

BEST PRACTICE

Issue 3 / 2018

THE DIGITAL TWIN
CIO TALK UNIPER
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RUSHHOUR WITHOUT DRIVER

... with my little eye

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Adel Al-Saleh,
Member of the Board
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**“Coupling virtual
and real worlds
requires rules.
And technologies
that help to
maintain them.”**

ADEL AL-SALEH

Customer relationships without collaboration are a thing of the past – for example in terms of developing solutions that bring companies and customers closer together. Which can already be seen in some ways today: Artificial intelligence (AI) will play a pivotal role. According to IDC, 19.1 billion US dollars will be spent this year on exploring and simulating the human thought processes, so-called cognitive computing. This corresponds to an increase of more than 50 percent compared to the previous year. By 2021, that number will increase to \$52 billion. And for good reasons.

A study by the McKinsey Global Institute shows the effect this market will have on our economy and industry, as well as on our lives and work. According to the study, the sum of goods and services produced worldwide could increase by 1.2 percent per annum through AI alone. Sounds manageable, but is unsurpassed by anything that humanity has experienced so far in terms of impact. With the steam engine, which rang in a new industrial age worldwide with James Watt in the 18th century, it was 0.3 percent.

With the internet, it was 0.6 percent for almost three decades. Each year. Engineering and automation, mobility, cooperation, and the increasing agility of how we work consistently describe areas where exponentially progressive development without AI would be unthinkable.

It plays a very central role in the creation of the digital twin. Only with AI can a digital twin simulate and predict the behavior and properties of products, machines, and equipment – an ability whose value can only be approximated today for the entire lifecycle of a product, process, or business model. And which thus becomes a business necessity.

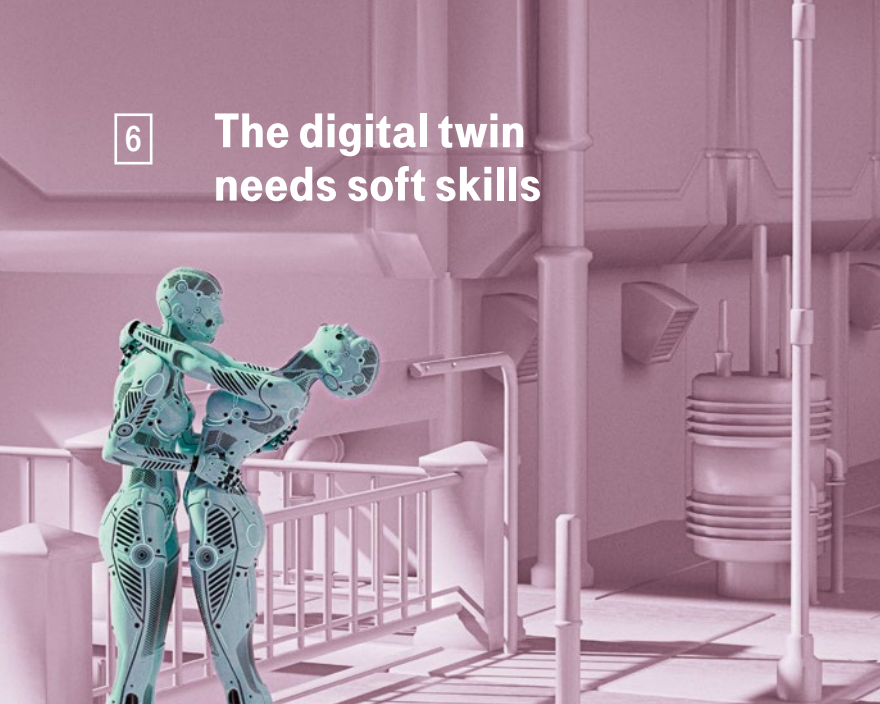
But this coupling of the virtual and the real world needs rules: ethical standards, uncompromising data protection, and maximum integrity. It also requires technologies designed to help keep the rules in place. IT security technologies, the Internet of Things (IoT) applications, cloud services, big data, and services in industries such as the increasingly important healthcare sector. For a beneficial co-existence. Between us and our future machines.

Best regards

Adel Al-Saleh

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The digital twin needs soft skills



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Matter of handling.

DIGITAL TWIN. Everyone understands the logic behind virtual representations of real products. Yet when combined with networks and clouds, artificial intelligence and machine learning take humanity and its digital twin to the limits of what should and should not be done.

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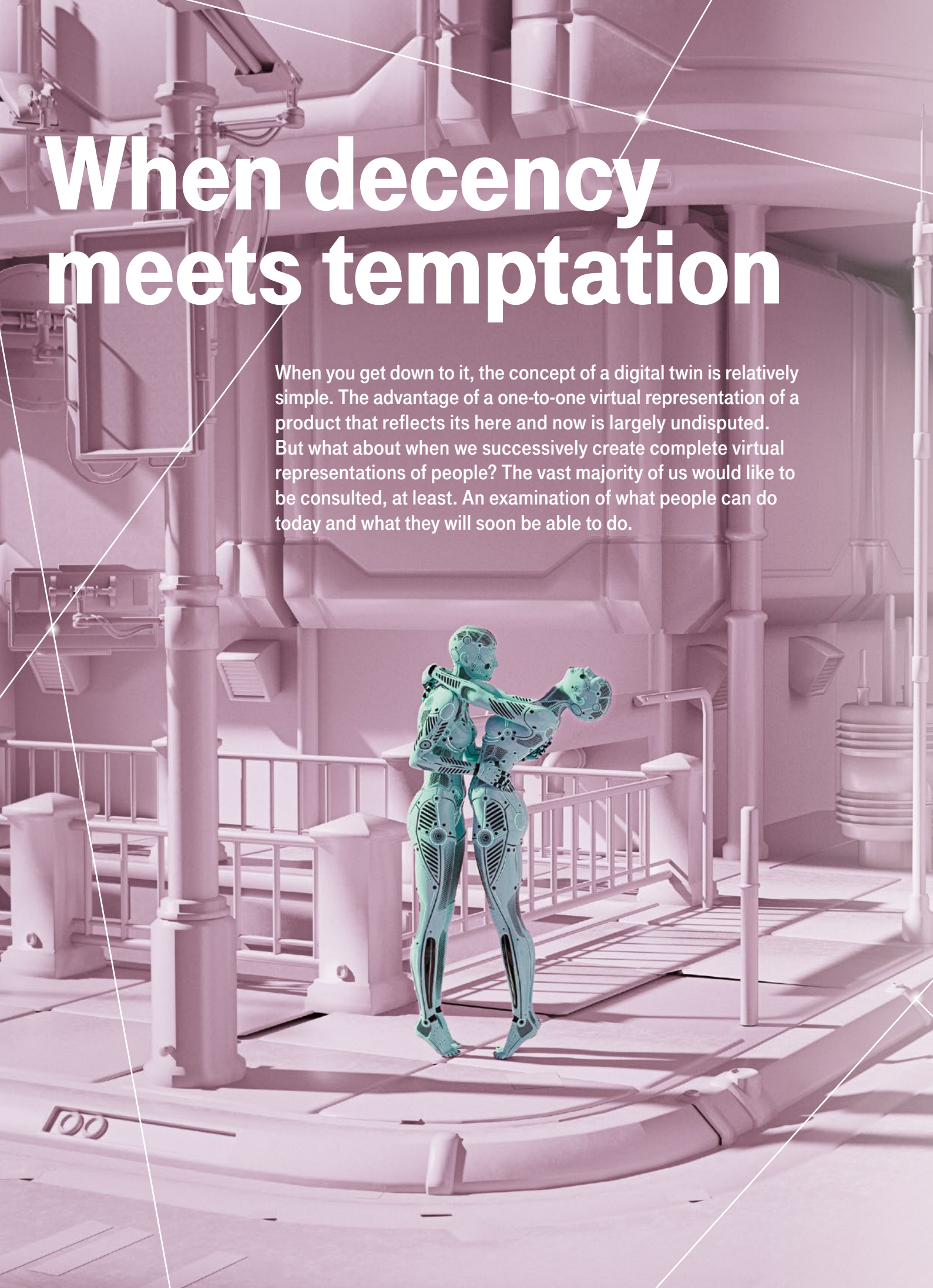
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When decency meets temptation

When you get down to it, the concept of a digital twin is relatively simple. The advantage of a one-to-one virtual representation of a product that reflects its here and now is largely undisputed. But what about when we successively create complete virtual representations of people? The vast majority of us would like to be consulted, at least. An examination of what people can do today and what they will soon be able to do.

COPY — Thomas van Zütphen

By 2021, the global business value of artificial intelligence (AI) will reach an unfathomable 2.9 trillion dollars. At the same time according to Gartner Research Director D'Onn Griffin in this year's July issue of the magazine Computerwoche, AI will save around 6.2 billion hours of worker productivity. It goes without saying that this productivity will still be generated, just not by us humans.

Sounds alarming, but in the face of such prognostications and the estimate that, with two million new jobs in artificial intelligence by 2025, significantly more jobs will have been created than lost, it is hardly surprising that enterprise and industry are working intensely on ways to take their value creation chains to the extreme with AI. For example, by using digital twins: virtual representations of specific products, systems or machines that accompany their physical counterparts analogous to the real product lifecycle (PLC) – over their entire life (see page 9 ff.). The energy industry is already talking about "plant health" when discussing the "fitness of their generator fleet" in lifespan calculations. Or, to put it another way: their energy-supplying power plants. Their welfare and proper functioning are at once a cost and benefit factor. Capex and opex. Profit and income.

Take Uniper: for a long time now, according to CIO Damian Bunyan, sensors and networks, IoT and, AI have made it possible for the operator of over 100 power plants worldwide "to use its own maintenance resources in a much smarter way than 10 years ago, thanks to predictive analytics" (see page 30 of the CIO Talk). But if this makes it possible to keep equipment, things, and technical infrastructures functional throughout their lifecycle and increase the earnings from their lifespan – why not, just as a first step, look after the health of us humans in the same way?

BETWEEN EASY AND FRIVOLOUS

As equally business-critical as socially fascinating is one point above all: are we handling the challenges that will soon be posed to us in building a relationship between man and technology that is profitable not just in terms of healthcare easily? Or rather frivolously? The fine line in between zeroes is on the question of how we're dealing with it. The more adept we become at exploiting everything technology can do, the more age-old virtues will turn into real soft skills. Responsibility, ethics, decency, morality will not only experience a renaissance, they will need to be imbued with immense significance, for this is a matter of data and transparency. Then, in the next phase, nanobots and man-machine interfaces. Even the limits of the gray area between what people can do and what they should do. And whether humans – literally in their essence – approximate machines and robots or

vice-versa. For this, what experts call unavoidable type of metamorphosis – either of the one or of the other – the virtual space is only the neutral ground. No longer as a training area. Or even more so?

This leads not just to legal questions, theological considerations, and medical reflections. On the spectrum of personal, transpersonal, and cultural identity down to the illusion of the self, computer philosophers are already posing questions about the ethics of machines and mechanical morality. Regarded ad hoc, a single mountain of questions that beg to be answered piles up. At the summit, as it were, are those about the fusion of personal identity with the dataspace of a virtual world.

For Dr. Wolfgang Schinagl, director of the Digital Content Research & Development Center at the Styrian Economic Chamber, one thing is certain: "The current age of digitization is followed by the era of virtualization, where algorithms render digital objects into complex, networked process systems. The step is parallelization, where the virtual and real world each involve strong, mutual interaction. And if the blending of real and virtual technologies results in personal identity getting sucked more and more into the dataspace of the virtual world, a virtualization of the self is inevitable." Yet, as no-nonsense as the lawyer's lecture was at the 21st International Legal Informatics Symposium at the University of Salzburg, the idea will not so dryly lose its strangeness. Getting used to it will be gradual – as the concept of cyborgs, for example.

THE APPEAL OF THE FEASIBLE

In principle, anyone whose body has a permanent, non-human part – such as a pacemaker or prosthetic arm – is already a cyborg. And in the rehabilitation of those injured in an accident or wounded in combat, there is no more than one connection between prosthetics and robotics. People around the world are currently working on refining what are called brain-computer interfaces (BCIs), which convert brain activity into signals for controlling things like computers, robots, or prostheses. The electrical brain signals are recorded using electroencephalography (EEG) or implanted sensors, analyzed by a computer and then translated into specific instructions. And each time life is made easier, it is not only those who are sick or handicapped who look at the interconnecting of man and machine with more and more positivity. And the rate of the relevant development possibly less vexing. For example, the founder of Tesla, Elon Musk, started the medical research company Neuralink in 2016 to work on the development of what is called "neural lace" technology. The goal is to fuse biological and digital intelligence. How far along research has come on BCI in particular became apparent in 2016 at the first "Cybathlon" in Kloten, Switzerland: people with only the power of their

Snappy investments

Company	Total R&D Spending (\$m)	R&D Spending as % of Sales
Alphabet	13.948	15.5 %
Apple	12.3	14.6 %
Microsoft	11.988	14.2 %
Facebook	5.853	21.2 %
Twitter	698	27.6 %

Source: FactSet

thoughts left used their brain waves to control an avatar in a virtual world. Yet to do this, computers need access. Personal progress, including with regard to health, is increasingly depending on how much we give up what is originally ours. This is already beginning in healthcare.

Turning back the clock to the present, companies like Alacris Theranostics GmbH are pursuing the goal of developing functioning, personalized healthcare and disease prevention based on "virtual patient" strategies (see article "A crash test dummy for medicine", page 22). Specifically, the spin-off of the Max Planck Institute for Molecular Genetics in Berlin, soon to be part of the multi-disciplinary EU project "DigiTwins," is optimizing treatment and prevention strategies using computers. In this approach, a "virtual twin" is used that can be treated at next to no cost and does not have to suffer any negative effects of treatments. According to Dr. Bodo Lange, the heart of this is the vision of "a truly personalized health and disease prevention system. A vision that will trigger a paradigm shift in healthcare by using the most advanced omics, sensor, computer and communications technologies to make possible truly personalized and preventive medicine."

INFORMATION AS PRICE, DATA AS CURRENCY

What did I eat and drink today, how much did I smoke? How far did I go on my bicycle, in my car or on foot? When did I even move and in what environment? How far we are willing to pay the price for subjective benefits and objective gains in quality of life with information has been apparent for years in how we interact with Amazon, Facebook, Google, Apple, and Microsoft. Anyone who claims these companies have a laissez-faire attitude about data protection that is similar to a large portion of their users would in no way run the risk of sounding unrealistic. The "Big Five" – so called in the US because, as an industry, they are so large they can exert political pressure on society – represent 40 percent of the shareholder value of all companies listed in the NASDAQ 100, at \$ 3.3 trillion. At the same time, the top five global tech giants invested \$76 billion last year in research, such as in the areas of big data analytics, AI, and cloud technologies.

Research on linking the neural nets of humans as much as possible with artificial neural nets is proceeding not just in the US. For scientists such as Nick Bostrom, director of the Future of Humanity Institute at the University of Oxford, it could (only) be another 300 years before humans have the chance to fully live in a parallel digital world. An artificial neural net will keep a copy of their brains up to date regardless of whether their physical bodies are still alive. Scientists call this world the Metaverse. And they call themselves transhumanists.

The most important question of all to be answered is: Do we want this? For whatever it is to which we pimp any type of our current nets: the fabric of relations between AI, IoT, BCI, digital twins and algorithms on the one hand, and prosperity and objective progress on the other, remains symbiotic. But for that result, for what we make of it, man is uniquely and solely responsible. Still.

MIRROR IMAGE WITH POTENTIAL

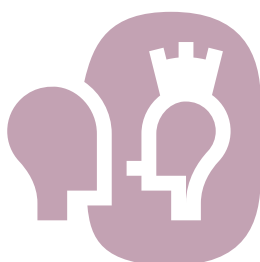
They help represent physical products and processes, predict their behavior and optimize their continued development: Digital twins promise much opportunity yet are barely being utilized.

COPY — Heinz-Jürgen Köhler

Silverstone on the last Sunday of August of this year – the Grand Prix of Great Britain: The bright orange Formula 1 car from the McLaren team takes the curve tightly, brakes at the peak, then accelerates mightily once again. What you do not see: a digital twin accompanies the real-world racer. The English team has created digital representations of their vehicles.



For people with prosthetic limbs, brain-computer interfaces (BCIs) promise to translate brain activity into control signals.



Comprehensive sensor technology records a multitude of data during the nearly 90-minute race and sends it to the computers at the company's headquarters some 80 miles away in Woking. Enriched with additional data – weather and temperature, for example – a digital twin of the race car is produced, a virtual representation in the real-life racing situation that provides prospective analyses. In collaboration with the University of Oxford and the consulting firm Deloitte, McLaren has been using digital technology for some time. “We’ve been doing this for 20 years and have created a digital model of the race car, a digital twin, but we don’t use that term,” explained Dr. Caroline Hargrove, CTO of McLaren Applied Technologies, in an interview.

NO CLEAR DEFINITION

A Google search for the German “digitaler Zwilling” currently returns 2.3 million hits, yet “digital twin” gets 316 million. Curious: most of them are in German. “The term is largely unused in the English-speaking world,” verified Damian Bunyan, Briton and CIO of the global energy company Uniper (see page 30).

That there remains to this day no uniform, binding definition of “digital twin” can quickly lead to misconception. “Many entrepreneurs think they have a digital twin just because they created a digital model of their products or

production,” said Dr. Kai Lindow from the Fraunhofer Institute for Production Systems and Design Technology. But that is not exactly a digital twin.

The virtual representation of a product or process that is fed with real data – this is the generally accepted definition. “For a digital twin, there has to be a digital master and a digital shadow,” clarified Lindow. The master would be something like a digital geometric model or, very generally, the master data; the data obtained over the lifecycle of a product or system would be the digital shadow. “If you put both together, you get the digital twin.” Different definitions focus on different aspects. What is undisputed, however, is that the twin is a comprehensive application for product lifecycle management (PLM) – with enormous potential. Such as developing entirely new business models. “Working out the specific application area for one’s own digital twin and focusing on one’s own issues plays an important role,” emphasized Uwe Weber, head of the Industrial IoT Center at Detecon, the consulting subsidiary of T-Systems. What processes are in the spotlight? What use cases does a company want to implement? What data is relevant for it? And how can sensor and operating data dovetail with business processes?

Let us take as an example the concept of “building information modeling” (BIM). This cooperative industrial



method is based on digital models of buildings on the basis of which all information and data relevant to their lifecycle are consistently recorded and managed. The goal is transparent communication between all involved to advance them for further/progressive processing. Aside from builders, owners or operators, this also makes it possible for building management – an industry with a turnover of over € 15 billion in Germany alone – to use an integrated, closed flow of information for sustainable and professional maintenance. From project planning and development to building preparation, implementation and documentation, to building operation. “Specifically, BIM-assisted simulations and analyses in the form of a digital building twin would already enormously facilitate the planning and steering of the construction process, the coordination of trades and virtual construction progress monitoring to standard,” explained Weber further. Whether in buildings or systems, machines or equipment according to the consulting firm Gartner, digital twins will exist for billions of things through 21 billion connected sensors and interfaces by 2020. And the digital association Bitkom estimates that the sum of all digital twins will be responsible for a productivity increase of € 78 billion by 2025 in the German manufacturing industry alone.

VERSATILE APPLICATIONS

The digital twin was first described by American Michael Grieves at the University of Michigan in 2002 (see page 14). Yet only modern technologies have allowed the concept to expand its potential: big data applications, IoT, the cloud and sensors. NASA was one of its first adopters: While developing a robot to be used on Mars, NASA combined a model with real data from the Red Planet. However, the digital twin has been out of the exotic spheres of space technology for some time and has come to industry, at least as a vision. The possible applications are extensive (see box). The technology can realize its full potential in combination with applications when, for example, the data from production monitoring is used as input for virtual start-up. Or when quality management finds the causes of known defects in the digital twin and the parameters for future production are then modified accordingly.

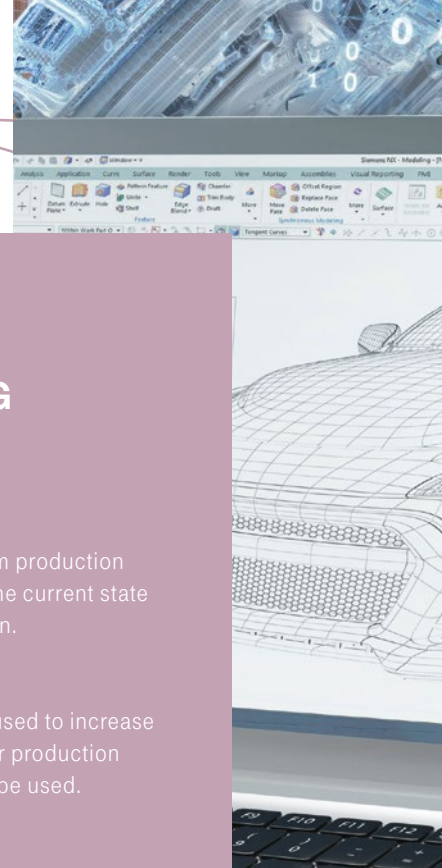
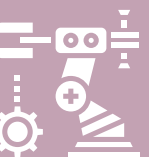
Ultimately, the continued networking between these applications could lead to a bidirectional system where the digital twin provides feedback to its physical brother – resulting in a self-controlling system. “Technically, that’s definitely feasible,” confirmed Lindow. “However, for that it would be necessary to enrich the model with artificial intelligence and machine learning.”

LITTLE USE IN PRACTICE

Where are digital twins already being used in industry? “It’s not yet happening nationwide,” said Lindow. “I have the feeling it’s still being researched in most companies.” For a field test, his institute worked with a scooter sharing service provider. The scooters were outfitted with sensors,

MULTI-TASKING

- **PRODUCTION MONITORING**
The data continuously collected from production creates a comprehensive image of the current state of the production system in operation.
- **PRODUCTION OPTIMIZATION**
Analysis of production data can be used to increase efficiency. Comparison with a similar production system at another location can also be used.
- **PREDICTIVE MAINTENANCE**
By reviewing historical data or comparing with a similar production system, it is possible to calculate upcoming failure in components and wear parts.
- **QUALITY MANAGEMENT**
Continuous monitoring of product quality offers clear advantages over random inspection.
- **REORGANIZATION**
Conversions of production to other products or smaller series (keyword: customizing) can be run through first in the digital twin.
- **SYSTEMS PLANNING AND VIRTUAL START-UP**
Analysis of historical comparative data makes it possible to predict the performance of a system that has not yet been constructed.
- **LOGISTICS PLANNING**
Optimization of the supply chain can result in significant increases in efficiency, especially for just-in-time or just-in-sequence production.
- **PRODUCT MONITORING**
Product lifecycle management is relevant for capital goods especially. Even for the end of life of a product, it can be interesting to know what materials are in the product to facilitate recycling.
- **PRODUCT DEVELOPMENT**
Virtual simulations help with development. Data collected from the use of a product can also help develop and improved version (design feedback).





Luxury sports car maker Maserati used digital twins to slash the design time for new car models in half.

so the use of every vehicle could be documented. Where was it checked out? Where was it checked back in? How far did it travel? And what rate was paid? This made it possible to compile a detailed analysis of individual users and the entire fleet, which may even make it possible to adjust the price structure and battery charging times. According to Lindow, the application is used at best in subfields. One example is logistics: At Airbus, digital twins help coordinate the 12,000 partners supplying the three million parts that make up an A319. Another is product development: In automobile development, engineers test load scenarios for individual components or entire vehicles, down to a virtual crash test. Fiat Holding's sportscar manufacturer, Maserati, has used this to cut the development time of its vehicles nearly in half.

"Digital twins have an effect on the business model," explained Lindow. That hinders its adoption. If a machine manufacturer, for example, realizes its customers want to buy the machine capacity but not the machine itself, does it then become simply a service provider?

Lindow emphasized that the adoption of a digital twin also needs to be preceded by an extensive analysis. "I need to be clear about what I want to achieve with the twin and where the business value is." Does my system already have sensor technology? How much data do I need? Is real-time monitoring necessary or is the data collected at specific points in time adequate? In the end, sensors, data transmission and data analysis are not free. Lastly, a company needs to look at what data outside of

production could be relevant. For a company that maintains aircraft turbines, it could be interesting not only to know how many flight hours a turbine has on it, but also what routes they flew. This is not obtained from the airline's data, but from a third party, such as a flight tracker. "At the end of the day, aircraft flying primarily over the Sahara are exposed to entirely different loads than those flying over the Atlantic," added Lindow. For the same reason, automobile manufacturers prefer to test their prototypes in wastelands – whether in the Arctic Circle or Death Valley. Considering the demands of those locations by dust, sand and co., the Formula 1 cars have it much easier – they always drive on hard asphalt.

"For a digital twin, there has to be a digital master and a digital shadow."

DR. KAI LINDOW,

Fraunhofer Institute for Production Systems and Design Technology



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The factory and its twin

The digital twin of a production system offers advantages over the entire lifecycle of the factory from planning and construction to production refitting. The most comprehensive expansion stage of the twin in production is a bidirectional model in which the twin gives feedback to its physical counterpart and both ultimately form a self-steering system.

COPY — Heinz-Jürgen Köhler



1. PLANNING, CONSTRUCTION

System planning: A simulation helps recognize planning and design flaws early on and optimize processes before the real system is ready. To do this, the digital twin of the planned system is fed data from comparable systems that already exist.

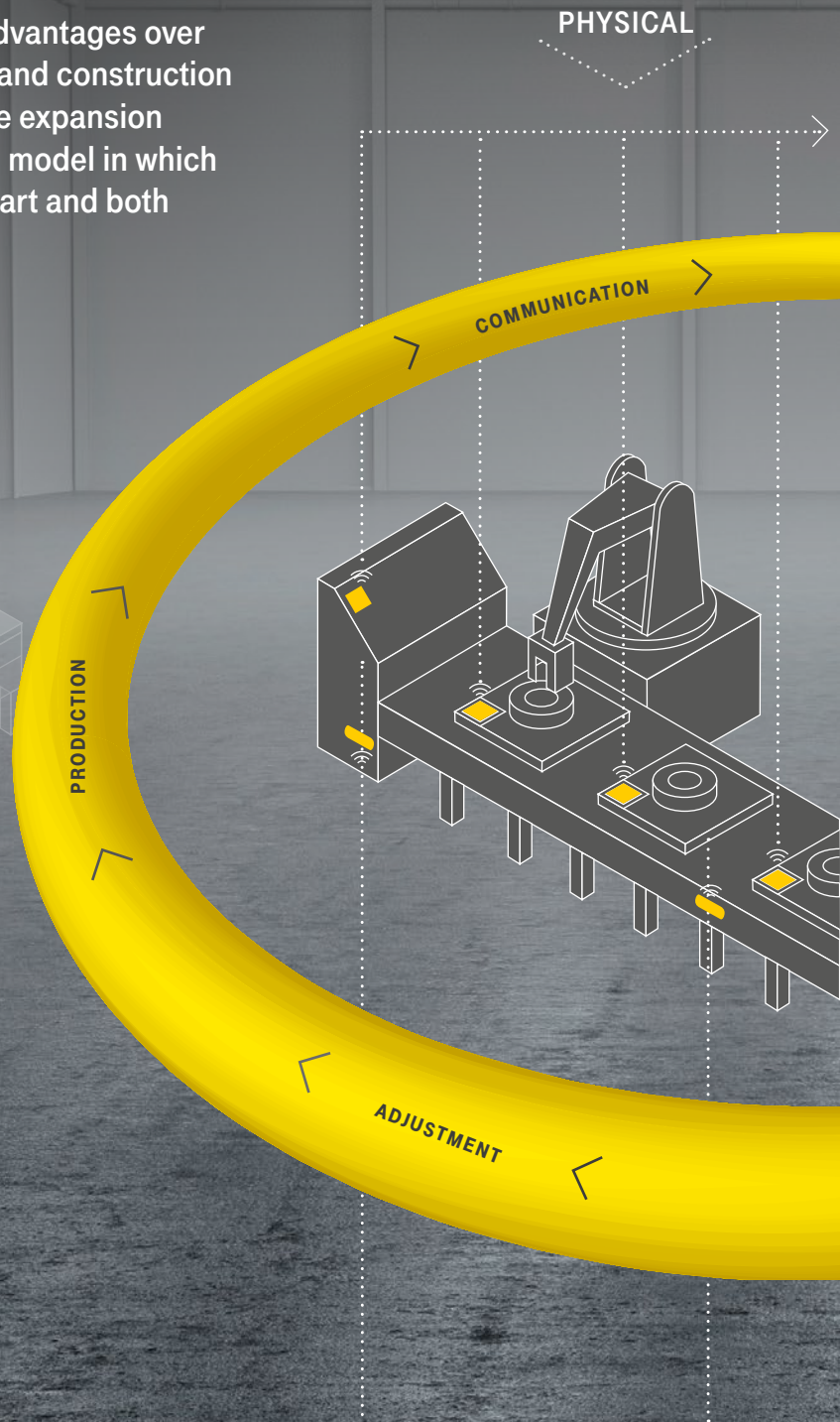
Virtual factory twin: Connecting the twin with virtual reality applications even allows the unbuilt system to be checked for aspects such as man machine cooperation and ergonomics. The reflection of the factory twin in a virtual environment makes the system accessible, perceptible, and interactively usable.



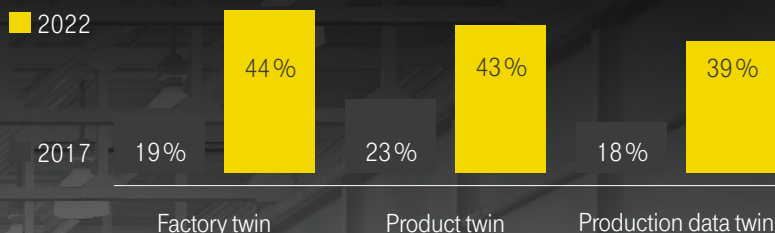
4. RECONFIGURATION

Model changes: Changeovers in production can be simulated. This makes it possible to virtually start up a modified production system in advance. This can also minimize retooling times.

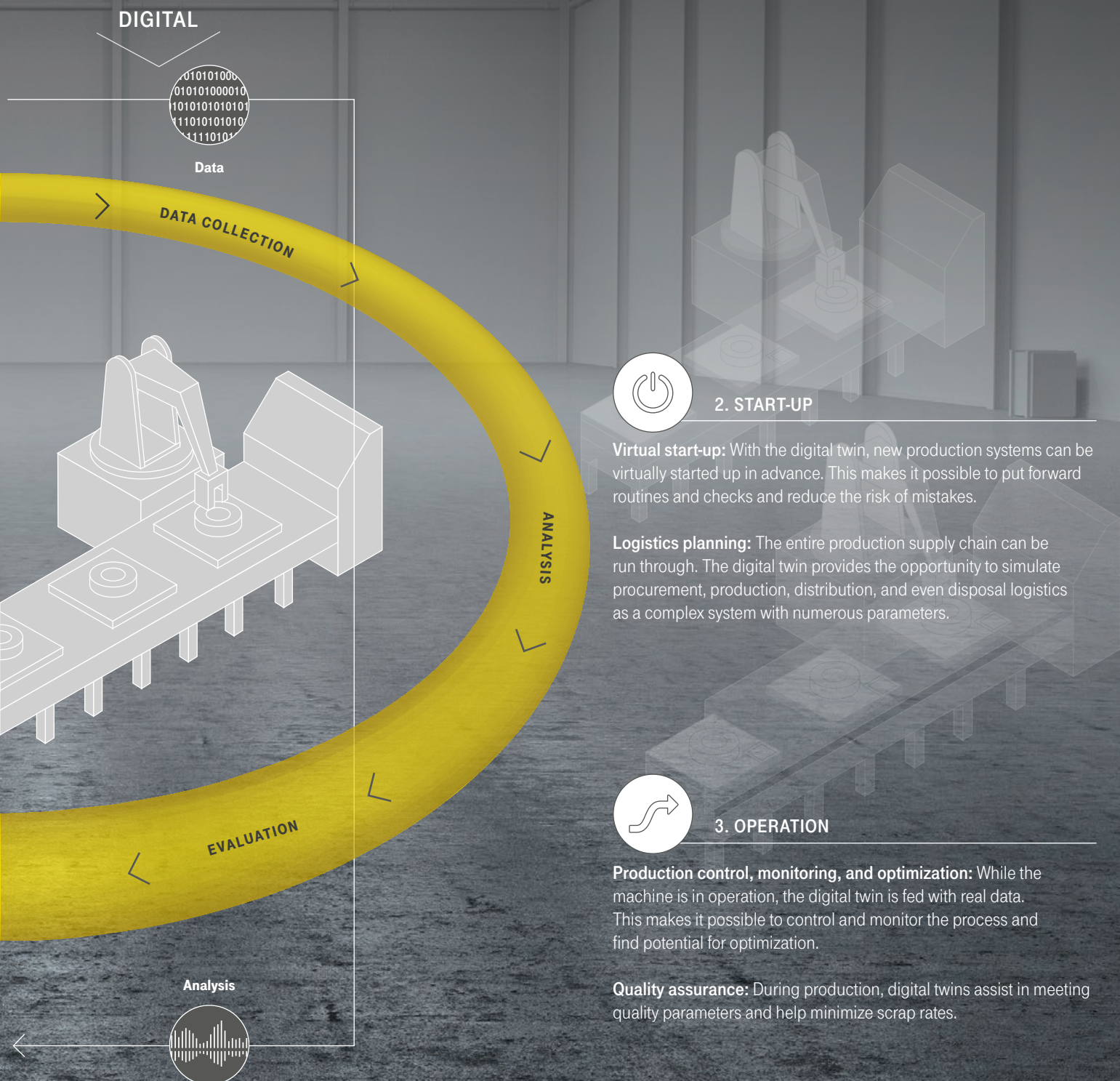
Customizing: The manufacturing of small batches down to single products can be simulated. This is particularly relevant in regards to quality requirements, which generally have to meet specifications from the start even with small batches.



Use of digital twins in German companies (2017)



Source: PWC



A black and white portrait of Dr. Michael Grieves, an older man with short, light-colored hair, wearing a dark blazer over a grey V-neck shirt. He is standing in front of a brick wall. The text "I called it Doubleganger" is overlaid in large white font on the lower left of the image.

“I called it Doubleganger”

Industry 4.0 is only possible with the digital twin. Dr. Michael Grieves is convinced of this. Grieves is the pioneer of product lifecycle management and invented the digital twin. Today, he gives lectures around the world. We talked to him by phone as he traveled between Detroit and Shanghai.

COPY — Sabrina Waffenschmidt

At first, I used the term Doubleganger,” says Michael Grieves. The American began pondering the idea of the digital twin in the late 1990s during his executive management doctorate program at Case Western Reserve University in Cleveland, Ohio. A few years later, in 2002, he introduced the concept as part of his product lifecycle management (PLM) research at the University of Michigan, Ann Arbor. He had already rejected the English-German descriptor “Doubleganger” at that point; the slide that contained the revolutionary idea showed a simple graphic with the sober title “Conceptual Ideal for PLM”.

While the term changed over and over again in the years to follow, this graphic already contained everything that still makes up the digital twin: a virtual image that contains all the information of a physical product and reflects it throughout the entire product lifecycle – an idea so visionary that it could not be achieved for many years. “At that time, we were not yet in a position to implement a comprehensive digital twin,” recalls Grieves. “I had been in the IT industry for over 30 years at the time and was firmly convinced that computers would be powerful enough someday to bring my ideas to life.”

ONLY ACHIEVABLE TODAY

His whole career, Michael Grieves has been switching between the academic and economic spheres. Today, he is a professor and the Executive Director of the Center for Advanced Manufacturing and Innovative Design (CAMID) at the Florida Institute of Technology, Melbourne, USA, as well as an advisor to leading global manufacturers. He is also a digital pioneer and in high demand as a lecturer around the world. Since developing the digital twin, Grieves has seen technological advances that have made his concept a reality. “Today, we have the ability to process huge amounts of data. Not only can we map the data, as we did in the past, but also analyze and use it for simulations and thus understand how the physical counterpart really works,” says Grieves.

The digital twin reduces costs and increases efficiency – it always exists before the physical product. “No one walks into a factory, pounds on some metal, and hopes an airplane or an automobile will miraculously form. I would like to develop a product virtually, test it virtually, create it virtually, and support it virtually. And only if the virtual product is successful in these ways will I make the physical product and put it to work,” says Grieves. Not only can products be steadily improved, they can also be continuously adapted to customer requirements. “Previously, a product left the factory as well as it could be made. And it stayed in that form for a long time. By putting products together virtually at the smallest level in the future, they will be able to constantly evolve, which in turn allows us to fine-tune the specifications even more.” According to Grieves, serial made-to-measure manufacturing will be possible someday.

INCREMENTAL TRANSITION

The digital twin is not yet established on a broad front. “But I do not know any industry that is not at least talking about the concept,” explains Grieves. In this sense, the twin can be introduced in the different increments. “It does not have to be an all-or-nothing project. There is a wide range of information that I can collect and process with the twin.” Digital twins could also be used in very specific, very limited scenarios.

Currently, Grieves is working on several levels to improve product lifecycle management. This includes the development of a smart digital twin that, coupled with artificial intelligence, can predict what will happen in production over the next few hours, days, and even months. “It can be used to correct errors before they even occur.” However, this would require even more information on the physical side and more applications to be implemented.

PLAN VIRTUALLY AND SIMPLY PRINT

Michael Grieves is also showing great interest in additive manufacturing processes like 3D printing. “When I plan, develop, and test a product virtually, I want to be able to just print it out right away. This is a logical step for me. Because this is exactly how I obtain the qualities – in terms of geometry as well as in behavior – that I want.”

Grieves considers a future without a digital twin not only unlikely, but also irresponsible in the area of Industry 4.0. “The twin will be closely linked to networked production – this will even be necessary.” The twin plays an important role in task monitoring when machines talk to each other, for example. “I’m concerned that without the digital twin in Industry 4.0, we will lose control and visibility, both in terms of efficiency and security.”

Bio

In 2002, Dr. Michael Grieves first presented the digital twin concept at the University of Michigan at Ann Arbor. In addition to academic research, Grieves also consults for companies and government organizations such as NASA. He is currently a professor and Executive Director of the Center for Advanced Manufacturing and Innovative Design (CAMID) at the Florida Institute of Technology in Melbourne, Florida.



Our Dual Existence

Data traces on the Internet create digital doppelgängers – and they just might catch up with us.

COPY — Professor Oliver Zöllner

Over the last 20 years, we have become accustomed to online shopping and conducting our banking and administrative affairs on the Internet. Its convenient, saves time, and feels modern. Social media networking and personal “profiles” have been norms for some time now. These activities are fun and often even efficient from an economic point of view, such as for professional purposes or seeking a romantic relationship. For a long time now, we have also used search engines to comb the Internet for information.

One thing is certain: We are the ones who provide information in the form of stored traces of data. Data sets that we consciously or unconsciously produce in the network can be linked to our very real existence: IP address, location, time, computer device number, past searches and purchases, as well as our “likes,” posts, comments, and preferences. Companies, marketers, and whoever for that matter, already routinely cross-link all of our database entries, for example, when you use your Facebook profile to log into your PayPal account. A paradise for data brokers!

LOOK-ALIKES

Such an information-saturated mirror image of our person often says more about us than we suspect – starting with something as simple as listening to our favorite tunes using a music streaming service. You could say: We have created a twin of sorts on the World Wide Web, a doppelgänger, which is constantly enriched with new information and – as we know from numerous privacy scandals – which we can barely control anymore. What exactly happens to our data? Where does it go? How long is it stored? We often find comfort in telling ourselves that everything is anonymous – and, after all: “Just a couple pieces of information won’t hurt anything...”. In reality, however, it only takes a few data points (four are enough) to de-anonymize anonymous profiles with 95 percent certainty, that is, to link all the details of our lives using just our name. Google uses tracking to follow the purchasing histories of Mastercard credit card holders in the United States to interactively correlate them with advertisements from its customers. The company simultaneously and diligently collects health data for its artificial intelligence subsidiary DeepMind.

The Süddeutsche Zeitung summed it up in September 2018: “Corporations collect everything they can get their hands on.” And the result is: we are no longer alone in our everyday life (a “data shadow” is always following us, in a sense) or private (hardly anything about us is hidden from others). What’s life like with this twin existence?

HUMAN AUTONOMY IN DIGITIZATION

One of the basic assumptions about man is that he is an independent, autonomous being within the rules and laws by which we live. As social beings constantly involved in a network of relationships with others, people must negotiate compromises, but in principle everyone is free and responsible for their own actions. But does this hold true in the age of progressive digitization? Increasingly, the former idea of the autonomously acting individual is replaced by that of a “relational self,” which, especially with regard to other people, is based on behavior in relation to habits. We could call this “modern network existence.” Of course, people already had to take into account other people and “higher authorities” before digitization. But these instances, understood as institutions of power, have changed. It is no longer primarily God, kings, and potentates who guide us, but rather institutions on the Internet that exert great influence on the thinking, opinions, and knowledge of many people.

We are no longer alone: this is the big, utopian promise of data and tech companies. We are constantly watching each other. We are no longer alone, but at the same time there is also the dystopia of the digital twin, the data shadow, which almost always accompanies us. We live in a kind of split existence. We are permanently evaluated and tracked and we behave accordingly. Human autonomy is gradually being transformed into a heteronomy. This has consequences. How free are we still?

FREEDOM IN DIGITIZATION

Nobody knows what foolish choices I made as a teenager in the 1980s (they were harmless, rest assured). Nobody saved my missteps. Today’s teenagers, however, live their lives on the net: on Instagram, Facebook, Snapchat, and WhatsApp. Every posted party picture, every selfie, every comment remains stored there – somewhere on the servers of providers. Stupidities and embarrassments included.



Photos: iStockphoto



Bio

Professor Oliver Zöllner has been teaching empirical media research, media sociology, radio journalism and media ethics at Hochschule der Medien in Stuttgart since 2006. He is one of the three directors of the Institute for Digital Ethics (IDE). His research interests include digitization and society, public diplomacy and nation branding. Zöllner has also been an honorary professor of communication and media studies at Heinrich Heine University Düsseldorf since 2006.

Probably forever. We do not know when or under what circumstances an artificial intelligence will put all our snippets of data into a larger image of ourself, but such an intelligence can certainly learn to do so. It is already starting to happen, even though we are still at the beginning of development. The results of such algorithmic computational operations, however, have long had an impact on what we know, who we meet, where we go, and perhaps what kind of bank loan we obtain (or not). Our data today is the basis for tomorrow's forecasts.

Such predictions are no longer necessarily predictions of our self, but about our digital twin: who and how he is and what he is likely to do if he behaves in the future as he behaves today. At its core, this projection, which is based on extrapolations, is a simulation. But this simulation, this belief in the truthfulness of an image of ourselves, is now dominating the way we perceive our world in the digital age. The twin rules and he is ruled at the same time.

NO FREEDOM WITHOUT AUTONOMY

We have to learn to preserve or regain autonomy over our data shadow – and thus over ourselves. Without autonomy, there is no freedom. We do not need an artificial intelligence “emergency stop button” for many useful applications, but rather an emergency button for thinking about how and for what purpose we can use big data and artificial intelligence in such a way that they help the individual as well as society as a whole to flourish. In short: we need AI and digital ethics so that our data shadow does not catch up with us.

“It only takes a few data points to de-anonymize anonymous profiles with 95 percent certainty.”

PROFESSOR OLIVER ZÖLLNER,
Hochschule der Medien Stuttgart



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www.t-systems.de/perspective/customer-journey



Bio

Heiko Scholz has been the Chief Marketing Officer of Barmer since 2013. Before that, the 51-year-old Wuppertal native headed the company's E-Marketing, Media and Public Relations departments. He started his career at the insurance company in 1984 with a vocational training program for insurance clerks.

“Predictive” for 300 years

Heiko Scholz, CMO of Barmenia Versicherungen, and Hans-Michael Schnelle of T-Systems on the healthy pace of digitization, confidentiality as core business, and “individual discovery” vs. crowd profundity.

COPY — Thomas van Zütphen

Mr. Scholz, what is at the top of the agenda in the insurance industry?

Throughout the entire industry, it's digitization, of course. But we at Barmenia don't think of digitization simply as an automation process at our company, but as the technological and organizational implementation of what our customers want. So, actually, we're becoming digitized. Customers use digital devices, functions, and they find out how others deal with their service expectations. They expect their digitization experience with insurance to be as easy as with Amazon or Apple. This is what's driving us immensely at the moment.

Does that mean you need to catch up?

In the sense that the insurance industry isn't exactly known for simplicity, but more for complex things, obviously yes. Our processes and policies run 10 or 15 years – maybe even a lifetime. It's not as easy as buying a device on Amazon. And that's the balancing act that we need to achieve in the future: making products, services, and processes “easy” so the customer ultimately decides Barmenia is the right choice.

Do you perhaps need to further personalize products and offers?

And do you then need to know more about your customers, who, in turn, would need to be willing to give you more information, more data in the first place?

This is also a balancing act: on the one hand, personalization and insurance are, in and of themselves, mutually exclusive as a business model. Insurance for just one person doesn't work. Insurance works because it is borne by a collective, thus it requires, in principle, a group

providing mutual support. However, personalization in addressing customers, in communication or processes that's what is driving us, what we urgently need to implement. For products to be flexible enough to “go along with” changes in a policyholder's living situation and almost automatically react when it comes to re-personalizing a product framework. Because if I, as a customer, expect my specific problem to be solved quickly and easily at any given point in time, the standard cookie cutter process isn't what I consider “personal” – that is, the personal addressing of individuals even within a collective.

You mean the opportunity for personalization is more at the point of contact with the customer than within the core process?

Correct. And if we don't take this opportunity, we run the risk of completely losing touch with customers and being reduced to our core business of risk balancing – of only being perceived as a system that pays bills and no longer as people. Let me give an example: in today's health insurance, we reimburse you for your medical bills. That's our business model. You have private insurance, you go to the doctor, get a bill, take a picture of it and send it to us, your insurance provider, through our app. We check it, reimburse you and you get your money the next day. Done. Everyone's happy, it all worked perfectly. In the future, we'll no longer just reimburse customers, we'll be a part of their lives – more accurately, their health. Why should we not much rather prefer to react by saying, “We know a lot about health, so we'll help you to not get sick in the first place”? Consequently, in the future we'll be much more in demand as a health manager. We've already taken this step by offering the Vivvy app, our health assistant.

To take this path from rigid insurance coverage to flexible, mobile companion – your customers will have to provide you information. Will that be a problem?

I believe, when it comes to security and health, our customers show us a high level of trust. This is the basis of our mutual relationship. Trust is our core business and for us, as a service provider, it is crucial for customer relationships to last years.

Unlike in other industries, an Accenture study shows the progression of technology in your core business will no longer be linear, but exponential. How are you handling that and where do you expect the greatest growth?

In the use of data, above all. Actually, our job is to make predictions on mortality, the probability of illness or fire. We use this to calculate premiums to protect our customers against risks and the resulting financial impact for the immediate future that is, the duration customers choose for their policies. We've been doing "predictive" for 300 years, if you will. Until now, however, we've always looked backward to do it. To past experience. What we now need for our customers is risk data going forward and not backward. It's about the use of data for our customers.

For a house, which is, by its nature, immobile, this is easy when it comes to fire. Cars, on the other hand, are almost constantly going back and forth between different levels of risk.

We're all familiar with the model where cars use a dongle, a kind of plug-in interface, to almost constantly monitor and communicate driver performance in order to determine premium discounts and offer them to customers. Something else we've done with Deutsche Telekom is based on the "Park and Joy" app to offer situational coverage for when my car is parked and I want to protect it from minor damage, for example. We've created insurance that automatically detects this: the risk situation is now present and it'll end an hour later. If I park in public places a lot, I need a lot of coverage; if I don't park so much, I need less. No other industry today is doing this. This kind of situational coverage, which would also be feasible when going skiing or bungee jumping for the first time, is made easier with data and digitization. Only when customers let us know where they're planning to do something so we can calculate probabilities that end up in a premium of, say, one euro, can we come up with a suitable offer.

"Simple individual discovery is at an end. What I want to know directly from customers is what they expect."

HEIKO SCHOLZ,
CMO Barmeria Versicherungen

We naturally always assume the phrase "tracking" puts people off. What's your experience with acceptance of this?

That's a question of value. If customers find it worthwhile to say, "I'm using the fitness tracker and uploading my data," it literally pays off – in the form of a better premium, for example. Or that we offer assistance: "Listen, with that blood pressure you should go to the doctor." So we're with them not just for their annual checkup, we're also their personal health manager. And if we can also offer customers "Hey, we're making an appointment. Should we go to your usual doctor?", then we're handling scheduling as well. The market will decide the extent to which the customer considers that a fair deal. We're taking the first steps with our health assistant, Vivy, which we offer our customers.

Looking at the market, you've played it safe when it comes to minimizing risks on new products and have gone after the Telekom crowd with situational insurance. How did you think of it, what were the initial results and where will it lead?

It will lead to innovation and services coming from customers to a much greater extent, and no longer "The customer is always right, I'll just tell him what he wants." We've done that for many years, but it's no longer possible. Simple individual discovery is at an end. What I want to know directly from customers is what they expect, what they're getting elsewhere, even in other industries. If I personally have an experience with Amazon or Apple, I also want to feel that with my power company and my insurance provider. In this sense, for example, the current restructuring of our customer portal is of major strategic importance to us. When asking "So, what do we do first?", at its core, it's about identifying the 15 most important processes. And this is where we said, "It doesn't matter what we want to do first, the priority is what the customers expect." What would be smarter than to call on the "wisdom of the crowd" for that kind of information?

Virtual and augmented reality, avatars and voice recognition, adaptive software – what will the next great trigger for Barmeria be in regard to its digital customer relations, and in what form?

Everything's on our radar. What we're currently working on, for example, is voice control. With Alexa, Siri, OK Google, we see the quality of these offerings has improved tremendously in the last two years, but we don't believe it's a sales channel. Someone sitting in their living room and asking Alexa to sign an insurance policy is still pretty much a pipe dream. In three years, though, perhaps I'll sing a different tune. It could work with another example: When buying glasses, I ask myself, "What will I actually get from my insurance for new glasses?". Depending on the rate, the benefits could be different. Different glasses, different frames – that is, if we set up our benefits in a structured way, it would be child's play for Alexa to find the answer. It checks the database, sees the customer hasn't received any reimbursement for glasses this year, so then you would get 600 euros to go to an optician and get new glasses.

According to Bitkom Research, every second insurance company is not yet generating that kind of actual customer benefit from digital touchpoints with their customers. Is your industry lagging in this area?

Yes and no. No, because we definitely have the data. If we were to use the data we already have, we would be way ahead. If we were to add the data we'll get in the future, the better it would be if we could use it. This is why the entire insurance industry is currently working on analyzing data in a more targeted fashion – to be better able to assess risk situations – and, in doing so, create risk profiles that are more customer-focused. The same goes for determining probabilities of need. Data analytics – that's the process of deriving information from data to be able to make customers a more precise offer – is an even more relevant topic. All of that, of course, is under the strict gaze of data protection, which naturally needs to be observed in the interest of faithful customer relations.



What does the future hold for the insurance industry? What trends, customer preferences, requirements? For Barmenia CMO Heiko Scholz (right) and Hans-Michael Schnelle from T-Systems, there's always something to talk about.

FACTS & FIGURES

Barmenia is one of the largest independent insurance groups in Germany, offering a range of products from health and life insurance to accident and auto insurance, to liability and property insurance. A sales and support staff of over 3,400 and a substantial number of agents serve over 2.2 million policies.

“InsurTechs” are considered nimble and potentially attractive cooperation partners for heavyweights, since they can implement innovations more rapidly in cases of doubt. How do you scout out these “young guns”?

We're a founding member of “InsurLab Germany” in Cologne, where we work with InsurTechs on a level playing field and develop ideas together. So there's absolutely no reticence there. Just the opposite: if these “young guns” sometimes naively approach certain topics, they learn quickly from the insurance industry: “Man, there's some experience that we should rely on.” And, conversely, we also learn some things from them.

What would be an example?

For example, that no customer wants three different portals for three different policies just because they took out three different policies with different partners. These days, our customers can keep Policy A and a different Policy B in the same place they keep their Barmenia policy. With how we used to view ourselves, we wouldn't have done that even a few years ago. In other words: someone had to come in and show us in the insurance industry that it's possible to think in this customer-oriented manner. But that characterizes the thought process these start-ups have mastered. They understand the customer. It's not witchcraft – just the opposite: it can be easily adapted. You just have to see things more often and more consistently from the customer's perspective.



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www.barmenia.de

www.t-systems.com/solutions/predictive



www.t-systems.com/video/barmenia

A crash test dummy for medicine

Preparations for sequencing:
First, standard laboratory work
(large picture and top right).
Then, the digital twin (bottom
right) is presented based on
the molecular compounds.

Photo: Michael Rathmayr



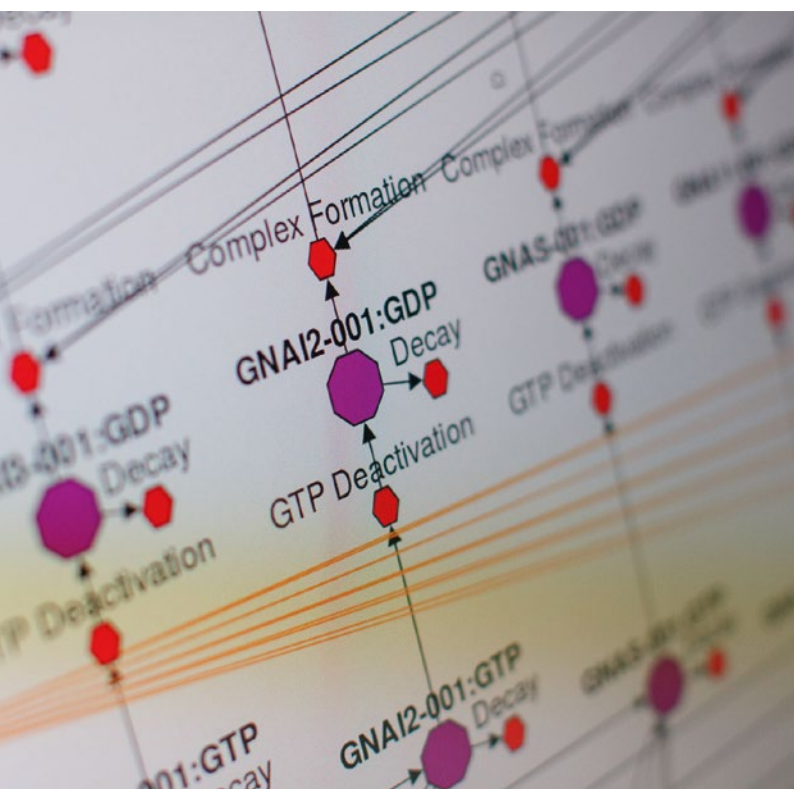


COPY ——— Isabell Spilker

Four futuristic looking beehives stand in the front garden of the Adlershof Technology and Startup Center in Berlin, Germany. Here, bees produce delicious honey in the same way their ancestors did in ancient times. Honey has long been valued for its healing power, above all in natural medicine, and has been tested time and again over ten thousand years. Scientists in the building complex next door are researching completely new recovery procedures and applications: They are developing technologies that can revolutionize our healthcare system. This is where man's digital twin is being created.

The company Alacris Theranostics was founded in 2008 as a spin-off of the Max Planck Institute for Genetics. It began its work after a first round of funding in 2011. The goal of Alacris Theranostics is truly personalized medicine. A person's digital twin can be created from different data, mainly from sequenced DNA, to serve this purpose. A simulation with this data serves as a kind of virtual crash test for different scenarios, currently mainly in the field of tumor diseases.

“Our point is to look at how the individual patient and the particular tumor reacts to certain drugs,” says Dr. Bodo Lange, Managing Director of the company. Personalized medicine means administering matching medicine to individual patients. So far, only groups of patients are addressed, not individuals. Which is not good enough for him. “Many drugs do not work very efficiently – only one-third of patients respond to drug-based cancer therapies.” This is bad for the patient and bad for the healthcare systems, especially when you look at the numbers across all clinical scenarios: up to 200,000 people lose their lives in Europe every year due to so-called adverse drug reactions. Knowing critical information about the genes of a cancer patient would dramatically reduce the number of patients who are unwillingly exposed to the side effects (and costs) of an ineffective drug.



Professor Hans Lehrach is the spiritual father of humankind's digital twins. He was involved in sequencing the human genome from the beginning.

TUMORS ON THE MOLECULAR LEVEL

20 employees, including physicists, biologists, medical-technical assistants, and bioinformaticians, are constantly working on implementing the idea in the laboratories and offices of Alacris Theranostics. Every tumor, every patient provides new information. Scientists sequence DNA from blood and tumors to do so. On the computer, 14 bioinformaticians then evaluate the concrete cases and create models of individual tumors. While the data is stored on a 800-terabyte server, their screens display cryptic plans and mark individual dots with numbers. "You can see small parts of the overall complexity at the molecular level," explains Lange.

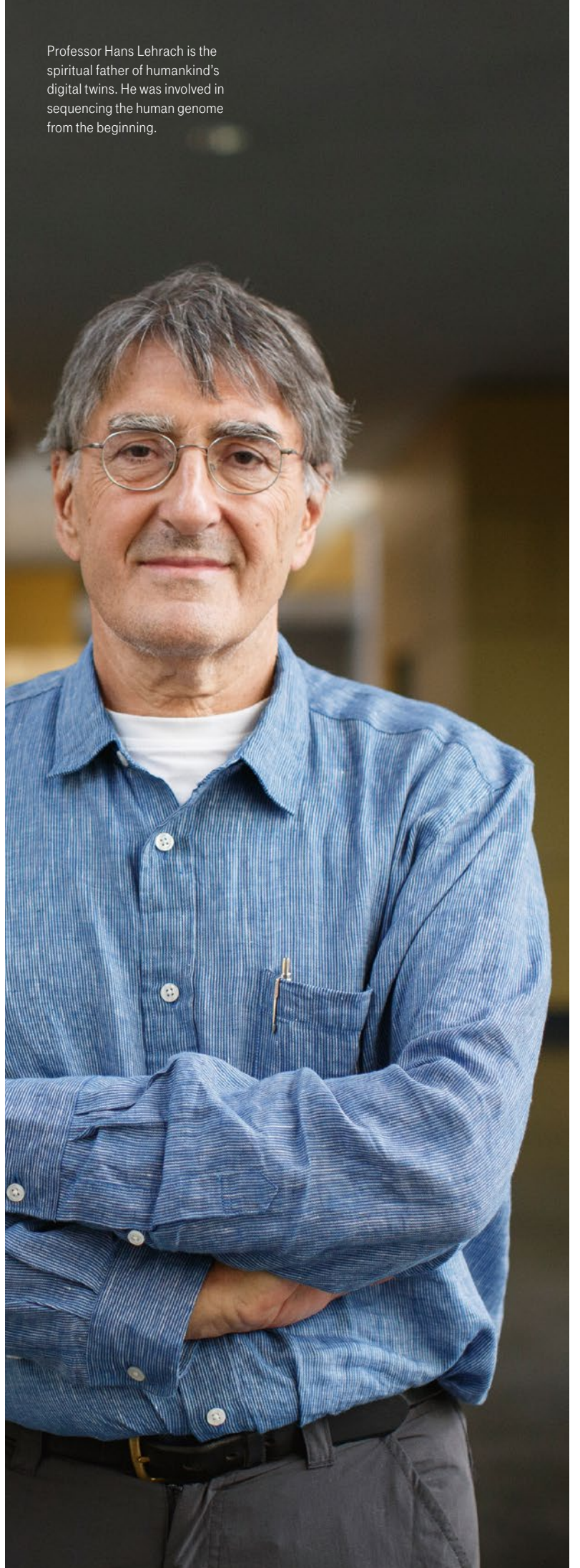
"All individuals are different," says Professor Hans Lehrach, Austrian geneticist and Emeritus Director of the Max Planck Institute for Molecular Genetics in Berlin. Alacris and the digital medical twin owe their existence to his genius, perseverance, and restlessness. Lehrach has founded several biotech companies and worked at institutes such as Harvard University in Boston, the European Molecular Biology Laboratory in Heidelberg, and the Imperial Cancer Research Fund in London to help decipher the human genome – and at 72 years old he is still not ready for retirement.

A patient's right arm is put in a cast, although he broke his left arm, simply because studies show a higher frequency of right arm breaks among patients. With such a drastic example, Lehrach describes the status of data-driven medicine. "Medications are molecular entities that interact with the human organism differently from disease to disease and human to human. Until now, doctors have not been able to see the molecular networks very well, and thus had a prediction problem." The only reasonable solution is to create a model for testing the digitized version of different drugs to apply the best available therapy and to exclude unwanted side effects as a prophylactic measure. In other words, to improve the quality of life and healing prospects of patients.

PATIENTS OF THE FUTURE

After sequencing, doctors have a detailed tumor profile and a specific recommendation as to which drug is suitable – be it unexpected or only approved in other countries. Participants in Alacris studies in collaboration with university hospitals, or wealthy private patients, are the only ones who have the chance to receive such a diagnosis.

Insurers do not usually pay the cost of such analyses of around 10,000 euros – with a few exceptions from Switzerland or the USA. "The problem is actually that we need to examine more patients to make it more cost-effective," sums up Lehrach. "The European healthcare systems spend 4.5 billion euros a day – in large part for drugs that do not work and cause only side effects. That is a massive problem!" Lehrach has joined 200 partners in his international "DigiTwin" research initiative and is currently



The digital twin of man – the sum of many equations

The computers need 24 hours
after DNA sequencing to test
90 drugs in the respective model
on the basis of approx.

10,000

differential equations.

working on another submission to the European Commission for about one billion euros. His goal: this technology should be part of normal diagnostics.

The scientists are also thinking beyond tumor diagnostics: "In the long term, every human should have their digital twin available, from birth to old age, that becomes better and better through life with all the information." Heart rate, complete blood count, metabolic data – all collected data feed the twin and not only help the doctor to find the optimal therapy, but also to set up training plans for a marathon, for example.

ANIMAL EXPERIMENTS ON DIGITAL MICE

The digital twin is also important for research and development. "We can test hundreds of medications on a virtual patient," confirms Lange. "And one drug that is currently being developed, on thousands of patients." This allows researchers to exclude patients from clinical trials who are unlikely to have a response. "We can even perform animal testing on the digital twins of mice – and only at the end perform the actual test on a minimum number of animals," explains Lehrach.

Is this what medicine will look like in the future? For Lehrach, the digital twin may not be the only correct answer to this question. "But it is the best."



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www.alacris.de

www.telekom-healthcare.com/en



Dr. Bodo Lange has been running Alacris
Theranostics in Berlin since the first round
of financing in 2011.



Professor Arun Nagarajah from the
University of Duisburg-Essen

“The twin investigates the reason why”

It's one thing to find mistakes. It's another to explain the reasons for them.
Digital twins can help opening up a new dimension in product optimization.
A field that Professor Arun Nagarajah researches at the University of Duisburg-Essen.

“Oil loss!” reports the car. The vehicle’s intelligence immediately starts calculating how much longer it can still drive, checks the driver’s digital calendar and sets up a service appointment with a preferred repair shop. “This car is a smart product,” says Arun Nagarajah, a professor of product engineering processes and data management at the University of Duisburg-Essen. One more feature would turn it into a digital twin.

Digital twins – in the product engineering sense that Nagarajah uses – go one crucial step further. “They investigate the reason why – why is the car losing oil?” Insights uncovered in this investigation are then used to develop a better car. A material failure in the oil pan? Bad gaskets? The fault diagnosis is fed back to the design team, who eliminates the problem in the next generation of vehicles. A perfect “lesson-learned system”, says Nagarajah.

CONNECTED CAPITAL GOODS

Many capital goods, from gas turbines to power plant cooling towers, positively bristle with sensors. The sensing devices are used to monitor production processes and make forecasts – on the service life of the entire plant or individual components, or on repair and servicing intervals for predictive maintenance. “The forecast may tell me that a certain bearing in my gas turbine will fail quickly and repeatedly,” explains Nagarajah. Often, the bearing just gets replaced without anyone finding out why it failed in the first place. An analysis with a digital twin, however, will uncover previously ignored material weaknesses. “Let’s say that I want to use bearings with different material properties. I just have to enter the parameters of the new material in the digital twin and run a complete simulation before replacing the physical bearing.” The focus on capital goods has economic reasons. “I could build a digital twin for a washing machine, but there’s no good business case for doing it.” The technology is already being used by countless corporations from thyssenkrupp to Siemens, reports Nagarajah, who spent five years in the private sector working in product lifecycle management at Hella, a supplier of automotive parts, before entering academia.

MIXED REALITY IN PRODUCT ENGINEERING

Nagarajah recently completed a digital project engineering for Siemens Power and Gas along with 16 master’s students at the University of Duisburg-Essen. “Our goal was to switch from drawing-based to model-based engineering,” explains the professor. Siemens had asked him to develop a valve for a gas turbine. “These days, engineers usually model components in 3D on a computer monitor and then transfer them to a drawing.” It makes more sense, though, to keep working on the model. To make that possible, Nagarajah and his students incorporated the model into a mixed reality application using a HoloLens.

The application opens up countless avenues for digitizing and optimizing the engineering process even more. “We model all the data associated with the engineering process in the application.” The information ranges from geometry data to initial test reports. Developers can retrieve and confirm the data using a traffic-light system in the HoloLens. “We can even present data in a context-sensitive fashion,” stresses Nagarajah. In other words, the system uses stored roles and rights to only show engineering team members the data they’re allowed to see. “This kind of development project benefits everyone,” promises the professor. Siemens was thrilled and is now building a physical product from the model. The professor teaches his students how to work with customers. And the students got to work on a real-life task in day-to-day operations. Plus, the project gave rise to a fairly smart idea in product engineering.



Light in the Blackbox AI

Explainable AI looks into the “brain” of artificial intelligence and can explain how algorithms make their decisions. An important step, because the new General Data Protection Regulation requires traceability.

COPY — Ingrid Kirsch

The Explainable AI research field has a new engine: the European Data Protection Regulation. Because AI systems require transparency. A demand that is still not easy to fulfill today. Why? To answer this, take a look back at Google's I/O Developer Conference in early May this year. The highlight: Google Duplex – an AI that independently arranges a hairdressing appointment on the phone. Spontaneous pauses in speaking, some interspersed “hmm's” – and already the computer voice could not be distinguished from that of a human being. The reaction? Cheers to the Google experts in the audience. Otherwise? The reaction was rather mixed. The reason: Google Duplex just sounds too real.

Because: Is it really okay if a software calls me and I think it's a human? “Clearly no,” says the European General Data Protection Regulation (DSGVO), which forces companies to be transparent in terms of artificial intelligence. As soon as automated decisions affect people, they must be understandable and explainable. Companies are obligated to disclose the AI aspects of their services, products, analyses, and processes.

AI DECISIONS MUST BE TRACEABLE

However, the demand for transparency is usually more difficult to meet. What exactly happens during machine learning is often hidden in a black box. Even the programmers are in the dark when it comes to answering the question of how the AI makes its decisions. Which is why, for example, Microsoft Research's Kate Crawford calls for key public institutions in the areas of criminal justice, health, welfare, and education to stop using algorithms. Too many AI programs, according to the expert, have discriminatory tendencies or erroneous assumptions, it was

discovered. Machines decide with high consistency, but also consistently inappropriately with unsuitable programming.

AI is relevant in more and more areas of life. Its importance will continue to grow. It can do many things: make medical diagnoses, buy or sell stocks for us, check our credit history, analyze whole business reports, or select job applicants. Software evaluates us according to certain mathematical criteria using so-called “scoring” methods. Therefore, the GDPR prescribes the “right of explanation” for the protection of every single person. This means: If an affected person submits an application, institutions or companies must be able to reasonably explain an AI decision or risk assessment.

MACHINE LEARNING REVEALS CASES OF FRAUD

It becomes difficult at this point. “The legality of decisions can only be examined by those who know and understand the underlying data, sequence of action, and weighting of the decision criteria,” writes legal scientist Mario Martini in *JuristenZeitung* (JZ). Scientists around the world are working on this explanation. Their research field: explainable artificial intelligence. Or sexier: XAI. Explainable artificial intelligence or explainable machine learning want to look into the electronic brain. For example, the consulting firm PricewaterhouseCoopers (PwC) places XAI on the list of the ten most important technology trends in the field of artificial intelligence.

However, the literally enlightening view into the black box is difficult because neural networks have a very complex structure. Decisions are the result of the interaction of thousands of artificial neurons. These are arranged in tens to hundreds of interconnected levels – with their

diverse interconnections, the neural networks of the human brain are modeled. Scientists are now also using the virtual dissecting knife in Berlin: The research group Machine Learning at the Fraunhofer Heinrich Hertz Institute (HHI) has developed a method called Layer-wise Relevance Propagation (LRP). Research Director Wojciech Samek and his team first published their explainable AI method in 2015 and already presented their XAI method at CeBIT.

LRP traces back the decision process of a neural network: The researchers record which groups of artificial neurons are activated and where – and what decisions they make. They then determine how much an individual decision has influenced the result.

EXPLAINABLE ARTIFICIAL INTELLIGENCE: THE PATH TO THE SOLUTION MATTERS

This type of transparent path, a kind of documentation, plays into the hands of the GDPR, because, as in the past, the solution and not just the results count in math lessons. Developing machine learning techniques that produce more predictable models should strengthen confidence in AI technology in the long term. PwC understands that many companies make use of explainable AI before embarking on algorithmic applications on a broader basis. The GDPR could even make explainable AI mandatory for state authorities.

And until then? Companies like Telekom are reviewing AI decisions through a review process. Employees constantly check whether the AI has decided on behest of the company and the person affected. If this is not the case, they can take corrective action at any time. “We should provide the algorithms with a sort of AI governance and prevent artificial intelligence from breaking out of ethical and moral guidelines,” recommends Claus-Dieter Ulmer, Group Representative for Data Protection at Deutsche Telekom AG. Under this condition, there is a lot of potential in AI. In their strategy paper “Künstliche Intelligenz als Innovationsbeschleuniger im Unternehmen” (“Artificial intelligence as an innovation accelerator in the company”), the PwC experts are sure that AI will develop into a decisive competitive advantage in the future, which decide the success and failure of every company.

**“We should provide
the algorithms with
a sort of AI governance”**

DR. CLAUS-DIETER ULMER,

Group Representative for Data Protection at Deutsche Telekom AG



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“Digitization needs people”

Bio

Damian Bunyan has been Uniper's CIO since 2016. Previously, Bunyan served on the Management Board of E.ON Business Services, where he was responsible for the E.ON Group's IT infrastructure. The 50-year-old has lived in Germany since 2004 and studied business administration and politics at Aston University.



Uniper CIO Damian Bunyan in a conversation with Thomas Novotny, CTO Innovation Manager at T-Systems, on the transformation to new business models, workshops as collaboration boosters, and the benefits of the “madness” PechaKucha.

COPY — Thomas van Zutphen

Mr. Bunyan, the speed of communication and collaboration is critical to the competitiveness of your industry. How can the group IT take this into account?

I have to go back a ways to answer that. With our 2016 spin-off, we also lost access to E.ON's data center. It was a huge opportunity for us to clean up with a very confusing application landscape, but of course this also meant a lot of work. So far, we have quietly separated 30 percent of our applications from the data center to the cloud. That alone is a big step forward in terms of speed. We have really cut back the jungle, and things have been looking much nicer ever since. For the first time as a CIO, I know how many applications I have and what our customers actually use. In addition – and most importantly – our applications are even more secure in the cloud. Our main application for electricity trading as an example: we are one of the world's largest electricity traders and the first company to bring such a trading application to the cloud.

Why is that important to Uniper?

Electricity trading processes are really complicated and IT-intensive. The volume of this one trading system reaches 350 terabytes at the end of the day. And that's just one of more than ten systems we use. Gradually bringing everyone else to the cloud still presents a huge challenge. In the cloud we saw for the first time where the computers are sometimes operating at capacity in the highest phase. And if we need a faster machine, we can build a network of machines in the cloud to essentially create a supercomputer. This is huge progress. Because when I take action and when algorithms work for me and we're going 24/7, speed plays a big role. Or take the example of incidents. We recently had one in our old data centers that would never be acceptable for cloud providers. They have a different scale, a different professionalism. If I need resources today, I don't build a data center. I go straight to AWS, Microsoft, or the Open Telekom Cloud and do it there.

By the time Uniper was standing on its own, you had switched from Outlook to Office 365, among other things. Why?

When you take a chance on something new, you don't just copy and paste from the old method. Likewise, we're transitioning from Windows 7, a variant that was built specifically for E.ON, to Windows 10.

I can serve my users so much better. With Office 365, once I optimize my security rules, I can allow my employees to work in a completely different way: managed and secure, from any device in the world and at any time of day.

That would have to be project-related for your external employees, who must also have access to specific systems in record time. How do you solve the problem?

Slowly (laughs). I do not have all the solutions yet, but I've learned one thing: partnerships are important. If I constantly switched suppliers, I would have a problem. But specifically to your question: If any of my employees can work from any device, anytime, and anywhere, then I have to offer that to my supplier as well. That's why when separating from E.ON, it was important to me that my relationship with T-Systems remained intact. Very, very important! The fact that external employees also have temporary access to our applications is an example of this. We are already building express routes in the cloud for this purpose. I'm not saying that we have perfected it, but if I work with a trusted partner instead of a collection of different companies, it's reasonably easy and, above all, secure.

You confronted the requirement for “fast, safe connections” head-on at the T-Systems “Collaboration Booster” innovation workshop. What's your experience on this front?

The experience is that my business case can actually be solved. I have employed about 2,000 externals across the world. Some for only six weeks, others a bit longer. And they each have two computers – one from me, one from the company. Totally unnecessary! The comparison between Current Mode and Future Mode has to be imagined as follows: the onboarding process in our old world can make you cry. The technology is relatively simple, but our processes behind it are so difficult that it is almost impossible to provide an employee with new technology in three months. This is unacceptable! Today, I am able to offer three types of devices to each traveling user, all automated. In the near future they will be able to work from any device. This is the specific business case – no matter what hardware, as long as my software that I can manage and control is on it. And once their contract ends, access is switched off. Now that's fantastic!

I know engineers who get alarms from power plants at three o'clock in the morning and are the ones who have to respond to problems. They drive as far as 40 miles to the power plant to evaluate the situation. The results of our HDS19 (Hybrid Digital Service) workshop allow them to get up, turn on their device, and check the cause of the alarm from home. This is enabling, an example of how we save our employees a lot of time. In the workshop we demonstrated how quickly external employees can be connected today: once their identity and credentials are established, an email address and password are set up and all security requirements are met in just three minutes. This workshop brought about a solution that I fought for at E.ON six years ago.

With the spin-off two years ago, the transformation of your company has just begun. How far have you progressed?

The spin-off made Uniper more radical from day 1. In terms of transformation, you have to think differently. At E.ON, I was part of an internal services GmbH. At Uniper I'm not a service provider, but right in the middle of business. I reject all discussions of the kind: we have to talk to business or we have to talk to IT. They are linked. So on day 1, we changed the model of how we manage IT. Today, as a CIO, I position myself much differently than at E.ON, which enables us to move forward quite quickly. And – to the pleasure of my board of directors – to be much more efficient at the same time. IT costs are sinking simultaneously. A win-win! Sometimes I can finance certain things myself, because I have less data center costs and invest money elsewhere.

Keyword “Plant Health,” the fitness of your well over 100 Uniper power plants: What role do predictive analytics play in managing your plants?

A major role. It's the only reason we can handle maintenance resources much smarter today. We have been using advanced condition monitoring, as we call it, for the last ten years. Planned maintenance, where we bring together the most important technological information and use our IT to map a digital version of each system. This helps enormously to be smarter with the “little money” that we have and above all to reduce our capex to the essentials. The important point with regard to the transformation that you have asked for, however, goes much further: with our know-how, we manage to operate power plants in a fairly optimal way. With all modesty, we are world class in this regard. And the ability to use predictive maintenance from the cloud to analyze plant and machinery information so we can help power plant managers use less capex is what we are now turning into a business model. We are currently discussing this with customers in Pakistan, India, Australia, Japan, and the Americas – in particular, using a specially developed “made in Germany” software. And believe me: This is a giant brand. We have to be very careful with the term transformation. But developing a business model from “I run power plants myself” to “I'm the advanced condition monitor for everyone else” is a transformation.



Thomas Novotny, CTO Innovation Manager T-Systems

What do you expect in this context from your IT service providers?

First and foremost, a clear commitment to curiosity about what digitization will make possible in our industry. When it comes to basics, a term which T-Systems has shaped itself describes my expectations very well: “zero outage”. That is, if you want to help me with my digital transformation, then the bread and butter must work. Because that provides a basis on which I can build upon the technology and with which I gain credibility and trust in the user. This is very important and I think it's feasible. The next point turns out to be much more complicated: as a supplier, to understand our day-to-day and all the new opportunities of our business. This is not easy. And if you “just” have a so-called key account team, the likelihood that anyone in this team understands the whole is clearly limited. Without fail, it only works when you involve experts. This means: All service providers are concerned with high client attention.

Where is your ideal?

I'm not just imagining it, I've been practicing it for a long time. I already have 50 IT people from other companies in this building on the second floor. They are also in the gym and doing the same Pilates class as my other staff. They smoke cigarettes together or I see them in the cafeteria. They talk to each other. And that's good. IT means people business. The world of digitization needs people! This creates ideas and things that may be easy to develop with new technologies. And then colleagues come to me with a proof of concept and say we have worked that out.

FACTS & FIGURES

With the spin-off of the E.ON Group in 2016, Uniper took over the core business of power generation in Europe and Russia as well as global energy trading, especially with gas. Power is primarily generated from conventional energy sources like hydro, coal, and gas. In 2017, Uniper SE generated sales of 72.2 billion euros with 14,000 employees in 40 countries.

T-Systems has everything in the drawer, everything! For digitization and transformations. If I want to operate both as an IT manager at the same time, and I have to, I am always latently in the emergency room. And then, as a CIO in the hospital, I just want to go to the head physician and explain my complaints. Most suppliers have not mastered this.

Maybe because they did not understand?

Maybe. But it works like this: As chief physician in the hospital, I cannot do all the surgeries myself, but I know the people who can. That's no easy task, because technology has developed so rapidly. Who can use the cloud, IoT, SaaS, machine learning, and algorithms at the same time? T-Systems can form such surgical teams. I'll reword the question for myself: how can I get the best from all suppliers? Not by making a tender with procurement every time and winning the one that is the cheapest. I need a small number of partners with whom I speak regularly. I want to have them near me. And I can do that.

If necessary, there is the presentation technique PechaKucha, which at that time was something completely new. We practiced intensively for two weeks, came here, and had an extremely positive experience because we brought in our personality. I think that was exactly what you wanted to do: with a clear roadmap along your strategy and knowing which partner to follow.

Absolutely. A little like casting. 15 slides, only pictures, no text. Each presented in 20 seconds. However, the preparation is utter insanity, because you have to perfectly reproduce what you want to say in 20 seconds, and that is a skill. What we also saw: at that moment, we had all the suppliers in the room and most of them found it really uncomfortable – to roll out ideas, concepts, and concrete directions in front of competitors. But competitors must find ways to work together. It will never be the case that I give everything to one supplier. That is not reality. All account teams are greedy and want to win. There's a lot of emotion involved that makes us all inefficient. And PechaKucha in this format brings the momentum we need. As a result, we were able to quickly select one of the most convincing suppliers to specifically integrate the T-Systems ideas and solutions into our innovation strategy for the coming years.

In September 2016, German magazine "Die Zeit" ran an article with a title that translates as "E.ON brings its grubby kid to the stock market." Since then, the grubby kid's stock price has risen by almost 150 percent. What does your IT have to do with this development?

When I virtually took over Uniper's IT department at E.ON, the annual budget was more than 300 million euros. This year we will get along with 30 percent less and the performance will remain the same. The stock price of Uniper has risen, because you can see that profit is generated sustainably. I now give back €114 million EBIT to the Group and thus to the shareholders. Which the share price reflects. We are also very proud of IT. The relationship between business and IT has changed completely compared to that time. The motivation in my unit today is the highest I've ever had. Because we see, we have a different relationship. And that is not far from perfect.



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Damian Bonyan, CIO Uniper



Blazing a trail through the subsidy jungle

All told, the EU spent around 58 billion euros on agricultural policy and rural development in 2017. For many German farms, these payments are a vital source of income: around 6.5 billion euros in EU agricultural subsidies will be going to German farmers between 2014 and 2020. Distributing the funds is a daunting bureaucratic task for Germany's states. Hesse, for its part, aims to tackle the challenge in the future with a special SAP-based cloud solution.

COPY — Roger Homrich

The sleepy town of Nidda is only one of Hesse's 524 municipalities. Straddling the Nidda River, this quiet community in rural Wetterau County is home to over 130 farms that received EU agricultural subsidies in 2017. Nationwide, Brussels paid subsidies to around 300,000 farms: from part-time farmers to big agribusinesses to producer associations who raise pigs, milk dairy cows, cultivate grain or grow fruits and vegetables.

Applying for subsidies can be complicated, however. There are 40 different processes, each with its own logic, architecture and system. To make matters worse, the underlying EU regulations are constantly changing. An IT system can only handle this kind of complexity if it is sufficiently powerful and flexible enough to adapt quickly to changes.

To meet this challenge, the Hesse Bank for Economic and Public Infrastructure Development (WiBank) decided to migrate its system for distributing agricultural subsidies to an SAP-based cloud software system. The software integrates a variety of business applications for digitally performing around 20 different funding procedures from the two primary funding programs of the EU's Common Agricultural Policy (CAP).

CERTAINTY FOR FARMERS

"Farm subsidies aren't just extremely complicated; they're also closely watched by the public," says Gottfried Milde, Chairman of the Executive Board at WiBank. "Hessian farmers need certainty and financial resources to make essential investments. They count on receiving their subsidies on time." The bank, a member of the Helaba Group, operates subsidy programs for Hessian companies, entrepreneurs and individuals and helps them tap state, federal and EU subsidies.

The subsidy programs can be hard to navigate and, to make matters worse, each of them calculates funding needs differently. The European Agricultural Fund for Rural Development (EAFRD), for example, pays out 1.35 billion euros alone to encourage sustainable, environmentally responsible land management and rural development. During the 2014–2020 funding period, Hesse is slated to receive around 319 million euros out of the EAFRD budget.

Another five billion euros is available from the European Agricultural Guarantee Fund (EAGF). This fund pays every farmer an average of 281 euros in income support for each hectare of land. These payments make up an estimated 40 percent of farm income in Germany on average. In exchange, the EU requires farmers to meet environmental and animal welfare standards.

DIGITAL FUNDING WORKFLOW

The new software manages and controls the entire subsidy application workflow: from application completion to calculation to payment. To accomplish this feat, the software provides 20 business applications for the EAFRD and EAGF funding programs alone – including selection and verification modules, interfaces to electronic applications and geoinformation systems. Security is strict, meeting the rigorous standards applied to banks and public administrations. The SAP-based platform will eventually support all relevant subsidy programs – from simple municipal funding processes to complex systems for the entire state or country.

"SAP has several proven base structures that lend themselves well to managing subsidies and incentives. At the same time, our platform is ready for HANA and supports state- and domain-specific modifications," says Uwe Ackermann, project manager at IBYKUS AG, the company that developed the solution. The software goes through the subsidy process in a standardized, yet personalized manner, dramatically lowering the administrative costs of subsidy management. All told, nearly 600 bank and government employees use IBYKUS's new SAP system, which runs in the T-Systems cloud in order to ensure that WiBank has enough scalable, highly available data center resources at its disposal.

REALITY OF E-COHESION IN HESSE

The new, customized cloud solution streamlines the processes even more. "To continue paying out subsidies as promptly as our farmers expect, I need a solution platform that provides maximum flexibility and reliability as well as a clear scaling strategy," says Milde. "The solution simplifies processes and speeds up processing times," Milde adds. "At the same time, we greatly reduce employee workloads and provide better service for our farmers. In Hesse, the kind of e-cohesion that leads to balanced, sustainable territorial development is more than a buzzword; it's our reality."



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While the path from Anon Mall leads past the Charlottenburger gate (on the right) via the Großen Stern to the Brandenburg Gate, an autonomously driving car records traffic situations much more complexly than a human could.

Autonomous through the Rush Hour

Along a digitally connected route through the center of Berlin used by diplomats and other visiting foreign dignitaries (Protokollstrecke in German), research institutes and industry partners are preparing for the nationwide rollout of a concept for highly automated driving. The greatest challenge, however, is less making cars smarter and more connecting their surroundings on the road with each system.

COPY — Thomas van Zütphen

“**D**ing!” Anon Mall does not let what is presumably a received text message on his cell take even one second of his attention. For the 23-year-old, distraction is not an option, especially now, while he is driving. The student works at the DAI Laboratory at the Technical University of Berlin. DAI stands for “distributed artificial intelligence” – an institute that operates probably the most sophisticated test bed for autonomous driving in Germany.

But autonomous driving, as is soon to be possible here in Berlin at what is called “Level 5,” is only possible through a combination of vehicle sensors and external sensor information. This makes it necessary to develop and monitor from end to end connected IoT landscapes, including 5G network technology and mobile edge computing. “Without managing this complex and safety-related system, autonomous driving won’t be doable in practice,” explains Jörg Tischler, Vice President of Customer Solutions for Connected Mobility at T-Systems. “In other words, the de facto situation is this: A car cannot see around the next corner by itself.” Yet that also can be essential for the three cars currently part of the DAI project.

3,350 MILES, 1.4 MILLION CARS

During his brief noontime drive from the Charlottenburg quarter of Berlin to the Brandenburg Gate, Mall could definitely leave his hands in his lap but would always be ready to jump in himself in case of doubt. Should his car respond in a manner other than Mall would think reasonable. Now, for example, when turning from Ernst-Reuter-Platz onto Strasse des 17. Juni. With up to 43,000 cars per day, this traffic circle is one of the hotspots of the capital’s traffic the linchpin of the digitally connected Protokollstrecke (DIGITNET-PS) in Berlin.

“A self-driving car whose technology can master these kinds of traffic circles can drive anywhere in the world,” Dr. Sahin Albayrak is convinced. And that is exactly one of the goals of DIGITNET-PS. The professor is head of the Chair of Agent Technologies in Business Applications and Telecommunication at the Technical University of Berlin. He is also the founder and director of the DAI Laboratory and a founding member of Deutsche Telekom Laboratories (T-Labs). It is no accident that the newspaper Berliner Morgenpost recently speculated that, on Dr. Albayrak’s watch, “traffic history could soon be written on Strasse des 17. Juni between Ernst-Reuter-Platz and Brandenburg Gate”: with DIGITNET-PS, the first step is to use project vehicles dedicated to a limited radius of motion to turn autonomous driving into a highly reliable matter of course. What will also be studied is how the results can be rolled out over longer segments, streets, boroughs and, at the end of the day, all of Berlin with its 3,350 miles of roads. A city where, according to the Berlin Senate Department for Urban Development and Environment, 1,417,866 vehicles were registered as of the start of this year. More than anywhere else in Germany. And that does not even include the trucks, passenger vehicles, and motorcycles that come into the city every day.

This makes a rollout quite the task; most autonomous driving projects are currently being conducted by manufacturers and Tier 1 suppliers. Based on their product roadmap and portfolio, they are testing their sensor technologies, developing algorithms and thus setting the foundation for legislation and product approvals. Collaborations and industry partnerships for future data platforms are moving forward. However, many of

Almost 15 percent of Berlin’s 250,000 street lamps are gas-powered. The World Monuments Fund WMF has put the ensemble, which is regarded as unique worldwide, on its watch list.



these research and development projects result in isolated solutions. “To realize practicable use cases,” Tischler explained, “connected IoT landscapes for multiple partners, multiple vendors, and multiple technologies must emanate from these isolated domains of experience and working models. Therein lies the challenge.”

To reach nationwide autonomous driving of the future, millions of sensors in cars, edge device’s and infrastructure elements will have to generate enormous amounts of data. This has to be managed and interpreted as a network. The problem: “Most standard monitoring and operating tools are neither suitable for simultaneously processing extremely large amounts of data nor capable of drawing the right conclusions from confusing, conflicting, or missing information from cars and infrastructures,” Tischler further explained. Technically implementing connected IoT landscapes therefore requires artificial intelligence (AI), anomaly detection, and learning algorithms. In collaboration with T-Systems, appropriate concepts should include compliance and safety aspects alongside technical factors such as stability, availability, and performance. To tackle these challenges in the DIGINET-PS project, DAI Laboratory currently employs around 120 research assistants and students. Mall is one of them.



“A car cannot see around the next corner by itself.”

JÖRG TISCHLER,
Connected Mobility, T-Systems

BETWEEN DATA PROTECTION AND MONUMENT PROTECTION

He drives his car east, crosses the Landwehr Canal and passes what is currently the only gas lantern museum in the world. Berlin and its lanterns, that’s a part of history unto itself – how else could it be worth its own museum? A part of history, nevertheless, to which the DIGINET-PS project is adding another chapter. It is also an example of

“the greatest problems in IT-based and communication-based innovation projects are sometimes not so much about data protection”, reports Dr. Albayrak. Sensors and cameras in cars and infrastructure do not record personal information and, furthermore, provide only pixelated video frames. In addition, the Berlin Data Protection Commissioner and various Senate agencies have been included in the project. “A veritable hurdle is, instead, the protection of monuments,” Dr. Albayrak revealed. This is because the several hundred lanterns Anon passes as he continues toward the Victory Column are all under a preservation order. “Right now,” said Dr. Albayrak, “we’re in talks with the boroughs over retrofitting the lanterns so we can use them to house our sensors. We would replace their innards without altering their appearance.” Yet experience shows talks of this kind can take a while.

For this reason, the test infrastructure has included a broad range of players from industry, research, government, and society since the start of the project. And the university’s plans have received major support from the government, in particular. The test bed is being funded by the Federal Ministry of Transport and Digital Infrastructure as part of its “Automated and Connected Driving on Digital Test Beds in Germany” policy. The Governing Mayor of Berlin, Michael Müller, and the senators of the state government of Berlin have also pledged their assistance to the research project. “That’s very important to us,” emphasized Dr. Albayrak. However, the infrastructure on the inner-city streets is a matter of the local boroughs. This even includes federal highways like the one Mall takes to quickly get to the Great Star. Where the B 2 and B 5 meet Spreeweg, Hofjägeralle, and Altonaer Strasse is where well over 40,000 cars daily make the traffic circle around the Victory Column into a second trouble spot along the four-kilometer DIGINET-PS Protokollstrecke. Here is where the project is examining the question of how much connectivity and how many sensors are needed when 40,000 vehicles need to communicate with their immediate surroundings or with one another at different (peak) times every day. And not just when they – as Mall did on this day – are driving under clear blue skies, but also in twilight, virtually at night or in fog, or when it is snowing or raining. And when, as in other test beds for autonomous driving in DIGINET-PS, it is not just cars on the move, but also bicycles, pedestrians, wheelchairs, skateboarders. And what actually happens when the

State of emergency. In a city where 1.4 million cars share the streets, something like “unrestricted travel” is considered unusual.



power goes out in Charlottenburg? Do the cars have to pull over? What does a fallback solution look like in terms of real incident management?

EVERYDAY INSTEAD OF LAB CONDITIONS

The variety of questions DIGINET-PS needs to answer makes one thing clear: here, in the heart of Berlin, since March of last year, every facet of automated and autonomous driving is being tested under real traffic conditions and in extreme traffic situations like nowhere else. Given the special features of the innovation site of Charlottenburg in particular, with its numerous university facilities, the Protokollstrecke can also serve as a reference solution for complex traffic situations in other urban spaces. One of the specific aspects of the project is to develop a "smart city" reference architecture. The goal of the project, which will run until summer 2019, is initially to develop a flexible and integrated solution for all of the technologies involved in being able to map highly automated driving in complex, inner-city traffic and simulate it in an open test environment. This requires the design of an open and scalable platform on which the various partners in this growing ecosystem can jointly develop new applications for connected and automated mobility.

"Our Protokollstrecke is very complicated and that is what distinguishes it," rejoices Dr. Albayrak every time he has a glance at "his" project from his window in the DAI Laboratory on the 15th floor of the former Telefunken building: A 2.5 mile, six-lane throughfare that virtually connects his office to the Brandenburg Gate, passing through numerous parks on either side. It is not only the view of the "project owners" that this "is one of the most demanding stretches in the world." Yet – with an emphasis on growth – work continues. For Dr. Albayrak, one thing is certain: "Automated driving will be an everyday occurrence for us in 10 years at the latest." The expert expects demand for fully or at least partially automated vehicles will grow substantially in the coming years. "On the one hand, society is getting older and older," Dr. Albayrak said. On the other hand, there are many of today's youth who would very consciously forego a driver's license and a car of their own because they can get almost anywhere in the city with a bicycle or public transportation. Even they would be potentially interested in a self-driving car. The market is there. The next step would be to run the test route from Nürnberger Strasse along Kurfürstendamm to Adenauerplatz, then to Charlottenburg Castle and back to Ernst-Reuter-Platz to over various segments such as residential, shopping and office areas. By 2021, Dr. Albayrak and his team, along with partners such as the Fraunhofer Institute, ADAC, BVG, VW, IHV, and T-Systems hope to expand the test route to around 10 miles. However, to do this, additional information sources well beyond the basic sensor equipment on today's new cars are needed. For one to train cars for autonomous driving. Second, tens of thousands of sensors are needed along the routes to increase the visibility of self-driving cars through digitized and intel-



With the DAI Labor in Berlin, Prof. Dr. Sahin Albayrak heads one of the world's leading research institutes in the field of agent technology.

ligent roads. "For everything to be able to communicate with everything else," summarized Dr. Albayrak, "requires the standardization or a wide array of protocols and the use of suitably powerful software stacks, among other things."

RESEARCH WITH ON-ROAD TESTS

At this time of day, Mall makes it through the occasionally seven-cane traffic circle of the Great Star without issue. A quick stop at Café Viktoria to get a latte to go? Even today, the cameras along the route help the largely self-driving cars of DAI Laboratory find a parking space. Using algorithms, the system can determine and promptly notify the vehicle where a parking space is available. The cars themselves use both their own cameras as well as sonar and IR technologies (impulse response), and laser scanners to optically gauge distance and speed as well as remotely measure atmospheric pressure. Instead of radio waves like radar, the LIDAR system in cars uses laser beams. In an on-board unit (OBU) in Mall's car, all data from external and internal information sources is compiled to reliably steer the vehicle along the most sensible, energy-saving, and safest route as traffic increases. As Mall can make out the Brandenburg Gate while driving by the Berlin Wall Memorial and the Soviet War Memorial, all vehicle, traffic, and environment information from his route converges 1.9 miles behind him – as it has been doing since the start of his journey – in a cloud. Essentially like a digital twin of what Mall's car is "experiencing" outside in real traffic. And not only that: at DAI Laboratory, data center-based future technologies for improving traffic flow are being developed to conserve the environment and create value.



Even if they "only" look like a tridirectional camera, the physical sensors of the DIGINET-PS protocol route can perform up to ten additional sensor functions.

ACT (Agent Core Technologies), IRML (Information Retrieval & Machine Learning), NGS (Next Generation Services), COG (Cognitive Architectures & Usability), NEMO (Network & Mobility) and SEC (Security) – these six competence centers are where DAI Laboratory is consolidating its numerous areas of research. At a control center, Dr. Manzoor Khan, Director of the Future Communication Systems Competence Center at DAI Laboratory and the project manager, can track all DIGINET-PS processes. How is the car responding? How continuously is the car being supplied with data? How is it interacting with infrastructure? And how quickly does it receive the necessary data and correlate it with historical data to send back the most accurate forecasts possible? In this project, it is just three cars. After a nationwide rollout, however, it will be an entire fleet of cars. But what information is currently relevant for what vehicle where? How can I protect the cars from data overkill? Questions one person alone could never answer.

BRINGING INTELLIGENCE TO THE STREETS

This is why part of the open test environment of DIGINET-PS also includes, according to Dr. Khan, carmakers such as Volkswagen, Daimler, and BMW “being able to supply complete traffic data for, say, an entire month in a packet of some kind. This, in turn, makes it possible for the OEMs to continue researching and working on their own autonomous driving applications in these virtual, but one-to-one authentic traffic scenarios.” For Dr. Khan, DIGINET-PS has become his “baby” at least to the same extent as for the founder of the institute, Dr. Albayrak. And both are driven by the same thought: if we just get the chance to extract external information sources from an intelligent environment out of the cars and use it, we will be able to really achieve the highest level of autonomous driving.

DIGINET-PS will get one step closer to this with the new 5G cellular phone network standard starting next year. But one of the most important requirements for this is safety: if, for example, at a later stage of the project with automated and connected vehicles, scenarios such as automated shuttle and convoy trips downtown are implemented. Dr. Albayrak, together with public transportation company Berliner Verkehrsbetriebe, is already planning to use two busses “equipped with window-size displays, so passengers can follow everything the bus is currently seeing”. And that it sees more than the man behind the wheel, who will of course still be there at the start. Such confidence-building companions are intended to help citizens literally go along. Get on board with the system, so to speak. “A single sensor already gives us several different types of data and scores of information,” confirmed Dr. Albayrak. “To secure their communication – from the street to the car, from the street to the infrastructure, from the street to the cloud, back in real time, with one another and, depending on relevant, supplied to all stakeholders in a dedicated manner,” stated Tischler, “makes safety an absolutely essential requirement of autonomous driving.”

SAFE IN DATA AND ROAD TRAFFIC

Meanwhile, Mall entertains not the slightest doubt that he will make his scheduled meeting time and place right near the Brandenburg Gate. A short trip, yes, but in these few minutes, Mall and his car have driven by dozens of cameras, sensors, and antennas – installed on buildings, by the roadside, and on traffic lights – all of which transmit essential information to his car. This includes information on the course of the road, traffic jams, construction zones, as well as environmental values such as nitrogen oxide emissions. For Mall, however, even more importantly: “Every movement the vehicle makes is under the premise of ‘safety first’.”

“The point of most concern,” explained Tischler, “is that the integrity of the data remains intact, which is extremely important for autonomous driving, and data manipulation is not possible despite any associated attack vectors. The security of data transmission, as well as its speed, latency, bandwidth, uplink/downlink – these are all aspects that need to interact and be monitored and protected on the technical end.” Then comes data protection and data governance/privacy, i.e., the questions: Who owns the data? Who can interpret it? What kinds of new business models can be established from the combination of vehicle data, driver data, user data, and public data? And how do those responsible for data traffic and road traffic deal with legal and ethical problems in the future? For example, the question of how long this kind of vehicle and traffic data needs to be retained?

“It is crucial for trust in and acceptance of virtually every concept surrounding autonomous driving that these questions are convincingly answered for every road user,” Tischler confirmed. And after all: according to a study by the Bertelsmann Foundation, 39 percent of participants in an EMNID survey in Germany could see themselves using a self-driving car.



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DEUTSCHE TELEKOM IN FURTHER EUROPEAN 5G PROJECTS

European consortium projects with significant participation of Deutsche Telekom include 5G CroCo (France/Luxembourg/Germany), 5G CARMEN (Italy/Austria/Germany) and 5G Mobix (several corridors in Western and Eastern Europe plus partner corridor in Asia). The projects are co-financed within the framework of the EU Horizon 2020 Innovation Fund. The aim is to provide 4G and early 5G capabilities including edge cloud computing for different CCAM* application cases in cross-border connectivity with interoperability between different network operators, telecommunication technology providers, transport infrastructure operators and of course different vehicle manufacturers and suppliers.

Bio

Dr. Robert Zores has been the CTO of REWE Digital GmbH since January 2014, where he has been responsible for strategic and technical direction and implementation. After pursuing undergraduate and doctoral degrees in physics and computer science, he started his career at the German Aerospace Center (DLR). Before joining REWE, Dr. Zores had held leadership positions at companies such as Sun Microsystems, Easynet, AOL and AutoScout24.



“Digitization? – A Single Continuum”

Dr. Robert Zores, CTO of REWE digital, and Christoph Günther, Director of Key Account Management at T-Systems, on voice commerce, the convenience of shopping in the future and how lateral thinking increases efficiency.

COPY — Thomas van Zutphen

Dr. Zores, to make REWE ready for digitization, the company founded REWE digital in 2014. Why was this job not simply given to the company's IT department?

Digitization isn't just technology or IT. It's about people, working environments, working differently, and perhaps also thinking differently. This is why the CEO decided on a greenfield approach and not a classic integration approach. At its core, it's always about the questions: how do I digitize my team? How do I make them agile? How do I use that to change how they work and what technology do I use?

From smartphone apps through social media activities to digital marketing – how do you make sure you don't digitize past the parent company and, instead, efficiently integrate your experiences and developments?

When integration fails, it's not because of the structures, it's because of the people. One of the strengths of our team is certainly that we engage in integration and collaboration with colleagues right from the start, and that none of us have forgotten the founding idea behind REWE digital, forgotten where we came from, whom we need to take with us. We definitely have a certain corporate sophistication, if you will, but it's not especially pronounced in anyone's ego.

With 75 cities in which REWE already makes home deliveries to its online customers, you're Germany's #1 online supermarket for fresh products. What part does the first fully automated "Food Fulfillment Center 2.0", which REWE digital just opened, play in further expansion?

With our own fleet of vehicles, we deliver around 20,000 products within a radius of 90 minutes by car from the facility in Northern Cologne. We're also working on a hub-and-spoke system with logistics partners who will take over additional routes. We are looking at using the new central warehouse as a distribution center, where we're picking orders today to deliver to online customers, to allow us to gradually eliminate some of the normal stores. Even in our so-called 'dark stores', where there are no customers, a picker can walk up to 9 miles in a shift. This walking is completely eliminated in the new center, since the goods come to the picker automatically. More efficiency, more convenience for the customers, and less cost – this is the experience we're getting with the food fulfillment center.

To what extent is it feasible to expand this assortment and the sales channel of food and non-food items into a proper REWE marketplace? What options does REWE digital see here?

The way we currently curate our 'Shop in Shops' in REWE shops is how we will do it in the online marketplace. Every baker, every butcher, even regional employees who occasionally go from store to store need to meet dedicated product and service quality criteria that our customers simply expect. This is a big difference from operators of other online marketplaces who aren't concerned with acting as curators. We, on the other hand, incorporate it and use it to continue online what the standard is in the real world.

What do you see as the future of voice commerce and what options/potential does REWE see in this area?

Voice commerce will be the biggest thing to simplify the customer's

purchase process, not least because of the major changes we're experiencing in the mobile world. For us, with a view to the technology needed in the background, it will be anything but trivial. You'll have to, for example, add artificial intelligence to the processes needed to interact with customers who buy via voice. This means your domain knowledge – about the variety of cold cuts at your counter, the option of the customer getting ham sliced thick or shaved, etc. – you have to instill that in a digital assistant interacting with the customer. Siri, Alexa, Bixby and Co. don't have the intelligence for this, only we do, because only we know what the customer wants, what their preferences are, their purchase history, and we don't have to ask the same questions every time. Of course, this means every voice commerce customer has to identify themselves. If anonymized, "voice" would remain rather dumb. It's the same as in a real store where our sales people in many cases know their customers or immediately recognize them: the potential for improving their service lies in knowing who they're dealing with.

There's a give and take of information behind that. How ready is a REWE customer for that and have you found national differences in your markets?

Absolutely. If we take Austria, for example, customers are very interested in that kind of exchange. We have a very promotion-driven market there, subsequently, for example, our national benefits club card has a penetration rate of over 80 percent. For better prices and making their shopping plans easier, customers in Austria are very open to giving us information about themselves, which puts them a bit ahead of our customers in Germany. But even our payback card is going very well here, both with customers who shop online and customers in real stores. That is: customers understand this "give and take" and want it more and more.

With almost 30 million people going to REWE every week, how quickly can you update your information on each one of your customers?

If we're talking about "real-time", we still need some time. Then we'll be equipped to immediately add new information provided by the customer. Ultimately, the whole thing naturally needs to make sense to the customer. Not least with this meaning, we also consider the European General Data Protection Regulation in effect since May as corrective not throughout, but in a series of aspects.

"Corrective" is a good word – how much do start-ups, for example, help you adjust some of the courses REWE is on?

We're also following several courses there. One regular tool is our "REWE Hackdays," where we try out and develop new services as well as entirely new business ideas. One of these is our recipe mapper. In principle, it's an AI solution customers can use to automatically have a shopping cart put together following a recipe they found online. A great solution, widespread acceptance, developed during the Hackdays within 48 hours. It's where we invite outsiders in to help us think laterally, out in left field and just differently. Of course, we also work with venture capital and our own start-ups.

Can you give an example?

"Commercetools" is such a young company that has been around

for three years under the umbrella of REWE digital, not only advancing the digital activities of the entire REWE Group with new webshop technologies, but also acting as an independent company in the e-commerce applications market. As a background partner, we're promoting the continued development of this young company and are further expanding our third-party business. In the Magic Quadrant, they're one of the four leading software developers in the e-commerce sector, and they were called a contender in the Forrester Wave B2C Commerce Suites in September after scoring the most points possible. At its core is a cloud-based API-first concept that allows retailers to quickly display shopping experiences across the entire spectrum of channels, devices, and touchpoints. This goes far beyond the possibilities of a traditional webshop.

You've put customer WiFi by T-Systems in nearly every REWE store. How does that help you address customer wishes with even greater precision?

These days, WiFi in the supermarket is as essential as light, water, and power. If you want to play omnichannel or purposefully guide your customers through the store, WiFi is a basic requirement. Or let's take just our REWE To Go stores at train stations – their customers need a hotspot to check the arrival time of their train. And paying with your smartphone wouldn't work at all without WiFi. In this context, we're also gradually putting WiFi in all PENNY stores and toom home improvement stores. But if we're talking about customer wishes, like feedback, then a salesforce service that's also hosted in a T-Systems cloud helps us, as well.

What cloud architecture seems to be the best for REWE's needs in your opinion?

Technologically, we're moving toward a multi-cloud setup consisting of our own data centers and various clouds. For this purpose, we're testing private cloud services as well as the Open Telekom Cloud, with its sites in Germany, for REWE, REWE digital, and subsidiaries such as Commercetools. This is particularly important for our European customers. However, at the end of the day, we consider the orchestration of virtualization infrastructures in the style of Docker to be of even greater relevance. That would raise many, many questions for companies that work with microservices like we do.

Which, for example?

How do I orchestrate my high volume of services? What kind of independence of services can I guarantee and how? How can I simultaneously set up the distribution of my data with regard to latency times between various data centers/sources to be sophisticated enough so the customer doesn't experience any wait time? At the same time, I have to keep an eye on security and always be able to answer the question: where actually is everything? All these things, it has to be clearly stated, have not yet been worked out that much so far.



This means I – especially in the interest of all subsidiaries with their different needs – first need to develop standards I can set for all providers, such as the Open Telekom Cloud.

What will be the next big thing for classic food retailing?

I believe that in the medium and long term, the payment options will have to be geared even more towards customer convenience so customers can shop much more easily and conveniently than today. This means computer vision, sensors, and IoT are at the very top of the agenda. That's exactly where I think our work with technologies and the integration of services should lead. You're right: there's always the next big thing. But exactly in this sense, digitization is a continuum: It'll always go on.



“WiFi in the supermarket is as essential as light, water, and power.”

DR. ROBERT ZORES,
CTO REWE Digital

Dr. Robert Zores, CTO REWE digital (left) and
Christoph Günther, Head of Retail T-Systems



FACTS & FIGURES

The commerce start-up REWE digital bundles all strategic and operative online activities of the REWE Group, one of the leading commercial and tourism companies in Europe with 345,000 employees. In addition to digitizing the grocery business, REWE digital works with its business units to develop omnichannel solutions, handles investments in digital ventures, and manages the parent company's holdings in digital ventures. The REWE Group owns the brands REWE, PENNY, toom, ITS, DER, Meiers Weltreisen, and Jahn Reisen as well as the Austrian chains Billa, Merkur, and BIPA. The REWE Group's revenue in 2017 was € 54.7 billion.



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Esperanto in the machinery

From frontrunner to last mover: Germany's SMEs reflect one-to-one the scope in which companies are digitizing. Mechanical engineering is right in the middle. Open IoT platforms could help not just the hidden champions in their industries, such as clutch specialist Mönninghoff, in elevating their position on the global market.

COPY — Sven Hansel

Whether button lift, T-bar lift, or chairlift, on the Brocken or in the Alps, in the Black Forest or in the ski hall: the thought of embarrassing themselves crosses the minds of even ambitious novice skiers before they ever start their first downhill. That usually happens when it's time to get on the lift. When skis, poles, and the center of gravity need to be coordinated all at once, pure physics or rather, inertia poses problems even for devout skiers at ideal weight. All too often they lose their footing and drop in the snow like a sack of potatoes to the amusement of everyone else in line. However, firstly, the lift is designed to generally make it somewhat easier for novices by slowing down and shallow braking, and secondly, this athletic challenge could become much easier in the coming years.

In no way will this be due to new training methods from ski instructors, but German high tech from the Ruhr. If only the digital twin's good ideas would be used in other industries.

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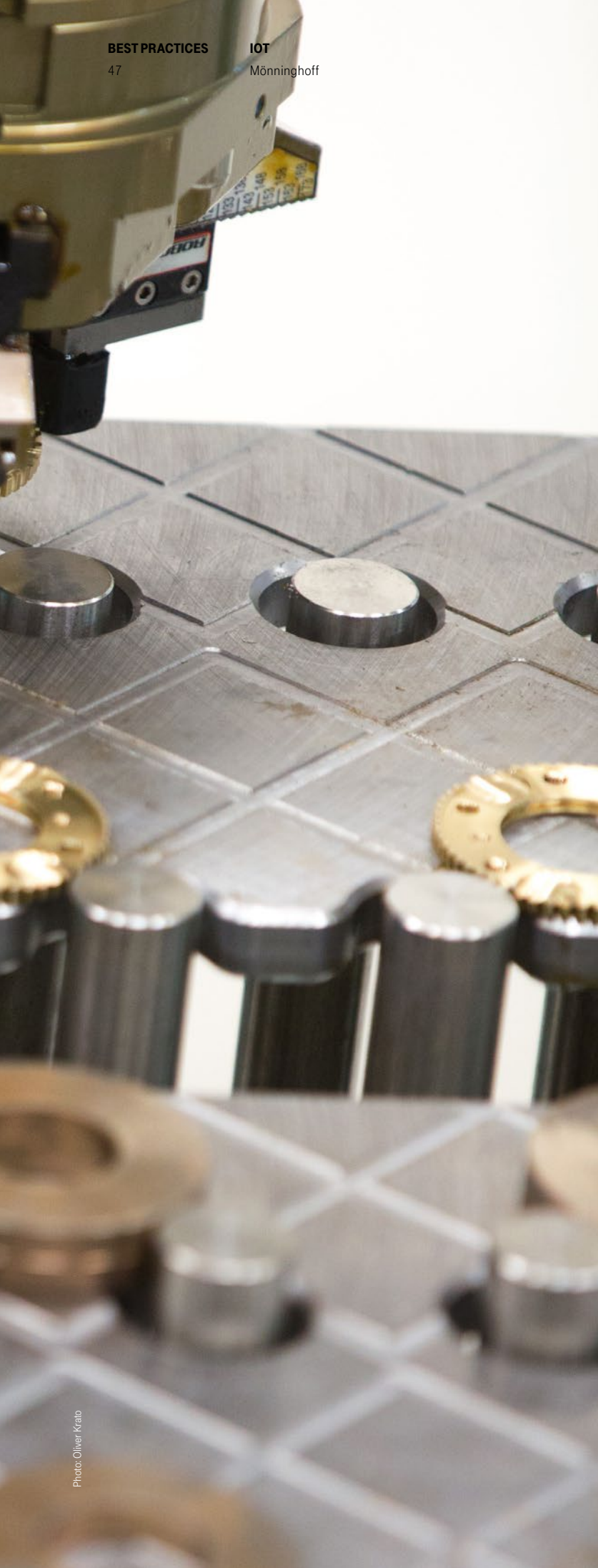
Number of teeth in
electromagnetic
brake clutches

Latest coupling
generations achieve

99 %
energy savings

NICHE, NOT MASS

The engineering company Mönninghoff has been manufacturing sophisticated drive technology from the center of Bochum for over 100 years. Brakes, clutches, overload systems: wherever forces, such as those between a motor and a gearbox, are efficiently transmitted, Mönninghoff products are used, but as is typical for medium-sized German enterprises not as mass-produced items, rather as small-batch, custom solutions for global machine and systems manufacturing. When something has to reliably switch in an aerospace application or a ski lift has to accurately slow down in demanding weather conditions, the technology by Mönninghoff and its 136 employees is often sought. "Clutch manufacturers are a dime a dozen. You put in a call this evening and you get 5,000 units the next day. We, however, specialize in elevated safety requirements or unique installation spaces. If you are at the airport and don't have a ticket to get through the turnstile, you can fight it all you want thanks to our technology, it won't move an inch. And if our drive technology doesn't work down to the last micrometer of a CT scan, the diagnosis most likely still leaves a lot to be desired," said Charlotte Finger, CEO.



These kinds of precision components play a major role in high-tech machine and systems manufacturing as well as in medical and environmental technology, which is why Finger does not prefer to think of the company as a supplier, but as a technology partner for its customers. This is why emphasis is placed on dialog with these customers' design engineers when it comes to finding the exact gear geometry for a given application. This customer focus, combined with high-precision manufacturing, forms the basis of Mönninghoff's competitiveness still. To Finger, the matter is crystal clear. "Longevity and quality alone will let us stay on the market for 30 years at most, then it's over," said Finger in giving a realistic assessment of the continued development that will be closely linked to digitization. The company's motto may be "A chip cannot produce torque", however, as Finger stressed, "While we still want to be manufacturing high-quality drive technology in a few decades, by then our products will need to have made a clear turn toward smart system solutions and additional digital services."

VALUE CREATION IN SYMBIOSIS

This is because the high-tech component from Bochum that is then finally integrated into an equally complex overall system and does what it is designed to do is just one of many. And it does it as is typical of German engineering often better than it actually needs to. "We may get a specification on the use of a product, but whether that's actually the case under real conditions is something we rarely able to determine later on," conceded Finger. This is because there is no direct contact between the component manufacturer and the end customer. That is left to, for example, the ski lift builder.

The solution here also lies in sensors and smart products that record the entire lifecycle of the product, as well as Mönninghoff's value creation chain in its entirety. A digital twin in the true sense, which can then offer valuable information from condition monitoring to predictive maintenance all the way to further product development. "This way, we would also know exactly what fluctuations occur during actual operation or at what maximum power our component is actually being used, and we would be able to adjust it accordingly. With more information from the entire product lifecycle (PLC), we could produce and design with much greater customization," affirmed Finger. In addition, smart products would arise that could be even better at helping customers solve their problems.

Mönninghoff would also have the opportunity to further optimize its production and, as a result, its cost structure. Obtaining this knowledge would also allow Mönninghoff to continue to be successful in the market beyond the next 30 years. Digitization would bring make-to-order manufacturing to markets that currently do not have close to the necessary budget. Specifically, there is a substantial price difference between a clutch that can switch four times per second and one that can switch just once or twice. Refined production planning would result in less waste while also reducing the need for prototypes.

IOT AS TRANSLATION AID

However, a critical challenge must be overcome for this kind of future scenario: the slew of languages used by the machinery. Mönninghoff is highly specialized and manufactures an enormous variety of products in top quality. "We have the Porsche of lathes, the Ferrari of grinders, and the Mercedes of hobbing machines in our hall. In addition, there is a wide range of software systems to keep everything up to date. And it all actually has to be incorporated into our ERP system and, on the whole, run like clockwork," said Finger, describing the mess. According to Finger, what would be desirable is an IoT platform able to bring these machine manufacturers some of whom even compete against one another under one roof and communicate all development, manufacturing, and assembly processes in a single language. Meanwhile, Mönninghoff's interim solution is to no longer pick from the colorful bouquet of German machine manufacturers, rather work closely with just one.

The next step for this platform could also be including small businesses and micro-enterprises, "Because we are the link between our often very big customers and considerably smaller suppliers. They sometimes still supply us with special screws with the most important details noted on a handwritten slip. We, however, are supposed to deliver products to our customers with a QR code containing information on the torque to which we tightened the screws during assembly," said Finger, explaining the current breaks in the digital chain.

Therefore, a kind of central translator, like the one T-Systems offers, would be important. A basic IoT infrastructure that is open for every machine type, every manufacturer, every industry and every trade, without exception. One that has no restrictions in terms of interfaces and, moreover, makes it possible to participate in the network beyond its own value creation chain. "The most important aspects of the platform are openness and neutrality," said Finger.

Once Mönninghoff is able to digitally represent its entire value creation chain, then perhaps nothing more would stand in the way of further optimizing ski lifts. They could then at some point take the turn even more easily and make getting on just a little easier. Novice skiers will be forever grateful to the company from Bochum.



Charlotte Finger, member of senior management at Maschinenfabrik Mönninghoff, in front of a picture of company founder Richard Mönninghoff.



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As agreed: Turning product ideas into blockbusters

Barmeria relies on T-Systems' crowd services to strike the perfect balance between customer benefits, functionality and price, as early as in product development.



COPY — Thomas van Zütphen

The recipe for a chocolate bar that bombs. A TV format whose viewing figures stay near zero from the start. The new leaf blower that just collects dust on hardware store shelves. Every industry can run off examples of consumers giving the cold shoulder to clever new products. Unfortunately, when the latest market craze is met with icy silence, the only thing left to do is to write off all the costs of research, development, advertising and production.

To nip product development flops in the bud, insurance company Barmeria asks customers to point out the problems. Specifically, it asks the crowd: Is there even a market for this idea? Who's the target customer? What are the main benefits for users and possible stakeholders? How much would consumers be willing to pay? These are all questions to which Barmeria can receive meaningful answers in record time: just two to three weeks with T-Systems' crowd service – from the first draft of the questions to the report on the findings.

PREVENTING TROUBLE A THOUSAND TIMES OVER

Barmeria's corporate strategy in Wuppertal was to analyze new potential insurance products to cover the parking process for motorists. "The only thing we expected T-Systems to do was put together a panel that our experts could ask questions so we could research four new insurance formats," explains Barmeria CMO Heiko Scholz (see CMO Talk on page 18 ff.). "Instead, they supplied an end-to-end service, including consulting – from developing the questionnaire to translating responses into recommended actions to advising us on ways to optimize prod-

uct ideas in line with market expectations." In the end, Barmeria decided to launch a situational insurance product that covers parked vehicles from damage caused by other motorists. Demand is strong. Every year, people file thousands of reports on dents, dings, scratches or scrapes caused by third parties who simply walked away from the scene – either accidentally or intentionally.

"It doesn't matter what we want first. All that matters is what the customer expects. So what could be smarter than to ask the 'wisdom of the crowd' for this kind of information?"

HEIKO SCHOLZ,
Chief Marketing Officer Barmeria

"All we had to do was explain what information we needed and describe our product ideas – the crowd team took it from there with their truly impressive market research capabilities," says Scholz. "The findings hold tremendous value for our business – much better than the usual market standard thanks to the active suggestions for improvement." That's music to the ears of Hans-Michael Schnelle, who is responsible for this crowd-based service in T-Systems' Digital division. "We've conducted at least 80 of these business model analyses since 2016, sending over 300 task packages to our crowd of more than

9,000 people, which has also allowed us to systematically enhance the Telekom prediction markets." Organizations truly value the team's high-quality results, too: customer satisfaction is at 97 percent.



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MIRROR OF EFFECTS

Mosaic of opportunities



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