different IT systems and data sets. How can this problem be solved?
Weckesser: Indeed, a consistent, shared database is indispensable – for example, our software solution Teamcenter. As a collaboration platform, it serves as the basis for all programs and tools used in our Digital Enterprise Software Suite that are compatible with each other during the entire lifecycle of the product. In the development stage, this includes the software programs from our product lifecycle management portfolio with which new products can be developed and optimized virtually. This includes, for example, our Tecnomatix development software and the NX CAD tool. In the actual production phase, our automation tools, such as Totally Integrated Automation (TIA) in combination with TIA Portal, come into play to allow all automation components to work together.

What can you tell us about software compatibility once the products are with the customer?
Weckesser: In this phase, it is mainly about the services, which should provide considerable added value to all those involved. We are therefore now introducing a further development of our existing and time-tested solutions for online services: the open platform MindSphere – Siemens Cloud for Industry. In the context of Big Data, industrial companies can use this platform to offer their own digital services, for example, in the area of predictive maintenance, energy data management, or resource optimization. This can also lead to innovative new business models.

Many companies use control systems and software solutions created by other manufacturers with their machines. How do you intend to better reach out to these companies?
Weckesser: Together with a connector box, MindSphere can also be used for devices and control systems from other manufacturers. Compared to the proven online tools used today, MindSphere offers the additional advantage that the platform is designed for larger data volumes and the data can be made available in a more user-friendly and comprehensible way. In this sense, the solution provides immediate added value to the management level as well.

How secure is this cloud technology?
Weckesser: The MindSphere platform has strong encryption and offers the greatest possible protection against cyberattacks.

In manufacturing, 3D printing is an important topic for the future.
Weckesser: It is also an important topic for Siemens. These manufacturing methods can be integrated into our software environment. We recently initiated a pilot project with one of the major machine tool manufacturers that uses laser melting to produce solid metal, 3D workpieces. ■



commissioning of a new plant or an entire factory with all its production processes. And as soon as the specifications for a new product are available, for example, computers can create the bills of materials for the required parts and components themselves.

When the product goes into the manufacturing stage, the design data are seamlessly transferred to production in the Digital Enterprise. That may seem obvious, but in practice things can often be very different. Since many software solutions are incompatible, the data usually need to be printed out and then keyed in again manually. This is usually a complex and also error-prone process.

Finally, digitalization includes all the services that help the customer achieve maximum productivity, reduce operational costs, and generally get the most out of the delivered product. This usually goes hand in hand with new business models and customer relationships (see interview on page 9).

Just like at SW, machine manufacturers have an online link to the delivered devices and plants, from milling machines and wind power turbines to jet engines. This makes it possible to automatically gather, transfer, and analyze the operational data to monitor the machines. It also enables preventive maintenance and servicing before the machines become damaged and malfunction.

The challenge of data security

Process digitalization and the disclosure of data to service providers entail security concerns. Without cybersecurity, many strategic concepts of the future will fail to gain traction, emphasizes the German Electrical and Electronic Manufacturers' Association (ZVEI, Zentralverband Elektrotechnik und Elektronikindustrie), which has set up its own working group on the topic. Although many security technologies in various industries are already working quite well, these often cannot be applied to other sectors. "For example, when it comes to IT issues, financial service providers are mainly concerned with data security. In industrial companies, on the other hand, plant availability is the main priority," explains Grundmann. These two very different premises require different solutions.

SW has demonstrated how many of the challenges of modern industry can be solved with digital solutions. Currently, the Swabians are working on the next evolutionary stage of digitalization. "We want to create full digital transparency for our machines using the new IoT platform MindSphere. Of course, we are talking about a completely different scale than what we are used to when it comes to data volume," says Heinz. However, that takes time and the involvement of customers with respect to the requirements they have regarding the data and the necessary security when handling them. "You cannot simply impose such a strategy on existing processes. It has to become a central component of product development, manufacturing, and services," explains Heinz.

It is an effort that in theory will pay off for SW, but also for others. For one thing, it opens up new service and business model possibilities. For another thing, effective digitalization strategies are of vital importance for one very important factor: the future viability of the company itself and that of its customers. ■

↗ **siemens.com/future-of-manufacturing**
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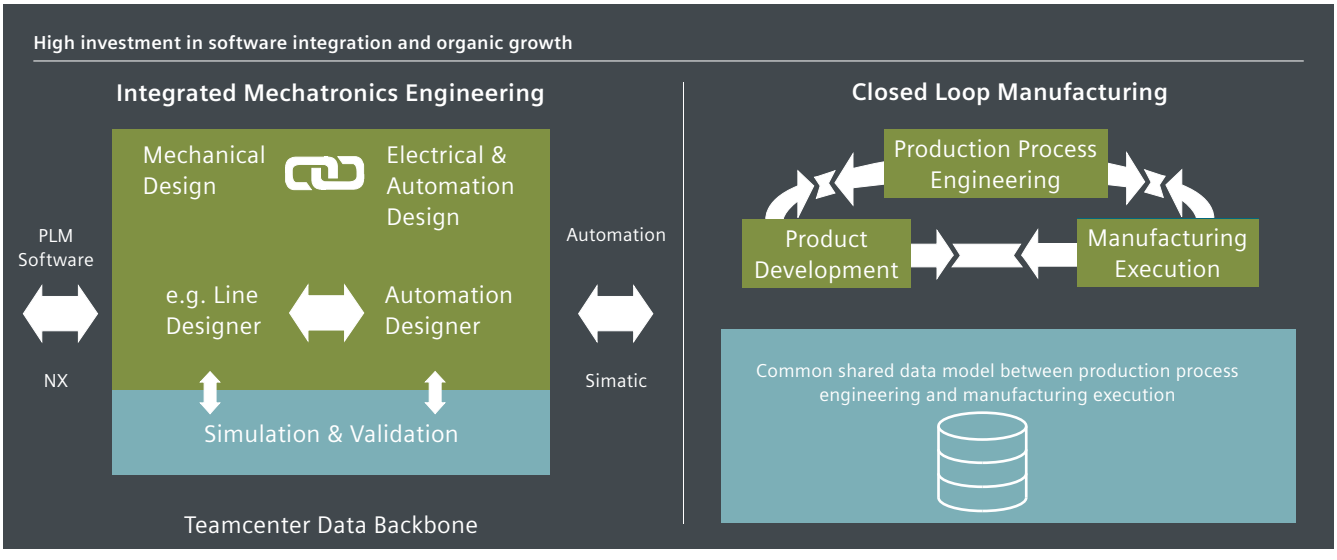
Industrie 4.0 is becoming a reality

In recent years, Siemens has invested a great deal in the integration of software that companies can use to digitalize their value chains. The results are the focus of Siemens' presence at this year's Hannover Messe. Three topics will draw visitors' attention above all: Closed Loop Manufacturing, Integrated Mechatronics Engineering, and MindSphere – Siemens Cloud for Industry.

Those who have followed the discussion regarding Industrie 4.0 and the Internet of Things in recent years have not always had an easy time separating the wheat from the chaff. What is talk only and what is actually feasible? What exactly will intelligent industrial value creation look like? Siemens does not have all the answers. But now the company is offering solutions that address central challenges facing industry during its digital transformation – solutions that allow customers to start the implementation step by step, with quickly noticeable results.

One of the greatest challenges – as all experts agree – is overcoming the format discontinuities between the main areas of the technical value chain: between the engineering of products, the associated planning of production systems and processes and the production execution itself. All this supported by an efficient coupling of the technical value chain with the relevant commercial processes. This challenge calls for a solution so urgently because Industrie 4.0 simply does not work with the isolated IT solutions that are customary today. At its core, this vision counts on the future development and manufacture of even highly complex and smart products, customized to individual customer wishes, at almost the price of mass production. How is that supposed to work if it takes weeks to find out where the requested product can be manufactured with what adaptations?



However, this is the level of technology today: With CAx – at Siemens with NX – product models are developed whose data ultimately lead to a parts list, known as a bill of materials. Then machines, equipment, and plants are developed for the production (all the way to the simulation of production and of the material flow) with systems for digital manufacturing – at Siemens with Tecnomatix. The result is a digital process description, called a bill of process. With product lifecycle management (PLM) software – at Siemens with Teamcenter – these data can be linked and the connections kept up to date. However, the data regarding the product structure and the operating machinery and equipment describe only the theoretical process. The actual control of a certain machine or production line requires more.

Starting with the order planning, the specific requirements for an individual order now need to be linked with the technical data. And they need to be supplemented by vendor parts and plant-specific data, including the layout of the plant. This is the job of the manufacturing execution system (MES), which speaks a different language from the technical systems of engineering. In many cases, it is necessary to reenter data and program processing steps.

Closing the value chain

With Closed Loop Manufacturing, Siemens is now offering a single data model that saves numerous processing steps and allows for a bidirectional flow of data. The data available from the PLM system can be used directly for controlling the specific production line. And the data from production are available to engineering.

It is precisely this data consistency that creates the preconditions for fulfilling the requirements of Industrie 4.0. Within minutes, it is possible to find out whether and where a product can be manufactured exactly as ordered and, if changes to previous products or processes are necessary for this, how quickly and at what price they can be made – because the data from production at all sites can be called up centrally to be matched with engineering. And once the order is placed, it can be executed with an automatic trigger from the enterprise resource planning (ERP) side in no time at all and at minimal cost. The NX, Tecnomatix, Teamcenter, and

Flexible and cost-efficient filling of cosmetic products at the production of Dr. Kurt Wolff GmbH & Co. KG. A multi-carrier system plays an important role, and the Mechatronic Concept Designer has been implemented to aid its development.

Simatic IT systems are all involved in the Closed Loop Manufacturing data model.

The cause of the second challenge faced by the digital transformation of industry is found in another format discontinuity: Today, all the specialist disciplines needed for the development and manufacture of smart manufacturing plants work with different systems and data models. The 3D model of the mechanics is not compatible with the logic schematic of the electrical systems. The behavior model of software development does not know any of the engineering details of the mechanics and electrical engineering. When a simulation model exists – created, for example, by Process Simulate – then its data are not usable for other models without additional processing.

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Siemens has now ensured that the software tools involved in Integrated Mechatronics Engineering understand each other. And the approach goes even beyond that.

Multidisciplinary items from the library

Whether in general machine building, machine tool manufacture, or a production facility, many components have been unnecessarily reinvented again and again. Now a mechatronics library of components and modules such as motors, drives, valves, pumps, and other parts can be developed that contains the detailed information from all the disciplines involved. The elements can now be easily imported as finished parts in the development of a machine because the data are centrally managed in Teamcenter. And since even automation with TIA Portal understands this language, engineering data can be used directly for the generation of PLC software and virtual commissioning. This integration eliminates data reentry, but more importantly it eliminates interfaces and their maintenance, which have historically cost a great deal of time and money. This is the automation of engineering in the literal sense.

Of course, the processes and procedures within the company and with suppliers also change with this simplification. The implementation of these new processes must therefore not be confused with the implementation of an IT project. But it is exactly these kinds of changes to operational processes that characterize the transformation into a Digital Enterprise. In the long run, it is precisely these changes that will distinguish a company from competitors that have shied away from the cost and effort of the transformation or that do not consider it necessary.

The situation is similar with regard to the third topic that Siemens is focusing on in its trade fair appearance in Hannover this year. Quite a few company executives, above all in Germany, are very cautious when it comes to the industrial use of cloud technology. This is surprising, because virtually everyone agrees that already in the medium term there will be no getting around it, if data from industrial processes are to be used for a wide variety of services via the Internet. Several companies are therefore working on implementing solutions such as predictive maintenance and intelligent logistics systems. With the consent of the customer, machines, mechanical equipment, and other products will be linked with the Internet and their data collected and analyzed.

Not every company can set up its own cloud for this, and not every cloud platform is suited for industrial applications. Security – of data, but above all of processes – is one of the challenges that differ significantly from those of clouds used for personal communication or e-commerce. In addition, the issue of real-time capability is defined completely differently in the industrial context as opposed to personal use of the Internet. In the control of a production facility, network interruptions lasting only a millisecond can result in damage worth millions. In using a browser, they do not matter.

This is why Siemens has decided to offer its customers a secure cloud infrastructure. Initially, this infrastructure is available as MindSphere – Siemens Cloud for Industry, based on SAP HANA. Additional platforms are to follow.

Siemens' trade fair appearance in Hannover signifies a break this year. From the discussion of the future possibilities of a Digital Enterprise, a large step has been taken toward the merging of digital and real processes, with the Digital Enterprise Software Suite. The investment of a great deal of effort in the integration of crucial IT components now differentiates Siemens from other suppliers. ■

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Data platform for the Digital Enterprise

Processing large volumes of data is especially important for networked companies with software-based production, also known as Digital Enterprises. With the open MindSphere – Siemens Cloud for Industry platform, there now is an inexpensive, virtualized data management system available.

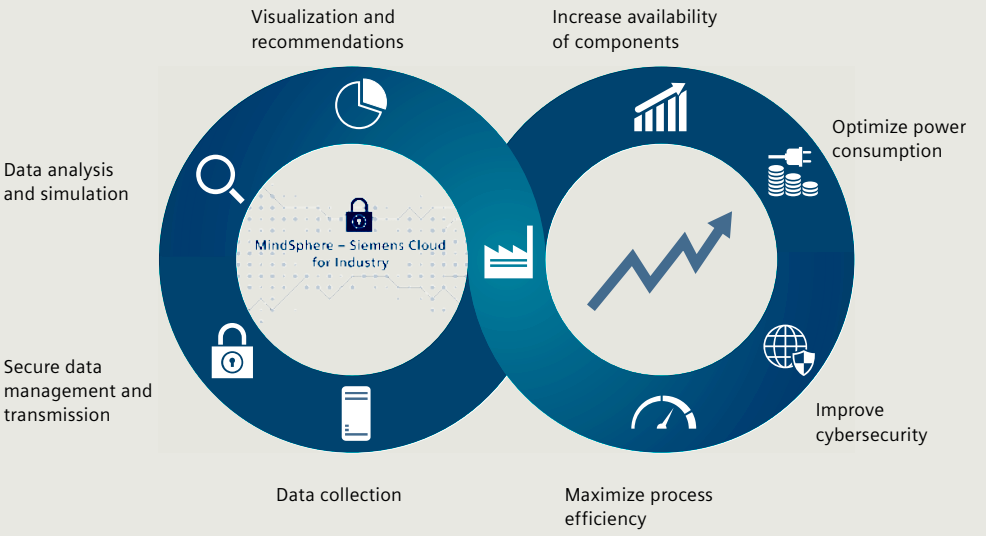
Reducing cycle times, increasing flexibility, enabling individualized mass production, and minimizing the consumption of energy and resources – these are the challenges manufacturing companies face today. To remain competitive, they need to improve their entire value chain, from design and production planning to engineering and services. This also means that in order to make the right decisions early, a vast quantity of captured data ("Big Data") must be analyzed, and it must be determined which of all these data are truly necessary.

MindSphere – Siemens Cloud for Industry brings real production into the virtual world. First, all company data defined by the customer are collected and transmitted to MindSphere at determined time intervals. Then the data are analyzed, and those that are relevant for optimization are made available. These Smart Data make it possible to increase production efficiency and tap the full potential of the plant.

Open cloud with many possibilities

Because MindSphere has been conceived as an open IT ecosystem, it is not only possible to exchange data outside the company itself, but the system can also link to a wide variety of products. "Open standards and interfaces make it possible to obtain data from industrial devices from a wide variety of manufacturers and analyze them in MindSphere with their own algorithms – for example, for online monitoring of machine tools that are distributed all over the world," explains Dr. Florian Beil, head of technical sales and mobilization at Siemens. This means that manufacturers, especially

From data to added value



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»MindSphere helps customers to generate added value with data and is the basis for providing digital services.«

Dr. Florian Beil,
Head of Technical Sales and Mobilization, Siemens AG

machine and plant manufacturers, can develop and offer new digital services – for example, in the areas of predictive maintenance, energy data management, and resource optimization. Because the system is open, customers and developers can develop apps, known as MindApps, and make them available in the cloud. The currently available beta release already includes the Fleet Manager and Visual Analyzer MindApps, which help users connect their machines to MindSphere, configure them, and read out and visualize the data. The data can be saved in either a public, private, or internal cloud, depending on the availability each user needs.

Reliably capturing and analyzing machine data

But how do the data get to the cloud? MindConnect Nano ensures good, manufacturer-independent communication between machines and plants and MindSphere. "MindConnect Nano relies on standards such as OPC UA and Siemens' S7 protocol. In the future, this function will be integrated into all communication-capable products in our portfolio," says Beil. The Simatic IOT2000 intelligent gateway will offer an additional means of communication. After being captured, the data are made available in MindSphere, which uses the same technology as the SAP HANA cloud platform. Beil explains: "We deliberately chose the SAP HANA cloud platform for MindSphere because with the partnership between SAP and Siemens, industrial customers can easily get started with the Internet of Things. I am sure that with MindSphere, we have found the perfect answer for the consolidation of information technology and operations technology."

Guaranteed data protection

For Siemens, it goes without saying that only the most advanced security and encryption technologies are used when it comes to capturing, transmitting, storing, and processing data, and the company has also made additional efforts to guarantee data security. For example, data are hosted on German servers in the SAP server farms, where the same strict security and data protection standards apply to all customers. An on-premise solution is even envisaged for the future. With this solution, the data remain on each customer's company premises and are processed in MindSphere from there. Finally, with Plant Security Services, Siemens offers holistic solutions that help minimize risks. In addition to these technological measures, it is also important to the users of MindSphere, whether plant operators or machine manufacturers, that whoever creates the data also owns them. Only the creator of the data can decide which data are transferred to MindSphere and who has access to them.

Future potential

"MindSphere helps customers generate added value with data and is the basis for providing digital services. This makes MindSphere an essential component of the Digital Enterprise Software Suite. Siemens is continually expanding the platform and driving digitalization in industry," says Beil, summing up the potential of the open cloud. ■

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Quick and flexible

Sollas wrapping machines are suitable for wrapping exquisite perfume and lotion boxes in a glossy film and also for sealing in the precious aromas of tea and cigars.

Packaging – custom made

Sollas wrapping machines quickly and flexibly wrap luxury goods in a protective film. Together with Siemens, the Netherlands-based packaging specialist develops modern drive solutions that combine sophisticated motion control functionality with the greatest ease of operation.

»Troubleshooting the drives via Profinet takes the place of the ear on the mechanism, as it were. This can be done directly at the control panel of the machine, as well as in the control room and, on request, also online.«

Dirk Verbeek,
Technology and Engineering Manager, Sollas

The packaging determines the appearance of a product and is a crucial factor in its success. Packaging machines by Sollas, a company based in Wormer near Amsterdam, give luxury goods a protective outer shell. They wrap exquisite perfume and lotion boxes in a glossy film and seal in the precious aromas of tea and cigars. The customer list of the Dutch packaging specialist reads like a who's who of the cosmetics industry, as well as the luxury foods, alcohol, and tobacco industries. The quality requirements for the wrapping machines are correspondingly high. The requirements for the speed and flexibility of the machines depend on the respective products and the customer's willingness to invest. There are also regional differences. With a machine portfolio that includes various levels of price and performance, the Dutch packaging specialist is successful all over the world.

Speed and flexibility make the difference

The technical term Sollas uses for the machines is "full wrapping machines." They wrap up to 120 cardboard boxes per minute while allowing for product changes on the fly. Up to 17 servodrives work in coordination so that even at these speeds, extremely thin film does not tear and every fold and heat seal point is positioned with absolute precision. This requires expertise – not only on the part of the manufacturer but also on the part of the operator – and that comes at a price. Not all customers require this kind of speed and flexibility, and the investment does not pay for every product line.

This is why Sollas also offers significantly simpler solutions. For example, machines in the lower performance range are interesting for contract packers. They are operated on a stand-alone basis and do not need to adjust to the high speed of an entire production line. This is why in principle, one servodrive is enough to gently transport the film; the remaining axes can be coupled mechanically according to the main shaft principle via an asynchronous main drive. Sales director Tobias Eggermont says, "The speed of innovation in this performance class is,

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nevertheless, just as great as in the high-end segment. Currently, it is characterized by the trend toward servo technology."

Servo technology drives innovation

Servomotors are becoming ever more compact and at the same time more efficient. In addition to a higher dynamic range and precision compared to asynchronous motors, they make it possible to reduce the number of components in the control cabinet, resulting in an overall more compact solution that is easier to maintain. Dirk Verbeek, technology and engineering manager at Sollas, says, "If we equip not only the film transport but also the main drive with a servodrive, we eliminate additional position encoders – after a malfunction or changes in manual mode, the position of the drives can be read out from the program at any time." Sollas implements this machine design with the Simatic S7-1200 controller and two Sinamics V90 servo drives connected via PTO (Pulse Train Output). This allows the machine to wrap about 40 boxes per minute.

Higher speeds can be achieved only through an additional separation of the axes, meaning that additional servodrives would be needed. Eggermont explains: "We meet the highest customer requirements with the Simotion motion control system. Scout TIA has proven itself as the perfect tool for configuring shared drive solutions and complex interpolations for our drive specialists. However, this cutting-edge technology also requires certain expertise on the part of the customer when it comes to maintenance.

"This is why we are very pleased that the Simatic S7-1500T now offers a control for the medium performance range that combines demanding motion control functionality with a high ease of operation."

User-friendliness is the decisive factor

Together with Siemens, Sollas will present the solution as a pilot machine at Hannover Messe. The new Simatic S7-1500 T-CPU is used as a control system here. The "T" stands for "technology." The firmware of these CPUs has sophisticated technological functions such as synchronized operation and cam discs. These are made available as technology objects in the system. The major advantage is that these technology objects are programmed with Step 7 in TIA Portal with PLCopen commands. No additional tools are needed. With the integrated cam disc editor it is possible to predefine splines in accordance with the VDI 2143 standard. Wizards increase ease of use when it comes to drive configuration. A runtime simulation allows the user to test the system behavior ahead of time, thus accelerating commissioning. For Eggermont, the focus is on the benefits for the

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»The trend clearly is toward an increased use of servo technology and synchronized axes – but it is only the option of being able to control this technology with familiar means that creates the confidence to really use it, too.«

Tobias Eggermont,
Sales Director, Sollas

operator: “Motion control functionality that is integrated into TIA Portal via Step 7 means that the service engineer can stay within the familiar software environment characterized by PLCopen standards. There is no need to acquire specialty knowledge in addition to the PLC know-how that is present in any production facility anyway, and no additional tools are required either. For us, this is an important competitive advantage, especially for customers that operate internationally. The trend clearly is toward an increased use of servo technology and synchronized axes – but it is only the option of being able to control this technology with familiar means that creates the confidence to really use it, too.”

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The packaging machine shown in Hannover has a Simatic S7-1500T as well as seven Sinamics V90 servo drives with Profinet and Simotics S-1FL6 servomotors. The pusher unit serves as the master axis. The film conveyor, the underflap folder, and the sealing bar are synchronized with the pusher unit. An additional increase in speed is possible with the Individual Product Transport system, which is powered by two servo-axes. It separates the products, thus ensuring that there is no bottleneck of products.

Profinet – one bus system, many advantages

The Simatic S7-1500T communicates with the Sinamics V90 servo drive system via Profinet IRT. This ensures the highest levels of dynamic range and precision, which are optimally transferred to the mechanics through the new Simotics S-1FL6 low inertia servomotors. Verbeek explains the technological possibilities of this plant configuration: “Wrapping machines that meet high speed requirements (approximately 50 packages per minute) can already be realized with four synchronized servo-axes. The new Sinamics V90 servo drives that are connected to Profinet enable the implementation of modularly expandable drive solutions. The bus cable replaces the separate wiring on the control side in this process, resulting in significant time savings and eliminating the potential for wiring errors.” The performance of the S7-1500T has enough reserve capacity for additional options. Therefore, with an S7-1500T, upstream or downstream units such as conveyors or stackers can be integrated into the automation system. At the same time, the integrated communication via Profinet supports especially efficient diagnostics. Verbeek says, “Troubleshooting the drives via Profinet takes the place of the ear on the mechanism, as it were. This can be done directly at the control panel of the machine, as well as in the control room and, on request, also online.” This makes the machines ready for the possibilities of the digital factory.

TIA Portal – the portal for integrated motion control solutions

Many customers operate Sollas machines on multiple lines. The integration of the automation and drive solutions into TIA Portal now makes it possible to choose the best solution in terms of both price and performance, whether with the Simatic S7-1200, the new T-CPU of the S7-1500, or Simotion. The basic knowledge for operation and maintenance only has to be acquired once, and expansions or upgrades can be carried out with very little effort, thanks to the integrated Profinet communication, the performance of the S7-1500, and the option of distributed drive solutions with the Simotion motion control system. ■

↗ **siemens.com/packaging**

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Automotive industry in the fast lane

Bernd Mangler, who is vice president of Solutions at Digital Factory and therefore also responsible for Siemens' solutions for the automotive industry, explains to us what exactly digitalization means for the industry and how Siemens is supporting this step.

Mr. Mangler, what does Siemens mean by digitalization in the automotive industry?
Bernd Mangler: There are four cornerstones that are necessary for digitalization. The first is consistent data flow from the design of the product to the design of production, the engineering of production, the business operations themselves, and the necessary services – or, in other words, the continuous value chain throughout the plant's entire lifecycle. Then there is what we call the digital shadow or twin: an up-to-date digital image of the product and the production plant that is available throughout the entire lifecycle. I call the third cornerstone the "transparent plant," which means that there are defined KPIs [key performance indicators] that are the basis for optimization, Big Data analyses, or even predictive maintenance. The final cornerstone is horizontal and vertical integration, which means that the shopfloor will be horizontally connected by Ethernet networks and that the worlds of the shopfloor and IT will converge vertically to a great degree.

What significance does digitalization have for the industry?
Mangler: Today, the automotive industry, which includes car manufacturers as well as their suppliers, is the most competitive industry and also is very capital-intensive. Digitalization supports faster and more efficient processes despite growing demands. If you look at the huge number of combination possibilities that a client has when ordering a car today, it becomes clear that the production processes are highly complex. Digitalization makes this complexity significantly more manageable, meaning that digitalization is an efficient assistance system for automotive production. The digital twin addresses the idea of achieving peak production immediately after starting up the plant. Everything has already been built, tried, and tested in a simulated environment, excluding production errors from the onset. The digital shadow also provides information that influences the design of other models and further increases the plant's flexibility.

What are the greatest challenges for the industry during digital transformation?
Mangler: First, the automotive industry has to change its way of

thinking, from "best of breed" to an overall view of the entire process chain, and also to the consideration of a plant's lifecycle. Only then will it be possible to leverage untapped potential. In addition, we need a clear picture to show which of the vast amounts of existing data are really needed, when and where the data are needed, and how to make these data accessible. I see the third challenge as the systematic and disciplined implementation of standards – the foundation of digitalization.

How far has the automotive industry come in terms of digitalization, and what would promote further progress?
Mangler: Compared to other industries, the automotive industry is the most advanced. I am convinced that the next step must deal with the interfaces between the individual domains, as all interfaces make the process prone to errors. The main issue will be the need for a data backbone – a consistent communications or innovation platform. We use the Teamcenter PLM software. Within the context of interfaces, we are also working very intensively on the Integrated Mechatronics Engineering. It connects the mechanical design process to the electrics data so that programs for the PLC [programmable logic controller] and corresponding E-CAD layouts can be generated automatically. We therefore also offer a virtual control with which we can test the complete program together with the plant simulation.

»Digitalization makes complex production processes significantly more manageable.«

Bernd Mangler,
Vice President of Solutions, Siemens DF

Siemens AG / A. Kradisch

What specific advantages does digitalization offer for the automotive industry? Could you give us some examples?
Mangler: This is something we are very familiar with. Many of the things we need already exist in the automotive industry. For example, Volvo Cars was able to halve its engineering costs by using Tecnomatix to plan and simulate its production lines. The Japanese car manufacturer Nissan managed to almost halve its development time for a new vehicle by using our NX CAD software in combination with Teamcenter. We will be presenting further examples together with other industry leaders at the Automotive Highlight Cube at Hannover Messe.

What can Siemens offer an automotive company on its way to becoming a Digital Enterprise?
Mangler: Siemens has built a portfolio that already enables our customers to integrate important parts of the product and production lifecycle and digitally supports their entire value chain. We call this the Digital Enterprise Software Suite. It consists of our PLM portfolio for design, planning, and simulation; the Totally Integrated Automation (TIA) portfolio for production engineering; and our manufacturing execution system (MES) portfolio for ongoing operations. Teamcenter acts as a collaborative platform. Another important aspect worth mentioning here: digitalization must take place on the shopfloor – and include the hardware. With TIA Portal and our new generation of control systems, we create the preconditions allowing the data that are available in the machine and the control system to be reloaded into an analysis tool with defined mechanisms, so that the plant operator can check the condition of the plant's individual components in order to intervene proactively. We also provide the corresponding analysis tools or applications, of course.

What will the automotive industry look like, say, 10 years from now, and how will Siemens provide support in the future?
Mangler: The automotive industry is on the brink of yet another monumental innovation drive. In the next 10 years, electric mobility will revolutionize the structures and production methods as we know them today, for example, by using lightweight materials or improved drives architecture. Collaborating robots and flexible transportation systems will break down the rigid structures of today's factories. Changes in social behavior will also need to be addressed, for example, the question of whether people will want to own their own car or only rent one by the hour or the day, and the increasing significance of connectivity and autonomous driving. We at Siemens Digital Factory will closely follow any developments that might influence production processes in the future. Together with our customers, we want to use our experience to actively shape the process of change. ■

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Energy-efficient conveyor technology

For the first time, car manufacturer Volkswagen has equipped the transport lines of a new production facility with the new generations of distributed frequency inverters and motor starters by Siemens. This makes the conveyor technology especially reliable and saves energy.

Volkswagen has been producing the eighth-generation (B8) Passat station wagon and sedan at the Emden factory since mid-2014. The body shop comprises an area of about 63,000 square meters. It was constructed on 5,100 poles extending up to 24 meters down into the ground. About 3,300 of them are "energy poles" used to cool down water used for cooling the welding plants. The water heated up through the waste heat is fed into the building heating before being cooled down again via the energy poles.

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The transport line with vehicle carriers for the body-in-white

»The main requirement of the conveyor technology: It must run continuously and reliably without redundancy in order to not affect the highly automated, dynamically timed production sequence in the body shop in any way.«

Hanno Wübbena and Dennis Watermann,
Production planners in the VW factory in Emden

Transport of body-in-white and body parts

VW set up extensive transport lines on two levels overlapping the set-up stations and welding lines for conveying and buffering the body-in-white and body parts. The transport line for the body-in-white on the first level has a length of about 4.5 kilometers and currently holds 550 vehicle carriers, called skids. The body-in-white lines are transported on these skids between the various processing stations. The car bodies can be coordinated and tracked using the VW manufacturing, information, and control system combined with radio-frequency identification (RFID) technology. The skid roller conveyor also serves as buffer during break times and in case of any failures. One level above, the body parts – floor, front, and side parts – are made ready in a labyrinth of about 8 kilometers of monorail lines (Electric Monorail System) and moved to the correct processing station just-in-sequence. The vertical link between the levels is made by 27 lifting/lowering stations that move the body-in-white on skids from the buffers onto the processing level and vice versa.

Availability of 99.5 percent

The main requirement of the conveyor technology: It must run continuously and reliably without redundancy in order to not affect the highly automated, dynamically timed production sequence in the body shop in any way. VW requires an availability of 99.5%. This also applies to each individual drive in the conveyor systems and lifters. At the same time, the manufacturer places great value on energy efficiency in all areas – emphasizing higher resource efficiency, reduced emissions, and increased use of regenerative energy at all locations.

Here, the conveyor technology has been equipped with distributed frequency inverters and motor starters. Where higher speeds of up to 140 meters per minute or high accuracy in rapid traverse mode/creep speed mode are required in the final positions (for example, in cross chain conveyors, lifters with a laser measuring system, and readers), modular Sinamics G120D frequency inverters with outputs between 0.75 and 7.5 kW are built in. There are more than 630 devices along the skid roller conveyor and another 30 in the monorail lines. Where motors need to be started from standby mode and stopped again easily, quickly, and energy efficiently, Sirius M200D motor starters are installed. They are predominantly built into the roller conveyors, with an output of 0.75 kW throughout. Both device types are connected in the transport lines with Simogear geared motors. The Simogear line covers all the customary drive types – cylindrical gear, bevel gear, offset gear, and worm gear – and is installation compatible with common standard motors. The Integrated Drive System (IDS) integrates the drivetrains into every application and into every automation environment, across the entire lifecycle of the plant. This is why the standard motors are designed for operation with inverters and motor starters; on-site adjustment is not necessary, notably accelerating the commissioning of the entire drive solution.

Rapid switching between devices

Both inverters and motor starters are available with Profinet interfaces, which allows them to be quickly and easily integrated into the production network and connected to the appropriate controller as well as the production planning and control system. This ensures automatic and real-time diagnostic and error messages, both locally and centrally. The inverters are modular and consist of a power module and a control unit. The connecting lines have plug-in terminals. Together, these features accelerate the changeover between devices, especially since the configuration can be optionally and automatically saved on an SD card located in the control unit and then moved from one device to another.

Additional energy savings are achieved in the body shop through a dozen-plus lifters. Here, the braking energy generated during the lowering of the body is fed back into the power supply system and is thus available for other loads. The usual braking resistance does not apply. ■

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Perfectly coordinated

A renowned manufacturer of mechatronic products relies on radio-frequency identification (RFID) technology with IO-Link readers and heat-resistant transponders. The readers reliably control the components' path in the modularly designed assembly of power electronic components for premium-class electric vehicles.

Zollner Elektronik AG is among the top 15 mechatronics service providers worldwide for electronic manufacturing services (EMS). With over 9,000 employees, Zollner implements customized mechatronic solutions. Customers include, for example, leading companies from the automotive, medical technology, and telecommunications sectors.

At its headquarters in Zandt in Bavaria, the company produces and assembles power electronic components – the electronic heart – for a well-known electric vehicle series. Zollner has a 2,200 m^2 clean room where it hosts the printed circuit board production using surface-mounted technology (SMT) or through-hole technology (THT) as well as the module assembly and final assembly, plus various testing stations. Zollner has chosen a modular design for the lines throughout, with independently controlled stations. These stations can be flexibly used and then easily modified for continued use. Reliability and a long service life as well as the availability of spare parts were important factors when selecting all components.

RFID technology contributes to the perfectly coordinated process flow across various manual and partially automated workstations. Crucial factors in the choice of the Simatic RF200 system in the IO-Link interface variant plus MDS D160 mobile data storage were the simple connection to the module controllers, the low system costs, and the high temperature resistance of the tags, which is critical during the casting of the completed electronic components.

Consistently verifiable quality

In total, there are about 100 reading points in module assembly and final assembly to control the production flow and to directly document every work step in overlaying databases. "Quality is the top priority, which has to be fully documented and traceable across all processes," says Bernhard Kist, director of marketing at Zollner. As both costs and effort must remain competitive, the company selected the Simatic RF210R reader with integrated IO-Link functionality from the HF range. These readers enable a connection to any controller that is compatible with the IO-Link standard. The control system employed by Zollner provides

Zollner Elektronik AG

Simatic RF210R readers (left) in the IO-Link version control the modules' path. The MDS D160 mobile data storage device is resistant to temperatures of up to 175°C

Zollner Elektronik AG produces and assembles complete power electronic components for premium-class electric vehicles

the right IO-Link master module for this purpose. No RFID-specific programming is required, which makes replacement easier.

The screw-type readers with integrated antennas automatically deliver the data read by the transponder – at a distance of about 10 mm when standing still – in this case the unique identification number (UID) of the given workpiece carrier. The UID is "married" to the base module of the power electronics at the beginning of the line and helps identify the component at every station, initiate the necessary work steps via the controller, and display work instructions for the worker at manual workstations. Relevant production data are immediately written to the database. In this way, track-and-trace data are collected, documented, and archived. Alternatively, any user-defined data from a predefined storage area can be read and processed. The data appear in the process image of the controller as soon as there is a transponder within the reader's range.

Easy assembly

The compact and rugged HF readers in protection class IP67 use the radio interface protocol of ISO 15693 and can read and write all mobile data carriers that conform to the standard. In the casting plant, the transponders are exposed to a temperature of 100°C for at least 20 minutes. "Not all transponders are capable of doing that on a continuous basis, and at a low price to boot," explains Andreas Meidinger, the responsible electrical and software planner.

There is one component that is able to do this easily – the MDS D160 mobile data storage device. This ISO-compliant, hardened transponder has been designed for use at temperatures of up to 175°C. It has proven its worth in industrial laundries and other thermally demanding processes and applications. Zollner installs the chip-shaped transponders in plastic spacers, which are affixed to either the bottom or side of the circulating workpiece carriers. Two workpiece carrier variants each are in use for the charger and DC/DC converter assemblies – a simple one for thermally uncritical stations and one for increased temperatures for casting only. A robot automatically relocates the assemblies.

Proven in practice

Since the end of 2012, Zollner Elektronik AG has been producing power electronic components without any failures or errors. The chosen RFID combination consisting of reader and transponder has proven its worth in daily operation and is now also being employed or specified for many other assembly systems. According to Meidinger, "In this instance, support from the supplier was not necessary, since all components are easy to use and – thanks to the IO-Link standard – can be integrated into a wide variety of controllers." ■

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In sync with the real world

The digital factory requires new approaches to planning, implementation, and control of both production and logistics. Automated identification via radio frequency identification (RFID) is the key factor for synchronizing digital systems with actual conditions.

Markus Weinländer

Simatic RF600 readers can be commissioned within just a few minutes, even in complex industrial environments

In the context of the digitalization of factories, every step of the value chain is planned, simulated, controlled, and monitored with efficient IT systems. This, however, only makes sense when all participants in the value chain have been integrated – creating a network of collaborating manufacturers and service providers whose division of labor results in the production and delivery of a product.

At this point, automated identification, and especially RFID, comes in, because the more complex the IT systems are, the more precise the synchronization with the real world needs to be. However, for the comprehensive use of RFID, several technological aspects must be kept in mind in addition to the standardization of symbolization and classification of the identification numbers across companies.

The right transponder

One important issue is selecting the right transponder. So-called closed-loop transponders, which allow the RFID data medium to be reused, can already be ruled out from the start due to the complex return process that would arise with multiple partners involved in the value chain. However, if the transponders remain permanently on the product, the mounting location must meet the requirements of both the production engineers and the RFID technology. In automotive manufacturing, for example, there is no position that can be used continuously from the start of production until delivery. Some stations must be controlled without this transponder. It may sometimes be possible to mount a second transponder or use the proven bar code.

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The digitalization of the factory affects all aspects of the value chain

Mechanical, thermal, or chemical stresses must also be taken into account. For example, high temperatures or pressures occur in various production processes, such as during the production of injection-molded plastic or carbon parts. From a process perspective, it would be desirable to have the transponder integrated into the workpiece – making it a "smart product." But such transponders would need to be ruggedized, which affects costs. The mounting of the transponders can also increase costs.

As a leading manufacturer of industrial RFID systems, Siemens offers a special tag customizing program and develops specific transponders for the respective areas of application. These tags are characterized, for example, by suitability for high temperatures or with a special mount. The relatively low cost for this customization can often be recouped through higher availability or faster mounting on the product.

Required: fast commissioning

There are also new requirements for RFID readers. For a large rollout, hundreds of readers may need to be set up. In this process, it is especially important that the commissioning take place quickly and smoothly – in other words, by employees who do not first need to go through RFID training lasting several days.

With the new Simatic RF600 readers, Siemens solves this problem through a number of automated algorithms, such as for the control of the transmitting power, for the independent selection of the antenna polarization for each reading process, and for filtering out overshooting. As a result, should ambient conditions or the tag-equipped products change, the reading points will still deliver reliable results without requiring a revision of the parameters or a reorientation of the antennas. Only an RFID reader that has sufficient intelligence and power reserves can handle the typical everyday changes in factories.

Efficient commissioning functions support the rapid determination of the correct parameters and the orientation of the antennas, allowing the readers to be set up quickly. No special software is required for the set-up; a standard browser suffices, thanks to the web-based management. As a result, readers are often ready for operation within just a few minutes, even in difficult environments.

Integration into the IT environment

A third key consideration is the integration of the RFID system into the IT environment. In the context of the digital factory, the readers will need to communicate not only via fieldbuses with the programmable logic controllers (PLCs), because in addition to the production control, the logistics systems, planning programs, and enterprise resource planning (ERP) need the information gathered through RFID as well. This is why, for example, the RF600 readers offer several interfaces and protocols in one device. Many companies are working intensively on preparing their production and logistics processes to deal with future challenges. Digital planning, implementation, and control of these processes is the key to increased flexibility and productivity. RFID as a core technology is ready to enable the synchronization of central processes with their digital depiction, even beyond company boundaries. ■

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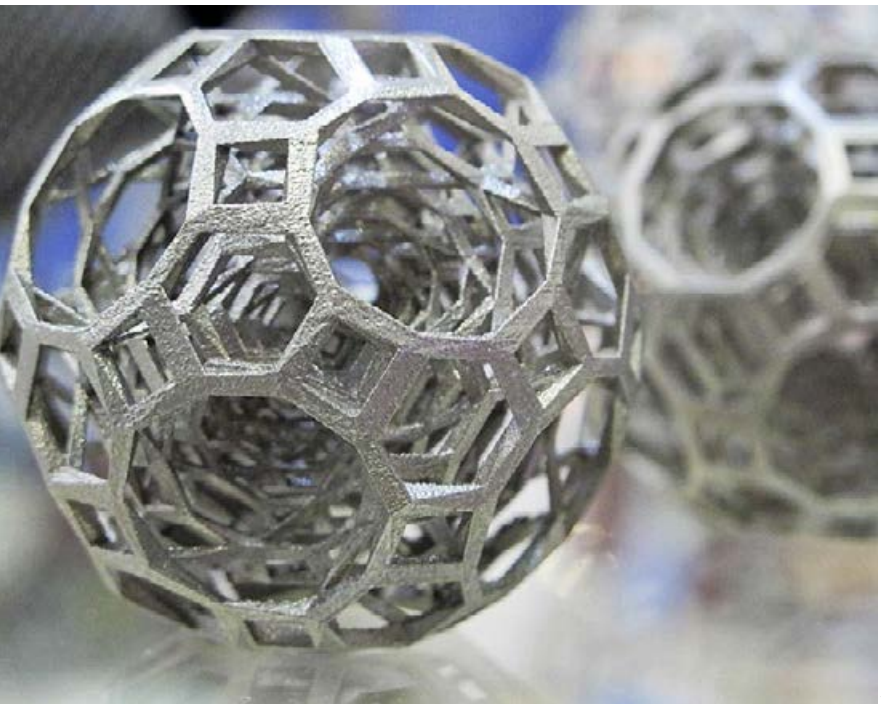

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From the CAD model to the finished product

In additive manufacturing, digitalization is a fundamental prerequisite. Three-dimensional physical objects are manufactured directly from a 3D CAD data set by layering material. The industrialization of additive manufacturing, however, is still in its infancy. Siemens has made this innovative new technology fit for industry.

The development of additive manufacturing (AM) began in the mid-1980s. At that time, these types of generative processes were used for rapid prototyping, among other applications. Since then, in the form of 3D printing, AM has reached nearly all sectors, even private use. However, not all AM processes are the same. Today, there are different types of procedures for different applications.

Layer by layer, the sky is the limit for designers

All these procedures have one thing in common: the workpieces are created layer by layer. Examples of this method are powder bed fusion, directed energy deposition, and material extrusion. AM allows for workpiece geometries that conventional manufacturing methods cannot handle. With AM, highly complex structures can be created from high-quality materials in a single process, while guaranteeing light weight and at the same time a high level of stability. Examples of this are spiral shell shapes and turbine blades with irregular cavities.

The material quality, stability, and low weight of the products, as well as the completely new design possibilities (freedom of design), make this process especially interesting for lightweight construction and bionic structures – for example, in the aerospace and automotive industries but also in medical technology.

Competitive advantage thanks to AM

AM creates innovative new products with special properties that can provide companies with significant competitive advantages. One of the added value factors of AM becomes evident in the design stage: already in the development process, all the steps can be checked immediately with rapid prototyping, making it possible to quickly and easily adapt the product to customer-specific requirements or technological chal-

lenges. In the production stage, no complex equipment and/or special tools are required – which is a great advantage for single-piece or small-batch production in particular. Because highly complex structures can be completed in a single step with this new method, no subsequent assembly steps are necessary. And spare parts handling becomes much more efficient in many cases, as it can be done in-house (spare parts on demand).

This has paved the way to industrialized AM. But even today, manual intervention is still necessary in many steps, for example, in the material feed or to separate the workpieces from their carrier plate. The integrated production automation of AM machines and their upstream and downstream processes (horizontal integration) is as important as meeting industrial standards, for example, for detailed order planning and control, automated order assignment and monitoring, and monitoring of the machine parameters. In addition, the documentation and traceability of the material flow and the production processes are a prerequisite for manufacturing certified products. These capabilities have yet to be established for industrial AM machines.

How can AM be industrialized?

Compared to its competitors, Siemens is much more advanced in its development and use of AM. Some of the company's business divisions are already using this technology. Siemens is also the only company to offer a systemwide software and automation solution for AM.

This makes it possible to implement AM-specific product designs and simulations using the NX PLM software (one of the leading CAD/CAM/CAE software packages). Integrating data storage in one platform, Teamcenter, ensures data consistency. This becomes particularly apparent if changes are made based on a parts simulation, for example. Such changes no longer require time-consuming conversion and implementation, as is often the case with traditional production methods. In addition, there is no risk of losing data during data conversions. On the contrary, NX enables highly efficient and accurate designs for AM parts.

For machine and downstream process automation, Siemens offers the scalable and integrated portfolio of the Sinumerik and Simatic automation systems. The TIA Portal engineering framework also allows for highly efficient engineering and maximum flexibility.

Detailed order planning and control, allocation of the required parameters, and traceability across the entire process chain are provided using software modules from the MOM (Manufacturing Operations Management) portfolio. MOM is a holistic solution that makes manufacturing processes fully transparent, allowing them to be continually improved. As an extension of a manufacturing execution system (MES), MOM makes it possible to determine many kinds of production sequences for the entire system, for example, quality management, workflow planning, nonconformance management, asset management, and so on. MOM systems are the core element that connects PLM and automation in real time.

With its integrated portfolio for production process automation and digitalization, Siemens possesses the know-how required to drive the industrialization of AM forward. Here, the close cooperation between research, development, and application creates the ideal base for the rapid advancement and optimization of the Siemens portfolio. ■

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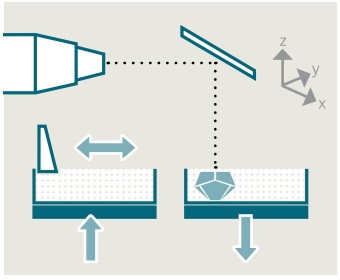
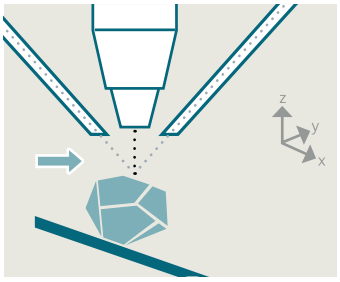
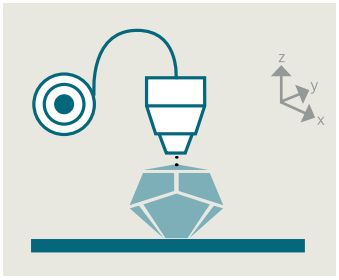


Powder bed fusion:
The laser beam melts the powder on the powder bed precisely in accordance with the provided CAD data, fusing the defined parts to the layer below



Directed energy deposition:
Metal powder is directly applied to the welding point, where a laser melts it



Material extrusion:
A thin plastic strand is melted and applied layer by layer

One step ahead

QuadTech upgraded its critical Product Tracking System for highly complex printing systems to the latest Simatic S7-1500 with WinCC Professional using TIA Portal to keep ahead of the industry's evolving demands.

Modern, high-speed printing requires presses that are highly automated and adaptable to perform a wide variety of jobs as economically as possible. As one of the industry's leading printing companies, QuadTech's parent company Quad/Graphics' expertise includes books, catalogs, direct mail, directories, journals, packaging, publications, and retail inserts. On the floors of Quad/Graphics' many printing plants around the world are huge, capital-intensive integrated printing presses with typically complex, end-stage material handling devices.

QuadTech's mission is to develop and support advanced, technology-based systems to ensure the highest quality and largest economical output. One of these systems is the QuadTech Product Tracking System (PTS). It tracks waste events that happen anywhere in the printing process and discards the product in question. Secondly, it provides count data for all in-process printing products. Since 2000, QuadTech had been using the Simatic S7-300 series PLCs in the PTS for its automation, monitoring, and control. In 2007, the company switched to the Simatic WinCC SCADA platform for the HMI. In 2010, Quad/Graphics became a publicly traded company, and today its facilities have increased six-fold, with many different legacy printing systems, which required the PTS. A retail insert business that produces high-volume color flyers for major retailers needed to implement duplex systems in which two side-by-side presses run either independently or together as one system.

Upgrade opportunity

QuadTech saw this as an opportunity to rethink and reengineer the PTS. It was particularly timely, given the debut of the Simatic S7-1500 PLC family with advanced features, modularity, and scalability.

During the rethink of how QuadTech could provide the intelligence behind the PTS monitoring and control system, the company wanted a single, modular code set that could handle every type of press and printing need. It also sought to reduce the amount of Statement List (STL) code and envisioned converting most, if not all, of the PTS code to ladder logic. In addition, QuadTech wanted to take advantage of the latest and most advanced PLC hardware and software available. To accommodate Quad/Graphics' growth, the scalability of the PTS could be further increased to rapidly expand its capabilities as needs evolved. To do so, the PTS had to become easier to install, use, and troubleshoot. QuadTech thus anticipates a lower total cost of ownership (TCO) over the PTS lifecycle thanks to the cost- and time-saving benefits brought about by achieving these goals.

Migration with no disruptions

As the next-generation PLC for the QuadTech PTS, the company specifically chose the Simatic S7-1516-3 PN/DP controller. For the main PLC rack, it combined the PLC with a CP1543-1 Ethernet module, a 32DI digital input card, a 32DO digital output card, and two high-speed counters. One counter supports up to two press encoders; the other monitors gas and ink levels. Within the S7-1516, one Ethernet connection is used for HMI communications, while the other is used for Profinet I/O. A Profibus connection links the PTS to legacy systems. The separate CP1543 Ethernet module communicates with Quad/Graphics' company-wide data collection system.

The main PTS operator interface uses a locally sourced industrial PC running Microsoft Windows 7 and Simatic WinCC Professional. The PC connects to a Simatic ITC 1900 display – a 19-inch, industrial, thin client. A Simatic TP700 Comfort Panel is also used as the PTS inspection station.

Simplified engineering

The migration of the S7-300 instruction set to the S7-1517 PLC was straightforward thanks to the Siemens Migration Tool. TIA Portal was instrumental in creating a single code-set that could adapt to all of Quad/Graphics' differing press installations. To do this, several key features of TIA Portal were used, including its Global Libraries, Integrated System Diagnostics, and the web server. In summary, TIA Portal reduced weeks of programming to days, if not less. For example, integrating alarms into the code

The capabilities of QuadTech's parent company Quad/Graphics include books, catalogs, direct mail, directories, journals, packaging, publications, and retail inserts

Fotolia / Goss Vitalij

may have previously taken as much as two days, but now only requires a few seconds of checking a couple boxes in the programming interface.

Importantly, 90% of the S7-300 code that had previously needed to be written in STL was converted to ladder logic. QuadTech was also able to make the code as modular as possible while still simplifying it. In the process, the S7-1500 code is much easier to install, use, and troubleshoot in the field. This was enabled by the increased memory and speed of the S7-1500 hardware, the optimized block access, and the ability to use indirect addressing of arrays.

Ready for the future

The cornerstone of the case for migrating to the S7-1500 platform has been the savings in development time, thanks to TIA Portal with its advanced features, integrated diagnostics, and modular scalability. These advantages will continue providing dividends in years to come, along with easier installations and updates. Technical support calls have been reduced.

A big part of the cost-justification is better waste management that will save about $50,000 per press each year. This is a result of more precise counting, which minimizes over- and under-runs, when a waste event occurs. This not only saves paper but also prevents landfill. Another source of green savings is energy. The new S7-1500 reduces the standby idling of the scores of one-horsepower motors, which are components in each press that keep products moving.

QuadTech is looking forward to many years of smooth operations as it deploys the PTS in more Quad/Graphics plants around the world. ■

90%

of the S7-300 code that had previously needed to be written in STL was converted to ladder logic.

Better waste management will save about

$50,000

per press each year

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Siemens AG

A digital 3D model provides efficiency advantages of up to 65% to machine tool manufacturer Kapp Niles

Ensuring advantages

Beginning from the idea of using simulations and function-oriented developments in machine building, a German machine tool manufacturer has been pursuing the concept of “virtual commissioning” in collaboration with Siemens. This has given the company quite a few competitive advantages.

»We are relying on systems engineering and want to move away from the classical sequential approach.«

Albert Fischer,
Head of Order Management, Kapp Niles

Testing potential problems with the mechanics, fluidics, electric systems, and software on a functional digital 3D model before building the real machine accelerates the new development of machines with customized designs. Most importantly, however, it reduces the time required for actual commissioning thanks to initial tests carried out during virtual commissioning. The development of such a digital machine model alone is already a great efficiency gain for the German machine tool manufacturer Kapp Niles.

The company produces machines and tools for the fine machining of gear teeth and profiles in Coburg and Berlin. Its customers come from a wide variety of industries, including automotive and commercial vehicle manufacturers and their suppliers; aviation companies; and manufacturers of compressors, pumps, industrial drives, wind turbines, and rail technology. Kapp Niles's goal is to realize both newly developed machines and commissioned designs even more efficiently and flexibly.

Competitive advantage: time to market

This is why five years ago Albert Fischer, mechanical engineer and now head of order management at Kapp Niles, asked himself: How can we develop new machines and significantly shorten time to market using simulations based on functional and mechatronic approaches? Then, two years ago, the breakthrough came in collaboration with Siemens, in the context of virtual commissioning. A 3D model prepared using the NX PLM software from Siemens serves as the basis for the creation of a functional model of the machine using the Mechatronics Concept Designer (MCD). MCD enables easy modeling and simulation, allowing alternative mechatronic development concepts to be available already at an early stage in the project so they can be checked while the costs are still low.

The functional model of the machine knows the characteristics of all the components and therefore knows, for example, the purpose of every sensor, the voltage it delivers, and where the signals go. A particular advantage in this process is the fact that the digital model of the real machine is created virtually during the development process according to the principles of systems engineering. This means that no significant additional effort for virtual commissioning is required. Combined with Sinumerik, a strong solution is now available for virtual commissioning: hardware-in-the-loop simulation.

Competitive advantage: commissioning time

Now Kapp Niles can commission its newly developed products virtually. "Today, we can test the functionality of our software ahead of time in the office and don't have to wait for the fully assembled machine anymore," Fischer explains. "With this approach, we know whether all the processes are functioning as desired already very early on in the development process – before the real machine has been completed." This enabled the company to almost halve the time needed for actual commissioning. The time savings for commissioning are estimated to be around 50% to 65%.

Kapp Niles is committed to working toward having a digital model of every machine that the company plans to make in order to accelerate the overall process from custom design to commissioning to later conversions and extensions at the customer's location. The next project phase also includes plant engineering.

Competitive advantage: future viability

The company is convinced: "Now is the right time to pursue these ideas. Those who wait another five years will miss the boat," says Fischer. And this is not the end of the initiative. In the future, digital integration will also accelerate the development process. "We are relying on systems engineering and want to move away from the classical sequential approach," he continues. "Instead, we are working toward an extensive parallelization of the development steps – from mechanics, fluidics, electric systems, and PLC programming, all the way to commissioning and integration at the customer's location." In his estimation, it should be possible to reduce engineering time by up to two-thirds through digitalization. ■

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Paper industry redefines itself

The paper industry is currently facing the greatest transformation in its history – a process in which digitalization has played and will continue to play a key role.

Today, digitalization is a double-edged sword for the paper industry. On the one hand, digital media are progressively replacing paper and threaten the traditional market for newsprint and office paper, which is shrinking by about 5% per year. On the other hand, digitalization offers great opportunities to increase production efficiency, fulfill high customer demands, and grow in new market segments – for example, in the markets for toilet tissue and packaging, but also for chemicals and textiles made of innovative fibrous materials. These changes are forcing the paper industry to reposition itself as a "fiber industry" with innovative products and business models.

Increased competitiveness and sustainability

Additional key success factors for this transformation include the unchanged high quality of the final product, conservation of valuable resources such as water and wood, and production processes with maximum flexibility. At the same time, these production processes must also be sustainable, because in this capital-intensive industry, investments in new production technology are amortized over several decades. The industry's varied and complex requirements require well-thought-out approaches that address both planning and operation in order to enable holistic management of the entire lifecycle of the plant.

From integrated engineering to integrated operations

For this reason, Siemens bases its solutions on a combination of integrated and perfectly coordinated drive systems (Integrated Drive Systems, IDS) and continuous digitalization with software solutions that capture, exchange, and document all relevant data. Because these data are available in


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Toilet tissue line equipped with drive and automation technology from the Sipaper portfolio

real time in a centralized location, plant owners can use the virtual copy of the plant that was created during engineering (the "virtual twin") to simulate, optimize, or even reproduce commissioning, operation, and maintenance processes. This transition from integrated engineering to integrated operations will enable the paper industry to reduce time to market, increase the flexibility and efficiency of its plants, and ultimately change the future of the entire industry. ■

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Digitalization of the Paper Industry 4.0 was the central topic at the 17th European Paper Week in Brussels organized by the Confederation of European Paper Industries (CEPI) in November 2015. We asked Bernard de Galembert, innovation and bioeconomy director of CEPI, what the industry thinks about digitalization.


CEPI

Bernard de Galembert

Mr. de Galembert, what opportunities do you think digitalization can offer the pulp and paper industry in general?
Bernard de Galembert: Like any industry, in particular in Europe where deindustrialization has been significant over the last decades, the pulp and paper industry sees in digitalization an opportunity to improve its competitiveness and profitability through better productivity, reduced costs, better market response, agility and adaptability, and further reduced environmental impacts.

What are the advantages of data-driven manufacturing for your member companies?
de Galembert: It might be too early to state what the advantages would be, since the sector still needs to further embrace digitalization, but one can guess: better control of plant operations, better stock preparation and fitness for purpose, reduced wastage, improved energy efficiency, faster and smarter maintenance, etc. In other words, from the forest to the consumer, digitalization would allow for better control, more efficient and leaner manufacturing, and better response to consumers' needs.

What stage is the European paper industry currently at with regards to digitalization, and what are the fundamental challenges for achieving a wider implementation?
de Galembert: While one can see some integration of digitalization in the paper sector in Europe, like for example with smart equipment, more use of RFID chips along the supply chains, connected products, and data-driven energy optimization systems, still more awareness-raising activities are needed to promote the opportunities and benefits and lift some of the myths and misunderstandings (e.g., security of IT, data privacy, etc.).

What are the next steps and how can technical suppliers like Siemens assist?
de Galembert: The uptake of digitalization in the sector will most likely be facilitated by examples of successful implementation in some of the members companies, but also in other sectors. Enabling conditions, be it at the national or European level, including through the establishment of funding opportunities, would also be a prerequisite to the development of data-driven manufacturing in Europe and in the paper industry. In that context, the Digital Economy initiative of the EU will have to be designed right. Siemens is a traditional supplier to the paper industry and a pioneer in Industrie 4.0. As such, it is very well placed to further promote the benefits and opportunities of digitalization and provide examples of success stories. ■

Fit for the future

The digitalization of production facilities is a central requirement in process automation. The huge volumes of data and information must be recorded, analyzed, and used. This is the only way to ensure efficient lifecycle engineering and plant management.

The Simatic PCS 7 process control system lays the foundation for this operational efficiency with an integrated data model. But in addition – through simulation, virtualization or mobile applications, remote maintenance, and remote services – the process control system also maximizes energy efficiency. The new version of the Simatic PCS 7 process control system, Version 8.2, offers increased user-friendliness, performance, and efficiency.

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With Simatic PDM, plants can be monitored via a standard web browser from mobile terminal equipment or any plant computer

When it comes to greater efficiency in engineering ...

... the new Logic Matrix enables the efficient switching of interlock statuses of even large-quantity structures and mass data thanks to automated switching rules. Calculations and comparison functions of the step sequences are now carried out centrally in the SFC (sequential function chart) editor. This allows processes to be analyzed more quickly, and errors can be significantly reduced.

Intuitive plant control and mobile plant monitoring ...

... is now possible through the new measuring point browser. With this browser, individual measuring points can be found quickly and easily, along with the corresponding plant information. In the group view of the measuring points, operation becomes more intuitive and efficient for plant personnel, and more importantly, recurring operating sequences are simplified. In addition, the operator can easily compile trend curves for a quick overview of the process in the control station using the new Operator Trend View.

Important production figures and information on trends or alarms can be displayed on smartphones or tablets, irrespective of the operating system. For this purpose, the integration of mobile terminal equipment for plant monitoring has been expanded. With the Simatic PDM process device manager, diagnostics, maintenance, parameterization, configuration, and commissioning can also be performed via a standard web browser, either using mobile terminal equipment or any plant computer.

Load management and cost control

When it comes to efficiency, the focus is also on energy and minimizing peak loads in the power supply. With the new version of Simatic PCS 7, all the energy-relevant consumption data of the entire plant can now be monitored – for example, including those of the drives, whose relevant data are already integrated into the technology library.

Cost-effective operation requires the continuous optimization of costs across the entire plant lifecycle, all the way to expansion and modernization. Now, analyses and specific exchange and update tasks can be planned more quickly via the Simatic Management Console, with an inventory of all components and all version statuses available at the press of a button. A software update service (SUS) supports the use of the new Windows 10 operating system on the control system and ensures that it is always up to date with very little effort. ■

↗ **siemens.com/pcs7**

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Winner in efficiency

Meanwhile, reluctance motors are establishing themselves increasingly as an energy-efficient and economical alternative to asynchronous and permanent-magnet synchronous motors. The extension of the performance range of these drives is therefore only logical.

In the range between 0.55 and 30 kW, and with additional shaft heights between 80 and 112 mm, new application areas are constantly opening up for the drive series with synchronous reluctance technology. Examples include pumps, fans, and conveyor technology in which permanent-magnet synchronous motors would be uneconomical.

The significantly higher efficiency levels at the nominal point of the Simotics GP/SD synchronous reluctance motors pay off above all in the partial load range when compared to similar asynchronous motors with an efficiency class of IE4. Their thermal load limit offers more leeway and enables a high power density at considerably reduced losses. Wherever short cycle times are required for maximum productivity of machines or plants, the lower moment of inertia pays off, for example, during the fast ramp-up and deceleration times of the synchronous reluctance motors. The Simotics reluctance motor can even be overloaded up to twice its nominal load for a while – a significant advantage, especially for changing motion sequences.

Perfect team

For an integrated synchronous reluctance drive system, the Sinamics G120 inverter is exactly matched to the Simotics reluctance motors for speed changes via the vector control designed specifically for reluctance motors. Together, the motor and inverter form an innovative standard drive system with the highest energy efficiency at all operating points. In addition to the high controlling dynamics from standstill, high control dynamics in sensorless operation, as well as low system costs resulting from perfectly matched power modules, all Siemens drive systems are characterized by already integrated special energy efficiency functions such as Profienergy and Eco mode. All data required for higher-level energy management are available.

Integration into TIA Portal

All electrical data for the reluctance motors are stored in the control unit of the inverter and can be transferred automatically from the motor nameplate to the inverter via a motor code. Only data such as the cable resistance or the inertia of the drive system are still entered manually.

Both the Simotics reluctance motors and the Sinamics G120 inverters are integrated into TIA Portal. With the aid of the Sinamics Startdrive commissioning software, which is also integrated into TIA Portal, it is possible to reduce engineering time by 30%. Maintenance and servicing are also not a problem – for example, exchanging a rotor in a reluctance motor is just as easy as in an asynchronous motor.

Conclusion: With their special advantages, the Simotics reluctance motors are perfectly suited for applications that require high operational safety and availability together with lifecycle-cost optimization. ■

↗ **siemens.com/reluctance-drive-system**

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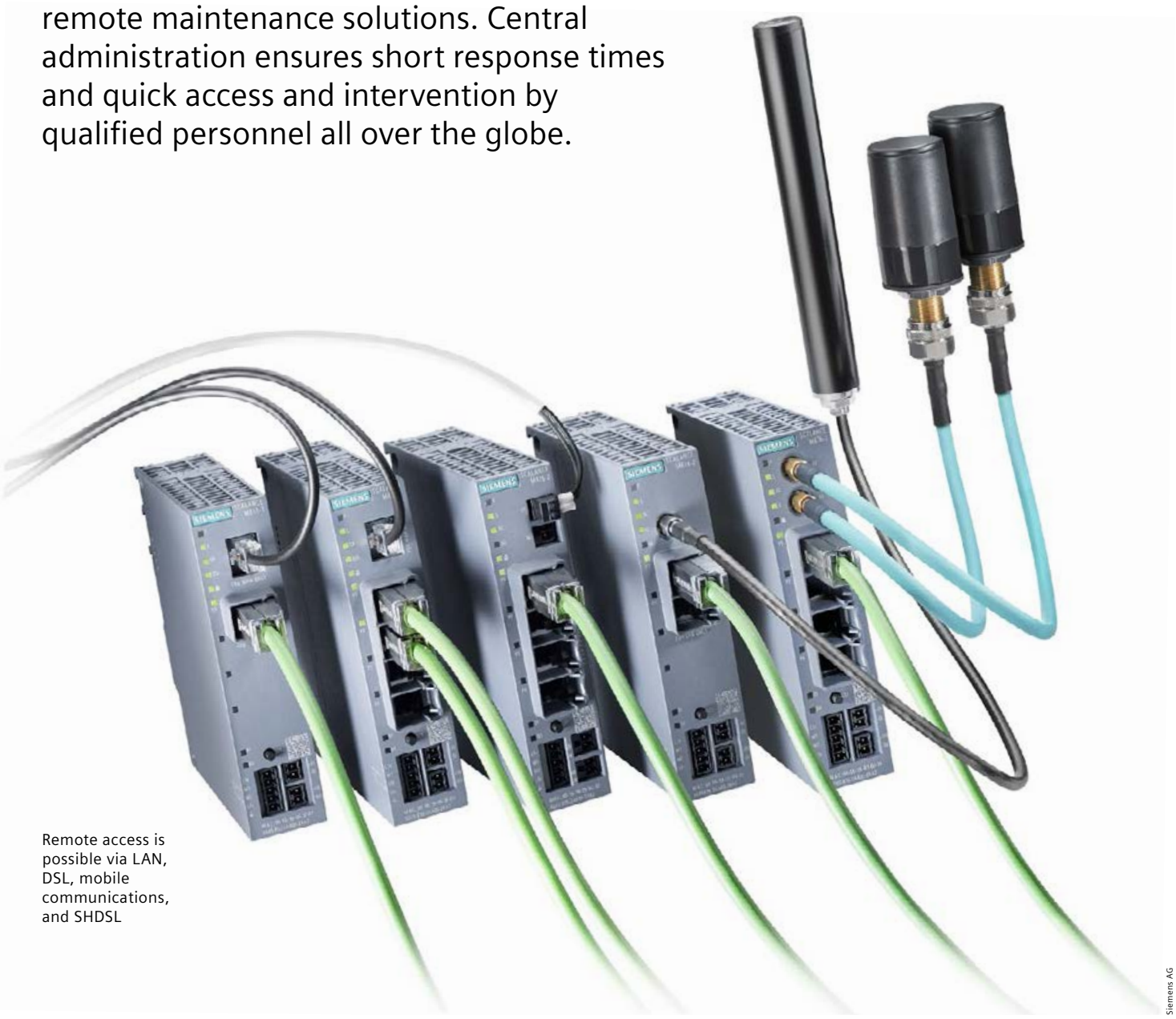
Simotics reluctance motors with aluminum housings cover a performance range between 0.55 and 30 kW and achieve high efficiency levels, especially at the nominal point and in the partial load range

Quick and secured remote maintenance

To further increase the availability of ever more complex plants and systems, enterprises are increasingly opting for remote maintenance solutions. Central administration ensures short response times and quick access and intervention by qualified personnel all over the globe.



Remote access is possible via LAN, DSL, mobile communications, and SHDSL

Siemens AG

High availability and minimal downtime are essential for enterprise production sites, which are often spread around the world. In particular, smaller locations often face the challenge of having no qualified service staff available on-site. To provide high availability for plants and machines at these sites as well, quick and cost-effective support via remote access is recommended. Today, widely distributed plants can be reliably and securely maintained from a distance via IP-based communication – via DSL lines, mobile communications networks, or private lines. In addition to industrial routers that are perfectly tailored to the needs of the automation industry, Siemens also offers a server application for easy administration of remote access networks, the management platform Sinema Remote Connect.

Central administration of end points

Teleservice and remote maintenance must be easily manageable and secured. Special software acts as a central management platform for settings and groups and makes it possible to intuitively set and administer worldwide access points. This makes it clear who is communicating with whom. The keys and certificates of the virtual private network (VPN) tunnel connections can be easily managed and always kept up to date. Log information, backups, and firmware updates of routers are also handled via the management platform. Routers connect plants and users via the software through secured VPN connections.

Sinema Remote Connect allows configuration of networks, end points, and OpenVPN connections via one clear user interface. It is supplied as a software appliance and can be operated either by a machine manufacturer or OEM itself or by a trusted partner. Dedicated hardware or a virtual environment can be used as a platform.

Once installed, the Linux-based system offers a web interface that can be accessed using many common browsers and via which a secured connection between the end devices and the server can be intuitively configured. The connection between end device and server is implemented by an industrial router such as the Scalance M876-4 LTE. Over a secured https connection, the server address and user data of the Scalance M876-4 LTE can be used to initiate the VPN connection, which is necessary to exchange the required certificates.

Other devices can be created accordingly and can be easily allocated to groups, with the appropriate communications rights assigned to them. In this way, a communications network of machines and plants is created via a central server and access to it is secured. The connection is generally initiated by the machine, that is, by the industrial router, so the plant operator in the field always has control over his or her machine's connection to the Internet and to the Sinema Remote Connect server.

Secured remote access for service staff

Service engineers also need secured access to the relevant machines and systems. The clear management of certificates and licenses in one central location offers many options for reducing the effort and, as a result, the response times in case of remote access requests.

Users can be created and administered in the server's web interface just as easily as devices. Users can also be allocated to various groups and their communications rights set. Secured user access is implemented via an OpenVPN client. The easiest solution to use for this is the Sinema Remote Connect client, which is included in the basic package.

A highlight is the address book function, which offers a very convenient solution for creating secured connections to serial machines by activating 1:1 network address translation (NAT). Plants with the same IP configuration on the machine side can be clearly identified in this way.

Users who are logged on to the server and have an OpenVPN connection to the machine are now able to use established tools such as TIA Portal for system diagnostics, maintenance, service, or troubleshooting the plant. The secured tunnel ensures that changes are made only to plants for which communication rights are granted.

In addition, machine manufacturers can now upgrade the end points themselves with the Sinema Remote Connect server. A new firmware version can be loaded onto the server and then transferred to the Scalance devices. The settings and project data persist, and the Scalance router automatically reconnects with the server after the update.

In large enterprises, where security policy prohibits direct access to machines and plants, Sinema Remote Connect can be installed in the data processing center of the end customer. The IT department itself grants rights to service engineers and therefore has full transparency of all persons accessing the company's network at any time.

In case of a failure of the Scalance industrial router, a key-plug supports the router exchange. The licensing and storage medium makes it possible to secure the current device configuration. The maintenance engineer on-site only needs to exchange the device and plug in the key-plug. ■

↗ **siemens.com/remote-networks**

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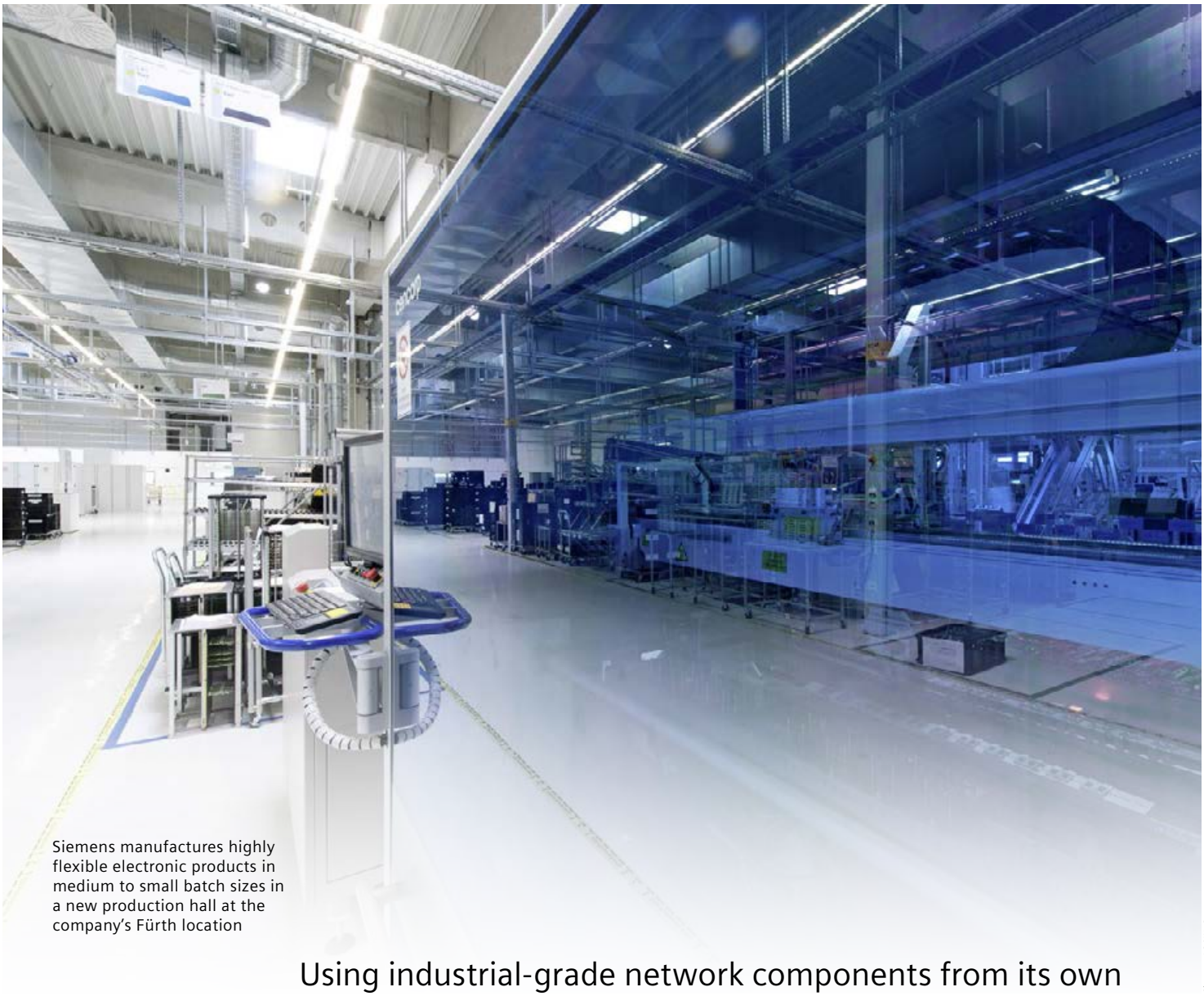
New network secures production



Siemens manufactures highly flexible electronic products in medium to small batch sizes in a new production hall at the company's Fürth location

Siemens AG / W. Geyer

Using industrial-grade network components from its own portfolio, Siemens has secured and optimized its production facility in Fürth, Germany. In addition, process-oriented, segmented VLANs and layer 3 (routing) procedures make the production network especially high-performing, available, flexible, and secure.

The previously distributed production facilities at the Fürth location have been concentrated into one new production hall and integrated into the production and business processes. Since March 2014, products in medium to small batch sizes, down to "batch size 1," have been manufactured there: from circuit boards to modules to complex controllers for a wide variety of industrial applications.

The extended network solution with components from the Scalance portfolio was developed, designed, and implemented in close cooperation with Siemens Global Services Information Technology, the IT department on-site, and the IT service provider and Siemens partner Atos Germany. Network specialists from the Siemens Industrial Communication department supported the process in an advisory capacity. Based on the specific availability and data security requirements, the experts developed a network design that would ensure secure networking of production and office environments.

Complex tasks and requirements

More than 100 IT systems in the production area had to be networked with the central servers in the Siemens data center. Work orders for machines and systems that in some cases operate around the clock in three shifts, work instructions for employees, and software updates and images for the controllers all need to be distributed via the network. At the same time, all processes with interactive data exchange between end devices and servers require increased availability and efficiency for tracking the process steps. Some of the activity requires approvals from a central office. All this calls for a highly reliable communication, while at the same time the demands on IT security increase.

To prevent failures, the production network in the new building was to be decoupled from the rest of the network and subdivided into logical segments based on the production processes. For example, overlapping firewalls in continuous layer 3 architecture as well as access restrictions via access control lists (ACLs) are used as security measures.

New network structures for efficient production

The communications network at the Fürth location is set up in three layers: core, distribution, and access layers. In addition to the core routers in the campus LAN and hardware firewalls already available, two Scalance XR528-6M switches were installed physically separate from each other in the distribution layer. They are connected via redundant 10 GB fiber optic rings and form an expandable production backbone. If one device fails, the other takes over. The overlapping hardware firewalls separate and regulate access between production and the rest of the network. The communication of the production Virtual LAN (VLAN) is also controlled by the firewalls.

Nine Scalance XR324-12M switches with several ports at the access layer are connected redundantly to the Scalance switches of the distribution layer. These are distributed to several wiring closets in the production area and combined into redundant rings. Via patch fields, end devices in production, grouped into VLANs, are connected to the redundant rings.In the field, end-to-end Gigabit Ethernet is realized through Cat 6 cabling.

Segmentation of production

The original VLAN with about 150 participants was not segmented, meaning that problems in the layer 2 communication could affect the higher-level layers. The network was not redundant, so failures could cause longer downtimes. With the implementation of the Scalance switches, the network for the production area in the new factory hall was separated from the rest of the location and segmented according to production requirements.

Siemens AG / W. Geyer

The Scalance XR324-12M switches redundantly coupled with the distribution layer connect about 20 VLANs to the data servers

Now there are about 20 smaller VLANs with a maximum of 11 participants each. This increases the bandwidth in the segments and thus the transmission speeds. Failures or attacks would now affect only a small number of devices. The interaction of the hardware firewalls and ACLs offers maximum protection against unauthorized access.

Thanks to good preparation and migration in the back office, the project team was able to switch and test the participants in coordinated maintenance slots, with no effect on operations. Even after the finalization of all function tests, Atos continues to look after the overall solution at the Fürth location through its so-called Full Managed Services. In addition, a team of specialists on call around the clock ensures the availability of the network. "We are truly pleased with the project progression as well as the stability, availability, and performance of the new network infrastructure in daily operations," says Lorenz Rappl, head of manufacturing in Fürth. ■

↗ **siemens.com/switches**

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Service technicians must be able to reach the nacelles of wind turbine towers even during the winter when temperatures are low

Safely reaching the nacelle – even when it is freezing cold

Wind energy plants with tower heights of up to 160 meters are no longer unusual. It is therefore even more important that service technicians get up to the nacelle quickly and safely – even in places where temperatures of -35°C are reached in the tower. The lift systems used here must meet the highest demands.

Hailo Wind Systems GmbH & Co. KG is a leading equipper of wind energy plants and a specialist in lift systems. The company's high-quality product line includes the Hailo TOPlift, a lift system for ladder-guided service lifts, and the GLOBAL-lift, a lift system for rope-guided lifts, which can be used to safely reach the nacelles of wind turbine towers. The system is developed and manufactured in accordance with the European Machinery Directive 2006/42/EC. The failsafe door contact with a tumbler is particularly important so that the shutter door remains closed during the entire journey.

Suitable for low temperatures

The Sirius 3SE5 safety position switch was exactly the product the specialists were looking for. Dennis Hardt from the engineering and design department at Hailo Wind Systems explains: "Manufacturers of wind energy systems expect a product to work perfectly down to temperatures of -35°C in areas with low temperatures." The Sirius position switch is even available for temperatures as

cold as -40°C. The switch was used for the first time in TOPlifts in the Cold Climate Version (CCV). The design modification for the door lock became necessary because the new version of Machinery Directive 2006/42/EC requires not only safety-oriented monitoring but also a tumbler system. A magnetic lock is particularly important at very low temperatures.

The project team opted for the plastic version of the manipulation-safe standard position switch with a tumbler and separate actuator, reaching a locking force of 1,300 N; if more force is required, there is also a metal version available with 2,600 N. Position switches have two sets of three contacts as standard, so that safety levels SIL 1/PLc or SIL 2/PLd can be achieved, depending on the control strategy. In applications where the highest safety level, SIL 3, is required, two position switches must be combined.

The service technician pushes the roller shutter manually downward in the slide guide until the actuator fixed on the bottom end slides into the opening on the position switch and locks the door. This is the moment when the control confirms that the service lift can start moving. The tumbler is available in different versions for optional coil voltages of 24 V, 115 V, or 230 V. To allow the technician to still be able to leave the service cabin in case of an emergency while it is locked, TOPlifts feature the unlocking version of the escape mechanism from the rear. The service technician reaches through a covered opening on the lift floor and pushes the unlock button on the position switch; the tumbler releases the actuator. The unlocking mechanism can be cancelled by simply pulling the position switch back.

Siemens AG

With service lifts (TOPlifts) from Hailo Wind Systems, accessing 160-m-high wind turbine towers is easy and safe

Easy installation thanks to rotatable actuator head

The actuator head of the Sirius 3SE5 position switch can be rotated by 90° at a time to be able to adapt to the appropriate locking situation. The actuators are coded to protect the position switches from all kinds of manipulation. In addition to standard actuators, there are six other versions, so that the position switches can be individually adapted to the given installation situation. "Thanks to this flexible actuation, we can always use the same position switch even if a design has changed or if it is used in another place," says Hardt. This practical strategy of using the same parts has benefits not only for the assembly department but also for the design department.

Service lift solutions for temperatures down to -35°C also require special solutions for terminal boxes with the control (which is equipped with heating), for the fall arrester, and for the rope drive hoist. In case of very low ambient temperatures, all these components must be heated up before they can be used. The temperature is controlled by a Sirius 3RS temperature monitoring relay. ■

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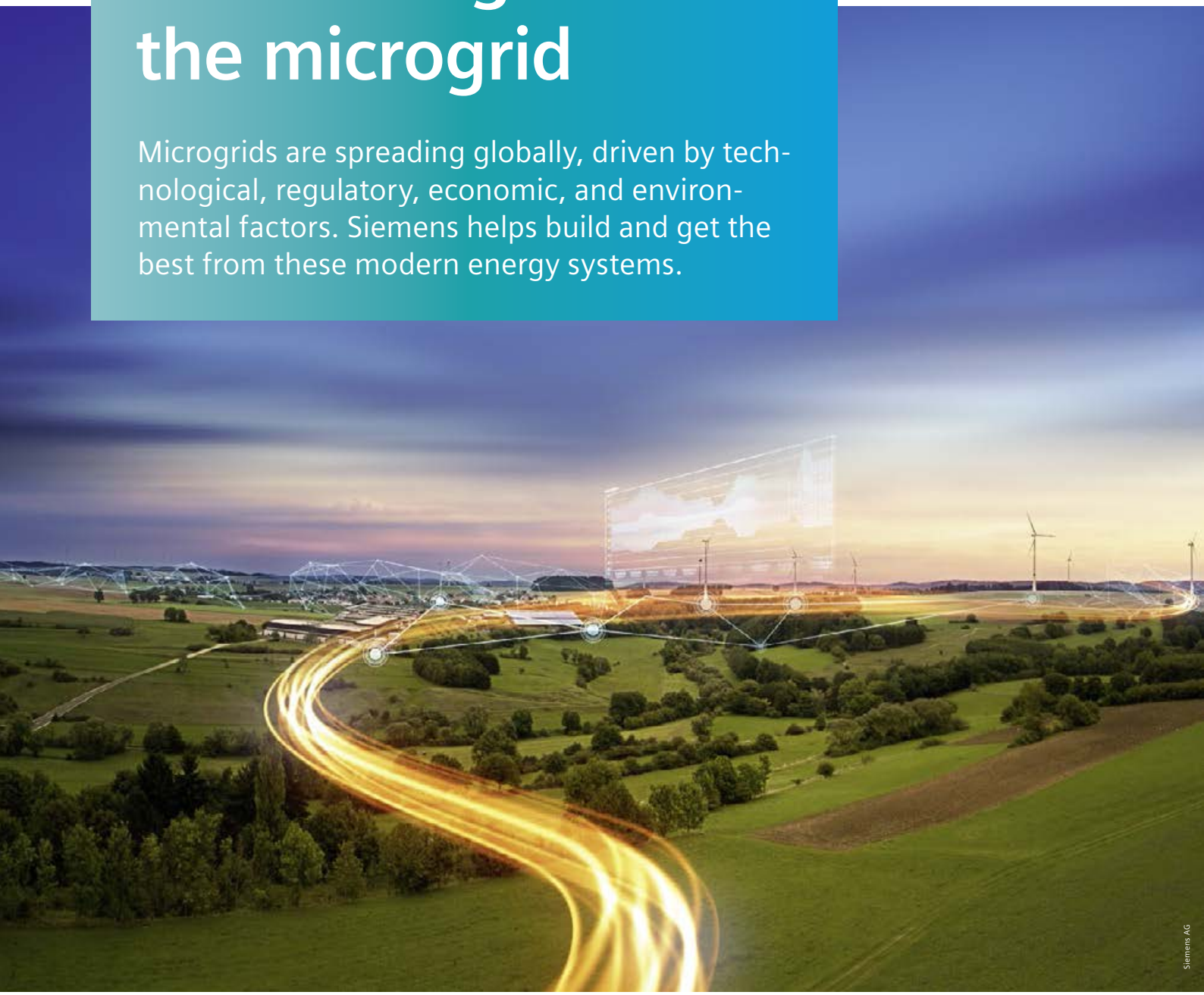
The makings of the microgrid

Microgrids are spreading globally, driven by technological, regulatory, economic, and environmental factors. Siemens helps build and get the best from these modern energy systems.



To a greater or lesser extent, every business needs access to reliable and economical sources of power. It is an additional bonus for some if that electricity can be generated using renewable sources. Modern technology allows businesses to meet these needs themselves, producing energy as well as consuming it locally, creating flexible networks known as "microgrids."

At the dawn of the electrical age, every grid was a microgrid – a locally limited system in which power was generated and distributed to users. Gradually these were subsumed into larger networks, becoming national or even crossing frontiers. Economy of scale dictated ever larger, usually fossil-fuelled generation plants, supplying often distant cities and industrial centers via transmission at high voltage.

But now the trend has reversed toward generation that is again decentralized, potentially renewably sourced, and often within flexible modern microgrids, able to attach or disconnect from the wider system at

will. Microgrid operators can take advantage of management systems able to tell them exactly when it makes sense to generate, when to draw power, and when to sell power to the local utility company. Businesses of various size, whether they use less than 1 or more than 100 MW, are evolving from being passive consumers to becoming active (if assisted) "prosumers."

Higher efficiency

Different reasons are driving this development across varied environments and customer groups. In Europe, regulated tariffs have risen and subsidies are offered for sales to national grids from renewable sources. This has led, for example, to more than one in six companies in Germany generating their own power. Technology has also assisted, with solar, wind, and gas turbine generation becoming ever cheaper, as has battery/hydrogen storage – all allowing insulation from the uncertainty of future utility tariffs. Microgrids' low voltage distribution achieves less losses than the transmission network, boosting efficiency further still.

For some users, cutting CO_2 emissions is also a goal, like the University of Genoa in Savona, Italy, where Siemens helped shape a microgrid based on solar power and micro–gas turbines. The Savona microgrid delivers 250 kW of power and 300 kW of heating for its 40,000 students, and this is viewed as a pilot for an expanded version for the surrounding green-minded city. Such combined heat and power (CHP) or combined cooling, heat, and power (CCHP) features are a common way to achieve still greater efficiency within microgrids.

Flexibility that can be relied on

In the booming US market, demand is driven more by reliability issues. Hurricane Sandy in 2012 left many New Yorkers without power for two weeks, a reminder that a big grid is not necessarily a safe one – and concerns relate to malicious attacks as well as natural disasters. Microgrids enjoy the option to disconnect temporarily from the main grid if outages threaten, or indeed can remain permanently as separate "islands." At the same time, if its own generation were to fail, a connected microgrid has the option of drawing on the main grid as backup.

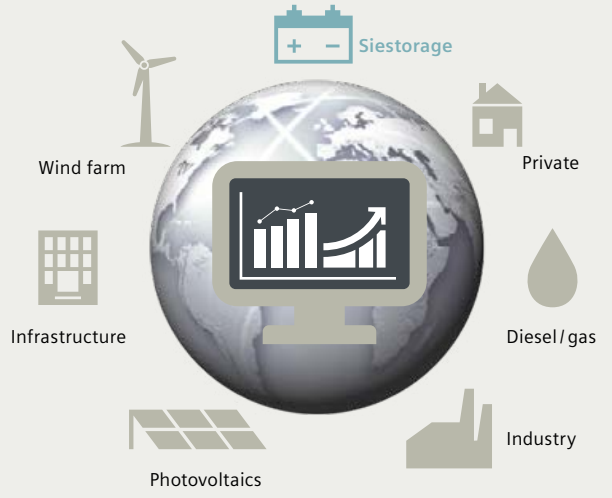
Major industrial endeavours, such as mines and chemical plants in Latin America for example, are attracted by cost reduction, as electricity can account for a tenth of the value of mined commodities. But they are also drawn by microgrids' "power quality," voltage, and frequency levels that will not vary because of wider system disturbance.

Siemens Digital Grid

Siemens Digital Grid delivers a range of software and services to help microgrids achieve these benefits, each modular and scalable according to customer needs. The SICAM Microgrid automated control system can check the status of local assets and the wider grid, using a rule-based algorithm to connect or disconnect. The more complex Spectrum SP7 MGMS management system can also take account of future load and weather forecasts to optimize in real time the energy dispatch and can interact with wholesale power markets to maximize economic return or minimize CO_2 emission over a longer term.

Naturally, linkage with the power system hardware and integration of equipment from other Siemens' divisions is smooth. In another project, residential customers in a district in Bristol, UK, were supplied with SoLa energy storage linked to rooftop PV panels. This increased the microgrid's resilience, cut costs, and delivered greater efficiency. In the next phase, Siemens will also work with largescale buildings to optimize energy efficiency.

Microgrids – efficient microgrid management by optimizing operational, environmental, and economic aspects



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Constantin Ginet, Siemens' head of Microgrids global unit, explains that "we can demonstrate to our customers what their payback will be, and therefore what is the added value of having a microgrid." He stresses the importance of understanding the as-is situation of a potential customer before laying out future scenarios. If they decide to develop a microgrid, customers can also choose between making their own capital investment or taking advantage of Siemens' experience in financing models. Constantin Ginet sums up: "Our offering, made up of consulting, core microgrid products such as control systems and storage, access to partners, and financing models is a complete solution to the market." As this rapidly expanding market segment testifies, Siemens is on trend with microgrids. ■

↗ **siemens.com/microgrids**

A strategy beyond replacement

Siemens has developed transformers that can be transported and installed in a very short timeframe. These mobile resilience units reduce restoration time to a few hours rather than weeks. The new innovative transformer solution plays a key role in the new grid resilience concept that is based on the three pillars "prevent – protect – react."

Energy security is a widely discussed topic today. The threat of a blackout due to natural or other catastrophes is a high concern at utilities, as well as at industrial companies. The effects of a blackout can be tremendous. Transformer in Grids, power generation plants, and industrial companies are key elements for energy transmission. Forced transformer outages have immediate impact on availability of electricity. Thus, solutions for resilience of transformers as a key asset are in high demand.

A well-known US-based utility made the decision to invest in grid resilience and the reliability of their grid. They requested spare power transformers for emergency situations that can be transported and installed within 36 hours instead of the several months to ensure fast recovery and reduce outage costs. Siemens worked together with the customer to design a power transformer that could be compared to a multifunctional pocket knife: compact, lightweight, quick and easy to install, and versatile in voltage.

Instead of one heavy-weight three-phase unit, Siemens designed three lighter single-phase units with a compact design, making transportation straightforward. Installation is made easy with the use of plug-in bushings and connections. The units are also made versatile, covering different ratings to enable reconnection between the 335/136kV-system (300 MVA) and the 132/136kV-system (150 MVA) in less than two hours. Furthermore, ester insulation adds to the units' fire safety and environmental friendliness.

Broad portfolio for resilience

Siemens takes its customers' concerns seriously and offers a broad portfolio for resilience. On top of reactive measures, protective measures are offered to safeguard units against geomagnetically induced current caused by sun storms or even bullets in the event of a physical attack. The third pillar of the grid resilience concept consists of a comprehensive portfolio of preventative services, including condition assessment, fleet monitoring, and repair and retrofit. These preventative measures address risks that may occur during operation.

Transmission grid operators, as well as both power generation plants and industrial companies, can benefit from the flexible and tailor-made resilience concept offered by Siemens Transformers. CEO of Siemens Transformers, Dr. Beatrix Natter explains: "Depending on the individual strategy of our customers, there are several ways to prevent assets from failures and protect them from harm. In addition to this, our mobile resilience units offer support beyond precaution and give operators a chance to react in emergency situations." ■

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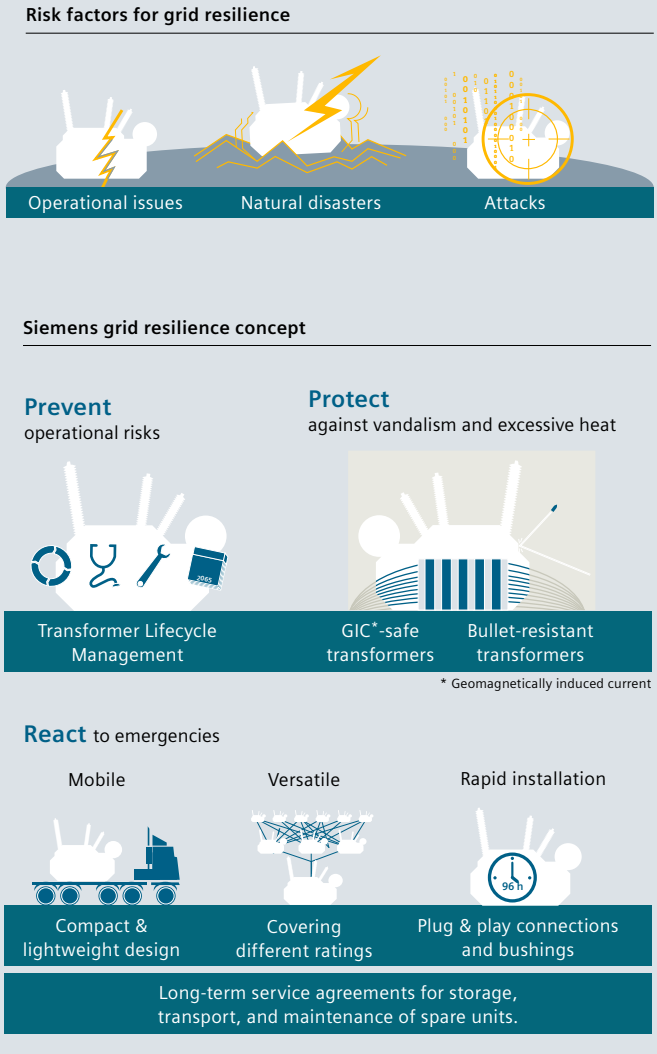
Simatic Energy in TIA Portal enables the intuitive configuration of components from Siemens' energy-efficiency portfolio



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TIP meets TIA

As digitalization and automation gain ground in industry, electrical power distribution faces new challenges as well. With an integrated portfolio of products, systems, and solutions for high-, medium-, and low-voltage networks, Totally Integrated Power (TIP) shows its full strength.

Modern power distribution systems do much more than ensure the high availability of electrical power. They can also be seamlessly integrated into automation environments. Devices to control and regulate electrical power – for example, frequency converters, motor management systems, and soft starters – can be integrated into the TIA Portal engineering framework. With TIA Portal V14, it is now possible to directly integrate components of energy distribution with intelligent protective devices such as 3VA2 molded case circuit breakers and power measurement devices for the power distribution system. Communication interfaces ensure the efficient interplay of all components.

Current measured values for power, voltage, output, and energy, for example, form the basis for systematic power and plant monitoring. This makes it possible to incorporate the power distribution system into holistic programs to increase energy efficiency.

↗ **siemens.com/transformer-resilience**
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Keeping on top of energy consumption

Companies that want to keep on top of their long-term energy costs and look ahead to the future focus their energy management efforts where most of the energy is consumed: production automation.

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»Saving energy is a way of reaching what is ecologically necessary through economically sustainable means.«

Wolfgang Voit,
Electrical Power Supply Officer,
Facility Management, SKF GmbH

The antifriction bearing manufacturer SKF (Svenska Kullager Fabriken) was one of the first companies to receive global ISO 50001 certification, in 2015. In the company's 38 factories all around the globe, energy management systems ensure the necessary transparency and compliance with the requirements imposed by an energy audit in conformity with the EN 16247 standard. The site in Schweinfurt, Germany – which in addition to the company's headquarters in Gothenburg, Sweden, is one of the main SKF production sites – was the trailblazer in this certification process.

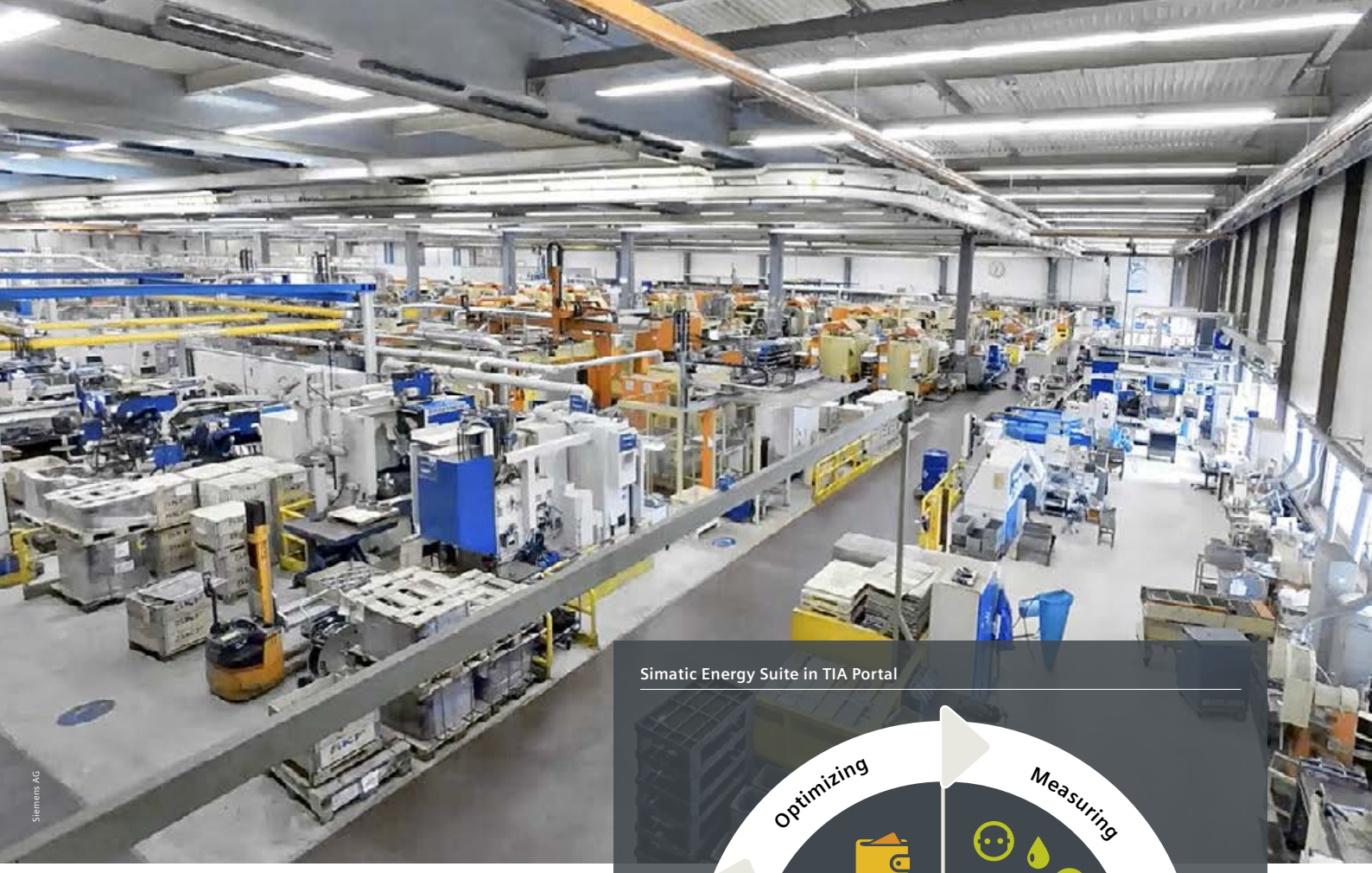
Keeping an eye on energy consumption

Five years ago at the Schweinfurt site, SKF had already set ambitious goals that went far beyond the requirements specified by ISO 50001 certification. The goal for 2016, for example, was that CO_2 emissions should be 30% below the emissions of 2011. To meet this goal, the entire product value chain, from the supply of raw materials to use by the customer, was scrutinized in terms of sustainability. Long-term energy-savings programs have also ensured that total energy consumption in manufacturing was 5% lower this year than a decade ago.

SKF has been using the Simatic B.Data energy management system since 2013 for systematic data processing and control. This system reliably captures and evaluates energy flow data for electricity, steam, water, gas, compressed air, and cooling lubricants at approximately 1,000 measuring points.

Reliable data processing

The scalable system for up to 30,000 possible data points can be used as a single-position system, as a client/server system, or with the optional B.Data web extension, in a standard browser. This was precisely the functionality SKF had been looking for to be able to access the system easily from anywhere across the group and at any time. With Simatic B.Data, it is possible to optimize energy procurement with a detailed overview of relevant indicators, and it is also possible to monitor energy consumption and consumption divergences in real time – both of



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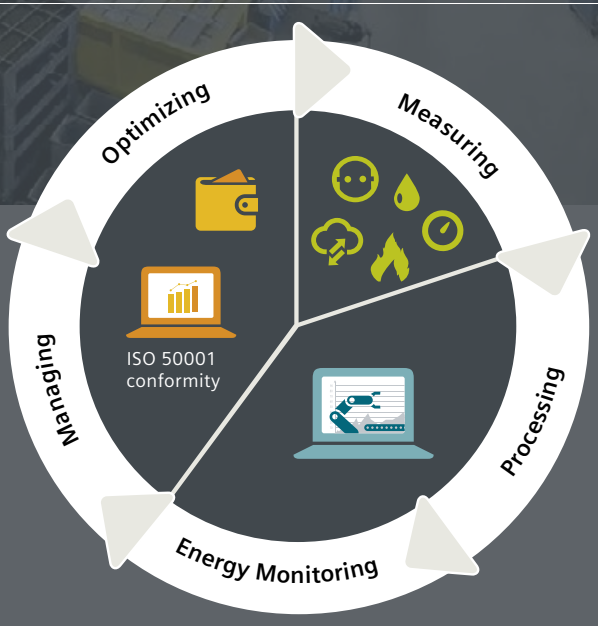
At the SKF production site in Schweinfurt, energy data are reliably captured at more than 1,000 measuring points

Simatic Energy Suite in TIA Portal



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which are crucial factors in implementing a sensible approach to handling energy.

Thousands of pieces of energy data are captured, evaluated automatically, and controlled by the plant's own Simatic S7 control systems. Wolfgang Voit, electrical power supply officer for facility management at SKF, especially appreciates the "easy transfer of data and automatic but above all dependable evaluation of Simatic B. Data, which uncovers efficiency potential and gives hints as to how to optimize the process."

Managing energy directly in production

For the first time, Simatic Energy Suite efficiently links energy management with automation in TIA Portal and brings transparency into the energy consumption of the production process. Thanks to the easy configuration of energy-measuring components from the Simatic, Sentron, Simocode, Sinamics, and Sirius families, the required time and effort are notably reduced. All the components are connected either to the cloud-based Energy Analytics Service or to Simatic Energy Manager Pro, the new and improved successor to Simatic B.Data. This enables the seamless transmission of the gathered data to a enterprise-wide energy management system that can be intuitively configured.

In addition, companies can fulfill all the energy-related economic and management criteria that are necessary for ISO 50001 conformity, from procurement to planning to controlling. ■

↗ **siemens.com/simatic-bdata**

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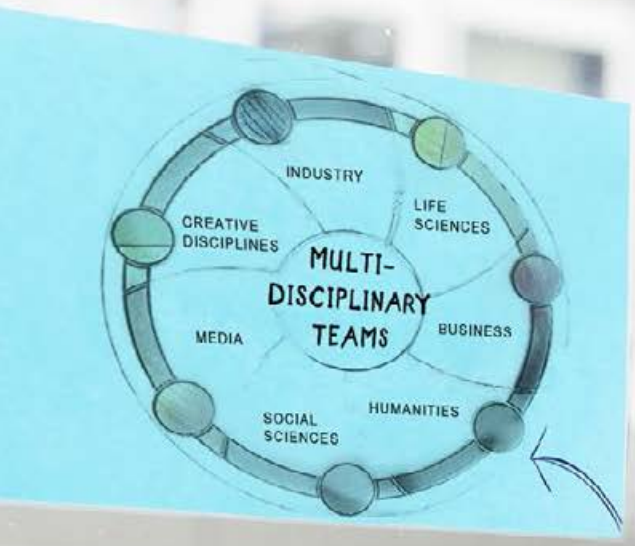
“Combining an analytical approach and creativity”

Design thinking is a successful tool for developing innovations beyond conventional methods. We interviewed Dr. Claudia Nicolai, academic director of the Potsdam School of Design Thinking at the Hasso Plattner Institute, on market research, interdisciplinary teams, and the value of traditional views.

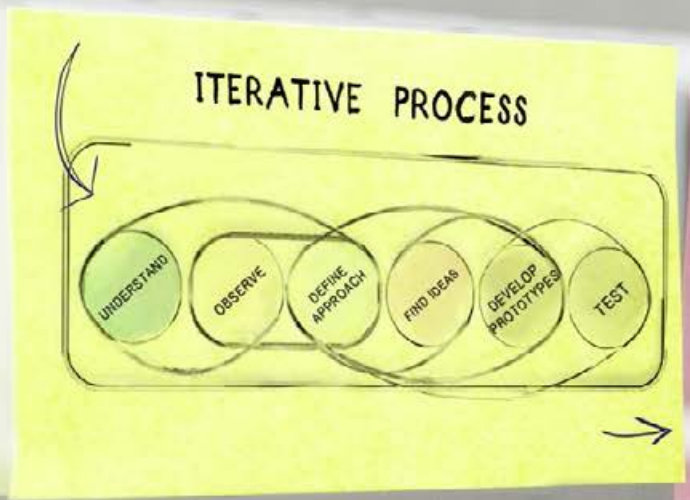


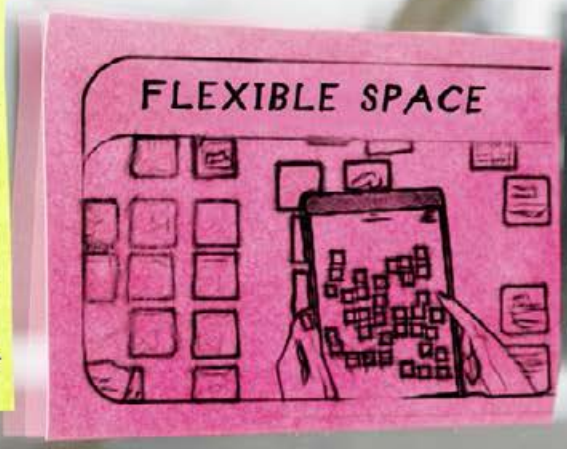
Dr. Claudia Nicolai

School of Design Thinking

Dr. Claudia Nicolai, a postdoctoral economist and social scientist, has been the academic director of the School of Design Thinking at the Hasso Plattner Institute (HPI) in Potsdam since 2010. Together with Stanford University (USA), HPI is running a research program for the further development of design thinking.

In the early 1990s, a computer scientist in California developed the innovation method, which is now used worldwide by an increasing number of companies in a wide variety of industries. In 2007, HPI introduced a one-year postgraduate course of design thinking studies. It also offers three-month-long introductory courses and three-day workshops for professionals in the field and managerial staff.





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Design thinking – that sounds more like art and aesthetics than a management topic. What exactly is it?
Dr. Claudia Nicolai: In a world that is changing ever more quickly, in which innovation cycles and times to market are drastically becoming shorter, we have to understand exactly how innovation processes really work. Only then can we deliver better and more creative solutions more quickly. That is what design thinking is all about.

What does that mean in practical terms?
Nicolai: Design thinking consists of three elements: First, when planning new products and services, manufacturers must focus from the very start on the requirements and wishes of later users and the benefit of the possible products. Second, the teams planning the innovations have to be interdisciplinary. And third, design thinking requires an environment that promotes creativity; a conference room is rather less suited for this.

But companies have already been doing a great deal of market research for decades to determine customer requirements and adjust their product development accordingly.
Nicolai: Market research cannot help you find out whether people would use completely new products. People who do not know the innovations at all have a hard time imagining the individual benefit.

Does this mean that smartphone apps or tablets would never have been developed with the methods of market research?
Nicolai: Possibly not. If we look ahead, car manufacturers are a good example. Today, they have to ask themselves: What will we sell to the customers? But that focus will increasingly shift from certain car models to a service: mobility. The meaning of mobility could be understood in a completely different way than it is today.

So design thinking is more about innovative product development and less about new business models?
Nicolai: Exactly. One central idea of design thinking is that companies will always have to scrutinize their business models and processes when planning innovations. Developers should think about one thing first: Have we even asked the right questions? Don't we have to look at the task from a completely different point of view?

How do innovation teams have to be put together to master such challenges?
Nicolai: When all team members have the same training and experience, they all look at the problem in the same way, and that is a problem for innovation processes. One central task of successful innovation teams is to combine the analytical approach of engineers and managers with the creativity of artists and designers. All essential functions within a company related to innovation should therefore be represented – from research and development to marketing. The product designers play a key role, as they have to make sure the new products not only look attractive but also are user-friendly and offer the maximum customer benefit.

How big should teams be for effective design thinking?
Nicolai: The perfect size for a core team should be between four and six people. This team is responsible for the basic planning of an innovation. Teams are always formed with the project in mind and are disbanded once the innovation cycle has been completed. So the structure is different from that in departments.

Don't such self-sufficient innovation teams meet with internal acceptance problems?
Nicolai: It has to be clear that many developers, engineers, and software specialists will have to be involved later for the detail work, as design thinking is poorly suited for that. Regardless, innovation teams have to be an integral part of the company's organization. This especially requires involving experienced managerial staff with traditional views, as well as young and unconventional employees. Otherwise, new ideas will not push through internally.

How can companies introduce design thinking effectively in their organization?
Nicolai: The best way is to define a flagship project. Then the organization will quickly see that design thinking leads to better solutions for customers.

For which industries is design thinking suited?
Nicolai: It works especially well for IT and technology companies. Siemens Healthcare GmbH, for example, has successfully used the concept to improve the coordination of internal processes. Since then, Siemens has been offering each of its customers one contact person who is responsible for the entire range of services, from medical engineering to logistics to hospital management. In the area of mobility, Siemens uses design thinking to develop new traffic concepts for conurbations, for example. But the method is also suited for other industries, such as retail trade and the food industry, or it can be applied independently of the industry – for example, for personnel management. ■

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