

The Magazine

for the Digital Enterprise

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**Fast cloud
access**

**Intelligent plant
data utilization**

Special – “Industrie 4.0”

In focus
Cloud solutions for industrial applications

Industry software
Smart assembly

“The digital
transformation
of machine building
and plant engineering
is not optional.
It is already
taking place.”

Actively shaping the digital transformation



Our lives have already changed tremendously as a result of digitalization. Industry is rapidly progressing toward “Industrie 4.0,” bringing new technologies and challenges for CEOs, management, and the workforce alike.

The machine building and plant engineering sectors have to deal with digitalization on two different levels. “Industrie 4.0” has to be implemented in their own company, and at the same time their customers require the best possible support on their journey to becoming digital enterprises.

Complete technology is now available for digitalization along the entire value-added chain. For this Siemens offers the digital enterprise portfolio, which consists of industry software, a large automation portfolio, as well as products for industrial communication, industrial security, and industrial services.

MindSphere is both the basis and the prerequisite for these data-based industrial services. This cloud data platform from Siemens offers medium-sized companies in particular an opportunity to begin their digital transformation and create profitable new business models. This enables customers and developers to develop, expand, and operate their own apps in the cloud. You can read more about this in our featured article.

The digital transformation of machine building and plant engineering is not optional. It is already taking place. Those who embrace it today will themselves be able to play a role in shaping the digital transformation.

A handwritten signature in black ink that reads 'Klaus Helmrich'.

Klaus Helmrich
Member of the Managing Board of Siemens AG

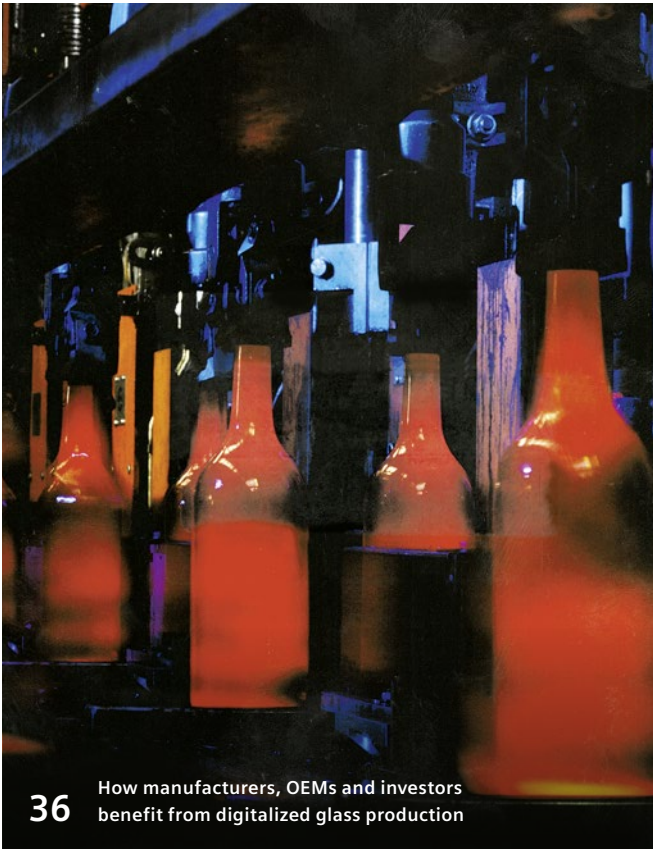


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With high tech to victory

Sir Ben Ainslie has won five Olympic medals in sailing for the UK since 1996, and his current goal is very clear. He wants to win back the oldest cup in the history of international sports: the America's Cup. Since the first edition of the regatta back in 1851, no British team has managed to win the trophy. But this could change in 2017, at the 35th America's Cup in Bermuda.

The races involving five other high-tech catamarans will decide who will compete against the 2013 champion, Oracle Team USA. One of the contenders is Land Rover Ben Ainslie Racing (BAR), consisting of experienced sailors, design engineers, and technicians.

Ainslie is well aware of the difficulty of the task: "The race is not only an athletic but also a technical challenge. It requires many people to work together to design, build, and then sail the fastest boat possible."

For the entire development phase of the boat, which began back in 2014, the BAR team has relied on Siemens software. The software allows Land Rover BAR to simulate, analyze, and test a variety of shapes to find the right balance for perfect speed and stability. "Software from Siemens is our team's number one choice when it comes to construction and planning tools," underlines Simon Schofield, design engineer at Land Rover BAR. "We trust it 100%." And trust is of the essence when it comes to developing a sailing boat. According to the America's Cup rules, the ACC catamarans can be tested no sooner than 150 days before the first qualifying race. The virtual race, however, has long been in full swing ...

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LAND ROVER

11TH HOUR RACING

LAND ROVER BAR

Fly Emirates

OMEGA

TOYOTA

LAND ROVER BAR



Starting down the digital path

Digitalization has been the baseline standard for many years already in larger corporations. Now small and medium-sized companies are following suit. Cloud solutions are an excellent starting point for predictive maintenance, energy data management, and resource optimization, among others.

Author: Alexander Chavez

Ordering a new car means decision time: How much horsepower do you want? A diesel or a gasoline engine? Or maybe electric? The choices don't stop there: You can choose your favorite color and the type of upholstery, you can decide to have a sunroof if you like, and you can select an entertainment system. These choices alone are representative of the highly complex nature of automobile production processes. For quite some time, car manufacturers have been relying on digitalization tools to help keep these processes under control.

Digitalization makes the inherent complexity of producing cars significantly more manageable – and it helps save money. Volvo Cars, for example, was able to halve its engineering costs by using a software solution to plan and simulate its production lines. And Japanese car manufacturer Nissan managed to almost halve its development time for a new vehicle by using Siemens CAD and collaboration software.

As these examples show, the real and virtual worlds are now beginning to merge in the production world. This is being referred to as the fourth Industrial Revolution, or "Industrie 4.0." Digital Enterprise is the product portfolio that Siemens offers for this area already today. The idea of digital production has been widely adopted, not only by the automotive industry but also by companies in industries as diverse as machine tooling and printing. One thing these companies have in common is that they are often large and sometimes have offices and production sites in locations all over the world. In contrast, small and medium-sized enterprises (SMEs) have been slow to embrace digitalization technologies.

More investment needed

In Germany, four out of five SMEs have invested in digital projects over the past three years, according to a study commissioned by KfW Group. However, these investments

are modest in their scope. "SMEs are still a long way from fully exhausting the potential of digitalization," says Dr. Jörg Zeuner, chief economist of KfW Group. As a result, many firms are at risk of "missing the boat," he adds. Less than a fifth of German SMEs have become digital leaders through investments in digital products, services, apps, or "Industrie 4.0."

For the rest of the German SMEs to join these digital leaders, they will need to invest more heavily in "Industrie 4.0" technologies. Research from the European Union shows that the necessary investments can be daunting for SMEs, especially because they are unsure how the changes will impact their value chains.

Other reasons SMEs cited for not making investments include a lack of IT skills among their staff and concerns regarding data protection and data security. However, in a paper commissioned by the Friedrich Ebert Foundation, researcher Christian Schröder from the Institut für Mittelstandsforschung (Institute for Small Business Research, ifm) argues that slow internet is one of the most significant hurdles: "The greatest shortcoming at present is the lack of comprehensive broadband connections to ensure very fast transfer rates without loss of quality."

SMEs: a strong economic force

Yet it is imperative that SMEs invest in digitalization. In the countries of the European Union (EU) plus Norway, SMEs account for around two-thirds of total employment and contribute more than half of value added. In the United States, SMEs provide 55% of all jobs and account for 54% of all sales in the country. Statistics are similar in other parts of the world. If this sector falls behind, the consequences could be dire.

Therefore, initiatives have been launched in many industrialized countries to help SMEs make the digital transition. The general aim



»We can now offer our customers new digital out-of-the-box services to increase machine availability.«

Gämmerler GmbH



»MindSphere enables us to pursue new digital paths for even more conveniently diagnosing and servicing our machines.«

Gehring Technologies GmbH

Building tomorrow's world

The Internet of Things' integration of the real and virtual worlds will offer rich rewards to those able to turn big data into smart data. The Internet of Things is predicted to be as transformative as steam power and electricity, and it is fast moving from science fiction into reality.

The Internet of Things will connect millions of wearables like smartwatches or activity tracker, devices in the home, cars, and data points to create the technologist's utopia: the smart city. The goal is to create a vast integration of data that will provide new insights into our physical and mental health while enabling businesses to make better use of resources.

For the Internet of Things to succeed, all these data will need to be linked together and stored in the cloud. This will enable the identification of what information technology research and advisory company Gartner termed "business moments" – powerful insights that can drive process improvements to as yet only imagined levels.

Collaborative control

Maintaining control over such a vast amount of data poses many challenges, as these data will need to be integrated across countless devices, platforms, and networks. Every device will need to speak the same language, and so industry-wide standards are essential.

There is no time to waste. If the development of standards for encryption and data storage are slow, security flaws could jeopardize the entire transition. Collaboration is the only way that the secure, stable networks required by the Internet of Things can be built.

With the open standard AutomationML, for example, factories can become fully automated and manufacture custom products to order. Production can be adjusted according to resource prices and drive huge cost savings without any human input. Even maintenance can be scheduled automatically in "Industrie 4.0." ■

Rob van Kranenburg

(born in 1964) is an Internet of Things expert. He is a teacher and the author of "The Internet of Things. A critique of ambient technology and the all-seeing network of RFID." He is the Co-Founder of Bricolabs and the Founder of the IOT Council. He ranks number 6 on the top 100 Internet of Things (IoT) thinkers list on Postscapes.

of these programs is to encourage companies to make greater investments in digital technologies. A starting point for many SMEs on the digital path is cloud solutions. According to KPMG and Bitkom research, more than 50% of German companies already report using cloud solutions. In industrial settings, cloud solutions can be used for predictive maintenance, energy data management, or resource optimization. All these applications have a proven ability to help manufacturers save money.

The cloud as a starting point

At Siemens, the open IoT Platform MindSphere enables these applications. First, data defined by the customer are collected and transferred. MindSphere is a key element of the digital enterprise Software Suite, Siemens' offer to all customers on their way to becoming a digital enterprise. Then the data are analyzed, and the information relevant for optimization is made available in the form of recommendations for action. Because MindSphere has been designed as an open IoT ecosystem, it is possible to obtain data from industrial devices from a wide variety of manufacturers, no matter the brand. Moreover, MindSphere provides customers and developers with the capability to develop applications and digital services, apply them and make them available to other users. In this way, totally new service and business models are possible.

Even if a company is not yet ready to use cloud solutions like

those described above, experts recommend ensuring that any new equipment purchased is outfitted with sensors and Internet capability so the equipment can be connected at a later date.

SMEs that have embraced digitalization say that doing so has brought them many advantages. In a study published by the European Commission, SMEs report that digitalization technologies have fostered entrepreneurship, enabled innovation, created and sustained employment, and promoted global competitiveness. Siemens' customers show how digital solutions have allowed them to optimize resource usage or reduce downtimes through predictive maintenance.

The digital transformation is happening. A survey from the Boston Consulting Group on "Industrie 4.0" in Germany and the United States showed that in both countries, expectations are high: two-thirds of survey participants on both sides of the Atlantic said they expect clear productivity and cost benefits, and more than 40% anticipate higher sales. ■

Alexander Chavez is a freelance editor and journalist from Munich, Germany. He writes texts and articles for industrial companies, institutes as well as communication agencies.

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»We anticipate that condition-based maintenance will lead to a considerable reduction in maintenance expenses.«

International automotive manufacturer

Supporting the digital transition

Initiatives have been launched in many industrialized countries to help SMEs make the digital transition. In Europe the initiatives carry names like "Industrie 4.0" in Germany, Factory of the Future in France and Italy, and Catapult in the United Kingdom. The common goal of these programs is to increase digitalization and ensure that European manufacturers are part of the new industrial revolution. In China the government is pushing for more digitalization via a series of activities under its Made in China 2025 initiative. In the United States, a whole range of federally funded programs have been initiated to promote advanced manufacturing – and they also benefit SMEs.



»The best time
to enter the
digital era is
right now!«

Jan Mrosik, CEO of Siemens AG Digital Factory Division

Dr. Mrosik, you have been CEO of the Digital Factory Division since June. What do you think industry will be like in the future?

Industry in the future will be 100% digitalized and networked via the cloud. It will be able to develop and manufacture new products many times faster than at present, and all perfectly tailored to individual customer requirements. This will be just as true for sneakers or smartphones as for cars or other products. And the amount of resources and energy needed will be much lower than today, without compromising product quality.

Why do you consider Siemens to be the right partner for a company on the path to the digital enterprise?

We understand our customers' world – and not just from outside, since we too are a manufacturing company. This means we know from our own experience how customers can get their products to the market faster, more flexibly, with maximum efficiency, and in top quality – in other words, by combining the virtual world of product development with the real world of manufacturing. We're the only company on the market right

Fast cloud access

Frequently, connecting plants to MindSphere barely takes an hour, according to Jan Mrosik, CEO Digital Factory Division.

So it's better to start the digital transformation now rather than wait?

Digitalization is the key lever that will enable companies to remain competitive into the future. This applies both to smaller operations and to major companies that are active around the world. Increasingly shorter innovation cycles mean that industrial enterprises constantly need to shorten their development and production times. This requires seamless integration of data along the value chain, from the idea of a product to the real product to service. Making use of the opportunities provided by digitalization to respond faster and more flexibly to customer requirements will provide an advantage on the market. So that means the best time to enter the digital era is right now.

now that combines the latest software for product lifecycle management with powerful automation technologies and services under one roof. Our Digital Enterprise Software Suite addresses and dovetails every stage in the industrial production process. With Siemens at their side, customers benefit from solid industrial expertise, a comprehensive range of services, and our leading technological skills.

Can you provide an example?

Take our own company: many of our plants have already implemented end-to-end integration, from the product concept to the manufacturing process to the actual product to service. Our Simatic S7-1500 controllers, the Nanobox industrial PCs, and many other products take shape in the

form of a digital twin on the computer and are simulated, optimized, and then manufactured using highly flexible processes on fully integrated automation systems. Of course, we have already helped many customers to fully digitalize their value chains, for example, in the automotive industry. As a result, development times have been reduced by as much as 40% and manufacturing volumes have increased substantially, with no loss of quality. Remember that this is in an industry in which every product is unique, made to the individual specifications of the automobile buyer.

If we assume that all companies decide to follow the integration path, how will they be able to gain a further competitive advantage?

I think the industry is just at the beginning of the digital transformation in many areas, not least in data-based services and cloud solutions. Siemens is also optimally positioned in this regard: our ecosystem for the Internet of Things, MindSphere, is really taking off now. It gives both end customers and OEMs new insights into their systems and plants.

But many other providers also make the same promise. What makes MindSphere so special?

Siemens is the only company to offer the total ecosystem, from connectivity, to the platform as a service (PaaS), to apps and digital services. That means customers can quickly and efficiently analyze the huge data volumes their plants generate, identify any weak points, and achieve even greater improvements in both production performance and availability. And, of course, all our knowledge of manufacturing processes and automation technology has flowed into the development of the MindSphere ecosystem right from the outset.

But even so, our customers know their own plants and their own machines better than anyone else. That's why it was important to



Jan Mrosik assumed duties as CEO of Siemens AG Digital Factory Division in June 2016. Prior to that, he headed the Energy Management Division, where he was responsible for the company's smart grid business. Jan Mrosik holds a doctorate in electrical and industrial engineering with specialization in the area of laser radar sensors from the RWTH Aachen University. He has held various positions at Siemens over the past 20 years.

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to MindSphere at set intervals. The connection via MindConnect Nano can often be set up in less than an hour. The data are then analyzed in MindSphere using the appropriate apps. At the end of the process, customers receive clear recommendations on how to optimize their systems.

For what types of companies is a solution like this relevant?

Every manufacturing company, regardless of size, can benefit hugely from cloud-based applications. I'm thinking of areas like energy data management, resource optimization, and predictive maintenance, where a relatively small industrial plant can be connected to the cloud just as easily as a global manufacturing landscape. The appropriate apps and services can then draw valuable conclusions on performance from the data that are gathered. And if systems are enlarged or new analytical functions are needed, MindSphere can be expanded without difficulty.

Even so, many companies still seem a bit cautious. Concerns about data security are holding them back from moving to a cloud-based system.

Data security is our top priority. It goes without saying that we comply with the current legal requirements in the different countries involved. All data are comprehensively protected using the best technical means currently available to us, and they are always encrypted for transmission. With MindSphere we work only with recognized, experienced partners in the IT industry. The other important point is that customers alone decide who receives access to their data. ■

design MindSphere as an open ecosystem for the Internet of Things. Customers can select from an existing portfolio of applications and services from Siemens or, using the MindSphere platform, develop and market their own applications to suit their individual requirements. Our goal is for the MindSphere platform to support our customers – machine builders, for example – when they add new applications and services to their machines. It's important for us not to find ourselves competing with them.

How does the road to the new world of data work, in reality?

With MindConnect, Siemens lets machines and plants connect to MindSphere quickly and securely. MindConnect Nano, for example, is a plug-and-play solution that records all data of relevance to the customer – such as status data from an individual drive or conveyor system – and transmits them

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An industrial (r)evolution

From bookstores to e-books – in the Internet era, markets are changing faster than ever before. With digitalization, manufacturing companies can benefit from new business models to stay fit for the future in the age of "Industrie 4.0."

Achieving more efficient and flexible production, increased availability, and reduced time to market are challenges companies need to face with increasing digitalization. However, it is not only the paradigm shift – with changes such as music sales shifting from record shops to streaming – but also the shift in focus, from a product focus to a customer focus, or from calling a cab to sharing a ride, that shows how cross-industry development works. While industries that are easy to digitalize, such as the media or the music industry, have already started the transformation toward the digital enterprise, more complex sectors such as the process and power industries will soon follow.

Siemens supports companies in integrating and digitalizing their entire value chains. The holistic concept makes it possible to digitally map and optimize each process step. Product Lifecycle Management (PLM) software simulates and analyzes each individual step. TIA Portal performs background tasks and basic engineering. The highly scalable Simatic IT Manufacturing Execution System (MES) increases production quality and transparency, allowing businesses to react to changes in production more quickly.

With MindSphere – Siemens Cloud for Industry, all products and plants are linked to digital data. This enables quick and consistent data management and analysis. ■

15%

Chemetal Group

... relies on Simatic IT in 20 production sites around the world. The company has increased its productivity by 15% with integrated data processing and plant transparency.

Suppliers

siemens

Lifecycle and
Data Analytics

50%

KMPG and Bitkom
... found that more than 50% of German companies rely on cloud solutions. Gearing, for instance, has considerably increased its machines' availability with MindApps.



24 months

Ducati
... has significantly reduced the time to market for a new model, from 40 to 24 months, using PLM software from Siemens.

17t CO₂

Audi
... reduces CO₂ emissions by at least 17 t per year in the production of the new A8 model in the Neckarsulm plant, thanks to energy-efficient drives and Totally Integrated Automation.



“Industrie 4.0” in plant design

The “4.0” label is making its presence felt, including in the process industry. Plant designers face the question of how digitalization will affect their business and products.

New business models are what's needed now. Companies that prudently maintain their traditional strengths while at the same time implementing new technologies with added value will have the greatest chance of maintaining their positions as pioneers in the coming digital age as well. “The list of requirements imposed by the process industry on its OEMs is long,” says Bernhard Saftig, who is responsible for Siemens’ business with suppliers to the process industry. “And this indicates how strong and solid the foundation needs to be before they can even start thinking about digitalization. As I see it, only the complete package means a competitive advantage.” He is certain that digitalization solutions will need to be included in this complete package in the future as well, so that end customers can achieve shorter project run times, greater flexibility, and increased efficiency. The foundation of an “Industrie 4.0” approach to achieving intelligent planning, pro-

duction, manufacturing, maintenance, and servicing is digitalized added value. “Not until all machines and subsystems consistently generate data and are networked together and linked to an information system will we have created the foundation for so-called digital twins. However, we need standards and the corresponding systems and software to implement this.”

Digitalization – it all starts with a plan

At the beginning of the value-added chain, plant designers have the option of relying on networked digital planning and simulation, followed by the virtual start-up of entire plants and facilities. This allows operators to put their plants into operation faster, and end customers can put their products on the market sooner. The plants can also achieve more stable production with maximum yield.

In the best-case scenario, plant designers will forward their data from the planning and commissioning

The process industry requires that its OEMs manufacture systems with ever-shorter run times, greater flexibility, and increased efficiency

stage to the end customer or plant operator, who can then use these data in the production phase to optimize the plant. Later, if any changes are made to the plant, the digital twin can follow suit.

Perfect synergy

For both the real and the digital plant, it is crucial that all system components are easy to integrate and perfectly compatible with each other. Standardization is another key strength that process OEMs can demonstrate when collaborating with Siemens. Automation standards not only allow increased synergy between all system components; they also significantly reduce engineering work.

Using valuable data during plant operation

Digital networks make it easy to determine the power consumption of both entire plants and individual consumers. For example, based on the captured data, a plant operator can see that fan motors do not all need to be running at full speed all the time when they are not actually required. The simple solution could be a converter. Another example: Thanks to digital networks, operators can estimate more accurately during the production phase when maintenance will need to be performed. Machinery and equipment can be serviced at exactly the right time before a problem causes downtime.

Maintaining traditional strengths

Despite digitalization, process OEMs should stay true to their traditional values. “High product and system

quality is one of the core competencies of process OEMs,” says Bernhard Saftig. These suppliers, which are usually market-leading medium-sized businesses, have in-depth process and sector expertise. “Their high-quality plants and subsystems often prove their worth thanks to integrated or connected Siemens technology. This enables process OEMs to give their customers the guarantee of high productivity and availability.” With the wide range of Siemens services – including automation and drive solutions, data-driven services, software and IT solutions – and a holistic approach, process OEMs always have a trump card up their sleeve to win over their customers. And to that Siemens’ international network and country-specific expertise can be added as well as the worldwide stock of spare parts and support during the entire lifecycle of the plant.

Staying ahead

“Those process OEMs that are already exploring the numerous possibilities of digitalization will be the forerunners who, with the support of Siemens, are sure to get ahead of their competitors,” claims Saftig. However, there is no instruction manual for digitalization. “It calls for bold movers and shakers among plant operators and equipment suppliers who can test something on a small scale before tackling gradually more challenging tasks.” ■

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Bernhard Saftig, responsible for Siemens’ business with suppliers to the process industry





Timely response to security threats

To enable a prompt and comprehensive response to security threats, Siemens has set up two Cyber Security Operation Centers (CSOCs), one in Europe and one in the United States, to monitor the security status of industrial plants. The CSOC staff reviews and analyzes all security-relevant data and immediately notifies the plant operator of any threats or attacks. In cooperation with the customer, CSOC experts then take appropriate countermeasures. Plant operators are legally obliged to notify the authorities of critical events in their infrastructure, so-called cyber incidents. The CSOC helps them comply with this requirement.

Cyber attacks – the danger from the Web

Every networked device is a potential target for cyber attacks. Manufacturers in all sectors face the challenge of protecting their industrial production facilities.

Networking production plants considerably increases the security risks. According to estimates by the security software provider McAfee, the damage caused by cyber attacks worldwide was about \$400 billion in 2014. It seems that company decision makers are aware of this threat, as evidenced by a study by the market intelligence company IDC, which suggests that worldwide investment in software to fend off cyber attacks will increase to more than \$100 billion by 2020. This represents an increase of about 38% from the predicted total of \$73.7 billion for 2016. To comprehensively protect plants, systems, machines, and networks against cyber attacks, all levels must be addressed – from the operating level to the field level, from access control to networks, terminal equipment, and copy protection. In Germany, another factor to be considered is the IT Security Act, which the German parliament passed in July 2015. This law requires plant operators to ensure comprehensive protection of their infrastructure. “We help industrial production customers create a holistic security solution tailored to their needs,” says Pierre Kobes, who is responsible for standards, regulations, and certifications at Siemens’ Divisions DF and PD. “Ours is a defense

in depth strategy that comprises three areas: plant security, system integrity, and network security.”

Plant security as the foundation

Plant security, which creates the foundation and ensures that technical protective measures cannot be circumvented, includes physical access protection measures such as fences, cameras, and card readers. These are supplemented by organizational measures, in particular a security management process that ensures plant security over the long term. Kobes describes the process as follows: “To make an informed decision on which measures make sense, we first analyze the risks. In this context, we consider the probability of occurrence as well as the extent of damage the risk could cause.” The results of the risk analysis are then used to establish security goals, which form the basis for organizational and technical measures. In the next step, the suggested measures are implemented to close any identified gaps. Ultimately, it is the human factor – the employees, specifically – that is and will remain important. Experts agree that 95% of all cyber attacks would become futile in an instant if all systems were updated regularly. So if a user keeps postponing a computer update, this can become a



400 bn \$

damage caused by cyber attacks worldwide in 2014



100 bn \$

estimated annual investment in software to fend off cyber attacks worldwide in 2020





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»We help industrial production customers create a holistic security concept tailored to their needs.«

Pierre Kobes, Product and solution security officer, responsible for standards, regulations, and certifications at Siemens' Divisions DF and PD

risk, too. Security solutions can only work if the staff understands their importance. "Workshops and web-based training increase employees' awareness of potential risks and teach them how to take appropriate countermeasures," says Kobes.

Sharing information about specific security incidents

Another hallmark of a comprehensive security concept is ensuring system integrity. This includes protecting automation systems and controls as well as SCADA and HMI systems against unauthorized access, and protecting the know-how they contain in the best way possible. The security concept also includes the authentication of users and their access rights as well as hardening the system against attacks. "If there are security issues, the Siemens service staff informs the companies and provides recommendations, updates, and security patches as quickly as possible. This way, we meet the requirements of the German IT Security Act," explains Kobes.

Protecting the automation network is crucial

Network security is at the heart of the security concept. This aspect includes protecting the automation networks from unauthorized access and checking all interfaces to other networks, such as an office network or the Internet. Transitions to other networks are protected by means of firewalls or a DMZ (demilitarized zone) – a network within a network, with controlled access to the data, devices, servers, and services in it. No connection can be established using the DMZ, even if one of the computers in it has been "taken over" by a hacker.

Production plants under cyber attack

For remote maintenance or telecontrol applications, it is often neces-

sary to connect plants to each other via the Internet. Hackers can easily detect unprotected entry points in plants with critical infrastructure using search engines, port scanners, or scripts. Here, it is necessary to implement protection measures against unauthorized access, the reading of confidential data, and the manipulation of parameters or control commands. Kobes explains the measures: "Our security concepts protect against potential threats to infrastructure with a high degree of networking and a high number of entry points." Multiple barriers are set up to fend off attackers as a threat management method. For example, even plant operators can access only certain plant sections, devices, or applications. Some have administrator rights, while others have only read or write access. Turning a blind eye to cyber attacks would be fatal and would limit the company's competitiveness. For cybersecurity expert Cameron Munter, targeted preparation is an absolute must if a company wishes to be ready for all eventualities: "There are two things to be aware of when preparing for cyber attacks. First, you need to understand the threat. This means that you have to know the abilities and intentions of all involved. Second, being prepared means being able to maintain operations if the operating environment is impaired after a successful attack. Large financial and telecommunications companies are already prepared. In other sectors, much remains to be done to increase resilience." ■

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Schunk GmbH & Co. KG

Smart assembly

Digitalization offers tremendous opportunities for assembly automation. To enable plant manufacturers and users to develop and implement their projects efficiently, Schunk, the world market leader for clamping technology and gripping systems, has been digitalizing its electrically controlled gripping system components.

Product lifecycles are becoming ever shorter, and innovations follow each other in quick succession. This translates into very high demands for flexibility and efficiency in machine and plant development, because the shorter the time to market for a new product, the further ahead it is compared to the competition. Highly customized assembly lines devel-

oped for very specific products play a key role in meeting these demands.

Schunk GmbH & Co. KG is setting new standards for handling systems. Using electrification, Schunk has introduced completely new, intelligent features to the pneumatics-oriented market of high-performance assembly, which makes setting up mechatronic assembly systems significantly easier. The mechatronic

24-V kit of gripping system components now, for the first time, makes it possible to realize entire assembly systems using 24-V technology, which reduces danger to personnel.

Shorter projects thanks to digital twins

In a further step, Schunk is now focusing on the digitalization of its electronically controlled gripping >

system components in cooperation with Siemens PLM Software. “Using the corresponding software, the entire kit is simulated virtually in three-dimensional space, and the entire engineering process, from concept to mechanics, electrical system, and software, to virtual commissioning, is mapped out, in parallel whenever possible,” says Ralf Steinmann, head of the gripping systems division at Schunk. He hopes that plant manufacturers and users will benefit from significantly shorter projects, faster commissioning, and a considerable increase in efficiency when building similar plants.

The digital images of the individual components contain their complete mechatronic functionalities: “The digital twin opens the door to integrated engineering and lays the groundwork for connecting all the disciplines involved,” Steinmann emphasizes. In the future, isolated software solutions or even manual procedures will be able to be integrated and mapped in the Mechatronics Concept Designer (MCD) engineering system in a considerably more comprehensive way than has been possible so far. Digitalization makes engineering more efficient and prevents errors in the planning process. “By bringing together all the information in one system and simulating entire applications, all the individual processes can be coordinated and optimized,” Steinmann says. The system also immediately detects if, for example, individual motions have been forgotten. But that’s not all: “The virtual model is the basis for programming the individual components as well as for traceability and real-time control in ongoing production,” explains the experienced handling specialist. And expert Martin Schleaf, head of the machinery and equipment industry business unit of the Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart, Germany, confirms the advantages of a digital twin: “Virtual commissioning saves a lot of time and money. One possible use of simulation tools is to test and evaluate manufacturing



Schunk GmbH & Co. KG

The company was founded in 1945 as a machine shop and today is a global technology and market leader for clamping technology and gripping systems. Headquartered in Lauffen am Neckar, Germany, Schunk has more than 2,700 employees in eight plants and 30 subsidiaries, as well as sales partners in more than 50 countries to ensure an extensive market presence. With 11,000 standard components, Schunk offers the largest range of products in clamping technology and gripping systems worldwide, and with 2,550 Schunk grippers, the most comprehensive standard gripping component portfolio on the market. The company’s customers include a who’s who of machine and plant manufacturing, robotics, automation, and assembly handling, as well as all major automotive brands and their suppliers.

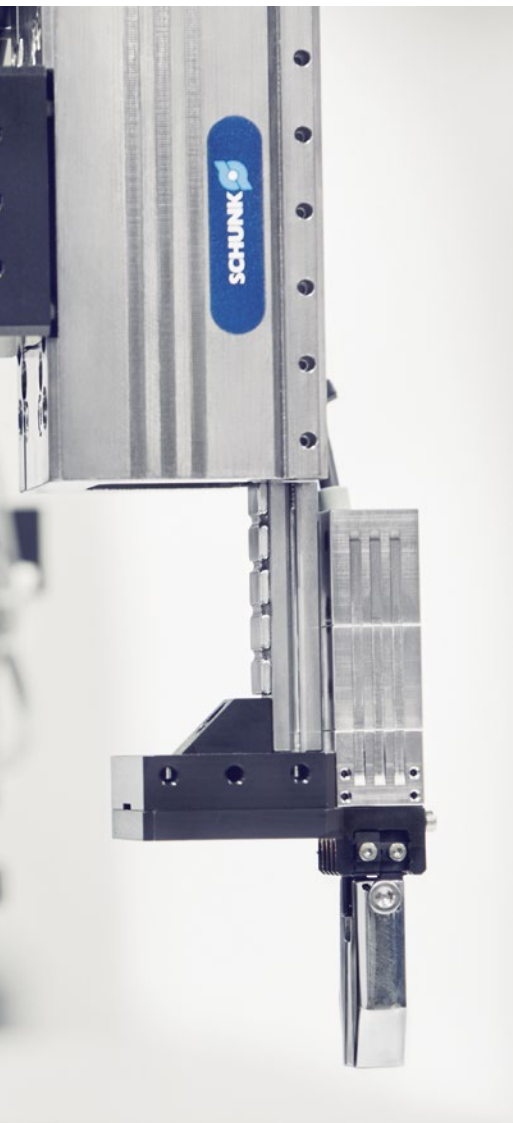
control systems ahead of time, thus shortening the entire commissioning and ramp-up phase. Disturbances that occur beforehand, for example, faulty parameters, can be eliminated.”

Virtual intelligence

A pilot plant made of Schunk mechatronics components, which Siemens presented at the SPS IPC Drives 2016 trade fair in Nuremberg, shows that all this is already possible with the MCD. In this pilot plant, all Schunk modules were equipped with virtual intelligence in the form of a kinematic model. In contrast to customary usage, the digital twins receive data not only on the outer contour but also on weight and stroke, as well as infor-

mation on moving parts and their acceleration, speed, and arrival at the end position. All aspects of the real machine behavior can thus be simulated and optimized in the virtual model.

All this happens in parallel in the engineering software. “Even though today it is not yet possible to transfer the virtually generated process as is to the real plant, about 70% to 80% of the sequential programming is already contained in it,” Steinmann estimates. In addition to the process sequence, the software displays all phases and dependencies. It is now possible to determine which motions are necessary or possible as early as the planning phase. Steinmann says: “We see it as our mission to lead the



Schunk GmbH & Co., KG

way here with our mechatronic kit and to actively drive the process of digitalization. In this process, it will be critical to design the digital twin in such a way that it fulfills its function for the design engineer in an optimal manner. Siemens PLM Software is a reliable and expert partner for us in this initiative.” ■

An interview with expert Martin Schleef is available online at sie.ag/interview-with-Martin-Schleef

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Schunk GmbH & Co., KG

“A digital twin will become standard at our company.”

Marcel Nagel, Head of central portfolio management, Schunk GmbH & Co. KG

We spoke with Marcel Nagel about the opportunities presented by digitalization and the collaboration with Siemens PLM Software.

Mr. Nagel, “Industrie 4.0” is becoming a reality at your company. What do you hope to achieve with the digitalization of your electrical gripping system components?

Marcel Nagel: With digitalization, we offer added value for our customers that others don’t. Of course, we see it as an opportunity that sets us apart from the competition. In terms of efficiency and hardware, our products have reached a level where there is little room for further growth. But when it comes to service, we can once more push forward into completely new dimensions, thanks to digitalization.

Could you provide a bit more detail?

Marcel Nagel: Ultimately, our customers want to bring their products to market faster. For them to do so, the engineering process has to become shorter and faster, and if this also results in cost savings – even better. The Mechatronics Concept Designer from Siemens PLM Software, which allows us to map our entire mechatronic kit for high-performance assembly and the entire engineering process, from mechanical design to commissioning, let’s do this.

Siemens considers itself to be the market leader when it comes to digitalization. What’s your opinion?

Marcel Nagel: Siemens has long been a proven partner in the auto-

mation of our depaneling machines. Here, we use TIA Portal, for instance. Also, we looked throughout the market for solutions for our digitalization project, but only Siemens really thought of everything, without omitting any production scenario. And most recently, for the virtual commissioning of the assembly line, we’ve had to deal with control systems – with hardware- and software-in-the-loop being critical – where Siemens is the market leader. Especially now, when we are still building our expertise with the Mechatronics Concept Designer, close cooperation is important. We have about 5,000 standardized products in our program that will all receive a digital twin. To achieve this, we need intelligent designs that allow for a high degree of standardization.

You demonstrated a pilot application at the fair in Nuremberg. What is the next step?

Marcel Nagel: About 50 of our components have already been modeled for this pilot plant, allowing for virtual commissioning, which saves a lot of time and money. You can already see that in this model. But it is important for the simulation that all the components of a plant have a digital twin. So there still is a lot left to do. If a customer has a specific inquiry, we can get started right away and give modeling priority to the required components.

Particle board production of the future

Dieffenbacher in Eppingen, Germany, designs and builds complete plants for the production of wood-based panels. Digitalization plays an important role in future-proofing the plants. This process requires both data transparency, as the foundation for optimization, and the protection of know-how, in order to safeguard investments.

As a mass-market product, particle boards sell primarily based on price. For this reason, competitiveness is always important in the wood and timber processing industry. Ulf Könekamp, director business unit industry automation at Dieffenbacher, summarizes the challenges: “Our customers expect not only high productivity and plant availability but also energy efficiency and the most economical use of resources possible. Fulfilling all these different demands at the same time requires know-how and innovative technology. The corresponding investments are doubly worth it, though: the more precisely we are able to control parameters such as glue content or pressing power, the more resources we can save and the higher the quality of the boards produced. This may well result in additional areas of application for the particle boards – meaning additional market potential for our customers.”

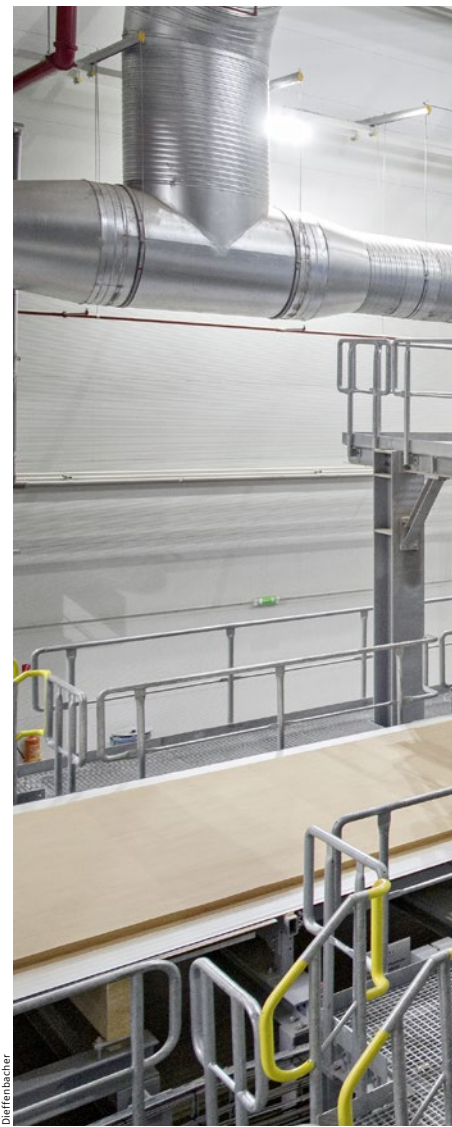
Significantly simpler: automation on a common platform

Press lines from Dieffenbacher have a modular design made of self-contained units. In addition to the specific control requirements, this results in high demands on communication between the units. Previously, resource requirements forced individual plant sections to use special PC-based solutions. Additional interfaces and different communications protocols led to increased expenditures and higher susceptibility to failure. Könekamp says: “With the new Simatic S7-1500 and the possibilities presented by TIA Portal V14, we are now able to design even complex control systems. The CPU 1518 allows for very short cycle times and handles motion control functions. The perfectly matched Sinamics drive technology is integrated into the joint configuration via TIA Portal. With one control system for all tasks, the number of interfaces is reduced,

making engineering substantially simpler. We save configuration time, and the customer benefits from shorter cycle times and more precise processes. Using Profinet and OPC UA as integrated communications standards all the way to the field level notably enhances plant transparency. The improved diagnostic options result in increased plant availability.”

Essential: protecting the know-how of the OEM and plant operator

With its know-how, Dieffenbacher has achieved an excellent position on the global market. Könekamp says: “The competitiveness of our



Dieffenbacher

Materials can be used more effectively and efficiently with press lines made by Dieffenbacher



customers – but also our competitiveness as a manufacturer – essentially depends on protecting our know-how and our plants from unwanted program manipulation. This is why we enclosed the programs of particularly sensitive plant areas in complex PC programs. This also caused additional engineering expenditures. With Simatic S7-1500 and TIA Portal, we are now able to integrate these components into automation as well. With support from Siemens, we found a solution for this that fulfills all the related requirements and eliminates the additional expenditure of maintaining separate programs. >

»Our customers expect not only high productivity and plant availability but also energy efficiency and the most economical use of resources possible.«

Ulf Könekamp, Director business unit industry automation at Dieffenbacher

Savings potential: transparent energy flows

Standard components for recording consumption, such as the energy meter, will become increasingly important. “The recording of energy consumption data and the resulting transparency enable energy savings,” Könekamp explains. “Until now, energy consumption data have been recorded and displayed only in a very limited way – and in parallel structures – or not at all, but these consumption data can provide valuable information on the condition of a plant and serve as an instrument for preventive maintenance.” With the Simatic Energy Suite, recording and displaying energy data is an integral part of the automation system. The customer decides whether to use the data for process optimization or perhaps even for optimizing energy procurement. The ISO 50001-certified Energy Manager PRO option offers all the possibilities of innovative energy management.

Guaranteed future: digitalization – with IT security

Dieffenbacher selected the new Simatic also because of the long-term availability and guaranteed future. “When we have to guarantee our customers availability of the automation technology for 10 to 20 years, we also have to ask ourselves how the plants are prepared for the requirements of increasing digitalization,” Könekamp says. “With the integrated support of OPC UA, we have an important argument here. Vertical communication with production control systems, along with the documentation of data and their target-group-specific preparation and extraction, is becoming increasingly important in the age of “Industrie 4.0.” A communications standard that is independent of manufacturers and platforms significantly reduces the effort for all that. Legal requirements and possible obligations to produce proof in connection with environmental regulations are also easier to fulfill this way.”

For plants with a high level of digitalization, the question of IT security also always arises. Siemens has already implemented IT security as an integral part of the development process of its automation and drive technologies – and was the first manufacturer to receive a corresponding certificate from TÜV Süd. Könekamp says: “IT security is very important to our customers. Siemens’ defense in depth strategy helps us meet our customers’ security requirements.”

Currently, Dieffenbacher is building state-of-the-art plants in Southeastern Europe and in Asia. Könekamp says: “Because of the optimizations we’ve carried out together with Siemens, we are confident that with our innovative and resource-efficient composite board plants, sustainably competitive production is possible in Europe as well.” ■

➤ [siemens.com/tia](https://www.siemens.com/tia)
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Electrification meets automation

Totally Integrated Power supports the distribution of electrical power along the entire value chain, with solutions for sustainably increasing efficiency and productivity from the planning stage to operation and also for future expansions and retrofits.

By integrating molded-case circuit breakers and communications-capable measuring devices, electrification becomes an integral component of the automation solution, allowing plant owners to easily monitor plant status and collect data for energy diagnostics. Once the data have been analyzed, they can be used to optimize energy consumption and capacity utilization, for example, per day, shift, line, or production unit of a plant, compared to other plants, also for procedures or processes, in a factory or across all sites.

Power distribution now also joins measuring devices and molded-case circuit breakers in being seamlessly integrated into the TIA Portal engineering framework.

In TIA Portal, users can parameterize power distribution products directly, put them into operation, and integrate them into the automation task. This facilitates single-tool engineering, intuitive configuration of power distribution systems, and access to measurement and diagnostic data.

The Simatic Energy Suite option in TIA Portal generates the energy data collection program automatically, reducing configuration work and making energy consumption in production more transparent. The data can be displayed directly on panels or with WinCC. The configuration already provided in the Simatic Energy Suite can be used in Simatic Energy Manager PRO to make company-wide and economic energy analyses, or the data can be analyzed with a cloud-based solution.

Learn more about power distribution in TIA Portal:

➤ [siemens.com/lowvoltage/tia-portal](https://www.siemens.com/lowvoltage/tia-portal)

Programming at the Sinumerik CNC keeps the company's engineers free to focus on new products and customer development



Siemens Industry, Inc.

“King of baskets”

Due to Sinumerik 840D sl, the Versaweld machine produces welds 30 times faster than other automated welders



Siemens Industry, Inc.

Marlin Steel exemplifies the future of the US machine tool industry. Facing global competition and decline, the company set out on a new course – one that has resulted in 700% sales growth and a strong position in America’s fourth industrial revolution.

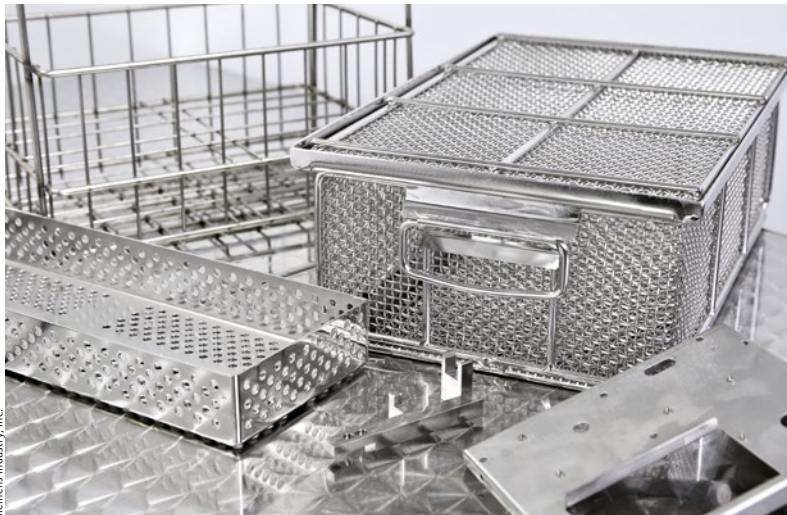
Marlin Steel is a machine shop dedicated to work-
 _____ place automation and investment in employee education. The shop has been featured in American business media such as Bloomberg Business, CNN, CNBC, FOX, the Wall Street Journal and the New York Times, among others. But this was not always the case. Marlin Steel was once known as the “king of bagel baskets.” Founded in 1968, the Brooklyn, New York, steel wire manufacturer established a niche by hand welding its manufactured wire to form baskets for the bagel market. The company went >

on to become the dominant supplier of wire baskets to bagel bakeries everywhere. So when Drew Greenblatt bought the company in 1998 and moved it to Baltimore, Maryland, the plan was to upgrade operations and bring a thriving business into a new century. After 30 years of bagel basket market domination, what could go wrong? What went wrong was that soon after purchasing the company, Greenblatt discovered that the bagel basket market was shifting in favor of foreign-manufactured wire baskets. The newly acquired company was in jeopardy because competitive basket prices were falling below what Marlin Steel paid for the steel alone.

Breaking away from the past

Around this same time, Greenblatt received an important phone call, which presented an intriguing and fortuitous question: Could the bagel basket shop custom engineer and manufacture a special basket for one of the world’s largest airline manufacturers? Greenblatt says the opportunity to work with a highly-renowned company made him realize the critical relationship between quality, engineering and speed: “Quality Engineered Quick became our mantra and our

Marlin Steel delivers specially developed and manufactured wire baskets to 39 countries around the world



Siemens Industry, Inc.



Siemens Industry, Inc.

Thanks to investments in highly modern CNC technology, Marlin Steel was able to significantly boost its productivity

future,” he recalls. “We were moving into the Siemens world, where you measure performance in increments of plus or minus 0.01 mm. Until then, we had done business in a world measured by plus or minus a bagel, and so long as the bagel stayed in the basket, the customer was very pleased.” Quality Engineered Quick meant breaking away from the past and from the hundreds of wire basket manufacturers using alternating current (AC) welding to produce wire-formed baskets. Dating from the early 20th century, the AC welding process involves the manual clamping of copper electrodes to weld the intersecting wires. Each weld leaves a deposit of scars, divots and pockmarks. This requires labor-intensive cleanup to produce a basket that is safe and hygienic for food, medical, pharmaceutical and other customer applications.

A greater return

Greenblatt says his company’s ascent with the airline manufacturer compelled him to invest in truly advanced, CNC-driven welding

»As a machine tool manufacturer, you have a choice: invest in modern technology based on Sinumerik and achieve success or go under.«

Drew Greenblatt,
Owner of Marlin Steel

technology. The opportunity was not to just cut costs and try to compete with Chinese wages. Greenblatt was determined to leap ahead of competitors by investing in CNC technology that would bring the highest possible return at every level – machines, operations and people. At the machine level, an incremental first step was to produce faster welds. But another need was to eliminate the post-weld cleanup process. “Our biggest technology investment was a Siemens CNC-driven medium-frequency welder,” Greenblatt says, “It’s a Versaweld CSR102 jig welding system built by Ideal Welding Systems. And it’s powered by a Sinumerik 840D sl control package.” A key advantage of the machine is the vertical motion of the z-axis welding head, which enables the automated welding of basket wires. In the time it takes to complete two welds using conventional AC welding, the Sinumerik-driven Versaweld CSR102 can finish 60 welds. Each weld is completed in 2/1,000 of a second, 30 times the speed of other automated welders on the market. So heat saturation

is diminished, minimizing deformities as a result of the weld and producing a basket without the cleanup time and labor costs.

New digital technologies

At the operational level, the investment in advanced CNC technology is helping Marlin Steel integrate a new generation of digital technologies, ranging from robotics to additive manufacturing. Operational schemes have been reconfigured for increased productivity; deburring has been eliminated by the Siemens-driven medium-frequency welding operations; and the system does not miss weld intersections, thus eliminating a rework step that was part of past operations. At the employee level, the removal of the costly cleanup phase has enabled the company to win new customers, increase revenue and redirect resources to support an entirely new business model: one centered on a more skilled and empowered workforce. “Today, 20% of our employees are degreed mechanical engineers,” Greenblatt says. “We are now shipping custom-engineered and -manufactured wire baskets to 39 countries – regions where we now have the competitive advantage.”

Anything is possible

The Sinumerik CNC platform has brought Marlin Steel a return that is game changing, but Greenblatt knows the game goes on. His company has only just begun its move into the era of “Industrie 4.0.” He has become an often-quoted believer in the return of American manufacturing by way of investments in leap-ahead technology that will lift up a new generation of skilled workers. “We are in a very dynamic, global marketplace,” Greenblatt says. “Quality Engineered Quick means we have to be even more focused on engineering, more focused on shipping faster, and that means staying focused on having the best CNC technology. ■

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Nanjing Lehui

is part of the Chinese Lehui Group, which is Asia's leading brewing and beverage engineering company. Lehui Group offers the full spectrum of services to the industry, including planning, consulting, design, manufacturing, system integration, commissioning, and training, and installs complete manufacturing lines as a turnkey service. Nanjing Lehui specializes in packaging machinery manufacturing. Since installing the Simatic S7-1500 controller and integrating it with TIA Portal, Nanjing Lehui has greatly enhanced the productivity and competitiveness of its production lines. This has enabled Nanjing Lehui to establish itself as a global leader in beverage manufacturing systems and put into practice its philosophy of "European Quality, Chinese Price."

The perfect brew

Nanjing Lehui shows how an individualization of mass production is possible today through digital transformation. With a reduced complexity of its beverage production lines Lehui now meets growing industry demand for individualized production and a reduction of time-to-market at the same time.



Lehui provides global customers with the most comprehensive and high-quality brewing and filling equipment

More than one-third of China's annual beer output is produced using Lehui's equipment, and the company has more than 500 customers worldwide, including Pepsi, Heineken, and Nestlé. To build on its 25-year track record of growth and expand its international business, Lehui wanted to raise its production line standards to be on par with those of competitors in the United States and Europe. Upgrading its equipment would prove critical to the development of the company.

Simplifying the complex

Each production line installation previously had to be customized to suit the customer's requirements, and Nanjing Lehui had to provide training and engineering tools, making every installation slow and complex. The key to improving productivity and reducing time to market was to eliminate this complexity. Nanjing Lehui also wanted its manufacturing lines to be capable of remote monitoring and control to minimize downtime.

To achieve these goals, Nanjing Lehui decided to upgrade its production lines. "We have been working with Siemens since the 1990s, and they continue to provide us with valuable support whenever we need to migrate or upgrade our systems," says Zhang Yongji, deputy chief engineer and manager of the automation department at Nanjing Lehui. Lehui now relies on an automated and advanced controller solution from Siemens. The system was selected due to its reliability and the advanced integration of diagnostics with security. "Using Siemens TIA solutions on brewery equipment production lines has helped greatly to reduce downtime and guarantee the flexibility, reliability, and efficiency of production lines for our customers," says Jiang

Yuchao, deputy manager of the automation department at Nanjing Lehui.

Exemplary engineering

Beverage manufacturing is a high-volume business, and avoiding downtime is critical. The benefits of the controllers' intuitive, colorful display were obvious from day one. It was essential that the controller be usable by non-English speakers, so its touchscreen buttons were given Chinese symbols that made them easy to understand. All the diagnostic information is also standardized so that maintenance staff can review it in Chinese without needing additional training or reference documents.

The buttons are sensitive enough to be used by engineers even when wearing gloves, and they can easily drag and drop on-screen elements instead of keying in commands. This saves time, reduces error rates, and improves efficiency. With multiple modules integrated into one interface, managing the spare parts inventory is now also a simple and less costly process.

Production and data security

Keeping customers' data secure was also of high importance to Nanjing Lehui. Therefore advanced security features, which include access control and protection of proprietary technology, were essential. These features give Nanjing Lehui's customers the reassurance of knowing that their data are protected against attacks and data leaks while ensuring the reliability of data communications. ■



Using Siemens TIA solutions on brewery equipment production lines can help greatly reduce downtime, and guarantee flexibility, reliability and efficiency of productions of end users. In addition, the fail-safe products can ensure machinery and personnel safety

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Flexible networking and efficient production

Plant manager Udo Wiggermann at the Siemens plant in Haguenau, France, faces quite a challenge: his production lines need to be changed and restructured regularly. A powerful communications infrastructure helps him flexibly respond to ever-changing market conditions.

Industrial communication is changing. And it is doing so at a breakneck pace: the number of machines connected to a higher-level control system in 2020 will be 10 times the number registered in 2010. In 2025, there will be 526% more industrial robots than in 2000. The annually transmitted data volume will increase by more than 30 times over the same period – to 40 EB (40 billion GB!). To ensure that the system can cope with the data volume, a functioning, flexible communications infrastructure is essential for successful production. Wiggermann considers this a prerequisite for continuous and yet flexible production at his plant as well.

The field instruments of the Sitrans families, including positioners, pressure and temperature transmitters, gas analyzers, and laser spectrometers, are manufactured at the Siemens production plant in Haguenau. “It is typical for our production that we frequently add new products and need to change or restructure the lines we already have,” says plant manager Wiggermann. “We want to make our production process as efficient and lean as possible.” For him, digitalization is coming right on time.

But wherever digital data is to replace paper, the data highway needs to be kept free of traffic. Failure to ensure this leads to production outages, delays in delivery, or waste of resources. For this reason, the office and production worlds are moving closer together to prevent disruptions in the production process. This is also the case in Haguenau.



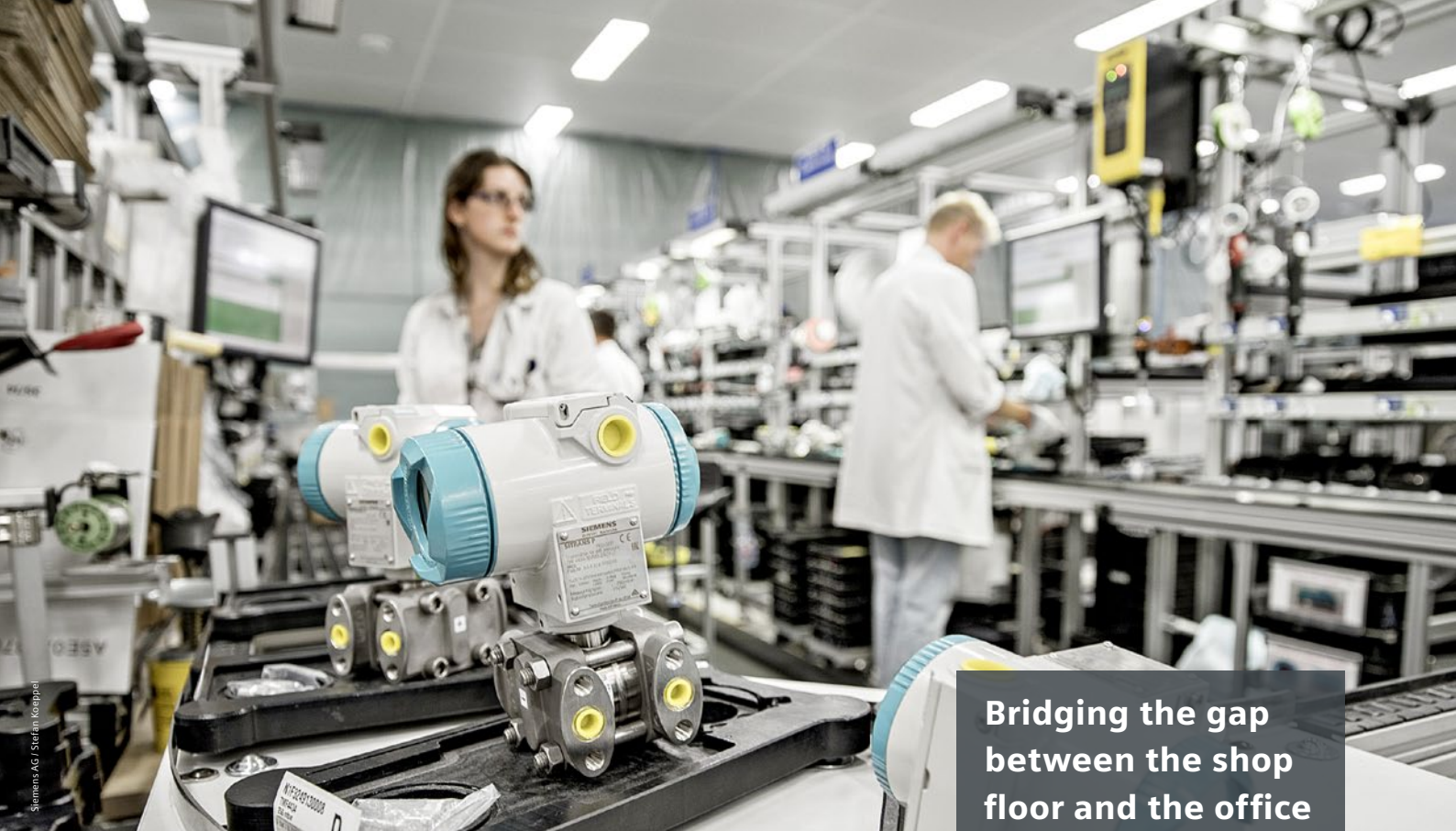
PCs and controls of the production lines and work stations are radially connected to the central data server via rack switches

Networks grow together

Open and generally accepted standards are the foundation for end-to-end communication. For computer and system networks, these standards include, for example, Ethernet and TCP/IP, while Profibus, Profinet, and HART have been embraced as the technologies of choice to control processes, production plants, and machines.

Ethernet remains the dominant system. It connects private laptops at home to the Internet, networks all the computers within a company, and is the connection solution behind countless mobile applications. Today, the transaction costs for saving and sharing information and for saving vast amounts of data in the cloud are negligible. Therefore, it is only logical that Ethernet is set to become more and more important in plant automation. The most important keyword in this context is Profinet.

One in three networked machines and plants uses this open Industrial Ethernet communications standard. Not only does it allow for real-time communication; it also enables integrated horizontal communication between the previously strictly separated worlds of office and production systems.



Siemens AG / Stefan Koepf

Bridging the gap between the shop floor and the office

Ethernet switches are used at three connection points to create a unified user experience for the office and industrial network. Industrial Ethernet switches from the Scalance X product family in different performance classes with a bandwidth of up to 10 Gbit/s meet the requirements for a reliable, secure, and rugged office network or industrial backbone.

A flexible network is needed to be able to constantly adjust the production of different Sitrans field instrument versions in small to medium batches

Big data as an engine of innovation

The office and production worlds are not the only ones converging. With integrated vertical communication in the industrial systems landscape from the enterprise resource planning (ERP) level to process control to each individual machine, new opportunities arise with access to big data and cloud-based applications. This results in, for example, production and process plants that flexibly respond to requests, monitor themselves, and report technical problems long before they can lead to production outages.

Intelligent production is no longer just a dream, because all the technology that is needed to make it a reality is available today. The result will be flexible production systems that can do much more than just manufacture a product in several versions. Hence, today's business model is called mass customiza-

tion. This term is used to describe the production of highly differentiated products under the economic conditions of automated mass production. Intelligent production also makes it easier to respond faster to changes in the market – which is just what Wiggermann needs in Haguenau.

New solutions for new challenges

With a flexible three-layer network architecture, it is possible to quickly and easily restructure entire sub-networks. This allows new controls and computers to be easily connected to production machines and workstations or to office computers or phones to meet the rapidly changing production requirements at any time.

Because Siemens' own products are used in the Haguenau plant, they are also tested for usability and performance in continuous operation. Wiggermann's objective is to make production as efficient and lean as possible. Thanks to the

stable network architecture with rugged and flexible components, he is on track. Didier Mayer, the director of information technology at the site, agrees: "We are very happy with our new production standards." ■

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Isolated solutions are ineffective

As in many other industries, digitalization is considered a necessary step in glass manufacturing. When digital data from a wide variety of sources can not only be generated but also evaluated and used as a basis for business decisions, all glass manufacturers, OEMs, systems integrators, and even investors can benefit.

Products from the glass industry can be found everywhere: in architecture, in daily life, and even in research and high-tech sectors such as the solar power industry. Even though glass is produced in large dimensions and quantities, it still is far from being a

mass product. Endowed with special product properties, it can be the decisive factor in whether there is light or shadow or whether power is generated or heat is regulated, and it is sought after for smartphones and touchscreens. Globalization and increasing competitive

pressure in both international and domestic markets, cost pressure and major investments in manufacturing plants, long research and development times, and, last but not least, energy costs and environmental restrictions pose a great challenge to companies in the glass





EME Maschinenfabrik Clasen GmbH

industry. At the meeting of the VDMA (German Engineering Federation) industry work group for research and development, Oliver Krapp, head of Siemens' glass business, concluded: "Glass manufacturers, just like businesses in any other industry, constantly have to prove that they are competitive. One way to do so is through digitalization and networking – for example, by shortening the time-to-market and increasing flexibility in production."

Digitalized glass manufacturing? Not quite!

In practice, however, the industry is not quite there yet. Independent from the degree of automation, every modern glass plant and every OEM generates and collects digital data. But much of this information is lost. The data need to be evaluated, combined intelligently, and expanded with the help of additional sensors and probes to optimize the plants.

In glass production, the lifecycle of production plants can be divided into the phases product design, process and plant design, engineering and construction of the production plant, and operation and services. In digital enterprises, these phases should no longer be seen as sequential processes that build on each other, but as a value-added chain with back links to all phases. It should therefore be possible to plan, test, and modify all production steps with the help of software. Nevertheless, many of the software solutions currently in use are not compatible with each other. Data sheets, for example, are still printed out and integrated into a different system by hand. This method is not only time-consuming and expensive but also susceptible to errors. What is more, glass plants often use different systems with individual solutions for automation, drives, instrumentation, and switching technology. But such isolated solutions are ineffective for

digital production, and the first steps toward digitalization are being taken with modern development and configuration environments.

California glass manufacturer uses digital engineering

The US glass manufacturer Gallo Glass successfully implemented this approach. To retrofit its plants, the company commissioned EME Maschinenfabrik Clasen GmbH to configure and upgrade the batch plant and parts of the cullet return system at its glass bottle production facilities. At the same time, the end-to-end automation system for the entire plant was equipped with a standardized process control system with simulation software – which was also a first. Especially for the batch plant, this was a challenging task. There were several hundred different combinations and transportation routes that the batch (raw materials) could follow on its way to the furnaces. With the new solution, weighing, mixing, and conveyor applications could be integrated into the automation system, taking considerable pressure off the operating staff. As an overall result, the production process could be designed to be more flexible and safer.

According to Rogel Knüttel, control engineering department manager at EME, digitalization pays off especially when it comes to virtual commissioning and plant simulation, because now "we can test and put our plants into operation without any mechanical or electrical hardware at all. Faults are detected and eliminated, and it substantially shortens the commissioning time on site." He calculates that engineering time in the configuration and testing phase was reduced by about two-thirds.

Gallo Glass has been operating with its modernized plant at its headquarters in Modesto, California,

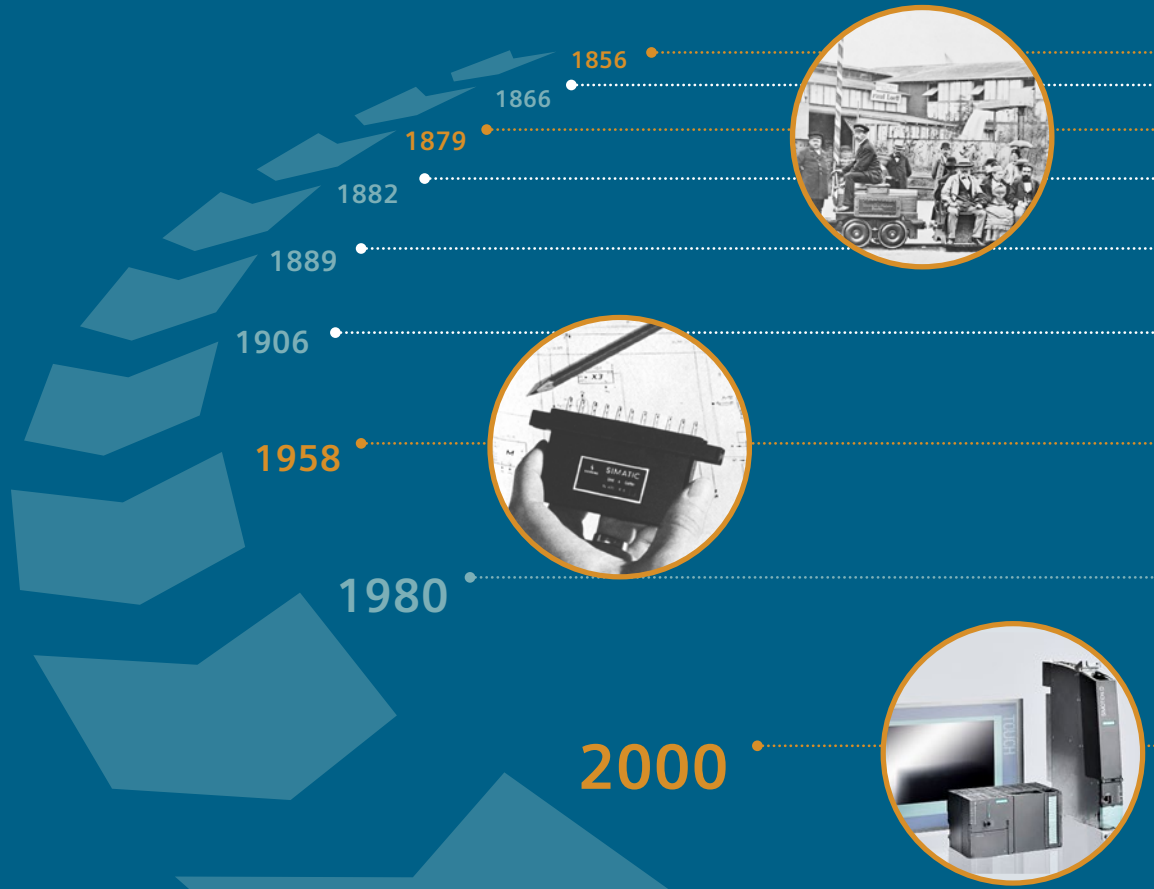
»Now we can test and put our plants into operation without any mechanical or electrical hardware at all. Faults are detected and resolved, and it substantially shortens the commissioning time.«

Roger Knüttel, Control engineering department manager, EME

since late 2015. The plant-wide automation with automated plant configuration using state-of-the-art controls is an important step toward increased flexibility and safety – and it was made possible by the Simatic PCS 7 process control system and the Simit simulation software. ■

Read more on the digitalization of the glass industry here:
sie.ag/digitalization-glass-industry

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Strong drive for 150 years

The discovery of the dynamo-electric principle helped electric machines achieve their breakthrough and to this day plays an important role in the electrification of the world.

Werner von Siemens discovered the dynamo-electric principle 150 years ago, and developed the first dynamo machine, which enabled electricity to be generated from work power. This laid the foundation for modern mobility and industrial mass production. The invention was based on two ideas: first, the generated power is at the same time the exciting current for field magnets, and second, the magnets' remaining magnetism is strong enough to induce the mutual amplification of the armature current and the magnetic field. This mutually-induced escalation is known as the dynamo-electric principle. Reversing the principle allows electricity to be converted to mechanical work. This

discovery opened the doors to the use of electric motors in industry and manufacturing 150 years ago and is still the basis for what we now know as modern mass production. This year would have been Werner von Siemens' 200th birthday. Just in time for this anniversary, Siemens presents an integrated drive system consisting of a reluctance motor and specially coordinated converters. These systems are taking hold as an energy-efficient and economical alternative, especially for pumps, fans, and compressors. Even in today's age of digitalization, electrical engineering is still bursting with innovative power, as is demonstrated by the integration of motors in the digital factory. ■



- **1856** Werner von Siemens invents a power generator with a double-T anchor
- **1866** Werner von Siemens discovers the dynamo-electric principle and develops the first dynamo machine with a double-T anchor
- **1879** Siemens presents the first fully operational electric train and the world's first electric tram at an industrial exhibition in Berlin
- **1882** Alternating current begins to establish itself as the competitor to direct current
- **1889** Mikhail Dolivo-Dobrovolsky, chief designer at AEG, develops the first serviceable (three-phase current) asynchronous motor
- **1906** Siemens builds the first reversible electric drive for a blooming train at the Georgsmarienhütte steelworks near Osnabrück, Germany, with a maximum performance of 6,800 kW
- **1958** Siemens introduces the Simatic PLC for centralized control of plants and machines
- **1980** Siemens develops a rolling mill main drive with three-phase current technology, marking the beginning of the end of DC drives
- **2000** The introduction of fieldbuses and the Simotion motion control system makes production automation more flexible and cost-effective
- **2013** For the first time, the Integrated Drive Systems concept takes an integrated view of all the components in the drive train

2013

2016

- **2016** Siemens presents an integrated drive train consisting of Simotics reluctance motors and specially coordinated Sinamics converters, with considerably increased efficiency; especially in the partial-load range, the system offers energy and cost savings

To find out more about reluctance drives, please visit siemens.com/reluctance-drive-system



Two pioneers join forces

The question at the core of every discussion on alternative energy in Germany: How can power be transported efficiently from the large wind farms in the north of the country to the south? A new hydrogen storage technology could be the solution – and it would even be affordable.

Hydrogenious Technologies and Siemens both have innovative energy storage technologies and have now joined forces in a pilot project. “With our approach, it is possible to store hydrogen safely, as it is bonded to what is known as a Liquid Organic Hydrogen Carrier (LOHC),” explains Dr. Daniel Teichmann, the CEO of Hydrogenious Technologies in Erlangen, Germany. One cubic meter of LOHC carrying hydrogen replaces approximately 60 gas cylinders. However, the real highlight is that hydrogen no longer

needs to be transported in molecular form. Instead, with this chemical storage method, the cargo consists of a low-flammable, non-explosive oil. With its Silyzer electrolysis system, Siemens can transform electrical power into hydrogen without releasing carbon dioxide (CO₂). So combining hydrogen production (Siemens) with hydrogen storage (Hydrogenious) seemed like an obvious candidate for a demonstration project creating an intelligent process chain from the sun to power consumption.

World market for hydrogen

The worldwide market for industrial hydrogen comprises about 650 billion Nm³ per year. Even though approximately 80% of hydrogen is produced and processed in on-site plants, about 130 billion Nm³ of hydrogen still need to be transported from point A to point B every year. The total market for hydrogen that has to be transported is worth about €70 billion to €100 billion. For many of the buyers, transporting and storing hydrogen is a major cost factor in their hydrogen supply chain. The market for efficient hydrogen plants is correspondingly large and could continue to grow, especially considering the future of electromobility.



Solar power for the car – even when it’s cloudy

At its Erlangen location, Hydrogenious Technologies impressively shows how this is possible. The power generated by the company’s own solar power plant is transformed into hydrogen with a Silyzer. Then the hydrogen is immediately bonded to the LOHC liquid. The hydrogenated LOHC is transported in a standard liquid tank, which can be either plastic or stainless steel, to Stuttgart, where the hydrogen is released again. There, on the parking level of the Fraunhofer Institute for Industrial Engineering IAO, the substance is transformed into electrical power in a stationary fuel cell



»The possibility of combining these technologies for off-the-grid power supply is particularly interesting.«

Dr. Daniel Teichmann, CEO and founder of Hydrogenious Technologies, Erlangen, Germany

Hydrogenious Technologies – a start-up with honors

Not so long ago, in 2013, Dr. Daniel Teichmann, together with Prof. Wolfgang Arlt, Prof. Peter Wasserscheid and Prof. Eberhard Schlücker, founded Hydrogenious Technologies, a start-up with roots in the Friedrich-Alexander University of Erlangen-Nuremberg.

In 2014, Anglo American Platinum came on board as an investor, and in September 2014, the company officially began operations at its current site, with four employees. The company has since grown to 30 employees and has won many start-up prizes with its patented technology. In April 2016, for example, it was awarded first prize in the start-up category of the 35th German Industry Innovation Awards.

and can then be used to recharge electric cars. The aim of the Fraunhofer project is to demonstrate the intelligent combination of renewable energies, storage options, and electromobility in a micro smart grid.

New horizons for hydrogen technology

Hydrogen as a raw material for industry is also at the center of yet another project by Hydrogenious Technologies that will be launched in mid-2017 in the United States, where a 300-kW plant will be built for a gas producer. It will be about 10 times the size of the project in Erlangen. With this technology, the

gas producer intends to expand its range of potential customers. Before, transporting hydrogen was only profitable for distances of up to 200 km. Now, it is possible to cover distances of up to 600 km. “LOHC can help optimize hydrogen logistics,” says Teichmann, thinking of the near future. “The possibility of combining these technologies for off-the-grid power supply is particularly interesting, for example, in remote regions in South Africa, where it could be a practical alternative to diesel generators,” he speculates. ■

➤ siemens.com/silyzer
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Product offering enhanced with know-how of PLM specialists



Analyzing the aerodynamics of a Cervélo bicycle

Siemens adds two suppliers of model-based simulation software, CD-adapco and Polarion ALM, to its industry software portfolio. CD-adapco and Polarion ALM are now part of the group so that customers can develop their complex and high-quality products even faster and better.

CD-adapco is specialized in simulation software solutions that cover a broad range of engineering disciplines, such as Fluid Dynamics (CFD), Solid Mechanics (CSM), heat transfer, particle dynamics, and acoustics. CD-adapco has a unique vision for Multidisciplinary Design eXploration (MDX), ensuring a highly reliable flow of information throughout the design process.

Polarion is the market leader for Application Lifecycle Management (ALM) solutions. With ALM software solutions, manufacturers can continuously integrate, check, and validate the growing software component of their products. The extended functions offered by Polarion integrate software specification, development, testing, and simulation further into the system-based environment for product development. Through the connection of the Polarion products with Product Lifecycle Management (PLM), ALM becomes an integral part of the product development process. ■

➤ cd-adapco.com

➤ polarion.com

Save on purchases

A new asset, for example, a new steam turbine, does not necessarily need to be purchased all at once. With a lease purchase agreement, it is also possible for a company to finance the investment through the savings achieved through its own production of energy.

The Kübler & Niethammer Papierfabrik Kriebstein AG paper mill decided on such a financing model. The Saxony-based company produces 100,000 t of web printing paper made of waste paper annually. Using cogeneration, the company produces process steam for two paper mills and power for their operation with its own natural gas power plant. To further improve energy efficiency, a back-pressure steam turbine was added downstream to the power plant.

This increase in energy efficiency needed to be financed economically.

Siemens therefore not only supplied the technology but also developed the financing model. The lease purchase model made it possible for Kübler to finance the investments related to the steam turbine project

from the savings achieved through the production of energy. This way, no capital was tied up in a direct purchase. ■

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Along with the latest technology, Siemens also offers customized financing solutions

“Industrie 4.0” in 3D

“Industrie 4.0” has reached the UK as well. The Manufacturing Technology Centre (MTC) in Coventry has developed glasses that give wearers a glimpse into the world of the digital factory, allowing them to see with their own eyes the virtual possibilities the fourth industrial revolution has in store for the British manufacturing industry.

Siemens was involved in this innovative project as one of the organizers. Using a virtual 3D production line as an example, the glasses show how consumer goods can be manufactured via mass production, yet still according to the customers’ wishes. The virtual

reality environment allows users to interact with a digital “live production facility” that is modeled on the real world. The tool is the first of its kind in the UK.

The project shows a continuous production environment and is designed to allow universities, manufacturing companies, and others to further develop production processes. The goal is a continued increase in productivity, quality, and energy efficiency in production facilities. ■

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Siemens AG

The latest development in the Manufacturing Technology Centre (MTC) in Coventry allows the wearer glimpses of the digital factory

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