

Industry Journal

Creating sustainable value through technological leadership

01 | 2012

SIEMENS



Focus:

Connecting
productivity and
efficiency

The way to success

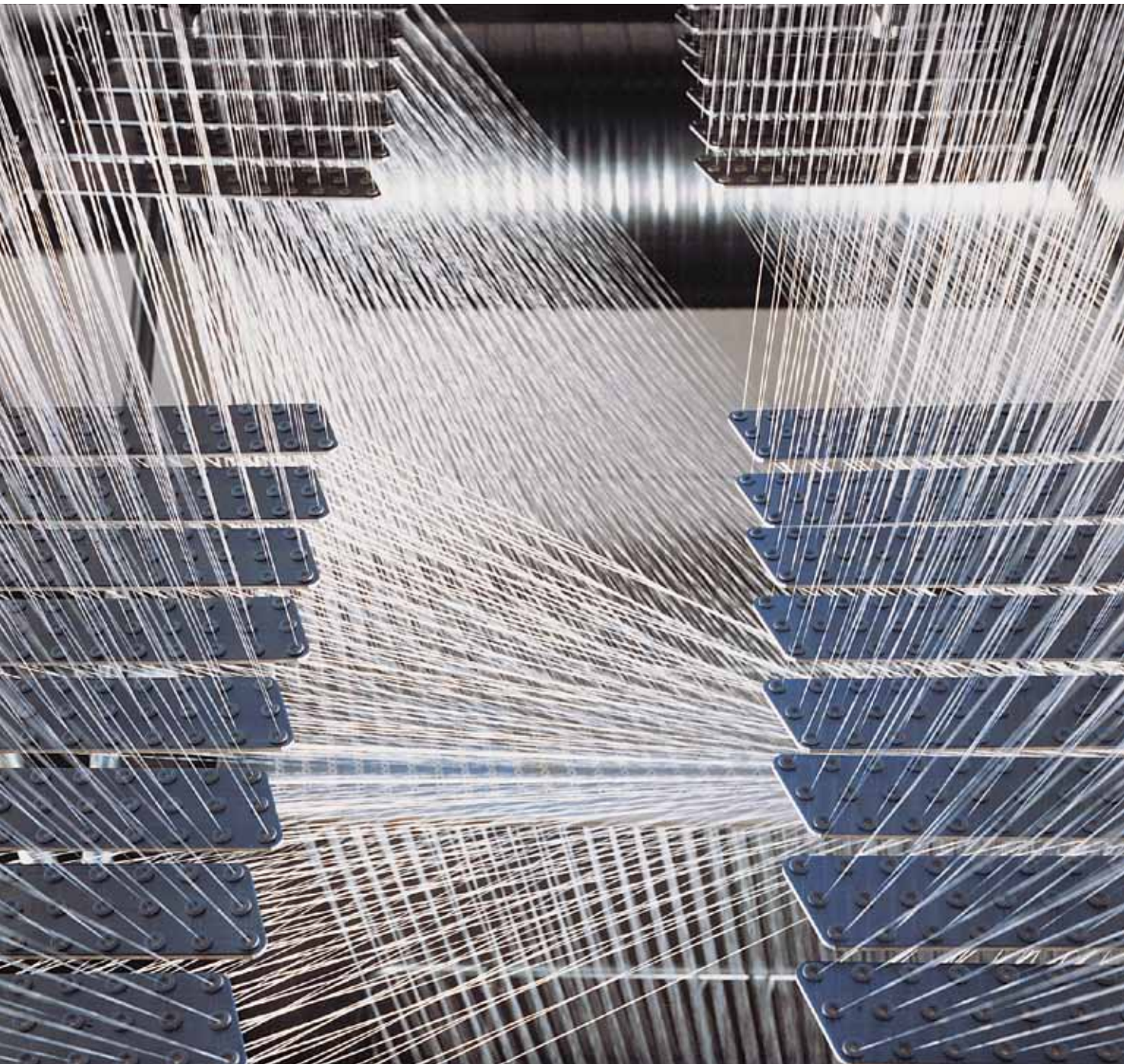
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Editor's note

Dear Readers,

We all experience the increase of speed and challenges in the daily work in our businesses: differentiated expectations of customers, a market transparency that was unknown until now, and the global competition demand for new efforts in order to remain successful in the future.

More than ever before, we have to think ahead and to consider new perspectives in order to increase competitiveness. In view of rising energy prices and diminishing resources, our customers are increasingly facing the same kind of questions: How can productivity as well as energy and resource efficiency be improved and the environment be spared at the same time. In all these challenges, we work in close cooperation with our customers as well as our partners and deliver the right answers with our products, solutions, and services.

Economy and ecology have long since ceased to be contradictions in the industry. Innovative technologies connect productivity and efficiency. Businesses become more competitive and production more sustainable. A prerequisite for connecting the two poles is to keep the entire production process in view and to identify the right regulating screws – from product design to production planning and all the way to maintenance. In this issue of Industry Journal we will substantiate this thesis and give examples for the positive effects of this approach.

I hope you enjoy reading this issue.

Sincerely,
Siegfried Russwurm



Prof. Dr. Siegfried Russwurm,
CEO of the Industry Sector

Connecting productivity and efficiency



10: The way to success

It is no contradiction to increase productivity and energy efficiency. Innovations connect the two poles and prove to be a solution for increased competitiveness. Provided that businesses keep an

overview of the entire production process – from product design to production planning as well as engineering and all the way to production and services.

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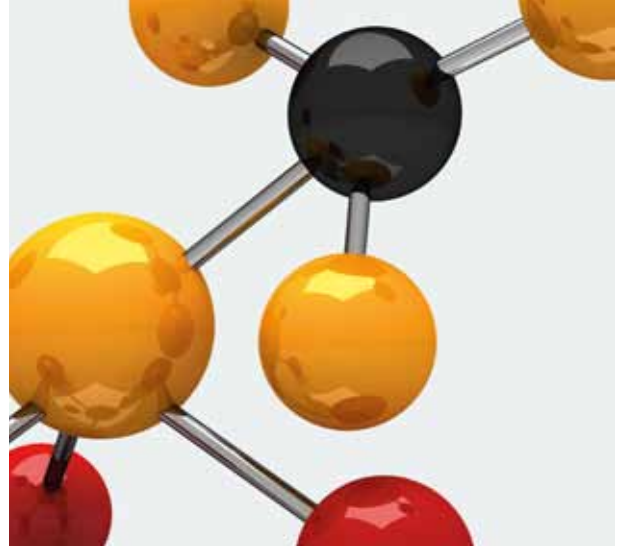
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The Big Picture

The new solar farm Les Mées in the Province Alpes de Haute-Provence in Southern France covers an area of 70 hectares. That is twice the size of Berlin's entire zoo and three times as large as the Field of Mars with the Eiffel Tower in Paris. The photovoltaic plant was connected to the grid in October 2011 after a construction time of only ten months. The project development company Eco Delta Développement (EDD) commissioned the plant.

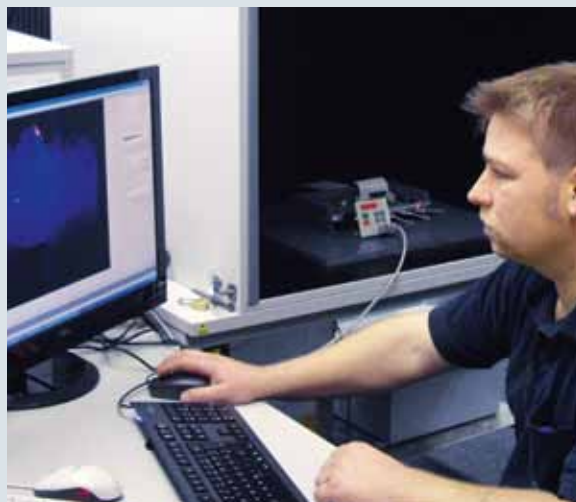
The plant's performance of 31 megawatts is sufficient to supply 12,000 French households with clean power in the future. Electrotechnical components from the Siemens Industry portfolio ensure frictionless operation and high energy yields. They include SINVERT inverters, switchgear, and transformers as well as components for centralized plant monitoring (Simatic WinCC) and secure, wireless communication (Scalance).

Siemens delivers products as well as services for plants of various sizes, and supports project developers as well as plant operators at every stage – from planning and implementation to commissioning and all the way to maintenance and modernization. In the last two years, Siemens equipped photovoltaic plants in Germany, Israel, Italy, the Czech Republic, and other countries.

Spotlight

Fast diagnosis for frequency converters

Siemens improves the repair service for frequency converters with a thermography-based analysis system. With the new method, thermal images are checked against reference images from a database as early as during the components' start-up. This means that components can be checked for thermal risks as well as damaged and weak areas within a few minutes. The diagnosis system independently compiles a report with suggestions for repair including a spare parts list for service technicians. Repair times can be shortened by up to 30 percent. Plus, the hit ratio is up to ten percent higher compared to conventional methods of analysis that do not use thermography. In future, the quality of entire production batches could be tested with the system in order to develop the components further.



New development software for Antonov aircraft



Antonov, a Ukrainian government-owned enterprise, relies on Product Lifecycle Management (PLM) software from Siemens in the production of aircraft. The business implements the product development solution NX and the life cycle management system Teamcenter from Siemens PLM Software. Antonov will carry out joint projects with the Russian aircraft manufacturer JSC United Aircraft Corporation. They are planning the joint production of a long-distance craft and a transporter for middle distances. Therefore the cooperation partners chose Teamcenter, a highly qualified management system for centralized data, in order to ensure location-independent access to product, development, and construction data.

Range of industrial software keeps growing

Siemens took over the majority of the Canadian IT company RuggedCom in March 2012. RuggedCom is one of the largest suppliers of rugged Ethernet communication products and network solutions that are suitable for industrial use and adverse ambient conditions, which exist, for instance, in energy distribution or the process industry. The range of RuggedCom ideally complements the Siemens product range in the area of industrial Ethernet communication, and extends its range of routers and switches that are suitable for industrial use. Additionally, the acquisition improves the coverage of the North America and Asia-Pacific regions.



Spotlight

Installation ship for offshore wind farms

More and more wind farms will be built in the open seas in the future – because of the comparatively high amount of wind and inconsiderable space issues. But there is still a lack of special ships for the complicated installation work under adverse conditions. Siemens equips a ship for the installation of offshore plants with drive and automation technology for the first time – the “Sea Installer”. The vessel is 132 meters long and equipped with a diesel-electric drive as well as with the ship automation system Siship Imac that controls all electrotechnical equipment on board. The “Sea Installer” can carry up to ten wind turbines and will be em-



ployed in German and British waters from the middle of this year.

Awards

Siemens holds first place in the Dow Jones Sustainability Index (DJSI) in the category “Diversified Industrials” for the fourth time running. In line with this, the German business magazine “Wirtschaftswoche” chose Peter Löscher, Chairman of the Siemens Managing Board, as the most important maker of the German energy turnaround in the company managers’ category at the end of 2011. The jury stated that the company could further the green reorganization with its



technology portfolio. The organizations World Climate Summit, The Gigaton Throwdown, and Carbon War Room placed Siemens together with Deutsche Post (German Post) behind the winner Schneider Electric from France at the “Gigaton Awards 2011” at the world climate summit in Durban. The Awards credit companies that perform great services to climate protection through the reduction of CO₂ emissions. Recognition of transparency and sense of responsibility came from China as well: The institute for Public and Environmental Affairs placed Siemens first in a ranking of 31 international technology groups with production facilities in the People’s Republic in 2011. The scientists stated that Siemens had implemented a computerized control system to monitor their suppliers’ pollution of the environment and made improvements a condition for further orders, if necessary.

More solar power thanks to astronomy

A further development on the basis of the Siemens control system for movable photovoltaic modules Simatic S7-1200 uses astronomical calculations to align movable solar plants exactly according to the position of the sun. For maximum energy yield of photovoltaic panels it is essential that the sun shines as vertically as possible on their surface. With concentrating technologies, such as CPV and CSP, the sunlight has to be focused exactly on a point or on certain lines. This is why the position of the module carriers in moveable plants is adjusted repeatedly in the course of the day. In order to achieve this Siemens has a license for a precise

algorithm from the American National Renewable Energy Laboratory (NREL). The independent research institute works for industry partners, governments, and institutions. The system calculates the sun’s position with an exactness of up to 0.0003 degrees and positions the panels or mirrors optimally. This leads to an increased energy yield.





The way to success

Faster, higher, farther – the words that inspire track and field athletes apply in modified form to industrial companies as well. For them, it is “more productive, more flexible, higher quality.” Businesses are under tremendous and growing pressure to produce more energy-efficiently, more sustainably, and with higher quality. When optimization measures address all points of the production process, productivity and energy-efficiency improvements can cross-pollinate. Innovative technologies and services build a stable bridge between the two.



British Nobel Prize-winning physicist Professor Michael Beard pulls no punches as he begins his speech before international financial investors in London: “The planet is sick. A cure is urgently needed, and it will be expensive. Predictions are that it will require two percent of gross domestic product worldwide.” That is not really what the investors want to hear.

Beard is a fictional character created by best-selling British author Ian McEwan, and the scene is from his book “Solar.” But this – or a similar scene – could take place in reality at any time. The problems and dangers of climate change are generally recognized and accepted. Yet the practical consequences stemming from this knowledge are relatively minor. According to the analysts of Bloomberg New Energy Finance, an annual investment of 500 billion US dollars in environmental technologies through 2020 would be necessary to meet the goal of keeping global warming at a maximum of two degrees Celsius. The actual investment of 243 billion US dollars is not even half this amount.

For many companies, there are other questions – ones that are different, more urgent, and existential – taking precedence. In particular, the worldwide megatrends of increasing globalization and urbanization, combined with technology leaps, economic crises, and credit squeezes, have led to a much tougher competitive environment.

Productivity and efficiency improvements

To make the best use of opportunities in this environment, all efforts are focused on improving productivity and boosting flexibility, speed, individuality, and quality. Efficiency improvements can make a major contribution to this – and vice-versa. For quite some time now, these two aspects have not been mutually exclusive. On the contrary, there is a positive interaction between the two, and with intelligent planning and control, they can reinforce each other. Thus, innovative technologies for higher energy efficiency often pay for themselves after just a few years. And the faster that energy prices increase, the faster the amortization.

In this context, a comprehensive approach is becoming more and more important. Companies that deal with manufacturing challenges only during actual production cannot fully leverage improvement potential. Instead, optimizing productivity and energy efficiency simultaneously requires that industrial companies address all phases of the production process, starting with product design, planning, and engineering, and including production itself as well as specific services like consulting and maintenance.

4 Production execution

Automation technologies are on the march in industry. Together with innovations like energy-saving drives, they can substantially boost productivity.

3 Production engineering

The more that hardware and software is used, the more important it is that individual systems communicate smoothly with each other.

2 Production planning

With industrial software, individual machines or entire factories can be designed on-screen, and production processes can be simulated and optimized.

1 Product design

Innovation cycles have become drastically shorter for products of all kinds. Industrial software can significantly shorten development times and reduce costs.

50 percent growth in the BRIC countries

Fast and effective action is required. Development cycles are becoming shorter, despite the fact that product complexity and the resulting data volumes in the development process are increasing significantly. The pace is picking up around the world. In the past 25 years, according to studies by the renowned analysis institution Oxford Economics, world economic growth averaged 2.7 percent annually. Forecasts are that this growth rate will rise to 3.3 percent per year by 2036. Even more importantly, by 2015 half of the world's economic growth will take place in the BRIC countries. In other words, in countries that – taken together – currently account for just 20 percent of the global gross domestic product.

In all the various verticals and regions, newcomers can enter the market and quickly become internationally competitive players. Sales markets are shifting from the traditional Western

Product design

Red Bull Racing: Faster to the finish line – with PLM software

In Formula 1 racing, winning is a matter of fractions of a second; in product design it is a matter of hours. That is why the Red Bull Racing team around world champion Sebastian Vettel relies on Product Lifecycle Management (PLM) software from Siemens. After a race, there are often only a few days to prepare the car for the next competition. The next track might place notably different requirements on the car, or it might be necessary to apply experience gained in the last race. Just hours after a race is over, the designers meet in a virtual room, where they bring

Optimization potential can be found throughout the entire production process

5 Services

Effective services include not just machine maintenance, but also support in planning, installation, operation, and modernization. Services play a central role in all phases of the production process.



together on the computer the 4,000 parts of a car in order to design new components, test them, and finally install them in the car. Of key importance is that engineers and technicians have access to the same data, and that changes are immediately propagated to all involved. The NX and Teamcenter PLM solutions make that possible. Data flows from NX to Teamcenter and from there to the Red Bull Racing ERP system, so the parts list can be taken directly into the production process. One mouse click, and the new parts are milled and stamped.

industrialized nations to Asia, and with them production facilities – not so much in order to produce cheaply for local markets, but rather with the goal of securing world market share from those locations.

This geo-economic shift toward Asia and Latin America will create tremendous challenges for the established Western companies and economies. Industry is going through an upheaval, the likes of which have not been seen since the start of industrialization in the 19th century. Technologies, markets, and legal frameworks are changing at great speed. As a consequence, companies must constantly examine their business models, adapt their portfolios, enter into new partnerships, and pull out of old ones. What works today is history tomorrow.

Increasing profit by one percentage point

Regardless of the direction the world economy takes, the need for constant productivity improve-

CO₂ reduction as a business strategy

These industrial companies show great responsibility in the way they deal with CO₂ emissions. They communicate their targets and measures clearly (Carbon Disclosure Score) and have effectively implemented many of them (Carbon Performance Score).

This has beneficial business effects – companies that save CO₂ emissions often do better economically. This is one of the central findings in the Global 500 Report put together by the consulting firm PwC for the Carbon Disclosure Project.

Company	Carbon Disclosure Score*	Carbon Performance Score**
Bayer	99	A
Siemens	97	A–
BMW	96	A
Lafarge	96	A–
Honda	95	A
Dow Chemical	95	A–
Novartis	94	A
Saint-Gobain	94	A–
Fiat	93	A
BASF	93	A

Source: PwC, Carbon Disclosure Project 2011

* Max. 100 points possible

** Scale: A–E

“To remain competitive, companies must increase their energy efficiency.”

Ralph Büchele, Roland Berger Strategy Consulting

ments to meet global competition will continue to become more acute. A major, and increasingly important, way to achieve this is for companies to improve their own energy efficiency.

In energy-intensive industries in particular, an efficiency increase of 20 percent can bring an overall profit increase of an entire percentage point, according to a study by Roland Berger Strategy Consultants. The study's authors also predict that energy prices will rise, for example by 70 percent in Germany by 2030, which would greatly add to the potential for increased profit through energy savings.

Efficiency increases of a quarter or more are by no means unrealistic. According to the Berger study entitled “Efficiency Increases in Energy-Intensive Industries,” energy efficiency in the paper industry, for example, could rise by some 50 percent by 2050, while the metal processing industry could be saving 40 percent in electricity costs by then. This would require targeted investments in efficiency, in particular better machines and improved production processes. For many companies in processing industries, energy savings by 2050 could be four times as much as the requisite investments, according to the report.

The renowned Heidelberg Institute for Energy and Environmental Research (IFEU) has arrived at similar conclusions. For example, according to an efficiency study it performed on behalf of the German Ministry of the Environment, German industry would have to invest 7 billion Euros by 2030 in order to achieve realistic and useful energy savings. “However, this increased investment should not be confused with increased costs,” says the study. “Through the energy savings, most of the investments will lead to reduced costs over the course of the depreciation period or product lifecycle.”

Investing to save costs

Investing to save costs – companies that are successful over the long run know that, if done intelligently, it adds up. For example, in this context many international corporations have set their own targets for reducing their CO₂ and greenhouse gas emissions, in large part so that they can lower their energy costs. Currently, some 300 of the companies on the FTSE Global 500 Index have their own reduction targets, according to a study by the auditing and consulting firm PwC. Just under half are already reporting successful emissions reductions.

The evaluation also shows that companies with consistent climate protection strategies are also more successful. From January 2005 through May

2011, companies on the Global 500 Index had an average profit of just under 43 percent, while the companies who are leaders in climate protection – as measured by the Carbon Performance Leadership Index – had almost double that at just under 86 percent profit on capital outlay.

“Today, nine out of ten companies see climate protection less as a cost factor and more as an opportunity to gain competitive advantage by establishing sustainable processes, products, and services,” says Michael Werner, PwC partner responsible for Sustainability Services.

Regulatory requirements are tightening

But it is not always just business calculation that drives a change in thinking. Often, government constraints provide the impetus for change. This is particularly the case for companies in the EU, whose climate protection targets are the world’s most ambitious.

Thus, in the spring of 2011, the European Commission presented its “Roadmap for moving to a low-carbon economy in 2050” and “Energy Efficiency Plan 2011.” Among other things, it calls for a 25 percent reduction in emissions of greenhouse gases in the European Union by 2020, based on the reference year 1990, and an 80 percent reduction by 2050. In addition, by 2020, primary energy usage is to be reduced by 20 percent compared to prognoses from 2007.

There is no limit to the creativity of individual countries when it comes to statutory climate protection measures. Thus, in Australia the government recently introduced a CO₂ emissions tax in order to create financial incentives for energy-efficiency measures (see page 23). In the current 12th official Chinese five-year plan, resource conservation and environmental protection play a central role. By 2015, it aims to reduce CO₂ intensity in production by 17 percent. The German Ministry of Economics and Technology is considering a switch-off law under which industrial companies would be compensated by up to 60,000 Euros per year if they are willing to temporarily do without electricity in emergencies, for instance during grid overload situations.

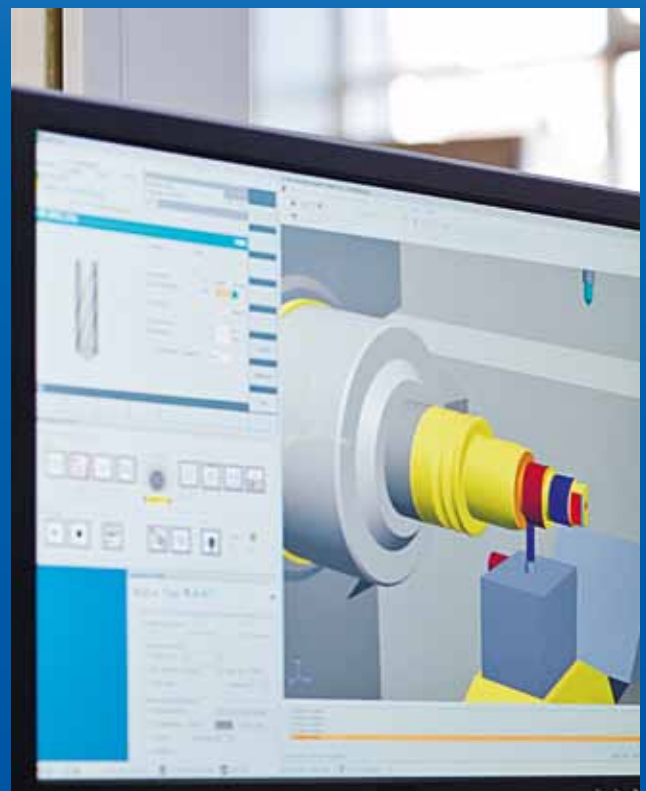
Around the world, pressure is growing for companies to reduce their greenhouse gas emissions and energy consumption. According to studies by the OECD, greenhouse gas emissions will rise 70 percent by 2050 if no further political action is taken.

This is something that the world community cannot accept over the medium term. “The door to the two-degree climate goal is closing. If

Production planning

INDEX: Melding virtual and real production

The productivity increases that can be attained through the integration of industrial hardware and software are shown by INDEX, a German maker of lathes and turning-milling centers, with its Virtual Machine (VM) software for production process simulation. VM is a precise digital counterpart to the physical lathe, and enables the absolutely realistic simulation of workpiece machining, including collision control. The ability to verify CNC and PLC programs on a computer means that programs can be optimized and tooling time on the real machine can be shortened. As control and drive supplier for the real machine, Siemens offers compatible building blocks for virtual machining – the virtual NC kernel (VNCK) that replicates the actual control, the Tecnomatix RealNC graphic simulation system from the Product Lifecycle Management (PLM) software family, and the original operating software (HMI). Only when everything works satisfactorily on the simulation are the settings transferred to the real machine. Testing and refining are done in the virtual world. Errors in the NC workpiece program no longer need to be sought out through painstaking adjustments and eliminated through repeated restarts of the real machine.



3 Production engineering

Totally Integrated Automation Portal: The highest engineering efficiency for production

The combination of industrial software with automation technology engineering brings together product planning with production and services, such as maintenance and repair.

The Totally Integrated Automation (TIA) Portal is a specially designed, efficient, intuitive, and proven engineering framework with which companies can configure all planning and production processes on a single screen, along the entire value-creation chain. This lets manufacturers improve their competitiveness and bring new products to market faster.

From development to assembly to commissioning to the maintenance and expansion of automation systems, the framework saves engineering time, costs, and effort. Its intuitive user interface allows users to concentrate on their engineering tasks, instead of having to learn a new software program. TIA Portal is the industry's first automation software with "One Engineering Environment."



something decisive doesn't happen soon, it will shut forever," warns Fatih Birol, chief economist of the International Energy Agency (IEA).

But what does that mean for companies? How can they reach their own business goals on the one hand, while complying with regulatory energy efficiency targets on the other? Price and cost pressure is rising in all markets. The complexity of companies and their processes has risen tremendously, from supply chain management to research and development to production, logistics, marketing, and sales. In addition, the global value creation network now integrates national and international locations and plants, research institutions and universities, customers and suppliers, consultants, and logistics companies. These factors alone create enormous issues that are challenging enough in their own right.

No more isolated solutions

To reach dual goals of increased productivity and efficiency, many companies are eschewing isolated solutions. Instead of focusing only on those problems where the leverage is the greatest, they are making adjustments at all points of the production process. Whether it is the design of a product or the systems used to make it, the production process itself, machine maintenance, or the modernization of system components, improvement potentials are today utilized in parallel and in an integrated fashion.

According to research by the Fraunhofer Institute for System and Innovation Research (ISI), the practical savings potential for industrial plants from energy efficiency measures alone averages 15 percent. The researchers attribute the fact that many industrial plants leave such high potential unused to a lack of knowledge about the energy consumption of individual consumers, so that energy costs are non-transparent and employees are not sufficiently sensitized to the issue. In addition, energy-efficiency investments and energy costs are financed from different budgets and administered by different organizational units, whose interests often are not homogenous.

Energy management systems save costs

The Fraunhofer research fully recommends the use of energy management systems (EMS) as highly suitable tools for identifying and utilizing energy efficiency potential. These make it possible, for example, to determine the energy consumption of individual system components.

This is beneficial for large as well as medium-size companies. For example, the 330-man

foundry company M. Jürgensen in Germany, which operates internationally and makes cylinder liners for drives in ships, locomotives, and power plants, implemented a certified EMS in 2011. By taking steps to improve its efficiency based on the data thus obtained, the company expects to save 10 percent of its energy costs by 2014. With a current annual energy consumption of 32 gigawatt hours, that can easily lead to savings in the six figures – per year.

In many cases, savings potential is already known and can be exploited without an EMS. Motors are an example. “In industry, there is particularly high potential for savings in the area of motors,” according to a German government study. Electric drives account for about two-thirds of the energy used in industry. The use of variable-speed drive systems can deliver energy savings of up to 70 percent.

Thrifty motors pay for themselves quickly

The greatest potential savings lie in the use of modern motors of efficiency class IE2 or IE3. IE3 motors have an efficiency that is up to 10 percent higher than IE1 motors. Energy-efficient motors cost more than their predecessors, but the higher costs are usually recouped in less than two years due to lower consumption.

Manufacturing is an example. Even at rest, production machines can still use up to 60 percent of the energy they use while operating. This can be reduced by up to 32 percent in the automotive industry, for example, by switching systems or components to a low-energy mode during limited periods of low usage. Even then, they remain fully available and there is no risk to the integrity of the overall system.

There is also considerable savings potential in industrial waste heat reclamation. According to calculations by the German Energy Agency (dena), it is possible to save an average of 15 percent of energy costs in Germany alone by improving the way heating systems use energy.

Opportunities through integration of suppliers

One of the largest areas of improvement in process productivity and climate protection is in companies' own supply chains. Many companies already include their vendors in their strategies for reducing greenhouse gases.

For example, Siemens is successively extending its company-wide energy efficiency program to its supply chain. The EEP for Suppliers program EEP4S identifies and evaluates energy savings potential in production processes, and can





4 Production execution

f | glass:
Automation for maximum productivity

German plate glass maker f | glass produces some 670 tons of plate glass or 570 tons of solar glass every day at its state-of-the-art plant near Magdeburg. The entire production and distribution system is automated, from receiving and mixing the raw materials, to the melting process, all the way to order picking. The heart of the system is Totally Integrated Automation (TIA) and Totally Integrated Power (TIP) from Siemens. Instrumentation, drive, automation, and energy distribution systems are interlinked, and all production processes are efficient and flexible. Through integrated energy management, f | glass always knows which devices are using how much energy at any given time. This gives the company a reliable and current data set that enables it to permanently optimize its energy consumption and reduce costs. The Simatic PCS 7 process control system serves as the heart of TIA, providing fault-free operation. The system is fully integrated and uses standardized hardware and software components that can be coupled with the Manufacturing Execution System (MES).





SEAT: **Reduced energy consumption**

With 13,000 employees, the Seat plant in Martorell near Barcelona is one of the largest factories in Spain. Since July 2011 it has been producing Audi Q3s. The high-tech production hall, built especially for this purpose and with 450 robots, is distinguished by its high energy efficiency. Low-consumption electric motors from the Siemens environmental portfolio drive the conveyors and elevators. Sinamics frequency converters reclaim a large amount of the braking energy used in the conveyor systems, and feed it back into the grid. As just one example, this has cut the energy consumption of the elevator drives in the high-bay engine warehouse in half. Siemens Sirius switching and protection devices also save energy, since they heat up in operation less than comparable devices and thus need less cooling.

Tyasa: **Electric arc furnace uses 20 percent less energy**

For Mexican steelmaker Talleres y Aceros S.A. de C.V. (Tyasa), Siemens VAI Metals Technologies delivered a new compact steelworks with an annual capacity of 1.2 tons of steel. At the heart of the plant, located in Orizaba in the state of Veracruz, is the world's first Simetal EAF Quantum electric arc furnace. This new design has numerous benefits for the plant's energy balance and productivity. It melts scrap in 36 minutes. Its electricity consumption of 280 kilowatt-hours per ton is significantly lower than that of conventional electric arc furnaces. In conjunction with its low electrode and oxygen use, the overall result is 20 percent lower specific conversion costs. All in all, CO₂ emissions per ton of raw steel are about 30 percent lower than with conventional arc furnaces. "We are proud to have built the world's first Quantum electric arc furnace here in Mexico," says Oscar Chahín Trueba, CEO of Tyasa, adding, "This complete solution for our compact steel works won us over, and we expect substantial operating cost savings from the new electric arc furnace in particular. This will doubtless make us a benchmark for other companies and further strengthen our position on the international market, especially in Latin America."





reduce consumption by up to 17 percent. One of the first participants in the program was a foundry that supplies Siemens with cast steel for steam turbines. A single suggestion by a Siemens consultant has saved the company 14,000 Euros each year since. In the first year, Siemens had already recouped half of its investment through savings.

In other industries as well, companies are taking a look at their suppliers' energy efficiency. In the lifecycle of consumer goods, up to 30 percent of the CO₂ emissions are released during manufacture. According to the "Carbon Performance Improvement Initiative," a climate protection initiative of well-known German retailers, even simple measures can eliminate up to 20 percent of CO₂ emissions. Energy waste, the Initiative maintains, is often simply a matter of a lack of awareness or knowledge.

Online questionnaires for savings potential

The Initiative hopes to change this, especially in developing and threshold countries. It uses an online questionnaire to show companies how they can save energy and thereby reduce costs, while taking into account local conditions.

Thus, a Chinese blouse manufacturer followed a recommendation to replace an outmoded boiler used to produce steam for the ironing station. The investment paid off within six months.

These and other examples show how closely productivity and efficiency improvements are interrelated, and that it is often not just sensible, but also indispensable, to make these improvements together in order to remain internationally competitive. The shift to a more sustainable economy offers companies and national economies alike opportunities whose medium-term benefits far outweigh their short-term costs.

The hero of Ian McEwan's novel, Professor Michael Beard, compares the possibilities presented by sustainable business and appropriate, innovative technologies to the first industrial revolution 250 years ago – when coal, iron, and steam engines became driving economic forces. He also compares it to the invention of the internal combustion engine and subsequent demand for oil, and the start of the digital age some 50 years ago. "Dare to take the next step," he challenges the investors at the close of his speech. All current facts and figures indicate that this advice is just as sound for the real economy. ■

5

Services

Metsä Tissue:**Optimized maintenance, improved performance**

Metsä Tissue is one of Europe's largest manufacturers of tissue papers for home and commercial use. The company employs around 3,300 people at plants in Finland, Germany, Poland, Russia, Slovakia, and Sweden. It is part of the Finnish Metsä Group, which has 12,500 employees.

Metsä Tissue commissioned Siemens Industry to analyze the maintenance processes at its paper mills in Småland, Sweden, and to develop a new system for subsequent implementation at all ten of the company's plants.

The goal was to make the processes more transparent and optimize operating costs relative to the utilization of production capacity. Siemens first performed a maintenance benchmark analysis to identify the major potential improvements in plant maintenance, and then created a cost estimate for the implementation of appropriate measures.

The results of the analysis led Metsä Tissue to reorganize numerous processes, including functions like replacement parts management, purchasing, and production planning. The success is clearly measurable. The proportion of preventive maintenance has risen from 30 to 80 percent, plant availability has increased by 20 percent, and costs for replacement parts have gone down by 10 percent with the new system.



Why companies combat climate change

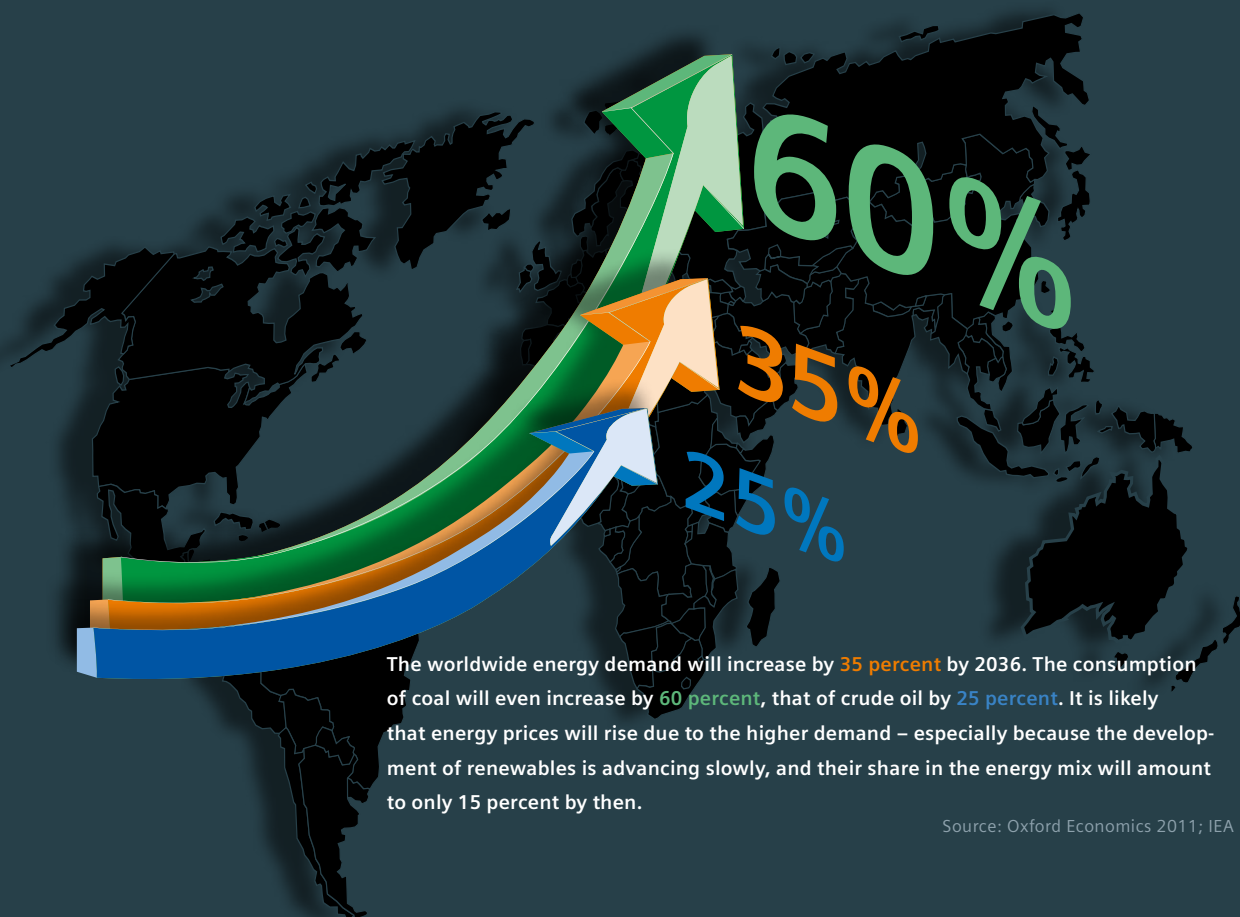
"Worldwide, what cost and image factors are the most important drivers of company initiatives to combat climate change?"

Driver	Responses (in %)
Energy costs	51
Changed customer demands	44
CO ₂ costs	30
Brand protection	27
Stakeholder expectations	26

Source: Ernst & Young "Action amid uncertainty" survey of top executives around the world

"Nine out of ten companies asked now see climate protection less as a cost factor and more as an opportunity."

Michael Werner, partner at PwC



Source: Oxford Economics 2011; IEA



Businesses fear energy shortage

A shortage of crude oil, water, and food – this is what top managers fear as the biggest threat to their businesses, according to an international study.

*“The **shortage** of which natural **resource** is the greatest risk for your business in the next three to five years?” (Figures in **percent**)*

Raw material	North America	Western Europe	BRIC*	Asia-Pacific*
Crude oil	47	30	27	41
Water	21	28	7	7
Food	7	5	25	23
Minerals	3	8	16	11
Rare earths	5	15	2	5
Natural gas	7	5	13	5
Others	10	8	11	9

Source: PwC 2011

*China is listed among Asia-Pacific as well as among the BRIC states

70%

energy **savings** potential unleashed through the use of **drives with variable speed control** when compared to conventional systems.

18%

of the German industry's **entire energy demand** could be covered by **improving the use of waste heat** that occurs during processes.

Source: Fraunhofer ISI; Working Group on Energy Balances; BMU

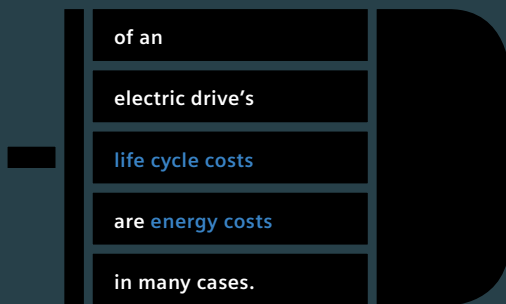
Businesses invest in climate protection

According to a survey, most of the world's businesses have recognized the importance of climate protection measures and integrate them into their business strategy.

Source: Ernst & Young, 2010

Investments in energy efficiency measures planned	82%
Increase of investments in climate protection measures in 2012 when compared with 2010 planned	70%
Cutting of investments in climate protection measures in 2012 when compared with 2010 planned	1%
Green business strategy is a great challenge	22%

95%



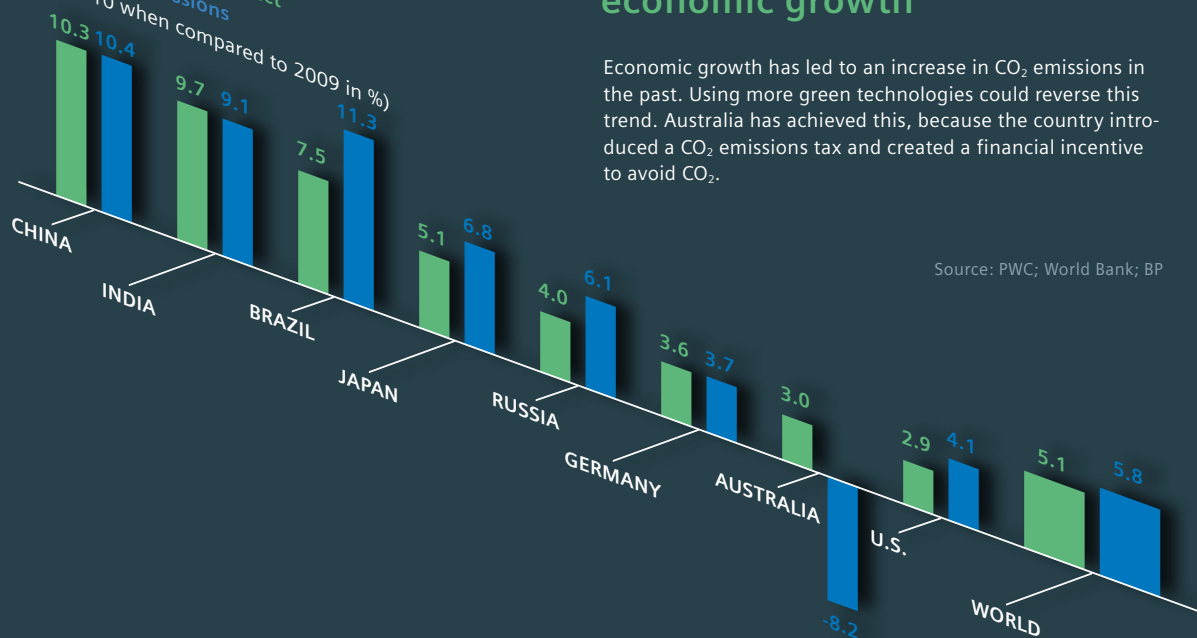
1 coal-fired power plant

a week is connected to the grid in mathematical terms to meet the country's soaring power demand.



Source: IEA

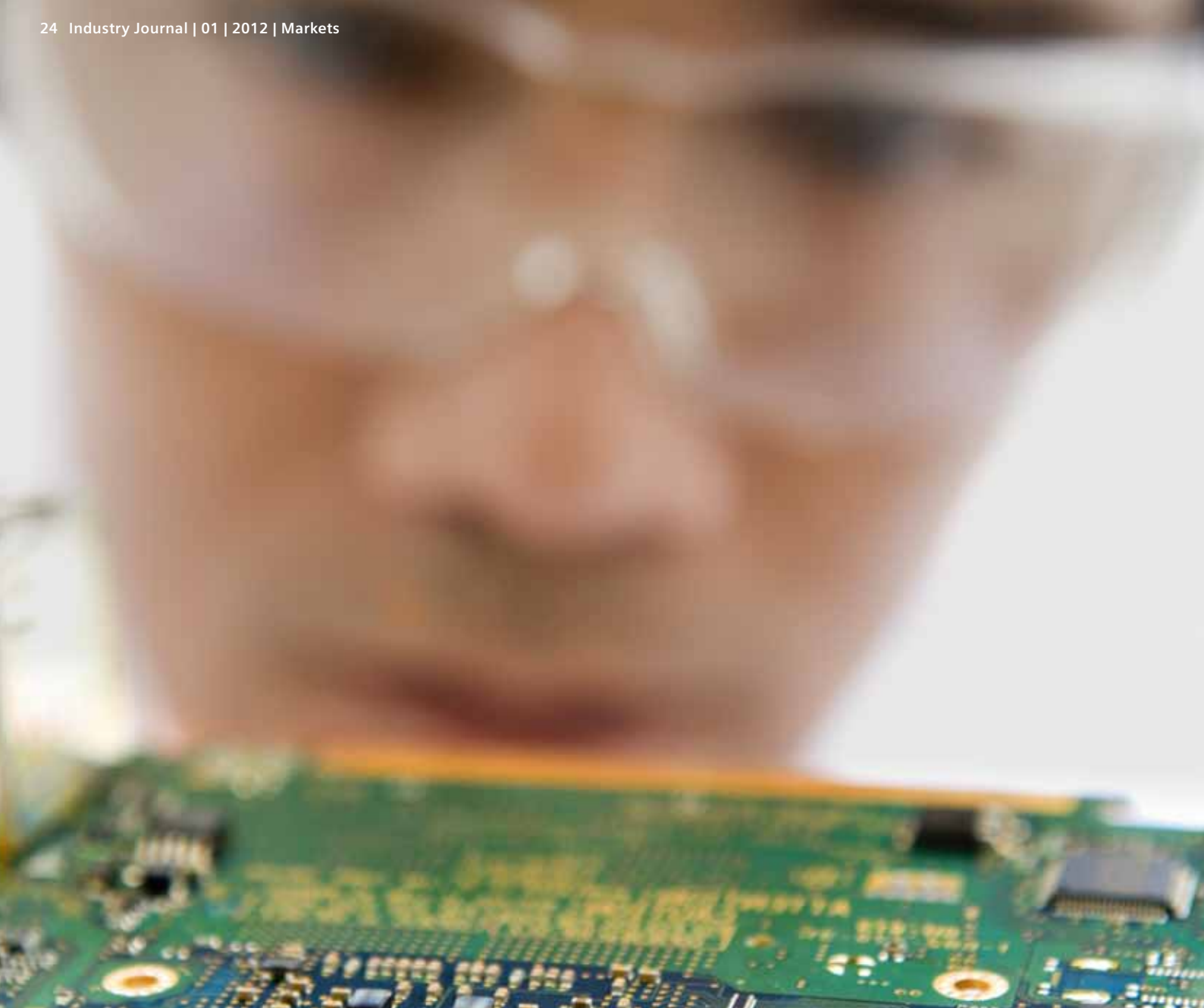
Gross domestic product
CO₂ emissions
(Increase in 2010 when compared to 2009 in %)



Source: PWC; World Bank; BP

Emissions and economic growth

Economic growth has led to an increase in CO₂ emissions in the past. Using more green technologies could reverse this trend. Australia has achieved this, because the country introduced a CO₂ emissions tax and created a financial incentive to avoid CO₂.



Faster, better, smaller

They are virtually everywhere, and virtually nobody notices them. This is due to their size: Microsystems have moved into everyday appliances, production, measuring and control technology, as well as into healthcare in the form of tiny components. More often than not they are only a few millimeters in size – and responsible for the release of a car's airbag in case of a crash, for the stabilization of a digital camera's photograph, and for keeping the rhythm of a pacemaker. Micro system technology is perceived as a key technology for products and processes and as having enormous opportunities for growth.

Some 770,000 employees in Germany alone, a turnover of nearly 100 billion Euros, a two-digit growth rate – these are figures that create attention in economically unstable times. But even specialists still regard micro system technology (MST) a niche technology. They are in the wrong: “MST has moved into virtually every industry”, says Klaus Zimmer, managing director of the Micro Technology association in the Verband Deutscher Maschinen- und Anlagenbauer (German Engineering Federation). “It starts with engineering and spans from the automotive to the healthcare and energy industries all the way to optical technologies, aviation, electronics, the information and communication sector, as well as to process engineering.”

It is not surprising that MST has become a key technology in recent years that has shown strong growth. Germany plays a central part in this development. According to the Bundesministerium für Bildung und Forschung (BMBF, Federal Ministry for Education and Research) the Federal Republic currently holds a market share of some 19 percent – and the trend is increasing. The growth projections for the industry are an annual 10 to 16 percent, depending on the source. This is why the support of MST is an important part of the government’s high-tech strategy. The BMBF assigned some 80 million Euros to micro system technology in 2010 alone.

Many materials and technologies

Micro system technology develops entire systems on a micrometer scale. These systems are in constant exchange with their surroundings. Three key capabilities enable them to do this: “sense”, “assess”, and “act”. Classical micro system technology differentiates between sensor technology for signal recording and actuator technology for an active influence on the environment. All microsystems combine various materials and technologies on a very limited

space – regardless of their field of application. Together, they can achieve far more than the sum of their parts would suggest.

One field that has been profiting from this additional value for many years is measurement and control technology. A good example is the football-sized gas chromatograph MicroSAM that Siemens introduced to the market as an alternative to conventional process gas chromatographs. “Process gas chromatographs are used in various processes and industries. For the control and quality control of plants in the chemical and petrochemical industry, for instance, and

for the measuring of energy for accounting purposes in case of renewables such as natural or biogas,” explains Stefan Malcharek, Product Manager of the MicroSAM product group with Siemens Industry. “Compared to traditional solutions that measure 1.5 by 1.5 meters, the MST-based, reasonable MicroSAM offers additional features and potential. Thanks to its compact size it can be installed in the field without an analysis

unit in a space-saving way. In addition to that it requires considerably less energy and gas.”

The MicroSAM separates component mixtures with so-called capillary separation columns in order to conduct measurements. These are tiny, coated glass tubes that have a diameter of 150 micrometers (µm), just like the hair of a horse. Together with a dosing unit and micro thermal conductivity detectors (TCD) the size of a small fingernail, they are the core of the gas chromatograph and enable a particularly clean separation of mixtures.

It is no surprise that an increasing amount of customers have decided for the more compact relatives of conventional measuring systems in recent years. “Siemens introduced the first MicroSAM as a pioneer in 2002. Today we see a long-term trend toward MST solutions,” says

80 Mio

Euros have been provided by the German government for the development of micro system technology in 2010.



— Horse hair —

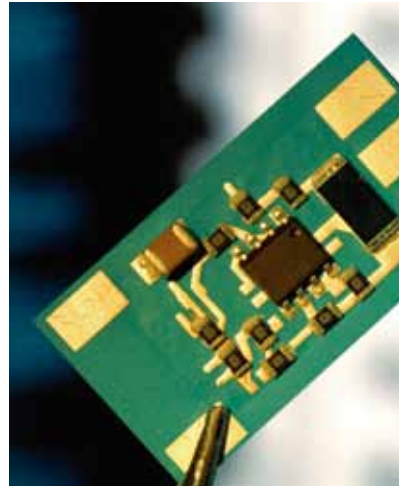


— Chromatograph tube —

The glass tubes of Siemens’ gas chromatograph MicroSAM have a diameter of only 150 micrometers – this corresponds to a horse’s hair (left).



MST is used in various technologies, for instance in radio-controlled assembly, production monitoring (top center), on intelligent ceramic foil for smallest switching (top right), and in airports' guidance systems (bottom right). The gas chromatograph Micro-SAM for the measuring and control technology is a veritable accumulation of MST, too.



Peter Berghäuser, Director of Product Management und Marketing Prozessanalytik (Director of Product Management and Marketing Process Analytics) with Siemens Industry. "One of the main reasons for this is that our customers can save costs in purchase, in the integration in their plant, and during operation."

Even if such solutions already show the advantages of targeted MST use today – they are only a tiny part of what is possible (see p. 28). Examples from today's fields of use show the comprehensive and cross-industrial importance of the technologies. Microsystems will be

able to do much more than sensing, assessing, and acting in future. They will be able to make foresighted decisions and to communicate with their environment, to perform self-diagnosis, and to react largely autonomously. "Characteristics that are quite close to cognitive abilities," the BMBF writes. This sounds visionary but is really based on a solid foundation. It is only a matter of time and of the innovative power of researchers and developers around the world to unleash the potential. ■

“Crossing borders”

An interview about self-organizing machines, mobility of the future, and the fascination of technology with Klaus Zimmer, managing director of the Micro Technology association in the Verband Deutscher Maschinen- und Anlagenbauer (VDMA, German Engineering Federation) and coordinator of the VDMA's Corporate Foresight discussion group.

Only few technologies get their own sector at the VDMA. Where does the current prominence come from?

Klaus Zimmer: The modern world has become larger through micro system technology. It has crossed the borders of what was possible for us. This enables completely new applications in industries such as engineering, the chemical industry, pharmaceuticals, and life science industries as well as in the automotive, electrical engineering, and electronics sectors – to name only a few.

Which trends do you see at the moment?

Zimmer: It is hard to summarize them because of the microsystems' diversity as well as their current and future fields of application and potential. One general trend in research and already developed solutions is surely the topic of the so-called learning systems. They make self-organization and -optimization in products and processes possible.

Which fields of application, in your opinion, are the most important ones for learning systems?

Zimmer: They cover a broad spectrum that spans from medical imaging to the prediction of wind power plants' performance. Without micro sys-



Klaus Zimmer is an expert for micro system technology with the German Engineering Federation.

tems in their various technical forms and combinations, those learning systems would not be possible.

What do you think are further important fields of research and application when it comes to micro system technology?

Zimmer: Quite a lot of research will be about bionic systems, human-machine interaction, and efficiency of energy as well as of resources. The micro system varieties play an important part in the fields of organic systems, polymer electronics, autonomous systems, cyber-physical systems, and macro-micro-nano integration.

Concrete fields of application are surely in industrial production and logistics, consumer goods, building technology, and technical textiles. Sensor networks, measuring and control technology, autonomous power systems and micro fuel cells, as well as personalized medical and information technology will increasingly profit from developments in MST. Another important field of application is the automotive sector and future mobility in general.

This sounds as if there were an infinite number of possibilities. What are the limits of MST?

Zimmer: When the balance between the fascination of technology and economical concerns becomes upset. This holds true for all new technologies, though – the fascination of technology can obscure the view for implementation and transformation into economic products.

Intelligent objects

When they are equipped with modern micro system technology, work pieces, conveyor belts, processing machines, and assembly systems learn to talk to each other and to organize their workflow independently.



As small as a sugar cube, but way smarter: Process-eGrains are particularly small and robust electronic components that consist of various sensors, a processor, and a wireless communication unit.

With the help of modern technology, objects can be identified automatically and can exchange data with their environment even today. In order to increase the practical use of these possibilities, the Fraunhofer-Institut für Produktionsanlagen und Konstruktionstechnik (IPK, Fraunhofer Institute for production plants and construction technology) initiated the scientific pre-project SOPRO – an abbreviation of “selbstorganisierende Produktion” (self-organizing production).

SOPRO aims at equipping objects in production with intelligence in future and to enable them thereby to coordinate and control production processes. “Intelligent work pieces as well as production and transport systems organize the manufacturing processes themselves in such a self-organizing production with distributed intelligence,” explains Eckhard Hohwieler, Abteilungsleiter Produktionsmaschinen und Anlagenmanagement, Bereich Produktionssysteme (Manager of Production Machines and Plant Management, Production Systems department) at the Fraunhofer IPK. “The work pieces move themselves through the production process on intelligent work piece carriers.

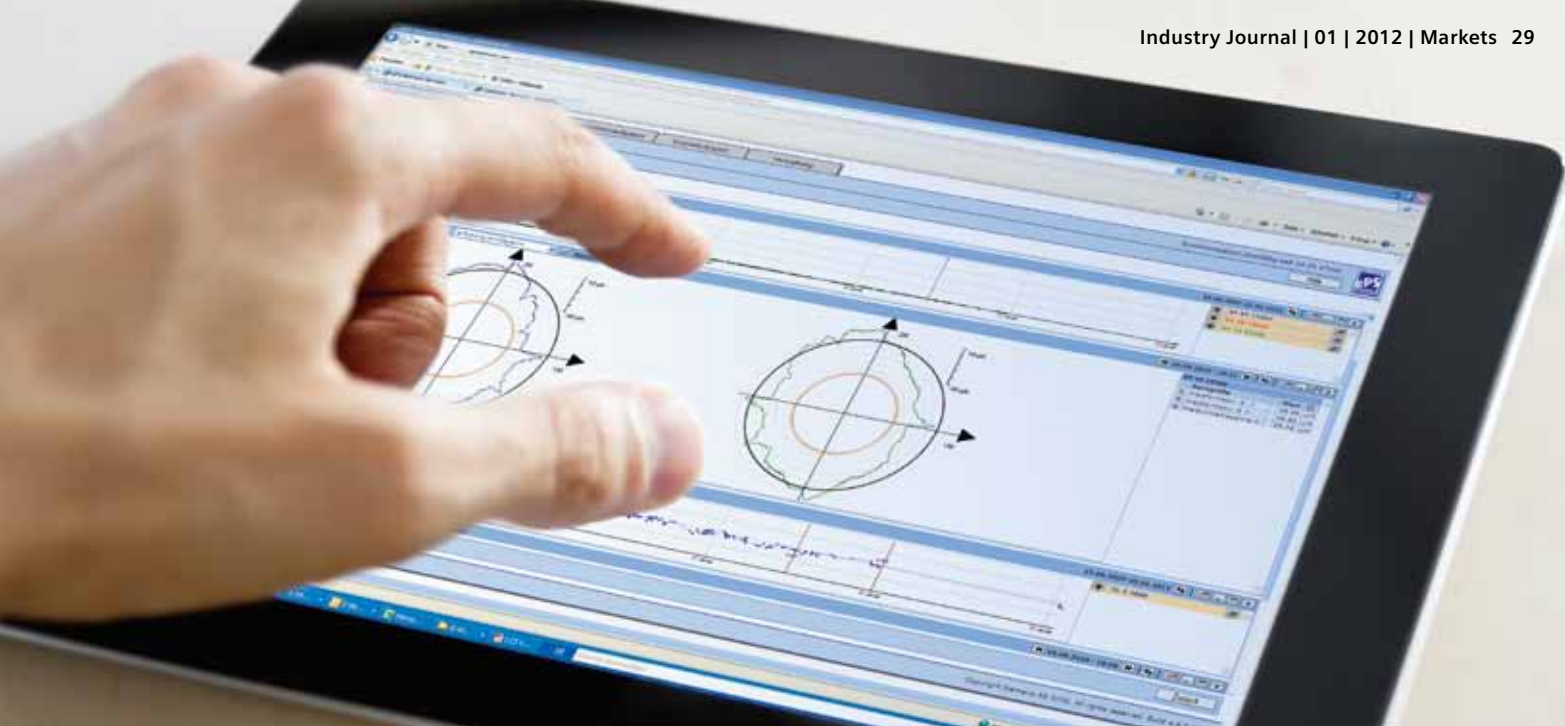
Production facilities know their own abilities and offer their services. Transport systems communicate with work pieces, and processing machines as well as assembly systems perform transport services. In this vision of intelligent objects and environments, the partners involved organize themselves in a task-oriented manner and negotiate the steps of action.”

SOPRO’s aim is to assess the potential of self-organizing structures in industrial production through autonomous, interlinked, intelligent wireless sensor nodes and to show it in production scenarios. Partners from production technology, automation, micro system technology, as well as from information and communication technology develop solutions and demonstrable applications.

The idea behind all this is that machines and work pieces communicate, learn from each other, and assign their tasks themselves in an efficient way. So-called Process-eGrains are the distributed intelligence that is required for this at the work pieces and involved components. They are tiny electronic units, which integrate functions such as wireless communication, various sensors, and a processor in addition to saving small amounts of data. This is how they exchange information with other components in the production process and, as a scalable soft- and hardware system, constitute the platform for the implementation of agent applications.

The SOPRO partners have already developed such intelligent wireless sensor nodes, which can be implemented in the production environment, transport systems, and production plants as well as being attached to work pieces. “They are particularly small and robust as well as having a multitude of functions. The Process-eGrains have an autonomous energy supply, various sensors, and communication interfaces. This means that priorities in the manufacturing process can be negotiated dynamically while specific process parameters are taken into account at the same time,” Hohwieler says.

A modular design concept that comprises the modules basic board, antenna, sensors, and energy supply has been developed for the implementation of the Process-eGrains’ micro system technology. It has already been implemented for the installation in rugged industrial applications. In order to be able to offer cost-efficient system solutions for new production concepts, Process-eGrains are currently optimized in regard to their robustness, mass production, and programmability.



Software rather than screwdriver

Innovative services reduce the downtime of machines and plants in case of repair or maintenance. The result: The productivity increases. The costs decrease. The environment is spared.

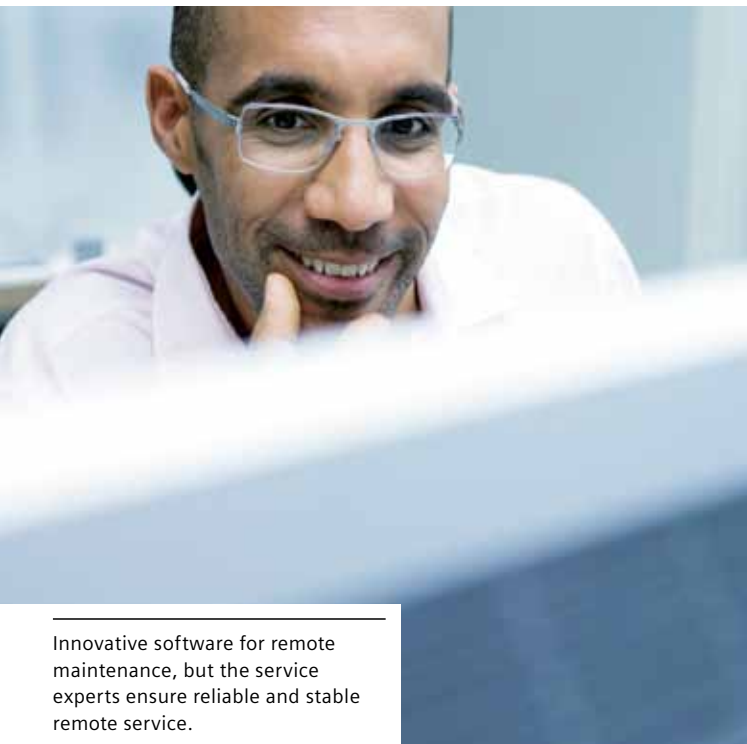
Production failures due to inadequate maintenance, unexpected damage to machines, services that have to be planned quickly – in many businesses those scenarios happened quite often just a couple of years ago. The experts could not be on-site immediately, and when they arrived, they had to analyze the damage before they could start the repair. Not only the financial losses were substantial by the time production was finally up and running again, but also the annoyance of customers waiting for their goods.

Maintenance, inspection, and modernization of production plants cause considerable costs, just like the long journeys of service experts. But the consequences of negligent maintenance can be even more expensive and detrimental to the environment: not only through the downtime of plants, but also through greater wear of mechanical parts and the corresponding increase in energy consumption caused by the

plant's operation and through the production of spare parts. It is a challenging task to find the thin line between unnecessarily frequent maintenance according to a fixed service plan on the one hand, and expensive repair due to badly maintained machines on the other. In order to manage this task, ever more businesses use remote services for preventive maintenance. This means that service companies can directly access their customers' machines and plants through a data line and with defined conditions for access. They monitor machines and plants from central control rooms, and remotely service and repair them according to defined service levels.

Remote ordering of spare parts

Required spare parts can be ordered and installed in due time and before damages occur, as well. The shipping company Aida Cruises' ships, for instance, are distributed all over the world.



Innovative software for remote maintenance, but the service experts ensure reliable and stable remote service.

The information of their on-board systems can be accessed via satellite from the company's Rostock headquarters. If an imminent defect is found, the required spare part is already waiting for the ship in the next port. In most cases, however, a couple of clicks with the mouse are sufficient to remove irregularities. The system platform for passenger ships that was developed and implemented by Siemens has proven itself: more and more irregularities are repaired with remote support today.

Intelligent planning of maintenance

The intelligent, sustainable version of machine and plant maintenance is called condition monitoring. It is the basis of better maintenance planning and its adaptation to the production process. Some businesses in the automotive industry already have up to 500 of their machine tools remotely monitored by various suppliers that use remote condition monitoring.

Other systems, such as Siplus CMS, contribute to a noticeable increase in machine and plant availability through continuous vibration monitoring of machines, rolling bearings, and drives. Plus, the continuous monitoring helps save energy. Defective drives require more energy than necessary – this means that they are less productive.

Jörg Bauer, who is responsible for the "Condition Monitoring and Reliability Services" portfolio of Siemens Industry, explains that difficul-

ties can in most cases be prevented in a smooth and efficient manner with a data line: "Our target is to avoid 80 percent of all problems through remote services. Businesses can save up to 15 percent of a project's cost by using the virtual service as early as in the commissioning stage of a machine or plant."

Remote services' fields of use are still in the first stages of their potential possibilities. The degree of permanent improvements and expansion of the applications is considerable. Some ten years ago, the connection was still rather unstable, but issues like that are a thing of the past thanks to the ever-improving performance of platform technologies. Security standards are so much better today than they were just a couple of years ago, too. New trends in the development of IT and software show that plants reliably detect imminent faults, reliably order services and spare parts, and can organize themselves in cooperation with other machines, if required (cf. "Machines of the future," p. 75).

Siemens already offers solutions in order to integrate various machines into the remote service and to enable a permanent contact between machine, plant, and service technician. Simatic Remote Support, for instance, is a standardized range of remote services for Simatic products. And the financial expenditure for the users of remote services has a good cost-benefit ratio: the customers do not require their own infrastructure for remote maintenance to keep in constant contact with the service provider. They can use Siemens' platform and only pay a license fee and the services they really use.

Remote monitoring becomes standard

Remote monitoring and maintenance supported by Siemens have become the standard in more and more companies. Chiron is a company from Southern Germany that specializes in production systems. It relies on ePS Network Services for the Internet-based teleservice of its CNC-controlled production centers at end customers' facilities all over the world. The goal of this Internet-based Siemens service is to increase the productivity and availability of machines and to optimize service and maintenance processes.

Siemens' remote service platform is the basis for the company's services. It supports service and support processes across companies and enables secure communication. As soon as the systems report a failure, the service technicians of the company that is headquartered in Tuttlingen, a small city near Stuttgart in Germany, access the machine control online. Repairs are then carried out together with the maintenance

staff or the machine operators on-site. Time-consuming intermediate steps, such as reporting the problem to the boss and the complicated diagnosis by a maintenance employee, can be omitted.

Even if remote maintenance becomes increasingly sophisticated, the traditional service tech-

nician will still be required, says Bauer: "People are the most important factor in service and will remain to be so. They are the experts and the core of our technology-based services. We perform tried-and-true processes that are always carried out in the same manner with innovative technologies." ■

"Our target is to avoid 80 percent of all problems through remote services."

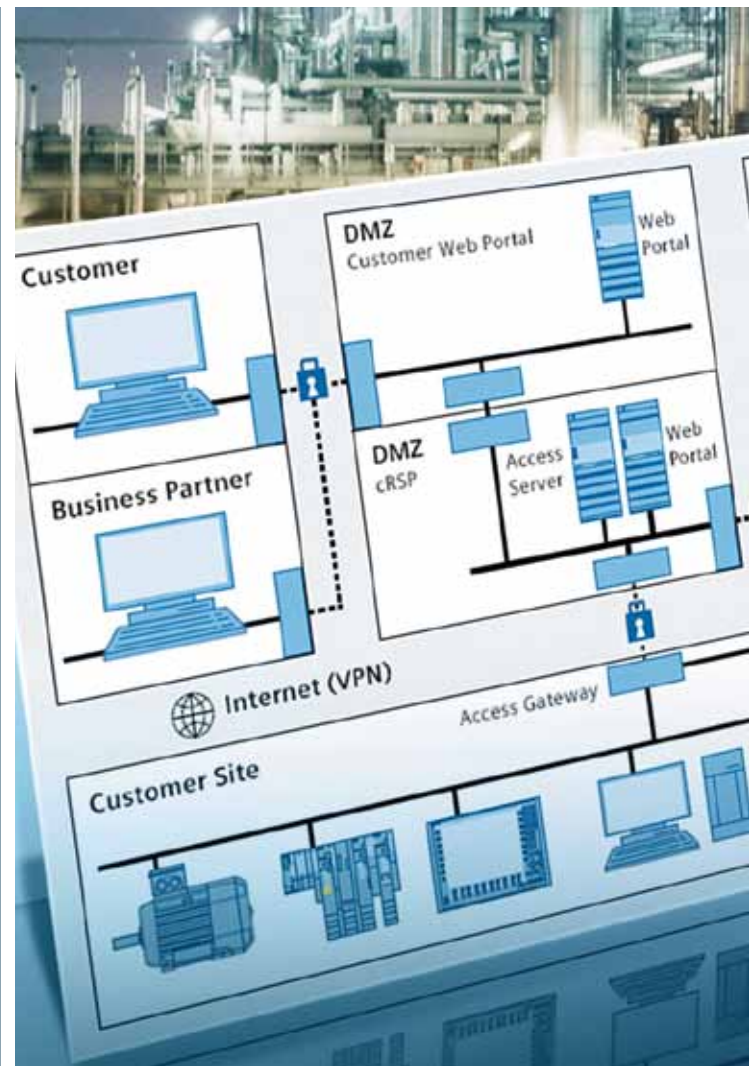
Jörg Bauer, Siemens Industry

Efficient remote service

Siemens' remote service platform has a standardized infrastructure and enables the remote access of industrial plants and systems.

Customers from various industries benefit from an increasing range of innovative services. This does not only reduce repair times and costs. The remote service platform facilitates the use of standardized analysis tools and offers valuable decision support for operation and maintenance.

The platform makes possible the easy connection of technical systems as well as flexible direct connections between plant and service applications. The solution has a security certificate as well as central administration and control functions in order to protect critical data from unauthorized access.



Case study

A city is freezing

200,000 people in the city of Chengde cannot heat their homes because the power plant fails after a fire. In the middle of January, at minus 20 degrees Celsius. The mayor promises that relief will be produced within 48 hours – although it usually takes months to provide the required replacement parts.

Chengde is very popular with tourists, lies some 200 kilometers northeast of Beijing, and has an administrative district with about four million inhabitants. In summer it is incredibly beautiful here at an altitude of more than 1,000 meters. In winter it is mainly one thing: cold. The temperature falls below minus 10 degrees Celsius at night and during daytime it rarely rises above 3 degrees. A failure of the heating system is life-threatening at these temperatures.

In Chengde, 80,000 homes are supplied with district heating from the Luanhe regional power plant. The plant's hot exhaust fumes are fed into the central heating system of the city to keep more than 200,000 people warm. But a fire destroys the coal conveyor system of the power plant in January 2011. Luanhe is down – and the people are freezing.

Mayor promises the impossible

The mayor puts on pressure: he promises to his citizens that the conveyor belts and with them the heating will work again in two days time. The power plant's management is now under a strong obligation and turns to its supplier, Siemens Mechanical Drive Systems Tianjin

SMDT: drives and motors from Siemens are a central part of the Luanhe coal conveyor system. But the fire has destroyed them. And now replacements have to be procured immediately.

It seems to be an impossible task for Siemens at first sight, because all drives and systems are custom made. "Every drive is different and so we usually manufacture on demand for such plants. This is why there were no suitable replacement parts for this plant in stock," says Li Bin, General Affairs Supervisor and chairman of the trade union at SMDT. Normally, it takes some three months from the order to the delivery of a custom-made new drive.

But nobody can wait that long in wintry Chengde. Siemens mobilizes all its power and attempts the impossible. Everybody, from plant management to sales and logistics and all the way to the production team, has only one goal: the conveyor belts of the Luanhe power plant have to be up and running again in two days time – no matter how.

It is impossible to produce new drives in this short span of time. That's why the Siemens experts try to find similar components that can be



modified quickly. Success is reported after a single day: the quickly created task force has found three suitable motors and one drive unit.

The replacement drive is completed overnight

The workmen at SMDT start their machines and work through the night. In the next morning the modified replacement drives pass the final tests, and only a couple of hours later they are on trucks and on the way to Chengde. Three Siemens engineers are also on their way to help with the installation on site. "The employees were extremely helpful," Li Bin remembers: "Nobody complained because they had to work overtime and take on additional tasks." After all, 200,000 people needed their help urgently.

After a four-hour drive and another ice-cold night the replacement parts are installed. In the small hours of January 15, the Luanhe power plant is starting up again. The plant management is satisfied – and nobody is cold anymore. ■



The mountainous Chengde is a UNESCO world heritage site – and thanks to its good road and rail links to Beijing an important traffic junction, too.

Siemens location since 2005

Siemens Mechanical Drive Systems (Tianjin) Co. Ltd was founded in 1996 under the name Flender Power Transmission Co. Ltd by the German drive technology manufacturer Flender. Tianjin became a Siemens Industry location through Siemens' global acquisition of the Flender Group in 2005.

The city of Tianjin is one of the largest trade ports of the People's Republic. It has ten million inhabitants and lies 150 kilometers southwest of Beijing. SMDT manufactures drive technology for various applications here, for instance standard industrial drives, worm drives, and particularly rugged solutions for the use in mines and pits.





The nation of superlatives

Every fifth inhabitant of the earth is Chinese. The economic growth is in the double-digit range. The government invests hundreds of billions in infrastructure projects and massively drives innovation, industrialization, and environment technologies. There is no way around the partner country of the Hanover Fair 2012 for Western businesses.

When Achim Wolfgang went to the country of the dragon in order to open the Chinese market for Zwilling, a company with a long history from Solingen, Germany, he knew well that who wants to be successful has to understand the country's culture. There was no other way in which he, as the representative of a German company, could motivate the Chinese not only to buy high-quality knives, scissors, and pots but to manufacture them in their own country as well. Rather than renting an apartment in a Western neighborhood, the former general manager of Zwilling J.A. Henckels Shanghai and his team moved to the residential and business quarter "SanLin Garden" in the suburbs of Shanghai – a good location to get to know the country and its people.

They met fellow residents in the entrance hall and were even invited over for a cup of tea. Wolfgang quickly realized the differences to the market at home – for example in how negotiations are conducted. How important a respectful attitude is. That a general rejection of contrasting opinions is of as little use as insisting on commitment. All this is a matter of course for

Chinese people and an arduous learning process for Western businesses.

The new insights paved the way into the Chinese business world for the Zwilling-team: They recruited new colleagues, rented buildings, bought machines, and negotiated with local partners. That was well over 15 years ago. Today, Zwilling has 1,500 employees in China. "It was the right decision to take the first steps very early," says Wolfgang, today member of the board in Solingen. Because China is booming. Foreign businesses that began with the groundwork early on profit from it today.

The world's second largest economy

The gigantic economy with more than 1.3 billion inhabitants is one of the most dynamic in the world. China secured a position among the world leaders through double-digit growth rates during the last decade. The People's Republic overtook its neighbor Japan in 2010 and is only excelled by the U.S. in the global ranking of economies. According to a study by Deutsche Bank the growth in 2010 could amount

Figures about China	
Population	1.34 bn.
Area	9.6 million square kilometers
GDP 2010	6.04 trillion US dollars
Growth 2011	9.5%*
Inflation 2011	5.5%
Foreign trade volume 2011	3.6 trillion US dollars
Foreign trade surplus 2011	155.14 bn. US dollars

* estimated

Sources: IMF, Foreign Office and Chinese embassy of Germany, Chinese Ministry of Commerce, U.S. Administration of Customs, CIIC.



Siemens and China cooperate in green technologies: Peter Löscher, President and Chief Executive Officer, signs a framework agreement in Berlin (top). The Volkswagen Group China is among the country's most successful foreign automobile companies and sold 1.9 million vehicles in 2010 (bottom).



to 8.3 percent. The Internationaler Währungs-Fund (IMF) expects a growth of some 9.5 percent for 2011 – after 10.3 percent in 2010. The economic growth was supported by a strong growth of credits granted and expansive financial politics of the Chinese central bank, though. This resulted in inflation rates of up to 6.5 percent last July.

High tech rather than low cost

There is no way for international businesses to avoid China. The country increasingly counts on modernization and rising living standards. Foreign businesses invested some 106 billion US dollars in 2010, predominantly in the service sector. The times of being a low wage country are over: China's imports increased fivefold to 1.7 trillion US dollars between 2001 and 2011. According to the Chinese ministry of commerce, the 2011 imports increased by 24.9 percent over 2010.

Such developments have turned the country into an important factor for foreign industries. China is already the largest foreign market for states such as Japan, South Korea, the Southeast Asian nations, Australia, Brazil, and South Africa. It is the second-largest trading partner of the EU behind the U.S. According to a survey by the international strategic consultancy Bain & Company, two-thirds of the German and Swiss businesses believe that the importance of the Chinese market will increase. "Most people, however, underestimate the dynamics," warns Michael Fülle-mann, who is a specialist for China and Partner of Bain & Company. Those people were satisfied with their growth rates and failed to realize that they were losing market share.

China's export business is booming, too: The People's Republic is the world's champion and shipped goods worth 1.9 trillion US dollars in 2011 – 22.5 percent more than in the previous year. The largest export markets in 2010 were the EU (19.7%), the U.S. (18%), Hong Kong (13.8%),

“Industrial enterprises should view China as a second home market.”

Michael Fülle-mann, Partner of Bain & Company

and Japan (7.7%). The most important export goods comprise electronic devices and electro-technology (41.5%), textiles (13.1%), machines (7.4%), and chemical products (5.6%).

The strong foreign trade has opportunities as well as risks. On the one hand, the Chinese hold the world's largest foreign exchange reserve that is worth more than 3 trillion US dollars. On the other hand, the Euro-crisis and the global economic weakness constitute a risk: The industrial production noted a decrease for the first time in 2011 after years of double-digit growth.

The government's most important goal is social stability – a real challenge. Agriculture is still the means of existence for more than a quarter of the population at the moment. But this quarter contributes only some 10 percent to the gross domestic product (GDP) and the tendency is falling. The share that industry (48 percent in 2011) and the tertiary sector (42 percent) contributed to the GDP increases simultaneously. The prosperity gap is accordingly large, even in the prospering coastal regions. A relatively high unemployment rate contributes to this: The Asian Development Bank assumes a total unemployment rate of 8.5 percent and of up to 30 percent in rural areas.

Economists are worried about the property market, too: The economic growth in conjunction with a lack of alternative investment options has resulted in a dramatic increase in property prices. In metropolitan areas such as Beijing, Guangzhou, and Shenzhen the price per square meter more than doubled between 2008 and 2010. If a real estate bubble should develop, its bursting would hit the Chinese economy very hard. A lot of Chinese invest in property as an old-age provision. Inflated property prices would threaten social peace just as much as a collapse of prices.

Central government counts on green economy

China's government has noticed the signs and initiated a change, for instance through a couple of base rate increases to counter inflation and various measures to limit property prices. "The Chinese leadership reacts very sensitively to crises and intervenes quickly and efficiently," commends Margot Schüller of the GIGA Institute of Asian studies, a foundation of the German government and the city of Hamburg. The promotion of export and federal investments advanced the Chinese economy in the last decades. Premier Wen Jiabao currently furthers sustainable growth from within and an increased industrialization through the twelfth five-year plan. It is planned to support eco-friendly and energy-saving technologies until 2015, alongside alternative sources

of energy, biotechnology, information technologies, the production of high-quality goods, and energy-efficient vehicles. "The central government wants to push industrial development and innovation," says Schüller.

The government has officially committed to creating a "Green Economy" that involves a gradual retreat from fossil energy sources, energy savings, and the increase of energy efficiency. A reduction of CO₂ emissions of at least 40 percent per GDP unit (kilogram CO₂ per US dollar) by 2020 is planned – in relation to the basis year 2005. So-called "clean coal" will be of central importance in this process. This means, however, that a reduction of the absolute CO₂ emissions is hardly possible prior to 2030. The government wants to introduce instruments that are close to the market to achieve this, such as CO₂ taxes or the development of a national emission trading system.

Top position in solar and wind power

It is no coincidence that China is the partner country of the Hanover Fair 2012, with its leading topic "greentelligence" and the leading trade fair "Industrial GreenTec". The country aims at achieving a leading position in the development of alternative energy. Clean energy and environment technologies are meant to comprise 15 percent of the GDP by 2020. The Chinese are already world champions in the installed capacity of solar and wind power plants today. China has launched a development plan for energy-saving cars with the goal of becoming the world's largest manufacturer of electric



China is the world's champion exporter and shipped goods worth 1.9 trillion US dollars in 2011. Its most important trading partners are the EU, the U.S., Hong Kong, and Japan.

cal vehicles by 2020. Subsidies of more than 11 billion US dollars are set aside to achieve this.

A strengthening of the domestic demand by 2015 is planned as well, especially through better social security and rising incomes. "We do not only have to make the pie larger, we have to distribute it more evenly, too," said Wen during the National People's Congress in March 2011. This would be advantageous for the global economy as well. China has gigantic consumption reserves, after all: More than 20 percent of the world's population live here accounting for only three percent of global consumption.

A middle class of some 350 million people has developed in the cities by now – more than in the euro zone. Those people are considered enthusiastic consumers as well as brand-conscious, and are creating new markets. "China is increasingly seen as a gigantic market," says Ilja Nothnagel, expert for China at the Deutscher Industrie- und Handelskammertag (DIHK, Convention of the German Chambers of Industry and Commerce) in Berlin.

China's advancing urbanization is particularly striking: The delta of the Pearl River around the cities of Guangzhou, Shanghai, and Beijing has a cumulative population of 65 million people – this equals the total population of France. Every second Chinese lives in a city already. In 2030 it will probably be 70 percent, which means more than one billion people.

Billions for infrastructure projects

They are attracted by the booming economy of the coastal regions. But the prosperity of the populous Central China is meant to increase, too. The government is improving the infrastructure in order to push the development. Roads, railways, and airports are being upgraded, telecommunication and energy networks extended. The investment of several billion Euros in infrastructure projects for the poorer western provinces is planned. Plus, the traditional industrial core in the northeast of the country is going to be fundamentally modernized.

The north-south redirection of water that is meant to remedy the chronic undersupply in the north with water from the Yangtze River in the south is a gargantuan project. An investment of over 50 billion Euros by 2050 is estimated for it. Foreign expertise in engineering or water pollution control is explicitly welcome here.

The expenditure for research and development for the transformation of low cost to high tech



is topped up steadily. International know-how is in demand in most industries, however. The country is missing comprehensive innovation structures.

Improvements are required in market orientation as well as in professional and tertiary education, according to a study conducted by OECD in cooperation with the Chinese Ministry for Science and Technology. The number of people enrolling in higher education increased fivefold between 1998 and 2005, but skilled craftspeople are still in short supply. This is the reason why an increasing amount of international companies are training people locally. Zwilling's Achim Wölgarten is better off: The company has been in China for 15 years and has fewer problems in finding well-trained employees than its competitors who are only starting to discover the Chinese market. ■

Strategies for success in China

The consultancy Bain & Company has determined five essential factors for a successful China strategy:

- 1 Fast expansion**
Those who proceed step by step will fail quickly.
- 2 Do not focus on the premium market**
The medium price range, the "good-enough sector," is turning into a profitable mass market. Western businesses have to learn to make solid basic offers.
- 3 Take local competitors seriously**
Local competitors that grow in the "good-enough sector" will threaten Western companies in the premium sector soon.
- 4 Thorough market analysis**
A thorough analysis of a market as gigantic and fragmented as China is indispensable.
- 5 Find and retain local specialists and managers**
Locals should constitute 75 percent of the employees in the medium term.



"The reasons for our success in China are that we have an in-depth understanding of the market, localize the value chain for the Chinese market, trust our local talents, and work in long-term partnership with our customers."

Dr. Marc Wucherer, Executive Vice President of Siemens Ltd., China, and President of Industry Sector North East Asia

Siemens in China

Siemens has been present in China for over 130 years: The Germans from Munich delivered the first pointer telegraph there in 1872. The company has some 70 corporations, more than 60 branches, and numerous local cooperation partners in China today. It is among the most important international companies in the country and its 29,000 employees make it one of the largest foreign employers. Siemens noted a turnover of 6.39 billion Euros in China in fiscal 2011.

The company offers a comprehensive range of solutions locally and holds leading positions in industry, energy, and healthcare. Siemens had notable success in all three industries in fiscal 2011. It constructed a turnkey assembly hall with machines and electrical equipment for Shanghai Volkswagen's fifth vehicle plant, for instance. Siemens' software business re-

ceived an order to develop a smart network platform for Shanghai's public transportation system. As a pioneer in high-voltage direct-current (HVDC) transmission, Siemens will deliver key components for two HVDC projects in southern China. These projects are meant to transmit eco-friendly power from southern China to the megacities Guangzhou, Jiangmen, Dongguan, and Shenzhen with low losses.

Siemens values fair partnership: In order to strengthen local value creation, Siemens VAI Metal Technologies is developing its location as well as the research and development center in Shanghai with some 60 billion Euros, for instance. The Chinese Institute of Public and Environmental Affairs recently honored the company for exemplary sustainable supplier management.



Companies to watch

Good figures as a business model

No matter whether milling machines, cars, lamps, or insulation materials – the software consulting company PE International from Southern Germany has found a way to calculate the environmental performance of any product in a way that is comparatively simple and scientifically sound at the same time. This business model would have been a sure flop 20 years ago. Today, businesses from all industries and from all over the world are customers of PE – from mining companies to chemical companies and food manufacturers and all the way to automobile companies. Because sustainability that can be measured and proven has become a decisive competitive factor.



Michael Betz, CEO of PE International, has chosen sustainability as his profession. He calculates ecological footprints for businesses as an industrial service provider and not as somebody who wants to improve the world.



Michael Betz met his Gabi at university. She plays a central role in his life until today – now in version 5. Because Gabi is not a woman but a software that is actually spelt GaBi – an abbreviation for Ganzheitliche Bilanzierung, which means integrated assessment. Businesses can calculate the ecological footprint of their products over their entire lifecycle with it: “Sustainability assessments that make sense do not stop at the plant gates. They start with the sourcing of raw materials and end with the disposal,” says Betz.

The 42-year-old physicist has been head of PE International since 2001. GaBi is one of the key products of the software and consulting company from Stuttgart, Germany, that started as a spinoff of the University of Stuttgart in 1991. This is where Betz was a student in the 1990s and was involved in the development of GaBi

at the Institut für Kunststoffprüfung (institute for plastics testing) later on. The team of Peter Eyerer, former head of the institute and naming patron of PE, developed a marketable software for lifecycle assessment (LCA) from the beta version over the years.

Automotive industry as source of inspiration

GaBi originated from a research project for the automotive industry: The question that was posed in the middle of the 1990s was whether the use of plastics in the manufacture of cars pays off in comparison with the use of steel when seen from an ecological perspective. A tricky question. A simple look at the operational stage of a car is not sufficient to answer it. Lighter plastics parts do help save fuel and emissions. But what about the emissions in the production of plastics? Which material can be

processed in a more environment-friendly manner – that means with as little toxic residues and waste as possible and with a lower expenditure of energy? And which one is better in regard to its final recycling? “Sustainability assessments that are really sound and reliable are always very complex,” explains Michael Betz.

The ecological footprint that a product leaves during its life is influenced by many factors that are often tightly connected and influence each other. Businesses that really want to make a difference in climate and in environmental matters need an enormous amount of data. To collect, compare, interpret, and meaningfully connect them is a job for expensive experts – or for GaBi. The goal of the software is to make sustainability assessments easier, more transparent, and finally more affordable. Michael Betz calls it industrialization: “The question is becoming more important and the answer more affordable. This is how the topic sustainability comes out of its niche,” he says.

People who choose his software do not only get a high-performance calculation model, but access to an extensive database of reference and comparison values that are validated and regularly updated. They concern, for instance, alternative sources of supply as well as the energy consumption and other aspects of waste and disposal of various ways of transport and production methods. “Our product contains 2,000 man-years of experience in the collection and evaluation of data,” says Betz.

20 years of experience in the project

Most of the nearly 200 employees hold an academic degree, mainly in a technical subject area or in a natural science. Many of them have worked in an industry or as a consultant and know their customer's processes and working methods. As an external consulting company, PE has a broader view and can access numerous projects from the last 20 years for its sustainability assessments. The valuable stored data is regularly checked by employees as well as by independent institutes and industrial associations.



Sustainability is an important topic for the automotive industry (top left), because fuel consumption and emissions that are harmful to the environment have to be reduced.



Michael Betz (left) shows businesses how they can measure, prove, and improve their commitment to sustainability.

Businesses from various sectors use the LCA software, among them mining companies such as Rio Tinto Alcan, chemical companies such as Wacker, food manufacturers such as Kraft, and automobile companies such as Toyota and VW. VW, for instance, established in its corporate directives in 2008 that all new car models have to have a better ecological performance than their predecessors – not only as regards energy consumption and emissions during their use, but also over the entire product life cycle. VW requires reliable statements about the ecological effects of various materials, designs, drives, and production as well as transport methods in the early development stage in order to achieve this: “Changes at a later point are too expensive in most cases and there is no time to implement them,” says Stephan Krinke, head of VW’s product and environment department. In addition to that, the results should be as unambiguous as possible and easily interpretable by the engineers.

Data directly from the ERP system

VW implemented GaBi and linked it directly to the company’s IT in order to keep the expenditure of time and cost at a reasonable level despite the complexity of the product car. In the first step, all data required for the ecological assessment are assembled in a consistent format. This step is the most time-consuming one and takes several days or weeks, depending on the model. In the second step, the input data are transferred to an analysis model in a fully automated way that takes only a few hours. It is now possible to concretely calculate the ecological effects of various product versions and to display them clearly. Previously, the modeling was a time-consuming job for an expert and took up to 40 working days. Better results are achieved with less effort through the application of software and they can be clearly communicated to the developers.

An increasing amount of people that do not belong to a company, such as customers and investors, are strongly interested in its environmental commitment. Michael Betz talks about a “war on many fronts” that businesses had to lead today in order to remain marketable and competitive. The awareness that a resource- and energy-efficient life style is indispensable rises, particularly among the populations of traditional Western industrial nations. Ever more people want to consume in an ecologically sound manner and expect clear information from companies for this purpose. Politicians recognize the need for action in ecological matters and issue

“Sustainability was a niche topic 20 years ago. Today it can be called a megatrend.”

Michael Betz, CEO of PE International

tougher legal regulations all the time, such as the German law for energy saving. The importance of voluntarily applicable climate labels from nonprofit and climate protection organizations is increasing as well. Consumers can recognize low-emission products more easily through them. The first label of this kind was developed by the British organization Carbon Trust in 2006. There are similar initiatives in Switzerland (Climatop) and the U.S. (Carbon Fund), for example. “Trade in particular is driving the distribution,” explains Michael Betz. Renowned chain stores like Migros or Tesco already have parts of their product range certified on a voluntary basis.

Environment leaflets for major purchasers

Industrial customers ask for the ecological assessment of investment goods and primary products with increasing frequency, too. Fleet managers who want to buy environment-friendly cars for a company’s vehicle fleet, for instance. And architects who ask for so-called Environmental Product Declarations (EPDs) in their calls for tender. The ecological effects of products can be compared accurately with those “environment leaflets”: Which floor covering emits less CO₂ during its product life? Which insulating material contributes less to the acidification of water and soil? Which lamp consumes the most energy in its entire life?

PE International: success with GaBi and SoFi

PE International was founded in 1991 as a spinoff from the University of Stuttgart. The company today has 200 employees worldwide and is among the leading software and consulting companies in the field of sustainability management. More than 1,500 businesses and institutions are its customers. The software solutions GaBi and SoFi are important providers of turnover. GaBi calculates a single product's sustainability, SoFi analyses how sustainable the general business management is, for example with regard to the energy consumption in buildings, the vehicle fleet, the way of business travel, and the office equipment. In addition to that, PE offers matching consulting services. The company prepares sustainability reports for its customers, for instance, and supports them in saving energy.



The Zumtobel group is headquartered in Austria and has an annual turnover of some 1.2 billion Euros. The supplier of lighting solutions wants to provide such information for buyers and architects in the form of a clearly structured online datasheet in future. The snag of the matter is that the cumulative weight of the brand's product catalogs amounts to seven kilograms. More than 30,000 products are listed in them. Naturally, Zumtobel does not want to commission 30,000 expensive single assessments. This is why the company has introduced GaBi and linked it to the ERP system. The LCA program automatically retrieves the relevant information, such as lists of materials and machine times, from the company's software and calculates the values for the EPDs on this basis.

From science to economy

"Sustainability was a niche topic 20 years ago. Today it can be called a megatrend that is present in all industries," says Betz. Just like he has changed from science to economy ten years ago, the topic sustainability has developed from a theoretical research model to a practical business model since then. Unlike in its university times, PE International earns money with sustainability solutions today. "We work for a good cause, but not for free," says the head of the company.

The change from a private limited company to a stock company has prepared the floor for

fusions and investments – and for continued growth. PE International merged with the sustainability consultants Five Winds from Tübingen, Germany, in 2010. Plus, the managing board has acquired financially strong investors. Siemens Venture Capital acquired an interest of four million Euros at the end of 2010.

Siemens plans to offer software solutions for sustainable product lifecycle management together with PE International in future. “Many Siemens products already aim at countering the climate change and improving the ecological assessment of our customers,” says Dr. Detlef

Pohl from Siemens Venture Capital (see interview). Michael Betz sees yet another difference to climate and environment protection organizations such as Greenpeace and the Carbon Trust: “We do not work from a world improvement perspective, but are perceived as suppliers of industrial services by our customers,” he says. Instead of instructing or even denouncing businesses, the consultants want to secure competitive advantages for their customers and to support them in reducing costs. A higher degree of sustainability can only be achieved through working with the businesses – and not against them. ■

“Very hard to copy”



Interview with Dr. Detlef Pohl, Managing Partner of Siemens Venture Capital, about market leaders, cooperation, and returns.

PE International is one of the businesses you have had an interest in since the end of 2010. How did you notice the company?

We were looking for companies that offer software solutions for industrial customers in the area of energy efficiency and sustainability. We use many sources for our research, for instance the Internet, reports from analysts, and trade show contacts, but also conversations with our customers and Divisions.

What was the most convincing thing about PE International?

We see the company as the market leader in Life Cycle Assessment, that is, in sustainability assessments over the entire product life cycle. PE has an outstanding database and employs experts from many industries. These factors are crucial for the quality of sustainability assessments – and very hard to copy.

What are your basic requirements that new investments have to meet?

We only invest in companies with which we can operate as well, for instance in form of development cooperation and supplier relations. Siemens will cooperate with PE International in the field of PLM software. We will be able to offer a complete solution in future that enables Siemens' customers to optimize their production processes sustainably.

So this is about know-how rather than about returns?

Not at all. It is always our goal to step out with a profit. We do not invest in start-ups that do not have more than an innovative business idea. Our investments generally have considerable turnovers in the two to five million Euro range when we buy in – and should be in the black in the foreseeable future. We provide the capital so that a promising business can keep growing.

Tags rather than taxis

Car manufacturers are focusing on their key competencies and transfer increasingly large parts of the production to their suppliers. This results in highly complex supply chains that can only be controlled with advanced technology. The project RAN is aiming at an industry-wide standard.





It is anything but an everyday tour for a taxi driver: a 450-kilometer sprint from Munich to Saarbrücken for 800 Euros. There is no vital donor organ on board, nor is there a courier with urgent diplomatic messages – the taxi transports boxes that contain parts for an injection system from Bavaria to the Saarland. A supplier is waiting anxiously for the unscheduled express delivery, because his end customer – a large car manufacturer – has increased his production at short notice and requires supplies as quickly as possible himself. The urgent delivery has a value of some 80 Euros.

The example is based on a true story. The parties involved prefer not to be named. Because what makes the taxi driver from Munich a happy man hurts every businessman and logistician – and is not even a rare occurrence in the complex world of highly specialized car production.

The degree of added value decreases

The reason: The car manufacturers (OEMs, Original Equipment Manufacturers) have outsourced part of their competencies in the last years and left an increasing amount of production to their suppliers. “OEMs contributed 30 to 40 percent to the creation of value ten years ago,” explains Professor Steffen Hütter, the car expert of the Hochschule für Technik und Wirtschaft (University of Technology and Economy) in Saarbrücken, Germany. “Today, their share is between 10 and 20 percent.”

This development is a logical consequence of modern cars’ increasing complexity: They are not only brimming with elaborate technology but are available in ever more versions as well. This is the reason why no OEM can keep the competence for all components in its own facility today. An increasing amount of specialized suppliers develop and produce parts such as xenon headlights or control units only.

These components have to be delivered to the OEMs’ production lines punctually and in sufficient amounts – preferably “Just In Sequence” (JIS). This means not only at the right time (to make intermediate storage sites smaller), but also in the right order (to make time-consuming re-sorting unnecessary). A combination of specialized suppliers and sophisticated JIS logistics reduces the cost of car production – as long as the complex network of suppliers, OEMs, and lo-

18

businesses are actively involved in RAN. All project partners on www.autoran.de



RFID systems from the Siemens Simatic range control the flow of material in car production (top) or support commissioning in the goods depot (right). The robust code-reading systems (bottom) are particularly suited for the registration of quickly moving objects.



50,000

indirect suppliers, that are suppliers of suppliers, are part of the supply chain of an automobile group today.

gistics service providers works frictionlessly. If there is a hitch at one point, all parties involved have to make new arrangements at short notice in order to ensure the supply of components and keep the workflow up and running. And sometimes taxi-express-transporters are the only way to achieve this.

A better overview thanks to data standards

Such costly emergency logistics could be avoided by keeping everybody in the production and logistics chain informed about the exact production status and possible bottlenecks at all times. This is exactly what the project RAN (RFID-based Automotive Network) wants to achieve. The Bundeswirtschaftsministerium (Federal Ministry of Economics and Technology) supports the project with 20 million Euros.

18 businesses and research institutions take part as project partners, among them leading OEMs and suppliers, IT service providers, and logistics companies. Numerous other businesses support the project as Ran-Friends. Dr. Raffaello Lepratti from Siemens Industry Automation explains what makes the project special: "Some companies already use RFID technology to control their production and storage. But RAN wants to create the first standard involving all parties that participate in the automotive supply chain." In the RAN-consortium, Siemens is responsible for the development of standards for the various classes of RFID infrastructure.

This infrastructure accesses and reads small electronic labels ("RFID tags" or "RFID labels") that contain information about the products –

“RAN aims to establish a standard that involves all parties that participate in the automotive supply chain.”

Dr. Raffaello Lepratti, Siemens Industry Automation

wirelessly and without requiring visual contact. These data could also be saved in bar codes and decoded with laser scanners. But this would mean that an employee would have to scan every label in a time-consuming and error-prone process. Thanks to the radio technology, numerous RFID labels can automatically be read at the same time. It is not even necessary to open boxes or remove foils because the radio waves do not require visual contact. The labels are meant to be attached to the transport pallets at first. Later on they could be attached to so-called small load carriers placed on top of the pallets. In future it could even be possible to equip every single component with a label. This would make the “internet of things” a reality, in which every product has an unmistakable identification number (ID) and can be tracked seamlessly on its way from the manufacturer to the customer.

Real-time production data

Every time a pallet, small load carrier and component passes an RFID reader on their way through the production and logistics chain, the information on the stuck-on label is read. “An RFID reader in an OEM’s production could track the usage of parts in real-time, for instance,” says Andreas Müller from Bosch. “The OEM’s IT system could generate a message with this information and send it to the respective suppliers, who learn immediately when they have to produce and ship new components.”

Currently, the manufacturers’ Enterprise Resource Planning (ERP) systems calculate only once a day – generally during the night – which and how many parts they require and send a message to the supplier’s ERP system. “This means that the suppliers only know the state of the day past,” says Müller. “If something changes in the production during the day, the people involved have to communicate via telephone, e-mail, and fax. This costs a lot of effort and precious time.”

Plus, every change triggers a small avalanche of communication. Because the car manufacturer’s

direct supplier (tier 1) has suppliers as well (tier 2), who in turn obtain components from suppliers (tier 3). A typical OEM has some 1,000 tier 1 suppliers, as well as some 50,000 tier 2 and tier 3 suppliers. This complex network could be managed most effectively if all parties involved could access their partners’ production status data in real time.

This is the ambitious goal of RAN. The network’s hub for relevant information is the “Infobroker”: “All occurrences, such as the consumption

Sustainably efficient processes

Siemens offers a comprehensive range of RFID and code-reading systems under the product name “Simatic Ident”. It comprises RFID systems for the HF and UHF band (Simatic RF200 and RF300, respectively RF600) and reading systems for optical 1D and 2D codes as well as OCR (Simatic MV420 and MV440). The systems can be used in parallel as well and can be integrated seamlessly into the Siemens control systems Simatic and Sinumerik. Even highly complex supply chains become transparent through the Simatic Ident solutions because all information is available in real time. This avoids bottlenecks as well as idle time and optimizes the storage.



of a pallet of components, are saved in the IT system of the manufacturer or supplier, and all other partners that are involved in the supply and production chain are informed," explains Frank Schmidt from IBM. "The Infobroker manages the participants' authorization to access this information."

Pilot projects start in 2012

This exchange of information between manufacturers, suppliers, and logistics companies will be demonstrated for the first time in pilot projects at the end of 2012. In addition to that, Siemens is working to connect its manufacturing control system "Simatic IT" to the RAN-Infobroker. "As soon as we have implemented this, we can directly use the RAN system's reports to optimize the production program, even in case of sudden

supply events, and thus optimally use the available capacity," says Dr. Lepratti. Siemens and the Technische Universität (Technical University, TU) München will start a large-scale test in May 2012: The experts want to investigate the RFID-controlled interplay of OEMs and suppliers with the help of a model production line.

The RAN-project will last until December 31, 2012. Afterwards, its results will become a standard of the Verband der deutschen Automobilindustrie (German Association of the Automotive industry, VDA). "The standard has to prevail globally in the long run," says Hütter, because supply chains span the entire world. This means that the automotive industry would become a pioneer for logistical excellence. Something that would make the industry happy – taxi drivers rather not. ■

Every part in constant view

Identification systems without gaps are in demand in the automotive industry.

Siemens offers various technologies for this purpose that span from the 2D bar code to RFID.

As customers can compile their personalized car from a range of modules today, individualized production control is in high demand in the automotive industry in particular. Lightweight components for the crankcases and cylinder heads of BMW engines are produced in the foundry of the BMW plant in Landshut, Germany. The castings are furnished with a data matrix code (DMC) in the plant in order that they can be identified. This kind of 2D bar code is employed for a range of purposes, for example for the durable direct labeling with a laser in production processes. The codes are lasered on and can be read faultlessly with a code-reading system that manages even challenging contrast ratios easily.

Rehau AG, one of the leading suppliers of plastic parts to the automotive industry, uses RFID for the comprehensive control of production and logistics in order to manage the broad variety of its complex production. Through the automatic data collection with Simatic RF600 – from the first steps of production to the outgoing goods department – Rehau is able to deliver the right product at the right time and to guarantee its quality.



In the BMW plant in Landshut, engine parts are produced and furnished with a lasered Data Matrix Code (DMC).



Show your colors

Brand products' countries of origin have considerable influence on their sales opportunities on the global market. German machines, financial services from Switzerland, and Japanese electrotechnology profit from the country-of-origin effect in the international competition. Strong brands can have the reciprocal effect of determining the image of an entire nation – an opportunity for emerging countries.

Three sweating Finnish men are sitting in front of a sauna sucking cough sweets – a great Finnish invention, as one of them claims. A small, indignant man in a suit comes running and the Finn confesses: The sweets are from Switzerland. The traditional Swiss brand Ricola uses commercials like this one in their advertising. Successfully: The sweets manufacturer with 400 employees in Switzerland is among the most famous brands of the alpine country, according to a study by the globally renowned brand agency Young & Rubicam.

The company enjoys a remarkable degree of prominence in foreign countries, too. The family business owes this not least to the so-called country-of-origin effect – the origin-based associations with

a product. This is why Ricola deliberately stresses its Swiss roots in foreign commercials as well: There is always a Swiss who flaunts his Swiss-flag tie in front of the camera when he points out the sweets' origin to Finns, Chinese, and Eskimos. The wrappers show herbs and mountains, and at the end of the commercial, the name of the company is yodeled.

Country of origin determines selling prices

Switzerland stands for attributes such as clean, reliable, precise, and close to nature – positive characteristics that customers do not only value in a cough sweet. "Original Swiss" products like watches, chocolate, cheese, and banking services



The label "Made in Germany" was introduced in England more than 100 years ago to protect British consumers from allegedly inferior German goods. But as the quality from Germany was quite convincing, "Made in Germany" soon became an international seal of quality for reliable technology.



The Heidelberger Druckmaschinen AG (Heidelberg printing machines plc.) was named after Heidelberg, its city of origin. This is one of the reasons for its fame.



The sweets manufacturer Ricola counts on "Swissness" – and is one of the most famous brands of the alpine country.

The term "Swissness" was coined in the 1990s in order to establish Switzerland as a trendsetting brand. Precision, reliability, political stability, cleanness, and fairness are seen as typical characteristics of the alpine country. The "brand logo" is the Swiss cross that can be found on various brand products – from bottles to watches, and all the way to pocketknives. The number of brands with addendums such as "Schweiz" or "Swiss" has quadrupled in the last ten years.

can be sold for higher prices all over the world, according to a study by the Eidgenössische Technische Hochschule (ETH, Swiss Technical University) Zürich and the University of St. Gallen.

Such a capitalization of a country's image does not only work for consumer goods. The place of production often serves as a promise of high performance in the case of investment goods, as well. The Heidelberg brand is a clear competitive advantage on the world market for the German manufacturer of printing machines of the same name: People from the U.S., Japan, Russia, and China know the German university city that attracts millions of international visitors every year. Potential customers from all over the world automatically connect Heidelberg with German engineering.

Businesses from the United States profit from this effect as well. Customers connect innovative strength and ease per se with their products. And products from emerging countries still stand for an attractive price-performance ratio. Marketing specialists use such associations for the international competition and stress the products' origin – or keep it secret and refine national products with international-sounding brand names.

Car manufacturers stress their origin

A study by the consultancy Globeone from Cologne, Germany, proves the positive effect of a country of origin, for instance. The German car manufacturers VW, BMW, and Audi are far better known in the BRIC states than is Porsche. They stress their origin with German slogans such as "Das Auto" (The car), "Freude am Fahren" (Enjoy driving), and "Vorsprung durch Technik" (The technical edge). Porsche, on the other hand, counts on international model names (Panamera, Boxster, Cayman) and does without a typically German claim. Next to the car industry, engineering, medical technology, and pharmaceuticals are seen as German key competencies. Most German businesses in those industries acknowledge their home country worldwide.

"Businesses that demonstrably come from Germany have a competitive advantage on the Russian market, for instance," confirms Jens Böhlmann, spokesman of the German-Russian Chamber of Foreign Trade in Moscow. "The label 'Made in Germany' is seen as a statement of quality, service, technology that is suitable for the international market, reliability, and durability – in the B2B sector, too."

The images of country and brand have to match

The image of the country of origin only unfolds its effect when the images of country and brand match. "You do not expect cheap watches from

Switzerland,” says Cassidy Morgan, the brand agency Interbrand’s head of Central and Eastern Europe. This was true for B2C brands as well as for B2B products.

Above all, consumers wanted to buy a bit of the country’s attitude with a foreign brand. And when it came to investment goods, buyers were trying to find additional warranties. The more a certain brand fitted the ideas of national behavioral patterns, the more trust the buyers placed in its performance, according to Morgan.

The brand-ranking “Best Global Brands” by Interbrand, for instance, shows what customers associate with certain countries: “National top brands show the strengths of their home country clearly,” says Cassidy Morgan. The car manufacturers Mercedes, BMW, Audi, and Volkswagen as well as Siemens are among the ten most valuable German brands, for example. The luxury fashion brands Cartier, Hermès, and Louis Vuitton are among the upper ranks in France. Italy excels with fashion and accessories from Gucci and Armani. High-tech from Sony, Nintendo, and Canon as well as cars from Toyota, Nissan, and Honda come from Japan. The easy-going American way of life is represented by brands such as Coca-Cola, McDonald’s, Starbucks, and Disney from the U.S. In the B2B sector, the country scores with innovative strength that is represented by brands such as Microsoft, Oracle, Hewlett Packard, Amazon, and Apple. “The U.S. are synonymous with the legendary Silicon Valley all over the world,” confirms Interbrand manager Morgan.

National characteristics have grown over time

Alexander Deichsel, head of the Institute for brand technology in Geneva, calls the national location of product characteristics “performance geography”. Just as climate and landscape brought forth a country-specific flora and fauna, national performance characteristics evolved over centuries in many places. Those historically developed distinctive features were anchored deeply in the minds of people, says the expert for brand management: “If you had the choice between a scent from Nigeria and one from France, you’d certainly choose the French one,” says Deichsel. The sociologist sees the country-of-origin effect as an important marketing tool in the global competition: “In a world where virtually everything is available everywhere, origins are becoming increasingly important,” he prophesies. Because if they are used in the right way, declarations of origin facilitate the orientation in an increasingly complex world of goods.

But a strong country-of-origin brand strategy has its risks, too. A country’s image – and with it that of its brands – can suffer from economic, ecologic, and political crises. No matter if it is the rescue of

MADE IN



Every second of the world’s 100 most valuable brands comes from the U.S. Their accumulated value amounts to some 800 billion US dollar. The brands are synonymous with lightheartedness (such as Coca-Cola, McDonalds, and Disney) and innovative strength (such as Ford, Amazon, Apple, and Microsoft).



The advertisement of soft drinks manufacturers such as Coca-Cola relies on the American way of life in foreign countries as well.

MADE IN



When a brand gives the expression of having foreign origins, this is called “foreign branding”. A well-known example of this is Häagen-Dasz: The American brand of ice cream sounds like Danish food-art to non-Scandinavians. But the Danish alphabet does not even have the letter “Ä”.

MADE IN



Japan is seen as a synonym for discipline and efficiency. The Japanese invented systematic process optimization (Kaizen) as well as lean production. Their export success is based on affordable high-tech. Businesses such as Panasonic and Toyota are among the world’s largest in their sectors.



The car manufacturer Toyota is the inventor of lean management and a national symbol for Japanese discipline and efficiency.

the Euro, the Arabian spring, or a nuclear accident – the risk increases that a government becomes unpopular through its national management of the crisis. “This can lead to purchase blockages in the worst case,” says Cassidy Morgan.

Sometimes, negative country-of-origin effects are used on purpose in order to stigmatize foreign products. The label “Made in Germany” was originally meant to protect the upcoming industrial nation of the United Kingdom from inconvenient imports from Germany at the end of the 19th century. The strategy failed impressively – the declaration of origin became a strong brand sign for German products.

Similar strategies are currently underway in the EU: Obligatory declarations of origin are meant to be introduced for textiles, leather goods, and furniture that are imported from third countries. The official reason for this is to warn consumers about the potential employment of children by and ecological sins of the manufacturers. It is hardly surprising that this attempt by the EU is supported mainly by EU states with strong competitors from Asia.

Even borrowed plumes are an adornment

In other countries, some manufacturers hide their origin rather than stressing it, because it does not match the desired brand image. They prefer giving their brand a foreign image to improve the sales opportunities – so-called foreign branding.

Strengths and weaknesses of the U.S.

The brand U.S. ranked first in the country ranking of the Nations Brands Index (NBI) for the third time running in 2011. The NBI was developed by Simon Arnholt, a political advisor from the U.S., and measures the image of nations. It is based on categories such as culture, export, tourism, politics, and foreign investments.

Xiaoyan Zhao is the director of the study and traces the success to the attractive mix of fun and pop culture on the one hand and cutting-edge technology and science on the other. Many of the globally leading universities are in the U.S., investments in start-ups have paid off quite often.

But there are negative connotations of the “Brand America” as well: The U.S. are internationally seen as being rather dominant and not very conscious of the environment. Manufacturers of investment goods in particular had to work hard to get rid of this image, says Zhao.

Strong nations, strong brands

Who has the most Global Brands?

Country	Global Brands	most valuable brand	in bn US dollar*
US	49	Coca-Cola	72
Germany	10	Mercedes-Benz	27
France	7	Luis Vuitton	23
Japan	7	Toyota	28
Great Britain	5	HSBC	12
Switzerland	5	Nescafé	12
Italy	3	Gucci	9

Source: Interbrand, Best Global Brands 2011. *Values rounded.

A Russian business group, for instance, sells its stationery under the German-sounding name “Erich Krause” in Eastern Europe. The slogan “every detail counts” hints at Teutonic precision. Some of the products do even look like their German models down to the last detail.

Alexander Deichsel thinks that such a strategy is risky: “Honesty is the basis of long-term success,” says the brand strategist. Who names detergent after a German housewife or cheese after a French monastery has to meet the created expectations in order that customers do not turn away quickly.

Businesses that place “cuckoo brands” in a provocative position have to expect legal measures. One example is Bork, a Russian manufacturer of domestic appliances, who advertised cheap products from the Far East as “S-class from Germany”. The French SEB-Groupe cautioned Borg for this. SEB sells the German brands Rowenta, Tefal, and Krups.

Brands shape the image of a nation

Just like a country can shape a brand image, strong brands can influence the image of an entire nation. This is particularly true for upcoming industrial nations with an international image that is still rather diffuse. “Samsung has a greater influence on how South Korea is perceived than South Korea on Samsung,” says Interbrand manager Morgan. An emerging country like Brazil profits from strong businesses such as Embraer, too. The aircraft manufacturer is a supplier to international airlines and works as a brand representative for High-tech “Made in Brazil” though this – for a new image away from samba, coffee, and carnival. For a country with a long tradition, such as Switzerland, and a company like Ricola, it would be way harder to reposition themselves. ■



My name is Pete, pleased to meet you

I manage AC/DC Motor Co., voted "Plant of the Year" thanks to 100 percent customer and employee satisfaction as well as immaculate product and process quality. You think that such a plant can't exist? Yes, it can – on the Internet.

Siemens developed the online-game "Plantville" in order to make as many real-world production sites as possible work perfectly one day, just as mine already does. The game is about the optimal management of production plants. I'm the proud "Plantville" avatar and accompany users online – as a helpful tutor rather than a playmate. Honestly, I think you'll soon find out I'm a pretty nice guy. We can have a lot of fun together and you'll hardly notice how much you'll be learning. Because what's more enjoyable than a smoothly running plant?

Even in large production plants a lot of people don't understand how demanding the plant manager's job really is. And how interesting. Not only engineers-to-be and Siemens employees of all Divisions are welcome to drop in at my plant, but also customers and partners – basically everybody who's interested. On the following pages I'll explain what players of "Plantville" can expect.



Welcome to the team

To climb the “Plantville” career ladder, you don’t have to endure an application process. You don’t even have to be a professional. Everybody who’s interested in technology, business, and games can join in. All you have to do is to register on www.plantville.com for free. Even those who have never seen the inside of a plant can try their luck here – and be very successful. I’ll teach you all you need to know. Training on the job, so to speak.

But that’s the biggest difference between game and reality. Once you’ve got your staff ID card, you’ll do exactly what all plant managers around the world are doing: you control and optimize complex production processes.

But I won’t let you set foot into my perfect motor plant – it wouldn’t really make sense because it’s already running great and you would quite possibly be bored. Your task is three other plants that don’t run that well: a bottling plant, a vitamin plant, and a train production. Various challenges wait for you here. They all have the goal of improving safety, quality, and delivery.



“The conveyor belts are moving, the production is running at full blast. Never change a running machine? Nothing of the sort! A lot of things can be optimized in this plant!”



Representation of real production

Creating fantasy worlds, tending to animals on virtual farms – we know this kind of pastime quite well from the Internet. “Plantville” is no trivial escape from everyday life but training for reality and its representation at the same time. The programmers spent weeks on taking a close look at plants of various industries, among them highly modern Siemens plants, to develop the game. Scores of real-life specialists supported the IT experts in their ambitious undertaking.

You get to know the elaborately simulated production sites during a tour right at the start of the game. I am the technical advisor and will give you the first professional hints. Just a word in your ear: you’ve got a real safety issue in your train production. I’d strongly suggest the use of better monitoring technology. And by the way: there is an order backlog in the vitamin plant because the box binder’s performance is far from efficient. Thorough maintenance, if not replacement, is called for. You have to make the decisions on your own – and to virtually pay for them.



“A degree in engineering is not required to perform maintenance on this plant. But it does not hurt as well.”



"Put yourself in the manager's position: the happier he is, the more efficient he will work. If you want to be successful you can't afford to lose sight of the human factor – despite all technology."



Man and machine in harmony

You keep a watchful eye on the performance figures of your plant that are always available in real time. This is why you'll quickly realize that investments in high-performance solutions, such as control technology and drive systems, pay off in most cases. They improve product quality as well as customer satisfaction and thereby secure your sales.

But don't make the mistake to think that this is just about modernizing a couple of plants. No matter how advanced modern plants are from a technical point of view – successful management is always about people, too. Unfortunately not all of them are as highly motivated as I am. This is why you have to ensure your employees' wellbeing as well as their security and to use their manpower optimally. Because what's the use of highly efficient plants when you have unsafe or unhappy employees? I should tell you something about the ever-increasing "Plantville" community. I have accompanied more than 20,000 teammates from all over the world through "Plantville" by now. They were happy that they had the opportunity to exchange their views. No matter if you look on Facebook, LinkedIn, or Twitter: fans of "Plantville" meet everywhere on the Internet. These social networks are the canteens of our virtual plant managers. They discuss their work here and give advice to each other when even I am stuck – which doesn't happen very often, of course.

Have a look at our videos on YouTube to discover how the game works through moving images or to get to know more about the "Plantville"-craze. Another highlight is the expert chats on plantville.com in which real-life plant specialists discuss topics such as the optimization of machines and energy efficiency as well as addressing user's questions.

If you still want more of me, you can order me on mugs, T-shirts, and other accessories – and do something charitable through it. The proceeds go to the charity "Siemens Caring Hands". You have to be a shining example in every respect as an avatar.

And now it's your turn: visit me and join in on "Plantville".

www.plantville.com





Welcome, colleague specialist

All over the world, it is getting harder and harder to find well-trained specialists. This applies to the U.S. in particular, where one out of every two companies is already complaining about the shortage of qualified specialists. The more sophisticated the products are, the more pressing the employee issue – especially for businesses in foreign markets. Small and big companies show the way forward through creativity.

Job interviews with applicants were Norbert Hennrich's nightmare for many years. "Some had unbelievable salary demands, others did not understand the product," the managing director of Weishaupt America, a German medium-sized business for burners and heating systems, remembers. It could not go on like this. The 43-year-old tried to find an alternative to the enervating candidate selection – and found it in a partnership with the local college. Hennrich: "We are now going our own way."

The shortage of specialists is a big concern of many businesses. Every third employer worldwide has problems finding qualified employees. According to a survey by the temporary employment company Manpower this even applies to every second in the U.S., the world's largest industrial nation. Technicians and craftsmen in particular are lacking. The problem will become even more pronounced in the next couple of years, when the so-called Baby Boom Generation retires: Over 2.7 million American industrial workers are aged 55 and older.

The problem is even worse for German companies that manufacture on the other side of the Atlantic. "They produce high-quality goods that require a great deal of know-how," says Dr. Benno Bunse, managing director of the German-American chamber of commerce in New York. Some 60 percent of the chamber's members reported recruiting problems last year, and even 75 percent of the small businesses. But they take the initiative and find solutions that have model character. "Time and again I am impressed by the entrepreneurs' creativity," says Bunse.

Junior employees directly from college

Just like Norbert Hennrich. The U.S. subsidiary of the German Weishaupt group is headquartered in Elgin, a city with 100,000 inhabitants near Chicago, Illinois. Its employees are service technicians who install and service the high-quality burners – precision work with specific requirements. "Even if we won over technicians from competitors this was not of much use, because our units have completely different characteristics," says Hennrich.

This was the reason why Hennrich was immediately taken with the idea of a cooperation that the Elgin Community College's head of department proposed to him over the phone two years ago. They quickly agreed on a model in which the theory is taught in college and the practical aspects in the company. The college adapted the contents to the specific requirements of the medium-sized company. "I was surprised and delighted by the degree of flexibility the teachers showed," says Hennrich.

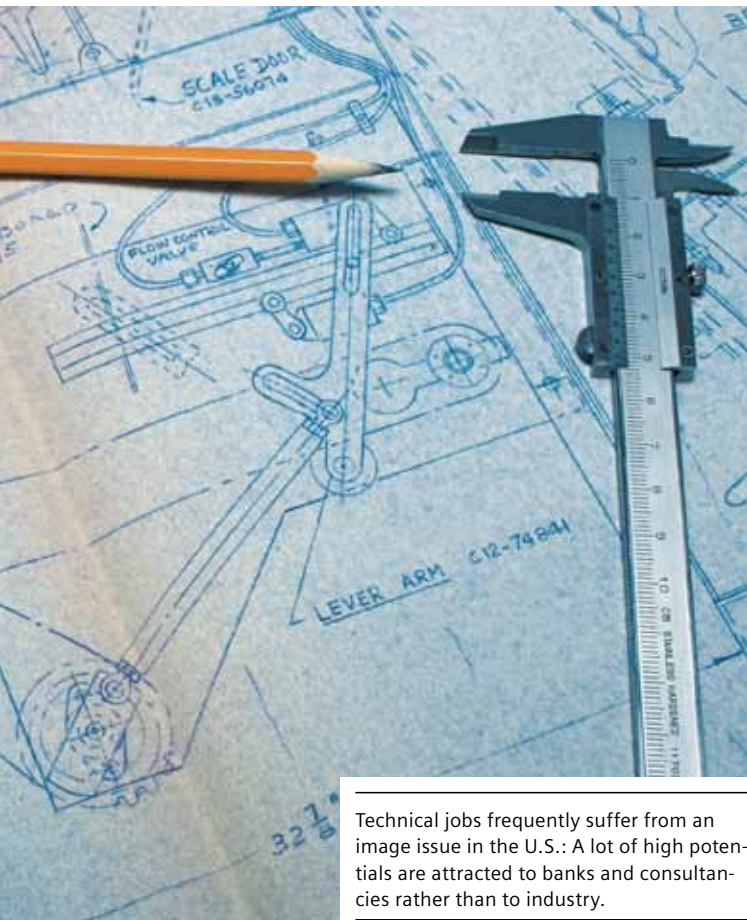
The image counts in booming countries

It is easier to attract employees when a company takes a clear position as an employer. The consultancy Kienbaum conducted a study among 26 international companies. It showed that an unambiguous, recognizable appearance helps in the recruitment of specialists, especially in the BRIC countries. 60 percent of the businesses there are convinced that employer branding is a must. In the U.S., 40 percent of the businesses agree – one-third less. In Eastern and Western Europe some 30 percent, that is only half, do so. Employer branding means that a company defines its identity as an employer as well as what it desires from and offers to employees. The company then communicates these messages consistently.

According to a survey conducted by the chamber of commerce, eight percent of the German-American businesses are already cooperating with colleges, another four percent want to give it a try. Other companies establish their own academies. The U.S. company Ipsen from Rockford, Illinois, produces vacuum furnaces. It recently introduced a five-month program, in which ten job applicants at a time pass through the company. They acquire basic knowledge and can decide for themselves in which department they want to get in-depth training later on. "We are growing very fast and need very many new employees," says CEO Geoffrey Somary. Ipsen pays a basic salary to the participants and even bears the accommodation costs of nonlocals. Volkswagen provides in-house training in cooperation with the State Community College at its location in Chattanooga, Tennessee, as well. The company trains car mechanics among others.



Theoretical lessons in college, practical ones in the business: Companies recruit specialists at an early stage through cooperating with establishments of higher education.



The combination of theoretical and practical training is rare in the U.S. and in many other countries – and one of the reasons for the shortage of specialists there. Another reason is the bad image that so-called blue-collar jobs have in North America. The technical jobs of university-trained engineers are frequently counted among them. “Young people tell me that they would rather become consultants or hedge fund managers,” says Martin Richenhagen, head of the farm machine manufacturer AGCO in Atlanta, Georgia. It is hardly known that modern industrial jobs are challenging, computer-aided precision work. “We as companies can contribute to the improvement of this image,” says Michael Krukliniski, Vicepresident Corporate Development & Strategy with Siemens Corporation in Washington, D.C.

The U.S. subsidiary of the German chainsaw manufacturer Stiehl in Virginia Beach, Virginia, for instance, sponsors high school courses that motivate young people to start a career as a mechanic. “More young people are interested in this again since the financial crisis,” says managing director Fred Whyte. In addition to this, Stiehl provides four-year training for trained employees who want to study further – under the supervision of an education representative.

The closeness to the German dual educational system is no coincidence.

Businesses increasingly try to find the “Teachable Fit” rather than people who already know everything. These are applicants with some basic knowledge and key qualifications such as ambition and discipline at work. Siemens discovered a highly interesting target group during this process: former members of the military. “The comprehensive technical training and experience veterans gain in military service makes them uniquely qualified for positions in innovative industries,” says Eric Spiegel, President and CEO of Siemens Corporation. The company hired some 600 veterans as engineers, service technicians, and sales representatives last year. It even achieved an enormous PR success through this, as America is proud of its soldiers and appreciates businesses that support them when they start careers in civilian employment. Plus, Siemens introduced a pilot project in cooperation with the Central Piedmont Community College (CPCC) in Charlotte, North Carolina, that trains certified mechatronics.

Transatlantic training program

Such initiatives are also important because obligatory educational standards are not the rule in the U.S. – something that makes the search for employees even more difficult. The understanding that uniform standards have their advantages increases only since a couple of years in the country that is adverse to regulations. The non-profit “Manufacturing Institute” is currently cooperating with companies and industrial associations to develop uniform requirement profiles for welders, metal construction workers, and plant engineers. International exchange furthers the raising of awareness, too: German and American institutions, among them the Industrie- und Handelskammer (IHK, chamber of commerce) Karlsruhe and the CPCC agreed on a pilot project for transatlantic “workforce training”.

Where it is hard to find new employees, it is even more important to keep top performers. “Our working climate has to be good in order that people like to work with us,” says Ipsen’s CEO Somary. At Weishaupt, Norbert Hennrich agrees on a minimum contract term with the junior employees because at the end of the day, the investment has to pay off for the company. Pilot-trainee Chris has now completed his first year. “He is doing quite well and has great career opportunities with us,” says Hennrich. The head of the company has acquired an additional job through the cooperation, too: He is now a member of the “Energy Advisory Council”, a board of practitioners that advises the college on the content of their curriculum. ■



Agility means stability

Reasonable reaction to crises is considered the high art of management. Its epitome, however, is the ability to anticipate crises, not to cling to the tried-and-true, and action in next to no time instead of reaction. This is all the more true in times of radical economic, political, and social change of our globalized world. The management buzzword describing these abilities is resilience.

Albuquerque, New Mexico: an overhead power line is hit by lightning. Not a minute later, the sprinkler system at the Royal Philips Electronics semiconductor factory is activated. Overvoltage within the power grid has led to a fire. The fire itself was quickly extinguished, but now the smoke penetrates through all cracks and crevices, and also through the cleanroom doors. Millions of microchips are contaminated.

The next day the company informs its customers: it will take a week to get back to normal. However, from one week it takes two, then three. Among the semiconductor manufacturer's major customers are two globally leading mobile phone companies. A bottleneck in chip-supply would be highly problematic for both - but their reactions could not be more different. Company A has two engineers fly over to assess for themselves the real situation. It quickly becomes clear that the damage is a lot worse than expected. The cell phone manufacturer pulls the ripcord and demands access to the files as well as extra shifts at the

Philips factories in Eindhoven and Shanghai. The company also taps its network: American and Japanese component suppliers come to the rescue. The competitor reacts completely different: even after they received a second phone call, company B does not see any need for action and keeps waiting for the things to come – until it is too late. The swift competitor has already bought up all remaining microchip reserves, and the thwarted company B does not have any contacts to other semiconductor manufacturers. The outcome is a loss of several hundred million US dollar.

Crises as an impetus for further development

This industrial accident already happened twelve years ago, but it is still a prime example for Barbara Heitger, founder of the Vienna-based consulting company Heitger Consulting. She strongly focuses on resilience – the ability to master crises by resorting to own resources and to see them as an opportunity for further development. Why is it that one company can easily



Successfully resilient companies promote direct interaction and open communication.

handle an unforeseen situation successfully while another one doesn't? It becomes more and more important to answer this question. "The big 2009 crisis is over," says Heitger, "but things remain turbulent." The general climate has changed according to the consultant, with clear view becoming increasingly rare.

The concept of resilience is quite new to the field of management, but not so to scientists. Physicists have always used it to describe materials that return to their original shape after substantial external impact. Accordingly, bone china – broken with a single blow – is not resilient, whereas foam rubber is a prime example of resilience.

Resilience can be learnt

In the field of psychology, Emmy Werner was one of the first who wanted to find out why some children who have been exposed to traumatic experiences, such as violence, sexual abuse, or a serious illness, still develop into self-confident, high performing adults. Her study on Hawaiian children, published in 1971, is known worldwide, and Werner, who is now 82 years old, is still invited to congresses. Resilience is an ability everyone can learn, just like steering a boat on a raging river. "Drivers permanently have to expect changes and often need to react in the wink of an eye," says Sylvia Kéré Wellensiek, a therapist and trainer from Munich. "They must keep a stiff upper lip and not lose hope that they will be able to master the dangers." Those who know quite a lot about

the river and have already had similar experiences are most successful. Mutual trust and interaction with the other passengers also prove useful.

Leo Barth, consultant with the renowned human resources consulting firm Egon Zehnder International, thinks that it is quite obvious why there has been a growing interest from organizational psychologists, managers, and management-trainers in the concept of resilience during the last four years. Of course, managers enjoy reading stories about successful turnaround managers who have saved a company by radically reversing a company's direction. However, skeptical doubts are starting to arise: Did it really take the near crash? Would it not have been possible to avoid the critical situation altogether?

"Sure you can't avoid certain downturns," says Barth. "Being resilient is more than being able to recover from such downturns as quickly as possible. It also means being able to anticipate and push through necessary change."

Better act than react

That's what U.S. management coach Gary Hamel is referring to when he demands companies to continually and dynamically reinvent their business models and strategies in view of constant change in the operational environment. Barth is convinced that the ability to change from within before external factors make adaptation inevitable can be trained – even in a more calculated manner than is commonly thought. What counts is the identification and development of managers with a high degree of strategic orientation, change-management skills, and personal resilience. Cooperation of the entire management is similarly essential: "Systematically determining the dynamics and processes that prevent necessary changes in order to counteract deliberately," is Barth's advice.

In Barbara Heitger's view, the mobile phone company that reacted quickly did several things right simultaneously at that time. The purchasing manager immediately realized how serious the situation was and passed the information on without delay. "Bad news travel fast, we don't hide problems," is a motto at the company. "This requires an appropriately open corporate culture," says Heitger.

The case was evaluated, classified urgent, and put on the internal daily watch list on the same day by a member of the board. Consequently, calls and inquiries were made every day. In addition, an international emergency team made up from suppliers, microchip designers, and

managers of the company was introduced to evaluate the consequences of supply disruptions that last longer than expected. A considerable investment: 30 people from Europe, Asia, and the U.S. dealt with various scenarios for days. After all, there was much at stake: The company planned the market introduction of a new cell-phone generation at that time and would have been unable to produce some four billion units without the microchips.

Basically, resilient behavior can be learnt from all organizations that have to deliver utterly

reliable performance under extreme conditions day after day, as Karl E. Weick and Kathleen M. Sutcliffe, professors at the University of Michigan Business School, point out. Specialized in organizational psychology and organizational management, they have been visiting so-called high reliability organizations (HROs), such as medical emergency teams, nuclear-powered aircraft carriers, or special police or fire service units, for years.

Persisting in chaos

There is one thing they have in common: they resist the temptation to simplify complex issues. They promote controversial positions and work with a wide range of worst-case scenarios. They track even minute errors and know their points of highest vulnerability. Their focus is less on strategy but on hands-on front-line work. “Parallels to successfully resilient companies are stunning,” says Heitger. However, companies should not learn from HROs because the latter seemingly know how to survive in a dizzying world, but rather because they constantly endeavor to figure it out over and over again.

Once resilient, always resilient? This equation does not work out. Even companies that showed an extraordinary capability of dealing with crises should not rely unconditionally on strategies that were successful in the past. They have to stay flexible, because agility means stability. ■

10 rules

Heitger Consulting, a business consulting company in Vienna, has identified the following abilities as shared characteristics of successful, resilient organizations.

1. The highest degree of vigilance for irregularities on all levels.
2. A distinct sense of responsibility beyond individual competence.
3. Straightforward, calm communication (motto: “bad news travel fast.”) Proactive and direct communication with all stakeholders.
4. Well-established radar-structures, such as the employment of a troubleshooter and keeping a “daily watch list.”
5. Awareness of its own vulnerability and of the fragility of value chains.
6. Close customer-supplier-relationships.
7. Quick and flexible reaction to the most urgent requirements during crisis situations.
8. Immediate availability of human resources (emergency teams).
9. Flexible and pragmatic solutions, such as the readiness to form temporary alliances.
10. Agility and initiative instead of reaction.

Suggested reading:



Karl E. Weick and Kathleen M. Sutcliffe:
Managing the Unexpected:
Resilient Performance in an Age of
Uncertainty. Jossey Bass, 2007, 194 pages

Sylvia Kéré Wellensiek:
Handbuch Resilienz-Training.
Widerstandskraft und Flexibilität für
Unternehmen und Mitarbeiter.
Beltz, 2011, 396 pages

Michael Faschingbauer:
Effectuation – wie erfolgreiche Unter-
nehmer denken, entscheiden und handeln.
Schäffer-Poeschel, 2010,
244 pages

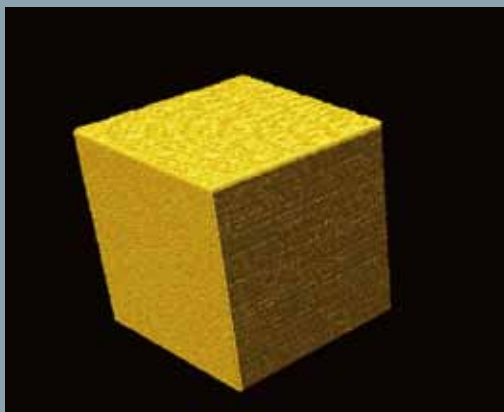
People to watch

The Sandman

Seth Copen Goldstein is a U.S. professor of computer science and works on objects from programmable matter – an accumulation of robots that are only millimeters small. They are meant to stick to each other, to move separately, be programmable, and to form movable, three-dimensional objects through computerized control. The range of these objects could span from furniture to firefighters as well as variable antennas and all the way to mechanical surgeons for telemedicine. Goldstein talked with Industry Journal about the complicated control of millions of microcomputers, possible applications, and virtual circuits.

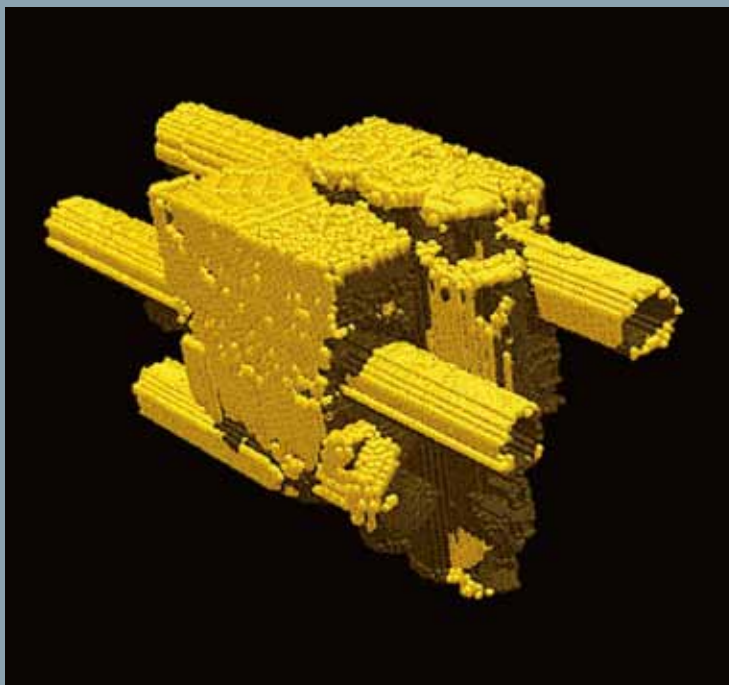






From a cube ...

It seems hopeless to build a musical instrument from particles that are as small as a grain of sand – except if they are Catoms. This is what the computer scientist Seth Goldstein calls his tiny programmable particles that are self-organizing and can move on their own. Complex 3D structures can be recreated with the mini-robots.



Mr. Goldstein, programmable matter is a topic that is often featured in science fiction: Objects made from intelligent particles that can take on any shape and color. Is this about to become reality?

This is exactly what I am working on with some 20 colleagues in our project Claytronics. Our aim is to create programmable matter that could be used to form tangible 3-D objects. These objects could be reproduced at remote places. Basically a transmissible synthetic reality. We call the principle “telepario” – from the Latin word “pario” for “to produce”, “to create”. The creation on a physical place that is different from one’s own. It would have a wide array of possible application areas.

Can you give an example of what they would be?

With pariomodeling, designers or architects could design a 3D object together at a live meeting when they are actually a great distance apart. Pariopresence would enable users to send a realistic representation of themselves. This would open up entirely new possibilities for doctors in telemedicine, for instance. Those are only some of the many ideas that could become reality soon.

How did you get those ideas?

Claytronics combines modular robotics, nanotechnology, and computer science. I am very much interested in all those disciplines. Before I began working on this project I was trying to find out how to build computers directly from molecules. During this project I came across a molecule that changed its conductivity when its shape was changed. Think of it as a very small computer link. So I began to think: If I can change the shape of a molecule to build a computer, what if I did it the other way around? What if I used very small computers to create a shape?

And then?

Then at a conference in 2002 Todd Mowry, former director of Intel research in Pittsburgh and also a professor at Carnegie Mellon University, and I had the vision to use this technology for teleconferences. Any participant who could not physically take part in a meeting could just send a “copy” of his body over. We thought that this was promising and started the project Claytronics.

What does the term Claytronics stand for?

We used “clay” because we could form things from our matter, and “tronic” because this matter will be electronically controlled.

... to a trumpet

There would be many interesting applications for the new technology – from antennas that align themselves optimally on their own accord to remote surgery on simulated organs. And perhaps one day musicians will be able to play first on a trumpet and then on a clarinet that are made from the same material.



How is this meant to work?

The basis of the matter is a Catom – a Claytronics atom. It is basically a very small programmable robot. The tiny machines should be ball-shaped in order for the matter to become very dense and to enable the robots to move easily past each other at the same time. And they have to be really small to allow for a high three-dimensional resolution and therefore a realistic representation of the objects and persons they will represent in their overall mass.

So the result would be some kind of all-purpose sand?

If you would like to say so. The Catom particles would have to have low costs of production, just a couple of cents for each of them.

What is inside these Catoms when you look at them from a technical point of view?

They must be as simple as possible. It is important that they have no moving parts inside

Seth Copen Goldstein

Goldstein is 50 years old and a professor of computer science at Carnegie Mellon University, Pittsburgh, USA. His research focuses on computing systems and nanotechnology. Before he joined Carnegie Mellon University he was CEO and founder of Complete Computer Corporation, which developed and offered an object-oriented programming language and development environment in the early 1990s. Today he is also co-founder of GGIdeaLab, Inc., which provides computer-related services.



of them, because this makes manufacturing cheaper and prevents technical failures. They would have to have local computation and memory storage facilities, of course. Next to it there would be devices for energy management as well as for communication and sensors to investigate the position at all times. Later the Catoms might also be painted with different colors on their outside. They could then rotate to present the appropriate color to the user to allow for even more realistic representations. Even light-sensitive sensors might be possible so that Catom constructions could be used as cameras or eyes.

The Catoms will have to move to form these objects. How is this going to work?

Depending on the Catom's size, electrostatics or electromagnetics could be used to enable

the single particles to move or to stick together tightly.

The particles will need energy for this.

We're thinking about many different ways of energy supply, from a special table platform with positive and negative electrodes to photovoltaics and all the way to touchless transmission with electrostatic fields. The Catoms should in any case be able to transfer power by cooperating. They virtually form circuits via virtual wires.

So your matter will consist of millions of micro-computers that move in a three-dimensional space. How are you going to control them?

That is the main challenge at the moment. The crux of the project is not the hardware but the software. It is virtually impossible to control millions of interacting elements with central intelligence. The complexity would be just too great. Plus the exchange of information and commands would use huge amounts of time and energy. So we developed a couple of programming languages that would give the Catoms local control and make central control unnecessary. They can start to work with this.

How does this work in particular?

First the Catoms need to be powered up, of course. When activated they need information about where they are and where they are supposed to go. For this purpose we came up with a relative coordinate system. So they don't know where they are in the world – but they could communicate with their neighbors so that they know where they are in relation to the other Catoms. This will enable them to self-organize and even to work around some single Catoms that fail due to technical problems.

Let us talk about the practice. How far has your research advanced?

We already have the programming languages that enable us to control huge amounts of micro robots and we have working algorithms that work in on-screen simulations. This gave us the possibility to demonstrate that the principle is going to work. At the moment we are working with prototypes in cylindrical form, which move by enabling and disabling magnets in order to roll along each other's surfaces. Their current size is 44 millimeters in diameter, which is about the size of a table-tennis ball. We are also working on sub-millimeter units which use electrostatics for movement.

The Claytronics project

The research project Claytronics was initiated in 2005 and is a partnership project between the School of Computer Science at Carnegie Mellon University and the Pittsburgh laboratory of the chip manufacturer Intel Corporation. They are jointly responsible for its scientific direction and financing. An interdisciplinary research team comprising 20 robotics researchers, computer scientists, and students is working on the project.

Carnegie Mellon University Pittsburgh

The Carnegie Mellon University (CMU), at which Seth Goldstein is an influential researcher, is one of several universities in the industrial city of Pittsburgh that has 300,000 inhabitants and is situated in the northeast of the U.S. The CMU's Robotics Institute, established in 1979, is considered one of the leading centers of robotics research in the world. CMU also has the internationally renowned School of Computer Science, founded in 1965, that is an influential supporter of the Claytronics project.

What will be the final size of a Catom?

Our experience shows that one millimeter is the threshold for a sufficiently realistic representation of forms you are just going to look at. If you want to touch the objects as well, you'd need Catoms that are about 50 micrometers in size, that is 50 thousandths of a millimeter, to simulate the texture of a surface. At the end we might have one-micrometer small Catoms which would enable realistic embodiments of objects and even of living beings.

Could you give some examples for what applications this would make sense?

It would open up an entire new field of applications – from transformable communications devices to tele-fire-brigades that work in potentially dangerous situations that would be impossible for humans. Another example would be telemedicine. This means that a surgeon in the U.S. performs intricate surgery on enlarged Claytronic replicas of organs while the actual organs are being worked upon by a Claytronic replica of the surgeon at the other end of the world. You send the surgeon over the Internet, so to speak. There could be more down-to-earth

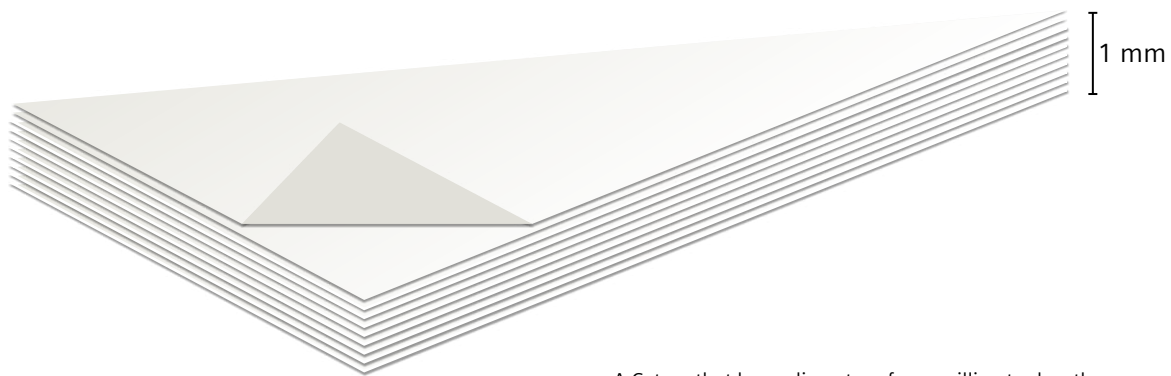
applications such as a multipurpose piece of furniture as well. People living in a small apartment would not have to cram it with a chair, a table, a couch, and a bed. They would just have a bag full of Claytronics particles. When they have guests over, it is a big table. When they want to go to sleep, it is a bed.

Those are quite a lot of visions. Which fields of application do you realistically expect first?

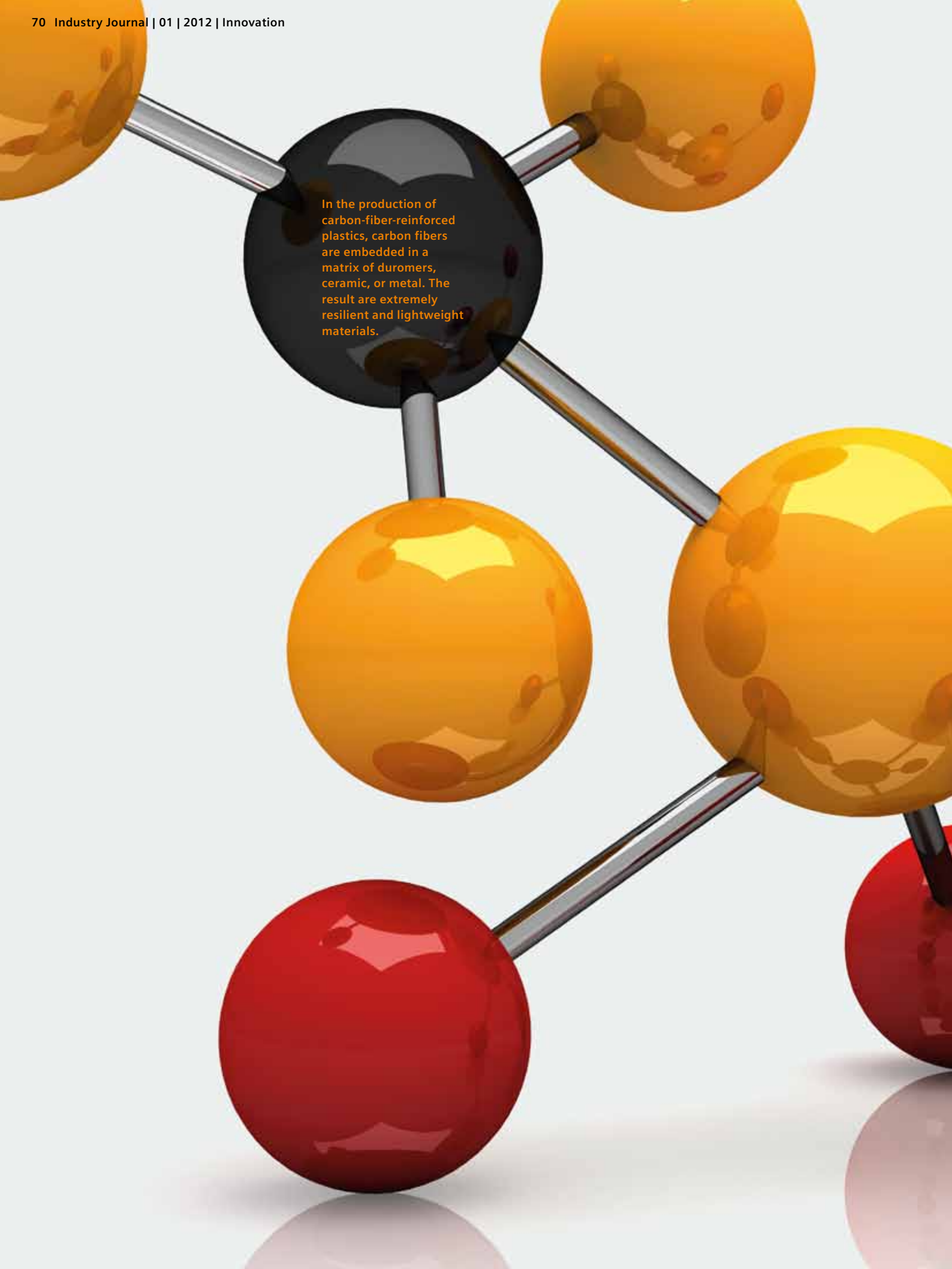
As a first application we expect antennas for mobile communication devices that change their shape and size in relation to the reception conditions.

When will the first bag of Claytronics sand be for sale?

That is hard to say because there are still a lot of big challenges to overcome in this project. But robotic modules are ever-shrinking and computing capabilities of computer chips grow steadily at the same time. There are going to be many steps in the development of new versions of Claytronics devices. I guess that the first working system that moves around and changes shape will be in front of us in less than a decade. ■



A Catom that has a diameter of one millimeter has the same thickness as a stack of ten sheets of paper. This is considered the upper limit in order to create realistic shapes out of robots.



In the production of carbon-fiber-reinforced plastics, carbon fibers are embedded in a matrix of duromers, ceramic, or metal. The result are extremely resilient and lightweight materials.



More than the sum of its parts

Whether it is in the automotive, the aerospace, or the consumer goods industry: The advance of composite materials is unprecedented. Two or more materials can be combined to a mixture that has the advantages of all of them. The resulting composites are particularly lightweight, durable, heat-resistant, and flexible to process.

Manuel Sattig is working full steam ahead – most likely until 2013. This is when the German car manufacturer BMW will introduce its new small car i3 if everything goes according to plan. Sattig plays a decisive part in the development of the electric car that people from all over the world are eagerly awaiting. The i3 and the electric sports car i8 that will follow in 2014 will be the first BMWs with passenger compartments not made from steel. The innovative material that is used instead has never been used in projects of this size before: carbon-fiber-reinforced plastics (CFRP). The material is lighter than steel and just as robust. BMW wants to reduce the weight of the i3 and the i8 by using the wonder material to increase the cars' performance.



The new electric cars i8 (left) and i3 from BMW: The i3 with its ultra-lightweight passenger compartment made from carbon-fiber-reinforced plastic is meant to go into serial production by 2013, the i8 in 2014. This is a technological revolution for car body constructors.

“CFRP is the lightest material we can use without compromising safety,” explains Sattig. Because of its batteries, the i3 is more than 300 kilograms heavier than a comparable car with a petrol engine. The car manufacturer compensates for the additional weight by using CFRP. BMW has used only small amounts of the material until now, for example in the roofs of some car models. But the intention to produce large quantities of the i-series is the beginning of a new era. “All knowledge gained from the new material will be used in the BMW Group,” says

Sattig. This means that CFRP will be increasingly used for other BMW models if the i-series is a success.

From cars to dentures

Composite materials are only at the beginning of an unprecedented advance and are currently moving into the most diverse industries. They are used in luxury yachts as well as in modern architecture and can be found in dentures as well as in subsea pipelines. Even Formula 1 vehicle bodies and sports gear such as golf clubs, racing bikes, and rowing boats are made from them. According to a study by the U.S. market research company Lucintel, the market for carbon-fiber products has nearly tripled in the last 15 years. The turnover from products made from composites is projected to grow from 38 billion Euros in 2010 to nearly 60 billion Euros in 2016.

€60 bn.

Expected turnover from products made from composites in 2016.

Source: Lucintel

The advantage: combination

CFRP, also known as carbon fiber, is a composite material. These are mixtures that consist of two or more materials.

If the mixture is right

the advantages of a couple of materials can be combined in them: the flexibility of plastics and the electric conductivity of metals, for instance. Thanks to their composition, composite materials can be adapted to various purposes. The extremely resilient brake discs of aircraft, for example, are often made from tensile carbon fiber embedded in hard ceramic. And the erosion-resistant, fast-curing polymer concrete that is used in the construction of motorway bridges is a mixture of minerals in plastic. By far the most important composites are glass- or carbon-fiber-reinforced plastics. They are produced by weaving such fibers into cloth, molding them with polymers, and baking them into accurate parts.

“New knowledge gained in the research and development of composites has enabled their wide success,” says Professor Klaus Drechsler, Chair of Carbon Composites at the Technische Universität München (Technical University Munich) and one of the leading researchers of carbon composite materials in Germany. According to Drechsler, components made from carbon fiber weigh only an average two-thirds of their aluminum counterparts and half as much as steel components. In addition to that, they are even more resilient. Fiber composite materials that consist of glass or carbon-fiber mats and cast plastics can be designed to combine different characteristics when stress is applied from various directions. This depends on the alignment of the fibers and means, for instance, that a component can be extremely torsion-resistant in one direction and highly tensile in the other. Steel, however, shows nearly the same degree of resilience regardless from which direction stress is applied. This reduces weight, too.

Resistant to heat and corrosion

In addition to all this, glass- or carbon-fiber-reinforced plastics are corrosion-resistant. Many of the materials that are baked at the highest temperatures suffer no damage when they are exposed to fire. “CFRPs in particular do not expand when they become hot,” says Drechsler. Manufacturers of big printing machines can profit from this, for example, because the printing rollers must not expand even at a high degree of stress and heat. Industrial designers have the utmost flexibility of design, as durable parts in all imaginable shapes can be made from the new materials.

The automotive industry is particularly attracted to saving weight. “Manufacturers and suppliers are working intensively toward reducing the weight of vehicles in order to minimize their fuel consumption,” explains Hans-Thomas Ebner, head of the automotive industry association’s technology department. A weight reduction by 100 kilograms saves an average 0.3 liters of fuel per 100 kilometers distance. “This is why the automotive industry is researching new, lightweight materials, especially carbon-fiber composites,” Ebner says. “They will be used increasingly in the future.” All big German car manufacturers have joined the carbon-fiber movement by now and either initiated cooperation with a carbon manufacturer or bought into one. Next to the automotive industry, the manufacturers of wind power plants in particular are interested in composite materials. The rotor blades of wind turbines consist mainly of glass-fiber-reinforced plastics. The longer the blades are, the more power is generated. Large offshore wind power plants work with blades of up to 60 meters length and 100 meters are currently being developed. “Due to their design, such lengths can only be manufactured with composites,” says Wolf Stötzl, technology expert with the federal

association for wind energy. Rotor blades have to endure strong wind and be lightweight at the same time in order that the plant does not use too much energy during start-up. According to Stötzl, there are no other materials that meet these requirements.

With CFRP into space

“The industry is mainly building on experiences from the aviation sector,” the wind energy expert explains. The construction of wings and rotor blades follows the same principles, and composite materials come originally from the aerospace sector. Aircraft, rockets, and space capsules always had to be constructed in an extremely lightweight and durable manner, after all. Especially on flights into space components are exposed to a very high degree of stress. This is why aviation engineers started to look for extremely resilient material mixtures at a very early point. The heat protection shields of U.S. space shuttles contained substantial amounts of CFRP, for instance.

Nowadays, aircraft manufacturers use the material to reduce the weight and with it the operating costs of a plane. Fuselage and wings of the new Boeing 787 Dreamliner are made entirely of carbon plastic. Composite materials account for half the weight of a 787. The situation will be similar for the long-distance plane A350 that Boeing’s competitor Airbus will introduce. Even completely new modes of construction are made possible through the new materials. The Boeing engineers were able to incorporate significantly larger windows into the 787 because the plastic fuselage can withstand higher pressure.

The fight against teething problems

But the new materials have presented Boeing with a couple of problems, too. The wing boxes

Be it in ultra-lightweight sportsgear such as kayaks (r.) or modern long-distance planes like the four-engined Airbus A380 (b.): Complex components made from lightweight composites save weight and energy.



“The industry is working to reduce the costs by up to 90 percent.”

Prof. Klaus Drechsler, Technische Universität München

of the 787 gave way in tests, for example. The problem: A computer simulation had given the wrong results. The engineers of the group had to make amendments and the delivery was delayed. This is not a single occurrence, because the behavior of composites is sometimes hard to calculate. The mixtures consist of unevenly distributed fibers and of polymers with various densities and stabilities. This results in highly complex characteristics of the plastics that can only be calculated with the most advanced software tools (see box).

But this is not the only teething problem of the new wonder materials. The comparatively high manufacturing costs are problematic as well. According to the carbon researcher Klaus Drechsler, carbon composites for car construction cost at least some 80 Euros per installed kilogram. Aluminum on the other hand costs 20 and steel only five Euros per kilogram. “But the industry is working to reduce the cost by up to 90 percent, for example through automating the production process,” says Drechsler. New production methods could contribute to reducing the price as well. Carbon fiber is made from crude oil at the moment. The industry is already

researching methods to produce the fiber from renewable raw materials such as lignin, which is made from wood. This is not the only innovation that would improve the environmental performance of carbon-fiber components.

Recycling carbon fiber saves costs

A closed raw materials cycle could spare the environment and reduce the cost of raw materials. Today, production residues and unusable components are sometimes simply shredded and added to cement. But CFK (CFRP) Valley Stade Recycling, an enterprise from northern Germany, has developed a method to reclaim carbon fiber in cooperation with the chemicals giant Dow Chemical. “The result is by no means a second-class product,” managing director Tim Rademacker emphasizes: “The fiber is of the same quality as the new product.” The first CFRP recycling plant became operational in early 2011. The main customers are the aerospace and automotive industries. Rademacker thinks that the future perspective is promising. “At the end of the day, a recycling method that really works is required in order that carbon fiber can become the material of the future.” ■

Software for fiber components

Companies that use carbon-fiber components in their products are faced with the task of further reducing costs and time-to-market in order to sharpen the significant competitive edge composites offer. Software tools, which are able to manage, calculate, and simulate the complex characteristics of composite materials and its production realistically, will enhance competitive differentiation.

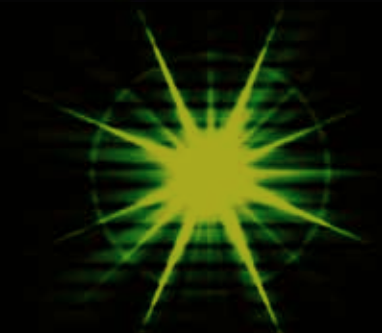
Siemens Industry has positioned itself on this important market through acquiring the industrial software producer Vistagy Inc. The company is based in Waltham, Massachusetts, USA. Around 300 customers worldwide, like

Bombardier Aerospace, General Motors, and Sinomatech Wind Power Blade Co. Ltd., are applying Vistagy's software products for a variety of applications ranging from composites engineering, design, and manufacture of simple components to complex assemblies and large structures.

Combined with its already leading position in automation and drives, Siemens will become the only company worldwide to support the whole value creation for carbon-fiber components with its software tools – from product definition and development to manufacturing and service.

Machines of the future

Intelligent, learning software is increasingly able to make precise prognoses that are based on the analysis of the past and present. It is already supporting the industry in making predictions that are more precise, and in optimizing its production processes continually.



What does the future hold? This question has always occupied the minds of humankind more than anything else. The art of soothsaying, that was once thought to be a gift of the gods, has evolved into a learnable science in the course of centuries: Modern prognostics that does without all fuss and refers exclusively to traceable causal connections.

Prognostics software works according to this principle as well. The reliable prediction of future developments in technology, production technology, society, and nature becomes possible with it. Just like every sound prognosis, this does not demand a look into a crystal ball, but one into the rear mirror. To put it differently: The key to understanding the future lies in the past. On the basis of what is already known, causalities are derived and hypotheses are established that help to anticipate the unknown.

Machine beats human

How will a product sell – and at what price? Which peak loads can threaten production? When is maintenance or a replacement of the system due? So much information has to be collected and analyzed to answer such questions that humans cannot do it on their own any more, even if they use statistical investigations and mathematical formula.

As opposed to the human brain, computers benefit from the increasing complexity and digital availability of information. While our biological cognitive system shows a decrease in performance when the flood of information increases, prognostics software virtually begs to be fed with data. Just when the image becomes so big that humans lose the general view, the machine puts all pieces of the mosaic together and recognizes the patterns in it.

“Prognostics is a race between the world’s increasing complexity and our increasing aptitude to model the world in a mathematical way with the possibilities of information technology.” This is how Dr. Hans-Georg Zimmer summarizes the central insight of his work. The Siemens researcher from Munich and his team have developed SENN. The acronym stands for “Software Environment for Neural Networks”. It is the name of a program that can, for instance, predict highly complex situations that depend on a multitude of factors, such as the development of the prices for energy and copper.

Computers learn how to learn

This is possible because SENN emulates artificial intelligence in form of artificial neuronal networks. It works with virtual neuronal networks. “The technically most elaborate high-dimensional, non-linear modeling system of its kind,” as Zimmermann proudly describes it, is not static but continues to adapt itself and reinvents itself all the time – just like our brain. With the difference that the computer does not forget anything and always keeps an overview. Conventional software only does the job of an advanced calculating machine in many cases, as it uses patent recipes, that is, fixed formulas, to develop one-dimensional and linear prognoses. SENN, on the other hand, is able to do something that has been impossible for computers for a long time, and that only humans were able to do: It can learn.

But what exactly is such a machine that learns? “The vision is a system that improves itself through interaction with its environment,” explains Dr. Volker Tesp, who is another researcher at Siemens and a professor for information technology at the Ludwig Maximilian University of Munich, where he is working at just this topic. “Learning with linked information is one of today’s most exiting fields of research,” he says.

Reliable prognoses for many sectors

This exiting vision of science is just about to become reality, as a look at the practice shows. Siemens Corporate Technology (CT) has created the mathematical foundations for more than 60 industrial prognostics systems under Zimmermann’s direction, and applied for 24 patents to protect the model architectures that are their basis.

The results that are already achieved with those systems are quite impressive: SENN prognosticated the sales figures of various models of switching cabinets in a recent study. The same figures were calculated with a conventional linear model at the same time.

SENN achieved a forecasting error of less than 25 percent while the conventional approach was wrong by more than 50 percent. The reason: The intelligent software considered noticeably more variables, such as variations in currency exchange rates or on the automation market.

Prognostics software is of decisive importance for power generation as well. Especially the

Precision cast in concrete

It is said that the former Prime Minister of the United Kingdom, Winston Churchill, once stated that “prognoses are difficult, especially when they concern the future”. This may still be true for politics. But predictions in industrial production are more reliable today than ever before – thanks to immense advancements in information technology.

A good example is the production of cement. How fine will it be? The question may sound profane, but it is very complex and occupies every plant owner. For instance, the owners of a ball mill in a cement plant in Southern Bavaria. The milling process in cement plants requires a lot of energy and accounts for nearly half of the overall energy consumption. The plant uses an innovative system that was developed by Siemens in order to reduce the energy demand and to increase the plant’s efficiency: Sicement IT MCO.

The neuronal, knowledge-based, and teachable software first collects the input parameters such as the amount of fresh goods or the kind of recipe. It then generates a prediction of the cement’s degree of fineness from them that can be compared to the laboratory analysis of the samples that are taken from the ongoing production. The result is a more uniform milling process. This means that the throughput quantities of the mill can be increased at the desired degree of fineness, and that the plant operator is relieved. In addition to that, the plant’s energy consumption per ton of cement decreases.



booming market for renewables depends on the ability to predict not only the demand, but also the supply. This is why it is no surprise that Siemens Wind Power from Denmark relies on the know-how of the SENN team for the calculation of a large wind park’s performance up to 72 hours in advance. “Such predictions are important in order to calculate when additional gas turbines have to be switched on, for instance,” says Zimmermann.

Artificial intelligence in plants

In order that prognostics software and other forms of intelligent IT can improve industrial production processes in all industries, Siemens is not only committed to research that takes place in its own ranks. The Sector Industry recently supported the technology initiative SmartFactory, a project at the Deutsches Forschungszentrum für Künstliche Intelligenz (DFKI, German Research Institute for Artificial

Intelligence) in Kaiserslautern, with automation technology worth 18,000 Euros. “Artificial Intelligence has great potential for the automation of production and manufacturing processes,” says Norbert Volk, head of Siemens’ Sector Industry in Central Germany.

The true size of this potential becomes obvious when considering the ambition with which experts like Zimmermann work on improving prognostics. He is not satisfied with the successes that have been achieved so far and that already concern important parts of industry and science. “The goal is to develop a software model that shows the real world in a mathematical way.”

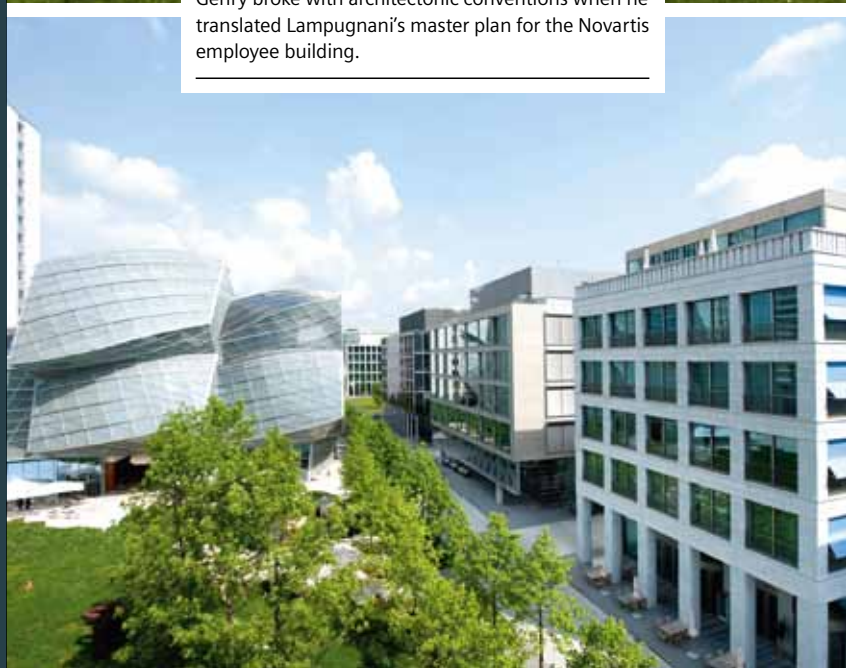
A soothsayer is not required to divine that research may find these increasingly universal formulas for the future very soon. ■

“Architecture can drive innovation.”

Vittorio Magnago Lampugnani is an Italian architect and professor for urban development. He created the master plan for a spectacular innovation architecture project with offices, laboratories, and leisure facilities for 7,500 employees in Basel, Switzerland. His client was the chemical and pharmaceutical company Novartis. Lampugnani talked with the Industry Journal about trailblazing innovation, new ways of communication, and beautiful people.



The famous Canadian-American architect Frank O. Gehry broke with architectonic conventions when he translated Lampugnani's master plan for the Novartis employee building.



The interaction of people, and therefore communication, is involved in innovation in most cases. How can architecture contribute to this and support the innovation culture of businesses?

Architecture can contribute a lot. It can create the rooms where people get together. These rooms are mostly, but not exclusively, public areas. It is possible, for instance, to channel the movement patterns in buildings and ensembles in a way that it becomes virtually inevitable that the people working there meet each other. This does of course not mean that they automatically talk to each other in such a situation – architecture can only make an offer and invite people to communicate with each other.

You created the master plan of the new campus for the chemical and pharmaceutical company Novartis in Basel. How does the offer of communication that promotes innovation become apparent there?

First of all, we understood the campus as a system of public spaces – streets, squares, and parks. Those public spaces are arranged in a way that leads to certain patterns of movement: there is, for example, a great choice of new gastronomical and other communal facilities that are distributed over the campus in addition to the traditional staff restaurant. All people who leave their building to have a meal, go shopping, and go to the gym inevitably have to walk a short distance. The fact that everybody has to do this creates lots of opportunities for spontaneous encounters.

Which additional ideas did you pursue with your plans for this knowledge campus?

We tried to create a compact “Novartis city” through comparatively small buildings that are quite close to each other. We wanted to create an urban atmosphere on the campus that contributes to communication in a very natural way. Two large parks in which the employees can spend time and which have direct access to the Rhine are intended to compensate for the relatively high density. This emphasizes the area’s beautiful situation at the riverside – the bank could not be used before because an old port was still in operation there.

This sounds as if you created a gigantic leisure area. Does such an environment not encourage idleness rather than high performance?

It is a common but completely wrong idea that pleasant working conditions entice people to be lazy. The opposite is true: beautiful surroundings

contribute decisively to motivation. Apart from that, work does not only happen in the office and stop immediately when people have a meal or take a walk. We did not suggest the cafés on the campus because people like to drink coffee. A pilot project in an existing building showed that people do not only sit around in a café. They rather talk to each other, have business chats, read, write – in short: they work, and very productively at that. After the idea had proven itself, we implemented it on the campus on a larger scale.

How open are large businesses that are traditionally rather conservative for such a modern approach?

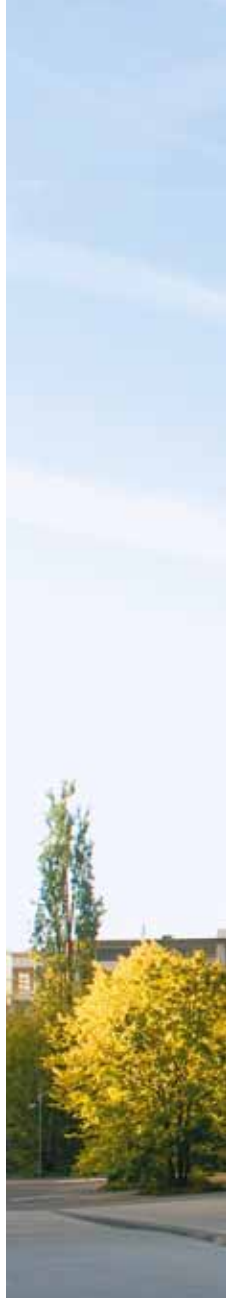


The person

Vittorio Magnago Lampugnani, 62, from Italy is professor for urban development and head of the institute for the history and theory of architecture at the Eidgenössische Technische Hochschule (ETH, Technical University) Zurich. In addition to that he has two architectural offices in Milan and Zurich. Lampugnani is the author and editor of numerous books and has been awarded many prizes. He developed the master plan for the Novartis-campus in Basel that is interpreted by internationally renowned architects and will be fully implemented by 2014.



The Novartis-campus that is situated on the bank of the Rhine in Basel accommodates 7,500 employees, among them 2,700 researchers (top). In the laboratory building, designed by the British architect David Chipperfield, as many walls as possible were removed to enable optimal communication. Openness through steel and glass creates opportunities for encounters on traffic routes (right).



Many of them have already internalized and implemented this idea, like Novartis. Otherwise, a campus like the one in Basel would not have been built and could not work: the architecture is only a tool. It provides a structure that can help to improve the work of people and the organization of businesses fundamentally, and even to revolutionize them, if necessary. This is exactly the task that Daniel Vasella, the former CEO of Novartis, had set for us.

This means that a working innovation culture remains the basic requirement. If you look at the Novartis-campus today – what has changed since this architectonic revolution?

Let me describe it with an anecdote: I got chatting to a young lady during the opening ceremony for one of the buildings and she told me that the people had somehow become more “beautiful”

after the construction of the campus. This was not just a nice compliment and it was not a metaphor, either. Actually, work has become much more public – people are moving in public more often and are more conscious of their own presence. Scientific studies prove that the new environment has had quite a lot of positive effects in Basel: We found that the company can save resources through the new architecture, the cafés, restaurants, and foyers as well as through the streets, squares, terraces, and gardens.

You have to explain that, please.

Problems are solved faster, for instance. People simply talk to each other now instead of writing dozens of e-mails as they did before. The work is done faster and better when employees are in personal contact with each other.



How is it with meetings: Can time-consuming, formal meetings be replaced by informal, often accidental encounters, too?

Of course they can. The new architecture suddenly brings people together who would normally never have had anything to do with each other. In those cases they realize quite often that they are working on the same problem. Or that a colleague has already solved a certain problem they are just dealing with. This is exactly the moment in which the architecture has not only made a crucial contribution to communication, but to innovation as well.

Trailblazing innovations are always based on the ideas and the commitment of brilliant minds. What role does the work environment play when it comes to winning and keeping those people?

A very important one. This is why it was part of our task to transform a relatively unattractive location – an old production plant – into an attractive center for research and administration. Basel is quite a pretty city, but, of course, it cannot compete with metropolises such as London and New York. This means that the top researchers a business like Novartis needs have to be attracted through a high quality of work. In addition to that it is important to create a shared identity – and I think we were successful in that: most of the employees are proud of what is created on the campus.

The pre-industrial city was your model when you created the campus. Why?

The pre-industrial city was mainly a city of pedestrians. And I think that the easiest and best communication takes place between pedestrians. This

is why we banned cars from the campus as far as possible. But for me it was not about creating an image of a certain historical city – it was simply about applying a couple of proven principles.

How does your idea of openness continue inside the buildings?

Seamlessly. We decided at the very beginning that the workplaces would be situated in a so-called “multi space”. This is a generous version of the open-plan office with numerous meeting rooms, retreat rooms, and areas for informal encounters. We started a pilot project for this: It was tested in an existing building how people react when an entire floor is stripped of its partition walls and furnished in a completely different way. After the positive experiences from this project, the concept was suggested to the architects of all the campus buildings. But they had and have the option to interpret this open-room-design freely from a creative and atmospheric point of view. This means that all buildings are completely different, even if they are based on the same concept.

In what way are the management levels included in the open innovation architecture?

The concept does only work if the management accepts this “dictate of openness” as well. The superiors are now sitting together with their employees and have their desk in a somewhat privileged position at best. But in general the same degree of openness is expected from both, bosses and employees.

This is quite easy to imagine for administrative areas. But does the principle of innovation through a more open communication work in research and laboratory areas as well?

Absolutely. Because technology is so far advanced today that all feed lines can be installed in a way that they come out of the ceiling. This makes a completely new flexibility possible: The open “multi space” concept was transferred from offices to a real laboratory environment for the first time in the Chipperfield building on the campus. ■



The car-free pre-industrial city is the model for the Novartis-campus. Cars were banned from the campus as far as possible because walking offers more opportunities for communication.

New office concept for more interaction

Siemens is increasingly focusing on flexible workplaces: Standardized single rooms and traditional open-plan offices are making way for areas of a different design and workplaces that are flexible in location. This creates a more transparent business culture and noticeably improves the internal communication.

People who enter the Siemens office in Düsseldorf discover an entirely new office world that is reminiscent of many things – but not of traditional concepts of work. Here are neither closed rooms nor the sterile atmosphere of classical open-plan offices. Instead, the employees can choose whether they want to sit down and work at a stylish counter, in a bright-red seating area, or on a minimalistic cube.

“There is a fundamental cultural change underway at Siemens at the moment,” says Jens Lauschke from Siemens Real Estate about the company’s new office concept. “Most employees will not have a fixed desk any more in the future and can work whenever and wherever they want to, for example in the office as well as from home.” In the office, they have several options: There are areas for concentrated work; others are specially designed for teamwork

or telephone conferences. “Thanks to modern IT, all employees can log on to the network with WLAN,” says Lauschke. “Their personal documents are stored in a mobile archive that can be used everywhere in the office.”

The new concept is based on the insight that many employees spend a large amount of their work hours outside the office, anyway – for example with customers, in other divisions, on trade fairs as well as on congresses, and in meetings. For most people it becomes less and less important to have their own desks, especially as the modern business nomads have most of their documents with them in electronic form on their notebooks.

The flexible concept means that all employees can create a better work-life balance for themselves. Siemens, in turn, can use its real estate in a more space- and energy-efficient way and creates a higher degree of transparency in the company at the same time. “The new architecture improves the communication dramatically,” says Lauschke. “Employees meet new colleagues more easily – even from other divisions. Because the new open architectural structures change the way of working together profoundly, too.”

The new office concept has already been introduced in several Siemens branches – apart from Düsseldorf, these are Vienna, Moscow, and Shanghai, for instance. Naturally, the new concept can be implemented in the most consistent way in new buildings. This is why the new Siemens headquarters in Munich will represent the new way of working in all its beauty from 2015 onwards.



Publication information

Industry Journal

Creating sustainable value
through technological leadership

Published by

Siemens AG
Industry Sector
Communications
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Print

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Photo credits

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Thinkstock: p. 8 center, pp. 10/11, p. 17, p. 18 left,
p. 29, p. 32, pp. 34/35, p. 37, p. 38, p. 48 top right,
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www.siemens.com/industry

Subject to change without prior notice
Order No.: E20001-A160-S100-X-7600
DISPO 06330
Printed in Germany
© Siemens AG 2012

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