THINK ACT

COO INSIGHTS

BUSINESS MODELS 4.0

A new game for providers and consumers

THE CLOUD

Heaven-sent business

JAPAN

The robots are taking over

Industrie 4.0? Step this way!

Bernd Leukert, Product Chief at SAP, wants to network industries and services

Roland Berger

KEY QUESTION

Industrie 4.0 and beyond: Can Europe learn to love digitization?

DR. VOLKMAR DENNER
CEO, Robert Bosch GmbH

TRUSTING IN NETWORKS

The Internet of Things is bringing about a fundamental change in all aspects of life. In many areas this change is already clearly visible, such as in industrial production. Particularly in high-cost countries, networks offer significant opportunities for boosting efficiency in manufacturing, including through new business models. This can be especially effective if the networks cover the entire value chain without any gaps. For this reason, Bosch operates in conjunction with partners in Europe, Asia and the United States. For example, we work closely with the Industrial Internet Consortium. Our core objective is to establish consistent technical standards and so create a common language, making it possible to benefit from networks that stretch across national boundaries.

At Bosch we see ourselves as both key consumers and key providers of Industrie 4.0. We believe that this dual strategy will pay dividends: By 2020 networked production will have secured us forecast cost savings of EUR 1 billion and brought us an additional EUR 1 billion in sales. We are taking a three-step approach at Bosch: First, we are introducing applications in some of our 250 factories around the world. Second, we are optimizing value flows right up to our end customers. And third, we are managing global networks.

A key component of our networking strategy is our proprietary cloud platform. The Bosch IoT Cloud offers a secure technical infrastructure for scaling up networked solutions. Many of our solutions and projects, as well as those of our clients, already build on this infrastructure. We also manage and analyze large volumes of data, especially in the area of industrial engineering.

A key aspect of networking is trust. How safe is the data and who does it belong to? Dealing with data transparently and ensuring clear agreements about how it is used form the basis of a relationship of trust. At Bosch our customers have the first and last word about how their personal data is used. That is our answer to privacy concerns. What is yours?

CUSTOMERS COME FIRST

Industrie 4.0 guarantees better products, more efficient production methods and tailor-made industrial services. Digitally networking complex processes in production, logistics and services is a significant – and challenging – issue for practically every industrial company in Europe. Industrie 4.0 is also a driving force in the United States and Asia.

US companies are trying out radical innovations. China is aiming for speed. Many European countries, including Germany, France, the United Kingdom, Italy and Sweden, boast outstanding engineering skills. Japan focuses on scalability in smart factories. But how has Industrie 4.0 evolved since we first encountered it? Where does its potential lie? For that, we need to look at the details.

As a consulting firm we invest a great deal of time and intellectual effort in providing clients with guidance and showing them the business opportunities that Industrie 4.0 creates. There is huge demand for this. Our Partners and Consultants in Europe have set up an Industrie 4.0 Core Group, an international platform on which we have been regularly exchanging project experience and findings for many years now. We use this platform to discuss examples of successful companies. We identify the patterns emerging in industrial digitization. And we use it to define new business models in 3D printing or, increasingly often, the cloud – and not only there, of course.

Everywhere we look we see a symbiosis between traditional production technology and new IT technology. At Roland Berger we understand both worlds; this has always given us a competitive advantage. How can COOs make Industrie 4.0 a success for their companies? In industry the same applies as what we have long known in the consulting world: Customers and their needs come first.

THOMAS RINN
Partner and Member of the Global Executive Committee at Roland Berger

Competition

4.0
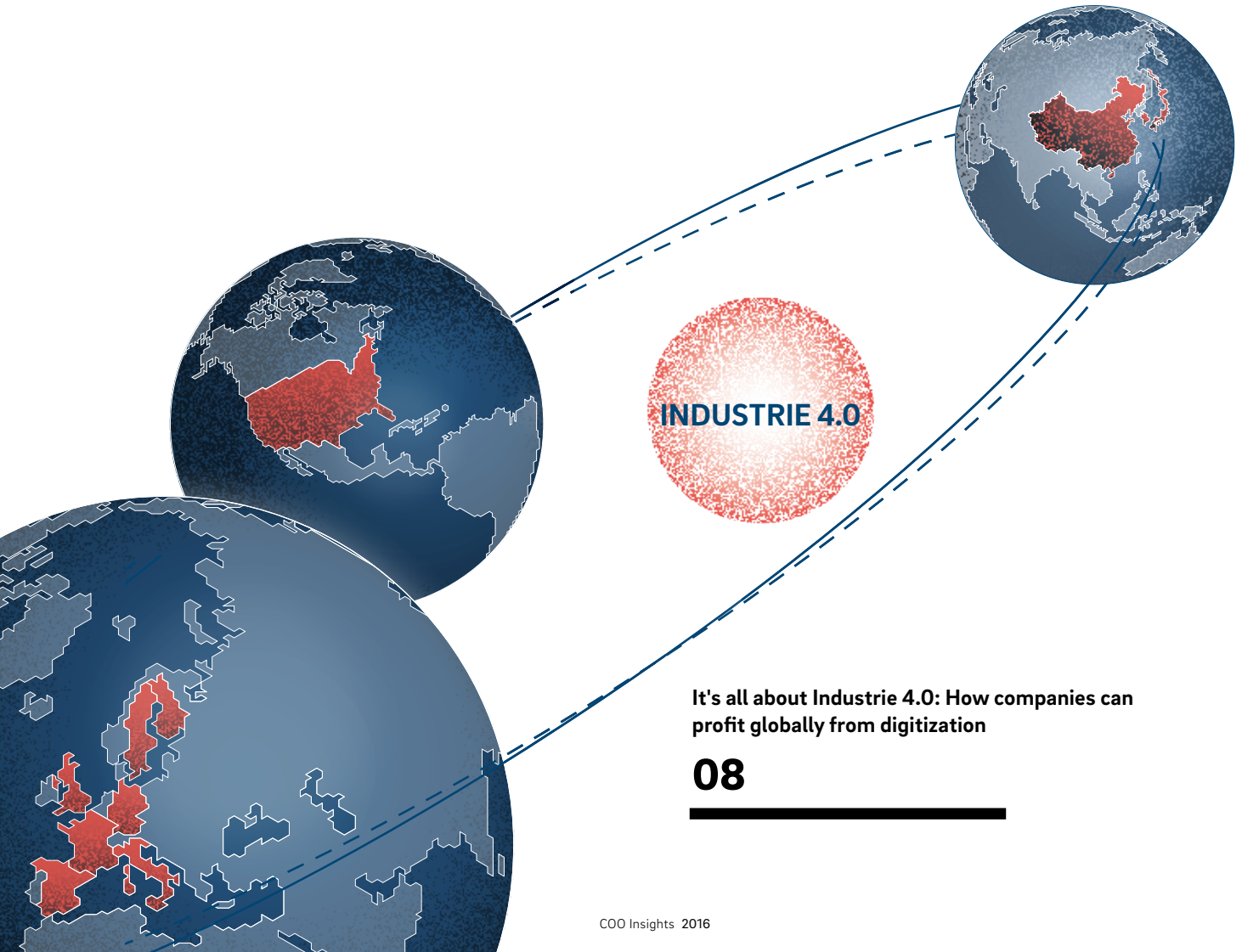
opens up unique opportunities for new business models

As long as newcomers and incumbents do the necessary work quickly and thoroughly

18

40
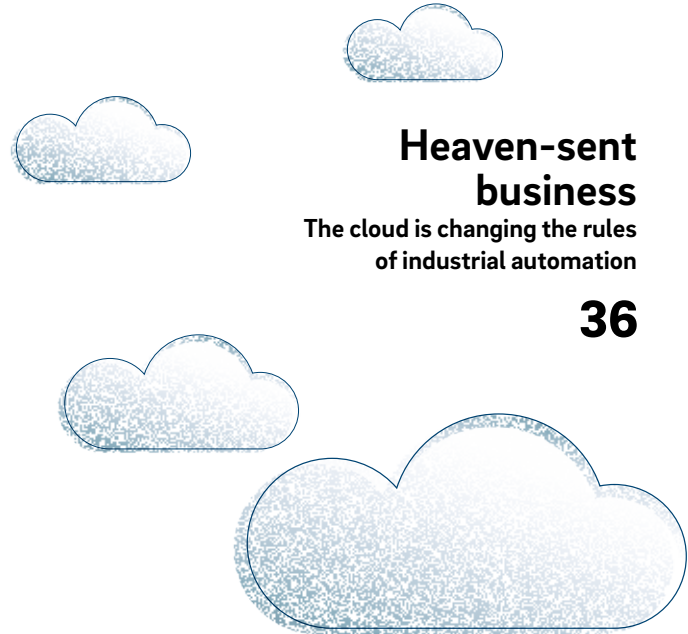**Japan is modernizing its industry. Robots play a vital role**

INDUSTRIE 4.0

It's all about Industrie 4.0: How companies can profit globally from digitization

08

Inside

Heaven-sent business
The cloud is changing the rules of industrial automation

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Masterminding the digital transformation at SAP. Interview with Bernd Leukert, Product Chief at SAP

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Work and value creation redefined

Entrepreneurs, managers, academics: What leading thinkers say about Industrie 4.0

"The fourth industrial revolution has the potential both to increase economic growth and defuse some of the biggest global challenges facing humanity."

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum

"Europe is in a position to create its own secure backbone. It is now a question of pushing ahead with EU-wide standards and laws across all industries."

Reinhard Ploss, CEO, Infineon

"The time to capitalize on digital factories is now. The US ticks all the right boxes to be the future of digitized automotive manufacturing."

Stephan Keese, Senior Partner, Roland Berger, Chicago

"After surveying the landscape, we are convinced that we are at an inflection point – the early stages of a shift as profound as that brought on by the Industrial Revolution."

Erik Brynjolfsson and Andrew McAfee in "The Second Machine Age"

"The value-creation cards will be reshuffled over the next five years. The place and type of service provision will change and all economic areas will have to do their homework."

Professor Thomas Bauernhansl, Fraunhofer Institute for Manufacturing Engineering and Automation IPA and University of Stuttgart

"In Europe, many of the conditions for Industrie 4.0 remain far too fragmented."

Volkmar Denner, CEO, Robert Bosch

"But even if intelligent systems can take on more and more of the standard tasks, it will remain indispensable for successful companies to exploit and develop their employees' experience."

Bernd Leukert, Product Chief at SAP

"You need to decide whether you want to be part of the change – or be changed yourself."

Joe Kaeser, CEO Siemens AG

"Work is not disappearing, it is being redefined. As production becomes networked, the demand for specialists in mathematics, computer science, natural science and technology will grow."

Henning Kagermann, President of the German Academy of Science and Engineering (acatech)

"This is an opportunity for social change: Industrie 4.0 can provide entirely new impetus for growth and employment."

Max Blanchet, Senior Partner, Roland Berger, Paris

A guiding star
for the decades ahead

Industrie 4.0 has revolutionized production. Different actors have different motives. But progress is nothing if not rapid.

Radical innovation:

Bringing digital innovation into the physical world. Startups for the Internet of Things and a renaissance of production.

USA

INDUSTRIE 4.0

Technical mastery:

Bringing excellence in engineering into the digital world. Visionary concepts that integrate technology, society and business.

United Kingdom, Sweden, Norway, Germany, France, Spain, Italy

Speed:

Practical application of quick wins and a long-term strategy. Use of mature technology, strategic development of key technologies.

China

Scalability:

Innovation through application. Massive expansion of smart factories and large-scale manufacturers that strengthen their products through internal demand.

Japan, South Korea

I f there is one term that is electrifying businesspeople, academics and politicians around the world it's Industrie 4.0. First widely used five years ago at the 2011 Hanover Trade Fair, Industrie 4.0 and other buzzwords like it – the Industrial Internet, advanced manufacturing – describe a process that will bring about nothing less than a new industrial revolution. Established industrial nations hope it will deliver more efficiency and greater competitiveness, which could lead to a renaissance of industrial production in high-wage countries. Emerging markets such as China, on the other hand, want to make the leap from being the "workbench of the world" to being technological pioneers in products and production processes.

HIGHLY NETWORKED AND EXTREMELY FLEXIBLE

Although the focus of international initiatives such as the "Industrie 4.0 Platform" in Germany, the "Industrial Internet Consortium" in the US and "Made in China 2025" differs slightly in each case, they all share a common vision: Tomorrow's manufacturing will be highly networked and extremely flexible. Ubiquitous sensors and intelligent algorithms will ensure that products can be manufactured in batch size as small as a single item – but still in series quality and with the same costs as mass production. Whoever sets the standards in this global race will be among the winners of globalization for decades to come. "Industrie 4.0 is definitely the guiding star for the decades ahead," says Wolfgang Dorst,

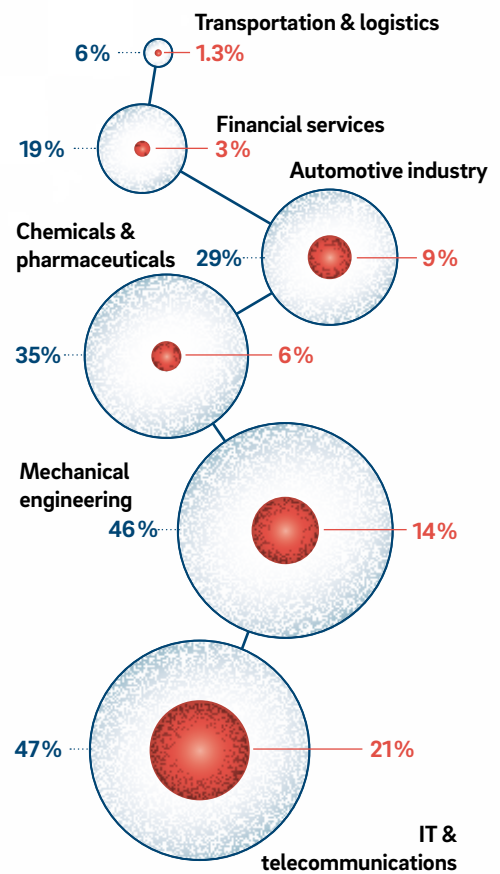Head of Industrial Internet and 3D Printing at German digital association Bitkom.

For the United States this process is a chance to bring lost production back to the country and reindustrialize the economy. Low energy prices, combined with a highly innovative IT scene, form a good basis for success in the race for tomorrow's customers. The intelligent handling of huge amounts of data will represent a decisive competitive advantage in the coming years, and this is an area where American champions such as Google and Amazon are unmatched in the world. Experts believe that North American companies will profit in particular from new services and business models.

Similar to Germany's Industrie 4.0 Platform, the US Industrial Internet Consortium (IIC) strongly promotes the fourth industrial revolution. Leading German technology companies such as Siemens, SAP and Bosch are also involved here. The German and US bodies agreed to create a partnership in March 2016 to jointly promote the topic. "The Industrial Internet means gathering data from machines and using it to generate useful insights for our customers," says Jeff Immelt, CEO of General Electric (GE), one of the companies participating in the IIC. "This creates value in the trillions and will transform GE."

In China transforming the economy is one of the top priorities of the Communist Party. It takes a strategic approach to this process. In 2015 the government

More knowledge than actual plans

Where the fourth industrial revolution is picking up speed: Industrie 4.0 has yet to arrive for SMEs in particular.

Transportation & logistics
6% — 1.3%

Financial services
19% — 3%

Automotive industry

Chemicals & pharmaceuticals
29% — 9%

35% — 6%

Mechanical engineering
46% — 14%

47% — 21%

IT & telecommunications

On average:

Knowledge of Industrie 4.0 — 18%

Existing or planned Industrie 4.0 projects — 4%

Source: ZEW 2015

DIFFERENT WORLDS

To compare the level of activity in the area of Industrie 4.0 for different sectors, Bitkom examined 203 applications from the Industrie 4.0 Platform. Mechanical engineering was the biggest sector (28 percent of applications). In terms of type of application, assistance systems for automation solutions was the dominant category (34 percent, right).

Industries

28

26

Mechanical engineering

16

Manufacture of computers, electronic goods, optical goods and electronic equipment

13

5

Manufacture of basic metals and fabricated metal products

Automotive industry

Other manufacturing industries

4

3

3

3

Manufacture of furniture and other articles, repair and installation of machinery

Manufacture of chemical and pharmaceutical products

Manufacture of rubber, plastics, glassware and ceramics

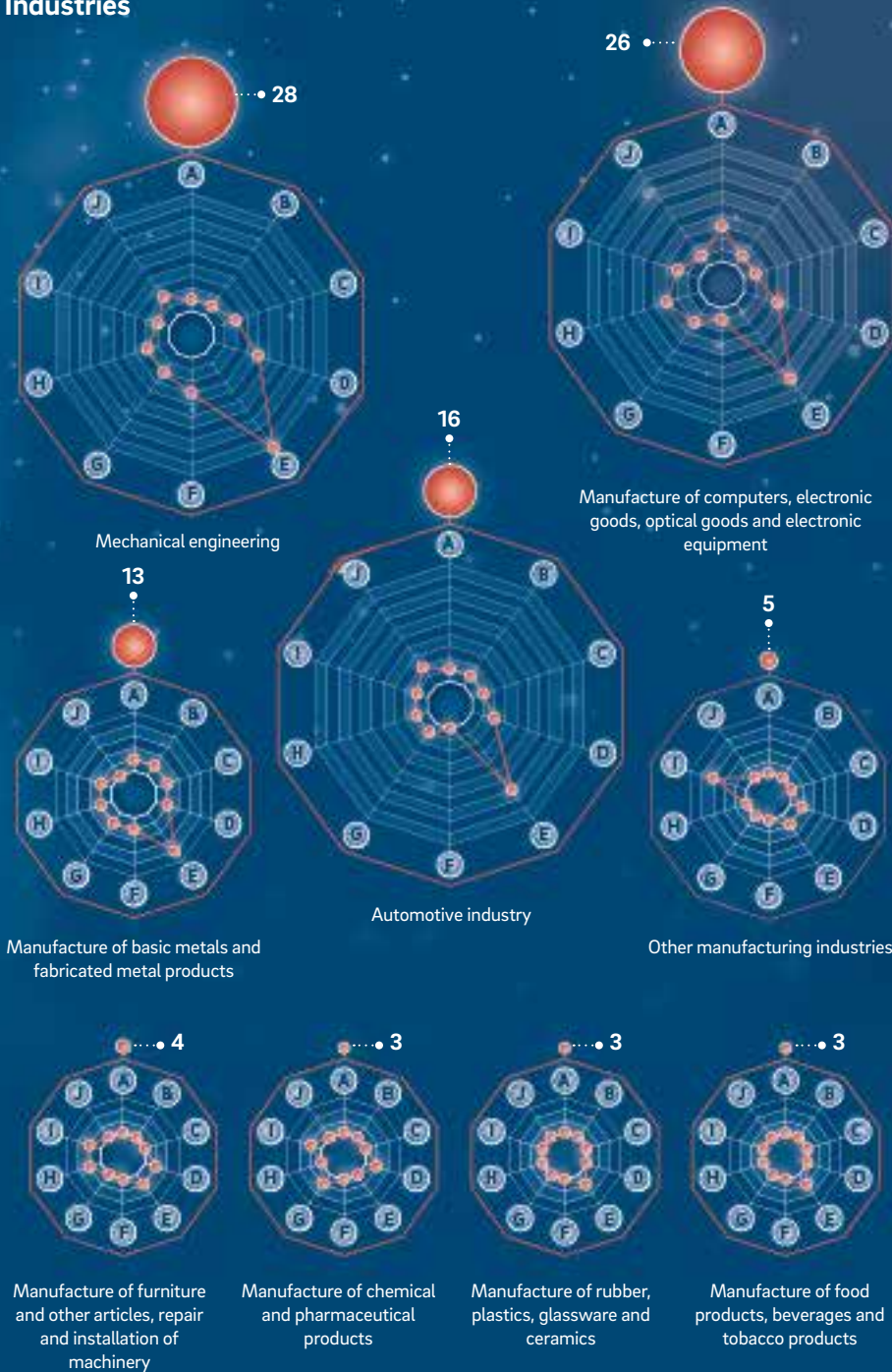Manufacture of food products, beverages and tobacco products

Figure to be read as follows: Mechanical engineering, for example, accounts for 28 percent of all Industrie 4.0 applications. It contributed 10 percent of all applications in the category Assistance systems for automation solutions (E) and 4 percent of all applications in the category Value-based services for own plants/machines (D).

Source: Bitkom 2016

Application categories

5
A

Order-driven production within the corporation

4
B

Order-driven production in a connected world

7
C

Value-based services for delivered products

12
D

Value-based services for own plants/ machines

34
E

Assistance systems for automation solutions

6
F

Assistance systems for enhancing energy efficiency

7
G

Transparency and adaptability of delivered products

9
H

Adaptive factory

10
I

Adaptive logistics

5
J

Smart engineering

launched the Made in China 2025 program, its answer to the German Industrie 4.0 initiative. In June 2016 a fund of around USD 3 billion was set up for the purpose of modernizing industry. The acquisition of the German robot manufacturer KUKA by the Chinese Midea Group was part of this strategy, as is the interest shown in other companies such as Aixtron (equipment for the semiconductor industry) and SGL (carbon-based products).

One of China's chief goals is greater automation for small and medium-sized enterprises (SMEs). From the point of view of the Chinese, the digital economy is the key to future prosperity. At the last G20 summit in Hangzhou, President Xi Jinping called for more support worldwide for innovation in this field. In his closing speech to the meeting, he told the delegates, China would forge ahead with structural reform to open up a new path for global growth.

Companies in Japan and South Korea, which are already highly developed, are primarily concerned with increasing their productivity through intelligent networking. Greater automation and the increased use of robots not only reduce costs, however – they are also a way to avoid the consequences of rapid demographic change in these countries. Driving the change in these countries are major industrial conglomerates, which are developing networked production systems initially for use in their own companies (see report on page 40).

In Europe, too, international competitiveness and demographic change play an important role in the restructuring of industrial production. Europe can build on its relatively well-developed infrastructure and its large number of qualified employees. Industrie 4.0 promises jobs that are also suitable for older workers, thanks to new technologies such as augmented reality and collabo-

FOCUS ON EFFICIENCY

What do companies hope to achieve through Industrie 4.0?
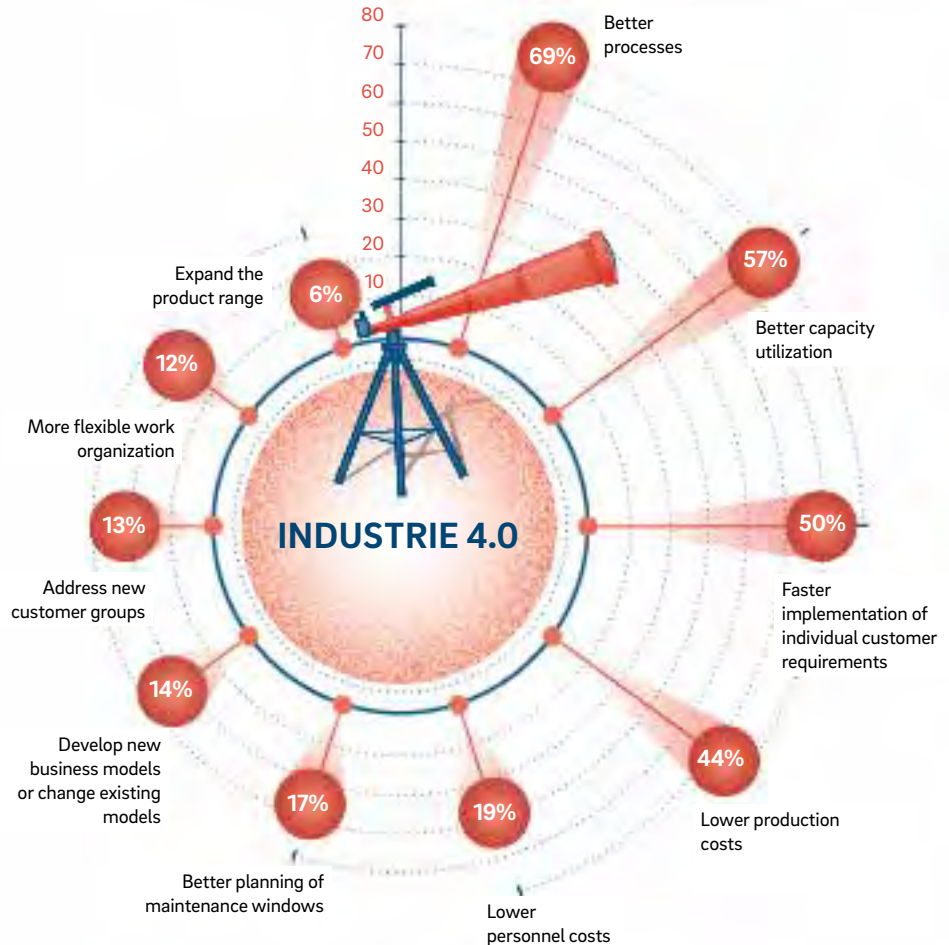
Source: Bitkom 2016, survey of 364 firms with 100 employees or more.

rative robots. Within Europe, Germany is the most important driver of the fourth industrial revolution. Germany not only builds the machines that are used in factories around the world, it is also itself a key consumer of new production technologies.

IMPLEMENTATION IS JUST BEGINNING
Industrie 4.0 has been a discussion topic in the German business, academic and political worlds for many years now. As a result, Germany also has the most comprehensive data on the current level of implementation by firms and what companies want to achieve in

the new paradigm. In November 2015, for example, the Center for European Economic Research (ZEW) published a study that has some surprising findings: "Only 18 percent of companies are aware of the term Industrie 4.0, with large companies much more frequently informed than small ones." And just four percent of those interviewed said that they were "already digitizing and networking production processes as part of Industrie 4.0, or planning to do so in the near future."

"We were surprised by the results ourselves. We expected a much higher level

of recognition," says Professor Irene Bertschek, Head of the Research Group Information and Communication Technologies Information at the ZEW. "There are some individual pioneers, but there are also other companies that have no capacity for the topic or who see Industrie 4.0 simply as the logical continuation of automation."

The level of recognition also depends very much on the industry in question, however. Particularly companies in the fields of IT and telecommunications, the electrical industry and mechanical engineering understood what Industrie 4.0 was about. The transportation and logistics sector, by contrast, came bottom of the list – despite the fact that Industrie 4.0 will be of great importance here as supply chains become more closely integrated in the future.

The Bitkom study "Industrie 4.0 – Status and Prospects" reveals what pioneering German companies are doing in this respect. Based on individual analyses of 203 applications from the "Industrie 4.0 Platform", it provides an overview of the industries in which companies are already carrying out projects and the most important categories of applications. The top industry, accounting for 28 percent of all applications, is mechanical engineering, which focuses on assistance systems for automation solutions.

The industry in the number two spot is no surprise: Manufacture of computers, electronic goods, optical goods and electronic equipment accounts for 26 percent of all concrete projects and, once again, assistance systems for automation solutions are the commonest applications. In third place comes the automotive industry, which accounts for 16 percent of projects and likewise focuses on assistance systems for automation solutions.

EFFICIENCY INNOVATIONS TO THE FORE

"Current applications mainly relate to automation", says Wolfgang Dorst, summarizing the results of the study. "These are efficiency innovations, not breakthrough innovations." Dorst is clear, however, that there is no alternative to Industrie 4.0 and its disruptive changes: "The critical thing is for as many companies as possible to start off down the road now."

FROM MARATHON TO SPRINT

Speedfactory not Industry 3.0: Adidas uses a highly automated, individualized production system that dramatically speeds up the introduction of new products.

**Adidas Speedfactory Delivery within a few days or weeks**

Some industry pioneers already have their sights firmly fixed on Industrie 4.0, the new guiding star. "Even if developments have been evolutionary rather than spectacular, a lot has happened in recent years," says Professor Jürgen Jasperneite, who has been dealing with the topic of Industrie 4.0 at the Fraunhofer Application Center Industrial Automation in Lemgo for many years now. "Companies have built up new competencies, especially for developing smarter products and optimizing production."

Unlike smart products and smart production, however, companies have so far neglected smart services – new, intelligent services relating to their products, says Professor Jasperneite. In the area of networked production, the topic of real-time analysis of machines, plants and entire factories is high on companies' agendas – a further indication that process optimization is currently the strongest driver of Industrie 4.0. But there are also some companies that are tapping the potential of Industrie 4.0 above and beyond efficiency improvements.

BRINGING MANUFACTURING BACK FROM ASIA

One such company is the sports article manufacturer adidas, which has already implemented Industrie 4.0 in some areas. Rather than producing sports shoes in large quantities in Asia – the old Industry 3.0 approach – adidas plans to use its Speedfactory, a production facility located close to its customers, highly automated and able to produce individual running shoes in a short space of time. "In today's constantly changing world, our consumers want the latest and newest products – and they want them now," says Herbert Hainer, CEO at adidas until September 2016. This is where the Speedfactory does its name justice: New shoes reach the customers in a matter of days or weeks, not after 18 months of design, production and shipping from Asia to Europe or the US.

Traditional
production
18 months to
market launch

17

16

15

14
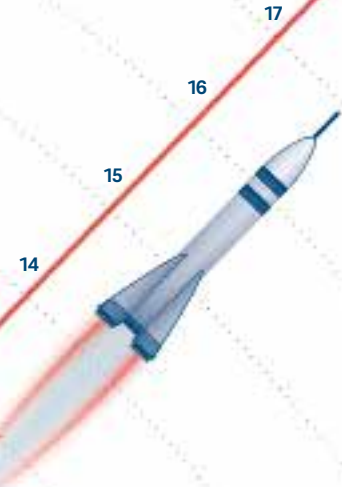
The first Speedfactory is located in Ansbach near the adidas headquarters and should be producing around 500,000 pairs of shoes as early as 2017. The second Speedfactory will be built in the US next year. "When I joined adidas in 1987, production had just been moved to Asia," says Hainer. "Now we've come full circle and production is coming back here."

Individualized mass production and the return of industrial jobs to high-wage countries in the West are two of the key promises of Industrie 4.0, as exemplified by adidas. If the fourth industrial revolution is to be a success, the broad mass of small and medium-sized enterprises need to share the enthusiasm for the topic currently shown by pioneering companies. Bridges need to be built for them today so that Industrie 4.0 does not take them by surprise at some point in the future.
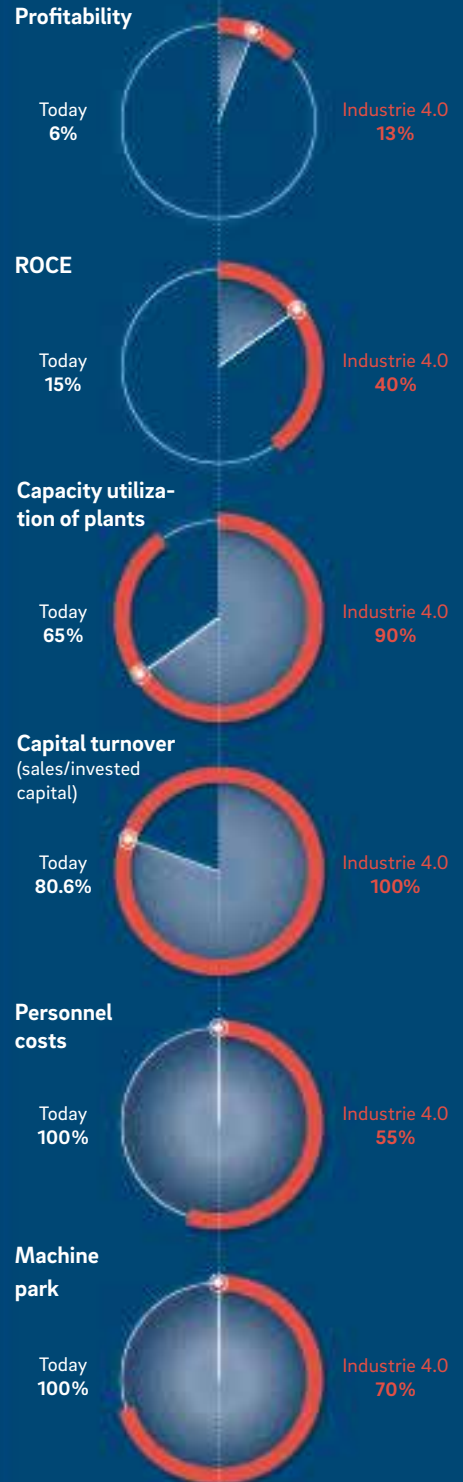
Companies that successfully manage the change to the new world of industrial production can hope to see a significant increase in profitability. Roland Berger has calculated how Industrie 4.0 affects return on capital employed (ROCE) for an automotive supplier, as an example. With a virtual factory (simulation of the production process), automated material flows, intelligent machines, predictive maintenance and a networked production system, the supplier's ROCE increases from 15 to 40 percent. This increase is due to improved productivity caused by falling wage costs, greater added value and optimized capacity utilization of equipment. Industrie 4.0 also leads to higher capital turnover: Each euro or dollar invested leads to higher sales, partly because machines can be adapted faster to new products and have shorter downtimes. Projecting the figures for Western European countries, Roland Berger estimates ROCE of 28 percent in the year 2035 thanks to Industrie 4.0, compared to 18 percent today.

"When I joined Adidas in 1987, production had just been moved to Asia. Now we've come full circle and production is coming back here."

Herbert Hainer, CEO at Adidas
until September 2016

INDUSTRIE 4.0 PAYS DIVIDENDS

Not just increased profitability: the impact of Industrie 4.0 for a typical automotive supplier

Profitability

Today
6%

Industrie 4.0
13%

ROCE

Today
15%

Industrie 4.0
40%

Capacity utilization of plants

Today
65%

Industrie 4.0
90%

Capital turnover
(sales/invested capital)

Today
80.6%

Industrie 4.0
100%

Personnel costs

Today
100%

Industrie 4.0
55%

Machine park

Today
100%

Industrie 4.0
70%

Source: Roland Berger 2016

360°
networks

From development to service: Companies benefit in multiple ways from Industrie 4.0.

by Oliver Herweg

The art of the O-ring
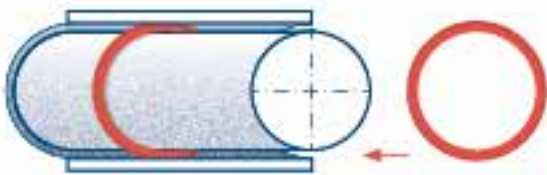
O-ring

Small component, big choice: O-rings come in various sizes. Industrie 4.0 makes it easier to select the right one.

smallest inner diameter
3.56 mm

largest inner diameter
400 mm

100

200

300

1.5

Thicknesses 1.5 mm–8.4 mm

Checking the parameters

major deviations

target range

minor deviations

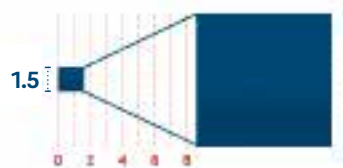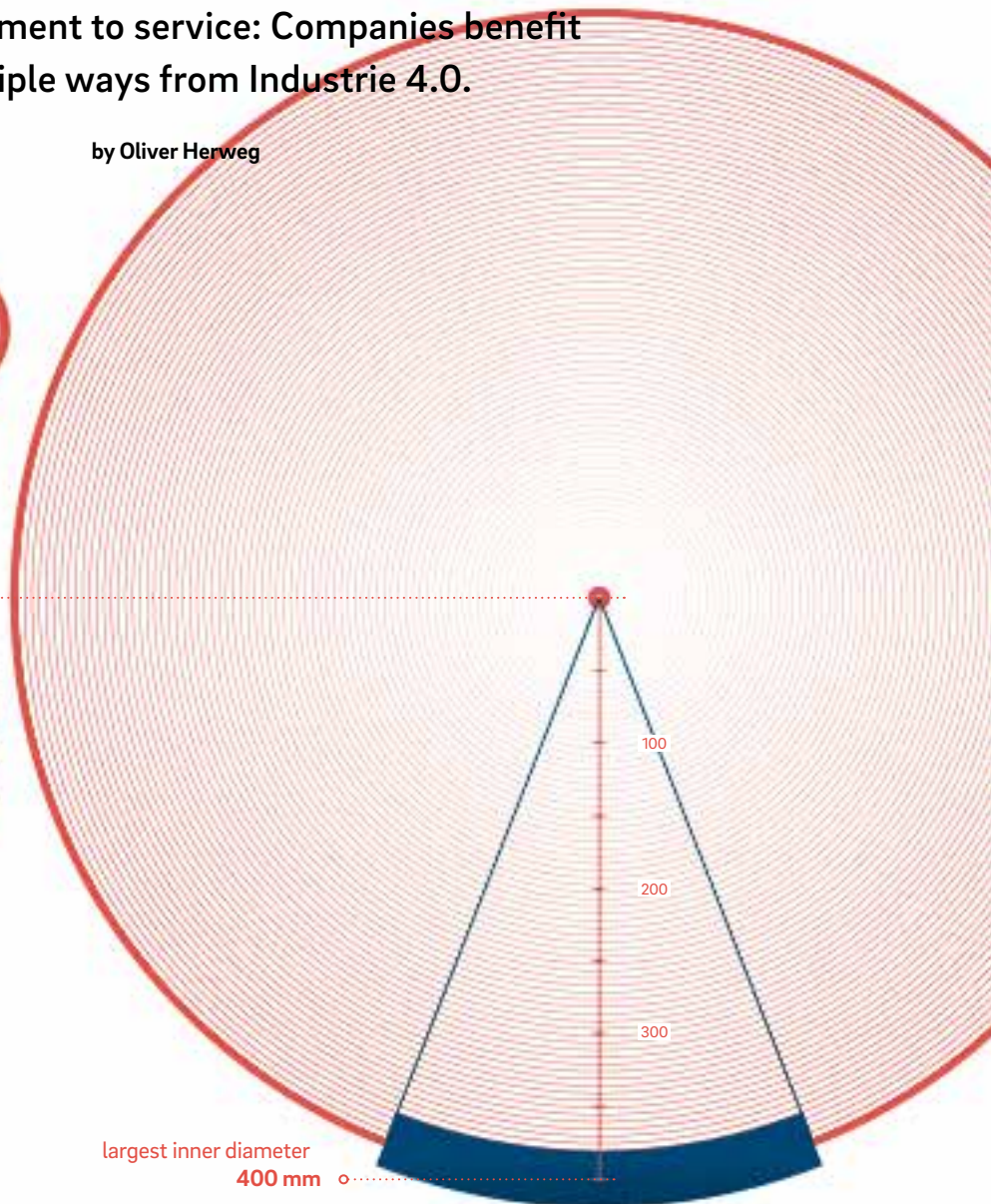Sometimes progress comes from the most unexpected places. From sales of O-ring seals, for example. O-rings are used in industry, as well as in millions of regular faucets. Customers of Freudenberg Sealing Technologies can use the company's online O-ring Configurator to order specific models from a portfolio of almost 30,000 articles. Choosing the right O-ring may sound like a simple task but in fact it requires a great deal of experience and know-how. "You need a whole range of engineering skills to choose an O-ring that is going to function reliably," explains Christophe Meyer, Senior Manager of Digital Business Development at Freudenberg Sealing Technologies. "Besides the dimensions of the installation space, you have to take into account the operating temperature, what it is you're sealing, the pressure load and other factors."

That's where the O-ring Configurator comes in. It takes customers step-by-step through a series of questions about the O-ring and where it is going to be used. Customers are then shown a design cockpit where they can check that all the figures are in the green range; any deviations are shown in yellow or red, depending on how big they are. The O-ring Configurator then selects the products from the Freudenberg catalog that best meet the customer's requirements. Next, the material assistant suggests the option that best suits what it is the customer wants to seal and the operating temperature, from 30 different options. "The biggest challenges when designing the O-ring Configurator were categorizing the different technical design parameters, programming the software so the options were displayed correctly, and designing a tool that customers could use intuitively, without having expert knowledge," says Meyer.

MAKING LIFE EASIER FOR ENGINEERS
Freudenberg's customers now benefit from a fast, uncomplicated ordering process. They can configure their O-rings around the clock, check their availability and in the case of selected customers order them immediately. The company's sales staff and engineers also benefit from no longer having to deal with standard inquiries. Instead they can concentrate on more demanding tasks. The O-ring Configurator is a good example of the changes that are taking place in Industrie 4.0. Products that can be individualized are becoming more and more important – as are sales tools that can help customers configure and order those products, while at the same time saving suppliers from having to deal with too many inquiries.

But Industrie 4.0 is not just fundamentally changing the sales process. The new paradigm will affect the entire value chain, from sales, product and production design, purchasing and production to logistics and aftersales. Different companies are affected in very different ways by the changes. Roland Berger has classified the different types of businesses and identified where in the value chain Industrie 4.0 is most likely to offer solutions for each type of company. Freudenberg Sealing Technologies is a good example of how sales of individualized mass products can be made more efficient through having a web shop: A complex piece of software guides customers through the selection process, makes sure the chosen item is fit for purpose and meets the relevant ISO standards, and allows selected customers to place their order immediately.

VIRTUAL MACHINES
Another area where Industrie 4.0 has many potential applications is in production planning. Companies that manufacture bulk mass products or complex products can benefit particularly here. For example Grieshaber, a German Mittelstand company based in the town of Schiltach in the Black Forest. Each year Grieshaber turns up to 3,500 tons of aluminum into high-precision parts for the automotive industry, specializing in parts that are particularly difficult to manufacture. The company uses complex multi-spindle machines with Siemens controls for production.

Grieshaber uses the Siemens NX Virtual Machine tool for NC programming and simulation. All the processing operations can be programmed on a normal desktop computer as if the operator were standing directly at the machine. The operator can then check that everything works as planned before actual production starts. This not only avoids collisions, it also creates transparency over the sequence and duration of individual processing steps. A simple graphic shows how long the individual tools on the spindles are in use. Detailed timing data provided by the virtual machine also forms a basis for optimizing production: Given the large numbers of items produced, saving a tenth of a second off a process can quickly add up to savings of several days over the course of a year.

But it's not only in configuring machines that Industrie 4.0 solutions provide great-

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Custom work not mass production

The business model is critical
The benefits of Industrie 4.0 and how urgently you need to act depend on the nature of your business.

Analyze the value chain
Where in the value chain you should focus on implementing Industrie 4.0 depends critically on what segment you are in.

Develop your own strategy
Companies must develop their own Industrie 4.0 strategy – blanket solutions are of little use here.

---

er accuracy. During the production process, quality can be further improved by intelligent technology. The industrial connectivity specialist Weidmüller from the city of Detmold in North Rhine-Westphalia has seen how this works in the metal-processing industry. The company produces metal parts for industrial connectivity using complex, multi-stage forming processes that need to be extremely accurate even when making large quantities of items. To ensure consistently high quality, Weidmüller uses a camera system that continuously monitors production and automatically counteracts any deviation from the specified geometry of the work pieces.

Thanks to this technology the manufacturing process can run continuously, even where deviations occur due to temperature fluctuations or wear on the ma-

> **"In the past we had to stop the machines and program the new process parameters manually. That took a lot of effort. With the new technology this is no longer necessary."**
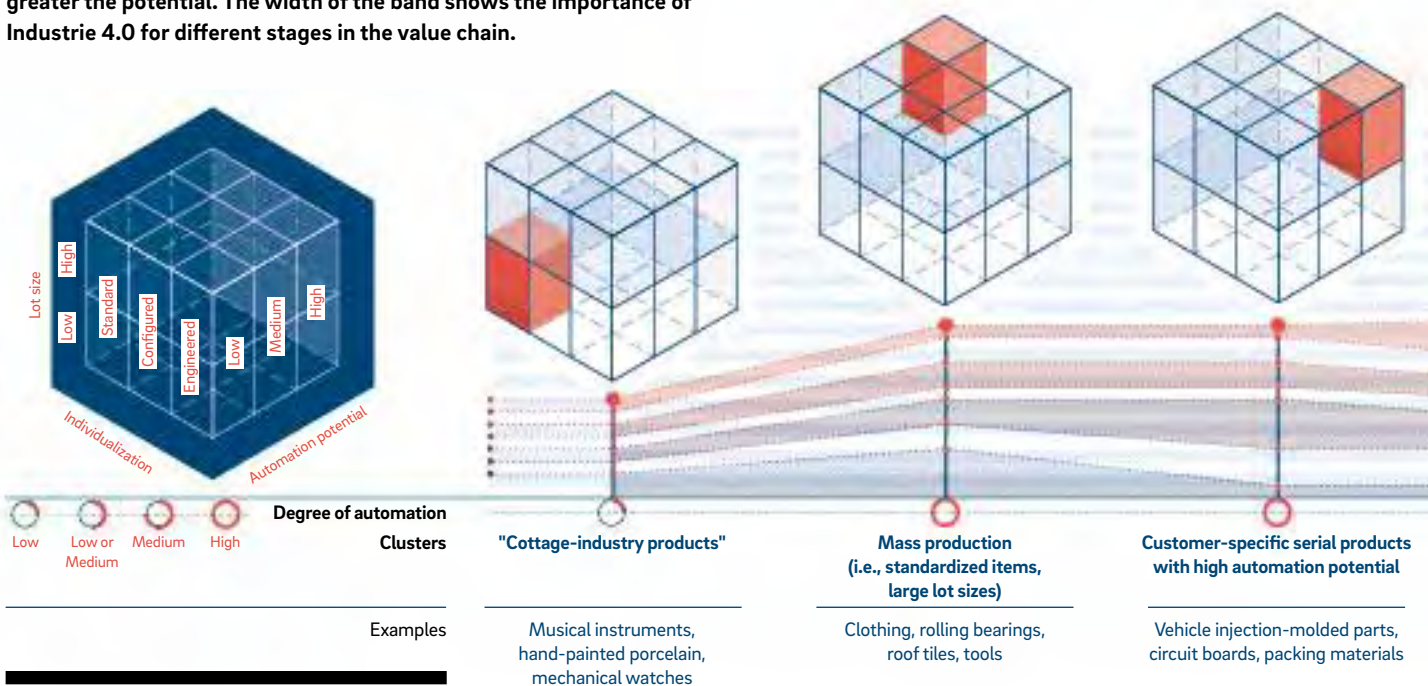>
> Horst Kalla, Weidmüller

chines. "In the past we had to stop the machines and program the new process parameters manually. That took a lot of effort, and the experience of the machine operators was important," explains Horst Kalla from Weidmüller. "With the new technology this is no longer necessary, which avoids interruptions and significantly reduces the amount of rejects."

SMOOTH SUPPLY-CHAIN PROCESSES

Businesses also face particular challenges when it comes to logistics. In the age of Industrie 4.0, logistics will change noticeably due to the increasing integration of suppliers, manufacturers and logistics partners. Smooth processes are essential for tomorrow's supply chains. Pioneering companies such as Herma from Filderstadt in southern Germany demonstrate how modern technology can be used to optimize logistics. Between 700 and 800

WHERE DOES THE GREATEST POTENTIAL LIE?

Industry clusters can be formed along the three axes "lot size", "individualization" and "automation potential". The higher the line, the greater the potential. The width of the band shows the importance of Industrie 4.0 for different stages in the value chain.

| Degree of automation | Low | Low or Medium | Medium | High |

| Clusters | "Cottage-industry products" | Mass production (i.e., standardized items, large lot sizes) | Customer-specific serial products with high automation potential |

| Examples | Musical instruments, hand-painted porcelain, mechanical watches | Clothing, rolling bearings, roof tiles, tools | Vehicle injection-molded parts, circuit boards, packing materials |

Source: Roland Berger 2016

pallets of adhesive materials and products currently leave the plant every day, and that volume is growing around 10 percent a year. "We have to avoid faulty shipments because they lead to high costs and major problems with getting the products to our customers on time," says Frank Baude, head of logistics at Herma.

OPTIMIZED SHIPPING LOGISTICS

Herma uses a broadband location method to optimize its shipping logistics. Each forklift truck is fitted with four tags that are used to determine their position and direction of travel to within a few centimeters. A display screen directs drivers to the location of the pallets and the waiting truck. "The system knows exactly where the goods are in the shipping area and which truck they need to be loaded onto," says Baude. "So we can immediately see if a forklift truck is heading for the wrong

pallet or wrong truck." Guidance systems for forklift trucks are just one element in tomorrow's logistics systems. Numerous research institutes are already working on solutions such as autonomous intra-logistics systems that draw on the principles of swarm intelligence.
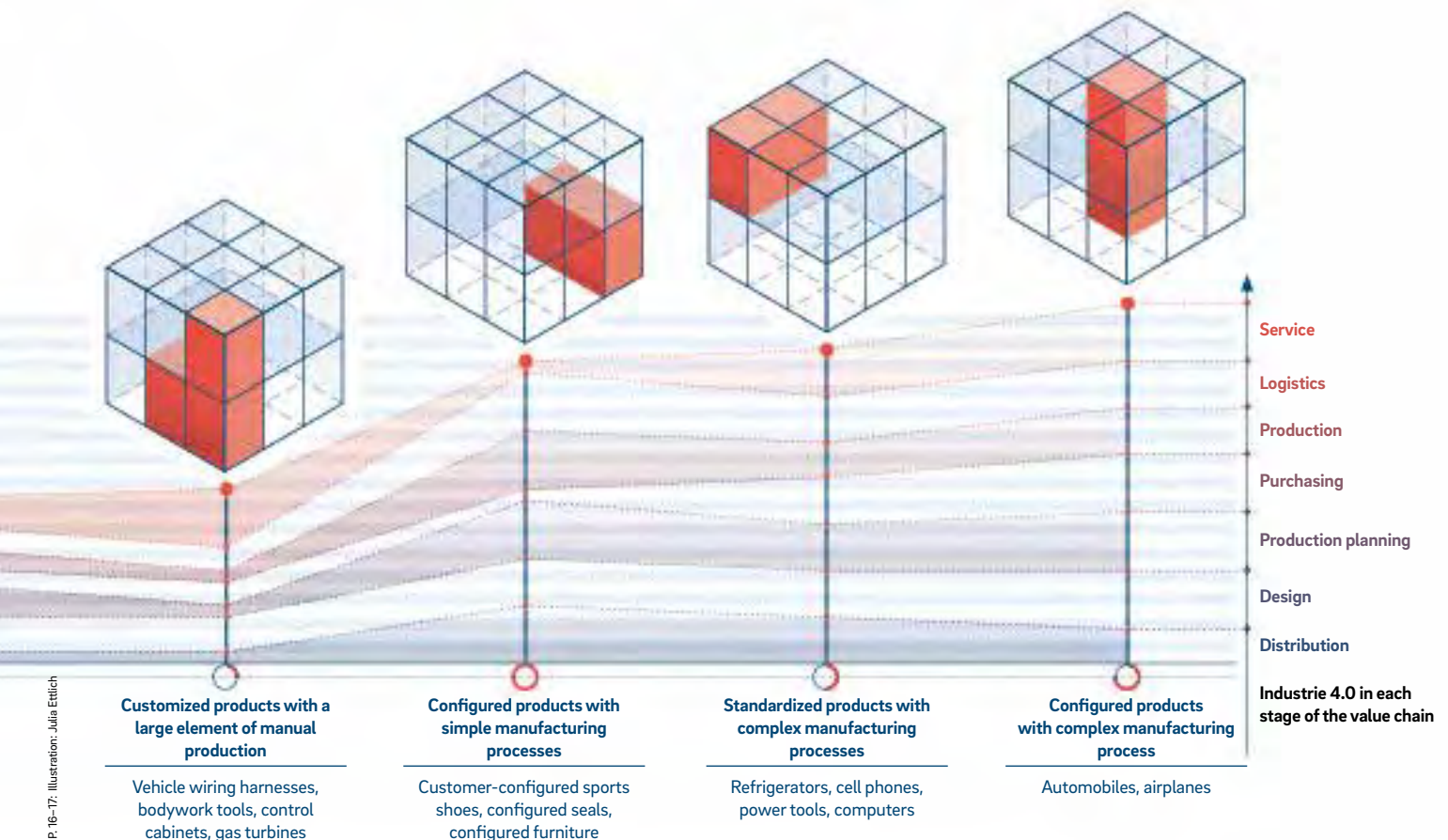
Delivery of the goods is not the end of the product life cycle, of course. Industrie 4.0 creates lucrative market opportunities in the area of intelligent services. As with sales, businesses can exploit these opportunities by using online solutions that give end users or dealers easy access to spare parts, for example. The automotive supplier SAF-Holland uses its SH Connect app to meet these expectations. "The app is useful for truck drivers who urgently need spare parts while on the road, for example," says Thomas Piroth, responsible for strategic business development at SAF-Holland. "It

uses GPS to tell you where the nearest repair shop is and gives you its telephone number." Drivers can also use the app to read the QR code on the defective vehicle part, which ensures that the breakdown service brings the right spare part.

CONNECTED INFORMATION

The vehicle repair shops can also access the SAF-Holland online catalog via the app, and get details on how to install the spare parts correctly. If shipping the part would take too long, the app tells you the closest dealer that has it in stock. This connecting of location information, parts identification via the QR code and access to the current inventory makes the app a model for aftersales solutions in the age of Industrie 4.0.

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P. 16–17: Illustration: Julia Ettlich

| Customized products with a large element of manual production | Configured products with simple manufacturing processes | Standardized products with complex manufacturing processes | Configured products with complex manufacturing process | Industrie 4.0 in each stage of the value chain |

Vehicle wiring harnesses, bodywork tools, control cabinets, gas turbines

Customer-configured sports shoes, configured seals, configured furniture

Refrigerators, cell phones, power tools, computers

Automobiles, airplanes

Service
Logistics
Production
Purchasing
Production planning
Design
Distribution

Pythons and products

Competition 4.0 opens up unique opportunities for new business models – as long as newcomers and incumbents do the necessary work quickly and thoroughly.

by Ralph Lässig and Christoph Schäff

If you want a foretaste of tomorrow's automation solutions, take a look at the ModBerry 500 produced by the Polish company Techbase. The small box houses a single-board computer based on the Raspberry Pi, a long-standing favorite with millions of school kids, students and electronics enthusiasts. But the developers of the ModBerry have a different application in mind: industrial automation, previously the domain of expensive special hardware. The tiny box packs ample computing power, storage space and interfaces, while the open-source operating system Linux provides a stable platform for numerous applications.

"In our experience many processors are replaced after just a short time, so we chose a tried-and-tested solution like the Raspberry module," says Bartosz Bielawski from Techbase. "Also, software is much more important than hardware these days. If we put the computer in an industrial box and implement the necessary protocols, it offers even more features than other solutions on the market – at a much lower cost." Techbase's customers use the ModBerry in areas such as machine-to-machine communication, con-
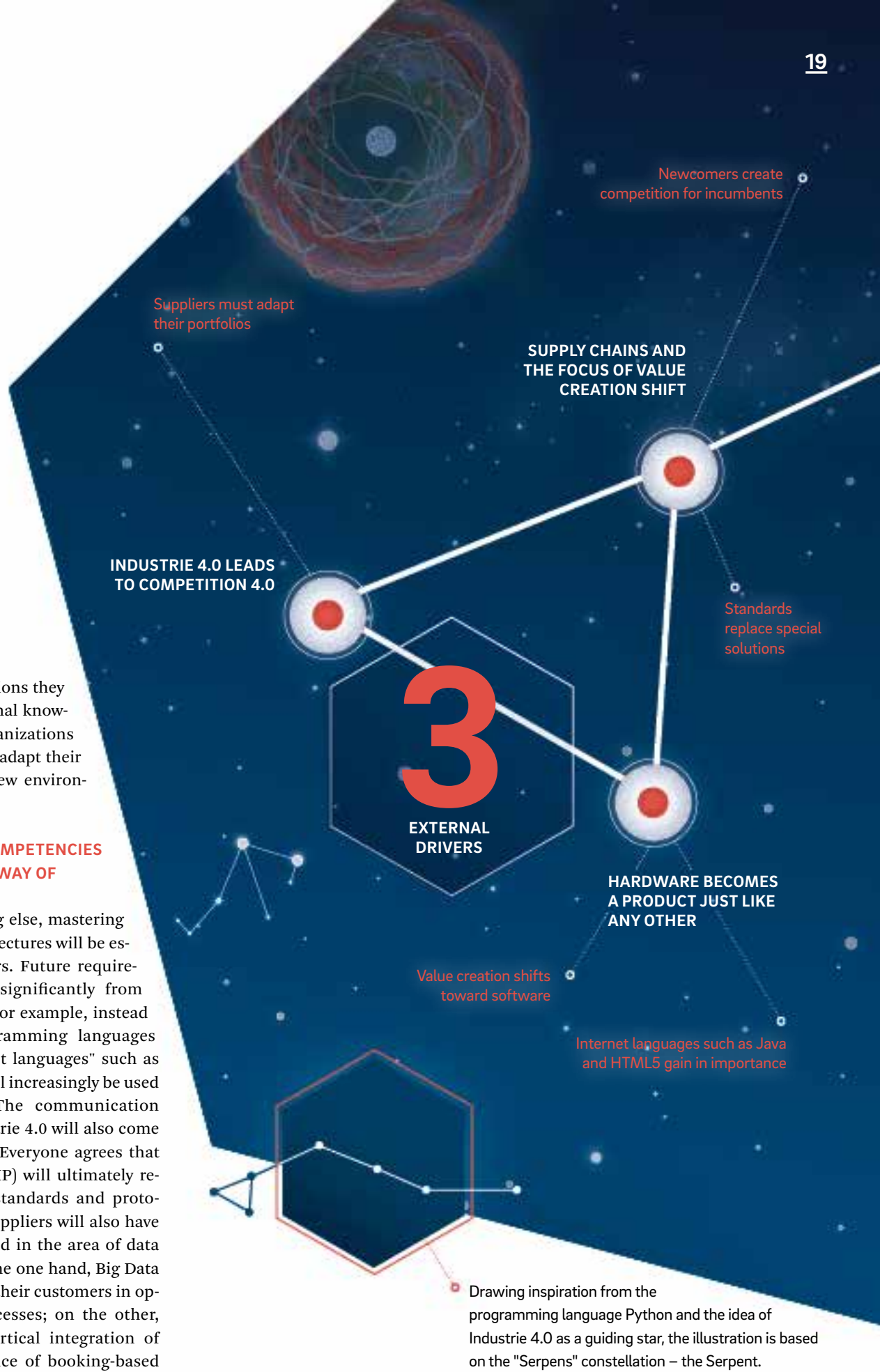
"If we put the computer in an industrial box and implement the necessary protocols, it offers even more features than other solutions on the market."

Bartosz Bielawski, Techbase

tainer management and monitoring mobile radio communication stations.

The ModBerry demonstrates that hardware will almost become a product just like any other in the age of Industrie 4.0. Suppliers who don't want to lose out in Competition 4.0 cannot rely exclusively on populated boards in the coming years – unless of course their products contain unique know-how for lucrative niche applications. This is not the only fundamental change facing industrial suppliers, either. Industrie 4.0 will lead to serious upheavals in discreet manufacturing. Established and new suppliers will have to make changes to their development, production, integration and mastery of automation systems. Supply chains will expand and a fundamental shift will occur in the focus of value creation.

Three levers are the key to success. Suppliers need to build new software competencies as value creation shifts away from hardware and towards programming. They must recognize the opportunities and risks created by the waning importance of hardware and react in a timely manner. Moreover, through partnerships,

Newcomers create
competition for incumbents

Suppliers must adapt
their portfolios

**SUPPLY CHAINS AND
THE FOCUS OF VALUE
CREATION SHIFT**

**INDUSTRIE 4.0 LEADS
TO COMPETITION 4.0**

Standards
replace special
solutions

3

**EXTERNAL
DRIVERS**

**HARDWARE BECOMES
A PRODUCT JUST LIKE
ANY OTHER**

Value creation shifts
toward software

Internet languages such as Java
and HTML5 gain in importance

mergers or acquisitions they
need to bring external know-
how into their organizations
so they can quickly adapt their
portfolios to the new environ-
ment.

**① NEW KEY COMPETENCIES
AND A NEW WAY OF
THINKING**

More than anything else, mastering
new software architectures will be es-
sential for suppliers. Future require-
ments will differ significantly from
those of the past. For example, instead
of hardware programming languages
such as C, "Internet languages" such as
Java and HTML5 will increasingly be used
for automation. The communication
standards in Industrie 4.0 will also come
from the Internet: Everyone agrees that
Internet Protocol (IP) will ultimately re-
place proprietary standards and proto-
cols in factories. Suppliers will also have
to tread new ground in the area of data
management. On the one hand, Big Data
plays a key role for their customers in op-
timizing their processes; on the other,
with increasing vertical integration of
data, the importance of booking-based

Drawing inspiration from the
programming language Python and the idea of
Industrie 4.0 as a guiding star, the illustration is based
on the "Serpens" constellation – the Serpent.

**NEW KEY COMPETENCES AND A
NEW WAY OF THINKING**

Bundle employees
in incubators

Occupy lucrative
niches

1

3

SUCCESS FACTORS

Outsource subgroups
of the company

**RECOGNIZE THE OPPORTUNITIES
AND RISKS OF COMMODITIZATION**

2

Sinking margins and
cutthroat competition

databases such as SAP may also grow, compared to real-time data from manufacturing execution systems (MES).

For suppliers it will be important not just to build new software competencies but to adapt to a completely new way of thinking and a new approach. Programming in Java not only enables platform-independent software development, it also calls for different software architectures. For particularly time-critical projects, in future it will be possible to use fault-tolerant programming languages such as PHP and Python, in which applications can be developed much faster than in C or assembly language.

The rules of the game are changing. How can suppliers adapt with the necessary speed? Two approaches are possible. The first is an "incubator approach", in which you bundle creative employees with the right mindset in a separate internal unit, helping them develop new ideas. The second is an "excubator approach", in which
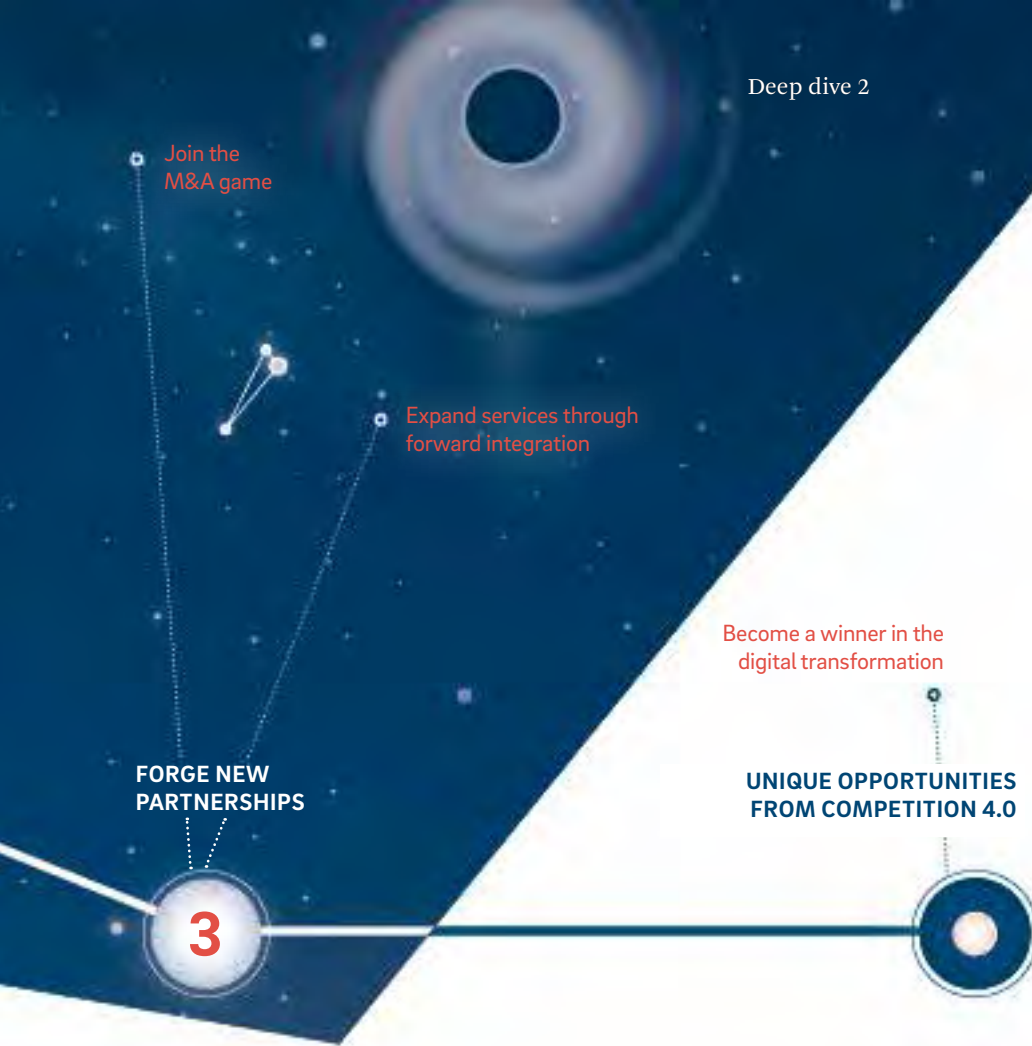
The rules of the game for companies are changing. Small, flexible units can speed up innovation.

you outsource a subgroup of the company, giving it a degree of autonomy and using it as a startup for generating innovative ideas.

**② RECOGNIZE THE OPPORTUNITIES
AND RISKS OF COMMODITIZATION**

The prospects for pure hardware suppliers are not good in Competition 4.0. Fewer possibilities for differentiation will lead to declining margins and cutthroat competition. As we saw before, unique selling points are really only possible with software or through innovation in the business model, such as additional modules or a particularly well-designed user interface. Another option is to introduce extra functions offering clear added value compared to regular features or open-source products, and making users pay for them – for example, free engine control with an optional chargeable module for wear monitoring.

Combining free and chargeable features, if done in a strategic fashion, can im-

Join the
M&A game

Expand services through
forward integration

Become a winner in the
digital transformation

**FORGE NEW
PARTNERSHIPS**

**UNIQUE OPPORTUNITIES
FROM COMPETITION 4.0**

3

prove a suppliers' market prospects. Using open-source software creates a broad user base for generating revenue from add-ons. What is crucial, however, is that the open-source software does not impinge on the core know-how of the provider.

③ FORGE NEW PARTNERSHIPS

Standard hardware rather than tailor-made solutions for automation: Suppliers of industrial software must adapt to this future trend and try to build on existing solutions rather than coming up with their own inventions. One option is to use open-source or standard APIs from the IT world. Companies can also integrate "software as a service", for instance incorporating Big Data algorithms or artificial intelligence into their product range. Developing your own software only makes sense if this creates possibilities for differentiation. As with PCs, in the world of Competition 4.0 suppliers should use existing products from the "community" wherever technically possible.

Forward integration may also be an attractive strategy. Expanding the range of services offered can reduce the complexity of the relationship between industrial customers and their suppliers. Producers of drive systems, for example, might want to add integrated drive control solutions to their portfolio. Suppliers of engines could develop a solution for executing individual three-dimensional motion profiles. Manufacturers of robotic systems could use their systems knowledge to offer a complete solution for assembly lines.

Expanded portfolios like these require companies to rapidly develop new competencies. This can be done through strategic partnerships, acquisitions and mergers. Suppliers will increasingly have to join the M&A game in the future. But before they do so, they need to answer some fundamental questions. In which product areas does a partnership make sense? Where would an acquisition be useful? In which areas is no action needed? It is crucial that suppliers retain their knowledge of the entire system

and continue to offer core elements of the portfolio themselves. Otherwise they risk losing their leading position and being seen merely as second-tier suppliers.

UNIQUE OPPORTUNITIES FROM COMPETITION 4.0

Industrie 4.0 is both good and bad news for suppliers. The bad news is that the cards are being reshuffled: Companies cannot afford to rely on the current success of their product range or market position given the rapid pace of technological change. Only those players that do the necessary work quickly and thoroughly, positioning themselves along the three strategic levers, will remain successful. The good news is that the upheaval brought about by Competition 4.0 opens up unique opportunities for newcomers and innovative incumbents. Make your products and processes future-proof today and you can be a major winner in the digital transformation that is taking place in industry.

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PEOPLE, MARKETS AND MACHINES

Intelligent products and tailored services: Digitization is revolutionizing the way we live and work. Yesterday's science fiction is today's reality.

Lending a hand

With the da Vinci Surgical System, doctors can perform operations remotely. The robot allows the surgeon to work with greater accuracy, while the minimally invasive technique reduces the risk to patients.

At your service

Server farms are the nerve centers of a networked, digital economy. In the old days telephonists used to connect people by hand; nowadays computers send huge amounts of data around the globe in the blink of an eye.

Shopping walls

No more waiting in line. In a Seoul subway station commuters can shop with the help of an app. You photograph the QR code under the picture of the product and the goods are delivered directly to your home. A similar service is also available at London's Gatwick Airport.

"We want to be the **'Intel Inside'** of the digital economy."

Bernd Leukert, Product Chief at SAP, talks about cultural change at SAP, the significance of having German roots in the global cloud business, Industrie 4.0 in Europe – and hypoglycemic Japanese bus drivers.

**Interview: Thomas Rinn, Carsten Rossbach and Thomas Reinhold
Images: Andreas Reeg**

SAP has long been selling a digital product. What about SAP's own digital transformation?

Well, if I said there wasn't one I would clearly be in the wrong job! In the past the software, which we've now been building for the last 44 years, supported core value-added processes. In the future it will become a part – an essential part, even – of those value-added processes, including for traditional manufacturing companies.

What do you base that on?

In the old days you had a Production Manager or Plant Manager, plus an IT Manager. The two functions were clearly separated in the company's organizational chart. In the future they can no longer be kept apart. Some firms are already trying to break down the divisions by appointing a Chief Digital Officer who makes the two sit down at the same table.

And SAP?

We have a Chief Digital Officer – partly because we plan to distribute our software in future through digital channels and partly because in the age of Big Data we want to explore new, digital business models with our clients and on their behalf. In the future, sales specialists will still visit clients to show them the products, and they will still present the products to clients at trade fairs, but these activities will become much less important.

A lot more will be sold via digital marketplaces?

Yes, because digitization creates market transparency and offers insights into competitors' products. Some people don't like that, but if you don't address this area of competition you'll soon be out of the game entirely.

That's what a lot of people are saying. How do your clients react?

When the president of a bank tells me that more than 50 percent of his bauspar contracts now come via Internet platforms rather than the branches, then obviously there's going to be a major rethink in the banking and insurance market – and at SAP, too. One of the things our Chief Digital Officer is going to do is create an online store, a bit like the Apple Store. We want to offer products on a smaller scale, not only to CIOs and COOs but also to the heads of business units, whether they are Chief Procurement Officers, Chief Finance Officers or Chief Marketing Officers. We want to give them with the tools for optimum control of their business areas using digital support.

That sounds almost as if the Chief Digital Officer's role was that of a sales manager rather than the person responsible for digitization at SAP.

The question is, what comes first? If I want to drive the transformation, I can try to turn the world upside down and convince my employees about the change process. Or we can start at the other end and try to transform SAP internally by redefining our commitment to clients.

And is it working?

Well, it begins with sales, but that's not where it ends. It also affects develop-

"Today we develop software together with our clients," says Bernd Leukert (center). In conversation with Roland Berger Partners Thomas Rinn (left) and Carsten Rossbach.

ment, the area that I'm responsible for. The way we develop software has changed fundamentally. In the old days we tried to understand the market, recording specifications and requirements in documents that were then approved in review processes. In the traditional waterfall model that meant software development followed by quality assurance and market launch, followed by feedback processes. We had to wait 12 to 18 months just to get the feedback.

Is it quicker now?

Yes. Today we develop software together with our clients. One company recently suggested setting up a joint "Internet of Things lab" with us. In other words, our clients have the expertise in whatever industry it is, and we provide the digital competence. In the digital world you can't build software without defining new business models.

Talking of business models, you have been active in cloud transformation for many years now. What has been your experience?

Bernd Leukert

After completing his Master's in Business Administration at the University of Karlsruhe, Bernd Leukert studied for a year at Trinity College Dublin, Ireland. On his way home **he bumped into a friend who was working at SAP.**

What started out as a chat over a cup of coffee became the cornerstone of his professional career. In 1994 he began working as a software developer at SAP R/3. **Since 2014 he has been a Member of the Executive Board of SAP** with global responsibility for the development and delivery of all products across SAP's product portfolio.

In addition, he heads strategic innovation initiatives and drives the development of new growth opportunities at SAP, for example in the area of the Internet of Things, Industrie 4.0 and SAP S/4HANA.

Consuming software from the cloud will be the standard default model in the future. No company is setting itself the goal of owning and operating a datacenter with all its hardware. What they want is to use the software. Today the only argument for running a datacenter yourself is that it gives you control over the data and its security. The question is no longer whether I should set up, under the CIO, an IT department whose job is to be constantly testing, installing and running software.

But there's more to it than that.

The second argument is that companies will find it increasingly difficult to keep up with the fast-paced cycles of digital change. Their IT departments need to be permanently up-to-date with the latest knowledge. Sometimes it's the CIO who puts on the brakes, although he's actually the person who should be driving digitization within the firm. But he needs a team that can actually implement what the market offers. We are seeing a change from having a product to simply using it,

from ownership to consumption. The important thing is how quickly you can implement innovations in the company, how quickly you can use those innovations to generate value. If you block the path with your own IT solutions, you risk being quickly overtaken by solutions from the cloud.

SAP has intentionally cannibalized itself. Did you face any resistance? How did you keep people on your side during the revolution?

That was a major transformation for SAP. We had to suddenly explain to our staff, after telling them for years that margin was important in the capital market, that now growth in the cloud was the important thing in the short term, and with it market presence and market penetration, and only then margin. That is particularly difficult for a company listed on the DAX and rated by financial analysts on the basis of traditional criteria, while new startups are rated purely on the basis of growth.

Do you have a secret recipe for cultural change?

I can only tell you about my experience. If you think you can leave existing structures unchanged and simply add new goals you are doomed to failure. Later on you will realize, painfully, that no change has actually taken place. You need to consciously establish a new business model and a new way of working, ideally in a separate organization. We recognized and implemented this at SAP. The second thing we had to learn – and this was the reason we made some acquisitions – was that moving into the cloud doesn't mean transferring overnight all the software that controls your core processes from your on-site datacenter to a cloud datacenter.

So, there are organizational forces that resist change?

Yes. But the person who makes the purchase decision about moving to the cloud is usually not the IT boss but the Head of Sales or the Head of Procurement.

Why is it important to bear that in mind?

At the time, we made the mistake of transferring SAP Business ByDesign to the cloud as an entire suite, while the market was initially only looking for partial solutions. Prior to the acquisition of SuccessFactors, Ariba, Concur and Hybris, integration was considered easy; later it became a major dilemma. What the market taught us was that you must consciously give up known assets in order to later revitalize them and convince customers of the added value of integrated business processes.

You say the cloud is coming. In the past the CIO was your customer but now that is less and less often the case. In other words, at the same time you have to shift the focus of your people onto other target groups …
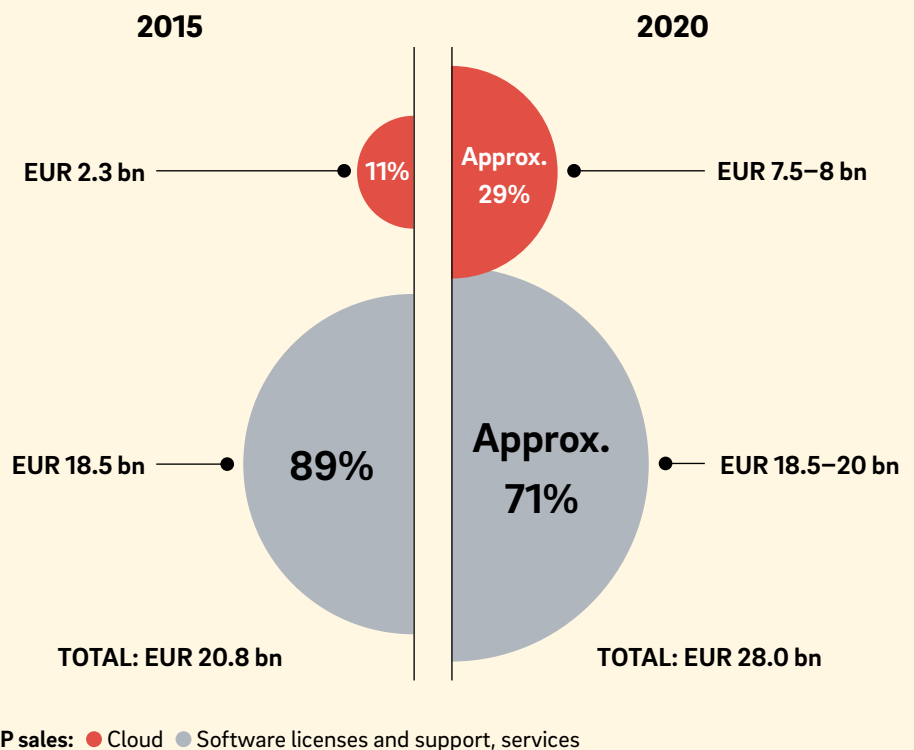
Exactly.

… and then reach those target groups functionally and via business areas, in some cases regionally. So, you get rid of your own customer basis in order to position the new product …

Well, not quite. We wouldn't have been able to build close relationships with the heads of HR departments like those we gained by acquiring SuccessFactors. Suddenly we had a development and sales organization that was focused exclusively on HR directors and their departments, and had built up relationships with precisely this group. The CIO was, intentionally, our second point of contact. We didn't just acquire a piece of software, a datacenter and a cloud business – we acquired customer relationships.

… which would have been inconceivable simply through organizational growth.

GROWTH IN THE CLOUD

Cloud services are becoming a significant factor in sales growth at SAP. Their share of total sales is set to almost triple by 2020, with even stronger growth in terms of hard cash.

2015

EUR 2.3 bn — 11%

EUR 18.5 bn — **89%**

TOTAL: EUR 20.8 bn

2020

Approx. 29% — EUR 7.5–8 bn

Approx. 71% — EUR 18.5–20 bn

TOTAL: EUR 28.0 bn

SAP sales: ● Cloud ● Software licenses and support, services

Source: Oxford Economics/SAP analysis update 4/2016

The second thing we could never have managed is the internal transformation – teaching the team that we're not just building software anymore but also responsible for operating it. We had no experience of what it meant to provide customers with a system 24 hours a day, 7 days a week, 365 days a year. In contrast, the CIO of every customer's company had this experience, but they were too slow. Through the acquisition we bought in speed as well as access to the decision-makers.

What can we expect to see from SAP in the area of service? We've heard about full responsibility for topics such as mobility in the area of processes.

Two points. First, we're making all SAP's core business processes available as digital services. But we're going further than that. The other thing is that we plan to provide software that will support the new business models that are made possible by digitization. And I use the word "support" intentionally: We don't plan to take over the business models. We want to be the "Intel Inside" of the digital economy.

Is there any alternative for SAP?

We could have become to the industry what Google is for consumers. That would have put us in direct competition with our clients. But we decided against it. We want to function as an enabler for all our clients, providing them with a digital platform and building services through co-innovation.

And the second point?

We are active in 25 different industries and we want to enable our clients to offer digital services across all industries. I never get tired of telling automobile manufacturers that although they can "only" offer mobility as a service, they have a tremendous opportunity: Their customers own the vehicle, in other words the platform. They can offer a whole host of other mobility services via that platform through digital access.

What sort of services are you discussing with them?

Why should the vehicle only offer me a navigation system that shows me the way

"In the digital world you can't build software without defining new business models."

from A to B, taking into account traffic jams? If I'm driving into downtown Heidelberg, say, I'd also like to be able to reserve a place to park my vehicle using an integrated system and not turn up on a Saturday morning to find all the parking garages full. And you can take this further. Once I've found a place to park my vehicle, I currently have to search for a parking meter using a card or chip, then go back to my vehicle. Why can't I just get in my car and go, and have the system identify the vehicle and send me a monthly bill, like with my cell phone? The same goes for filling up with gas or booking restaurants. The vehicle manufacturer could charge the party involved a small fee each time. At SAP, we want to be the firm that networks industries and services and brings them into the vehicle.

So, we're just at the beginning of the road.

The same thing goes for other industries. Customers don't really want to own air compressors, they want to consume compressed air. If German manufactur-

ers claim to have a quality advantage, they should offer to put a compressor in your factory and just invoice you for use of the machine.

But they already do – Kaeser, Air Liquide. Why do we need SAP?

Because we can make it digital. We can continuously monitor the state of the compressors. We know all about connecting end devices to platforms via sensors, offering evaluations, triggering warnings from the service center, preferably before the compressor breaks down. That's predictive maintenance. Turning this into a business model – along the lines of "my vehicle never breaks down" or "my compressor has zero downtime" – is a clear competitive advantage. We have the necessary platforms on which to connect innovative business models to a digital core. That brings the Head of Production and the CIO together. Suddenly they discover that they like each other and want to work together.

But there are plenty of companies specializing in monitoring solutions that can beat you on price or speed because they occupy niches. Is size an advantage or not?

Of course, such companies do exist. They make our life difficult with some clients, there's no denying it. But many of them have problems when they try to go beyond the pilot project, proof of concept or isolated area of business to global rollout. That's where scalability comes in. That's what separates the wheat from the chaff. Suddenly the client needs service centers in Latin America, Asia and southern Europe – and it realizes it's sourcing the service from a startup.

So, really, you are saying you support operator models with software?

Yes – innovative, digital business models.

Many companies are unable to go on delivering services for long without advance payment. They need to be selling machines in order to be financially stable. Could SAP act as a partner by supporting financing models?

What we offer is a risk-sharing model. We don't want to develop financial services as such.

"We want to be the firm that networks industries and services."

Don't you have to, for your business to be successful?
I don't think so. Companies are willing to share the risk with us along with the benefits. For instance, we offer to develop digital solutions without the client having to pay for the licenses right away. This will be the next pillar of our business that grows in importance as a result of digitization. The only risk for clients is if they change their model and have to pay large fees to SAP for licenses or to the cloud, but their customers haven't accepted the new business model yet. If we're willing to share the risks with our clients and co-innovate with them, then the days are over when SAP makes prelicensing deals worth millions.

Instead you have a more sustainable business model, one that allows for advance planning.
Exactly. Machines and plants are getting connected, vehicles are being networked, and that also makes advance planning easier in our industry. But for the financial market, it still means that neither the customer nor SAP has those big upfront deals at the beginning.

In the age of Industrie 4.0 it seems like ev- eryone should be offering their own platform. Other companies also want to be the enablers for digital business models. How many platforms can there be?
I have a strong opinion about that, one that not every company agrees with.

That's what we thought.
I look them straight in the eyes and ask them what they want their company's core competence to be going forward. If they want to compete with SAP, Microsoft and IBM, that's their prerogative. We don't plan to start producing lawn mowers or refrigerators – although we could, and indeed some IT companies are actually doing this, such as Google and Apple with their cars. I believe that companies that do not look for a strong IT partner will fail sooner or later.

Firms that work with you don't need to worry that you will monetize their data again elsewhere?
No. We give our clients a written guarantee of that. The European General Data Protection Regulation with its right to data protection and privacy will ensure that other corporations do the same in the future. Any company that breaks the rules will have to pay 4 percent of its annual revenues as a fine, so if they do it 25 times that's all their revenues gone for the year. We've always supported these ethical principles.

Data security, data protection … Do your clients still see you as a German company or as a multinational corporation?
We are a global company with our head office in Germany. Our company is committed to the moral principles of the Western world and respects – and indeed goes beyond – the requirements of both German and European data protection regulations.

Is it sometimes useful to position yourself as a European company, as people still have reservations about giving their data to the cloud?
Yes, there's no secret about that. It's not just about technology, it's about trust. For more than 40 years we have had access to our clients' data and intellectual property. And we have never misused it. That's something I'd like to stress. This is something that is highly valued in digitization. In my discussions with decision-makers, security and trust are always among the top-three discussion points. So, having our head office in Germany and having the ethical roots of a German firm gives us clear advantages.

Let's leave SAP for a moment. You were one of the key individuals driving the Industrie 4.0 Platform. How satisfied are you with the progress that has been made?
We have made great progress moving the topic of Industrie 4.0, which was focused on production, onto digital services. In particular we have brought together businesses, social partners, trade unions, politicians and academics, and also given SMEs and Mittelstand companies access to digitization via the Labs Network Industrie 4.0. Without a large initial investment. That was an extremely big hurdle.

So, what's next?
Now we need to make it clear to everyone that the industry's digital race will not be won or lost in Germany or Europe. We must open ourselves up and work with

partners in the US (the Industrial Internet Consortium) and Asia. We have made great progress, enabling access to technology, creating a model for how to define and deploy standards – the reference architectural model RAMI 4.0 – and providing practical examples. The next step is to increase our cooperation with partners in Asia and the US. For the first time, the IIC's quarterly meeting took place this September in Europe, in Germany – or, more precisely, at SAP. We spearheaded this, together with Bosch, because we are represented on both committees. Digitization will not be contained by national or continental borders. In fact that lack of physical boundaries, if politicians allow it, is one of the great things about digitization.

Who do mean when you talk about Asia – China? Japan?

The Chinese are very ambitious. They want to turn Made in China into Innovate in China by 2025. Anyone who knows how disciplined Chinese companies are should see this as a wake-up call. Digitization is also a fresh opportunity for Japan, which after kaizen and lean almost got left behind. I often visit Japan to position smart services and the Internet of Things and forge innovation partnerships. And not only with the traditional electronics group that everyone automatically thinks of, but also with clothing manufacturers.

That sounds interesting …

For example, in one Japanese city we're planning a pilot project with bus drivers.

Seeing the bigger picture: "Increase cooperation with partners in Asia and the US."

Why not put sensors in their uniforms that can spot if they're feeling tired or about to go hypoglycemic even? If they're tired, sounding an alarm is enough. If they're going hypoglycemic, the bus can be automatically brought to a controlled stop. We're also talking to mining companies. Sensor technology is already used in the passages and shafts but not attached to the miners themselves. Recently there was a fatality at a German chemicals company when an employee was crushed by a machine after he entered an area where he shouldn't have been. Sensors installed in safety clothing could make the machines shut down automatically in emergency situations. The necessary technology for this already exists.

What will support for jobs look like in the future?

We will see machine-learning and artificial intelligence being used in all applications. We need to transform our own applications into a decision-making support system. I see this as a major trend that will lead to the transformation of society.

Should we be worried?

The Mittelstand will change as a result of intelligent algorithms and machine-learning. But even if intelligent systems can take on more and more of the standard tasks, it will remain indispensable for successful companies to exploit and develop their employees' experience. At the same time new business fields and jobs will emerge in the digital world, creating new employment opportunities. The result will be a shift in skills.

Do we talk too much about digitization in physical processes and too little about digitization in intellectual work – in administration, office work, freelance professions?

Yes. We will see a massive change in intellectual work. Personally I believe that machine-learning, artificial intelligence and understanding the environment in which people operate will become much more important in the future and will start entering our everyday lives.

Heaven-sent business

The cloud is changing the rules of industrial automation. New entrants don't have much time left to rethink. Top management must get involved.

by Carsten Rossbach and Daniel Lock

Field, machine, factory, enterprise: Many engineers still divide the world up along the lines of the classic automation pyramid. Their new competitors from the IT industry take a rather different perspective: Thinking in terms of cloud categories means that instead of physical objects you see digital layers in which new business models can emerge. At the bottom, in the physical layer, we have the sensors, actuators, embedded computers and network components – supplying metrics for production, performing actions, doing calculations and relaying information. Here little has changed. But directly above the physical layer, in the cloud service layer, is where the competition for new solutions for In-dustrie 4.0 begins – solutions such as predictive maintenance for machines and maximum transparency about the current performance of factories or wind farms, say.

BASIC SERVICE: CLOUD INTEGRATION

New service providers are already fighting for market share with their various business models. In the simplest model, the company enables its clients to connect to the cloud and the many services it offers. Firms such as New York-based Temboo connect sensors and other hardware from the Internet of Things to online services and databases via the cloud. The company acts as a digital go-between, performing critical security functions such as authentication on behalf of its clients, as well as transporting data. Temboo even offers simple feedback and control mechanisms. For example, its clients use the cloud service to determine the level of water tanks and to detect and deal quickly with any leaks. Other companies monitor medical trials or enhance data analysis. These companies do not provide their clients with anything more than data transport and simple evalua-

Cloud calling: Companies are outsourcing more and more jobs, and service providers are expanding their range of services.

P. 36–37; Photo: Bloomberg/Getty Images

tions, and this applies to all applications. The clients have to do the data storage, management and analysis themselves.

FROM ANALYTICS TO COMPLETE SOLUTIONS

Other providers of cloud services also perform the latter tasks on behalf of their clients. Companies such as Xively and Amazon with Amazon Web Services (AWS), for instance. In addition to pure connectivity, their clients can access mathematical tools that they can use to analyze streaming data in real time, for example. This requires so much computing power that outsourcing it to the cloud makes sense for many businesses. Other firms take up the offer of NASA's Mars rover to store and analyze large volumes of patient data and measurements.

Providers of complete cloud solutions for entire industries go one step further. Traditional industry heavyweights are trying to gain a foothold in this segment of the market with a combination of years of industry knowledge and newly developed IT know-how. Besides automation, they also offer control of certain applications. The Siemens MindSphere, for example, is a platform that besides secure data transport and storage also enables companies to optimize their industrial assets; MindApps provide predictive maintenance for plants and enable them to be optimized in line with predefined criteria, such as energy or resource consumption. GE's Predix-Cloud is a similar product. With its help, apps can be developed for the predictive maintenance of wind turbines, for example.

The machine-tool company TRUMPF has also recognized the potential of the cloud. Through its subsidiary AXOOM it offers a digital platform on which customers can easily network all the steps in the value chain. "Consistency of the horizontal value chain is currently a major issue in industry," says AXOOM's CEO Florian Weigmann. "Companies want maximum transparency – from tender-

CLOUD EXPANSION

More and more processes and services are moving to the cloud – and global spending is growing accordingly.

Spending on cloud infrastructure
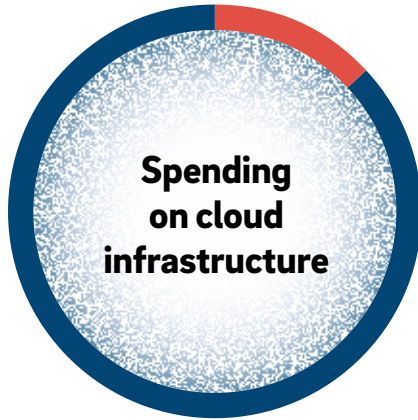
13.1%

CAGR from 2016-2020, from USD 37.1 bn to USD 59.5 bn

Spending on public cloud services

19.4%

CAGR worldwide from 2015-2019, from approx. USD 70 bn to more than USD 141 bn

Source: IDC 2016

ing, material procurement, production planning, material management and production to shipping and invoicing." Each customer has its own specific needs and uses a different software system, so the offer can be structured in a modular fashion. That way it will suit clients needing an ERP solution as well as firms looking for a manufacturing execution system (MES), say.

ENCRYPT AND CONNECT

Via the Internet, machines produced by different manufacturers can be encrypted and connected to the AXOOM cloud. The infrastructure for European customers is located in Germany, guaranteeing data protection. "Our clients see current data from production on dashboards," says Weigmann. "This includes information about the condition and utilization of the machines. With permission from other clients, it is even possible to carry out benchmarking between different companies."

Deutsche Telekom offers its clients a similar service with its Cloud of Things. Again, firms can transport their data to the cloud and have it evaluated. "This offer is a kind of toolbox with all the basic functions needed for the Internet of things," says Marketing Manager Christian Krebs. "It saves our clients a lot of effort when developing the solution, the required IT infrastructure and the security measures, for example." Besides displaying current sensor data and providing functions based on the data such as alarms and predictive maintenance, the Cloud of Things also helps protect against theft by using GPS to localize machines (geo-fencing) and supports automatic firmware updates. Unlike most of its competitors, Deutsche Telekom has its own network. In the future it will be able to support wireless networking of equipment and devices using the new mobile communication standard 5G, for example, or carry out local data analysis using "edge computing", where time-critical calculations are carried out as close
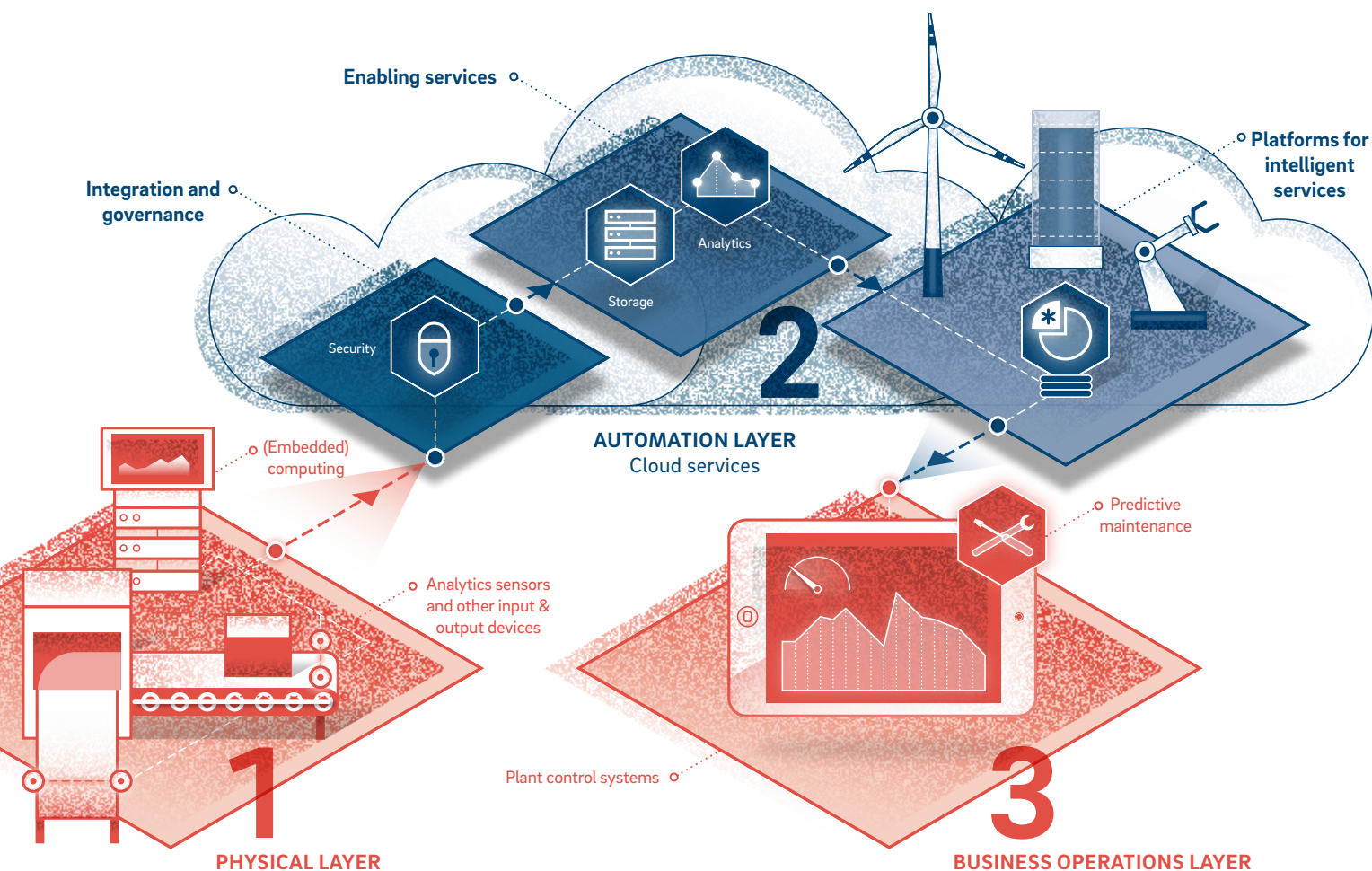
as possible to the customer's location in order to achieve reaction times in the milliseconds.

DIFFERENTIATE ALONG FOUR DIMENSIONS

Companies aiming to establish themselves as providers of cloud services can differentiate themselves from the competition in four key areas. Besides the services they offer (integration into the cloud, analysis and data management or complete industry solution), the payment model, the technology platform, and the level of value creation play a critical role.

In terms of payment models, pay-per-use gives customers the greatest flexibility and at the same time ensures cloud providers a relatively high margin. The basis for calculating the fee can be the amount of computing time used, for instance, or the volume of data traffic. Providers of complete industry solutions often charge a basic fee, which may depend on the number of users. In a freemium model, customers can use certain services for free but have to pay for anything that goes beyond the basic offer.

The technology platform is another area for possible differentiation. Service providers need to decide which services they want to use to make themselves stand out from their competitors. For particularly time-critical applications it would be possible to combine cloud and edge computing, for example, whereby data would first be processed locally then sent to the cloud. The services offered by different providers can easily be combined using networking, making it simple for companies to adapt their level of value creation in line with their own offer. They can decide what services they want to provide themselves and where it would make more sense to include services from partner companies. Alliances will therefore play an important role in the world of the cloud. Firms providing complete solu-

Enabling services

Integration and governance

Platforms for intelligent services

Analytics

Storage

Security

2

AUTOMATION LAYER
Cloud services

(Embedded) computing

Predictive maintenance

Analytics sensors and other input & output devices

Plant control systems

1

PHYSICAL LAYER

3

BUSINESS OPERATIONS LAYER

tions for specific industries could get together with Amazon to buy basic functionalities, say, allowing them to concentrate on their core competencies.

TOP MANAGEMENT MUST GET INVOLVED
Many companies have already jumped on the cloud bandwagon – international corporations such as Siemens and GE as well as startups. New entrants don't have much time left to position their offer in this fast-growing market. Top management must get involved: The new services must be developed quickly and at the same time form part of a long-term corporate strategy. It's not enough to push

the issue at CIO or CTO level: The CEO needs to be fully involved.

Large companies especially should not see cloud services simply as an extension of their traditional business. A more promising approach is to outsource these activities to new units that can act flexibly, like startups, and report directly to the CEO. Firms must also pay close attention to cyber security right from the outset: Increasing networking based on known IT standards makes industrial plants more susceptible to attacks. Finally, companies should pursue a flexible development approach and work with pilot customers,

enabling them to improve their products little by little rather than waiting until they find the perfect solution.

DON'T DELAY
This new way of thinking goes against many established habits in industry. But if companies fail to adjust on time, the cloud will not be shone through with rays of opportunity but rather hang menacingly over the providers of traditional automation technology with the promise of storms ahead.

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I, Robot?

**Deregulation, collaboration, digitization:
Japan is modernizing its industry. And robots are
playing a vital role.**

by Daisuke Nakano

Japan is a land of future technologies. It doesn't matter if it's fuel cells, sensors, or nanotechnology – the island country is a leader in many sectors. When it came to digitization, however, for a long time Japan assumed an observational role. That could now be changing. For around the last two years, the Internet of Things (IoT), Big Data, and Industrie 4.0 have been at the top of the government's priority list: By the time Tokyo hosts the 2020 Summer Olympics, the so-called "fourth industrial revolution" should be generating around 5 percent of the gross domestic product.

The plan is to reach this goal through a number of initiatives. For one, Japan wants to relax regulations in certain areas, for example by promoting the commercial use of drones and bringing self-driving cars to the streets of Tokyo by 2020. A closer collaboration between businesses, science, and politics will also be pushed. This will treble the amount of research funds that companies provide to universities and other institutions by 2025 – to the figure of JPY 240 billion (around EUR 2.1 billion).

INNOVATION AND ICT

In addition, several platforms and committees have been newly set up in which company representatives, scientists, and public officials can work together to plan the funding of promising industrial sectors. Among them is the *Smart Japan ICT Strategy*, which is seeking to make Japan the "most active country in the world" in the area of information and communication technologies by 2020. Wider-ranging is the interdisciplinary *Strategic Innovation Program (SIP)*, which will provide JPY 50 billion to projects in ten industrial sectors during the current fiscal year (by the end of March 2017).

The government is placing especially high hopes on robot technology – a sector in which Japan is a worldwide leader. According to the Ministry of Economics in Tokyo, Japan produced a good 50 percent of all industrial robots worldwide in 2011. Even if this share may have changed in the meantime, manufacturers such as Fanuc, Yaskawa, and Kawasaki Heavy Industries are producing for a market that boasts annual percentage growth rates in the double digits. According to the International Federation of Robotics (IFR), in 2014 annual revenues reached USD 10.7 billion.

A STEP FURTHER

"The robot boom marks one of the most important milestones in the implementation of the fourth industrial revolution," says Joe Gemma, President of the IFR, presenting the latest figures. With their digital interfaces, industrial robots can be seamlessly integrated into the networked structures of smart factories. The number of purchased service robots is also increasing, according to the IFR. Japan is taking this trend a step further – with the development of increasingly advanced models including the so-called "humanoids" that have human-like limbs.

Since 2000, for example, Honda has been developing the *Asimo* robot that can make friendly greetings, open cans of soda, and climb stairs. The mobile company SoftBank is marketing a service robot called *Pepper* that's fitted with a screen and language system. And the electronics group Toshiba is programming robots that look like young women at first glance – including facial expressions and gestures – for tasks as receptionists and interpreters. Some of them are already in use: At a hotel near Nagasaki, the concierge, receptionist, porter, and wake-up call service are all robots.

In order to promote the even faster spread of robots and their digital networks, in May 2015 the government start-

Japan could especially profit from the increased application of robots.

Robot Revolution Initiative Council

ed the *Robot Revolution Initiative Council* led by the former head of Toshiba, Tadashi Okamura. More than 300 companies are members. On one hand, the Council concentrates on increasing the use of robots in nursing care, hospitals, and in disaster control. On the other hand, on nothing less than the modernization of the whole of Japanese industry, including the integration of IoT, Big Data, and artificial intelligence (AI) in the production process.

The government and experts agree: Japan could especially profit from the increased application of robots. The economy is suffering from an aging and shrinking population. Economists forecast that the demographic shift could lead to negative growth rates. In many sectors – and especially in construction and care – the labor shortage is already leading to problems. "Our mission is to offset a declining gross domestic product caused by a drop in labor productivity with the help of innovation," says Yuko Harayama, who helped shape the technology policy of the Japanese government as a member of the Council for Science and Technology Policy.

CONFORMITY VS. CREATIVITY

The problem: Japanese society values conformity over creativity. Organizations are less open and strict hierarchies are still
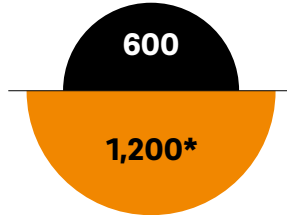
SPREADING FAST

With the help of robots Japan hopes to modernize its industry.

▶ **Industrial robots:**
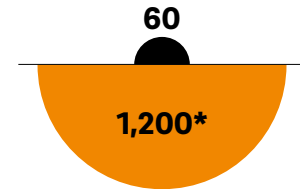Japan has great ambitions on the domestic market

JPY bn

600

1,200*

2014-2015
2019-2020

▶ **Service robots:**
The market is expected to grow by a factor of 20 within 5 years
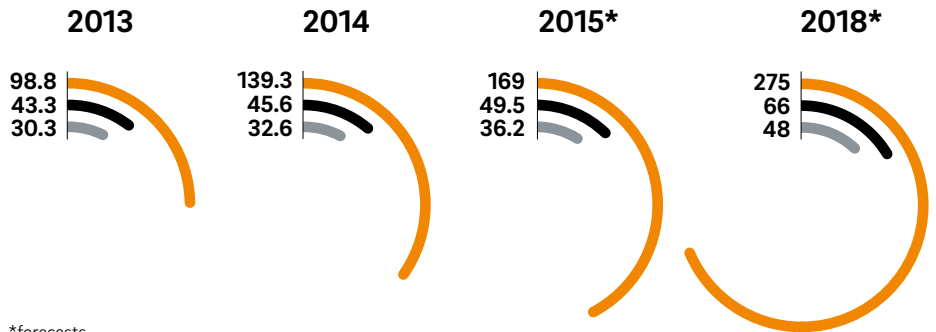
JPY bn

60

1,200*

*JPY 1,200 bn correspond closely USD 11.5 bn

OUTPACING THE COMPETITION

No comparison: estimated annual shipments of multipurpose industrial robots ('000 units).

● Asia/Australia   ● Europe   ● America

2013
98.8
43.3
30.3

2014
139.3
45.6
32.6

2015*
169
49.5
36.2

2018*
275
66
48

*forecasts

Source: World Robotics 2015

A different approach

Making data usable: Mitsubishi Electric

Takeshi Tamai,
Deputy General Manager
e-F@ctory Strategy and
Business Planning Project

What is the e-F@ctory Alliance?

It is a company group founded by Mitsubishi Electric. With around 300 partners, we offer intelligent solutions for production processes. Our goal is to reduce total costs for our customers. To this end, we connect manufacturing levels over easy-to-use interfaces with the IT level. Many of our customers already have a large data pool, but can't use it optimally. We want to make data not just visible, but also usable.

Who are your partners?

For the most part, they come from three sectors: system integration, software providers, and device suppliers. German companies such as Eplan and Balluff are among them. The strength of Mitsubishi Electric

the norm. In addition, there's a lack of IT specialists. "We lack data scientists, but also planners who understand how to implement this data into products and services," says professor Ichiro Sakata, Director of the Policy Alternatives Research Institute at the renowned University of Tokyo. That leads to a lack of interest on the part of many companies in how they can use their data optimally. "Even when data is collected and recorded, it isn't used as the basis for making decisions."

CLOSER TIES WITH GERMANY

Although Japan's companies traditionally place great worth on interaction with their customers, the use of social media and AI is still inadequate. Sakata is convinced that Japan's companies won't just understand the needs and desires of their customers better through the use of technology, but will also lower their costs. Personality profiles, for example, can be created with AI to show which employee would be best suited for a sales conversation with which customer. "That would be very time-saving and promote efficiency," says Sakata.

Still, the use of personal data is contested in Japan and security is often insufficient, as numerous scandals have proven. To ensure that Big Data is useful, the government has built platforms such as *Resas*, which combines the databases of cell phone providers, transport companies, and public authorities and makes them accessible to everyone. "There is a housewife blog, for example, that uses the data to forecast how crowded Disneyland Tokyo will be on any given day, at any given time," says Gou Soda, who is responsible in the Cabinet Office for the development of *Resas*. Elsewhere, thanks to *Resas*, Japanese mayors are able to analyze the trade flows of local companies for the first time.

Both Industrie 4.0 and Big Data have done a lot in Japan. What is still missing is a strengthening of international collaboration. This will be about setting standards as much as expanding into foreign markets. Japan and Germany resolved to be more closely involved with each other in the field of Industrie 4.0 with the signing of a Memorandum of Understanding in April. Groups such as Mitsubishi Electric and Siemens are working on the compatibility of their standards. And Japan's major corporations are looking abroad more and more when it comes to investing in IoT technology. This growing openness means growing opportunities – not only for Japan's economy, but also for German companies seeking strong partners in the Far East.

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From the customer's point of view

In Japan, the customer isn't just so much "king" as "god". Those looking to optimize their customer relationships should take this perspective on board.

▶ **1. TARGET GROUPS AND BRAND VISION**
A good product does not guarantee success. Companies must understand what added value their customers want and orient themselves accordingly.

▶ **2. PRESENCE AND ATTENTIVENESS**
Interactions with the customer don't only serve sales purposes. They help to convince a customer of a product and its uses as well as helping to foresee changing needs.

▶ **3. COSTS DOWN, USE UP**
Smaller and lighter components and modules improve efficiency. Partnerships with innovative suppliers are essential to achieve this.

▶ **4. REDUCE DELIVERY TIMES**
Those who supplement their stocks with flexible intermediary products can quickly make a larger variety of products and services available.

▶ **5. OPTIMAL DELIVERY DATES**
In order to limit the costs of their inventory holdings, companies should determine an optimal time frame for delivery, for themselves and for the customer.

▶ **6. ADDITIONAL REVENUE**
Extensive consulting with the customer on the use, handover, and disposal of the product enables increased sales.

▶ **7. REINVEST PROFITS**
Companies should make funds available to create added value for the customer. Moreover, investment in artificial intelligence enables gains in productivity.

lies at the manufacturing level. In order to collect the incidental data, however, and digitally measure it, filter it, analyze it, feed it into an IT system, and use the results in real time to manage production processes, we need an alliance of experts.

Who are your customers?
They come from several sectors. Since we founded the e-F@ctory Alliance 13 years ago, we've completed around 7,000 projects worldwide. One example is the digitization of an Intel semiconductor factory in Malaysia. By containing costs and improving the decision-making process, USD 9 million is now saved there annually.

How do things differ from Germany?
Our approach is different. In Japan, we build gradually on available solutions, whereas Germany is pursuing the "ultimate smart" vision. So far the results are similar. Nowhere is there a factory that's completely "smart". Instead we're seeing a lot of small steps in this direction.
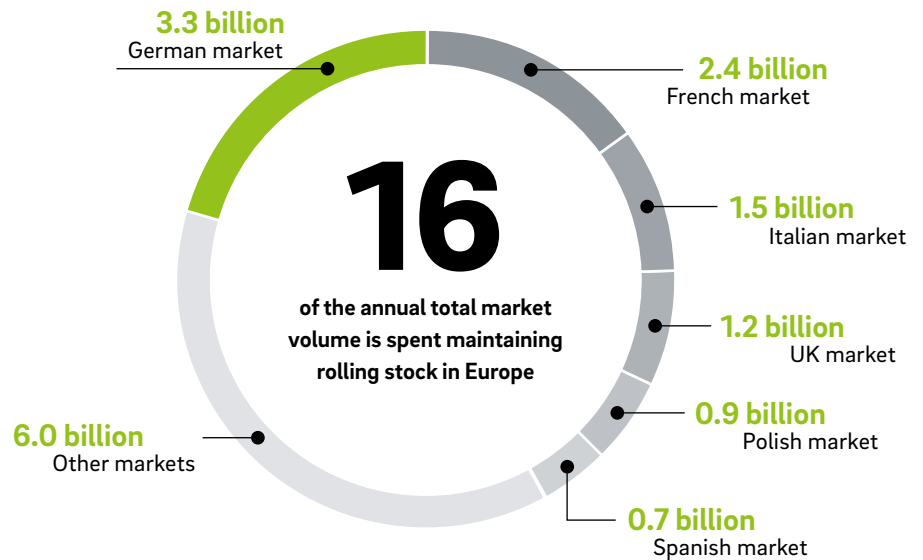
COO workshop

Food for thought: relevant knowledge and studies from Roland Berger

MAKING DIGITAL TRACKS

A large part of railroad companies' costs relate to maintenance. What will digitization mean for this sector, with its annual business volume of EUR 16 billion in Europe? We talked to executives from the railroad industry. We propose six levers for moving services in the direction of a digital Maintenance 4.0: share data, invest in sensors, review the overall picture, trust external experts, employ innovative methods, and improve your own competence.

http://rbsc.eu/2agr378

16

of the annual total market volume is spent maintaining rolling stock in Europe

3.3 billion
German market

2.4 billion
French market

1.5 billion
Italian market

1.2 billion
UK market

0.9 billion
Polish market

0.7 billion
Spanish market

6.0 billion
Other markets

THE TAKEOVER MERRY-GO-ROUND

There's a lot of noise about M&As at the moment. Consolidation among automotive suppliers is fueled by the need to develop expertise in technology, materials and processes. A study by Roland Berger reveals that many components for internal combustion engines and pure mechanical drives will soon wane in importance, current sales falling by as much as 40 percent. They will be replaced by components for alternative drives, electronic parts for networking, driver assistance systems for automated driving and new lightweight materials. Our magazine ACC Insights analyzes the biggest challenges facing suppliers.

http://rbsc.eu/1QLYfzg

40%

Automotive suppliers will likely **lose** 40% of **their current sales** due to technological changes.
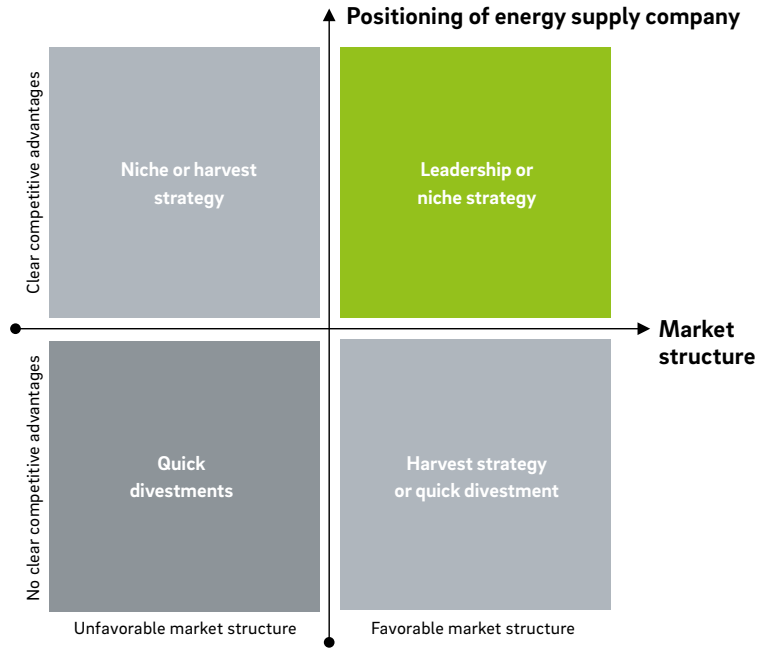
INDUSTRIE 4.0 ON "ARTE"

The impact of Industrie 4.0 is felt right across the economy. Be part of this revolution, training your employees and digitizing production – otherwise you run the risk of getting left behind. So says Thomas Rinn, Partner at Roland Berger, in an in-depth documentary produced for the French-German TV channel ARTE. SMEs in particular still lack the necessary momentum. Thomas Rinn's French colleague Max Blanchet, also a Partner at Roland Berger, says that many businesspeople are still hesitating because they confuse the concept of Industrie 4.0 with automation. In the documentary Rinn, Blanchet and other experts from Roland Berger talk about the great possibilities opened up by Industrie 4.0.
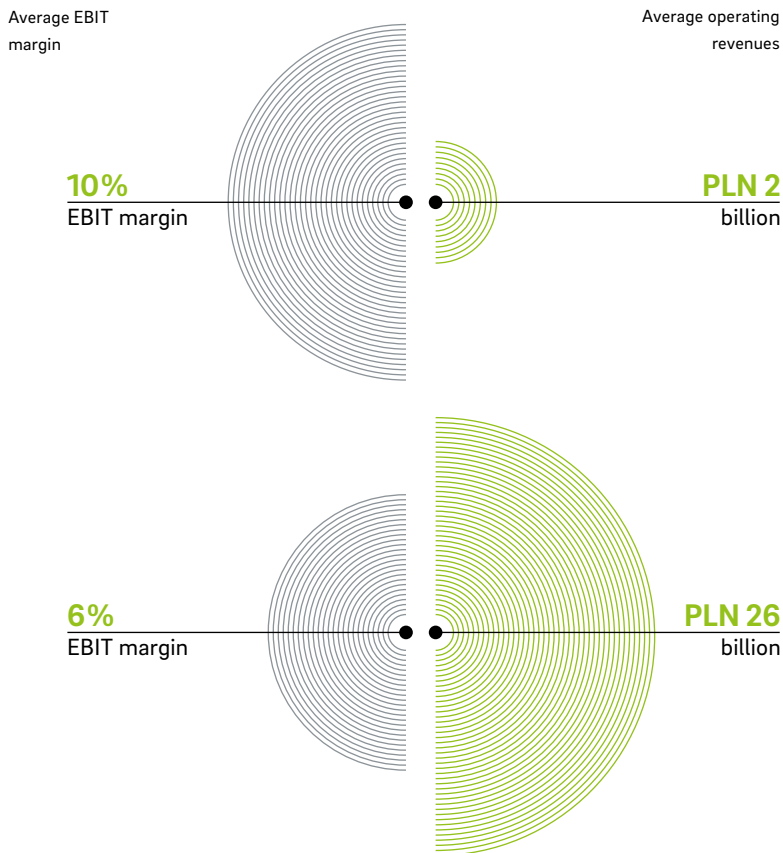
http://rb.digital/2fawkRw

Showdown in the energy sector

The trends of digitization, decentralization and technology convergence are threats to the traditional energy markets. They mean shrinking markets and dwindling margins for the companies that produce and trade energy. New products and players are emerging, calling traditional business into question. The transformation of the energy landscape is gathering speed, unhindered by national borders. The only credible response to these developments is an entrepreneurial one, combining courage and flexibility. To enhance company value and prepare themselves for further competition in the (very) near future, a leadership, niche or harvest strategy can be just as appropriate as quick divestments. Only if energy companies develop new businesses will they be able to survive the competition.

Positioning of energy supply company

Clear competitive advantages

Niche or harvest strategy

Leadership or niche strategy

Market structure

No clear competitive advantages

Quick divestments

Harvest strategy or quick divestment

Unfavorable market structure   Favorable market structure

Level of digitization (self-reported)

Average EBIT margin

Average operating revenues

10%
EBIT margin

PLN 2
billion

6%
EBIT margin

PLN 26
billion

Digital Index for Poland

Companies reporting the greatest degree of digital maturity are also ahead in terms of their financial results. In Poland, these companies recorded the highest average EBIT margin in 2015, at 10 percent, with average operating revenues of PLN 2 billion (almost EUR 470 million). By contrast, the least digitized companies had an EBIT margin of just six percent with average revenues of PLN 26 billion (EUR 6 billion). The current Roland Berger Digital Index suggests that Poland should focus on digitally transforming production and developing the professional skills of its workforce in order to expand its competitive edge. Poland is already ahead of the Czech Republic, Hungary, Romania and Bulgaria in this respect.

http://rb.digital/Digital_Index

Why the new <u>industrial revolution</u> affects us all

by Thomas Bauernhansl

By 2020 an estimated 50 billion objects and 4 billion people will be connected to the Internet. The potential services for people, vehicles, household appliances and machines are innumerable, including new forms of economic activity such as the sharing economy (use rather than buy or own) and prosumer models, in which consumers are integrated into value creation. At the core of this development are new system architectures known as cyber-physical systems (CPS), one of the most frequently discussed but often misunderstood concepts of the fourth industrial revolution.

The physical part of a CPS consists of a man-machine interface in which new forms of interaction are possible, such as speech and gesture control or augmented reality. The CPS uses sensors to help build a comprehensive digital picture of users' behavior. The cyber part of the CPS comprises a platform on which the data from the CPS is processed. For example, the data is correlated with other data from social networks, resulting in new services for users, as well as for the CPS. Thus, the truly intelligent functions are located on the platform and no longer tied to the physical system. This revolutionary architecture makes completely new value-added systems possible.

We can now integrate customers and entire development communities into the further development of services and products, thereby massively reducing the complexity costs of personalization, as well as the transaction costs. In addition we can dynamically adapt a product's functions to user demands throughout its life cycle, charging variable costs for this (pay-per-use). Platform-based business ecosystems blur the borders between B2B and B2C. The focus is no longer on the value chain – the journey from raw material to end customer – but rather on user-centric value creation on platforms, with all the related economic network effects. The concept of business-to-user or B2U arises, in which the objective is to quickly meet all the needs of end users.

To establish these value-creation systems, companies need to form both strategic partnerships and loose cooperation agreements with a large number of players – actors in the Internet economy, for example, or even their own competitors. The platforms themselves must be open and attractive so that partners get connected quickly. Openness, a willingness to change, and the ability to cooperate are increasingly the key success factors here. New business models are emerging around how user data is accessed and used. Here we are likely to see a substantial shift in core competencies and service offerings in the direction of IT and Big Data.

US corporations such as Google and Amazon are already trying to transfer their dominant position on the Internet, with its focus on services in consumer markets, to the Internet of Things and hence to industrial markets. Asia will quickly implement cost-effective automation, to all intents and purposes skipping the third industrial revolution. Europe, and Germany in particular, will be able to secure and expand its own value creation through Industrie 4.0.

It is crucial for customer value that all services are available via a single platform. Customers are not interested in logging in to multiple platforms and saving their data in various locations. The value-creation cards will be reshuffled over the next five years. The place and type of service provision will change and all economic areas will have to do their homework.

Professor Thomas Bauernhansl
Since 2011 Director of the Fraunhofer Institute for Manufacturing Engineering and Automation IPA and the Institute of Industrial Manufacturing and Management (IFF) at the University of Stuttgart.

Terra Numerata

In an exponential world, mastering the digital transformation in-house is all but impossible. The skills required come from a range of disciplines and are seldom found under one roof.

Terra Numerata™ unites those skills scattered across the continents, and it connects the dots of the fragmented digital company environment. In this sense, it aims to link Europe with the high-tech hubs in Palo Alto, Shenzhen and Shanghai.

Combined with Roland Berger's international network of experts and extensive knowledge of markets, Terra Numerata™ brings the best of the different worlds: sectorial and functional expertise plus connection to digital communities. This alliance meets the key expectations of corporate as well as startup players. It is open for collaboration and co-creation between partners, focused on making the digital transformation happen.

▶ In Berlin, we have a joint cooperation with Visa Europe: the SPIELFELD digital innovation hub, where everyone learns from anyone. It is all about agility and the hunger for the new.

▶ International ventures fund e.ventures collaborates with Roland Berger to offer learning journeys, trend radars, and business model disruption sessions with startups.

▶ In Paris, Roland Berger collaborates with NUMA, a startup incubator and accelerator, one of the key reference points of the digital environment in France. We offer Digital Labs, prototype development, and we help to launch innovative startups.

▶ In the US, Roland Berger joins forces with Wind River, a leader in delivering software for the Internet of Things, to offer the full range of strategic, business, technology, and developmental requirements for automotive customers.

Terra Numerata™ and Roland Berger tackle key stakes of digital transformation: from internal efficiency, revenues and a sustainable value proposition, to new disruptive business models. Join us!

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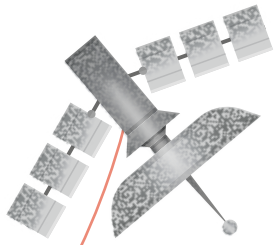
Individualized mass production and the return of industrial jobs to high-wage countries in the West: two of the key promises of Industrie 4.0