

The Future of Industry



1/2016

WHO GOES FIRST? **WHO** SHAPES THE NEW?
WHO CREATES PROGRESS? **WHO** OFFERS
PERSPECTIVES? **HOW** WILL WE WORK
TOMORROW? **WHAT** ARE WE LEARNING?



Berlin offers not just sights worth seeing but also sounds worth hearing. Discover the chamber music festival "intonations".

Setting the tone in Berlin for several years now, the Jerusalem International Chamber Music Festival is back in Germany's capital! From April 16–21, 2016, Elena Bashkistrova invites you to the Jewish Museum Berlin to experience chamber music at its finest, presented by talented young performers and top international musicians. "intonations" promises a veritable feast for the ears. We look forward to welcoming you.

We support culture. For the love of it.



EVONIK
INDUSTRIES

“We must always make sure that the new technologies are of service to human beings”



Klaus Engel, Chairman of the Executive Board of Evonik Industries AG

Dear readers,



When discussions turn to the future of industry, many people automatically think of Silicon Valley in California. Today the market capitalization of the six biggest Silicon Valley companies is over €1 trillion. That's two and a half times the market value of all the German companies in the DAX 30 stock index. But the Internet revolution doesn't consist only of Google, Facebook, and Twitter. These are basically big new media companies that earn their money through advertising and the collection of customer data. People often overlook the fact that the real digital disruption is taking place in the production industry. We are now in the midst of the fourth industrial revolution, the next phase after the steam engine, the electric assembly line, and the introduction of the computer. This fourth revolution encompasses the entire value chain of traditional industry, and thus its potential turnover is far greater than that of Silicon Valley.

Because the real physical world is increasingly merging with the virtual world to form the Internet of Things, production processes can be completely digitized and react to changes in the market practically in real time. The buzzword “Industry 4.0” means that machines, customers, and the goods rolling off production lines will be more and more closely linked with one another in the future. The intelligent factory of the future will stand out not only because of its greater flexibility and productivity but also because its use of energy and resources will be much more efficient. At Evonik as well, the digital future is already in full swing.

Industry 4.0 and the Internet of Things, together with the rapid development of artificial intelligence, will not only transform industrial processes but also have far-reaching effects on society. The ways in which we live and work will be transformed from top to bottom. That's why it's high time to take these themes out of the research labs of industry and open them up to discussion. Should we really implement everything that is technically possible? I have a very definite opinion about that. We must always make sure that these exciting new technologies are first and foremost of service to human beings.

This issue of *Evonik Magazine*, which deals with the future of industry, is offered as a contribution to that discussion. Pleasant reading!

Sincerely yours,

A handwritten signature in blue ink that reads "Klaus Engel". The signature is fluid and cursive, written in a professional style.

In | dus | try

MASTHEAD

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ORIGIN From the Latin “industria” (diligence, perseverance). Entered late Middle English via the French word “industrie” (vigor, energetic activity)

TYPICAL ASSOCIATIONS Chemical industry, industrial park, Industrial Revolution, industrial culture

SYNONYMS Mechanical/series/mass production or manufacturing

ANTONYMS Skilled trades, craftsmanship

USAGE

BUSINESS: The mass production of goods by mechanical methods. Also emphasizes integration and value creation within a certain sector, such as tourism or the entertainment industry

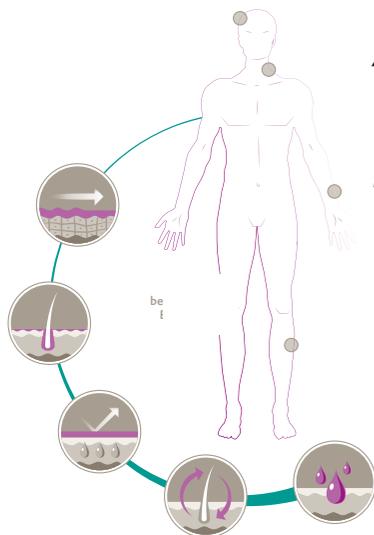
ARCHAEOLOGY: Cultural patterns demonstrated by uniform artifacts found in all areas of a region—for example, the hand axe industry



“For a long time, ‘old industry’ kept pace with its turbines’ rhythm; ‘new industry’ dances to the tune of algorithms”



Gabor Steingart is the publisher of *Handelsblatt*. He believes that Germany, as a highly industrialized nation, is well prepared for the challenges of digitization. And he is convinced that we are currently living through nothing less than a revolution. This issue’s cover story—his article about the fourth industrial revolution—starts on page 14



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Automation and the Internet of Things are restructuring the foundations of our world. *Handelsblatt* publisher Gabor Steingart believes that Germany, a nation of inventors, is ideally prepared for the changes

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How an ingenious mayor in the state of Thuringia is bringing industry back to his town

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The factory of today is clean and quiet, so it’s allowed to return to the city. Are homes and workplaces once again moving closer together?

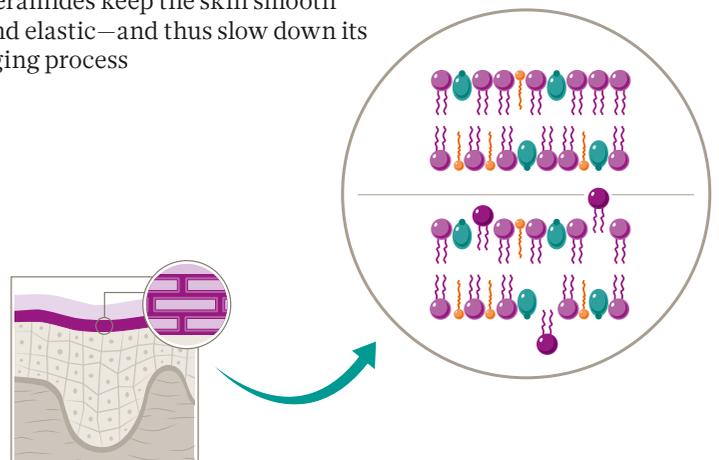
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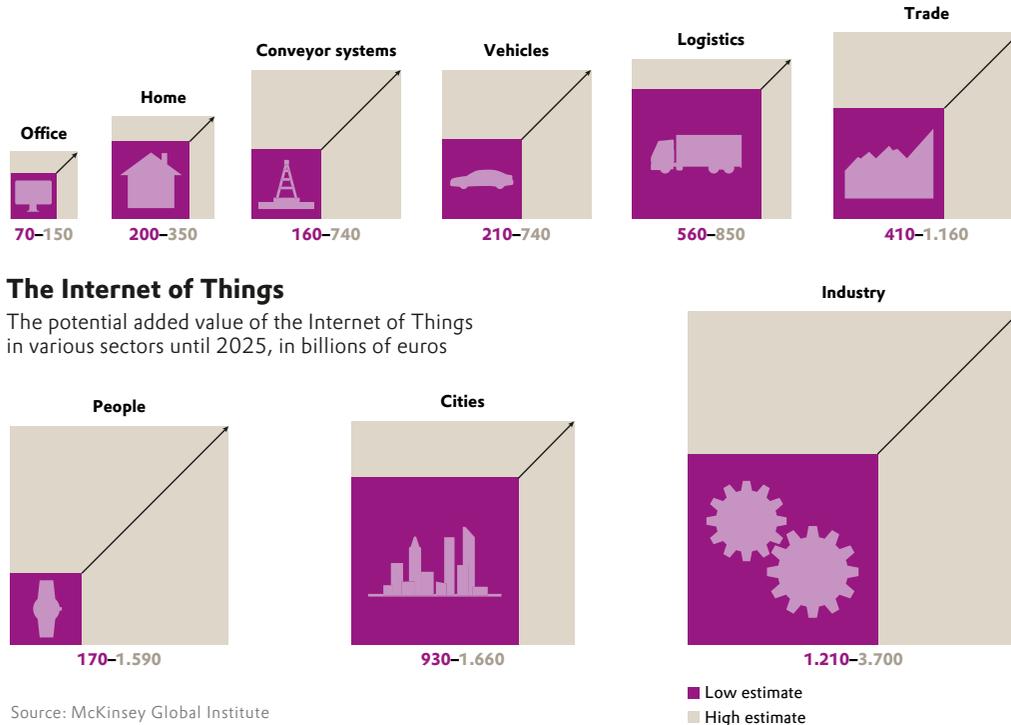
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Ceramides keep the skin smooth and elastic—and thus slow down its aging process



Facts + Figures



The Internet of Things

The potential added value of the Internet of Things in various sectors until 2025, in billions of euros

Source: McKinsey Global Institute

TASKS

What Industry Must Do in the Future



Harald Welzer
Director of the Futur Zwei Foundation

I expect industry to focus on the common good in its business operations and to take on much more social responsibility than is currently the case. However, this does not mean that it shouldn't strive to achieve profits and growth. However, industry will have to finally see itself as a player within civil society. Otherwise, neither industry nor society as a whole will survive the 21st century.



Hannelore Kraft,
Premier of North Rhine-Westphalia

For me, industry is our future and not some "old economy." We are proud that North Rhine-Westphalia is an industry-focused state, and we want it to stay that way. Digitization will thoroughly transform industrial processes, and we are exploiting the opportunities that the digital transformation offers us in and for North Rhine-Westphalia. That's because our companies are successful in North Rhine-Westphalia and throughout the world, thanks to our excellently trained employees, who are already shaping our future today!



Olaf Tschimpke,
President, Nature and Biodiversity Conservation Union (NABU)

For our future to be livable, we need industry's pioneering spirit and a change in lifestyle toward one that knows its limits and focuses on moderate consumption. Industry has to change processes that cause pollution and waste disposal problems. The fact that industry is increasingly viewing environmental protection organizations such as ours as advisors is, I think, an expression of a changed mindset. The task of lawmakers, meanwhile, is to protect finite resources and create environmentally friendly pricing policies.



Reiner Hoffmann,
Chairman of the German Trade Union Confederation (DGB)

Industry must take advantage of the opportunities that digitization brings for employees. This development is not preordained—it can be shaped—and it must not be centered on the technically feasible, but on the people involved. Good work 4.0 is an essential part of Industry 4.0. That's because industrial work will always have a future in Germany as long as we can succeed in making training, codetermination, and qualification into the leitmotif of work in the digital society.

3 QUESTIONS FOR

Michael Henke
"People will do the planning, managing, and networking"



1 Will people soon have no work left to do?

Although some studies paint a rather bleak picture of the future, I don't think that will happen. On the contrary, people will become the most transformable factor in manufacturing and logistics. With their wealth of experience, people will be the decision-makers who plan, manage, and network the "cyber-physical" systems of the future.

2 What new jobs will be created when industry becomes digitized?

We will get hybrid systems that combine products with services. A key role here will be played by the management of data, which will be the most important resource in the future.

3 Which sector is spearheading this transformation?

Sectors that are strongly impacted by IT could take on a leading role. An example of this is logistics, which is the third-largest sector in Germany. However, every company will have to be able to quickly develop new business models and consistently implement them within its organization. The buzzword here is Management 4.0.

Michael Henke heads the Fraunhofer Institute for Material Flow and Logistics in Dortmund, Germany.

97

percent of the companies in Germany consider human labor indispensable. According to a Fraunhofer study, it will continue to be important or very important in manufacturing in the future.

Employers in industry feel a sense of responsibility for their workforce. That's why they are promoting social innovations

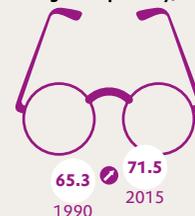


IN FIGURES

How should people's lives improve by the year 2015? In the year 2000, representatives of the United Nations, the World Bank, the OECD, and the International Monetary Fund presented their Millennium Development Goals. Although not all of them were attained, there are many positive developments:

Worldwide

Increasing life expectancy, in years



Reduced child mortality, in millions



Fewer hungry people, in millions



More people with access to drinking water, in %



IN DEUTSCHLAND

More people employed, in millions



Fewer high-school dropouts, in %



Sources: The Lancet, Unicef, FAO, WHO/Unicef, Destatis, Destatis/Caritas

GIMME SHELTER

Industry promotes progress—in more areas than just the economy. In many places, it was committed entrepreneurs who set exemplary high social standards.

Housing

Although there were enough jobs in cities during the heyday of the Industrial Revolution, there was a serious lack of housing. In response to this problem, entrepreneurs created their own neighborhoods, which were more than just bedroom communities. When Wilhelm Fueg created the Eisenheim community for workers of the Gutehoffnungshütte steel mill in 1846, he also planned in vegetable gardens and areas for keeping livestock. Similar communities were created in England soon after in order to combine entrepreneurial spirit with social reform. In Germany, the government began to subsidize housing during the Weimar Republic.



1
The idea. Whether it's the introduction of an eight-hour day, sabbaticals or home offices, it's the motivating force the employees need. That's why they are rejected at first.

2
The test. Some companies nevertheless conduct initial tests that lead to more productive employees. Word of this success gets around.

3
Law. Once an idea has been accepted by society, governments turn this new situation into law.

Healthcare

People who are ill can't work and earn money. Should they starve? To prevent this from happening, the Krupp steel company established a health insurance fund in 1836. In 1883 the government finally required all employees in Germany to have statutory health insurance.

Pensions

Werner von Siemens insured his workforce at a healthcare, burial, and invalid insurance fund that was set up for machine production workers in Berlin in 1853. Germany introduced a statutory pension system in 1891—the same year as Denmark. The United Kingdom didn't follow suit until 1908, one year before Australia.

Eight-hour day

In 1856 protesting workers achieved an eight-hour workday for their sector in Melbourne, Australia. In Germany, Degussa, a predecessor company of Evonik, introduced the eight-hour day in 1884. The eight-hour day became law in Germany in 1918, although ten-hour work days were allowed again only five years later. The eight-hour day was instituted again in 1946.

Company childcare

Philipp Karcher, Head of Frankenthaler Zuckerfabrik, set up a plant daycare center for his employees in 1883. However, daycare centers were very controversial at the time, and they were still banned in Prussia in 1860.



**“Even in the
digital factory,
people still
set the pace”**

PIONEERS IN NEW WORLDS

Being ahead of the rest means being in uncharted territory. And feeling fear? No, being curious! These five people encounter change with enthusiasm. They roll up their sleeves, get involved, develop ideas, and implement them. They are shaping the future of industry and creating a future for everyone.

Transformer

→ Janina Kugel, Member of the Managing Board of Siemens AG responsible for Human Resources, prepares Siemens employees for the industry of tomorrow

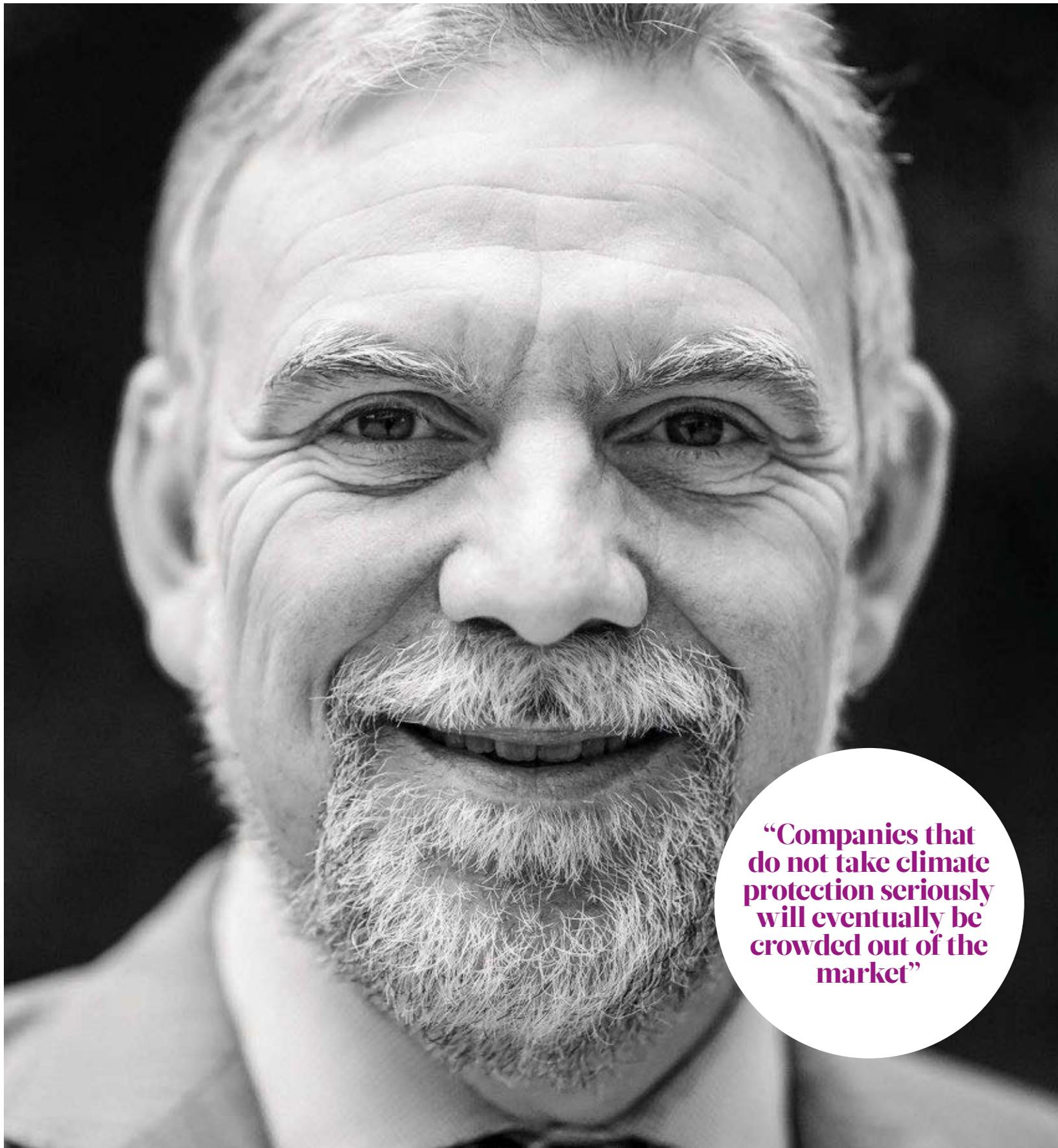
Janina Kugel enjoys the advantages of a digitized workplace every single day. She can end her workday early enough to put her children to bed—even though she's the Head of Human Resources at Siemens, Europe's biggest industrial group. Going home on time is

no problem, because afterward in the peace and quiet of her own home she can answer e-mails and questions from Siemens personnel managers from all over the world. Together with them, Kugel is making Siemens' 350,000 employees fit for the future. The

team has identified about 30 professions whose processes and learning content are being changed by new technologies. Who needs to be familiar with 3D printers? What qualifications will be required in the future? How should processes be reorganized? And

what fears should be addressed? Janina Kugel believes that leadership must become more horizontal and that traditional career symbols are outdated. People still set the pace, but every individual employee has to stay open to new insights for a lifetime.

Kugel believes this applies especially to managers. The era of the ivory tower is over. Issues will have to be discussed more openly in the future—in some cases, after the children have gone to sleep.



“Companies that do not take climate protection seriously will eventually be crowded out of the market”

Climate regulator

→ Jochen Flasbarth makes sure climate protection is on the right track

Anyone can complain, and in the past Jochen Flasbarth was no exception. As President of the Nature and Biodiversity Conservation Union (NABU), he lashed out at German politicians’ ignorance of climate issues—until 1997, when Angela Merkel, who was then

the Minister for the Environment, signed the Kyoto Protocol, the first international climate protection agreement. Flasbarth thought, “Something’s happening here after all!” Today he himself is setting the pace as a climate expert working for the German govern-

ment. Officially he’s a State Secretary in the Ministry for the Environment; in effect, he’s a troubleshooter. For example, at the Paris climate summit in the fall of 2015 Flasbarth was appointed to the inner circle of negotiators whose job was to resolve tricky disputes,

such as how much each country should contribute to the funding of climate protection. When he carries out such missions, Flasbarth keeps in mind not only the climate but also the future of industry. Only if we use our resources sustainably and responsibly will we still

have a livable planet 50 years from now. We can achieve this goal only if all of us work together. The 195 countries that were represented in Paris signed an agreement on measures to contain global warming. The wealthy countries will support the poor ones in this endeavor.

Development assistant

→ In order to restructure the Schonlau iron foundry as fast as possible, Markus-Peter Dürkes gave his employees free rein

The economist Joseph Schumpeter once wrote that the driving force of economic progress is “creative destruction.” At the Schonlau iron foundry in the German town of Geseke, creative destruction occurred in a way its Managing Director, Markus-Peter Dürkes, had never expected: In 2005 the facility burned down overnight. As he stood gazing at the smoking ruins, he had tears in his eyes. But then he said to himself, “Entrepreneurs don’t whine—they swing into action!” To his disheartened workforce, he announced, “We’re going to rebuild!” The insurance company expected the reconstruction to take at least half a year. But Dürkes said, “Six weeks at the most.” All the employees helped, practically around the clock. The Managing Director trusted his team implicitly. “Don’t ask for permission to buy what you need or how expensive it will be. Just buy it!” he told them. The team invested €12 million in a digital switching system, ultramodern furnaces, and an optimized production hall. The result was a state-of-the-art foundry. After seven weeks of work, the foundry was once again in operation. Since the fire, productivity has grown by 25 percent and morale has soared. And today any necessary modernizations are carried out without any fuss. “Before the fire, we wouldn’t have had the confidence to do that,” Dürkes says. If he were still alive, Joseph Schumpeter would be delighted.

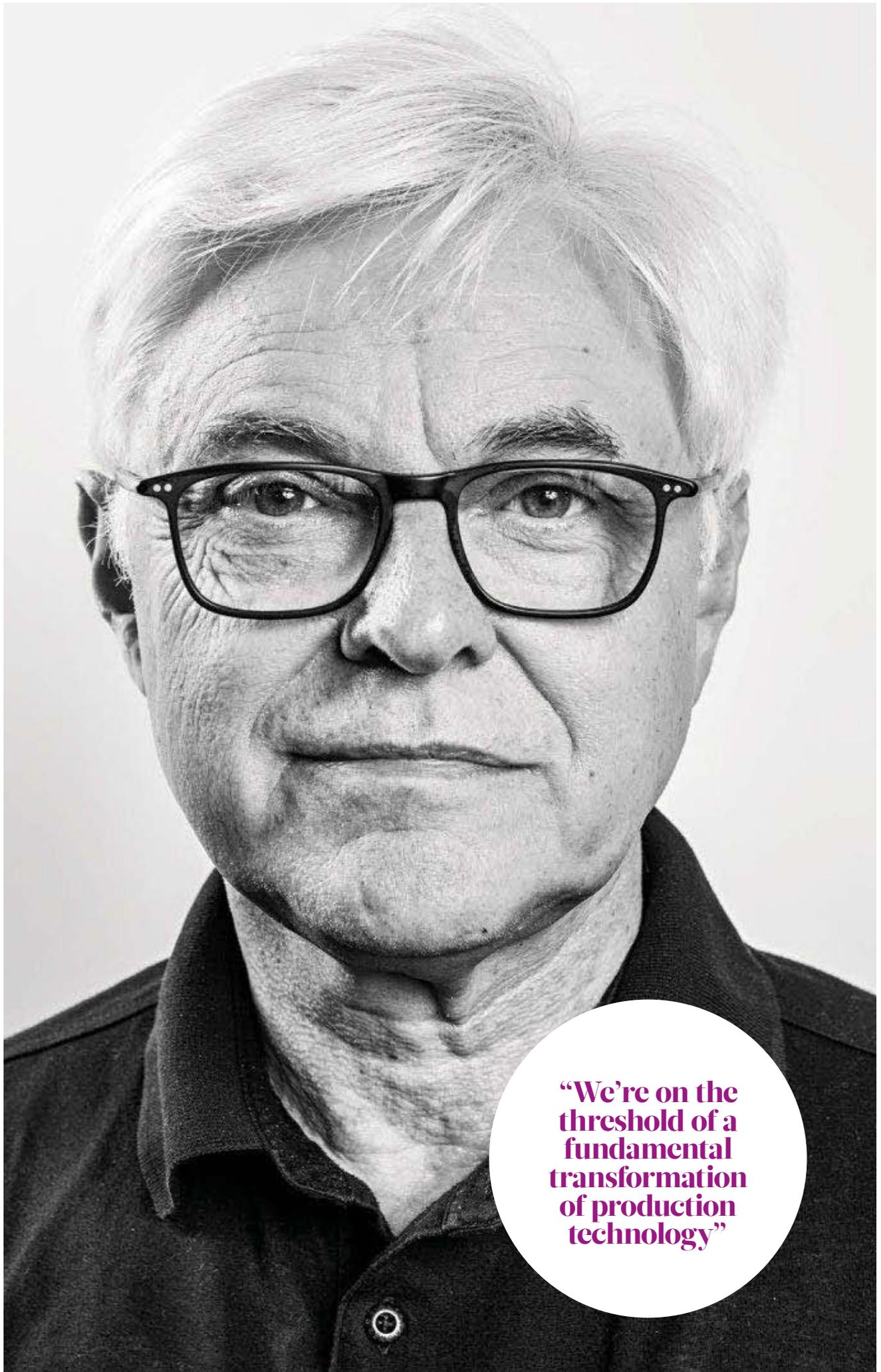


“My managers should, and can, make most of their decisions by themselves”

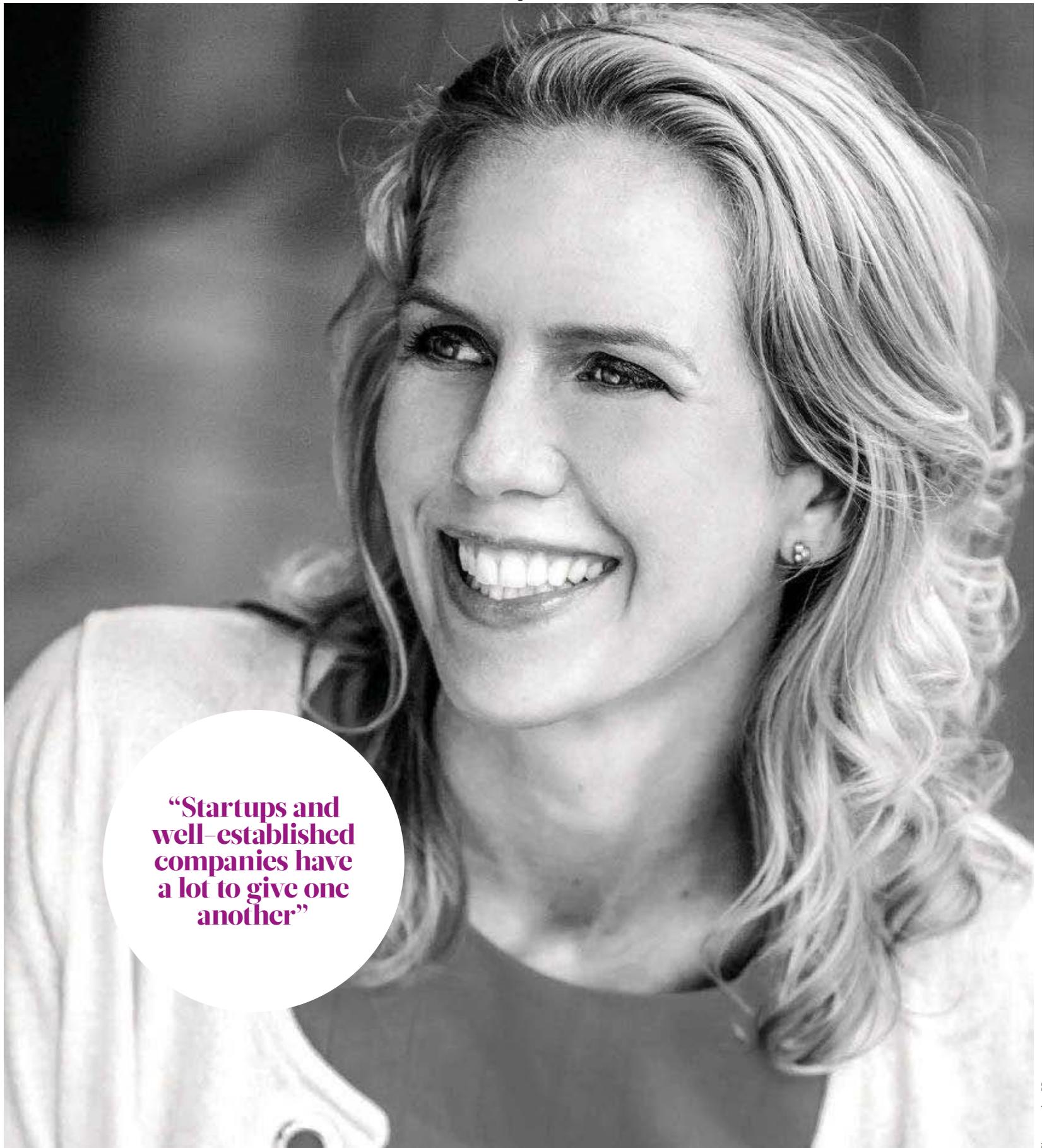
Model builder

→ Nobody knows the factory of the future better than the Fraunhofer expert Detlef Zühlke. That's because he built it himself—over a decade ago

Many people are somewhat afraid of the future, because they don't know what it will bring them. That may be why Zühlke is such an optimist: He knows exactly what the future will look like, because he has already built it. As the Director of the Fraunhofer Institute for Information and Data Processing (IITB) in Karlsruhe, he is the inventor and founder of the revolutionary "Smart Factory," a demonstration factory with a mini-format production line. This is where Zühlke demonstrates what Industry 4.0 may look like. Visitors from all over the world are impressed by this facility, which has a completely modular structure that makes highly flexible automated production possible. Zühlke, a visionary who has received numerous awards, wrote a book called *Der intelligente Versager*, which entertainingly explains how computers ought to work in order to genuinely help us in our daily lives. Today he is convinced that "smart factories" would keep Germany's manufacturing sector in the forefront and generate many new jobs despite high wages. People like Detlev Zühlke generate optimism.



“We’re on the threshold of a fundamental transformation of production technology”



“Startups and well-established companies have a lot to give one another”

Networker

→ Simone Lis is bringing the innovative spirit of Silicon Valley to German managers

Everything is so laid back here! On the third day of the seminar at the latest, the German managers have taken off their ties after strolling through the Google campus and checking

out the atmosphere at Twitter and Facebook. The mood is relaxed, communication is direct, and the ideas are bubbling up—and this is where Simone Lis enters the picture. She

puts German managers in touch with startups and regards herself as more of a go-between than a tour guide. In order to convey the spirit of corporate entrepreneurship to

German top managers, she chooses not the big names but startups that are practically unknown but match the needs of the German visitors. As a result, the meetings are not “bazaars

of the bizarre” in which the Germans marvel at the crazy startup culture. Instead, they are dialogues that benefit both sides—often in the form of new business deals.



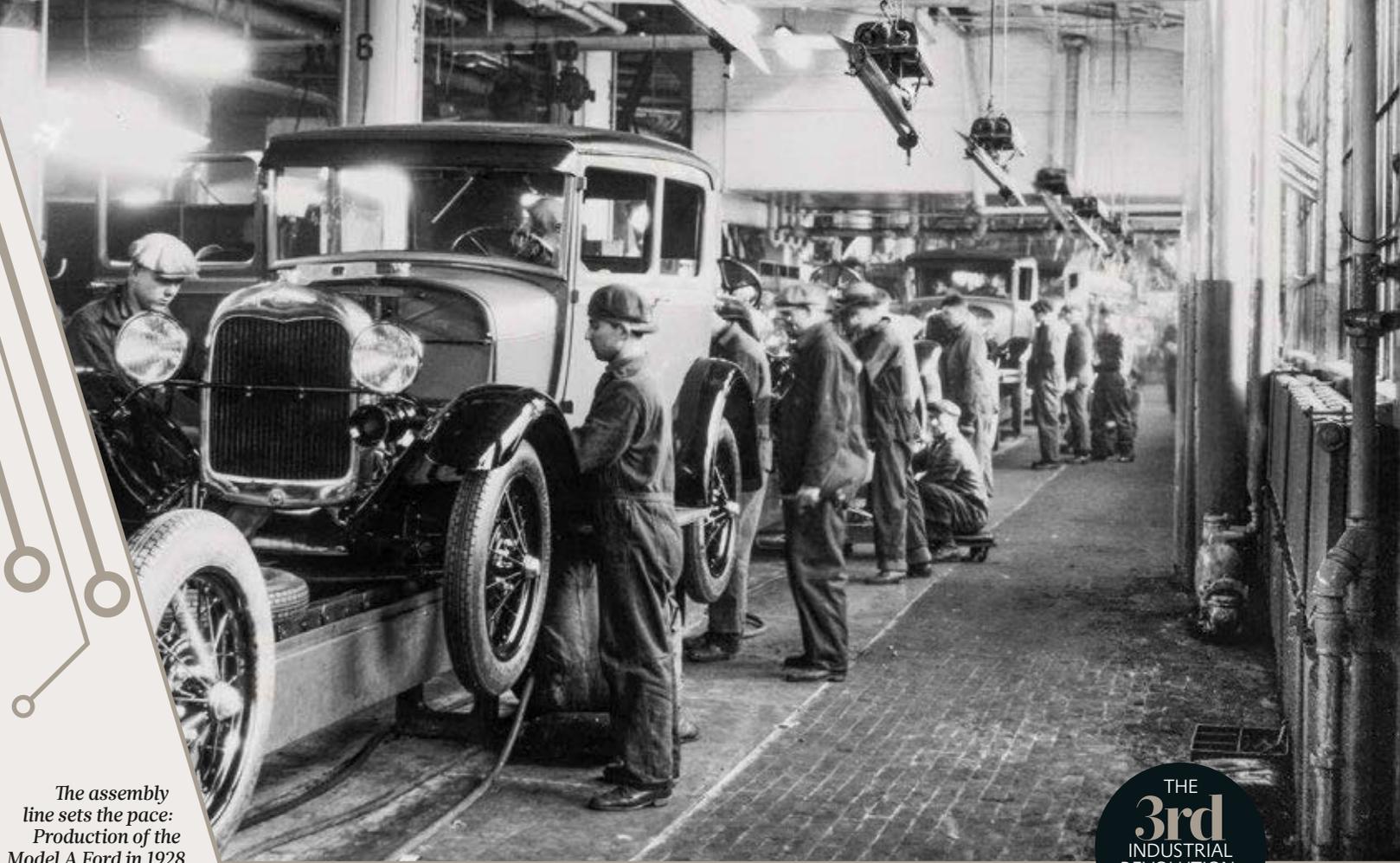
Many people fear that the fourth industrial revolution will end human labor. Gabor Steingart, publisher of *Handelsblatt*, disagrees. He argues that revolution brings risks but even more opportunities, especially for a highly industrialized country like Germany.

WHAT WILL WE MAKE TOMORROW?

THE
4th
INDUSTRIAL
REVOLUTION:
ROBOTS AND
BIG DATA



Robots work, humans control: A look at the highly efficient BMW plant in Oxford, England, where various models of the Mini are produced



The assembly line sets the pace: Production of the Model A Ford in 1928

THE
3rd
INDUSTRIAL
REVOLUTION:
THE ASSEMBLY
LINE

➔ Everyone's talking about revolutions. Psychologists are proclaiming the sexual revolution, and of course geneticists and the entertainment industry are also announcing a whole series of breakthroughs. For some it's a cloned sheep, while for others it's 3D glasses. If the concept of revolution could protect itself against its inflationary use, it would file a complaint with the United Nations.

The mother of all the revolutions of today took place in the 18th century, when there was a sudden unexpected upsurge of interest in the natural sciences. More and more young people wanted to become mathematicians. Prosperous citizens set up laboratories in their homes. And in clubs such as the Royal Society in London and the Académie des sciences in Paris, a new kind of individual emerged on the global stage: the discoverer who was, for the first time ever, search-

ing not for distant lands and rare animals but for scientific insights.

A world of spectators had become a world of inventors. The number of patent applications increased dramatically. In England, around 300 patent applications were submitted in 1770. In 1810 that figure had risen to 1,124, and 20 years later patent applications were submitted for 2,442 inventions. Science had left its niche existence in order to serve the world as a force of production. During this era, the new phenomenon was not the unique insight but the invention of invention itself.

The Industrial Revolution was launched. Almost all the factors that are driving the global economy today were developed in the countries that are now regarded as "old Europe." An Italian invented the electric battery in 1800, a Frenchman invented the sewing machine, Englishmen launched the

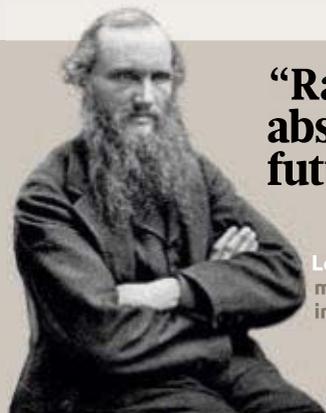
first big iron ship in 1838, and photography was invented in France in the late 1820s. All of the countries on the continent, even the small ones, contributed to the success of industrialization. A Swede invented dynamite, a Bohemian the marine propeller. As though all of them were connected by a burning fuse, brilliant flashes of insight sparkled all over the continent.

Germany industrializes

Germany played a major role in this dramatic revolution. Carl Benz invented the automobile, Werner Siemens the dynamo. Further chapters in the history of this revolution were written by Otto Lilienthal with his glider and Robert Bosch with the spark plug. An interesting thing about Germany's scenario of discovery is that it's still going on today. The processes of refinement and rejection, adjustment and invention have become

**Great men,
big mistakes**

Intelligence is no guarantee of farsightedness. Clever people sometimes completely miss the mark. Some examples:

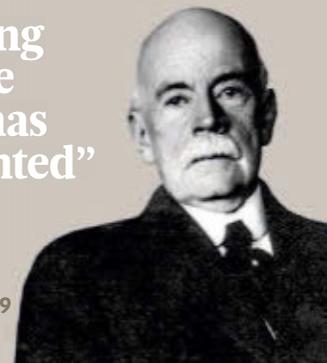


"Radio has absolutely no future"

Lord Kelvin, mathematician and inventor, 1897

"Everything that can be invented has been invented"

Charles Duell, Commissioner of the US Patent Office, 1899





*Into the future:
A 1960 ad for a
portable phone in
London. The bus in
the background
transmits the
phone call to the
landline network*

Improved Efficiency Less Input, Better Results

Wasting resources is morally questionable and economically senseless. Throughout industrial history, the use of resources has decreased and effectiveness has increased. This development benefits all of us



+ 500%

Wind energy The 20th-century wind turbines on the North Sea coast feed only 500 kilowatts into the power grid. Many of them are being replaced by taller wind turbines with longer rotors in an improved geometric design. Their power yield is six times greater

- 92.5%

Heating energy Forty years ago, keeping a house warm required 200 kWh per square meter per year. In the following 25 years this figure shrank by half. Modern passive houses require only 15 kWh to keep families warm



+ 800%

Fuel A VW beetle of the 1970s consumed nine liters of gasoline per 100 kilometers; its engine had a meager output of 25 kW (34 hp). The BMW ActiveHybrid 3 Sport Line Automatic is exactly nine times more powerful—and consumes less fuel

- 83%

Drinking water Thirty years ago, a washing machine could clean five kilograms of laundry and used 180 liters of water per wash cycle. Today, 50 liters of water are sufficient to clean 40 percent more laundry. Today's toilet tanks save even more water. They need only two liters instead of 12 for a standard flush.



- 99.9994624%



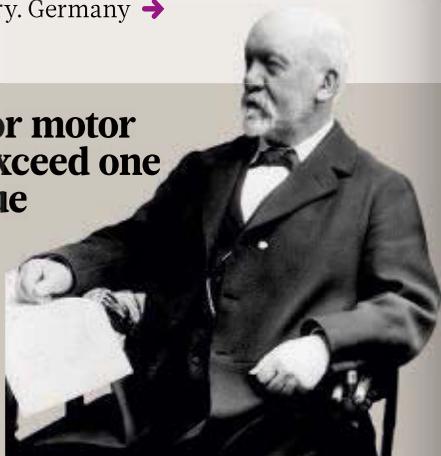
Data storage Microchip factories are still the champions of efficient data storage. A 64GB SD card for a cellphone or a car radio can hold up to 10,000 pop songs—the equivalent of a 300-liter car trunk full of record albums or 300 C 90 cassette tapes for a party

a cycle of renewal that drives the industrial giants in Germany's stock market index and the country's medium-size enterprises onward with never-ending new inventions. Germany's old industrial companies are rejuvenating themselves. For example, Siemens alone registered 7,650 inventions in business year 2015. When it comes to innovative spirit, chemical and pharmaceutical industries can match the plant construction and automotive sectors. An annual research budget of €8 billion ensures a constant stream of new ideas.

Whereas many countries have decided to cut back these roots, Germany nurtures them. The Italians believe in God, the French believe in the state, and the English believe in the wondrous ability of the City of London to multiply money. Only the Germans have believed, and continue to believe, in the reliability of their industry. Germany →

“Global demand for motor vehicles will not exceed one million—simply due to the lack of available chauffeurs”

Gottlieb Daimler,
inventor, 1901





Occupations

Two Men, One Job, Three Concepts

The changing tasks of industry also mean changes in occupations—and in their names, as Peter Dorendorf and his son André found out to their surprise

Of course Peter Dorendorf wanted to know who would be training his son as a process electronics specialist. After all, he works at the Marl Chemistry Park himself. When he met the trainer, he could hardly believe his eyes. “What are you doing here, Bernd?” he asked. After all, Dorendorf knew him as his trainer from his own apprenticeship—in measurement and control engineering. And that’s how father and son realized they had both opted for the same apprenticeship occupation. The job that was called measurement and control engineering in 1970 had developed into process electronics engineering in 1997. On that day at the Chemical Park, father and son first looked at each other in bewilderment. “Then we laughed ourselves silly,” recalls Peter Dorendorf.

Their occupations have different names because their tasks have also changed—a common process in industry. Whereas an auto mechanic would lie under cars, his successor, a mechatronics specialist, sorts out the onboard systems electronically. And whereas shop mechanics used to work with pliers and wrenches, today industrial technicians work at computer-controlled CNC machines. Similarly, the electrician’s occupation has also evolved into that of the system electronics specialist. All of these developments have one thing in common: A knowledge of how to deal with data and electronics is indispensable.

Peter Dorendorf has experienced this trend throughout his career, ever since he started to work at Evonik’s predecessor company



André (left) and Peter Dorendorf work at the plant fire brigade at Marl Chemical Park (top)

Hüls AG in 1970. Back then, the occupation of measurement and control specialist was still revolutionary. It required all-round expertise combining intelligence and manual dexterity. “But then technology quickly took off,” remembers Peter Dorendorf, who is now 60. The tasks became too complex for all-rounders. Electronics played a growing role in the pneumatic gas measurement systems that Dorendorf inspected, maintained, and repaired. His 35-year-old son, André Dorendorf, also learned to deal with pneumatic systems, as part of the skill set of up-and-coming process electronics specialists. However, he has seldom had to use this know-how in practice. In fact, manual dexterity is hardly needed in this occupation any more. “Computers are much more important today than they

were just ten years ago,” Dorendorf says. “More and more tasks are being done with computer support.” When he wants to test something, he simply connects it with a computer. The advantage of this is that the likelihood of human error is reduced to zero, and all the documentation is created automatically.

André Dorendorf wouldn’t mind if his son entered the same occupation as he did—but that’s impossible. Process electronics specialist has now become electronics specialist for automation technology, with a new set of tasks. This job profile, along with its name, will also be reworked various times before André’s son is ready to choose a profession. Julius Dorendorf is only three years old.

→ without its industrial base would be like Tuscany without its hills.

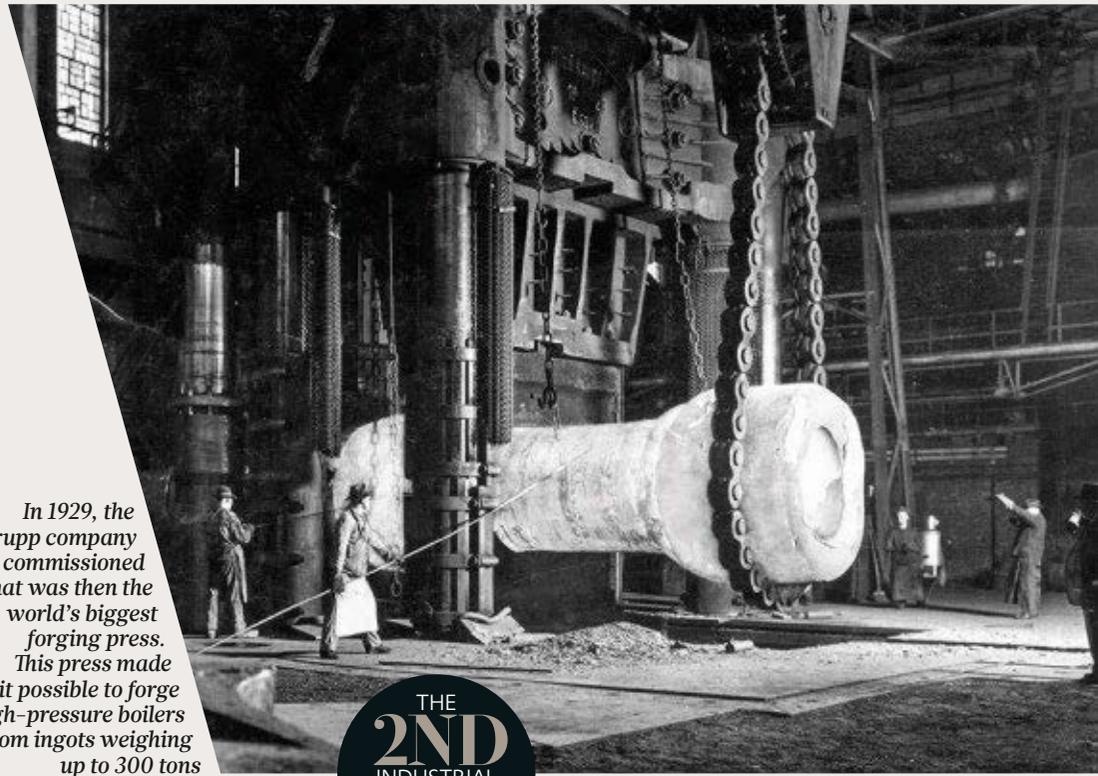
And the good news is that the process that began over 200 years ago with the acquisition of arable land along the Rhine and Ruhr rivers to build mines, factory smokestacks, and blast furnaces continued in the 20th century with the creation of an industrial infrastructure that cannot be found anywhere else in the world. In 2016, nowhere else in Europe is industry as strong as it is in the Federal Republic of Germany. Today the country has 22,400 manufacturing companies with 5.3 million employees and an approximately 25 percent share of Germany's GDP. If we add industrial service providers, the share of GDP is almost 40 percent. In a word, Germany is an industrialized country.

Suddenly everything's digital

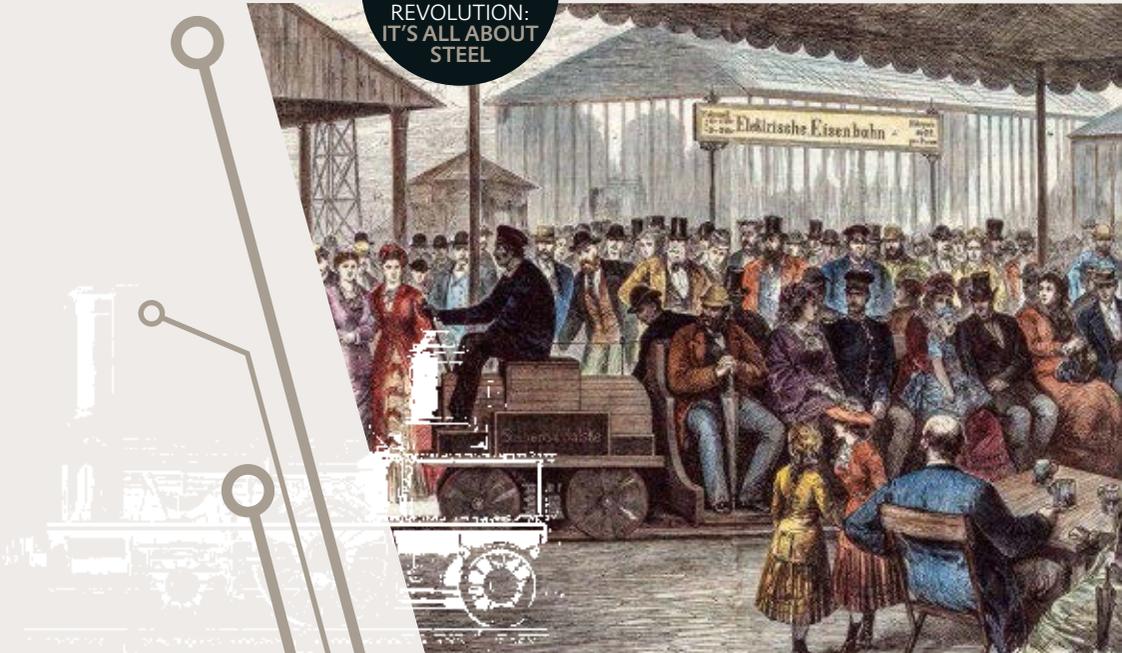
Germany's industrial history would be a success story from A as in automobile to Z as in zeppelin if it were not for a recent development that also deserves to be called a revolution. The digital wave of renewal arising in Silicon Valley—driven by companies such as Google, Apple, Cisco, Hewlett Packard, Facebook, and Twitter—is a force to be reckoned with, technologically and otherwise. In fact, this younger revolution is seriously challenging the older one. It doesn't intend to negate the achievements of its predecessor or to dispense with its products—automobiles, trains, planes, refrigerators, and machines that make other machines. Nevertheless, it does aim to, in effect, tear out the brains of the creations of the first industrial revolution and replace them with new digital control centers. Cars would still be cars, but they would be steered by the new digital giants. Energy producers would continue to build and operate coal, gas, and nuclear power plants, but the networks linking plants with one another and with their customers would be controlled by others. Media companies could continue to support their expensive editorial staffs, but the content they produce would be distributed by the new technological platforms.

The new revolutionaries don't want money—all they want is our data. They know how to spin straw into gold. And they are →

In 1929, the Krupp company commissioned what was then the world's biggest forging press. This press made it possible to forge high-pressure boilers from ingots weighing up to 300 tons



THE
2ND
INDUSTRIAL
REVOLUTION:
IT'S ALL ABOUT
STEEL

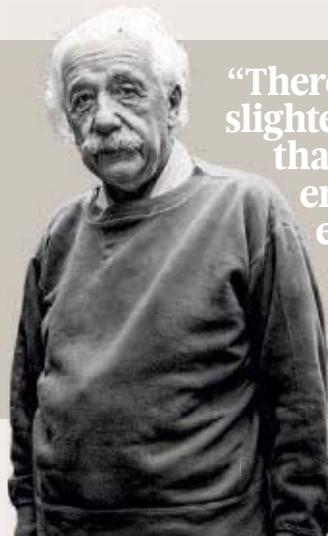


At the Berlin Industrial Exhibition in 1879, Werner Siemens presented the world's first electric locomotive



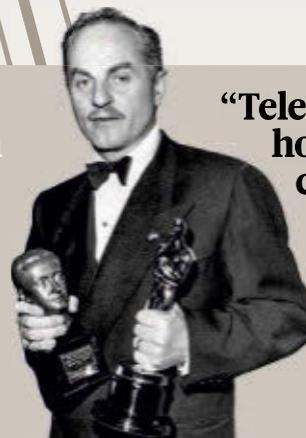
“Who the hell wants to hear actors talk?”

Harry M. Warner,
head of the Warner
Brothers film studio,
1927



“There is not the slightest indication that nuclear energy will ever be obtainable”

Albert Einstein,
inventor and Nobel
Prize laureate, 1932



“Television won't be able to hold on to any market it captures after the first six months. People will soon get tired of staring at a plywood box every night”

Darryl F. Zanuck,
head of 20th Century Fox, 1946

THE
1st
INDUSTRIAL
REVOLUTION:
THE POWER OF
MACHINES



The textile factory of the Wetter brothers in Orange, France, in 1764

→ no longer beginners. Yesterday’s “garage companies” are today’s global giants. The global economy’s center of gravity has shifted from Europe to the USA. The market capitalization of the six biggest Silicon Valley companies is over €1 trillion. Together, Google and Apple are worth as much as all the DAX 30 companies combined. Google’s profits are seven times higher than the combined earnings of Burda, Springer, and Bertelsmann.

Today there is hardly any traditional industry that is not being confronted by the sudden emergence of a digital challenger. For a long time, “old industry” kept pace with its turbines’ rhythm; “new industry” dances to the tune of algorithms. The new factory hall is the cloud. All value creation takes place inside computer networks. The new revolution is a silent revolution that doesn’t thump or emit clouds of steam. Its most striking visuals are the packaging that

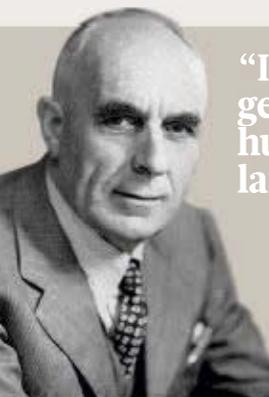
marketing experts create for new products. Everything gleams and flashes—sometimes to signify an absence.

Change becomes imperative

In other words, the intersection of these two revolutions is not proceeding as peacefully and harmlessly as people would have us believe. “Old industry” has already left three waves of renewal behind it. First, human muscle power was replaced by machines, then work was automated by means of assembly lines, and finally it benefited from the assistance of robots and computer technology. Now industry has to master its fourth transformation, which has already begun: the merging of information technology, telecommunication, and the manufacturing industry. We’re seeing the rise of smart factories, humanoid machines, and transparent customers.

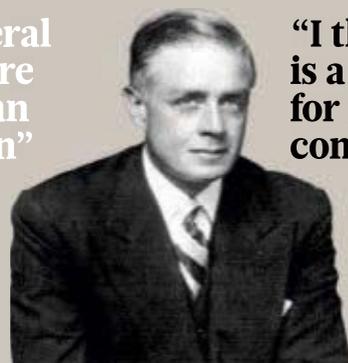
This development, termed “Industry 4.0,” can be seen as a call to arms, because old industries are being called on to demonstrate their viability in this new context. The challenge is “Change or die.” Industry 4.0 is also an attempt to defeat the attacker with its own weapons. Old industries accept the need to replace the “brains” of their products and assembly lines, but now they want to replace them with digital brains of their own making. Daimler wants to go on being Daimler rather than a Google clone. Siemens and all the other industrial giants also realize they must never give up the control of their production or the management of their customer relations to outsiders. They want their cooperation with the digital companies to go only so far and no further. There’s a new word for this overlapping of friends and enemies: “frenemies.” In other words, Industry 4.0 is not simply an opportunity for

Photography: Glasshouse Images / Alamy Stock Photo, DeAgostini / Getty Images, Hilary Morgan / Alamy Stock Photo, The Print Collector / Corbis, PR, Alexander Widding / Alamy



“It will take several generations before human beings can land on the moon”

Sir Harold Spencer, astronomer, in 1957, 12 years before the first moon landing



“I think there is a world market for maybe five computers”

Harold Watson, CEO of IBM, 1946

“There is no reason anyone would want a computer in their home”

Ken Olsen, President of Digital Equipment, 1977





As seen by posterity:
James Watt (1736–1819),
one of the inventors of the
steam engine

Germany, as some people keep insisting—it's an imperative. This term stands for the urgently needed renewal of Germany's industry, which can maintain its status quo only at the cost of its own decline. To put this in even more drastic terms, the price of staying put would be to disappear altogether.

This challenge has been not just understood but also accepted. Today there is hardly an industrial company in Germany that has not made data digitization processes a top priority. The current generation of industry owners and managers is aware of its responsibility. The role it must play on the revolutionary stage of world history is just as important as that of its predecessors. Industry 4.0 is its mandate: to revolutionize the revolution.



Gabor Steingart is one of Germany's most prominent authors and journalists. Formerly Editor in Chief of *Handelsblatt*, today he is on the management board of its publishing house

“Two years from now, spam will be solved”

Bill Gates,
Chairman of
Microsoft,
2004



Value Chains The Links Form Networks

A tree becomes a beam becomes a table: That's how value creation works. How is this process changing in the digitized world of Industry 4.0? Patricia Solaro from the Future of Industry alliance offers some initial answers

Ms. Solaro, you do research on the value creation structures of the future. What kinds of things are you looking at?

We're investigating how value creation industries are changing and how value creation can be safeguarded in Europe in spite of internationalization. Value creation is traditionally visualized as a chain, from the raw material through various stages of processing to the end product. However, very few industrial products are still being produced in this sequential fashion.

So the metaphor of the chain doesn't work any more?

Exactly, and that's the topic we're addressing. Today there's hardly any more "chain" production in which each link follows the last one. Because of increasing digitization, the steps of production are not taking place one after the other but instead more or less simultaneously. The structure of value creation is changing from a chain into networks, and the individual nodes of these networks can change again and again.

What does this mean for the value creation process?

Familiar partners, such as suppliers, are playing a more important role, and new players are entering the game. For example, customers are moving ever closer to the production process and voicing their own expectations—which can't just be ignored. The key elements of the value creation network are communication, data sharing, and everyone talking with everyone else.

But the CEO still ultimately decides...

A CEO's responsibilities are changing. Management can no longer decide everything from



Patricia Solaro works together with associations, ministries, and trade unions in the "Future of Industry" alliance

the top down. Instead, the individual production teams have to act quickly, and therefore as independently as possible.

Doesn't that make processes more complicated?

No, industrial production has always been complicated! But we've come to grips with complexity through automation. Today production is complex, and because the processes are simultaneous they are becoming less plannable. We have to learn how to deal with that.

One of the tasks of your working group is to formulate recommendations for political action. What would you recommend?

Politicians like to ask for a master plan, but there's no such thing. Instead, we have to promote diverse approaches.

Interview: Saphir Robert

Patricia Solaro is a member of the Board of Directors of the Association of the Electrical Engineering and Electronics Industry (ZVEI), where she is responsible for the business areas Business, Economic Climate, and Policy.

Who will shape the future—people or machines?

Embracing Progress

We can only take full advantage of the opportunities offered by industrial transformation if we look forward and plan for the future. Why should machines be operated only by human beings? The future of work could be cleaner, safer, more interesting, more self-determined, and more authentic. To create this future, what we need most of all is education.

➔ The monitors of the Wendelstein 7-X nuclear fusion facility in Greifswald were shining brightly last February. For the first time ever, German scientists had successfully generated hydrogen plasma. A long-cherished dream of mankind had come true: Clean energy was produced from a substance that is almost infinitely available. It was claimed that one day a similar process could be used to gain just as much power from four pails of water as from 40 tons of coal. This unprecedented news was followed by reactions that were equally unprecedented in the local German context. The reactions ranged from benign to neutral and possibly slightly skeptical, but there was no hysteria and no apocalyptic predictions. There was not a trace of hostility to technology—even though Germany's reputation would seem to indicate otherwise.

English speakers, who love to tease, like to speak of “German angst.” This expression refers to an odd, and usually unfounded, fear of all kinds of potential disasters—fear that inevitably ends in outrage or ostentatious general pessimism. To people outside Germany, it seems that these emotions are often directed against new technologies or even progress itself. Nowhere else has there been such bitter opposition to nuclear power or so much controversy over an administrative procedure—a national census. And in protests against genetic engineering or the discussion of radiation emitted by mobile phones, the supercritical, pessimistic Germans always seem to be in the forefront. This leads one to ask how this nation of doubters and protectors of vested interests can possibly assert itself in the disruptive world of Industry 4.0.

What do we need to do?

The Internet of Things is a promising development for production technology. The comprehensive networking of machines could bring about a new flowering of manufacturing in Germany. In any case, increasingly powerful computers and ever smarter robots could replace human labor in many areas. The vision of factory halls without any human workers (the “lights-out factory”) is becoming a reality.

For the first time, the emphasis is not only on manual labor but also on office jobs that machines can simply carry out more efficiently. Robots will initially only replace muscle power, but eventually they will also do the thinking. This outlook is making many employees feel insecure—and not just in Germany. This anxiety is being aggravated by studies and research results. According to

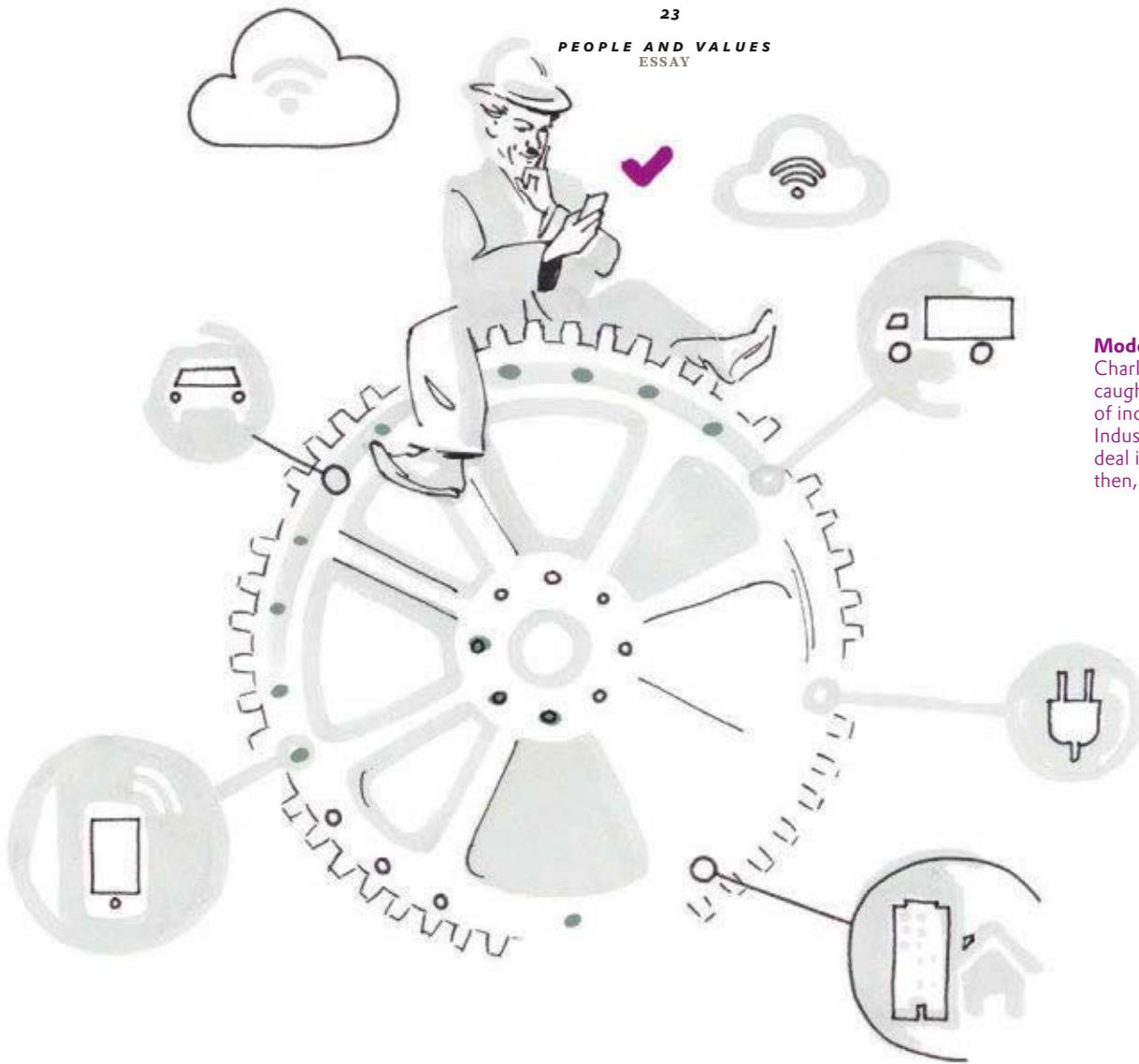
calculations made by the A. T. Kearney consulting company, 45 percent of jobs in Germany will be jeopardized by automation in the next two decades. Economists such as the Harvard professor Richard B. Freeman are warning us about a “new serfdom” of less qualified workers who will have to accept ever lower wages in competition with machines if they want to have any jobs at all. People who live with this kind of anxiety will regard progress as a threat and try to block it—but may miss opportunities in the process.

What are we ultimately proud of?

Of course there are optimists who point out that so far every form of technological progress has generated not only greater prosperity and more high-quality jobs but also new areas of employment and more jobs in general. When assembly lines were introduced in the USA, many people were afraid they would lead to mass unemployment. In fact, employment doubled during the following decades, while the country's gross national product grew sixfold. Nonetheless, today many academics and business leaders believe that smart machines could theoretically stimulate the economy, economic growth, and prosperity indefinitely—but would not necessarily increase the volume of employment. How are the economy, the society, and individual workers dealing with this prospect?

To answer this question, we have to start by understanding the difference between abstract and concrete risks. Abstract risks such as genetic engineering and nuclear energy affect everyone. They are simultaneously obstacles to, and accelerants of, progress. Countries that decide against nuclear power invest more money in alternative sources of energy. By contrast, anxiety regarding the increasing automation of production is a concrete risk for every individual employee in the industries involved. What comes into play here is an economic factor that is often overlooked: the individual's cost-benefit analysis.

From an economic standpoint, technological progress is fundamentally desirable. Every step in the direction of automation increases efficiency, makes workplaces cleaner, promotes growth, improves products, and leads to greater diversity. If we look at the economy as a whole, this progress affects (almost) everyone, and thus (almost) everyone benefits. However, the concrete costs are borne by those workers who are suddenly replaced by machines. An employee who loses his or her job to a robot is not comforted by the fact that this de-

**Modern times:**

Charlie Chaplin was literally caught in the gears because of industrial progress. Industry has changed a great deal in the 80 years since then, but the fears persist

velopment may lead to better jobs for others or may make better products available. The individuals who are in this situation will regard progress as a threat—and they will reject it.

This argument is increasingly being accepted in retrospect regarding the industrial saboteurs of the 18th and 19th centuries. In England the Luddites, a group of textile workers named after their leader Ned Ludd, destroyed many wool and cotton spinning mills in a struggle against the social consequences of the mechanization of their work. In Germany there was a series of analogous weavers' rebellions. Karl Marx and Friedrich Engels initially regarded these movements as narrow-minded opposition to technology, but through these actions the affected workers were basically struggling against the loss of their privileges and their sense of security. They did not want to be the only ones paying the price for technological progress. This motivation has remained unchanged down to the present day.

What do we want to see in the future?

The more that people fear being replaced by automation and excluded from the economy, the greater are their anxieties and their resistance to technological progress. That is not a desirable development for either business or society.

Ulrich Klotz, a former leader of the IG Metall trade union who is today a member of the expert commission "The Future of Work" in the Federal Chancellery, believes this fear is unjustified. He welcomes increasing automation because it will result in less work that is dirty, mind-dulling or hazardous. And

"Nobody wants to be the only one paying the price for progress"

Rainer Schmidt studied economics in Bonn, Baroda (India), and Göttingen, as well as journalism in London. Today he lives in Berlin with his wife and two children. His latest novel, *Die Cannabis GmbH*, is currently being filmed by Nico Hofmann and Oliver Berben. His new novel, *Legal High*, will be published in August

he argues that the aim of progress is not to strengthen people's ability to do repetitive work in factories, but instead to promote their creativity. He believes there is a worthwhile future in what is known as "unique labor"—individual jobs in the knowledge society. According to Klotz, we should therefore provide education and training that puts many more people in the group of those who are benefiting from modernization. The prospect of not becoming expendable even under changing conditions, and of benefiting from change instead, takes the threat out of technological progress—and safeguards people's prosperity over the long term.

"Education" has therefore become the most important buzzword for many companies hoping to benefit from Industry 4.0. Only if they have well-educated, creative employees can companies master the digital revolution successfully and with sufficient flexibility. Only well-qualified employees can look forward with self-confidence to a future that nobody can precisely describe as yet. This may require a new sense of solidarity between industry and state-funded educational institutions. We will soon see whether these institutions are really equal to the task, whether there has been enough investment in key areas, and whether the right strategic course has been set.

What we can actually achieve, above and beyond all the fears and reservations, may be suggested by the public reaction to the hydrogen plasma created in the Wendelstein 7-X nuclear fusion facility. We might be slightly skeptical or somewhere between neutral and benign. But we will not be anxious, because we are obviously not doing so badly after all.

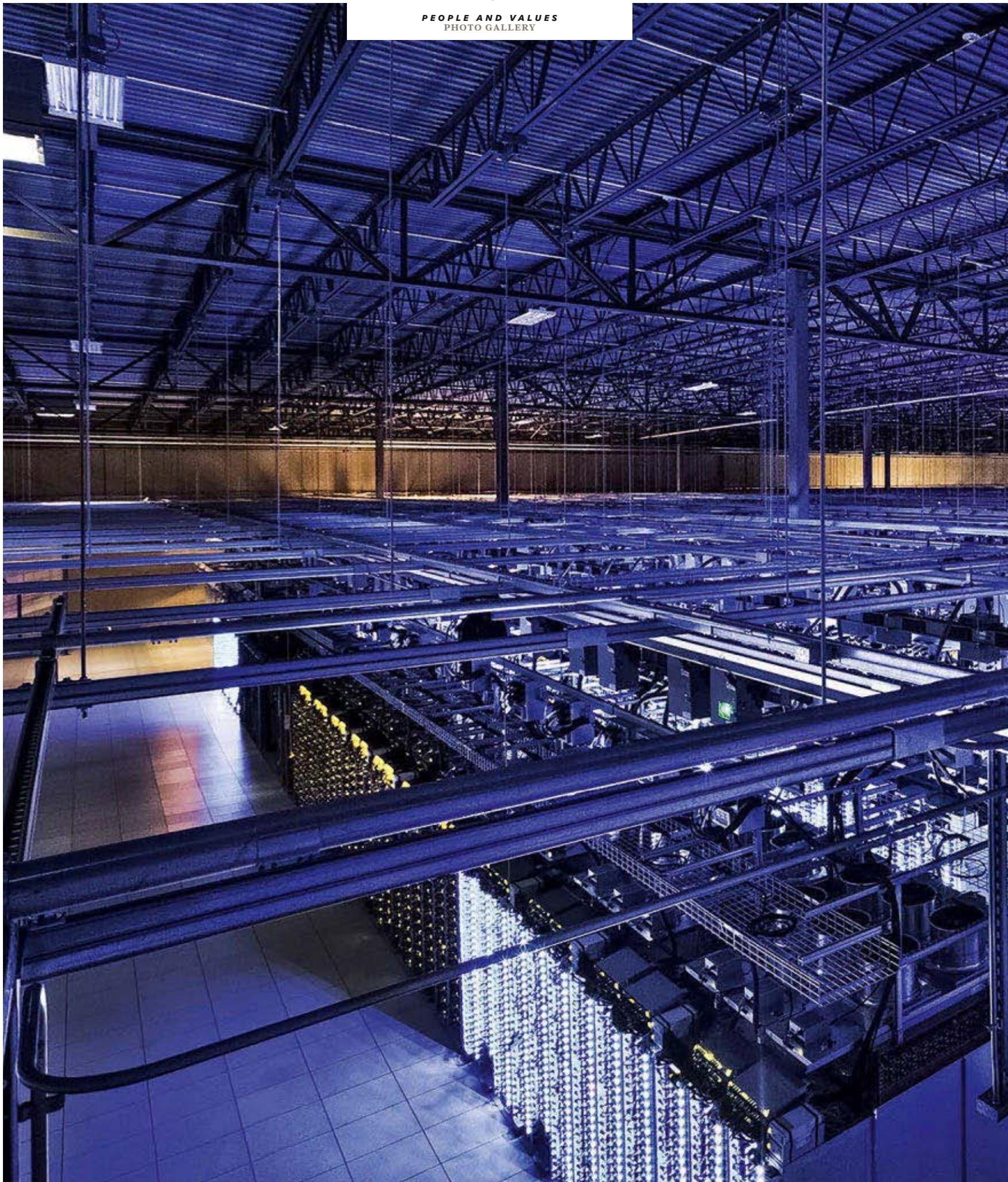
Paths for Products



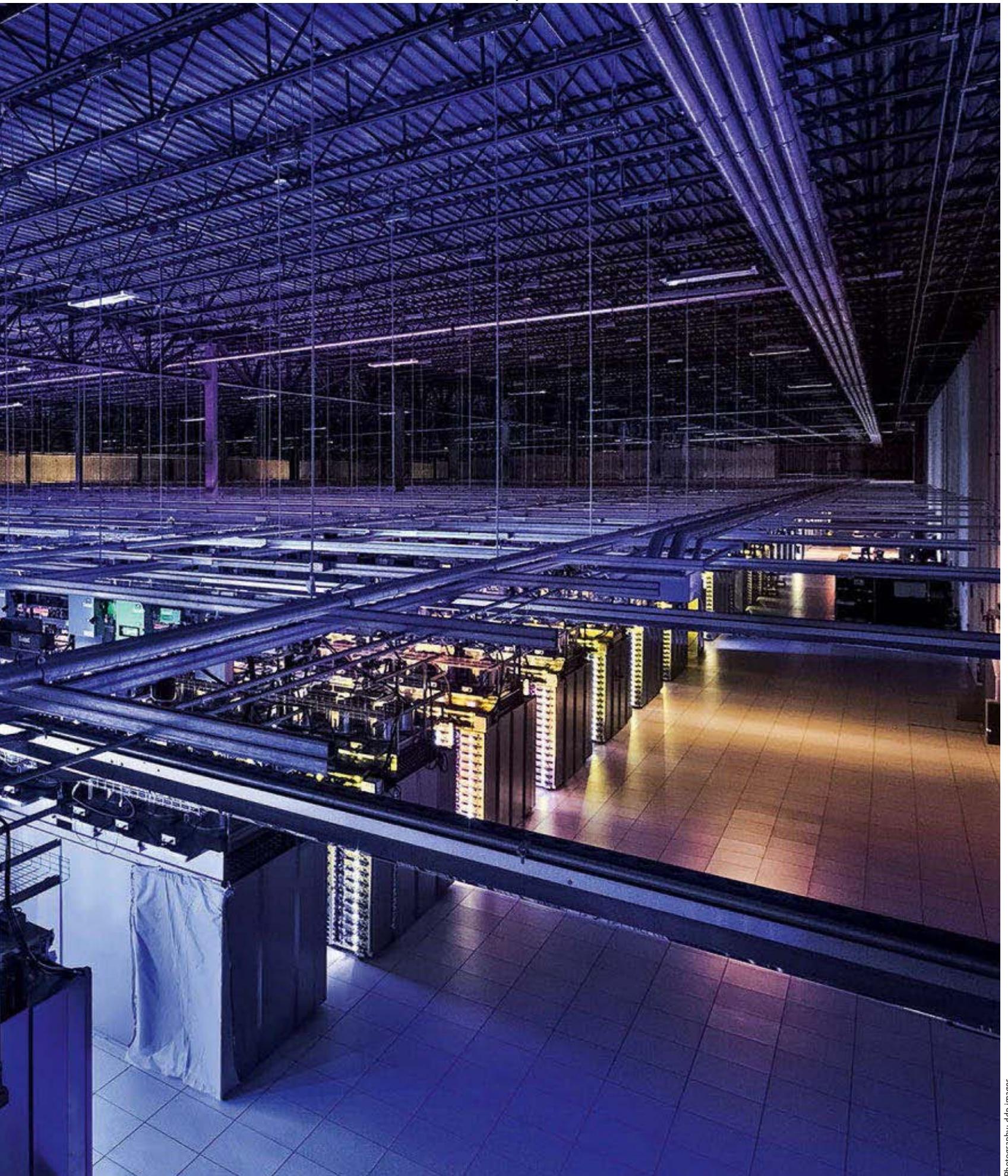
Industry requires infrastructure. In this photo series we show roads, intersections, passageways, and paths of commerce that range from ancient trade routes to modern data highways.



Today young Kirghiz nomads guide their donkeys along paths that once were used by Alexander the Great and Marco Polo. At an altitude of 3,016 meters, Lake Songköl lies along the Silk Road, which used to be one of the main global trade routes linking the Mediterranean region with China. A revival of the Silk Road is now in the making. China is working to build a “New Silk Road”—on rails



Probably every Internet user has taken advantage of these servers at some time or other. They are located at the Google computer center in Council Bluffs, Iowa, in the USA. Google operates 13 centers like this one throughout the world. With its servers, Google processes billions of search queries and YouTube views every day. These servers are driving the digital revolution by transmitting the most precious commodity of the modern world: data



Photography: ddp images

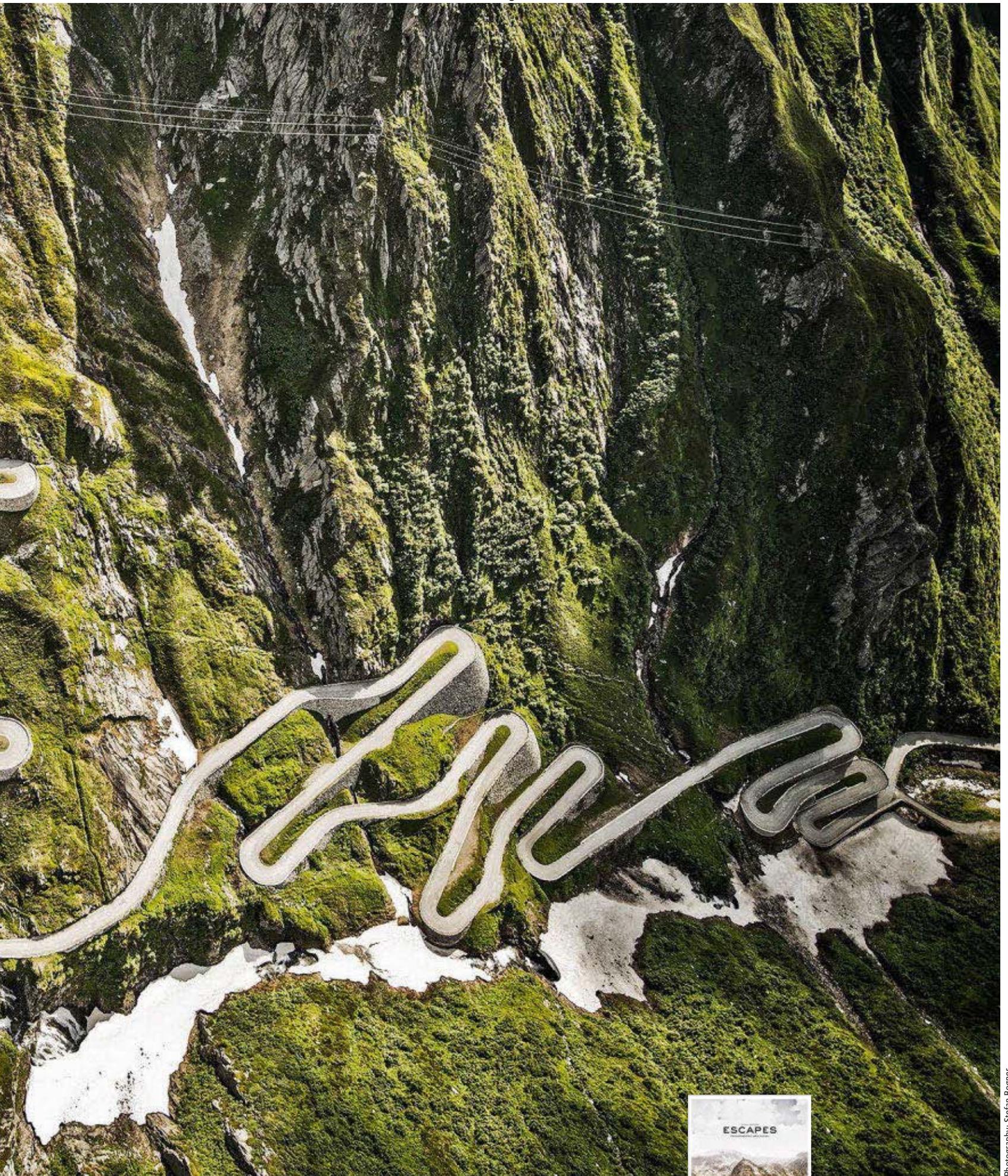




Navigating the desert. A tanker glides through the Suez Canal, which connects the Mediterranean Sea with the Red Sea over a distance of almost 200 kilometers. The canal, whose completion in 1869 was celebrated with sensational headlines, was a blessing for international trade. It enabled European goods to be shipped from the Atlantic coast to Asia without having to sail all the way around Africa. We still benefit from this trade route today



The serpentine curves of the Tremola road wind up to the St. Gotthard Pass. Built in 1832, this listed road is one of the “dream routes” through the Alps. From the Middle Ages to the early 20th century, this Swiss mountain pass was a major route across the Alps—for carriages in summer and sleighs in winter. Today it’s ideal for nostalgic travelers, but those in a hurry can take a tunnel straight through the mountain



This photo comes from the book *Escapes – Traumstraßen der Alpen* (Delius Klasing Verlag)

Photography: Stefan Bogner

Facts + Figures



3 QUESTIONS FOR

Richard Soley
 "We can expect big convulsions"

it's already becoming obvious that there will never be just a single standard.

1 When will the Internet of Things arrive?

We are already in the midst of its introduction, even though it isn't felt everywhere in the world with the same intensity. These differences have less to do with nationality, however, than with mindsets. Some companies are very active in this regard—while others are not.

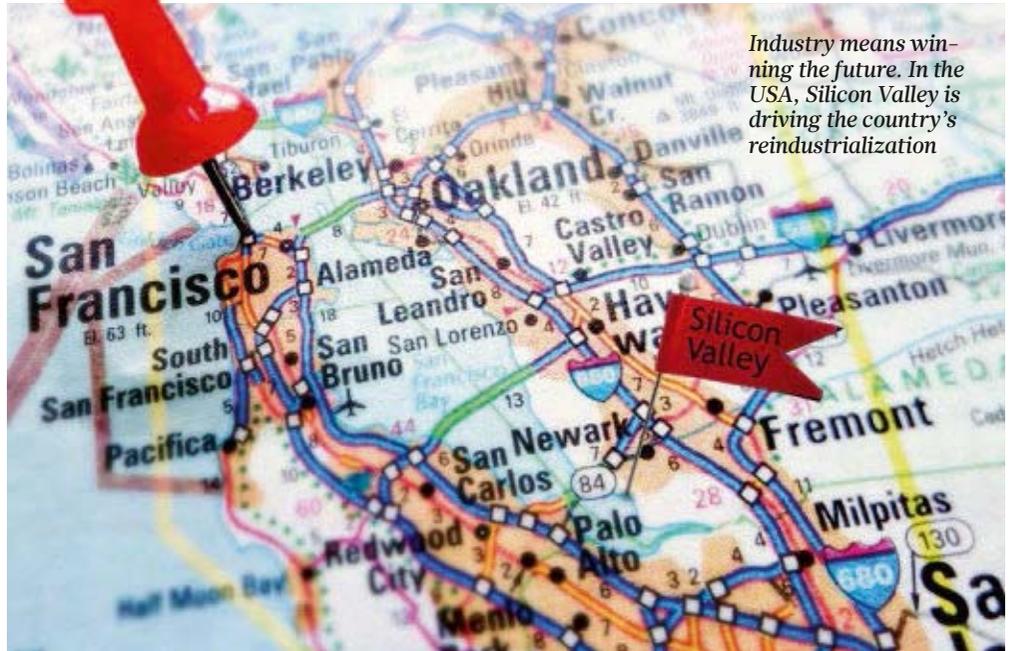
2 Maybe these other companies are still waiting for the introduction of mandatory standards?

Everyone wants standards and data security. Three things are needed for this: research, research, and more research. We at IIC are trying to coordinate this research and to transfer knowledge, because nothing helps one as much as learning from one's mistakes. No matter which sector you look at,

3 Many European employees are afraid that the digitization of industry will eliminate their jobs. Are these concerns justified?

Employees in Japan, Chile, the USA, and Nigeria are also worried. It is a global concern and it's certainly justified. We can expect big convulsions. That's why governments will have to make sure that their education systems are able to produce versatile citizens who can respond effectively to the opportunities and changes on the market and in the culture.

Richard Soley is the Executive Director of the Industrial Internet Consortium (IIC), which brings together 200 companies and organizations from all over the world to investigate the future of industry.



Industry means winning the future. In the USA, Silicon Valley is driving the country's reindustrialization

We Want Our Industry Back

Germany serves as a role model, because its industry enabled it to recover more speedily from the recent global economic crisis than its neighbors. That's why the European Union member states are aiming to strengthen their industries again. For example, British Prime Minister David Cameron promises to provide targeted help to rebuild the UK's industry in order to achieve an "export-oriented upswing" and create a new "economic equilibrium."

The USA is well on its way to becoming "reindustrialized," as many companies are relocating their manufacturing operations back to the United States. This development

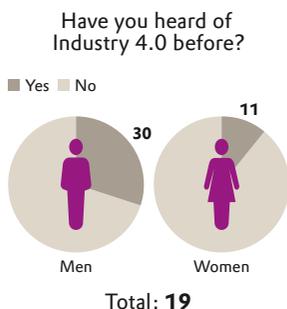
is made possible by decreasing energy prices, low wages, and a growing population. Outsourcing is no longer profitable.

The next stage of industry development will also appear first in the USA, thanks to Silicon Valley. The specialists there devise new digital manufacturing techniques that are then immediately introduced by local industries. According to an Accenture study, the Netherlands is the only other country in the world where digital technologies are as commonly used as in the USA. The study ranks Germany in the middle, which means it is somewhat exemplary.

SURVEY

How Will We Benefit from Industry 4.0?

All figures in percent



Source: FORSA 2015 *Multiple answers possible

21 percent less greenhouse gases are being emitted by Evonik into the air than in 2010. Emissions of sulfur oxides declined by 90 percent, of nitrogen oxides by 58 percent, and of particulates by 69 percent.

ENTREPRENEURS

Big in China

**Jack Ma**

says of himself that he combines "Asian wisdom with Western know-how." Ma created one of the world's largest Internet trading platforms, Alibaba, which drove eBay out of China.

**Ma Huateng,**

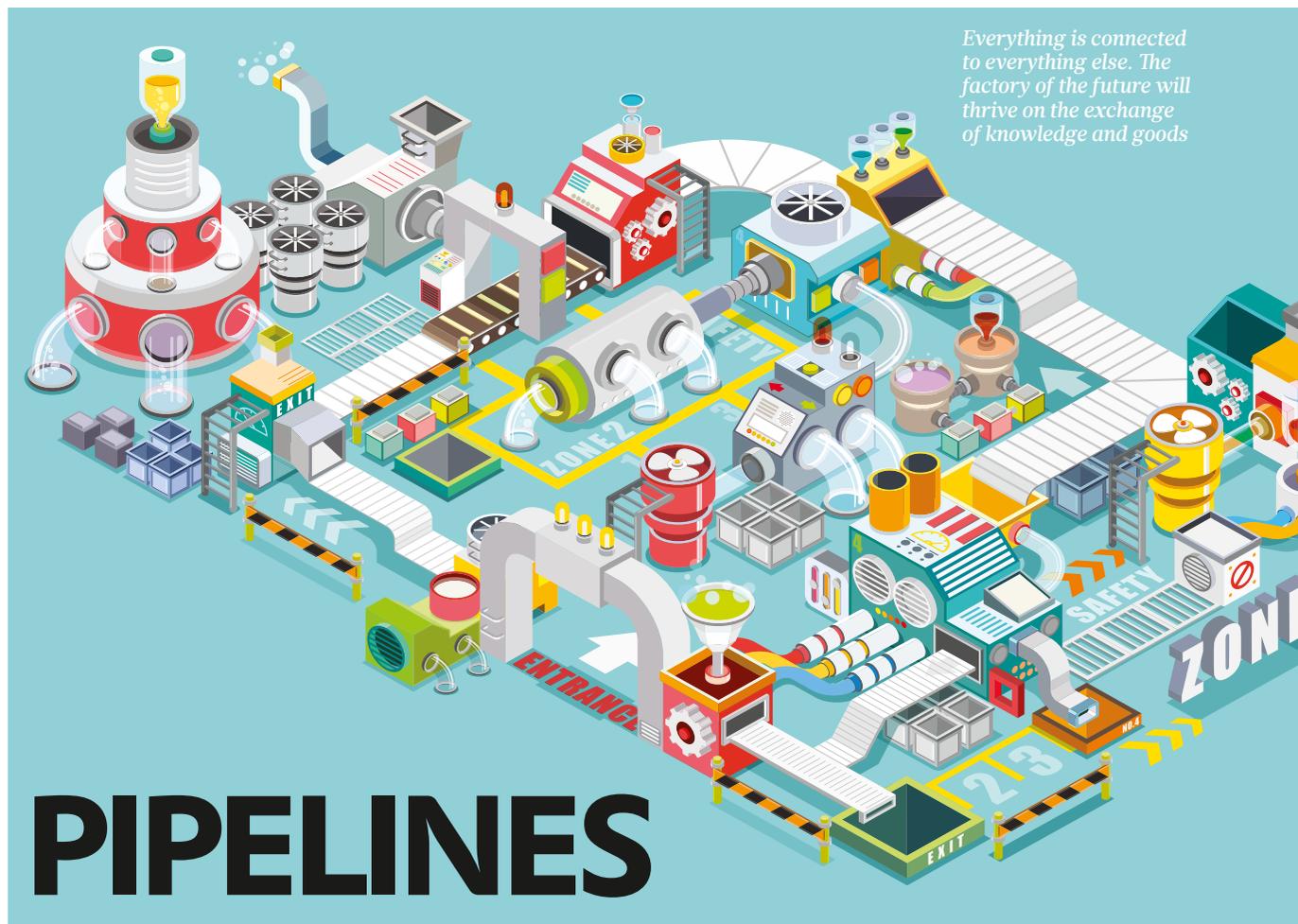
aka "Pony Ma," developed the instant messaging service QQ, which is the most frequently used online service after Facebook and WhatsApp. QQ reached a world record on July 3, 2014, when 2.1 million of its users were online simultaneously!

**Robin Li**

founded the search engine Baidu, which enabled him to earn a fortune worth billions. Li is now primarily investing this money in the development of artificial intelligence.

**Jun Lei**

heads the world's most valuable startup: Xiaomi. Established only five years ago, Xiaomi is now the third-largest manufacturer of smartphones in the world.



Everything is connected to everything else. The factory of the future will thrive on the exchange of knowledge and goods

PIPELINES

Learning from data: Factories have also long been networked with one another. Experts refer to such operations as "fence-to-fence" production, because goods are transported through fences in pipelines.

Goods go back and forth in Leverkusen. From its plant, Evonik sends AEROSIL through a pipeline to Momentive Performance Materials next door. This facility, in turn, produces chlorosilane as a by-product, which is sent back to Evonik, because it is needed for AEROSIL. The production of AEROSIL also creates hydrochloric acid, which is sent through a pipeline to Momentive, because it can also use the acid.

The fences are merely decorative, and only seemingly separate processes that have been interconnected for many years. The process that Evonik calls "fence-to-fence" has become an industrial standard worldwide. Whenever a company plans to build a new factory, it makes sure

that the suppliers are grouped around the new facility as closely as possible. Doing so reduces distances and makes it possible to hold consultations at short notice.

Goods arrive at the customers right after they are produced. The transport route can be measured in meters. No trucks, no freight trains, and no ships are needed, so there are no logistics costs. And traffic jams become irrelevant when companies produce goods "fence-to-fence."

Such exchanges have long gone beyond goods, too. The plant directors in Leverkusen meet every week to share information and discuss what they have planned. As a result, everybody knows when one of the facilities will be undergoing main-

**fence-to-fence**

1
It speeds up production, because the partner facility is located right behind the fence.

2
It's less hazardous, because it eliminates transport risks.

3
It's less expensive, because it involves no transport costs and few storage expenses.

4
It makes companies independent of external factors so that traffic jams and bad weather become irrelevant.

5
It stimulates the brain, because sharing expands our horizons.

tenance work, for example. Evonik also has a plant in Castro, Brazil. This facility is located right next to a plant run by the US corporation Cargill. The two plants share not only products and knowledge, but also wastewater facilities as well as water and power supply systems.

The next step is to share an entire factory. This has been done for years now, even though such joint production is rarely apparent at first glance. That's because many of the machines in the factories are merely leased. One example of this is the industrial robots that Ford uses to assemble cars in Cologne. This is done because it is in the interests of both parties to utilize the plants at an optimum rate.

AEROSIL® is a registered trademark of Evonik Industries AG or one of its subsidiaries. It is indicated in capital letters throughout the text.

THE LONG ROAD OF FRANK ZWEIMANN

Once industry has left a town, it's hard to get it back. This is the story of a small-town mayor in Thuringia who struggled with the fatal consequences of deindustrialization and won back a great deal: jobs, tax receipts, infrastructure, and a future for his town, Kölleda.



Frank Zweimann stands at "his" rail connection. This link with the railroad network brought Kölleda its first global player, Krauss Maffei



Behind walls built in 1702, a town council that sets a fast pace: Kölleda's City Hall



In the scrapbook: Newspaper clippings from Zweimann's 20 years as mayor



He even plays guitar: Frank Zweimann at home in his recreation room

➔ A hint of luck and future prosperity wafted through the spring air as the newly elected town councillors stepped onto the PVC-covered wooden floors of Kölleda's old City Hall in May 1990. The comrades of the GDR had been ousted, the Berlin Wall had fallen, and the countryside was flourishing. One of the new town councillors was Frank Zweimann. "I had no idea how to manage a municipal budget," recalls Zweimann, a trained electrician. Two years later, aged 32, he was elected mayor of this town with its population of 6,000—after running as the only candidate.

It had taken only two years for the euphoria of the new town councillors to disappear and for a sense of melancholy to spread throughout this small town in Thuringia. One business after another had closed down. People had been told over and over that their technology was outdated and their employees were badly trained. The Kölleda companies that had found refuge under the roof of the German national trust were treated no differently than the other companies in the former GDR. They were "phased out," in the jargon of the reunification process of the 1990s.

"The new German states were largely deindustrialized after 1989," wrote Klaus von Dohnanyi, a government counselor and former national Minister, in 2009 in his final report on the rebuilding of eastern Germany. Lothar Späth, a former state Premier and Chairman of the Supervisory Board of Jenoptik AG, made the following comment about the years of transition: "Everything was done completely right in terms of politics and completely wrong in terms of economics." Companies were closed down much too soon, talented workers moved to the West much too fast, and the East became ever emptier. As a result, its infrastructure shrank. Its schools, hos-

pitals, fire departments, libraries, movie theaters, cafés, and markets now lacked the people they needed to run them profitably. And Kölleda is no exception. Many people cried as they talked to the young mayor during his office hours.

Nobody knew how life could go on. But Frank Zweimann had a plan. "However, I couldn't talk to anyone about this plan. People would have called me a megalomaniac," he says almost 25 years later.

The biggest industrial park in the East

Frank Zweimann aimed to attract internationally operating companies to Kölleda in three steps. First, he would need land. Next he'd build roads, railroad lines, and paths. Finally, while addressing the first set of companies, he'd carry out Step Three: restructuring the town administration as a service organization.

Zweimann's plan was not megalomaniac; it was strategic and based on geographic considerations. If you cut Europe out of an atlas and balance this piece of paper on the tip of a pencil, the central point is the Thuringian Basin. And if you superimpose Thuringia's land utilization plan of that time on the map, you will notice a cross-hatched gray area that stands out. This is exactly what the young mayor did. What he saw was that the planned A71 highway would go right past Kölleda and connect up with the A4 highway 30 kilometers south of the town. The A4 crosses Germany from east to west. Not only was the small town of Kölleda situated in the middle of Europe—soon it would also be ideally connected to the international transport network.

In the following years, Frank Zweimann used charm, chutzpah, and development funding to buy up the biggest continuous commercial space in eastern ➔

"People would have called me a megalomaniac"

Frank Zweimann, the mayor of Kölleda, told no one about his plan to attract industry to his home town



Frank Zweimann on a visit to Logatec in the industrial park (far left), talking to CEO Ralph Zühlsdorff



The view from above: Zweimann with CEO Joachim Kuhn in the production hall of va-Q-tec



→ Germany. He attracted mid-sized companies and large industrial groups. And when he handed over his mayor's baton to his successor two decades later, a dozen companies had set up shop in Kölleda's industrial park between fields of rapeseed and peppermint—including the Daimler AG subsidiary MDC Power. These companies brought the town 2,700 new jobs.

Step 1: Buy lots of land

Frank Zweimann has a round, friendly face with a modest mustache that's almost beige in color. He's wearing jeans and a sports coat and seems unobtrusive—until he starts to talk. At that point you realize the mayor is a brilliant communicator.

Zweimann tells anecdotes about his early career as a sailor and a “state-certified DJ,” clearly explains complex municipal problems with a few gestures, inserts a joke about Erich Honecker and bits of worldly wisdom, and repeats, with an actor's skill, dialogues he used to have with local farmers. He also recounts how he shrewdly played various sellers against one another, begged, persuaded, and negotiated until 1997, when he had accumulated 40 hectares of land—the biggest commercial space in eastern Germany. What's more, he was offering incredibly cheap lots for extremely moderate trade tax rates. At every opportunity, the mayor told that to all the state politicians and high-ranking officials who were negotiating with potential investors. He found out that Opel, BMW, Bosch, and Cargobull had opened branches in Eisenach, Erfurt, and Gotha. For lack of space, Porsche had had to move to Saxony. “The

next big company will come to us,” he said to himself. In 1998 Kölleda welcomed its first global player: the arms manufacturer Krauss-Maffei Wegmann. The company was looking for a location in eastern Germany, where more and more army units were being stationed. In its future plant it would be repairing Leopard tanks. Was Zweimann bothered by moral scruples? “I suppressed them,” he says. “I was only interested in the rail connection.” The company was demanding a rail link in order to transport its tracked vehicles. Zweimann knew that rolling freight trains would considerably boost the value of the industrial park. After all, infrastructure was Step 2 of his plan. And there was an old railroad line that passed close by the town. But who would pay to build the missing kilometer and a half of tracks?

Step 2: Build roads and railroad tracks

Krauss Maffei had almost signed the contract, but Kölleda had no money to build the tracks. The mayor told himself, “When things get complicated, you simply have to think.” He went to the state capital, Erfurt, and talked to state officials. “I can't save the state alone,” he said, and demanded that the state pay 90 percent of the costs. “You want to extort money from us,” said one undersecretary. “I've never regarded it as that,” said Zweimann. He got his way.

The rail link was built and Krauss-Maffei came to Kölleda. One useful feature was that the tracks to the industrial park branch out from a stretch of railroad that is over a century old and connects Kölleda with neighboring towns. The railroad company had actually

“When things get complicated, you simply have to think”

Frank Zweimann shares his recipe for success



*A short pause:
Zweimann in the
Logatec canteen.
The woman standing
is his wife Iris*

wanted to shut it down, but now it modernized it for the many expected freight trains. That also benefits regional passenger transport, which Zweimann has revived as a side effect.

But the mayor scored his biggest coup just after 2000, when he brought over 1,000 jobs to Kölleda at one go. The officials of the state's development company had invited him to a meeting in a luxury hotel in Weimar. They warned him to keep his mouth shut, because they wanted to conduct the negotiations alone. Several well-dressed gentlemen introduced themselves as corporate consultants whom DaimlerChrysler had commissioned to assess about 100 sites worldwide for a new engine plant. Zweimann recalls that the man sitting next to him was wearing a chunky sweater and jeans and "constantly making inept remarks." "Psst," Zweimann whispered to him. "Not now. We can talk about it later." Zweimann believed the man was a chauffeur, but he turned out to be Volker Stauch, the director of Daimler's main plant in Untertürkheim, who was responsible for the planned engine plant MDC Power.

The two men got along beautifully. In the following months the search for a site narrowed down until finally only Kölleda and Győr were competing. The Hungarians also offered favorable conditions; Audi had already built a gigantic plant in Győr. There are various explanations for Kölleda's final victory, but one factor was clearly the great rapport between Zweimann and the "chauffeur" Stauch. Over the following years the connection became a real friendship. If you visit the home page of MDC Power Kölleda today, you'll see a pulsating engine shaped like

a heart. The company regards itself as "an engine for the region and the people who live here," says the message beneath the heart. The plant in Kölleda-Kiebitzhöhe is the district's biggest employer today. The engines for almost all of Mercedes' model series have been assembled here since 2003—over four million so far.

Step 3: Speed up the administration

Zweimann's third trump card, lean administrative processes, also helped him to attract Daimler. "Administration is usually an obstacle," he says today. But things are different in Kölleda. If a company wishes to move here, the mayor invites it to a conference in City Hall. That's what he did in the case of Stauch, Daimler, and the projected engine plant. Also at the table were the officials responsible for civil engineering, building construction, fire protection, wastewater, drinking water, energy, and roads. Zweimann set a fast pace. He insisted that the plant should be able to start production on the greenfield site in a year's time, and that this was the opportunity to discuss relevant issues. The administration would then have two days to deal with the application. "In other towns, you couldn't even get a permit to build a garage this fast," Zweimann boasts.

His pragmatism goes down well with industrialists. "He is very visible, witty, and tough," says Norbert Reimann, the Sales Manager at Fromm Plastics, which moved to Kölleda in 2001. "He's one of the most reliable partners you could imagine." And at Krauss-Maffei they call him "extremely dynamic." "He's an initiator, a can-do guy," says Joachim Kuhn, the CEO of va-Q-tec, which built a plant for insulation panels in Kölleda-Kiebitzhöhe in 2008. "He gets totally involved and makes you feel that he's going to help you and make things come out all right."

But in spite of all the praise from industrialists, not enough of all this progress has reached the town so far. Zweimann forged ahead until 2012, and then he stepped down. His initiatives had created almost 3,000 jobs and increased the town's trade tax revenue from practically zero to €3.5 million. Unemployment decreased to 11 percent and the outbound migration stopped. People are once again moving to Kölleda.

However, Zweimann says that in his 20 years as mayor he subordinated everything else to his goal of job creation. That meant requiring the townspeople to put up with potholes, missing manhole covers, and dilapidated streetlights.

It's true that jobs exist again, but many of the plant workers are commuters from elsewhere. "I always knew that one day these will be the workplaces of Kölleda's children. The better-qualified people all left immediately after reunification, of course," he says. It will still take some time for Kölleda to fully recover. The positive developments that started in the industrial park in Kiebitzhöhe are now urgently needed in the town as well. Kölleda's outdoor swimming pool has still not been renovated, and many house fronts have been only temporarily painted over. There are no cafés or restaurants, only a few shops, and just one hotel. The expanding companies in the industrial park are urgently seeking skilled workers, but they haven't yet made contact with the secondary schools in Kölleda, says the mayor. It was difficult enough to attract industry to Kölleda. Now that it's there, it really ought to be discovering this little town and helping to bring it back to life, says Zweimann. That shouldn't be too difficult, because all the preconditions have already been met. ●



Carsten Jasner,
a writer based in Berlin, was impressed by how much energy and patience an individual can summon up when he or she has a clear vision

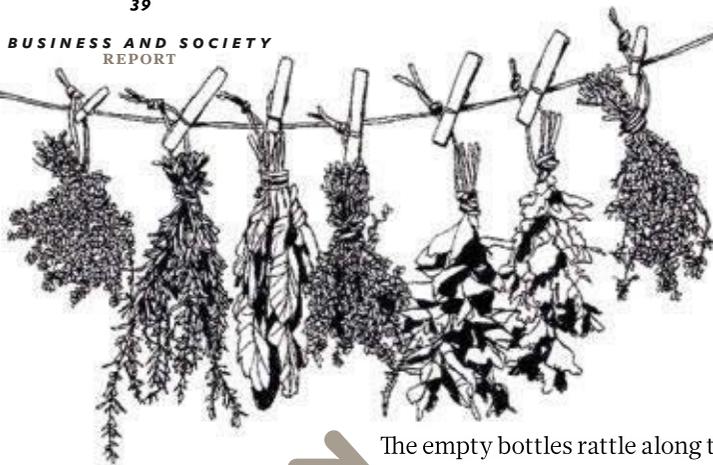


Clearly visible from outside: Storage tanks on the third floor of the Killepitsch company's vertical factory in Düsseldorf

Photography: buenasoma, Dominik Asbach Illustration: Hanka Lux

FACTORIES ARE GOING URBAN

Because factories used to be noisy and smelly, they weren't welcome in cities. Today's factories are clean and quiet—but whether they return to cities depends on entirely different factors.



→ The empty bottles rattle along the assembly line and across the platform. Now they're filled with a shimmering deep-red liquid. And off they go. Is this boring to watch? No way! The bottle parade has turned out to be a real eye-catcher behind the glass facade of the Killepitsch liqueur factory in Düsseldorf. Other companies brew, mix, bottle, and cork their products behind the scenes, but here all of these processes take place behind a display window that is several stories high. They can be seen 24 hours a day, seven days a week. And they're even illuminated when it gets dark.

“We want our factory to look interesting from the outside”

Peter Busch
CEO of the Killepitsch
liqueur factory in
Düsseldorf

“From the very start, we planned to provide people with interesting things to see from outside,” explains CEO Peter Busch. His transparent factory is located in the city center, so it's hard to ignore. “Killepitsch is a Düsseldorf product, so we have to produce it in Düsseldorf,” says Busch. This herbal liqueur has existed for 60 years, and the Busch GmbH & Co. KG liqueur factory was rooted in its site in Düsseldorf since 1858—until the founder's great-grandson ran out of usable space and started looking for an alternative site. “We didn't want to move to a place where no one could see us,” he says. He found the right spot in the MedienHafen complex in the harbor district, next to the popular residential neighborhood of Unterbilk. Here industrial production has become a stage show.

The trend is called urban production

The liqueur factory, which nestles between TV production sites and “in” restaurants near the posh neighborhood of Zollhof, is just one example. Others include a gear manufacturer that has built a facility in a city in southern Germany and the Volkswagen company's “transparent factory” in the middle of the venerable Great Garden baroque park in Dresden. Is this becoming a trend? Will factories soon be returning to the cities? Hans-Jörg Bullinger, a long-standing president of the →



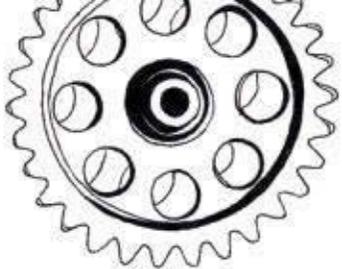
**VERTICAL
FACTORY**

HEIGHT: **27 meters**

AREA: **5,500 square meters**

≈ 40,000 KILOS
1m² ceiling





→ Fraunhofer Society, thinks so. “We used to say that factories should get out of the cities, they’re noisy, they stink, they pollute the environment. Today many factories don’t make any noise and no longer generate any harmful emissions,” says Bullinger, a professor of industrial science. Using a vivid visual metaphor, he predicts that in the future people will “go to work and come home again in their bedroom slippers.”

Matthias Horx, the founder of the Zukunftsinstitut (Future Institute), also sees a change. “Cities are experiencing a renaissance as sites of craftsmanship and production,” he says. At international conferences and forums, this trend already has a name: “urban production.” For this purpose, factory buildings could be used differently than they were in the past, says the architecture expert Nina Rappaport from Yale University. For example, the bottom floors could be used for production, with offices on the middle floors and apartments further up. “This brings working and living closer together. Industry is no longer being pushed into the outskirts,” she says.

To make the return of factories possible, ergonomists, architects, and industrial engineers are investigating how urban production could work. Researchers are calling the urban factory of the future an “ultraefficient factory.” At the Fraunhofer Institute for Machine Tools and Forming Technology (IWU) in Chemnitz, the “E³-Research Factory for Resource-efficient Production” occupies a demonstration area of 1,600 square meters. “E³” stands for Energy and resource savings, Emission neutrality, and the Engagement of people in the production process. The goal is to carry out an integrated observation of processes, process chains, factories, and the factory environment in order to find synergy effects.

Nothing to hear, smell or see

That sounds good—but does it work? What does it look like in real life when factories are built not on green fields but in the midst of neighborhoods where people reside, sleep, shop, and go about their daily lives? How do the new factories manage to square the circle? How can they be discreet, silent, odorless, and traffic-friendly while working at maximum efficiency?

Our first stop is the Fellbach commuter train station in Stuttgart. After walking 200 meters, we come to an urban production facility of the drive systems specialist Wittenstein, which was built directly next to a residential neighborhood in order to “bring the workplace to the workers.” The low building tucked between the red roofs of the adjacent houses doesn’t look very much like a



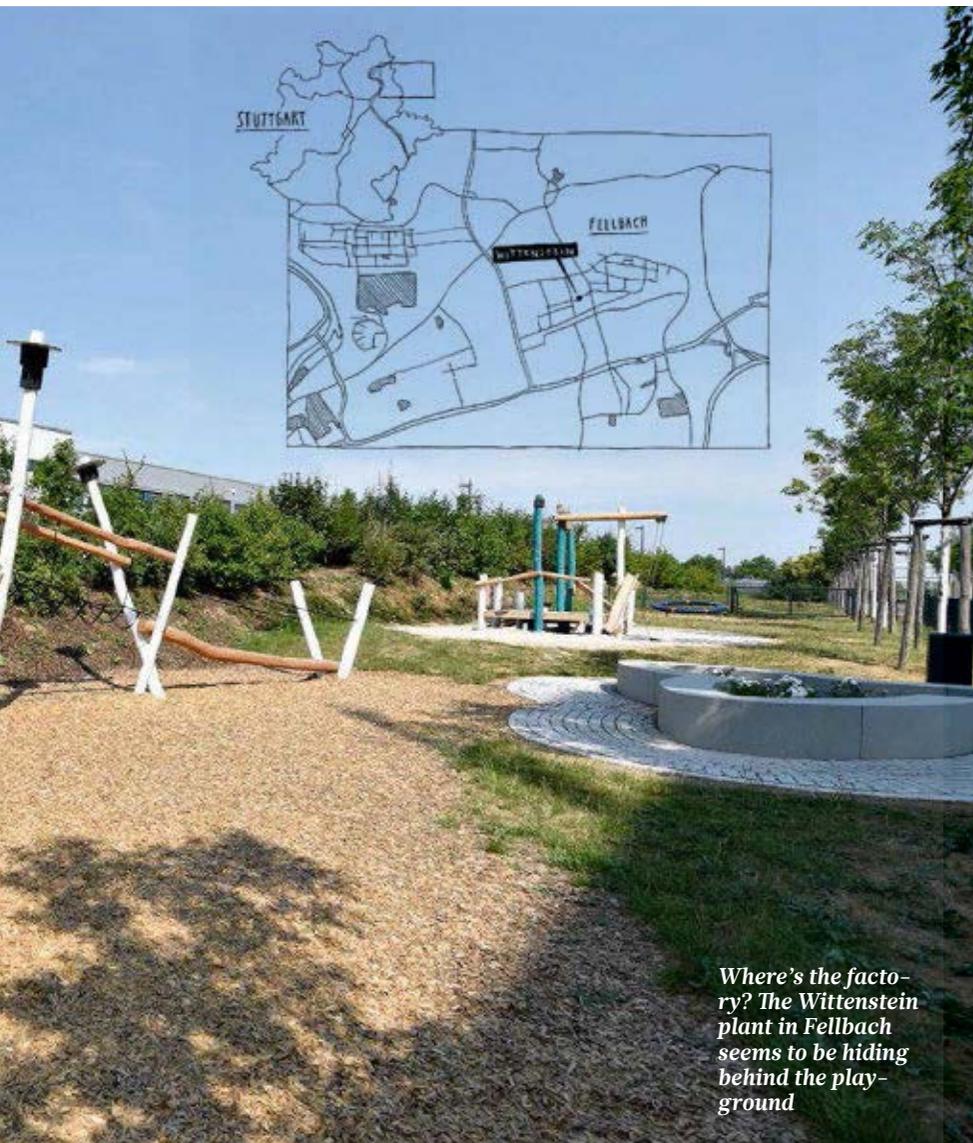
Photos: Reiner Pfisterer / Wittenstein AG, Massimo Colombo / iStock, Wittenstein AG | Illustration: Hanka Lux

OF THE ENERGY
REQUIRED FOR
PRODUCTION

= 20%

700,000 kWh
OF
Energy
GENERATED
IN-HOUSE
FROM RENEWABLE
RESOURCES





Where's the factory? The Wittenstein plant in Fellbach seems to be hiding behind the playground



“We want to build the factory of the future”

Manfred Wittenstein
Supervisory Board
Chairman and, for
many years before
that, CEO of Witten-
stein AG

factory. It looks as though it's saying, “Don't mind me—this is a residential neighborhood.” Children are romping around in the playground, but there's not a sound from the factory next door. There's no smell either. And if a truck does come around the corner, it's immediately swallowed up by the two-story building with the Wittenstein logo on the facade. People outside the factory can't perceive what's going on inside. This factory in the midst of a residential neighborhood simply becomes invisible.

This particular factory produces high-tech gears. For this purpose, metal parts are unloaded, machined, hardened, and loaded once again onto trucks—a chain of noisy processes. The factory's planners made silence a priority in order to comply with the city's noise limits. In fact, they voluntarily did more than was required and made the factory's use of resources as low as possible, even though that raised the construction costs sky-high. For example, the factory's energy comes from micro-turbines fueled with biogas, and it's heated with waste heat from production. The trucks stop not outside but inside the building, because this is quieter and doesn't disturb the neighbors.

Today's factories are also coming to grips with the problems of noise and odors. “Production processes are becoming increasingly quiet and emission-free, and new technologies and specializations enable a more efficient use of space,” says Karin Wilhelm, a professor →

New York City Work Is Entertaining

See and be seen! Why cottage industries are reconquering New York today

The city's cottage industries are not hiding from the public. On the contrary, they are showing off: Look here, we're working! It starts with the goldsmith creating earrings in his display window and continues with the handbag maker who has moved his workshop from the back room into the showroom. The skateboard designer in the city center is also a person you can talk to. And you're allowed to touch his products.

At best, fine craftsmanship in the city means human interaction. And that's what makes it so attractive. New York has realized this and is promoting its craftspeople with the label “Made in NYC” (www.madeinnyc.org). There are about 6,000 of these workshops in the city, employing 75,000 people. Some of them, such as producers of liqueurs or gluten-free ice cream, are riding trends,

while others produce cables, wooden furniture or transport boxes using traditional methods. Because space is scarce in New York City, companies like to set up shop in high-rises, where it's easy to expand. “Companies can rent a floor or several floors, or limit themselves to part of a floor,” says the architecture expert Nina Rappaport. If necessary, everything can be changed. In the Garment District in mid-Manhattan, this vertically arranged work environment has been normal for decades.

It's especially attractive for companies in the B2B segment, such as suppliers, because if you operate on the third floor of a vertical factory you remain invisible to the public. Companies that want to be seen have to move down to street level. People want to see how entertaining craftsmanship can be.



When things get crowded, as they do in New York, factories rise up into the sky. It's not an option for everyone

And What Is Evonik Doing? Being a Good Neighbor

What can you do if the city crowds in on your plant? Evonik has a few tips.

For example, Wesseling: Be accessible

In January the plant opened a citizens' office in the city's pedestrian zone. People who have questions, need information, or have a complaint can stop by here. "It's normal for neighbors to chat across the fence," says the plant director, Gerd Wolter. "By setting up this meeting point we've given people more opportunities to stop and talk to us."

For example, Worms: Show commitment

Evonik considers it natural to get involved with all the places where it operates. In Worms, for example, it supports projects at kindergartens and schools that could not be financed otherwise. Evonik is a training partner of schools in Worms and grants scholarships to

students at the University of Applied Sciences Worms. The plant has close contacts with the city's fire department, and Evonik is a sponsor of the local Nibelungen cultural festival.

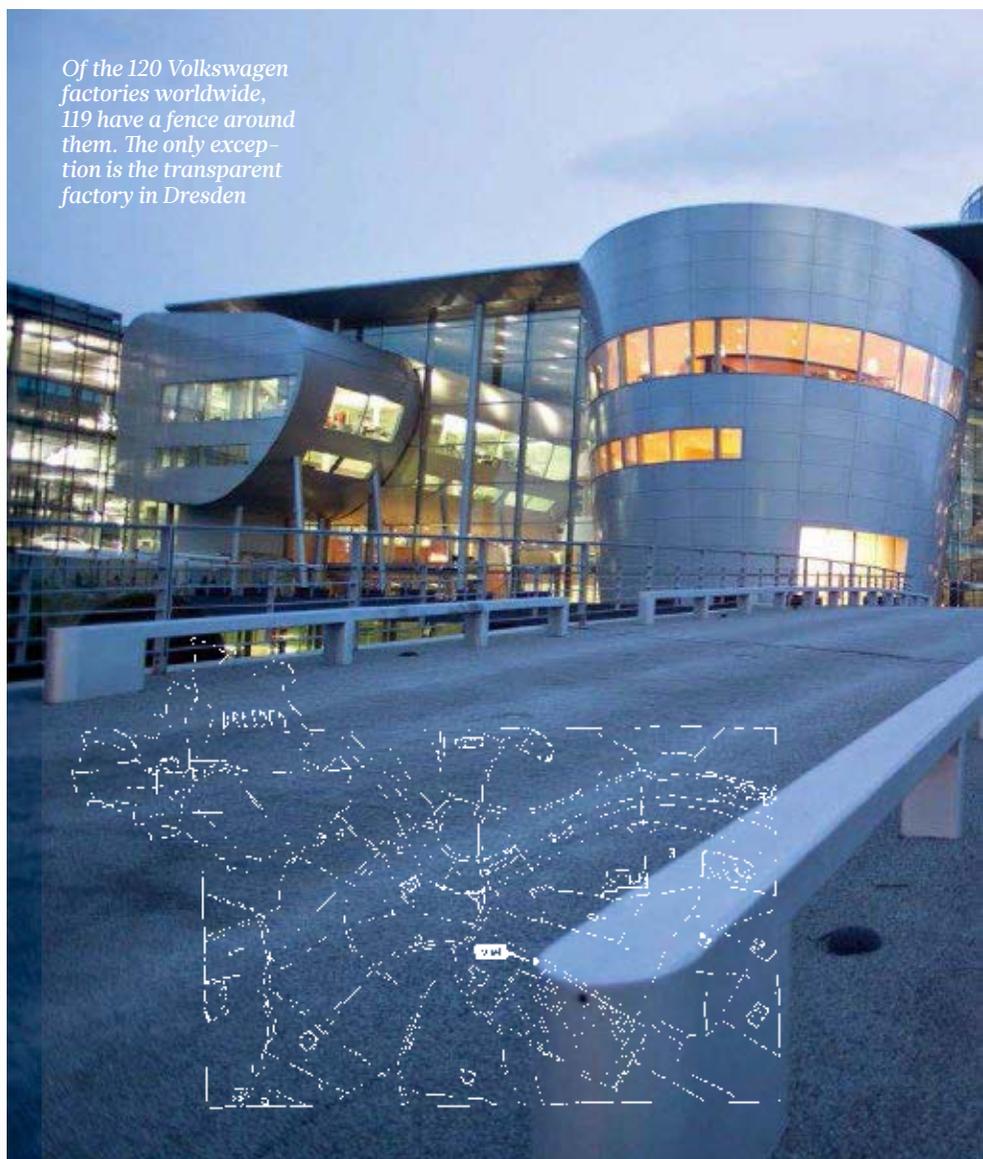
For example, Rheinfelden: Find new perspectives

Companies, government agencies, trade unions, politicians, and citizens have been working together since 2013 in the initiative "The Chemical Industry on the Upper Rhine" to find new perspectives for the region. The initiative aims to safeguard the chemical industry's central position and favorable public image in this region. To this end, it conducts an open dialogue with citizens, political decision-makers, and agencies.

→ of urban theory. The logistics are a bit more difficult. Goods have to be delivered and picked up. That results in lots of traffic and irritation for the neighbors. The Killepitsch brewer Peter Busch in Düsseldorf kept that in mind when building his new factory. "Our site here in the harbor is ideal," he says. "It's close to the city center but not right in the midst of it." That avoids the problems that used to be caused by delivery vehicles. Today, bigger trucks wait on a little-used access road, "sometimes even for several minutes, without disturbing traffic," Busch says.

The transparent liqueur factory also solves a further problem that plagues entrepreneurs who move their plants into cities: space. In cities such as Hong Kong, New York, and Singapore, factories have been shooting up into the sky for decades now. Peter Busch copied this idea: His factory is six stories high.

As a result, some of the ceilings have to bear a weight of 40,000 kilograms per square meter. The building's statics can bear three times that weight, and the floor slabs are up to two and a half meters thick. The ceilings store heat and cold, "so we don't need to heat the building in the winter or cool it in the summer," says Busch. That saves energy costs. "And we've reduced our emissions almost to zero," he adds. The alcohol that is brewed here can't be smelled, either inside or outside. This transparent factory was intentionally created as a "showcase for



Of the 120 Volkswagen factories worldwide, 119 have a fence around them. The only exception is the transparent factory in Dresden

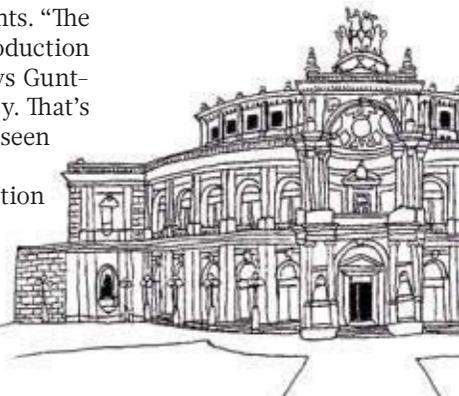
Killepitsch," says Busch. That's because he understands that in the midst of a city's hustle and bustle a factory can and should be presented as a place where unusual things happen.

There's hardly any other place where production and attractions are as closely interwoven as at the "transparent factory" in Dresden. This is where Volkswagen is investigating just how much production activity is possible inside a city. Only a few hundred meters away from the baroque city center, the automaker built a transparent cube on the edge of the Great Garden. The building, which is covered in glass on every side, doesn't look at all massive. A front building several stories high serves as a warehouse for the car bodies of VW Phaetons and Bentley Flying Spurs. In the evening, passersby can see what happens inside: Step by step, the car bodies are built into entire cars with all the necessary components. "The production levels are stages on which the production process takes place as a permanent show," says Gunter Henn, the architect of the transparent factory. That's why an unusual amount of manual labor can be seen here. That costs money.

However, Volkswagen admits that production efficiency was not a top priority here. "The transparent factory is to a large extent a marketing tool," says Carsten Krebs, the factory's press officer, as he leads visitors through the

"Whatever is open to public view has to be interesting"

Gunter Henn
architect of the transparent factory in Dresden





Michael Prellberg is also a producer, especially of texts and magazines. Unfortunately, watching him work is not all that exciting

Photography: Ralf Kreuels / laif, HENN Illustration: Hanka Lux, C3 Visual Lab

halls. The car bodies, which are already painted, come from Zwickau. Everything else is delivered by streetcar. All processes that are noisy or smelly are avoided. And the German name of the plant is “Manufaktur” or manufactory, to signify that picturesque manual production is done here. However, today’s industry operates differently. It relies on machines and robots.

There are only four robots in the Dresden plant, and they work fairly discreetly, because production is staged here as painstaking craftsmanship. The handover of a finished car is celebrated as an event, often combined with an overnight stay at the Kempinski Hotel and an evening at the Semper Opera. Phaetons and Bentleys will be assembled here until the spring, but starting in 2017 the facility will probably manufacture the automaker’s other premium-class models. Visitors who want to see the assembly process inside the building can take a tour through the halls. About 140,000 visitors took this opportunity last year alone. “There are 120 Volkswagen factories all over the world, and 119 of them have a fence around them,” says Carsten Krebs.

The Dresden plant, of course, does not. On the contrary, last year 181 events—concerts, galas, and dance productions—brought visitors inside the factory. The architect Gunter Henn explains that the integration of the factory into public life was planned from the very beginning: “As a citizen, I’d like to be open to the city in order to be a good neighbor.”

Production becomes entertainment

Being a good neighbor begins with making one’s work visible. “Being visible promotes communication,” says Henn. But this work has to create products. There are already enough office buildings with transparent facades that reveal people staring at their computers. What they are doing remains abstract. Production processes create something we can see. And it is very tempting to look in on these processes.

Thus the renaissance of the factory is always a renaissance of production as well. This is obvious to Volkswagen, Killepitsch, and many small businesses that are rooted in their respective cities. In their display windows they present not their products but their production. Here, people are working. Spectators can see rings being polished, ties being cut to the right length, and longboards being glued. Glimpses into the workshop are not just permitted—they are welcomed. And everyone comes to see.

This openness is more important than any issues of noise or logistics. “Whatever is open to public view has to be interesting,” says Henn. If it isn’t, nobody will look.



Facts + Figures



Augmented Reality, Reality Plus

Corporations are the main purchasers of data goggles

Because the world is not enough, a little extra cannot hurt. Goggles that augment reality with additional data are now available on the market. Businesses are very interested in such systems, because data goggles enable warehouse workers, for example, to just glance at a pallet in order to know its contents, its source, and its destination. This information is directly transmitted to the goggles, where it is displayed.

This technology also works with laptops, as Jürgen Lumera has shown. Lumera, Director Innovation Automotive at Bosch, recently

stood in front of a Ford Focus with his computer. The laptop's camera recognized the car because the software obtained all of the requisite information from the car's onboard computer. Like in an X-ray image, a defective sensor appears on the screen at precisely the same location as in a real-life automobile. A single click is all it takes to have the spare part prepared in the warehouse.

Boeing supplies employees with goggles that show them which part has to be installed in which order in the solar panels of a satellite. When

the worker looks at the panel, the part highlights the area where it belongs. As a result, mistakes are now much less frequent and the pace of assembly has increased.

German researchers are now working on systems that will make goggles and laptops superfluous. Their idea is to project information directly onto the workstation as 3D holograms. Such holograms will soon accompany assembly workers, for example, when they move from one workstation to the next.

IN FIGURES



2.85 percent of Germany's GDP is spent on research and development (R&D)—a figure far above the OECD average

Source: OECD

57.2

billion euros are invested in R&D by Germany's industrial companies alone. This expenditure has increased by 22 percent since 2010.

Source: DIW

371,000

jobs in the German economy are devoted solely to R&D. The figure was only 250,000 in 1983.

Source: Stifterverband für die deutsche Wissenschaft

FILTERS

The Air Is Cleaner

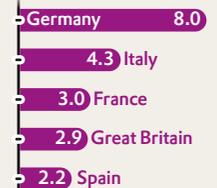
Nobody has to hold their nose nowadays if they live near a power plant. That's thanks to the trilobal fibers used to make the filter bags that keep fine particulate emissions in the air down to an absolute minimum. The fibers, which are made from Evonik Industries' high-performance polymers, show off their capabilities

wherever filters have to function reliably at temperatures of more than 180°C—e.g. in coal-fired power plants and cement factories. "They are all high-performance filters," says Axel Kobus, Head of the Fibres, Membranes & Specialties Product Line. These high-performance filters are so effective at removing



The vital thing is that nothing is emitted in the end

dust from gases, for example, that they can easily meet the increasingly stringent legislative standards for particulate emissions. "This is especially important near large cities," says Kobus.



8.0 million people earn their livelihood in Germany's industrial sector—the same number as ten years earlier. However, this figure has dropped in other EU countries.

Source: Eurostat

3 QUESTIONS FOR

Henrik Hahn
"We want added value for our customers"**1 You and your team are developing a digitization strategy for Evonik. Why is such a strategy needed?**

The intelligent analysis and use of data are transforming value chains and innovation processes. New business models are being created, as are new products with digital service components. It's crucial that Evonik adapt itself to this development early on. We think we have a good chance of improving our competitiveness and of setting ourselves apart from other companies.

2 How will you exploit these opportunities?

To begin with, we have to look around and see which of the many different facets of digitization are in any way relevant for Evonik. From this, we can then draw up a digital agenda with specific options of what Evonik can do. Take, for example, new technologies and new business

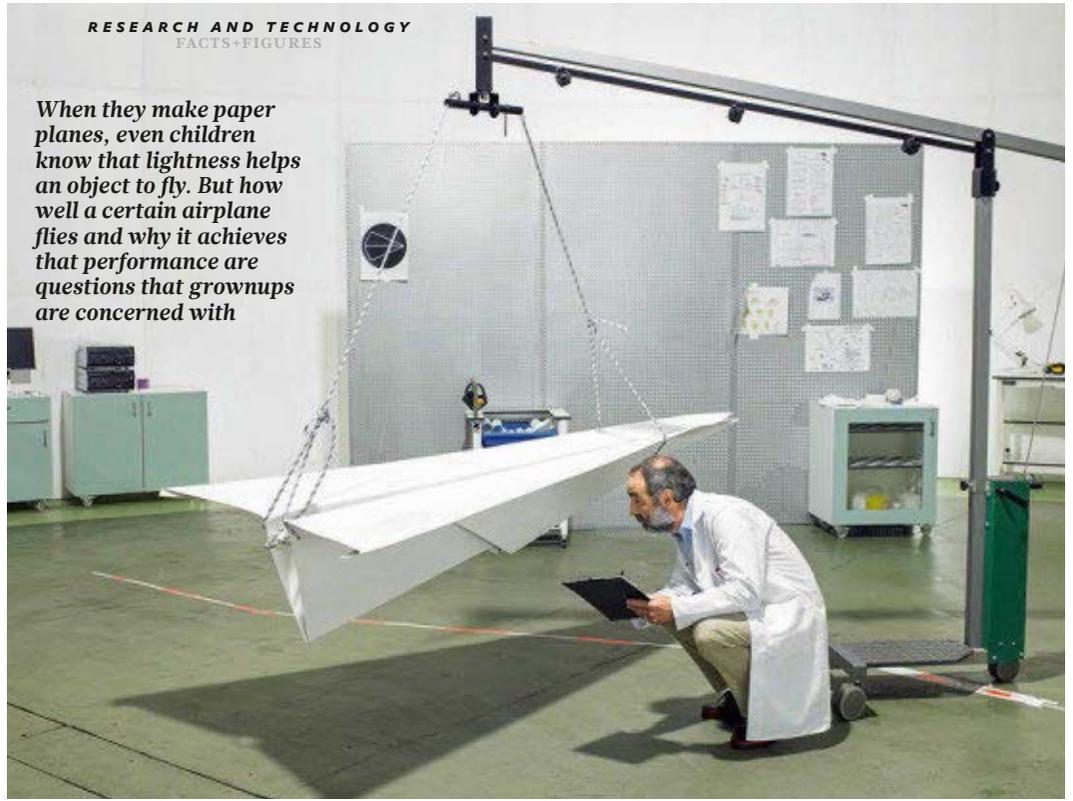
models as well as future customer requirements, new connectivity models, and cooperation options.

3 How will customers benefit from digitization?

Ideally, it will provide them with added value—and that's precisely what we're aiming for. We see ourselves as "problem solvers." Customers want better products, simpler processes, and faster service. There's a lot of unused potential here already, and we want to work together with our customers to exploit it.

Henrik Hahn heads the Digitization Strategy team at Evonik Industries

When they make paper planes, even children know that lightness helps an object to fly. But how well a certain airplane flies and why it achieves that performance are questions that grownups are concerned with



LIGHTLY DOES IT

Too much weight makes us sluggish and slow. Those who lose weight conserve resources, save energy, and can achieve more. It's therefore no surprise that companies the world over are also studying lightweight materials.

Featherweights are rare in the auto sector. Today's VW Golf weighs over 1.2 tons, 50 percent more than the Golf II of 1983. That's because the many extras of recent decades take their toll. Getting such a heavy-weight rolling takes more fuel and harms the environment, because carbon dioxide emissions rise as fuel consumption increases.

Legislators are demanding a limit of no more than 95 grams of carbon dioxide per kilometer. Although this won't go into effect until 2030, automakers have their work cut out, because most vehicles emit much more. The key to reaching this goal is to make cars lighter.

The diet of choice is called carbon. It weighs half as much as steel, is equally strong, is crash-resistant and doesn't rust. It even weighs 30 percent less than aluminum. For this reason, automakers

have been researching carbon fiber-reinforced polymers (CFRP) for years now, though this work was largely done on the side. They also follow and copy developments in the aircraft industry.

The fuselage of the Boeing Dreamliner is made of CFRP, and the Airbus A 350 XWB also has wings of this material. In the Airbus 380, copper cables are replaced by aluminum ones, saving 300 kg. In semiconductor brackets, titanium is increasingly replacing aluminum, leading to a 30 percent reduction in weight.

What about auto-makers? The BMW i3 has a series-produced carbon passenger compartment. However, this component is way too expensive. BMW therefore plans to cut carbon costs by 90 percent in the long term.

Lightweight design is conquering other sectors. In wind turbines, carbon fibers often replace glass fibers, cutting weight by 20 percent. The new Center for Lightweight Textile Engineering in Chemnitz, Germany, will also study carbon fibers.

Metal is indispensable in cars, but researchers from the Fraunhofer Institute for Chemical Technology have managed to all but dispense with it, even for the engine. Their plastic engine is based on fiber-reinforced polymers, and lightweight metal is only used where pressures and temperatures are especially high. This reduces weight by about 25 percent.

90

percent of the decision-makers in business and politics consider data security one of industry's future challenges. According to an Allensbach poll, 70 percent of the people surveyed are concerned about the misuse of data

THE INTERNET OF COWS

How will the digital revolution affect desserts? The creation of a sour cherry-nut yogurt in 12 easy steps with the help of "Industry 4.0."

→ Although the desserts of the future will taste the same as before, they will be produced in a completely different way, thanks to state-of-the-art digital technology. Manufacturers are still far from exploiting all the options. The possibilities of the future are presented here on the basis of an imaginary sour cherry-nut yogurt, which is produced in the nonexistent Dairyjoy dairy with milk from the fictitious Farmer Huber.

1. Sensors report ideal grass for grazing

It's summer and Farmer Huber's cows are out grazing in a pasture. Following recent rains, the grass is now especially lush. Sensors and minicams on fences and in the ground have registered perfect fodder processing values on the basis of the humidity, the rainfall, and the intensity of the sun. These values are transmitted via satellite to the farmer's central data recording system, which, in turn, is synchronized with the computer at the Dairyjoy dairy company.

2. Comparison of data at the dairy

The Dairyjoy computer compares the incoming data with the dairy's operating requirements, which are updated and adjusted on an hourly basis. While scanner cash registers report on the items that are sold in supermarkets, the computer also takes online orders into account. In this way, the system determines the actual demand for milk at the dairy company so that buyers can obtain products that are as fresh as possible. The precise production times are clearly printed on every cup of yogurt.

3. Every cup has its own specific carbon footprint

The dairy company's computer remembers the paths that the milk took before it was turned into yogurt. The precise carbon footprint of every individual cup of yogurt on the supermarket shelves is indicated because the total amount of carbon dioxide emitted during yogurt production can vary widely, depending on the transport distances to the various pastures.

The ABC of the Future

You may have heard of some of these concepts. Although you might know what they refer to, it's even better to actually understand them

Affective Computing

The recognition and depiction of emotions by computers that analyze and interpret nonverbal messages conveyed by facial expressions, pitch, and body language. Such messages make communication more intuitively understandable to people.

In practice: SimSensei, a virtual psychotherapist at the University of Southern California, diagnoses patients on the basis of their body language.

Outlook: Computers and robots will soon recognize us on the basis of our emotions. But will we ever understand ourselves? Probably not.

Trend score: ★★★☆☆

Artificial Intelligence

Artificial intelligence is a specialized field of computer science that aims to develop intelligent computers and machines.

In practice: At Audi in Ingolstadt, intelligent robots work hand in hand with people. After independently determining whether an employee has finished a particular work step, these robots give the worker the next component or tool.

Outlook: People sometimes behave irrationally. Computers don't. So are computers better workers?

Trend score: ★★★☆☆

Augmented Reality

A technology that projects digital objects and information about the physical world onto the lenses of data goggles. Google, Apple, Samsung, and Facebook are all working on such systems.

In practice: The US company General

Electric is developing an augmented reality app for data goggles to make work easier for mechanics. The app will project instructions into a mechanic's field of vision so that he has his hands free to do the work.

Outlook: It is already being used for tours of cities, cultural sites, and museums. In addition to thrilling fans of video games, AR is also fantastic for neurologists because it provides them with a new field of study: AR dizziness.

Trend score: ★★★☆☆

Autonomous Systems

Unmanned cars, drones or robots that can move around on their own.

In practice: The Hexo+ mini-drone is equipped with a video camera so that it can follow users independently like a personal cameraman.

Outlook: In 20 years at the latest, every household will have a drone as basic equipment.

Trend score: ★★★★★☆

Big Data

The evaluation of huge amounts of data in order to find patterns and interrelationships and to obtain new insights.

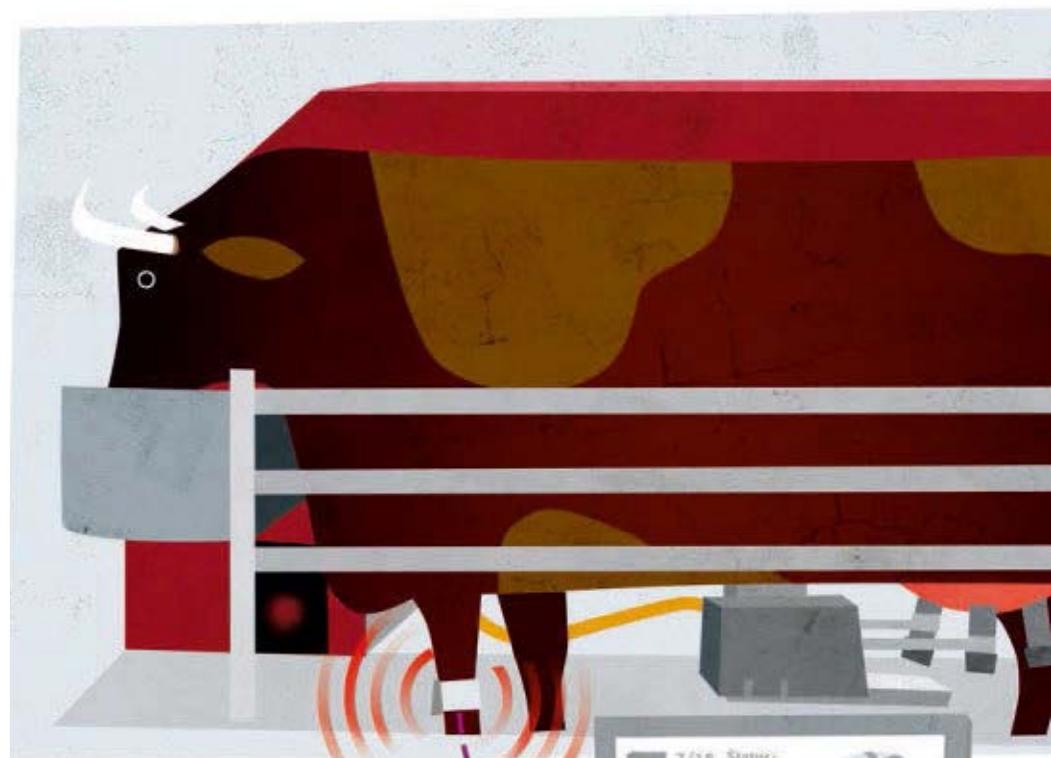
In practice: One of the top research topics at almost all industrial corporations. The aim is to create predictive algorithms that increase efficiency, safety, and even proximity to customers.

Outlook: It's a bit as if a soothsayer were miniaturized, pasted onto a printed circuit board, and stuck into a computer.

Trend score: ★★★★★☆

Context-Aware Systems

Computer systems that use sensors to perceive their surroundings and adapt their behavior accordingly.

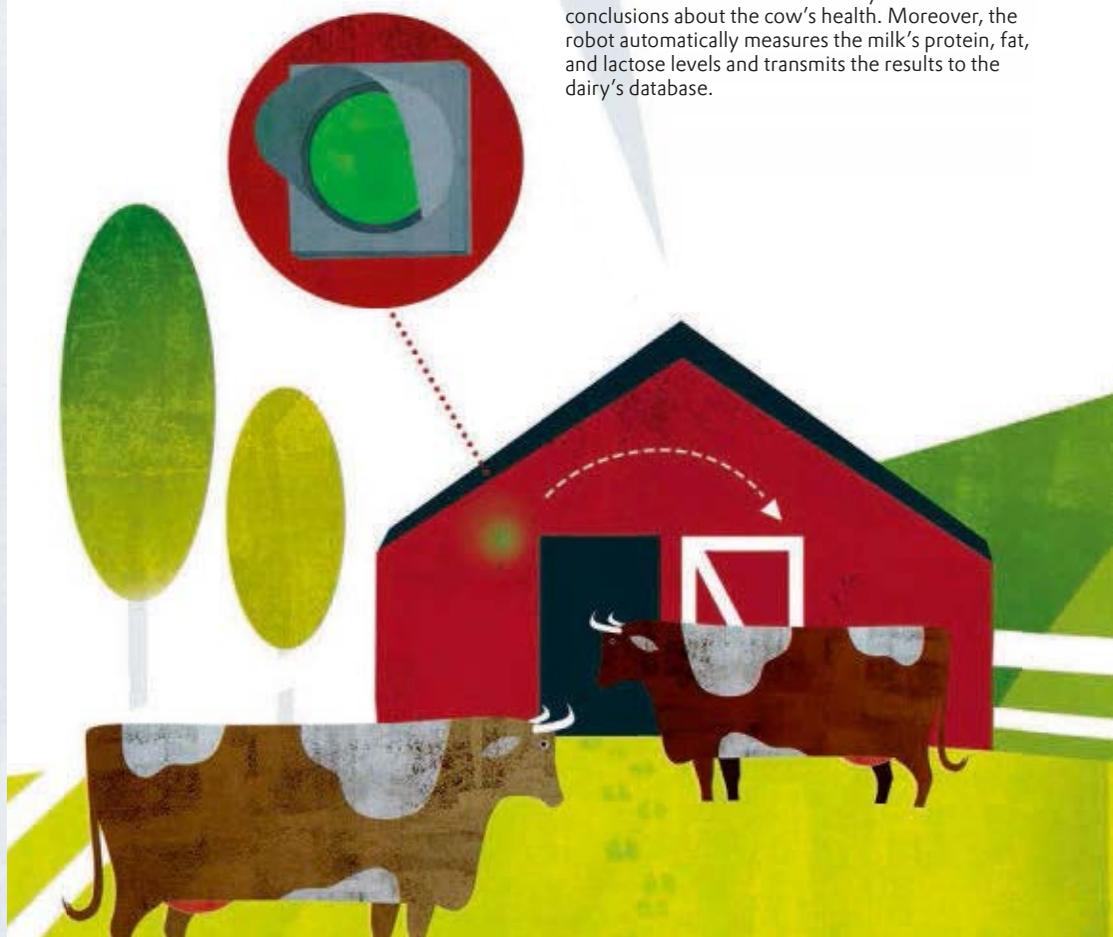


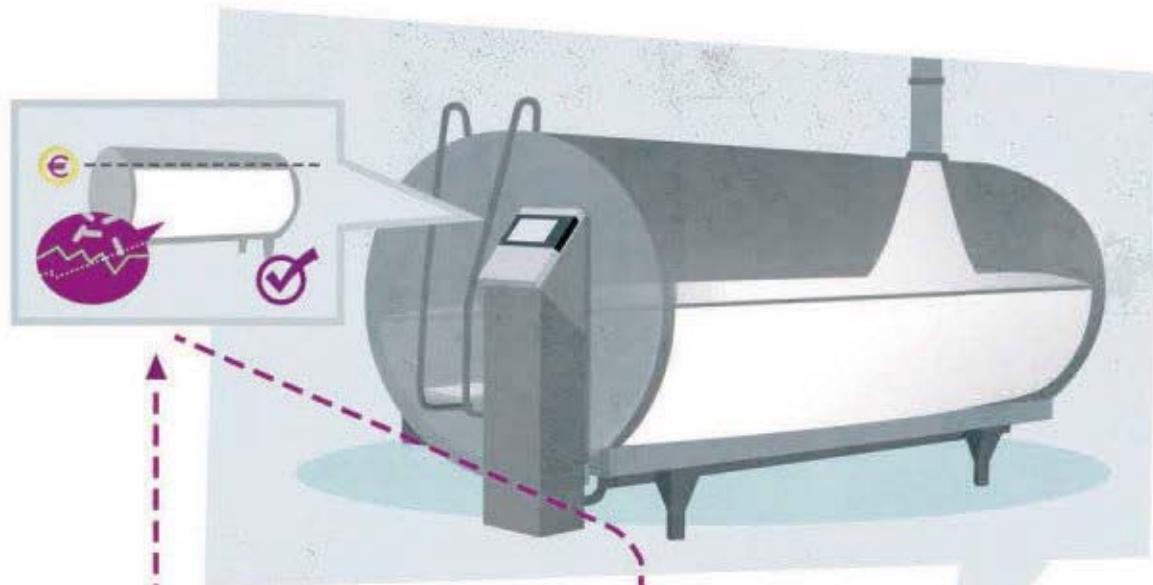
4. Milking robots get the milk flowing

Via the Internet, Farmer Huber's central control unit commands the decentrally installed milking robots to milk the cows until the prescribed amount of milk is obtained. The milking gates of the local milking parlors at the selected pastures open according to the set parameters.

5. Transponders check the quality

Every cow wears a transponder that communicates with the milking robot. The robot records the time the milk was obtained and measures its electrical conductivity in order to draw conclusions about the cow's health. Moreover, the robot automatically measures the milk's protein, fat, and lactose levels and transmits the results to the dairy's database.





6. Monitoring milk during transport

Milk in the required quantity and quality is transported in a tank truck to the dairy. The information concerning the distance traveled, the time it took, and the temperature of the milk during the entire trip is transmitted to the database.

7. Automatically checked and paid for

At the dairy, the milk from Huber's cows flows into a tank, where the most important lab values are immediately measured. The data concerning the time of arrival and the registered amount of milk initiates payment for the delivery, and the money is immediately transferred to Huber's account. The comprehensive recording of all data along the entire value chain enables the dairy to precisely monitor the milk and the resulting yogurt before, during, and after production. Because everything occurs completely automatically, there is a greater risk of tampering or IT errors. That's why the dairy company and the farmer invest considerable sums in data protection.

Illustration: C3 Visual Lab





In practice: Google Now notifies its users about upcoming appointments and recommends appropriate routes and transportation systems.

Outlook: It was always an advantage to know where you were and whom you were dealing with before you made a suggestion. It's convenient that software can do that now as well.

Trend score: ★★★☆☆

Mass Customization

An industrial manufacturing technique that responds flexibly to customer wishes.

In practice: Customers of Adidas, Nike, and Puma can configure their own shoe designs from a variety of predefined options.

Outlook: All of us are somewhat creative, but do we all want to be designers?

Trend score: ★★★☆☆

OmniChannel

The merger of all sales channels into one. Traditional channels such as catalogues, branch stores, and posters are expanded to include e-commerce functions.

In practice: The British clothing chain Marks & Spencer has installed digital shopping walls in its branch stores. Customers can directly buy the clothing that is depicted on these walls in its real dimensions.

Outlook: We will have to get used to even more "Buy now" buttons.

Trend score: ★★★★★

Predictive Analytics

Large amounts of data (big data) are used to determine the likelihood that certain events will occur.

In practice: The US retail chain Target determined from a teenager's behavior that she was pregnant and sent her ads for baby items before her parents even knew about the pregnancy.

Outlook: We will get even more advertis-

ing for the things we already buy anyway.

Trend score: ★★★★★

Proximity Marketing

People receive information on their mobile devices as soon as they linger at a particular location.

In practice: The US retail chain Macy's has iBeacons in its stores that detect customers' cell phones. For example, if somebody stands in front of a shelf full of blenders, a video of the various blender models will appear on the person's cell phone display.

Outlook: More spam. However, it will now be more personalized and feature animated images and sound. And it will appear directly on your cell phone!

Trend score: ★★☆☆☆

Quantified Self

The measurement and recording of our physiological data (pulse, food intake, exercise) so that we can optimize them.

In practice: The Swedish company Acreo has developed an extremely thin microchip that is stuck onto the skin to measure parameters such as the wearer's body temperature, skin moisture, and pulse, and transfer them to an app.

Outlook: Do you already look at your wrist if somebody asks you how you're feeling?

Trend score: ★★☆☆☆

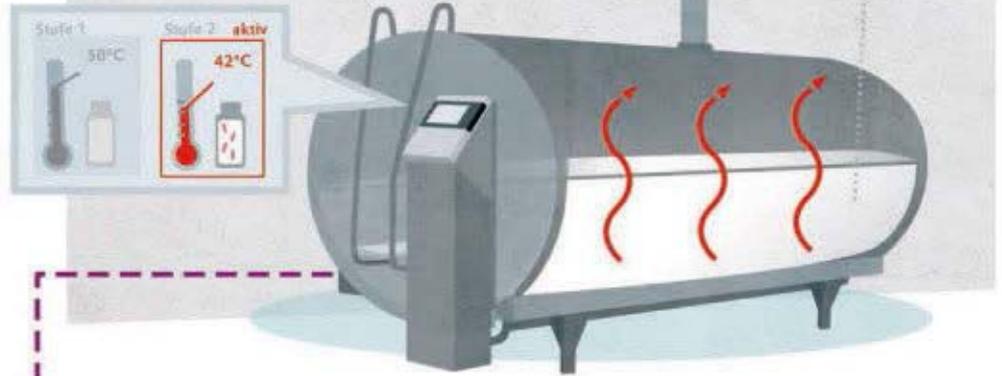
Sharing Economy

An economic model in which people share certain products or services—either for money or free of charge.

In practice: At Neighborgoods, neighbors can register objects (e.g. ladders, bicycles, power drills) that are then shared. Doing so can lead to friendships and promote a sense of community. Commercial examples include Uber and Airbnb.

8. Killing microbes, producing yogurt

The milk is heated in a special tank in order to kill microbes. The temperature is then lowered to a level that is only slightly above normal so that carefully selected lactic acid bacteria can cause the milk to ferment in the hours that follow and eventually turn it into yogurt of the predefined firmness.

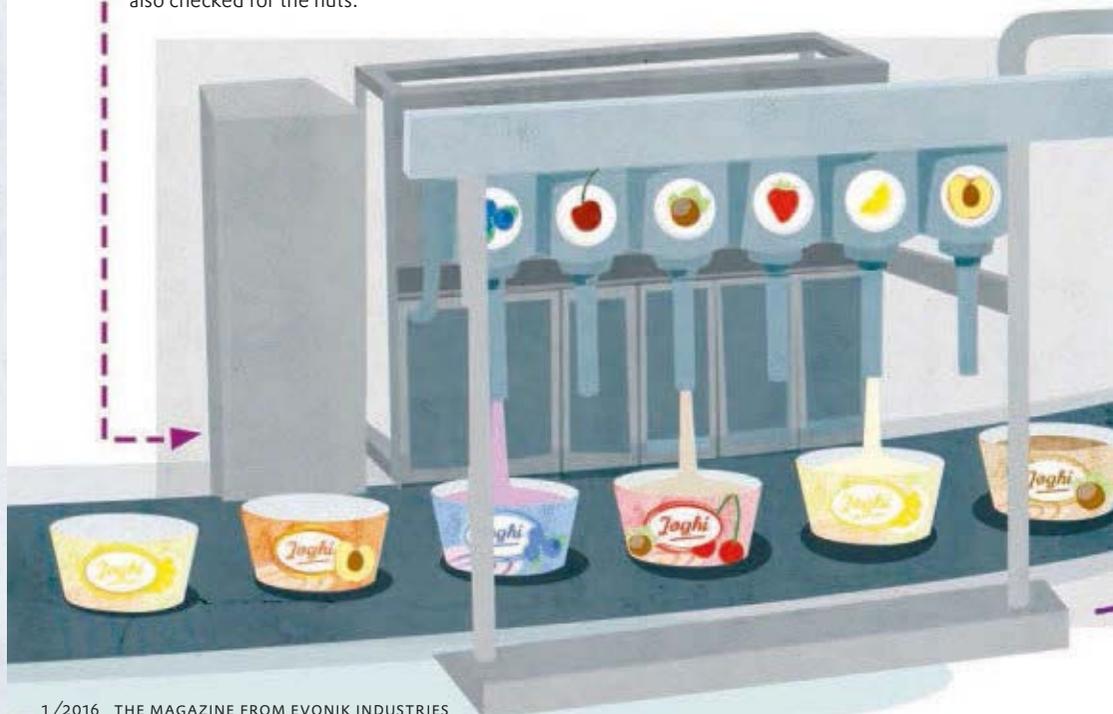


9. Individual blends

The classic yogurt flavor "sour cherry-nut" is also available in a personalized variant. Although 75 percent of buyers purchase the regular ratio of sour cherries to nuts, the others prefer different proportions. This is no problem for the computer, which determines the desired fruit-to-nut ratio for every yogurt cup and then allocates the cups to their respective purchasers during the packing process so that the yogurt is sent to the correct address. Prior to every step, the computer also determines if the selected ingredients meet the buyer's standards. Among other things, it checks the source countries and orchards of the cherries, the number of hours of sunshine the fruit received before it was harvested, and the carbon footprint it generated. The same information is also checked for the nuts.

10. Personalized labels

The corresponding machine is commanded to pour the precise amount of cherry and nut elements into the recently finished yogurt cup, which has automatically been given a personalized label. In the production hall of the Dairyjoy dairy, workers manufacture dozens of different yogurt flavors, but the central computer makes sure that only the now cooled-off milk from Farmer Huber is poured into the sour cherry-nut cups.



12. Delivery by self-driving trucks

Smart conveyor belts move the large packages into self-driving electric trucks, which drive independently along their routes at all times of the day and night. After they have arrived at their destinations, the trucks autonomously dock on to the unloading stations in order to bring the desired sour cherry-nut yogurt to the customer as quickly as possible. Thanks to the central data recording system, Farmer Huber and the Dairyjoy dairy know at all times where every single yogurt cup is located and thus always have an overview of the processes.

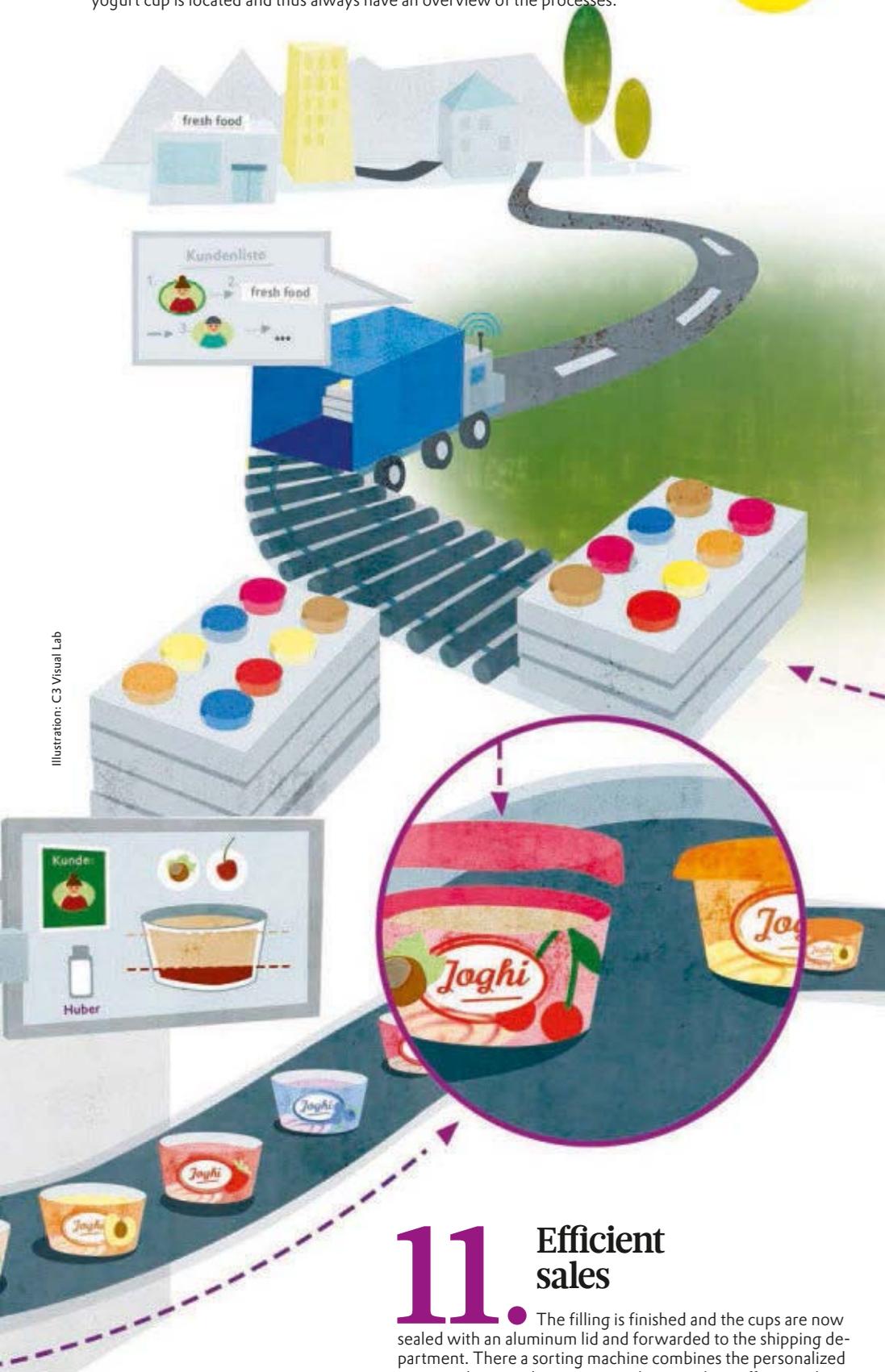


Illustration: C3 Visual Lab

11. Efficient sales

The filling is finished and the cups are now sealed with an aluminum lid and forwarded to the shipping department. There a sorting machine combines the personalized cups into large packages in accordance with an efficient sales plan that was meticulously drawn up by the computer.



Outlook: Maybe we'll soon arrange our coffee dates in the same way?

Trend score: ★★★★★

Smart Home

The use and networking of digitally controllable devices in the home. The integration of sensors and controllers for temperature, lighting, consumer electronics, and other systems.

In practice: Smart refrigerators contain sensors that notice if the milk has run out and independently order a new carton.

Outlook: It might be somewhat superfluous, but it's certainly high-tech. An absolute must!

Trend score: ★★★★★

Social Innovation

A business philosophy that puts higher priority on improving social conditions such as health, employment, education, and social justice.

In practice: At GoFundMe.com, people who have fallen on hard times can call for donations. For example, GoFundMe helped prevent a retiree in the USA from being evicted from his home after he was no longer able to pay the mortgage because he was caring for his wife, who suffered from Alzheimer's.

Outlook: Nobody can object to that, can they?

Trend score: ★★★★★



Max Celko is a trend consultant, innovation strategist, and author who lives in Zurich and New York. He scouts out new trends in technology, design, and society at large, and uses them as a basis for developing innovative concepts, digital products, and user experiences.

Social Robots

Robots developed to interact with humans. Most have voice computing and affective computing systems.

In practice: The Japanese telecommunications company SoftBank wants to set up a cell phone shop in Tokyo, where customers will be served by robots. The use of such robots is already being tested in nursing homes.

Outlook: Note: It won't be the robots' fault if grownup children rarely get in touch with their parents. However, people will still claim that this is the case.

Trend score: ★★☆☆☆

Wearable Tech

Tiny computer systems (e.g. wristbands, watches, glasses) that are worn directly next to the skin or incorporated into clothing.

In practice: The US sports clothing company Under Armour Inc. sells a "HealthBox" consisting of a digital wristband, a chest strap, and sensor-equipped shoes. The wearer's vital signs are measured and analyzed by an app.

Outlook: The tiny systems on the wearer's skin are only an intermediate step to the introduction of subcutaneous technology.

Trend score: ★★★★★



Stephan Sigrist is the founder and director of the think tank W.I.R.E. and has been analyzing social and economic developments for many years. The main areas he focuses on are the life sciences, digitization, urbanization, and new forms of production.

W.I.R.E. is an interdisciplinary think tank that is based in Zurich. W.I.R.E. examines global economic developments, the life sciences, and society at large. It focuses on the critical assessment of well-established viewpoints and on the development of ideas, strategic concepts, and innovative products.

CERAMIDES

Smooth skin lets us feel—and look—youthful and agile. Ceramides from Evonik Industries have an anti-aging effect that brings us a step closer to achieving this goal. That's because ceramides lastingly protect the skin against damaging external effects and keep it smooth and elastic.



Skin has to retain moisture if it is to remain youthful and elastic. Ceramides help in this regard, and when combined with other substances from the skin, they create a water-repellent and lipid (fatty) structure. They act as a barrier in the outermost layer of skin, where they provide protection against external influences and help balance moisture levels. As a person ages, the amount

of ceramides—which belong to the class of sphingolipids—in his or her skin decreases. Certain illnesses and harmful external influences have a similar effect.

However, this decline can be resisted. When applied in a cream, ceramides can repair the skin structures from the outside. They also contribute to the skin's regeneration and protection so that it stays youthful longer.

Areas of application

Sagging skin: SPINGOKINE NP is a short-chain ceramide that promotes communication between cells, thus making skin smoother

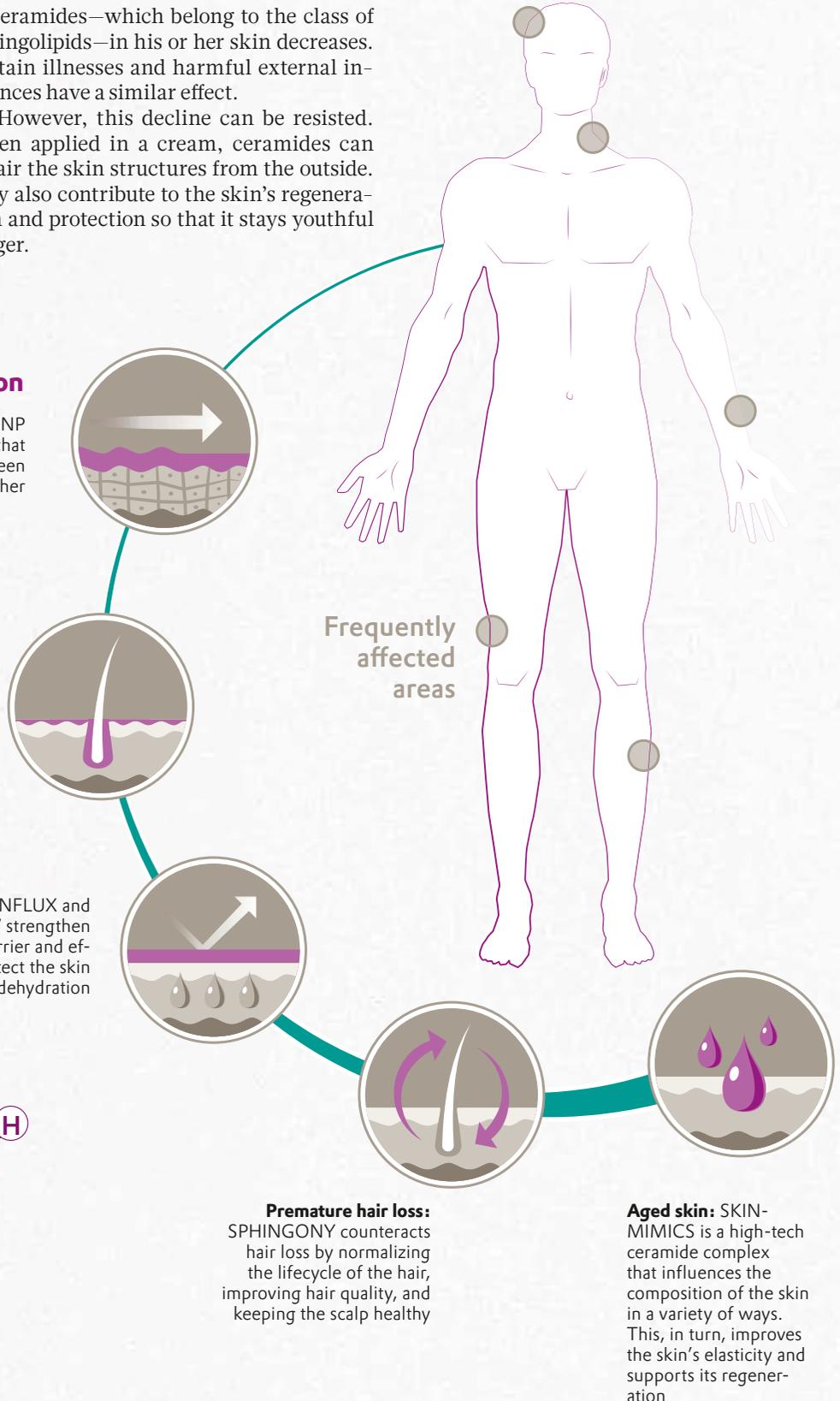
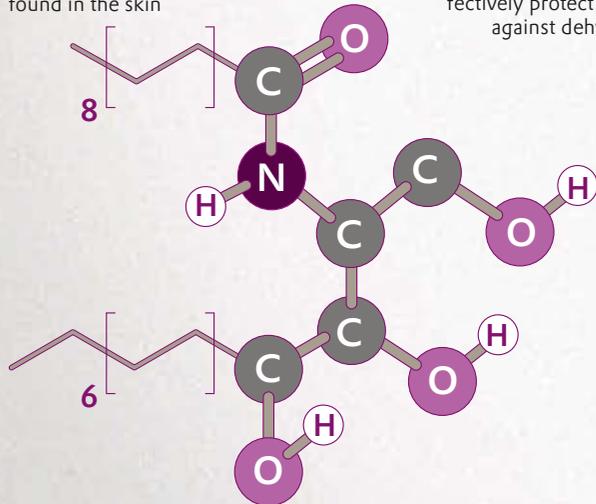
Photoaged skin: Phytosphingosine SLC mitigates light-induced skin damage and reduces the size of the skin's pores

Dry skin: SK-INFLUX and SK-INFLUX V strengthen the skin barrier and effectively protect the skin against dehydration

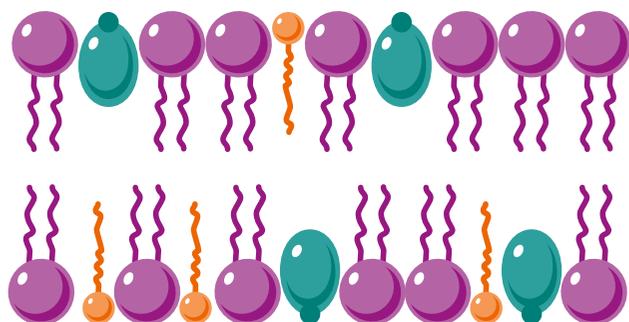
Frequently affected areas

Structure

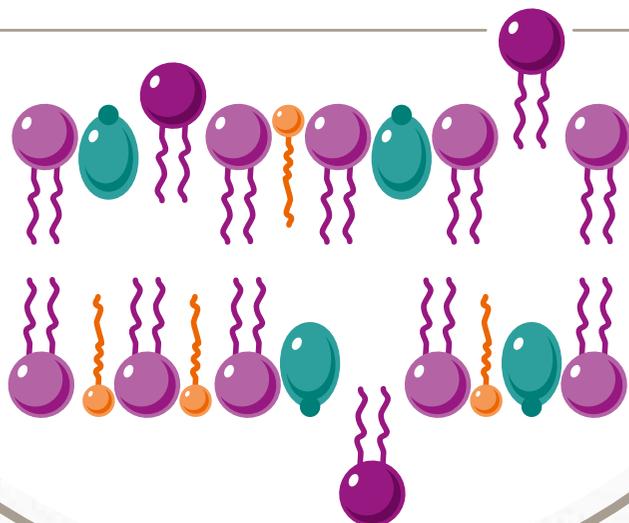
Phytosphingosine, a sphingoid base that is extracted from a yeast, provides the basis for making ceramides. When this structure is combined with fatty acids, it creates lipids (such as ceramide III shown here) identical to those found in the skin



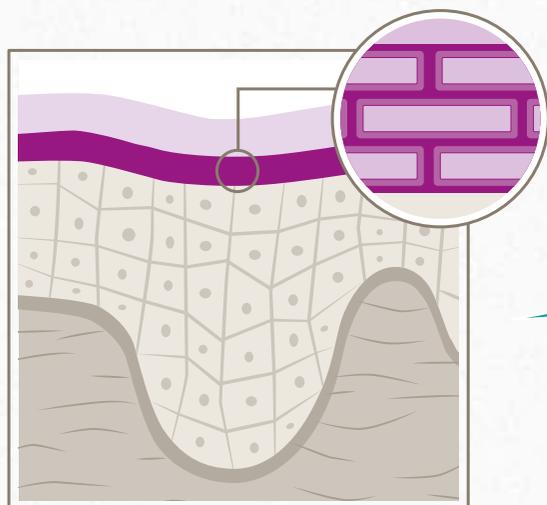
Ceramides,
free fatty acids,
cholesterol



Normal skin barrier structure



Damaged skin barrier structure



Layered protection

The skin is our largest organ. It has a complex structure composed of several layers that protect us against external influences and prevent our bodies from drying out. The topmost layer, the stratum corneum, consists of dead skin cells. Between these cells is a layer of fat that gives skin its water-repellent properties. This layer consists mainly of free fatty acids, cholesterol, and ceramides



You can find additional milestones of chemistry at: geschichte.evonik.de/sites/geschichte/en/inventions

SPHINGOLIPIDS

The Decoded Sphinx



You can give your dessert a touch of vanilla-like taste by sprinkling it with ground tonka seeds. However, if you examine the surface of the **tonka bean**, you will discover a species of yeast known as *Wickerhamomyces ciferrii*. Beginning in 1994, the Dutch company Cosmoferm and, later, Evonik, have used this yeast to produce phytosphingosine from renewable raw materials in bioreactors. Phytosphingosine is an important precursor molecule for ceramide production. The combination of phytosphingosine with a variety of fatty acids creates a range of different ceramides that have diverse properties and are identical to those found in skin.

History

- 1874** The German physician and founder of neurochemistry, Johann Ludwig Thudichum, discovers a new kind of lipid in nerve tissue. Because their function is a mystery to him, he calls them sphingolipids after the legendary Sphinx
- 1932** Discovery of the yeast *Wickerhamomyces ciferrii* on the seeds ("beans") of the tonka tree in the Caribbean. It turns out that this yeast produces substantial quantities of the sphingoid base phytosphingosine, one of the key components of ceramides
- 1994** The Dutch company Cosmoferm develops a fermentation process for the production of phytosphingosine. This makes possible the biological production of ceramides identical to those found in skin
- 1999** Goldschmidt AG (today a part of Evonik Industries) acquires Cosmoferm and expands it as a technology platform
- 2002** The introduction of Phytosphingosine SLC, which repairs photoaged skin
- 2007** The multipurpose lipid concentrate SKINMIMICS is launched on the market
- 2012** The new skin-smoothing product SPHINGOKINE NP
- 2014** SPHINGONY is introduced to counter hair loss

A Special Thrill

The music industry is easing out of the market for recording media. We're living in the era of the download. So why has Jack White, who used to be the lead singer of the White Stripes, established a vinyl record label? It's because he's a step ahead of the music industry—he's turning away from mass-produced goods and betting on the specialty trade.

Mister White, why are you so fascinated by vinyl records?

I believe that vinyl records are part of a feel-good culture—something you can touch, look at, and listen to. Besides, putting an album or a single on the turntable and setting down the needle is a kind of ritual—a celebration of music that you listen to much more closely because you want to understand individual parts of the puzzle, which consists of the artwork as well as the sound and the message of the song. This is different from consuming a CD, which has miserable sound quality and doesn't even have a real cover. CDs are carelessly produced plastic things, and that's why I avoid them...

...and why you've established a label that produces vinyl records. What's the philosophy behind Third Man Records?

First of all, we wanted to produce songs on vinyl that had already been produced elsewhere as CDs. We initially wanted to produce records that would be available everywhere and to everyone. Soon after that, we added special editions that are only available to subscribers or at the concerts at our headquarters in Nashville. We start making the records right after the final chord sounds. That takes 20 minutes per album side, and it's more or less the antithesis of the mouseclick generation. These are records that give listeners a special thrill or remind them of a special moment.

What's the special thing about records in the Texas format?

These are records that are a bit bigger than normal. We developed them for a festival in Texas because people in Texas like to order super-sized steaks. We thought this format should also be available in vinyl—and in fact people really went for them.

Do you really expect such gimmicks to save the music industry?

Why not? We want to get back the old audiences and mobilize new ones—with good music and exciting presentations. When I see a young guy come into our store and

buy a record because it glows in the dark, I know that soon he's going to try out other things and fall in love with the music as well.

So the packaging makes people curious about the content?

I don't have any scruples in that regard. There are so many media you can turn to for entertainment. And music is competing with things like video games in which you dive into a virtual movie. If you want to compete with that, you have to be very creative.

Records are over 120 years old. What else can you tell us about them?

The great thing about records is that they actually offer lots of ways to develop something new. Whether it's the shape, consistency or color of the vinyl, Third Man has developed countless products that nobody has previously dared to create—for example, a single that is hidden in a maxi and an LP that smells like peaches. These things might make some people ask, "What's the point?" But I love these things because they appeal to my inner child—and because I know other people feel the same way.

Do you want to appeal to a mass audience at all?

We make records that we think people will be interested in—or because we think it's necessary and important to release them. It doesn't matter to us whether we sell 200 or 200,000 copies of them. We simply want these records to exist. We want them to appeal to music fans and collectors and to spark discussions between fans and music lovers. It's all about creating something that didn't exist before. I like that.

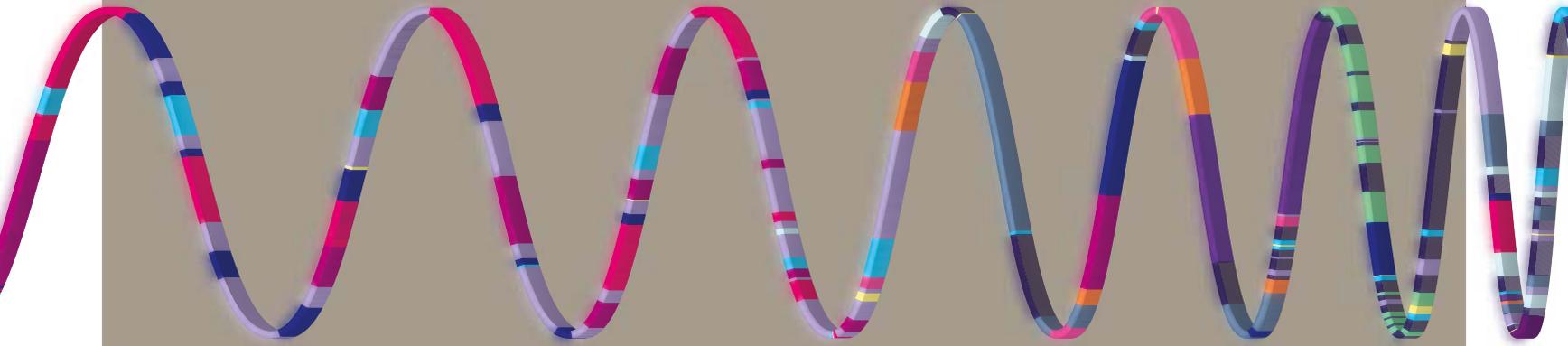
The song "Seven Nation Army," composed by Jack White, has become the stadium anthem of Italy's national soccer team, the Azzurri



Of course Jack White's record company also has a website: thirdmanrecords.com. Incidentally, the market for vinyl records grew by over 30 percent in Germany alone in 2015.

Edition Knowledge N°7

Everyone's talking. Mobile phones, cardiac pacemakers, Wi-Fi networks, electronic car keys, satellites, baby phones, the police, firefighters, and worried parents are all communicating wirelessly—and we don't want all of these messages to be scrambled. But as soon as the Internet of Things really gets going, radio frequencies could get crowded. The seventh poster of our Evonik Knowledge Edition explains the world of electromagnetic radio waves and shows who has reserved which spot in the ether and how the spots are distributed.



OF WAVES, BANDS, AND FREQUENCIES





“Today there is hardly any traditional industry that is not being confronted by the sudden emergence of a digital challenger”

Gabor Steingart, publisher of *Handelsblatt* (from page 14)