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Perspective.

Annual and
Sustainability Report
of Porsche AG
2018

Perspective.

Sustainability as routine is Porsche's overarching strategic aim. Financial success, environmental consciousness and social responsibility do not contradict each other as far as Porsche is concerned. Quite the opposite, in fact. They combine to form a whole that determines the company's behaviour.

Financial success is a Porsche watchword. But social sustainability is too. Particularly as a maker of exclusive and powerful sports cars, Porsche sees that it has a responsibility to increase the company's acceptance and that of its products worldwide through socially and ecologically responsible behaviour. Responsible actions that help the company, the environment and society is not just what our customers, business partners and investors expect. Doing business sustainably is also important to our remaining competitive in our business environment.

That is why Porsche combines its annual report with its sustainability report. The report is intended to send out a signal. Namely, that the twin themes of finances and sustainability go hand in hand.

Financial strength, innovative vehicles, customer orientation, protection of the environment and responsibility for employees – in all these areas, Porsche sets the highest standards and is committed to improving continuously and in the long term.

There are two volumes in front of you: Perspective is intended to inspire, excite and motivate you – to confront you, challenge you and familiarise you with topics and propositions that a car company like Porsche needs to face up to in a time of dramatic shifts across the industrial landscape.

The future and how to shape it are happening today, because tomorrow is right in front of us. Continuous change is the motor of the future and thus also what drives Porsche to find solutions today for new challenges. But how can we keep ourselves up to speed in times of transformation?

Volume two is called Performance. It contains all the results of fiscal year 2018. In it, you will find developments, summaries, explanations, figures – and documentation covering all facets of Porsche's comprehensive commitment to sustainability.

As different as the two volumes are, they have one thing in common: communication on various levels. That is why some articles offer the option of augmented reality. You will find instructions on the pages in question, and no small number of surprises!

Porsche e-performance era

Oliver Blume, Chairman of the Executive Board of Porsche AG

In 1948, Ferry Porsche invented a car. Its name: the 356 Roadster, or "Number 1" for short. It was his dream of the perfect sports car that he couldn't find anywhere else – the start of the Porsche era.

Seven decades later, Porsche is about to launch its second incarnation: with the Taycan, the Porsche e-performance era begins.

The first purely battery-powered sports car made in Zuffenhausen marks a turning point: the transformation from a pure sports car manufacturer into the most successful provider of exclusive and sporty mobility. The transition from a hardware producer to an integrated hardware, software and service enterprise. We are continuing our business model into the digital era. But our aspirations remain those of Ferry Porsche: the dream of the perfect sports car.

At Porsche, innovation and continuity have always gone hand in hand. The new factor is the pace at which the classical business models are continuing to develop. We will need to be increasingly quick to meet customers' desires for more flexible, safer, more individual and more sustainable mobility. Despite this new dynamic, traditional core competencies remain indispensable. Porsche is changing, but our identity remains the same.

Our product strategy gives substance to this approach. It is built on four pillars – four dimensions, orientated to the different desires of our customers: our *basis* consists of the familiar models with sensible derivatives. In the second dimension, we celebrate our racing sport tradition. With purist, uncompromising GT and RS driving machines, we cultivate our image and refine our brand. In the "lifestyle" dimension, we combine modern vehicles with iconographic elements of earlier generations. Our plug-in hybrids and pure e-mobiles form the fourth pillar. A supporting pillar. Our future.

Where drive types are concerned, we are ringing in the electric era with a triad of highly emotional petrol engines, powerful plug-in hybrids and, from 2019, purely electric drives. We will therefore be serving the wishes of our customers just as much as the needs of the markets – which are by and large moving quickly in the direction of electromobility.

Porsche has set the course. In Europe in 2018, more than half of all new Panameras came onto the roads as hybrids. In 2019, we will celebrate the première of the Taycan. And with the Cross Turismo, the first derivative is already on its way. Electromobility has convinced us with outstanding performance values and optimum efficiency. We welcome it.

Last year, we also said goodbye to another technology: Porsche has never developed or built diesel engines itself. This technology has always played a relatively minor role for us. We have therefore decided to do without it in future. With this decision, we are refining the core of our brand: that of a sports car brand. Consistently geared towards the mobility of the future. Porsche and electromobility: they go together perfectly. And, as ever, when Porsche starts a race, it aims to win. In 2019, therefore, we will be competing in Formula E for the first time, in addition

to our commitment in the GT class and in customer sport. Because Porsche's heart is in motor sport. This is our soul, with the race track as a laboratory for innovations.

In this area, the electric era already began years ago: in 2013, with its record drive on the Nürburgring, the 918 Spyder showed us how superior a hybrid can be in the super sports car segment. Then, with the 919 Hybrid, we revolutionised endurance racing and won the 24 Hours of Le Mans, the toughest race in the world, three times in succession. The Evo version of the 919 even undercut the 35-year-old lap record on the Nordschleife of the Nürburgring – by almost a minute.

Experience that we gather on the race track is successively fed into standard production. In 2014, Porsche was the first manufacturer in the premium segment with hybrid systems in three model ranges. Since then, we have continuously optimised our performance and electric range. The most recent example is the Panamera Turbo S E-Hybrid, which not only enables emission-free driving in inner cities; the electric components of its hybrid drive also support the sporty driving dynamics, if necessary. The driving experience typical of Porsche.

Just like the Porsche 919 Hybrid, the Taycan also relies on 800-volt technology. This voltage level lays the foundations for the entire electric drivetrain: from the battery, electronics layout and electric motors to the performance of the charging process. Porsche has developed the corresponding components in pioneering work which touched the limits of what is technically feasible. The liquid-cooled lithium-ion battery also has its origins in the high competitive pressure of motor sport. In four minutes, it charges sufficient energy for a range of 100 kilometres. This makes the Taycan suitable for everyday driving and for touring.

The prerequisite for this are high-performance charging systems. At home, the Taycan *fuels up* with the Porsche Mobile Charger Connect – overnight and fast, up to 22 kW. We will also offer inductive charging. Through the joint venture IONITY, we are also building fast charging stations throughout Europe, together with Audi, BMW, Daimler and Ford. By the end of 2019, 400 locations will already be on the network. In America, the Volkswagen Group initiative "Electrify America" will offer similar charging options. Furthermore, Porsche is planning more than 2,000 AC charging stations at very busy stopping points worldwide, to be completed by the market launch of the Taycan.

Starting a new era requires a large investment from us. Six billion euros are flowing into electromobility alone, of which one billion will benefit our headquarters in Zuffenhausen. There, we have built a

factory for the Taycan and, with it, around 1,500 new jobs. All the Zuffenhausen colleagues are supporting this project by waiving part of their pay rises. This future package is unique in the industry's history.

The demand for the Taycan is already massive. We are optimistic that it will also enable us to meet the increasingly strict EU climate targets for cars. After all, Porsche is not a volume manufacturer. Zero emissions immediately make

an impact in a model line such as the Taycan. As with the Cayenne, other plug-in hybrids will follow. The new 911, the eighth generation, has also already been developed with a hybrid capability. In 2025, over half of all newly delivered Porsche models could already have an electric drive.

Porsche stands for acceleration, and this also applies to transformation. In this area, we benefit from our strength: above all,

the transition to the new exhaust gas measuring method WLTP and the associated bottlenecks, as well as our abandonment of diesel, have demanded much of us in 2018. This makes the balance that we achieved this year all the more remarkable: despite all the adversities, 2018 was a record year once again. In the 2018 financial year, Porsche AG delivered a total of 256,255 vehicles (plus four %) and increased revenue by ten % to 25.8 billion euros. The operative result increased by four % to 4.3 billion euros (2017: 4.1 billion euros). Despite very high levels of investment in electric mobility and future technologies, the operating return on sales of 16.6 per cent exceeds the strategic target of 15 per cent.

The refurbishment of our model range, considerable investments in the development and infrastructure of electromobility, the qualification of the workforce for new technologies – all this has its price. In addition, there are the material costs for an electric vehicle, which are between 6,000 and 10,000 euros higher than for a combustion engine. This initially reduces the profit per car. Despite this, we will continue to stick to our strategic target of an operative sales return of at least 15 percent. This is the only way to secure jobs and make investment in new technologies possible.

In 2018, we therefore set a results programme. On the one hand, we want to place even more emphasis on digital business areas, and therefore new sources of revenue. On the other hand, we are reviewing our structures with a view to where we can streamline our processes even more or become even more efficient, what we can do without and which synergy potential we can use to better effect. By 2025, this will enable a total of six billion additional euros to be generated as a result. If our measures are effective, two billion euros will then be generated each year from 2025. Our targets are ambitious. We must and will make even more effort than ever to remain on course in the coming years. We have what we need to do this: stamina, expertise, passion.

And efficiency. Made visible in the form of our new Taycan production and assembly, a factory within the factory at Zuffenhausen. We are implementing driverless transport systems in continuous flow for the first time there, with the so-called Flexi line. We are therefore combining the advantages of the classical flow principle with the flexibility of an adaptable assembly.

Under the motto "smart, green, lean", the Taycan will be created CO_2-neutrally. Our target is what we call the Zero Impact Factory – a factory with no environmental pollution.

Two years ago, we completely converted our production sites in Germany to natural power. Since

its foundation 18 years ago, the Porsche factory in Leipzig has been one of the most modern and sustainable automobile factories in the world. Energy efficiency measures have enabled a total of 9.3 gigawatt hours of electricity to be saved there since 2015. This corresponds to the average annual consumption of approximately 1,900 four-person households. The rail transport of the finished vehicles is also powered by green electricity. This saves 6,200 tons of CO_2 per year. Photovoltaic systems in buildings provide solar power for the body assembly lines of the Macan and Panamera.

With Porsche Impact, we are also giving our customers the opportunity to reduce their carbon footprint for the first time. Depending on the mileage, model and vehicle features, Porsche Impact calculates the emissions of the vehicle. The customer can then compensate them on a voluntary basis by supporting suitable climate protection projects.

Sustainability, digitalisation, connectivity, artificial intelligence: Porsche is well on track. Our objective is to become the leading provider of mobility solutions in the premium automobile segment. The art lies in interpreting the technical possibilities of digitalisation in Porsche's terms. Not as an end in themselves.

We are therefore working on our own solutions which will improve functions for customers or facilitate our processes. In production, as well as in the vehicle. The best example is the wet mode, a worldwide innovation in the new 911. It gives a warning when it is beginning to rain and offers safe driving assistance. A night vision function with a thermal imaging camera helps you through the night. We are also the first automobile company ever to equip a vehicle, the Panamera, with the digital security technology Blockchain. The decentral storage technology is well-known from the world of finance. Together with the Berlin-based start-up XAIN, we are bringing it into the vehicle.

Cooperations are part of our strategy. We have therefore increased our IT budget from 150 million euros to 450 million. With young start-ups, we are securing our access to exciting new technologies. For this purpose, Porsche Digital GmbH has opened a new Digital Experience Foundry in Ludwigsburg. Here, digital products and services connected with the vehicle are developed and modern working methods are implemented.

In 2018, we were already able to present our first results: Porsche 360+ navigates customers through their everyday lives. A personal lifestyle assistant orders presents, plans trips and buys tickets. Even for sold-out concerts, around the clock. With offers like these, we are opening up for the first time to customers who do not own their own Porsche. In the past year, we have already had very good experiences

with the subscription model Porsche Passport: for a monthly fee, the customer can choose from 22 Porsche vehicles and change to other models as they wish. This is currently only available in Atlanta in the USA, but will soon also be offered in cities in Europe and Asia.

With the Taycan, we are going even one step further. For the first time, we will offer updates "on demand" and "over the air", either long after the purchase of a car, or just for a certain time. Because the path to the autonomous car goes through numerous assistance systems – for example, the congestion pilot or instruments which enable the car to search for a parking space and park itself.

A Porsche will still have a steering wheel in the future. People will always want to drive a Porsche themselves and be able to, because driving pleasure is part of the essence of the brand. In automated driving, we are therefore supporting solutions which fit the needs of our customers, for example on the race track. The autopilot knows the ideal course and shows how bends can be perfectly braked into and where it is best to accelerate.

Digital transformation ensures social progress. It makes life simpler, more pleasant, more sustainable. But not everyone will still be able to do the job they are doing today in ten years' time. New digital business models require new employees with a different mentality and approach. We are preparing our team specifically for this. We want to qualify them right across the spectrum between the cornerstones of tradition and innovation so that everyone in the company can benefit and nobody loses out.

32,325 people were working at Porsche at the end of 2018 – more than ever before. This corresponds to an increase of nine percent in comparison with the previous year. Porsche's attractiveness as an employer is unabated. Around 150,000 applications per year and regular top placements in employer rankings prove this. And although our workforce has more than doubled since 2011, we at Porsche place particular value on the feeling of togetherness and cooperative interaction with each other. Since these values are not mere lip service but are also actively practised, we have started a new Employer Branding campaign. With it, we present ourselves, particularly to students and career starters, as an authentic, human employer: authentic and down-to-earth. The basis for this is the culture guideline, refined in 2017 by more than 500 employees from all areas and with the involvement of the workers' representatives, with the central values of "pioneering spirit, dedication, sportiness and family" – our self-image.

We remain true to these values. They are our foundation, which was laid by Ferry Porsche with the "Number 1". In this consciousness and with the experience of over 70 years of sports car history, Porsche is facing the transition – even though much depends on external developments: the regulatory, the economic and the political.

We want to, and we will, continue to set standards. To enjoy competitive advantages and to fulfil our responsibility. We generate revenue. Revenue creates innovations. Innovations create investment and excellence. They ensure prosperity, social security, work and the education of young people.

The future begins today. Porsche is embracing it.

MOMENTS AND IMPRESSIONS

"The essence of our brand is what has made us what we are today and will be tomorrow."

Wolfgang Porsche

70 Years of Porsche.
A sculpture.
A monument? No. A challenge.
Not higher, not further.
Ever better.

70

1948
2018

PORSCHE

A benchmark in its sights.
A record in acceleration.
Nothing short of domination.
911 GT2 RS.
A driving machine at the limit.
A statement.

Evolution is the principle.
Preserve the tried and tested.
Design and function.
Exclusivity for the quotidian.

Macan: Fuel consumption urban: 9.5 l/100 km; extra-urban: 7.3 l/100 km; combined: 8.1 l/100 km; CO_2-emissions (combined): 185 g/km

Elegance and power.
Balance defines the concept.
Design and function are one.
The new amid the venerable.
The new 911.

The team. More freedom.
So that every individual
can personally decide
to make the common goal her own.

Done it!
Through heaven and hell.
Le Mans. Wimbledon.
Relief. Tears. Jubilation.
At long last.

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Freedom prized by many.
The solitary Highlands.
Fantastic landscapes.
Life down a winding road.
Delight with due care.

Passion for our past.
Responsibility for a shared future.
Symbiosis: the Mission E Cross Turismo.

Porsche reunion. A comeback.
On the track. Behind the wheel.
Four Porsche wins at Le Mans.
A legend is always there: Jacky Ickx.

Brawn. Beauty.
GT3 RS. The power is in the moment.
Lap after lap its character emerges.

"For me, Porsche has always expressed
something unique, something personal.
And always without any claim to perfection.
The result is a unique kind of poetry."

Peter Lindbergh

Nürburgring. Nordschleife.
919 Hybrid Evo.
05:19.55
A time that stands still.
For all time?

**Project Gold: greater than the sum
of its 6,500 original parts.
The sum of our experience.
For a good cause.**

Continuity emerges looking back.
Transition yes, radical change no.
So new, but provocatively little changed.
The epitome of individualist utopia.

911 Carrera S: Fuel consumption urban: 10.7 l / 100 km; extra-urban: 7.9 l / 100 km; combined: 8.9 l / 100 km; CO_2-emissions (combined): 205 g/km

From darkness into light.
The challenge ever new.
Not tradition and innovation.
Innovation out of tradition.

A mass of custom cars.
No one is like another.
Singularity amid elegant uniformity.
Unbending will in an epidemic of conformity.

When does a racing suit become art?
When it breaks the mould?
When the design moves people?
When it becomes a symbol for the times?
Something of them all.

**Performance and comfort.
Dynamism and efficiency.
Seeming contrasts unified.
Nothing is ruled out.**

Forging ahead.
Breaking new ground.
Powered by resolve.
The Cayenne E-Hybrid.

Tradition marches onward.

Taycan

Do it?
Do it!

It's good to talk about change.
It's even better when we actually do it.

by Wolf Lotter

An image of a young female riveter, which was created in 1942 for the Westinghouse corporation in the United States, only achieved fame four decades later — and became a leitmotif not only for the women's movement. Today we encounter Rosie the Riveter's resolute gaze on coffee cups, posters, T-shirts and water bottles. The image is an iconic symbol of action. Don't dither. Get moving.

But is the message still meaningful? Wasn't that awfully long ago and isn't the notion of *taking action* ancient history by now?

Rosie still looks us straight in the eye.

Her image was created after the USA had entered the Second World War. At the time women were routinely replacing men at production lines and work stations. And they weren't second-rate substitutes. They exceeded all expectations. Never before in human history were so many complex technologies advanced in such a short period of time. A quantum leap was also made in how labour was organised. It is amazing what the combination of systematic research and resolute action is able to achieve. Nothing seemed impossible anymore. That was by no means simply a product of wartime demands and the necessities of defence. Rosie the Riveter and her era also radiate confidence in the future and readiness to take on concrete tasks. Times of great change always bring numerous imponderables and no guarantee of success. But those who tackled the problems quickly realised that the world could be changed for the better. We can do it! The world belongs to the capable and competent.

Rosie reminds us of what we are — agents of change.
And above all — doers.

Doers?

Can we even use that term? It has certainly lost its lustre just about everywhere. It refers not only to those who roll up their sleeves and get going, but also to those who like to talk about challenges — but then prefer to take action for action's sake as opposed to engaging in productive activity. The producers of many words and few results.

On the one hand, doers can trigger social, economic and moral changes as well as crises. Certainly they always seem to accompany such events and periods. They leave the impression of wanting to solve problems, but without taking action. Their lack of activity cheapens the decisions and the ideas associated with them. The result is a constant stream of talk that leads to little or nothing — the "frenetic stasis" that the philosopher Paul Virilio has called the new normal.

But beware, it pays to look more closely! There are different kinds of doers: the *pretenders* who present the appearance of wanting to set things in motion, and the *contenders* — like Rosie the Riveter — who actually tackle the problems. Especially in times of disruption, what is needed is to live and work in a new era. And to develop an eye for real doers, which is not always easy because the *pretenders* generally attract more attention. They seek the spotlight while others are already coming up with solutions. Without the *contenders* we wouldn't move forward. We need them now more than ever.

The 21st century has a long to-do list: *grand challenges*, mega-problems that affect all of humanity, and open questions for which we need to find concrete answers. Certainly climate change is one of them, as is digitalisation which is fundamentally changing the ways in which we work and live — much like the Industrial Revolution once did.

The question of how to improve mobility is pressing in a world growing both locally and globally. How can we get around without restricting our options to the point of no return?

And the biggest challenge lies in the good news that we are all living longer. Greater prosperity and better healthcare thanks to numerous high-tech advances are helping life expectancies to increase worldwide. But how can we handle the associated changes? Are our social welfare systems able to adapt? Are we prepared to ensure that the process of ageing will no longer be hidden from public view?

Nearly everything involved in solving today's problems is both complex and systemically interrelated with other fields that have their own problems. Work on one field frequently has a direct effect on other fields. That is also true if we do nothing at all. And something else is common to all of these questions: it's less a matter of recognising the problems than of putting solutions into practice.

That is a bit odd.

The world is what we make of it. We can also describe this as the *normative power of the actual*. In both cases we see a constant quality of human nature, namely the fact that we are all doers. Homo sapiens is inevitably Homo faber, a *human who creates*, who acts deliberately and exerts influence. We are doers, in other words, who are no longer driven solely by destiny and the naked need to survive, but who take the initiative to shape our surroundings and improve our lives. In fact, that is a neat summary of human history. It is our essence. Homo faber is not satisfied with the world as it is. This species knows that it need not leave the world and its things as they are, but that it can change them by careful consideration, comprehension, and implementation of knowledge.

New ground is always being broken, even though there are times in which action and active living fade into the background.

In the Middle Ages people turned to belief and let themselves be driven by destiny. That which we call the modern age is nothing other than

reflection on the fact that we need not simply accept everything but are entirely capable of making something out of it. And that is why the launch of this period was also known as the *Renaissance*, or *re-birth*. Reflection applies to a number of values from antiquity as well as to what it means to be Homo faber, the humans who do things and create things. Nothing has to remain the way it is. And nothing changes on its own. That approach would lay the foundation for exploration, research and the systematic acquisition of knowledge plus the abilities to put this knowledge into action. The sciences arose and grew, and people were soon distinguishing between theory and practice. But the main feature and major constant of the modern era has remained the propensity to take action, and to take things on. Theory and practice were marked by the principle of *learning by doing* discovered by Aristotle and rediscovered in the 16th century by the scholar John Comenius. The focus was always on integrating the acquisition of abstract knowledge and the implementation thereof. "What we have to learn to do, we learn by doing" was how Aristotle described the principle. It is not a matter of setting as precise a goal as possible and then following a plan as closely as possible, but rather of working up to the goal in the literal sense of the word.

In the process of doing, we learn. All theory is famously grey if it does not allow something to be done with it.

We no longer live in the Middle Ages, of course, but our era has one thing in common with earlier times. Challenges have always appeared too big to be solved. So we may as well not even start. We can make do with the way things are.

That is the second side of our nature that contrasts with our Homo faber capacity. And it has more to do with people in the Middle Ages than we in the 21st century might wish. *Let's wait and let others do something; we'll see what happens.* That attitude applies to both large and small challenges. The idea of *procrastination* was added to the debate a few years ago. It comes from the Latin verb *procrastinare*, which means something like "postpone".

Appearances deceive. The world doesn't stand still for those who settle comfortably into their illusions. Whilst some people procrastinate, others take action. Nothing changes on its own. We just don't notice it as quickly as we used to. Complex systems tend to mean we aren't immediately confronted with the consequences of inaction. Society is becoming increasingly segregated into milieus with very specific views of reality. High levels of division of labour amplify this effect. We are all specialists, which also means that the segments of the world we see may be more detailed than before – but also smaller. Individuals no longer think they are capable of taking action that can launch developments or change their course.

Everything outside one's own milieu appears strange and different. This is another major challenge, and one that is often overlooked. Action precludes the fear of change. It is not a matter of blind fervour, or action simply for the sake thereof. Instead it develops skills for the future. It means the ability to deal with surprises.

That ability will play a key role in a digital knowledge-based society.

Planning was the dominant factor in industrial societies. Mass production and the organisation of masses of people were the basis of the Industrial Revolution for a long period of time. That period brought something most people had not previously known: security, dependability and a plannable life from cradle to grave. True, it all too frequently remained theoretical, but the vision took root and remains an ideal for large parts of society to this day. If you have plans, you can modify their details, monitor and optimise them. That in turn fosters progress – up to the point where you start limiting your own options. Systems are like people once they begin to suffer from diseases of civilisation. But that is generally seen as a disturbance and ignored. The system will right itself again. Let's wait and see. Developments are repressed until problems get out of hand.

And then we face something that the American economist Clayton Christensen calls *disruption*, namely an – apparently – sudden break in technologies, organisational forms and systems. The plan implodes. Ambushed by reality.

Nothing changes on its own. We just don't notice it as quickly as we used to. Complex systems tend to mean we aren't immediately confronted with the consequences of inaction. Society is becoming increasingly segregated into milieus with very specific views of reality. High levels of division of labour amplify this effect.
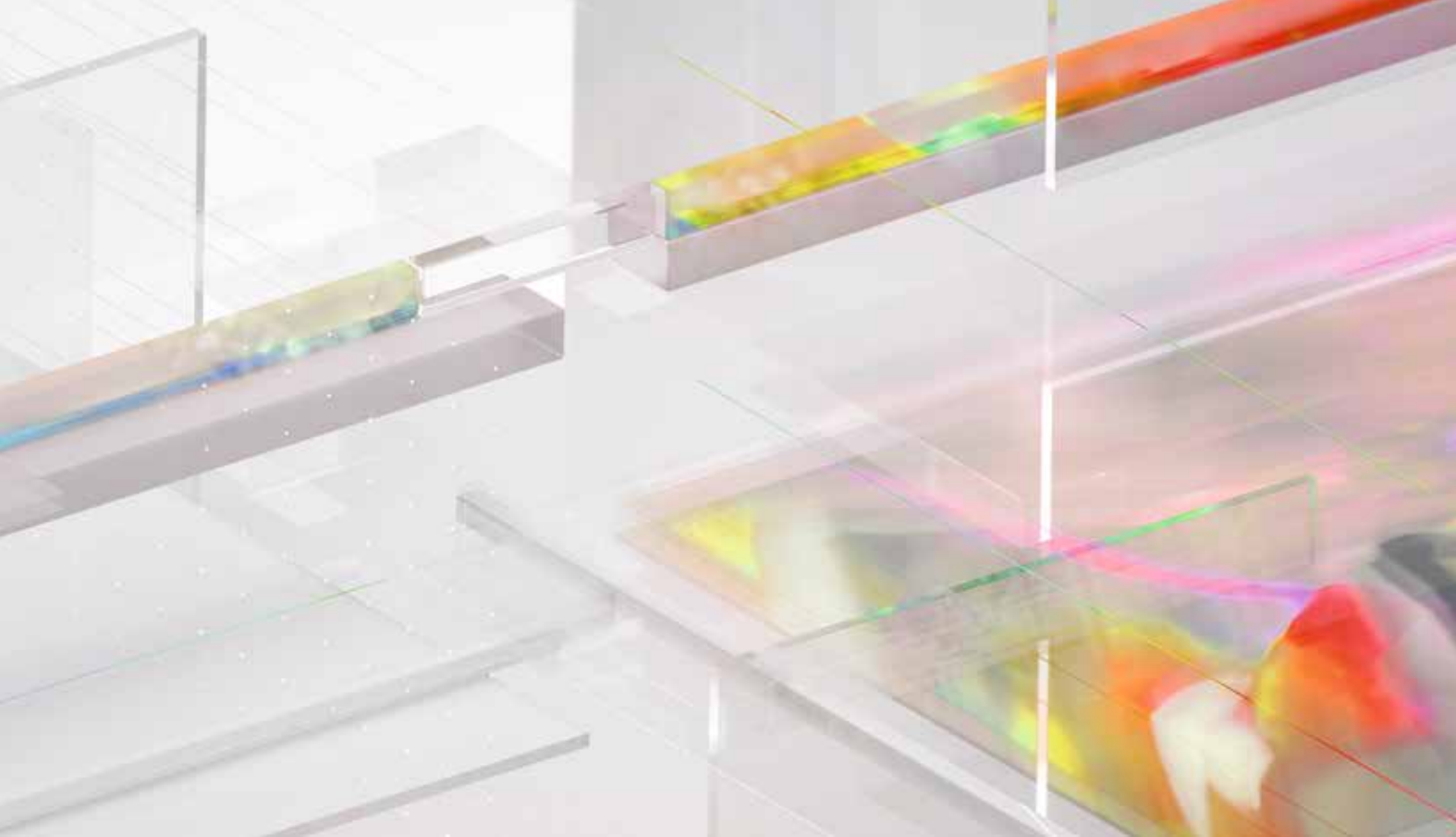
We need to replace narrow plans with more open strategic thought worthy of the name. Strategies are open concepts per se, which have much more to do with *learning by doing* than with plodding step-by-step through a to-do list. They describe a culture of doing.

These are the events that we – in retrospect – should have seen coming, as they say. But that we didn't see because we were caught in our own web of plans.

The only known antidote to such cases is openness. It consists of replacing narrow plans with more open *strategic thought* that is worthy of the name. Strategies are open concepts per se, which have much more to do with *learning by doing* than with plodding step-by-step through a to-do list. They describe a culture of doing. That becomes clear when one recalls the words of the Prussian general and strategic mastermind Helmuth von Moltke. Strategies were a "system of expedients" for him. As a young officer, he had already learned that the more rigid a plan was, the less successful it would be in battle. Every change would inevitably lead to defeat. So von Moltke introduced a foundation on which decisions could be made in flexible ways – depending on the situation. It enabled decisional capacities to be decentralised wherever possible. That in turn creates a need for self-reliance everywhere. And a willingness to keep learning.

What is true of plans also applies to methods. Both are tools that we use when needed, not dogmas on which everything else has to be based. So this also resolves the paradigmatic division between theory and practice that stands in the way of action.
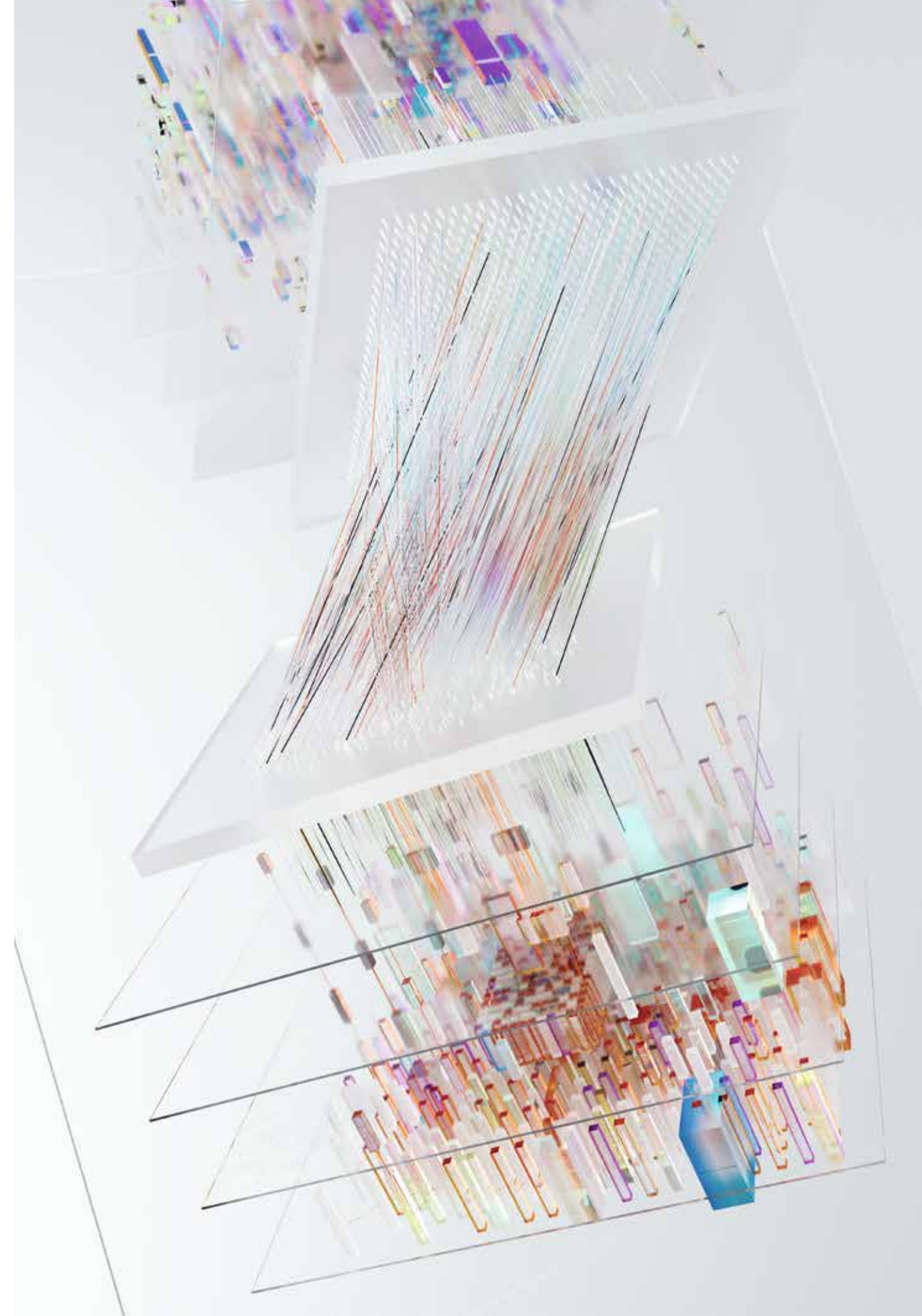
Over 40 years ago the Austrian-American philosopher Paul Feyerabend foresaw precisely that for a knowledge-based society, and described it in his book *Against Method*. His message consists not only of a call to see the bigger picture – and act in a wider context. It also lies in the notion of open-minded innovation, whereby monocultures dissolve to form new constellations and perspectives. This introduces more colour into thought. That not only improves results and expands horizons but also has a crucial side effect. New and surprising elements no longer threaten the system and individuals, but rather induce a healthy sense of curiosity.

This makes a crucial difference. Surprise no longer comes as a shock that induces paralysis and stasis, but rather as a challenge that we approach with genuine curiosity.

Curiosity is the engine that drives Homo Faber. It doesn't appear on command, but at most in response to a friendly invitation. Curiosity cannot be separated from independent thought and action. That is no new insight, but rather one we are well advised to remember these days.

The great successes of the Industrial Revolution in the 19th and 20th centuries were not built on a tight corset of planning and methodology, but rather on the realistic interplay of theory and practice. Independent entrepreneurial thought combined research and development with applications.

What was true for machine builders and engineers back then also applied to the pioneering figures in digitalisation. Curiosity with the intent to do something with it drove them into garages and labs. They all wanted to know how things worked and what would result. Perhaps the most fitting designation here is the entrepreneur, namely an individual who does things to see what is possible – or who learns by doing.

Curiosity and strategic thought are essential prerequisites for action. They foster the skills of a doer, namely the capacities to try things out and experiment. Those who focus on risks instead of opportunities may view the notion with mistrust. But the future, innovation and changes for the better will not come without experimentation. An experiment is a clever combination of theory and practice, of reflection and action. It resolves the apparent contradiction between thinking and doing, and brings them together in a natural progression. The future then arises of its own accord.

This is nothing new, but something that is always worth rediscovering. One can find it in the words of the Enlightenment philosopher Georg Christoph Lichtenberg: "The only way to recognise the new, is to do it."

It also lies in the notion of open-minded innovation, whereby monocultures dissolve to form new constellations and perspectives. This introduces more colour into thought. That not only improves results and expands horizons but also has a crucial side effect. New and surprising elements no longer threaten the system and individuals, but rather induce a healthy sense of curiosity.

Wolf Lotter is an economic analyst who focuses on transformation, and a founding editor of the *brand eins* business magazine.

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Let's go for it.

SCAN
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The vision the future is expanding and becoming multidimensional. Agility and individuality are the characteristics of transform-ative innovation. A radical rethink of the nature and value of things is occurring. Everything remains new.
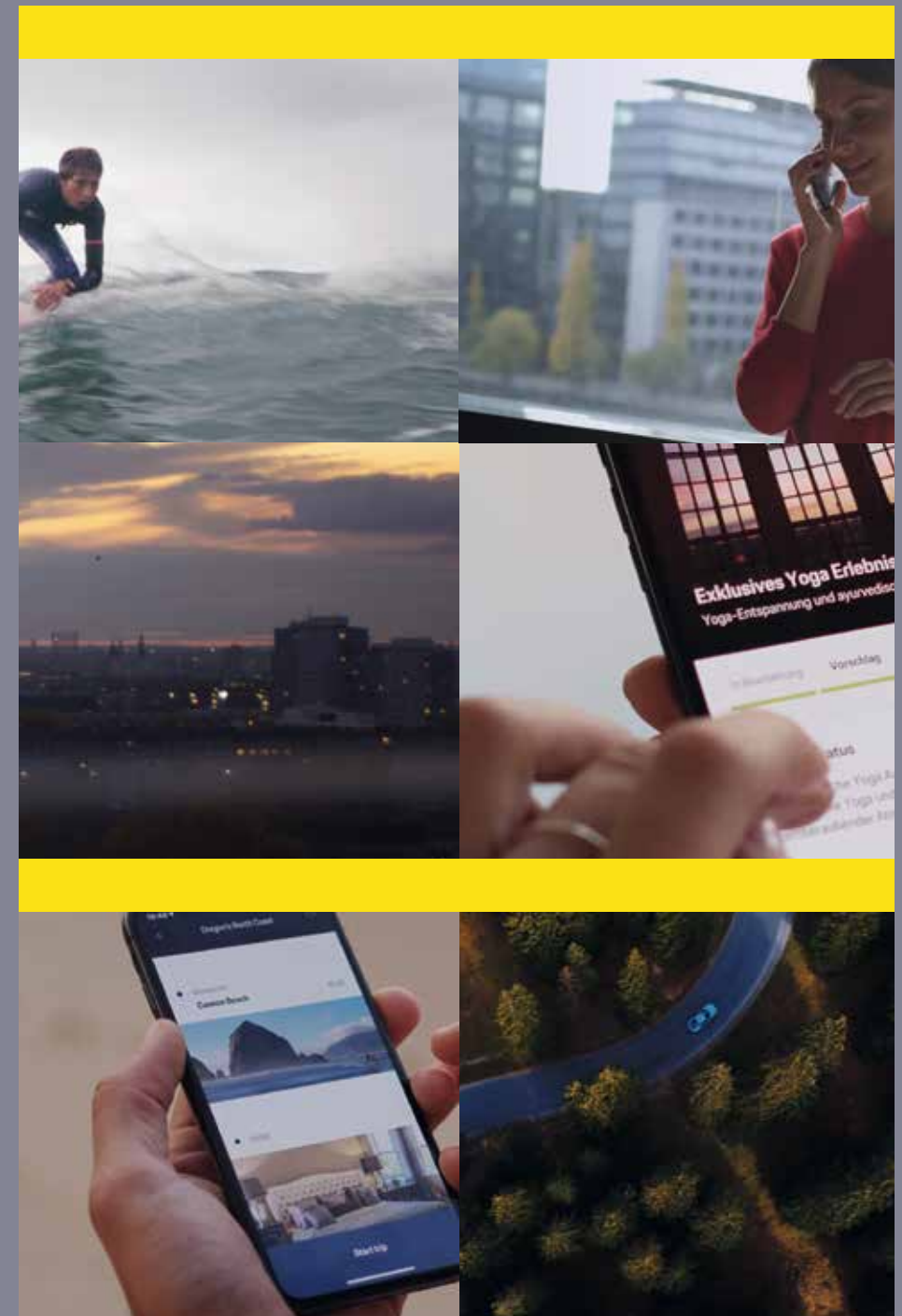
Change in perspective

"People don't want to buy a quarter-inch drill. They want a quarter-inch hole." – Theodore Levitt

Service needs to be redefined from the perspective of the customer. Perceived use is on the rise, whilst the principle of ownership is on the decline. That has far-reaching consequences.

by Winfried Felser

In the old goods-dominant economic logic, the value of a product is that of the object itself. A car is a car. A washing machine is a washing machine. But in service-dominant logic (SDL), the basis for economic exchange is the actual or potential service for the customer: a product or service only acquires value for the customer in the context of its use.

A car can have value as an asset, but in the absence of a driver's licence it has no immanent value. Similarly, as a status symbol a car only derives its value from its owner's individual assessment of the popularity of other brands. This value arises on a purely subjective level, and is phenomenological. The product called a drill is not the machine. It is the hole.

Service-dominant logic has actually been around for quite a while. Theodore Levitt, a German-American Harvard economist and one of the most well-known figures in the field at the time, formulated the main idea more than 50 years ago. But the full force of the idea has only become evident to companies in the age of digitalisation.

In a ground-breaking article entitled *Marketing Myopia*, Levitt asked the following question: What business are you in? His answer: companies have to extend the boundaries of their respective sectors as much as possible in order to make the best possible use of opportunities for growth. Two marketing experts, Robert Lusch and Stephen Vargo, pursued the idea further. In 2004 they published their first

article on the subject , "Evolving to a New Dominant Logic for Marketing". The theory had reached maturity.

It calls for radically rethinking a traditional goods-based approach and exploring the idea of service from the customer's perspective.

As a product, a washing machine provides what is expected of it – it washes. No more and no less. Washing, or clean laundry, is its value in use. The value in use is based on a value in exchange, i.e., a value for which one can purchase a washing machine. As a first step, smart washing machines are more transparent (they provide extensive information about all the performance indicators). They are more intelligent (for optimal energy consumption). They show future maintenance requirements, and they are becoming more autonomous and more collaborative.

SDL adds a second step that promises an entirely new dimension in the orientation toward use and value. Wouldn't it make more sense if customers did not have to think in terms of washing machines but instead could have a service network in the form of comprehensive home service, perhaps on a flatrate basis? If customers no longer paid for washing machines but instead for the services they use as part of a comprehensive home service platform? And if this platform combined different household services on a very individual basis?

Instead of the old model that optimises added value only along the axis of efficiency, SDL takes an entirely new tack. Instead of enhancing technology, it seeks to transform all levels of design, including the company as a whole, the associated ecosystem, and the community of everyone active in the respective industry. The result is a new, holistic approach and a real break in the company's interacting systems. And a changed perspective on our economic future. It places the focus on optimum service – above and beyond the previous product, company and transaction-dominant perspectives. And that from the standpoint of customers in the context of applications rather than the context of companies and their transactions with goods.

Service-dominant logic means a shift in marketing from a goods-centred to a service and value-centred approach. The focus has long

since moved from manufacturing products to creating values. Values in the sense of service values with the human being at the centre of the value-adding process. What is needed are customer-specific solutions. The product itself becomes the service, which in turn means that services in the future will become as tradable as products once were. Servitisation describes the shift from a technology production company to a service company, such as one that offers customers not just driveable cars but mobility in the broadest sense. Car makers are becoming mobility service providers, and the car is becoming a mobility solution.

Service is the foundation. And if service is not a service in the classical sense but rather the perceived use of a product or service from the perspective of the customer, that necessarily dissolves the duality between companies and customers. Customers and other agents participate in the process as co-producers. Creating value is the work of an entire ecosystem of resource integrators – according to SD logic.

How do customers experience their product? What services do they need for their everyday lives? What supplementary digital features do they expect? No one knows better what customers want than the customers themselves. The value of a product only arises from the acquisition of knowledge and skills, and from its integration into the sociocultural environment of the buyer. Or, as Lusch and Vargo explained: the value of a service only arises during the process of consumption. The only thing of importance to the customer is the service experienced by means of a product. Value only arises from the provision of the service.

Service first, products second – digitalisation accelerates this development. Layers of digital services, which radically rethink user experience and the value of products and services, are creating a new dimension of product use. Libraries fit into compact readers, record collections into streaming services. Access to books, films, lectures and music is now digital. Apps and cloud services are making this new type of use possible. Digitalisation commands enormous creative potential. It erases material boundaries, and creates products that once must have sounded like science fiction. Platform and sharing economies are meta-disruptive provocations for our current material state of affairs.

Cars can be used without having to own them. Strategies and models for convenient temporary access to cars have been in existence since the late 1980s. They only became – and are still becoming – a key component of mobility since smartphones made it possible to reserve, locate and return them in uncomplicated ways.

Ever more people around the globe are making ever greater use of carsharing, whether in traditional station-dependent or free-flowing station-independent forms, and of peer-to-peer (P2P) models that offer shared use of one or multiple vehicles. They share the view that ownership can be more of a burden than the expression of a successful life. In 2015 there were around seven million carsharing users worldwide. In 2025 that figure is expected to reach 36 million.

Sharing is just one aspect of this shift. Understanding disruptions like digitalisation is a complicated matter. Especially in the early phase, responses to change were often marked by cargo-cult thinking, pseudo-measures with no chance of sustainable success, or purely technology-centred refinements of old forms of logic.

In SDL, value only arises if a service, solution or use is provided within the respective context and is perceived as value. Those who take this view seriously have to reorient their future scenarios, business models and organisational concepts to customers and their ecosystems in completely new ways.

Digital transformations are radical, in order for provocations to lead to opportunities. The future will not only change cars, but also the experience of driving. Following the launch of the Porsche Passport subscription model, the P2P pilot programme known as Host is now underway in Los Angeles and San Francisco. It offers app-based rentals of privately owned Porsche cars for anywhere from a day to a month.

The Porsche e-performance era is beginning in 2019 with the Taycan. The first purely battery-run sports car made in Zuffenhausen marks a turning point: the shift from a leading provider of exclusive sports cars to a leading provider of exclusive and sporty mobility, and the change from a hardware producer to an integrated hardware, software and service company.

The user experience (UX), not the hardware, is at the forefront. It is the sum of all the customer's interactions with a product or software.

Service-dominant logic can offer satisfying answers to such questions and provide fertile ground for new models of creating value. For SDL always focuses on the customer or the user, and on fulfilling their wishes and meeting their needs along the entire value chain, even and especially when these wishes and needs change.

Whether the use is digital or non-digital is irrelevant. In very simple terms, a car that seldom needs repairs or maintenance meets a basic expectation of its buyer. Emotionally charged moments with the car reinforce a positive user experience – according to the UX approach. Emotional experiences can be triggered by a lap on the Nürburgring-Nordschleife, but also by the use of supplementary digital features.

One example is the Porsche Impact emissions calculator. It enables customers to determine the specific CO_2 footprints of their Porsche cars and offset them with financial contributions to climate protection and biodiversity. The amount depends on the car's model, characteristics and mileage. Porsche itself is leading the way. The company's entire fleet of nearly 6,100 vehicles, including its race cars, are part of the project.

Porsche 360+ is a 24/7 digital lifestyle assistant. With the help of certified partners it can also fulfil exceptional wishes such as tickets for a sold-out concert, exclusive gifts and individualised trips.

"Porsche stands for fascinating experiences that also transcend the car," says Thilo Koslowski, CEO of Porsche Digital. The company serves as Porsche's centre of expertise for digital customer experiences, products, business fields and processes. 360+ seeks a digitally connected world that is self-learning and that fulfils customer wishes before they are even expressed. This approach is also

reflected in Porsche's Road Trip app, which shows the world's most beautiful routes with appropriate points of interest – including spectacular views as well as unusual hotels and restaurants.

As customer requirements change, so too do the opportunities for a company to attach value to products. The journey has long since begun and the course is clear: physical products will remain important to people. They bring out our emotional sides, mark our identities and give us a sense of stability in the world. The benefits they bring and the opportunities they should provide are being completely rethought in the course of digital transformation. The most important questions for customers today are: Do I really need that? And how can it be integrated into my life?

Service-dominant logic can offer satisfying answers to such questions and provide fertile ground for new models of creating value. Because SDL always focuses on the customer or the user, and on fulfilling their wishes and meeting their needs along the entire value chain, even and especially when these wishes and needs change.

Viewed in this way, the process of designing services is never over. This means that the concept, design and generation of products and services will be continuously developed, tested and adapted to new requirements – like software. Ever more sophisticated product beta-versions will arise on an ongoing basis – and will become part of a connected world in which the new constant is continuous change.

Dr Winfried Felser as the deputy director of a Fraunhofer Application Centre, assisted companies with exploiting new technologies to transform products and value-creation processes. Today, his work focuses on intelligent, collaborative production and organisation systems, Business 4.0 and (digital) transformation.

IT'S TIME TO FOCUS
ON WHAT'S IMPORTANT

DISCOVER
NEW THINGS
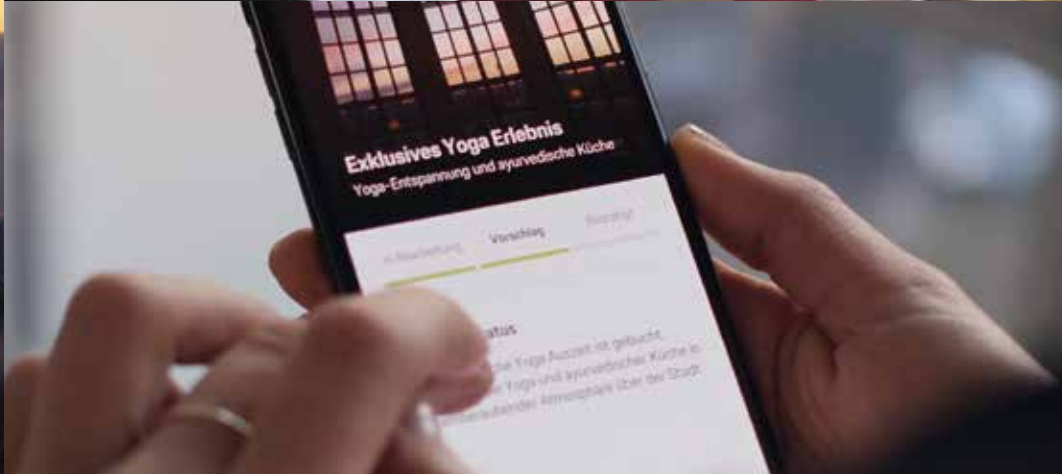
A SIMPLE REGISTRATION IS ALL IT TAKES FOR PORSCHE DRIVERS TO JOIN THE PORSCHE   IMPACT PROGRAMME AND SUPPORT WORLDWIDE CLIMATE PROTECTION AIMS.

SIMPLE TRIP
PLANNING

FASCINATING
ROAD TRIPS

When machines learn to love

Machines do what humans want them to do. But can they also feel what humans feel? Affective computing is pushing the boundaries.

by Eva Wolfangel

"You look tired," says the voice. "Maybe you could do with a nap. There's a service station in 25 minutes. I'll wake you then and you can buy yourself a coffee." I hadn't noticed that the light had grown warmer and softer. The music matched my heartbeat, but always a beat slower to relax me. I smiled. "You're not normally convinced so easily. Sleep well," says my car. And drives me to my conference in Hamburg.

– A vision of the future from Marco Maier.

Humans and machines: an interactive relationship. Machines give us directions, remind us about our appointments, and warn us when we are not moving enough. They can drive, cook, paint, make music, sometimes provide a more accurate diagnosis than a doctor and anticipate problems. Yet we complex beings with our hidden thoughts and feelings remain a mystery to them. The question is: for how long?

Human interaction uses many different ways of communicating: language, writing, facial expressions and gestures. Interacting with a computer is exactly the same. Program codes, in other words written instructions, make sure that machines do exactly what humans ask of them. Screens react to a swipe. Voice-based interfaces wait for a command. They are based on explicit statements and orders. Yet the unsaid can often be as telling as what is actually said out loud. The machines of the future will not just be smarter. They will be empathetic too, detecting our emotions from voice alone, for example.

Shrikanth Narayanan, an Indian-American Professor at the University of Southern California in Los Angeles, and his colleagues spent two years recording hundreds of conversations from couple therapy sessions. This material was supplemented with information on the marital status of the people involved. Narayanan's team added voice data to their algorithm, analysing the data according to volume, pitch, and jitter and shimmer symptoms.

That was all it took. The system was then able to predict with 80% certainty whether a couple would still be together at the end of the observation period, outdoing the assessments of the therapists involved in the trial. Narayanan is very optimistic about the future of this technology, claiming that machines are moving very close to people when it comes to recognising emotions. He also explains how our voices transport a great deal of information about our mental state and our identity.

Affective computing focuses on machines that not only function but can also adapt to people and understand their feelings. The growing popularity of voice assistants has lent huge impetus to research in this area of computer science. Voices, more than any other human expression, transport emotions. They are a key element in the interaction between humans and machines.

Meanwhile, the steadily growing autonomy of machines and their ever increasing scope are changing the emotional human/machine interaction. Instead of following orders, the "smart agent" only has a framework for action and an optimisation target. From abstract business process optimisation systems based on artificial intelligence (AI) to autonomous vehicles — machines are making decisions that affect our everyday lives, dimming the lights at home after a hard day at work, adjusting the room temperature or music volume, and even running a bath.

"Emotion AI technologies pick up on the smallest changes in individual parameters and can derive a person's state of mind from that information. Not just language, but also visual and physiological data provide valuable information," confirms Dr Marco Maier from TAWNY, a company that specialises in affective computing and is already trialling the technology in everyday applications. How, for example, should work be distributed among members of a team so that nobody feels overburdened and stressed and, conversely, nobody feels underused and bored? Smart systems independently optimise workflows, and measure and take account of the impact on the safety, productivity and well-being of workers. Empathetic consumer devices dynamically adjust their functionality to the user's state. Professional athletes use this technology to support their training to achieve the longest possible flow. Sales staff practise their presentation and attitude using an empathetic companion.
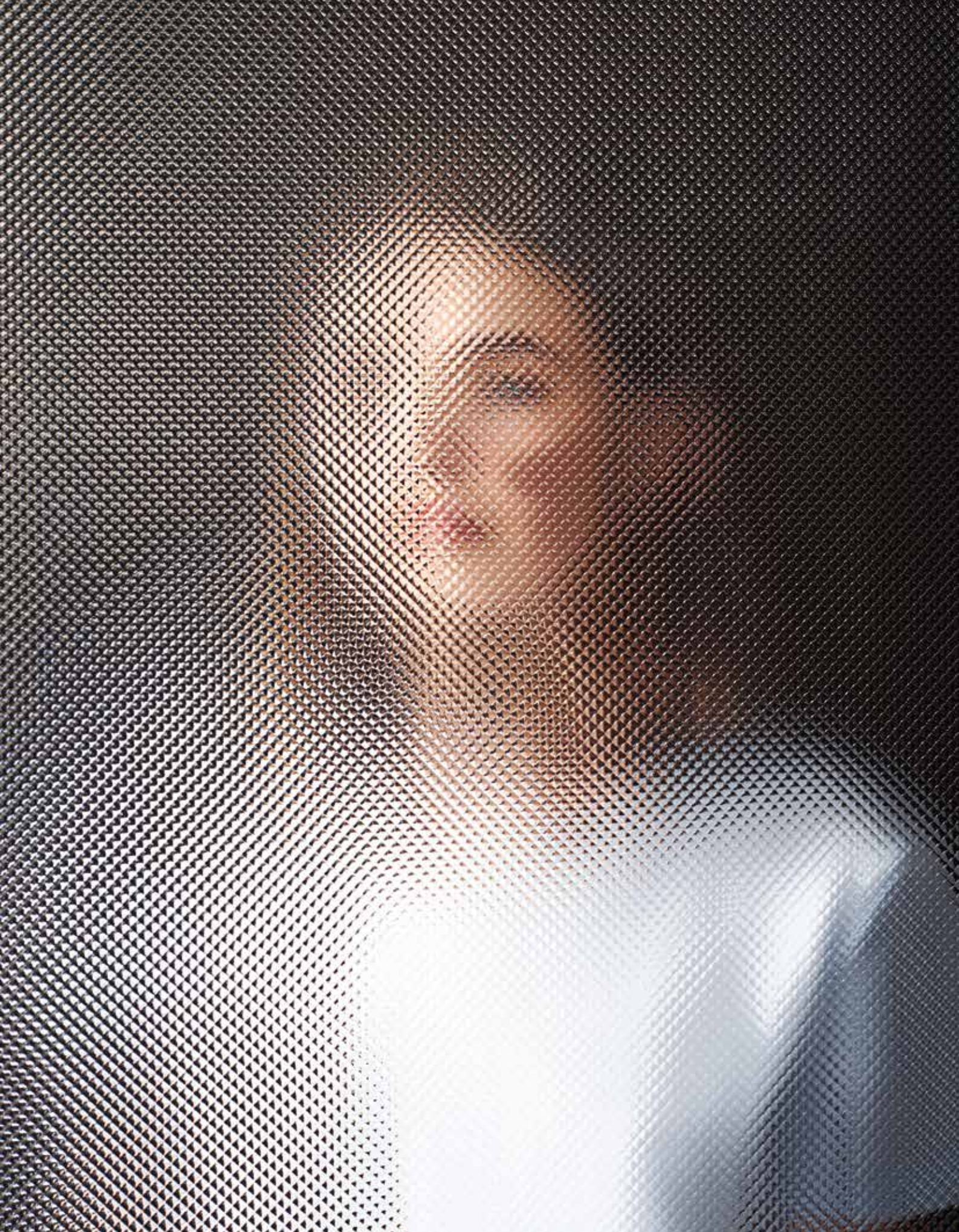
Being able to accurately assess a person's mood is a vital part of genuine communication

without misunderstandings. This is leading directly to a second trend, namely pervasive or ubiquitous computing — the concept of computing that is made to appear anytime, anywhere.

The American Thad Starner, a professor at Georgia Tech and one of the developers of the Google Glass, is a pioneer in this field. Starner has been wearing a computer for about a quarter of a century. Wearable technology is as natural to him as wearing a jacket and trousers. Over the years he has worn a hip PC, donned a clunky pair of glasses and kept a Twiddler in his trouser pocket (a chorded keyboard). Starner refers to himself as a cyborg and remembers very well how he wrote his dissertation while walking around and was able to rehearse his lectures while lying on the couch in his office. His students thought he was sleeping.

Starner laid his smartphone to rest about ten years ago now, frustrated by the unwieldy design and the fact he never had his hands free. His preference remains glasses with integrated computers, which are becoming ever smaller to the point of being invisible. It is still to have a breakthrough, but he firmly believes that this type of smart system, combined with voice commands and an assessment of mood, will soon be able to recognise what the user needs: a weather report or route navigation on the way to an appointment, or even, if the user is stressed and rushing to an urgent meeting, learning only to put through important phone calls. These systems "sense" what their wearer is doing and predict what he is about to do. They can, for example, project the next stages in a work process on to smart glasses or directly on to the desk using augmented reality, or provide unobtrusive assistance by briefly illuminating the box containing the correct screws. Dieter Schmalstieg, augmented reality expert at Graz Technical University and author of the book *Augmented Reality – Principles and Practice*, refers to these wearable devices as "all-knowing organisers". "Information is becoming a component of the real world."

The majority of machines in the world have an emotional IQ of 0. But what is already clear is that the machines of the future will not just be smarter. They will be empathetic too.

Modern-day cars, devices on wheels, are already busy collecting data. Sensors can monitor the driver's stress levels by recording skin conductance or pulse, recognising when he or she is excited or angry and reacting accordingly. The Fraunhofer Institute for Industrial Engineering IAO in Stuttgart is developing demonstrator models and prototypes for the short-term future of automated driving. These use the principles of persuasive computing to track the mood of drivers and passengers at any given time, by evaluating eye movements, for example. If they detect fatigue or a lack of attention, a blue light within the vehicle or a small movement of the steering wheel alerts the driver to the situation.

Emotionally adjusted machines will change our future. "The added inclusion of emotional and social messages allows an interactive interplay between humans and technology", explains Tanja Terney Hansen-Schweitzer from VDI/VDE Innovation. What that feels like can be experienced at a conference organised by the German Federal Ministry for Education and Research focusing on "Socially and emotionally sensitive systems for optimised human/technology interaction".

The man on the training bike is pedalling hard and putting in a huge effort but suddenly starts grimacing. "You look like you're in pain," his instructor says sympathetically. "Try cycling more slowly." The man follows the advice and the instructor is happy: "Much better."

The instructor is not a human but an avatar on a huge screen on the wall. In some miraculous way, this avatar senses how its charge is feeling. This is a project being run by Augsburg University in Germany, in cooperation with Ulm University Clinic. The aim is for the virtual trainer on the screen to help old people in particular, ensuring the correct level of exertion. To do this, it interprets facial expressions but also monitors noises, such as heavy breathing. The system also measures skin conductance and pulse, thereby recording stress and signs of over-exertion. Based on this information, the instructor can adapt its facial expressions and gestures in line with how the person working out is faring.

Björn Schuller has launched a start-up called Audeering, offering voice-based emotion recognition services. "Emotions are important because people need them to survive.

The smart agent learns which actions – bright or dark, loud or quiet, warm or cool – steer the user in the desired direction, in other words what makes them relaxed or attentive, awake or sleepy, calm or energetic.

SCAN THIS IMAGE

And that also applies to artificial intelligence." Ideally, Schuller wants to see machines adapt to people in the same way as another person would do. Alongside the US, Germany is a driving force in this type of research.

Audeering's customers include market research companies interested in using analysis of customers' voices to find out what they really think about a product. According to Schuller, the analysis of voice data from the internet (such as YouTube) is another huge market, enabling "opinion-forming to be tracked on a real-time basis". Schuller is in no doubt. Before long, emotionally sensitive systems will be having conversations with humans, and not just controlling devices with language. Siri's response to a marriage proposal might be: "It's nice of you to ask." But in a real conversation the dialogue would have to continue, and "for that I need emotions," explains Schuller. "The computer can then carry out a perfect analysis of mood and knows if I am feeling strong, weak, happy or sad."

"Socially sensitive and cooperative systems are the future," says Professor Stefan Kopp from Bielefeld University in Germany, where he heads the Social Cognitive Systems working group. But only if machines learn to adapt to humans. What happens if they do not was demonstrated during trials carried out by the German Research Centre for Artificial

Intelligence, during which socially disadvantaged young people took part in practice job interviews with an avatar. The researchers subsequently added an emotion recognition feature, after the first trial ended disastrously, as least as far as the technology was concerned. One of the users was driven to distraction by the avatar on the screen as it confronted him with unpleasant experiences over and over again with no concern for his emotional state.

The young man's response was to throw the monitor out of the window.

Eva Wolfangel is a science writer and feature journalist, speaker and presenter. Her work, including pieces for Die *ZEIT*, *Geo*, the magazine *Technology Review* and *Der Spiegel*, reports on technologies that are changing our lives.

Evolution   meets   revolution

Icon meets première. Evolution meets revolution. Classic meets pioneer.
The new 911 meets the Taycan – the first fully electrical sports car by Porsche.

Two pure-bred Porsche sports cars which sustain the core of the brand.
With these cars, Porsche has impressively proven that it is possible to change radically – while remaining true to oneself.

Sporty flyline. Flared hip. Despite all the innovations, the new 911 is the same as the old one too.
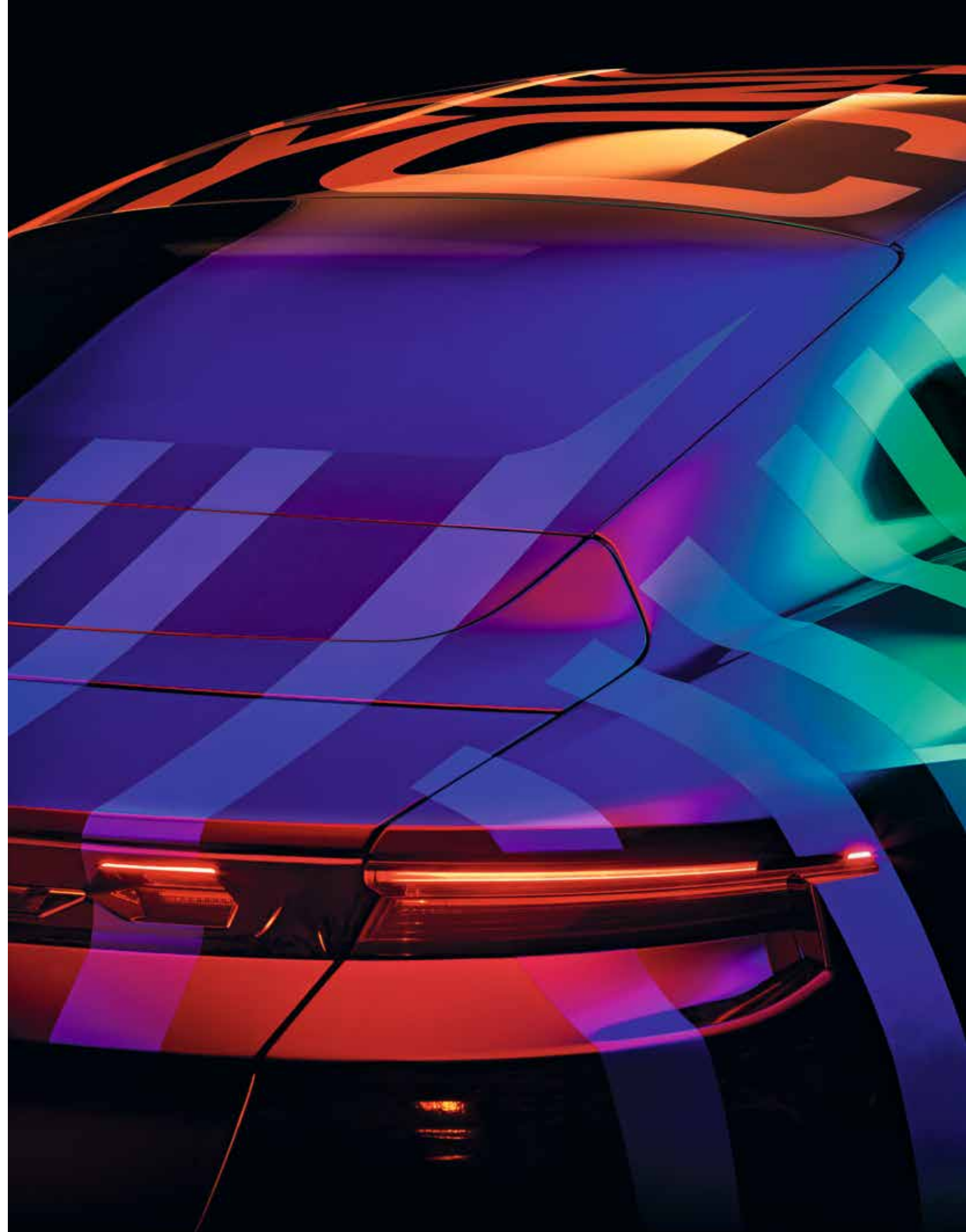Everything remains new – and it remains the best 911 of all time.

Porsche gene: each in their own way, the new 911 and the
Taycan stand for progress which never loses sight of its origins.

Front: 911. Rear: Taycan. Two perspectives. Two apparently opposite worlds.
One statement: the Porsche brand remains true to itself by constantly reinventing itself.

#SoulElectrified

Soul, electrified.

TAYCAN

A view into the future: in over seventy years of sports car history, the Taycan is the first fully electrical Porsche.
A completely new plant at the headquarters in Zuffenhausen is being built for its production.
Thus, the Taycan points the way to the future – while at the same time returning to its roots.

SCAN
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Electromobility is changing the face of Porsche from the ground up. The eighth generation of the 911, however, remains an expression of puristic sports car culture. How does a brand manage to remain true to itself by constantly reinventing itself?

by Harald Willenbrock

It is a warm early afternoon, around 1 pm, in an inconspicuous hall in an industrial zone on the edge of Stuttgart. The windows of the building are completely covered up, the gates are carefully locked so that nobody can look in or come in without authorisation and nothing is leaked to the outside. Inside is a bewilderingly camouflaged test model of the Taycan. In 70 years of sports car history, it is the first purely battery-powered Porsche from Zuffenhausen. At this point, only rough outlines are known about; the trade journals and its outdoing each other with more or less futuristic phantom images, but one thing is clear: the Taycan will enter a completely new dimension of the Porsche brand, which traditionally draws its power from high-performance combustion engines. A quantum leap. And, like any radical change, not without risk.

Right next to it, in the dark, the new Porsche 911 is parked – the classic which, since its première in 1963, has been engraved in the collective conciousness, whether as the absolute core, synonym or heart of the Porsche brand. A myth, with more than a million cars built, a phenomenon of contemporary, cultural, technology and design history, an automobile which is constantly new and yet so provokingly unchanged.

Two worlds collide – but they have a single origin. And a common goal: to define what Porsche is in a new way. What the brand stands for. And what it means to the two men who are now circling the vehicles, busy in discussion.

August Achleitner, a lean, rather boyish-looking 63-year-old, is more or less the brain of the 911. The automotive engineer has been head of the model line for 18 years; the eighth generation of the 911 will be his last. He has constantly preserved this inheritance by carefully developing it in line with the Porsche values of tradition and innovation: transition yes, radical change no. He has shaped the 911

as few others have done, although he would scarcely admit it. If you mention his role to him, his answers quickly meander towards "my team" or "my people".

"The development of the 911 is always an evolution, never a revolution," he says. "At the same time, we have created each new generation in such a way that it will not devalue its predecessors. This explains why Porsches are so timeless."

Stefan Weckbach, a good 20 years younger than his counterpart, oversees one of the most demanding tasks which Porsche currently has to offer. With a degree in business administration, he used to be head of the model line for the Boxster, and is now in the same function as the man behind the Taycan, a revolutionary vehicle concept with a completely new plant at the headquarters in Zuffenhausen. An additional 1,500 employees are being hired here

and, in the course of the electric mobility campaign, around six billion euros will be invested. A future pact by the staff and plant management enables this feat of strength. Together, they are sending out a strong signal: the radical new Porsche – due to be presented at the end of 2019 – will be produced at the birthplace of the brand. In pointing the way to the future, it will return to its roots.

Weckbach's mission is to prove that the effort is worth it, that the brand can, at the same time, renew itself and remain true to itself. "As the first fully electrical Porsche, the Taycan has to show that it is a fully-fledged member of the Porsche brand," he says. "Of course, this is a great challenge – and a huge expectation, both internally and externally."

Another reason expectations are so high is that the Taycan is to be nothing less than the pioneer of a whole series of partially or fully

"The development of the 911 is always an evolution, never a revolution. We have created each generation in such a way that it will not devalue its predecessors. This explains why Porsches are so timeless."

August Achleitner

electrical Porsche models which will come onto the market in the next few years. According to Porsche's plans, more than 50 % of the new vehicles sold are to have an electrical drive as early as 2025 – which is practically the day after tomorrow. Whether this will really come about will very much depend on how the Taycan and, soon afterwards, its derivative, the Cross Turismo, a lifestyle-orientated variant with a higher utility, will prove themselves on the roads and on the market.

The brand must, therefore, shed its skin and remain true to itself at the same time. It has to keep its fans excited and simultaneously gain new customers who may have no idea today that they will decide to buy a Porsche tomorrow. The brand must do one thing without losing track of the other. To put it in driving terms, it must keep in its lane and pull out at the same time – at high speed.

How can such a manoeuvre be carried out without being torn apart by centrifugal forces?

For August Achleitner, a substantial part of the answer lies in the new 911. With Weckbach, he is discussing the many large and small innovations which they have built into the latest 911, while at the same time protecting it against too great a desire to change. "Like the previous ones, this 911 does not dare

to question its own legendary status," in the words of an independent motor journalist. "No noise protection law in the world can silence the striking raspy voice of the artificially ventilated 3.0-litre six-cylinder flat engine; the typical coasting rattle has prevailed over the decades just as has the high-revving roistering; the combination of Sport Plus driving programme and activated sport exhaust bring the plaster crumbling from the ceiling of dilapidated tunnels when at full throttle and in low gear."

In other words: despite all the innovations, the new 911 is the same as the old one too. Everything remains new. Is it, therefore, the best 911 of all time? "Of course," Achleitner replies without hesitation. "It is, just as every generation before it has been the best to date. But we have a lot of creative engineers, designers and other clever people on board, who will be sure to have ideas this time, aswell, about what could be done even better for the next generation."

Most telling, however, is which of their numerous ideas Achleitner and his team did not implement in the course of the model overhaul, which took place without market research meetings or product clinics and solely by trusting their instincts. "We have a very special team at Porsche who are, themselves, the greatest fans of our vehicles," Stefan Weckbach interjects. "They know exactly what is right and will bring us forward."

"Every now and then, people from outside say that we have to be careful not to lose our DNA," says Achleitner. "I don't see any danger of that." That's because the brand's gene pool is in the people who plan, think, build and live the Porsche. And like any genetic material, the formative features change a bit more with every evolutionary step. And, at the same time, remain true to themselves by permanently changing.

For some people, this transformation conjures up an almost magical effect. Wolfgang Porsche, for example, talks of the "magic of Porsche", which must be retained. The grandson of Ferdinand Porsche and Chair of the Supervisory Board of Porsche AG reminds us that, today, not a single part of the 911 is identical with its counterpart from the 1960s – and yet, the essential core of the sports car icon has remained the same for more than 50 years. "That's because it is not the technical details that constitute the identity of a 911," he explains. "The decisive factor is that a thing remains true to its own essence. And I don't

know of any car which has remained so unchanged in its essence, despite all the technological and Zeitgeist-related changes, as the 911."

Those moments at which the 911 did experience extensive innovations proved how flexible and, at the same time, how robust the Porsche brand philosophy actually is. The change from air to water cooling, for example, or the decision in favour of the turbo, were bound to cause gasps among hard-core fans. At least initially. Because, just as surely, each revised model also eclipsed the sales figures of its predecessors – thus disproving those doubters who had already thought the classic vehicle was going astray.

"Our people live and love Porsche," says Achleitner. "For them, their work is more than just a job. This means that, in reality, they themselves are the most careful preservers of the Porsche gene."

A different case but with a similar effect: the newly introduced model lines Cayenne, Panamera or Macan each ensured a greater acceptance of the established model lines. What seems paradoxical at first glance is, at second glance, proof that the "preservers of the Porsche gene", as August Achleitner calls them, very clearly possess some skill in sustaining the core of their brand by constantly renewing both its substance and its manifestations. Another example of this is the Taycan.

If you believe Stefan Weckbach, the newest addition to the Porsche family stands neither for radical disruption nor for a new beginning. Rather, the first fully electrical Porsche is simply "the next logical step": not simply another electrified premium vehicle, but undoubtedly a Porsche, even if it will be more digital, and of course more electric, than any Porsche before it.

Of course, there are certainly some sporty e-cars on the market which started off accelerating impressively, only to reach their performance limitations, says Weckbach. "That wouldn't be enough for us. A Porsche must offer reproducible performance, which means that it has to offer the highest performance at a constant level."

Weckbach tells of how his developer colleagues are working under pressure to adjust many apparently smaller, some larger and, above all, decisive last screws in order to achieve this goal with their usual precision. On intelligent

cooling systems, for example, on the elements of the innovative 800-volt technology and many other things with which they are installing maximum performance, large range, short charging cycles and Porsche's typical driving dynamics into the Taycan. The aspiration of never standing still and never being content with what has been achieved, but rather of leading the field with extraordinary achievements, even if this often demands an exceptional commitment: this, too, is typical of Porsche.

For example, the decision to equip a Porsche with a purely electrical drive after seven decades of the combustion engine did not provoke the slightest resistance within the company, says Achleitner. "On the contrary, a self-confident attitude prevailed: let's show them that we, too, can make a fully electrical sports car. Something that has never existed before – just as when we made the first sporty SUV a few years ago with the Porsche Cayenne."

To focus primarily on the drive type, in Achleitner's opinion, falls short in any case. To be more precise, it snags, so to speak, in the engine compartment. For Porsche, the drive system is only a part of the whole. And very different things are decisive for this whole. Achleitner then tells of how he got behind the wheel of one of the first Taycan prototypes for the first time. How he adjusted the seat

and the steering column, scrutinised the digital dashboard and felt the "basic ergonomics" of the vehicle. How he then closed his eyes and thought: "It fits! A genuine Porsche."

But what is a genuine Porsche, exactly? What can, may, or must submit to evolutionary change? Which of the brand's features are unchangeable?

There is the sporty flyline, the flared hip, the contour of the windows, the four-point daytime driving lights and the slender head on broad shoulders: all of these mean that a Porsche is already identified long before its engine sound can be heard. For Stefan Weckbach, other parameters apart from this are also characteristic of Porsche: driving dynamics, emotion, quality and performance, for example. "What characterises a pure-bred Porsche is the fact that it always actively involves its driver," Achleitner elaborates. "And this philosophy is contained in the Taycan, just as much as in the 911. The adjustment period from one vehicle to the next takes a few minutes. If even that."

Seen in this way, both Porsche models are pretty much built along the same ideal line with which the brand is being continued. Each stands for an autonomous, unmistakeable personality. And yet they are obviously similar in many essential respects.

"We have a very special team at Porsche who are, themselves, the greatest fans of our vehicles. They know exactly what is right and will bring us forward."

Stefan Weckbach

In this sense, they resemble the two model line heads, who are now slowly strolling towards the hall exit. Even though they belong to different generations, the two men have a surprising amount in common. Both spend as much time as they can on two wheels in their spare time: Achleitner also on a motorbike on occasion, and Weckbach always in the saddle of his mountain bike. They both work in the development centre at Weissach, only a single floor apart, and exchange views whenever necessary, quickly and at the drop of a hat.

Weckbach tells how, very soon after he had started working for Porsche, he acquired a 997 Carrera S as a leasing vehicle. How, when he had to return the car with great regret, his father bought it for him. "The best thing is that the car is still standing in his garage."

Achleitner's Porsche initiation happened even longer ago, in his youth. At that time, the programme *Blickpunkt Sport* on Bavarian Television was accompanying the racing driver Walter Röhrl in his preparation for the 24 Hours of Le Mans: "on the Porsche test track in Weissach," as Achleitner recalls. The images of the dynamic car and its driver never left him after that. Born in Munich and the son of a BMW head of department, this finally led to him to make his way to Stuttgart and Porsche as a young automotive engineer in the 1980s.

As a developer, he then experienced how the Porsche product family developed in a way that many people would never have thought possible. How, among others, an SUV, a Gran Turismo and a compact SUV supplemented the family and extended its fan community. How the brand caught on not in spite of, but because of its ability to transform.

Achleitner's heart is still set on the 911 after all this time: "This car that is really irrational and yet enormously suitable for everyday use," as he calls it. Therefore, there will always be a 911 parked in his garage. When the two men finally leave the hall and go to their vehicles, he adds: "But in future, I could also imagine owning a Taycan."

August Achleitner assumed responsibility for the 911 model line in 2001. The new 911 is his third and last; the Austrian will retire at the end of March 2019.

Stefan Weckbach switched from management consultancy to Porsche in 2008. Weckbach, who has a doctorate in business administration, has been head of the Taycan model line since November 2014.

Harald Willenbrock is an author for the business magazine *brand eins* and frequently writes about companies which have to press the reset button while travelling at full speed.

The whole is more than the sum of its parts: Co-creation is the credo of a new generation of digital revolutionaries. Sharing is shifting individual boundaries.

"We want to bring the future to the road"

New technologies, new products, new competitors, new customers, new rules: Lutz Meschke, Board Member for Finance/IT and Deputy Chairman of the Executive Board, on transformation in turbulent times – and why he doesn't want to abandon a 15% profit-margin target.

by Denis Dilba

Mr Meschke, Porsche has stated that it is developing from a sports car manufacturer into a provider of sporty mobility. When will you stop building cars altogether?
Ferry Porsche, the man who founded our company just over 70 years ago once said, "The last car ever built will be a sports car." And I hope it will be a Porsche.

What is the difference between sports cars and sporty mobility?
Primarily that we have more to offer than just extraordinary vehicles. For most people, mobility just means driving. But in reality it is much more than that. In the future, we will accompany customers throughout their daily lives – everything to do with the digital lifestyle with products that typify Porsche. The core of Porsche 360+ is a personal lifestyle assistant that is at the customer's disposal around the clock. It will simplify daily life and enable exclusive experiences.

A beautiful new Porsche world?
Our world! It is characterised not only by a rising demand for mobility, but also an increasingly diverse range of forms of mobility. We are experiencing an evolution of mobility. Digitalisation, electrification, connectivity – it's all happening in sync and at full speed, so to speak. And it's not only us who are undergoing a deep transformation. The entire automotive industry is moving toward the technology and IT sectors to some extent.

What does that mean for Porsche?
Nothing is unaffected. It starts with the mentality: over many years, we've enlarged and refined our model ranges, perfected the vehicle technology, continuously improved our production mechanisms and adapted our sales activities to changing customer desires. We did what we has always been our forte: developing and building exclusive sports cars. We went from success to success, on all levels: sales, profits, employees. But everything we did was always close to our traditional core business. That won't be enough in the long run.

Will Porsche become a new company?
It won't stay the old one. We will never forget our DNA. The famous Porsche experience will always remain the focus, but we want to connect it to the future. We don't want to play the physical and digital worlds off against each other; the idea is for them to be complementary. So we have sent a clear message: our annual IT budget is now set at just under half a billion euros. Half of that is going into digitalisation.

SCAN THIS PAGE

How significant is the pressure to revitalise?
It's high. If we don't take the next step, then we'll have another two years of success and after that we won't have any answers to the challenges ahead. If we don't want to be relegated to the ranks of pure hardware providers, we have to demonstrate our digital expertise now. The automotive industry will change more in the next five or six years than in the previous 50 years.

Porsche wants to significantly increase its digital business, and in a relatively short period of time. The target is a double-digit share of sales by 2025 at the latest. How far along are you?
We're in the thick of it. The biggest difficulty is simply recognising the need for a change in the first place. It sounds banal, but it is by no means an easy thing to grasp. We continue to be the most successful sports car brand in the world. We lead our segment in technology and design. Our profitability is the benchmark in the industry, as our current figures have underlined once again. So the first task is to check our self-perception. That applies not just to us, but to Germany as a technology centre as a whole. We are the world market leaders in many sectors. But we're falling behind in terms of digitalisation. That is particularly disastrous for our industry, since two million people are sustained by it, at least.

What's lacking?
We have to develop our capabilities in completely new directions. On the one hand I think it's absolutely essential for us to open up as a company. Particularly with regard to new technologies and people who have a completely different mindset to us but who can do a lot to help us change ours. On the other hand we have to make sure that we bring our people along for the ride, prepare them for collaboration and train them for the digital world. It simply won't work without their capabilities. That's our foundation.

How do you promote digital culture in such a way that your established employees and new partners quickly pull together as a strong team?
That's the major challenge. It certainly isn't simply a matter of having a few management conferences and adjusting the strategy. The company management has to exemplify the transformation every day. Full stop. It's not always easy, but it is, in my opinion, critical in deciding whether the team will be fully on-board or not. All employees should understand: we're really serious about the new digital culture, and trying to manage the digital

Meschke: "On the one hand I think it's absolutely essential that we for us to open up as a company, get external technologies and people on board who have a completely different mindset to us, but who can do a lot to help us change ours. On the other hand we have to make sure that we bring our people along for the ride, prepare them for collaboration and train them for the digital world."

transformation as a sort of side occupation would be a huge mistake. And continually facing the team is a part of that. And getting their input just as regularly. If I want to get my employees on board here, I have to take an active part in the change process.

Porsche doubled expenditures for e-mobility from three to six billion euros and additionally boosted venture capital activities by 150 million euros annually. Are the digital transformation and e-mobility more expensive than expected?
It was always clear that we had to invest and that these outlays would rise over time. In that respect, there was no surprise. The current situation is actually much more a reflection of the fact that we want to get the future on the road very quickly. The trends are irreversible and are speeding up. Environmental regulations are rapidly increasing in number – and not only in Europe, but also China and the United States – but also so ambitious that they can no longer be fulfilled with a conventionally powered vehicle fleet no matter how much research and development you put into it. So for us, the investment uptick from three to six billion is just a logical consequence.

Meschke: "We have identified some customer requirements going forward for which we currently have little to no in-house capability. That applies not only to electrification itself, but also the other two megatrends in the automotive industry: digitalisation and connectivity. Where we identify gaps, we want to tap that expertise through partnerships or acquisitions."

The Porsche model strategy rests on three pillars: the first pillar is traditional combustion engines – high-revving, highly emotional naturally aspirated and turbo engines. The second pillar is plug-in hybrid drives with greater driving pleasure, boost power and a larger electric range. The third pillar is e-mobility. What's the focus?
One thing is clear: from 2030 onwards, there probably won't be any vehicle model from Porsche without an electric variant. I actually presume that by 2025 we will have electrified significantly more than half of our entire model range. But the combustion engine will still be around in 2030. Our 911s will hopefully still be driving with them for a long time to come. Conventionally powered vehicles will at that point be the niche in our electric fleet.

And what role do Porsche's venture capital activities play?
We have identified some customer requirements going forward for which we currently have little to no in-house capability. That applies not only to electrification itself, but also the other two megatrends in the automotive industry: digitalisation and connectivity. Where we identify gaps, we want to tap into expertise through partnerships or acquisitions. And we're well under way with that. We founded Porsche Digital GmbH 2016 and later established a presence in Silicon Valley. Porsche Digital is focussed on identifying and developing digital customer experiences, products, business segments and processes. Innovative information technologies are identified and tested at the Porsche Digital Lab in Berlin. In addition to our internal innovation management, these units provide a platform for collaboration with technology companies and start-ups. Porsche is also deliberately opening itself up to collaboration with the research community. One example is the collaboration with the HHL Leipzig Graduate School of Management. And finally, with an innovation office in Tel Aviv and investments in venture capital funds, we aim to attract talent and secure access to innovative technologies.

Which technologies are the focus?
Overall our holdings and investments are focussed on solutions that expand the customer experience. This is followed by technologies that are important for the further development of our core product and the expansion of our core competencies. The guiding question is always: With what or with which partner can we so distinguish ourselves from the competition that we can claim something that sets us apart. If we're really convinced by

something, we will naturally also look for strategic partnerships through direct interests.

Is the Croatian super sports car manufacturer Rimac an example of that?
Rimac has been working on the field of electrification for almost ten years and has demonstrated its expertise with two electric limited production runs in the super sports car segment. Through a strategic partnership we bring in additional know-how on the vehicle side in the high-end range. Another example is our investment in WayRay. This interest actually covers both aspects: a unique technology and the customer experience.

The start-up from Zurich develops and produces holographic augmented reality head-up display technologies and is working on seamlessly integrating virtual objects into the driving experience.
The team from WayRay has unmatched technological expertise with deep experience from the aerospace field as well as hardware and software development. It is clear that the innovative ideas and products from WayRay have enormous potential. We strongly believe that we can offer our customers typical Porsche solutions in the future on that basis.

What's special about it?
The WayRay solution is exciting technologically because the production technology is very compact. It is therefore a great alternative for sports cars, which generally have very little interior space, to bring in a head-up display in a very appealing form. At the same time the technology can be used as a digital marketplace and do things like showing functions-on-demand on the windscreen. These additional functions, such as extra horsepower on a race track or additional dynamic headlights, could be paid for with a simple click directly in the car. Another attractive possibility of the marketplace: information about restaurants, petrol stations or sights along the route displayed for the driver and passenger. The providers could buy their way into the windscreen. We would then receive fees for the service.

Functions-on-demand and the displayed recommendations sound very much like a smartphone and pay apps.
That's exactly the idea. That's why the WayRay technology is so interesting to us. I think that customers expect that in the future it will be just as simple and convenient in the vehicle as it now is with a smartphone on the sofa. We have to provide this seamless customer satisfaction in a Porsche as well.

Meschke: "Overall, our holdings and investments are focussed on solutions that expand the customer experience. This is followed by technologies that are important for the further development of our core product and the expansion of our core competencies."

Convenience is one thing – safety is another. WayRay delivers here as well. It is much safer not having to look down to a screen in order to be navigated. And take our new 911. With continuous connectivity and new functions and services, the car is taking the next step into the future in terms of digitalisation. The Porsche Communication Management system encompasses, among other things, standard swarm data-based online navigation. The standard wet mode is actually a world première. This function detects water on the road, conditions the control systems accordingly and warns the driver. The driver can then set the vehicle for particularly safety-minded driving at the touch of a button or using the mode switch on the steering wheel. The warning and brake assist function detects potential collisions with moving objects and triggers the emergency brake if necessary. For the first time, a night vision assistant with thermal imaging camera is optional for the 911. The

Meschke: "In terms of digitalisation, with continuous connectivity and new functions and services, the car is taking the next step into the future. The Porsche Communication Management system encompasses, among other things, standard swarm data-based online navigation."

adaptive cruise control function includes autonomic gap control, a stop-and-go function, reversible occupant protection and a new type of autonomous emergency braking function. It's all top-notch technology.

Can you really charge for dynamic headlights?
Well, hold on a minute! There's one crucial thing to say here: this is not an essential safety function, it's an additional convenience function. Everything required for safety and normal comfort levels will naturally already be included in the base version of the future vehicles. The difference: in the past, you ordered a particular set of optional equipment, paid for it at the outset and perhaps never used it. Today you only pay when you book the function and really want to use it. You'll be able to choose flexibly between a one-off payment based on time used, a flat-rate or an ongoing subscription. That's real added value.

THE AUGMENTED REALITY INTERFACE ILLUSTRATION IS SUBJECT TO CHANGE

Customer-focussed functions like that are seldom developed in the quiet of the engineer's den. You have to be prepared to approach customers with the product at an early stage. You have to be prepared to make mistakes. Is Porsche, renowned as an absolute perfectionist, ready for this cultural transformation?

We have to be. That's the great task we have before us. Thinking in terms of contributing a single process step to a product and then handing over responsibility for it to the next department has to be driven out of the company entirely. That's why we are, to a large extent, already working in agile teams using the sprint methodology.

In other words:

We're breaking with the classical perfection machine known as Porsche and no longer waiting with a result until we're 120 % certain that it works. By the time a digital product is completed that way, it has already lost its currency. Instead, we're aiming to create an initial product that I can test and present to customers within two, three, four weeks. It doesn't have to be perfect at that point; it may be just 60, 70, 80 % finished. At that point the customer says: Great idea, but I see room for improvements in the following areas. Or they say: Sorry, this product doesn't interest me. Either way I reach our goal more quickly with the feedback. So it must become normal to make mistakes. It's actually good to make them as quickly as possible. As of 2019, projects that we start in IT will be 100 % agile. Without exception.

Are there areas where it makes sense not to take an agile approach?

Yes, there are indeed. Release changes, for example. But we have to set ambitious goals to achieve the best possible result. That's why we say: 100 % agile. I strongly believe that it's the only way. Otherwise we will not accomplish the complete change of mindset that is required.

As the Board member for IT, you are aware of the necessity of extensive investments – but as the board member for finance, you are still calling for 15 % margins. Doesn't that create a very slim margin for error?

It only appears contradictory at first glance. The two demands complement each other very well. The 15 % profit margin that I would like to see long term can only be achieved if we do not continue the way we have done in the past. I can only achieve that goal by investing in my future viability, in technology, my employees, and the cultural transformation. Furthermore, we aim to cover part of the targeted six billion in additional investments over the next six to seven years through savings gained through the use of modern technologies, among other measures.

Is the 15 % bar part of the typical Porsche self-image?

At Porsche we want to continue to represent uniqueness – in technology, performance and design of our products, and very importantly in terms of business results as well. Being successful is an attractive thing. In that sense, it speaks to a sense of self that we simply can't get away from. That is what our brand stands for. And of course it's also true that we absolutely need the premium profits in order to fund the future technologies for the premium products to come. That's where it all comes full circle.

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Lutz Meschke, MBA, came to Porsche from Hugo Boss in 2001. He has been a Member of the Executive Board, responsible for Finance and IT, since 2009 and has been the Deputy Chairman of the Executive Board since 2015.

Denis Dilba writes about science, technology and carmaking for *brand eins*, the magazine *Technology Review* and other publications. Before completing his studies at Deutsche Journalistenschule, he studied mechatronics.

Achieving things together

**Co-creation redefines relationships between companies and their customers.
Passive consumers become active participants.
When does it work? And where does it end?**

by Tobias Hürter

Jonathan Calugi captures the essence of co-creation with a seemingly endlessly flowing line, accentuated by signal colours. Upon closer inspection, what initially looks like a doodle becomes a world of complex, carefully elaborated patterns and eccentric geometric shapes. Different dimensions coalesce into a shared story — the line traces the effects of many, joined in a common action.

Anyone who goes to the theatre knows what to expect. The audience sits in silence, listens, applauds. The actors act and bow to the crowd when they're done. If a spectator jumped up on the stage mid-play and tried to join the troupe, it would cause an uproar. The evening would be ruined.

Industry does theatre as well. Developers, manufacturers, suppliers and buyers — they're all actors, but their roles are changing. The theatre is not what it once was. The line between the stage and the seats is disintegrating as the internet connects the actors in new ways. Customers, who previously could only pay for and receive the products, are suddenly in the spotlight. No one in this theatre should be surprised if the audience now wishes to join the action as well.

The keyword in this new theatre of business is co-creation: active participation in the development of products and services with the aim of creating shared values that benefit all involved. It's the great trend toward open innovation, a concept elaborated all the way down to the customer by the American organisational theorist Henry Chesbrough back in 2003.

Together, we achieve more: it sounds like the oldest platitude. And even the insight that one should listen more to customers is anything but revolutionary. As early as 1982, McKinsey thought leaders Tom Peters and Robert Waterman implored their customers to get "close to the customer" in their best-selling book *In Search of Excellence*. But what do you do when you get there? Listen to them? Allow them an active role? Peters and Waterman talked about placing the customer at the centre of every single decision in the company — but not about letting them take part in the decision.

Viewed in relation to the speed with which management hype comes and goes, however, co-creation is old news by now. Coined in 2000 by the Indian-American economists Coimbatore Krishnarao Prahalad and Venkat Ramaswamy in their *Harvard Business Review* piece titled "*Co-opting Customer Competence*", the concept was framed as a new paradigm, but soon underwent the boom-bust cycle typical of management trends. As was to be expected, just a few years later the same publication published a piece warning of the dangers of co-creation.

But then Prahalad and Ramaswamy's prophecy came true: the broad socialization of the

Cooperation is predicated on a certain degree of communication, trust and understanding. It is something that one might call "good, old-fashioned co-creation".

internet fundamentally changed the scenery and gave co-creation the decisive push it needed. Co-creation is no longer a vision, but a reality. There is scarcely a coach or consultant who doesn't carry the concept in their armoury. Many large companies implement co-creation processes, plan with it or talk about it.

From basic research to interface design: nowadays, consumer viewpoints and desires drive much of the product development process. Some companies operate virtual labs where customers suggest designs for products or have the chance to vote on components. Others outsource entire development steps, holding public competitions in which anyone can participate. Customers are brought into the development of hardware and services, and even advertising campaigns. They design sports shoes, furniture and the plot lines of video games. They decide on new types of beer and coffee aromas.

Prahalad and Ramaswamy, the founders of the term co-creation, described the relationship story of the companies and their customers thus: well into the 1980s, communication between consumers and companies was a one-way street. In short, the former attempted to persuade the latter. Starting in the mid-1980s, the era of help desks, call centres, showrooms and customer service programs began. Monologues became dialogues — communication now went in the other direction as well, i.e. from the customer to the manufacturer. Companies recognized the importance of ongoing personal relationships. "Relationship marketing" was the catchphrase of the day, which lasted into the 2000s. Yet the customers remained mere buyers and consumers. Now the times are changing dramatically: they are now involved in the creation process. And sometimes they are actually in control of it.

So what does co-creation mean exactly? The term is not sharply defined. One can read the "co" as a nod to the concept of cooperation. Co-creation as a form of working together. But the type of collaboration that truly deserves the name necessarily involves the participants developing what philosophers refer to as "collective intentionality": shared intentions and objectives that go beyond those of the individual participants. Cooperation is predicated on a certain degree of communication, trust and understanding. It is something that one might call "good, old-fashioned co-creation". That is how Prahalad and Ramaswamy understood the concept they coined.

But one can also read the "co" in co-creation differently. At this point, much of what goes by the name co-creation operates without collective intentionality. Providers of search engines, online navigation systems and music streaming services no longer require any relationship to their users in order to improve their services through observation of user behaviour. In this context, co-creation generally happens involuntarily, not intentionally — virtually on its own.

Prahalad and Ramaswamy saw the internet as the strongest technological driver. But the internet is not the only place where co-creation takes place — and perhaps not always the best one. Some companies are moving towards creating physical spaces for co-creation, studios equipped with all manner of design tools, from post-its to 3D printers. They are intended to create a particularly creative atmosphere. What the company does in that space is no longer to present completed products for appraisal and improvement, but rather to demonstrate its capability to create goods with added value. It is the opposite of the digital, non-intentional form of co-creation: analogue and relationship-oriented.

One special market segment in which co-creation flourishes is high-end sports watches. Highly complex devices with a mind-boggling array of sensors and antennas, with functions for GPS, acceleration, the earth's magnetic field, temperature, optical pulse measurement and Bluetooth. Their development is accordingly elaborate.

The initial time after the market launch of a new watch is something like a public beta phase, and the initial product descriptions are like roadmaps. The watch's software is at a level which, while it does make the device usable, still does not accomplish some of the announced functions, and the sensors still

require fine-tuning. Manufacturers therefore open up the final phase of development: users tell the manufacturer about their experiences with the device, problems and desired features via customer support or social media. Recommendations then frequently find their way into the next software update. The watch providers, in turn, receive user data and feedback on a scale that would not be possible in conventional beta tests.

It is interesting to observe how differently users in forums and on social media react to the manufacturers' new strategy. Some enjoy the chance to be involved while others make no secret of their dismay concerning the "unfinished" product. They feel misused.

Observations show that co-creation is not just a question of process design. It rests on the ability to guide and shape relationships with customers and partners. Co-creation does, however, require a new attitude in the company: in development, in marketing and sales, and in the corporate strategy.

For their part, customers must understand the idea behind intentional co-creation. Above all, they have to be ready for it. It is, among other things, a generational question. Younger people who have grown up with social media, are more amenable to it. But it's also a question of expectations. Does one wish to participate in
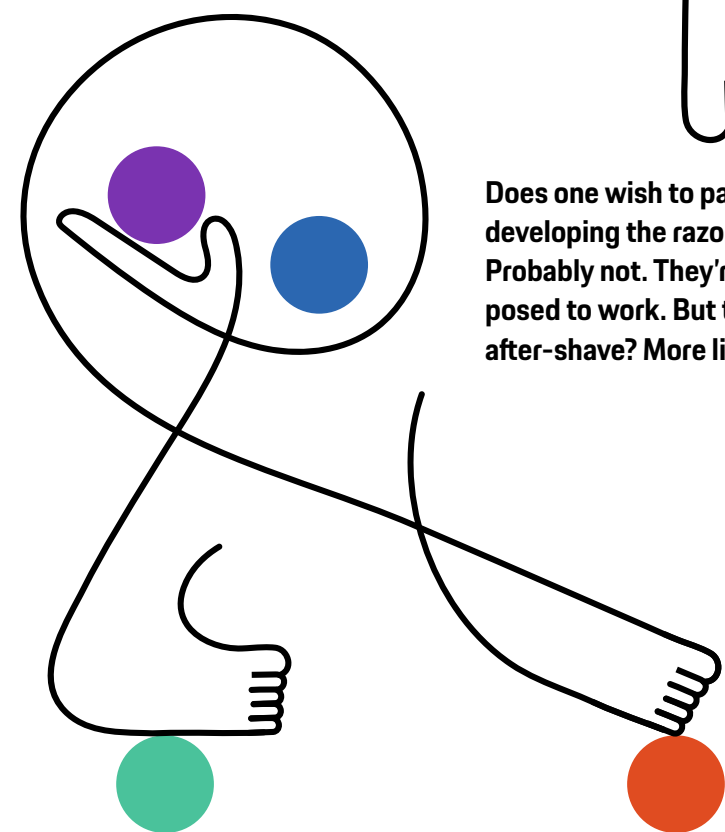
Does one wish to participate in developing the razor one uses daily? Probably not. They're simply supposed to work. But the fragrance of after-shave? More likely.

developing the razor one uses daily? Probably not. They're simply supposed to work. But the fragrance of after-shave? More likely.

One time-tested concept of management theory is enjoying a bit of a revival: the concept of the lead user, introduced in 1986 by economist Eric von Hippel of MIT's Sloan School of Management. Even back then, long before the internet era, von Hippel recognized that important innovations often come from users rather than the manufacturers.

The first mountain bikes were built and ridden by a couple of young hippies in the mountains of California. Bicycle manufacturers caught wind of it and developed commercial models together with the mountain bike pioneers. In a representative customer survey, demand for all-terrain bikes with fat tyres, powerful brakes and small gears had not been captured.
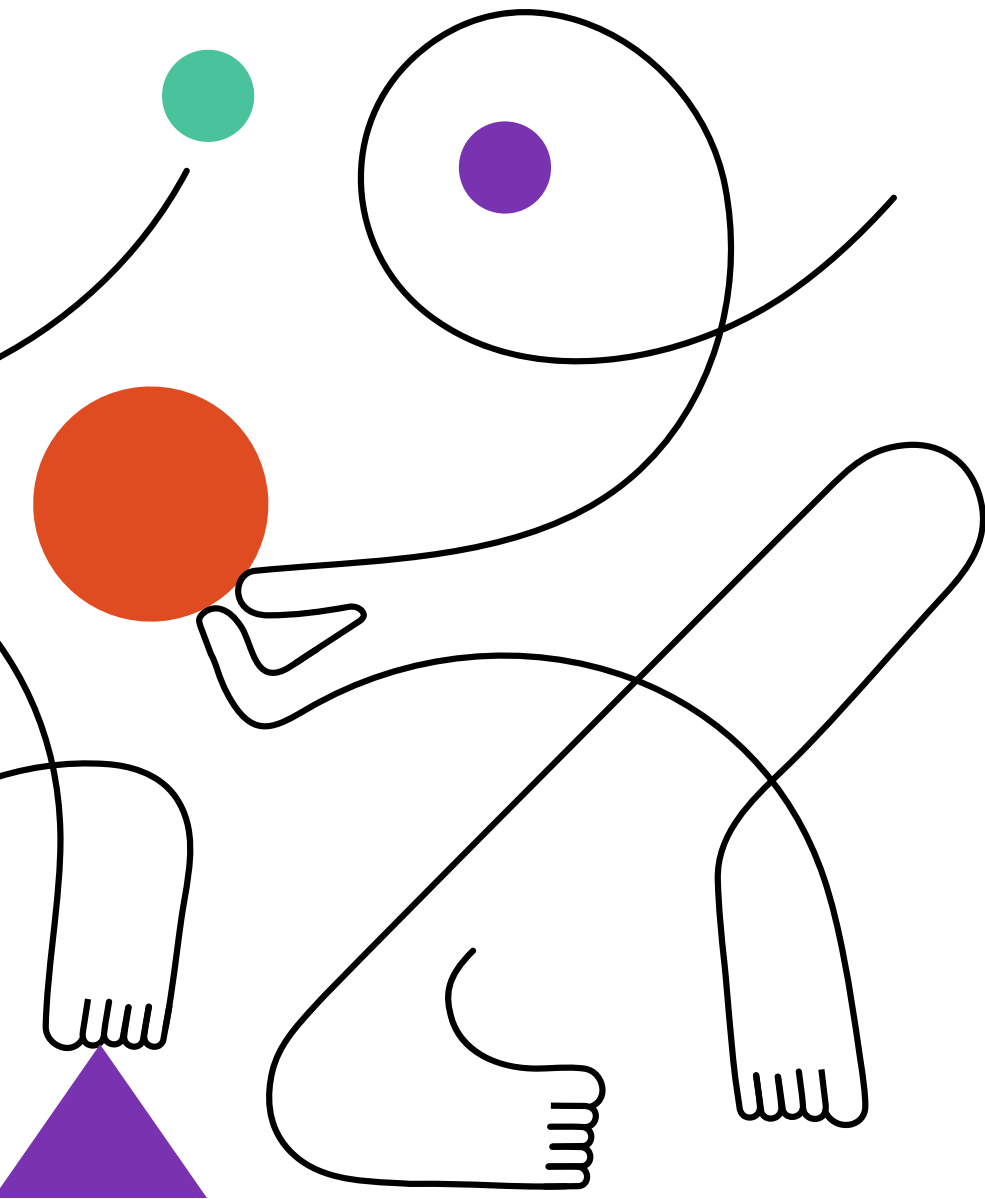
Of particular interest is co-creation between OEMs and suppliers. Their relationship to each other has traditionally been a competitive one. In many cases the parties are not just partners, but also competitors — or they collaborate with each others' competitors. They fiercely negotiate prices and delivery schedules. But that relationship is in transition. In Prahalad's original conception of co-creation, manufacturers and suppliers were still "close partners". Now they share development processes and know-how, loan out personnel or develop joint standards for the training of technical specialists.

In the automotive industry particularly, this transformation represents both an opportunity and a challenge. Companies are shifting from being pure vehicle manufacturers to mobility service providers. Engineering and design traditions painstakingly shaped over decades

In the automotive industry particularly, this transformation represents both an opportunity and a challenge. Companies are shifting from being pure vehicle manufacturers to mobility service providers.

One difficulty resides in the nature of creativity. Many creative processes require the very opposite of togetherness: they call for quiet, concentration and focus.

meet the enormous, challenging, promising, welcome and threatening potential of digital technology. Old and new, sometimes unfamiliar and often completely distinct capabilities collide. Co-creation can be the mediator. In addition to capabilities, three additional C-factors play an important role:

Complexity: calls for a broader distribution of tasks.

Convergence: technologies and solutions from different companies force them to come together.

Customer focus: consumers are increasingly demanding customisation of products. Porsche, for example, mass produces one-offs. Due to the numerous customisation options, no two Porsches leaving the plant are identical.

Active participation on the part of customers is scarcely necessary: networked digital systems continuously provide data that can be used to improve products and services – good conditions for non-intentional co-creation. The more deeply the systems are integrated into the everyday life of the users, the better the insights that can be gained from the data. The software of the systems can be more precisely and quickly adapted to the customer requirements.

While co-creation has proven useful in many cases, it is no panacea. One difficulty resides in the nature of creativity. Many creative processes require the very opposite of togetherness: they call for quiet, concentration and focus. American writer Jonathan Franzen closes himself off to write, with the curtains drawn and without the internet or a telephone. It would ill-serve his novels to have each paragraph discussed to death. He could perhaps write congenial books that way, but not great literature.

And what is true for authors holds true for companies in some ways as well. In his theory of "disruptive innovation", Harvard professor and consultant Clayton Christensen argues that companies that wish to create something groundbreakingly new should do more than just listen to their customers.

If companies had only ever taken their cues from customer wishes, there would be no such thing as smartphones and we might very well be travelling about the country in steam-powered cars.

Tobias Hürter studied philosophy and mathematics in Munich and Berkeley. He was an editor with *Die ZEIT* and is the co-founder of the philosophy magazine *HOHE LUFT*.

Jonathan Calugi is an Italian artist and illustrator. As a young man, he dreamt of a career as a rapper; today, art is his greatest passion. His work has appeared in *Wired* magazine, *The New York Times* and *The Washington Post*.
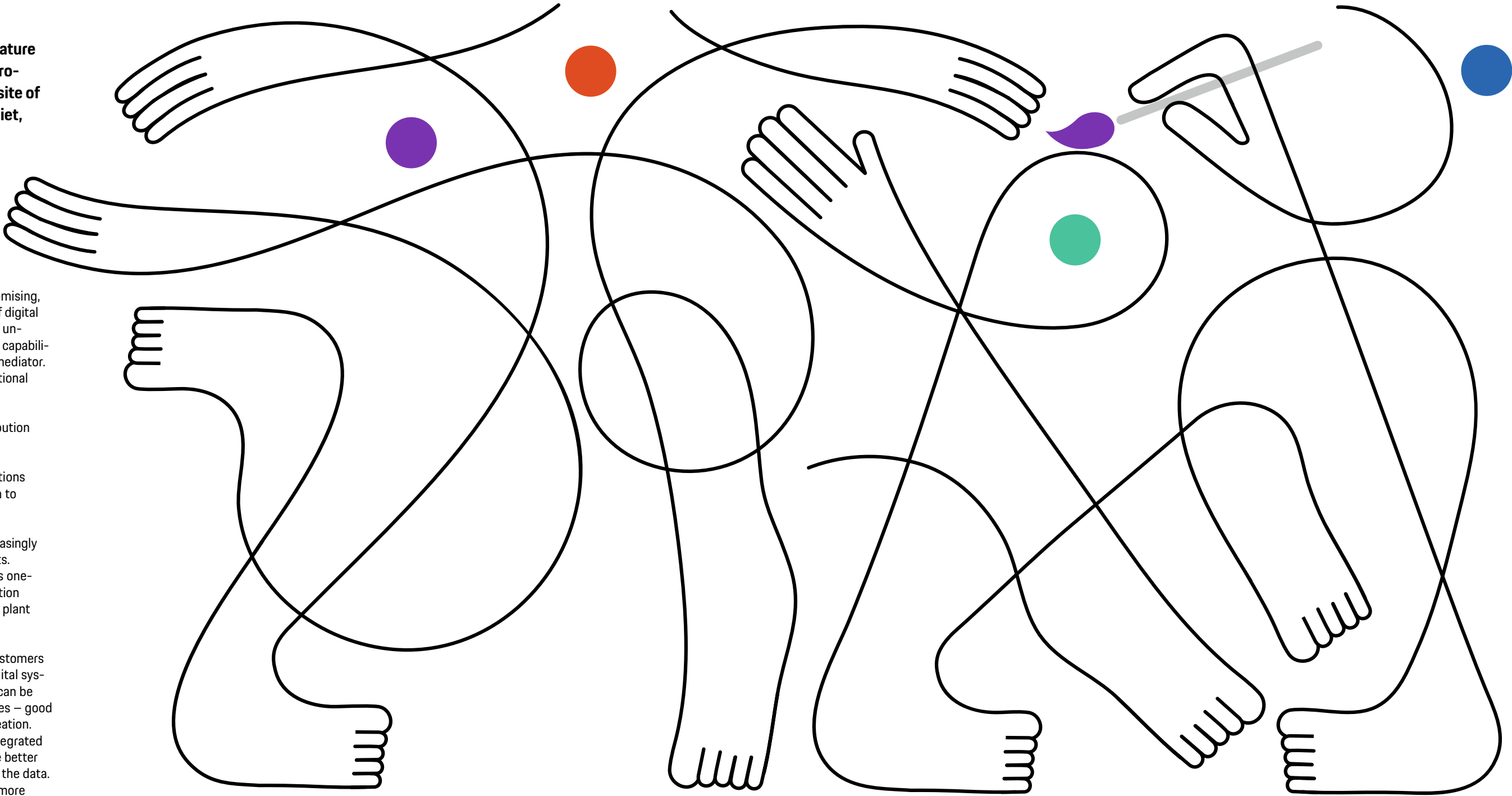
TEAM SPIRIT

Photographed by Martin Schoeller

Grow together. Progress. Be brave. Challenge elegant conformity and crippling interchangeability. Be aware that you're creating something new that moves people. Across boundaries. "The whole is more than the sum of its parts." Aristotle. The spirit of partnership between young, ambitious companies and Porsche is the driver of progress: Porsche Ventures.

What brings them together? New cultural ground for both of them, a partnership of equals. Here you will find the confident energy of the international start-up scene, young companies in their early and growth phase — impulses, ideas, permanent hunger for the unconventional, not bound to any convention except the idea that failure is an option. While, on the other hand, you will find financial strength, the unbreakable bond between tradition and innovation, the experience and excellence that come from a good seven decades of making sports cars.

The objective: Access to business models connected to customer experience, mobility and digital lifestyle as well as to trends and new technologies such as artificial intelligence, blockchain and virtual and augmented reality. That is why Porsche is increasing its investment in venture capital activities for the next five years to 150 million euros — opening doors to the most successful brand of exclusive, sporty and digital mobility solutions.

No project is just like the next one, and creativity needs space to breathe. Porsche supports each partner in an individual way depending on their stage of development and direction. Accelerator APX, a project by Axel Springer and Porsche Digital, has, since 2018, supported companies in their foundation phase and invested in digital business models across sectors and industries, particularly from the fields of lifestyle, mobility, travel, finance and insurance technology, media and health. Start-ups receive a financial shot in the arm of at least 50,000 euros.

Two years before, Porsche had started a collaboration with the HHL Leipzig Graduate School of Management. In a topical partnership with the SpinLab, HHL Leipzig's accelerator, young scientists were able to make their own concepts ready for market. The focus was on financial services of the future/fintech, data-based business models, the experiential world of sports cars and digitalisation in production. As part of the innovation platform "Startup Autobahn" in Stuttgart, Porsche is working with established start-ups — together with Daimler, Deutsche Post DHL, HP Enterprise, DXC Technology, ZF and BASF. "Startup Autobahn" is Europe's largest innovation platform. Porsche alone has completed around 40 projects from around the world since February 2017. One third of these have fed directly into the series development of vehicles.

"I grew up with motor racing." Today, smart vehicle technology is the speciality of <u>BRYN BALCOMBE</u>, Chief Strategy Officer at Roborace. The start-up is developing the world's first electric, autonomous racing series, a project intended primarily to stimulate research and development among car manufacturers. Balcombe is pursuing the even loftier goal of "Vision Zero", an initiative that aims to use artificial intelligence to reduce accident deaths. The thing that particularly excites him about the "Startup Autobahn" programme is the diverse exchange of ideas: "I find the collaboration between various groups to be a crucial factor in innovation."

"Collaboration is the success factor of the future." As Innovation Manager, <u>CHRISTIAN KNÖRLE</u> introduces the world's best start-ups to Porsche employees. In two years, "Startup Autobahn" has developed into Europe's largest innovation platform with over 20 partners – together with Daimler. Since then, over 40 projects have been completed and several technologies have gone into series production with the Taycan. "Start-ups offer new innovation impulses, while our departments offer the specific application. As with Roborace, what seem not to be intuitive worlds – autonomous driving and motor racing – can combine to form something totally new."
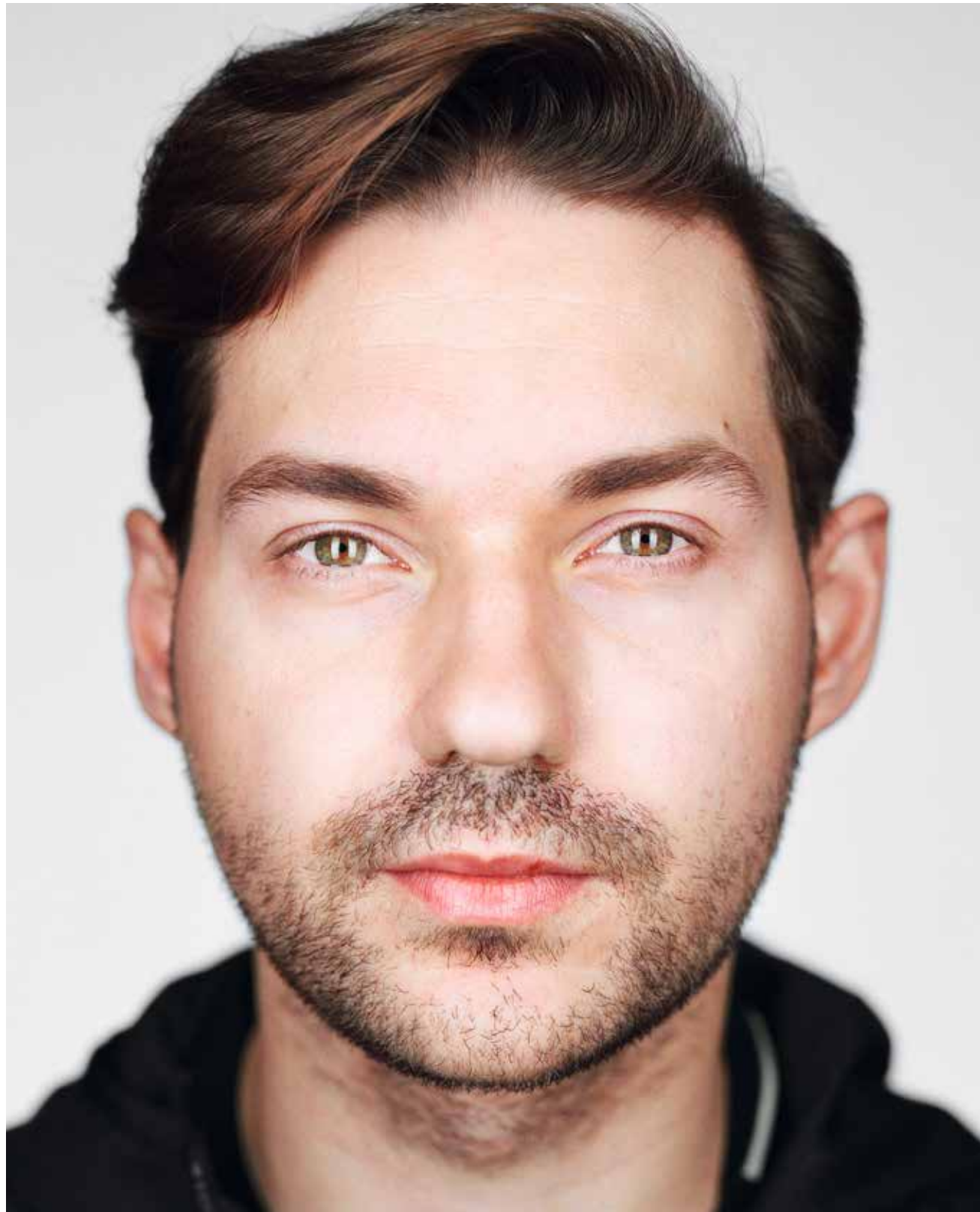
"Even as a child I knew that I would later work in a technological field." With WayRay, which was founded in 2012 by <u>VITALY PONOMAREV</u>, his vision became a reality. The company's idea was to make holograph- ic head-up displays that make driving safer. Unlike a conventional navigation device, the company's solution overlays information directly within the driver's field of vision – meaning that he or she no longer needs to avert their gaze. The collaboration with Porsche offers Ponomarev fresh perspec- tives: "The management team helps us to implement our goals quickly. We learn to think not only as a company but as a start-up".
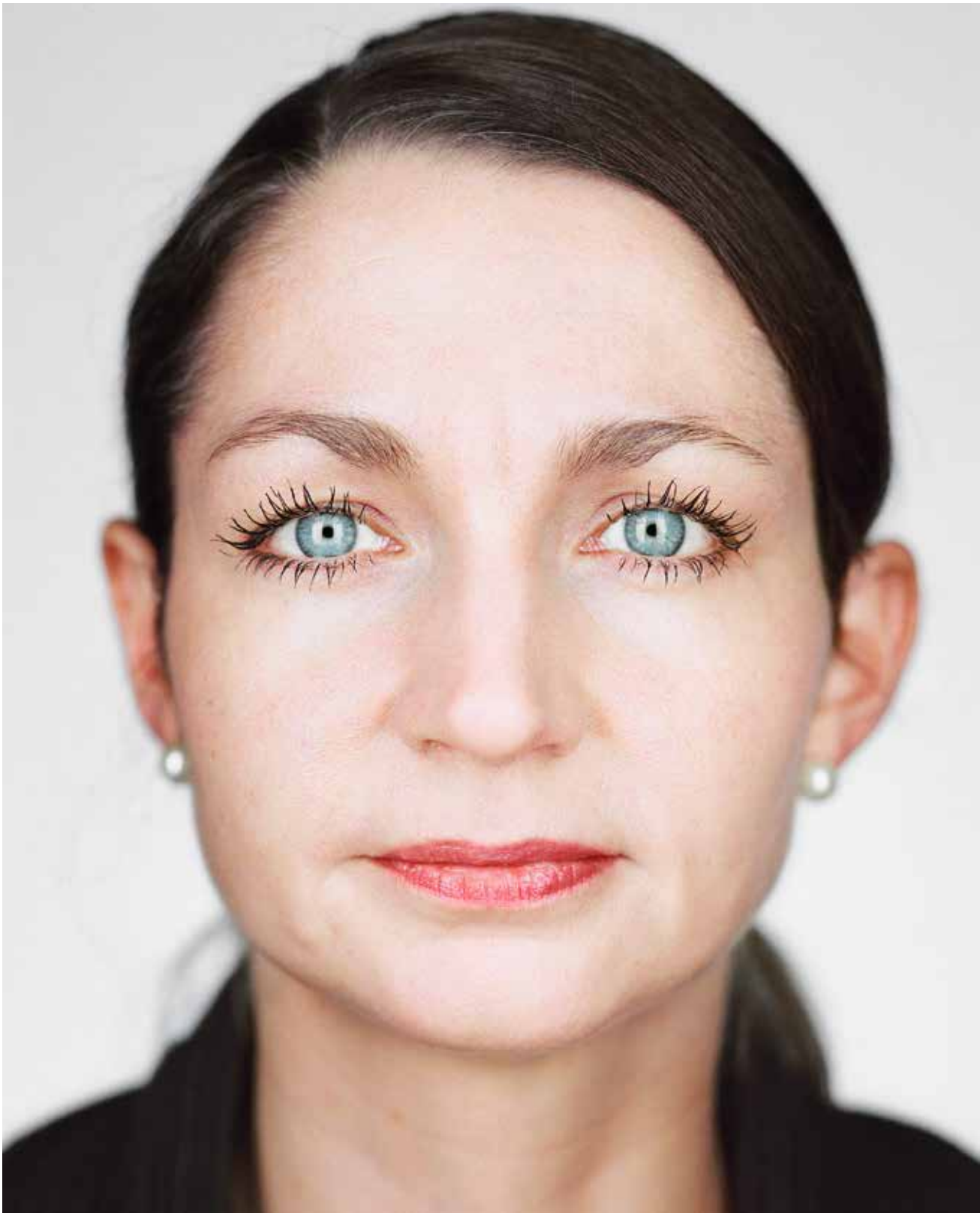
"I pool the knowledge of the experts at Porsche." <u>THERESA BAUMSTARK</u>, as Man- ager for Mergers & Acquisitions and Venture Capital, concentrates on start-ups. Her most important task is communicating. The participation expert looks at all the informa- tion that will be used to make a decision be- fore Porsche commits itself. As well as the project partners' shared vision, she puts great store in direct exchange of views: "With its customer-focused and future-ori- ented technology, WayRay fits in perfectly with the Porsche vision. And so not only our engineers but also our strategy colleagues were keen on our involvement.

"We are building an app ecosystem with millions of developers." Even before <u>RISTO VAHTRA</u> founded the start-up High Mobility in 2013, he was already working on a platform for connected car software. To- gether with Porsche, High Mobility – as part of an open innovation team – used this basis to create a digital interface that exter- nal developers can use to present their ap- plications virtually in a vehicle simulator. Vahtra can see enormous potential in the venture: "We are working together to make Porsche the most digitally advanced com- pany. It is a blueprint for the whole automo- tive industry."

"The human factor is enormously important in cross-functional teams." <u>ANDY GRAU</u> is Project Manager for Innovation Manage- ment and Open Innovation Platforms at Porsche. The Accelerator programme "Startup Autobahn" is what drew his atten- tion to High Mobility. It only took 100 days to turn the idea of an open innovation plat- form into the finished product. Grau sees the collaborative establishment of a plat- form as a significant development step: "Fast, flexible, motivated and ready to adopt a new spirit. That all works very well within our teams."

"Our vision is to make road haulage around the world more human-centred and yet more efficient. The idea behind the Spanish start-up Trucksters, co-founded by <u>GABOR BALOGH</u>, was to keep trucks on the road constantly – not autonomously, but in the traditional way with human drivers. Once a truck has been on the road several hours, a new driver takes the wheel at a handover point. The benefits are that time spent at the wheel is reduced, as are operating costs. Balogh developed his idea further in the Accelerator APX with Porsche: "Having an expert's view, whether in supply chain management or marketing, is a huge motivation."
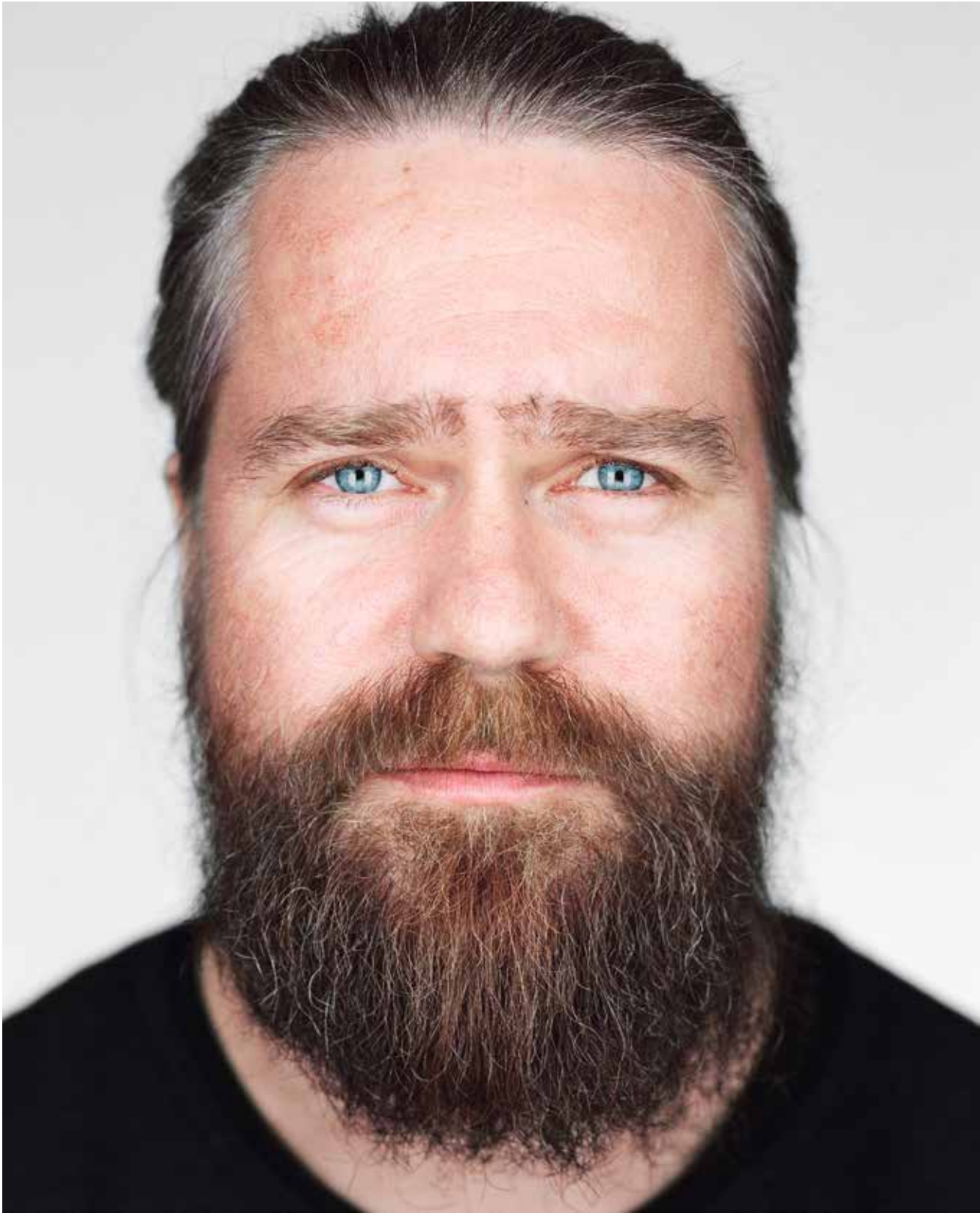
"I think of myself as Rob the bridge builder." At Porsche Digital in Berlin, <u>ROBERT MARTIN</u> looks after the Accelerator programme APX, which Porsche set up this year in tandem with Axel Springer. It looks to find promising teams of company founders, to invest in them and to provide the best possible assistance in their development. Martin organises networking meetings to allow start-ups to find the right partners at Porsche and within the Volkswagen Group. International teams of founders benefit particularly: "Trucksters, from Spain, was able to exchange ideas with experts about the particularities of the German market early on."

Where will human and machine end up? A symbiosis? The subversive character of intelligent technologies requires a new awareness: Culture is the principle of correlations.
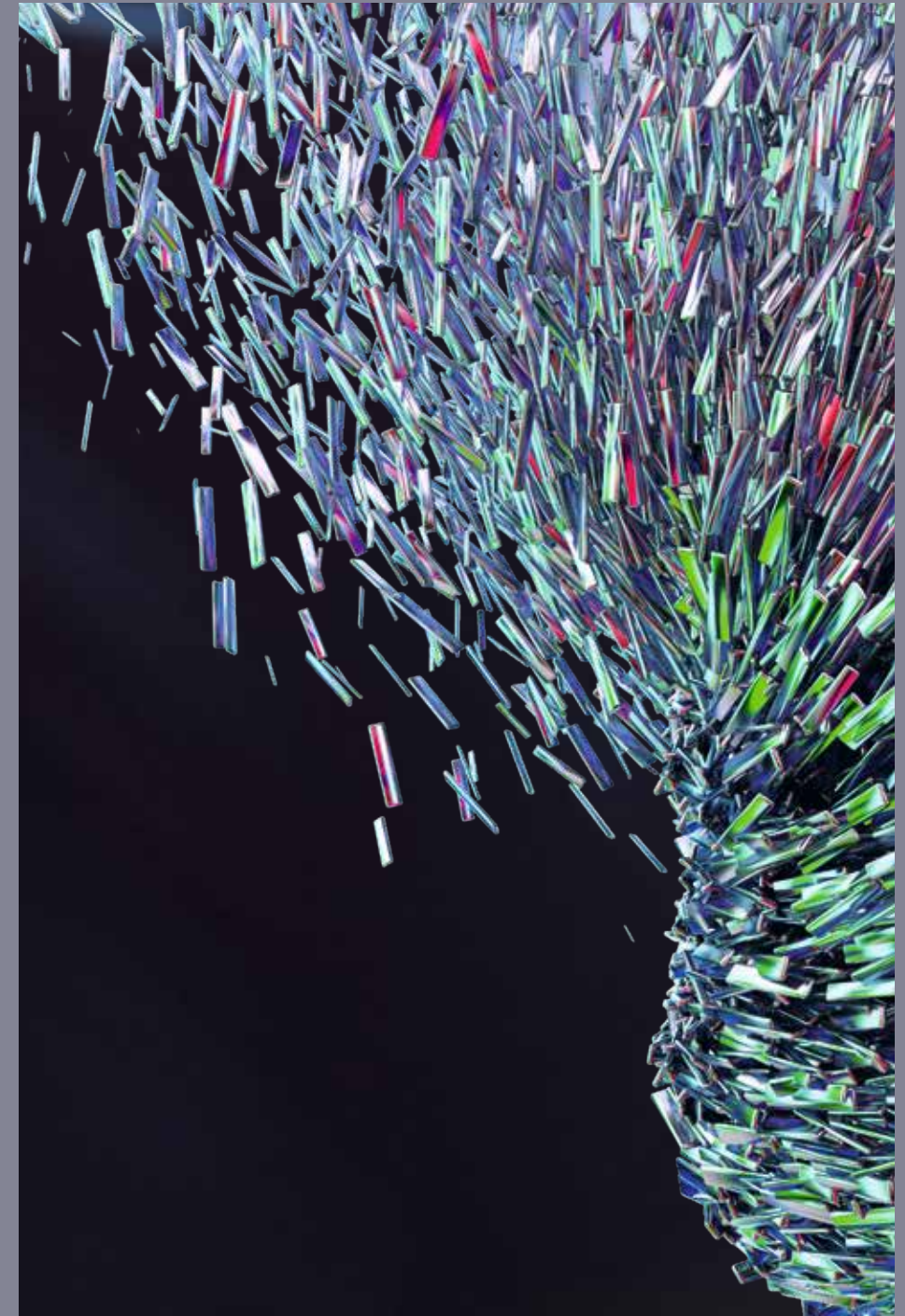
The centaurs

Germany wants to use artificial intelligence to reinforce its position as a leader of global industry. Porsche is promoting the use of centaur systems that combine the capabilities of people and machines. What's the potential?

by Johannes Winterhagen

First came checkmate, followed by losses at poker and the strategy game of *Go*: having stepped up in defence of humanity on 11 May 1997, former chess world champion Garry Kasparov was forced to concede after the sixth game against the IBM computer *Deep Blue*. Two decades later, the supercomputer *Libratus* from Carnegie Mellon University outdid the top poker players in the world in the gambling mecca of Las Vegas. At roughly the same time, Chinese *Go* player Ke Jie, at the time the best player in the world, was defeated by the Google program *AlphaGo*.

Mere games have become a grinding day-to-day reality: more and more, artificial intelligence (AI) seeks to emulate human perception and human behaviour through machines. What once began as a method of computer programming is increasingly linked to the study of human thought.

Digital assistants and learning machines are intended to aid people – make their lives easier, safer and more predictable. They analyse the usage behaviour of customers, predict life expectancy, find the best candidate for a job, speculate on the stock market, comb business reports and warn of dangers before they occur. If one believes the consultancy McKinsey, the application of AI could boost value creation to the tune of 13 trillion dollars by 2030. This in turn, would amount to a 1.2 % annual increase in global GDP over the growth rate that would otherwise be expected. In contrast, the introduction of industrial robots in the 1990s, say the consultants, added just 0.6 % more growth per annum.

The message has been received: in November 2018, the German federal government launched an "artificial intelligence" strategy aimed at promoting both research in Germany and applications in the private sector. As part of the strategy, the government has mooted billions in additional investments as well as the prospect of 100 additional professorships at universities.

Powerful neural networks, with the aid of which machines can analyse unstructured information such as video images, were already available in the late 20th century. The enormous computing capacity required for the task, however, could only be achieved with room-sized supercomputers at research centres. The exponentially growing data volumes, driven initially by the pursuit of ever-better graphics in computer games, are today handled by machines roughly the size of a refrigerator. Using smartphones and smart speakers at home, today anyone can access such servers from almost anywhere.

Current AI systems are highly specialised: some have learned to analyse images of human faces, while others recognise the meaning of spoken commands. Still others comb through massive reams of data for meaningful correlations.

In some areas, this "weak" artificial intelligence equals or even surpasses human intelligence. "Strong" artificial intelligence, by contrast, operates on at least the same level as the human brain – imaginable, but still in the distant future. "It will probably be a matter of decades before machines have even remotely the motor and cognitive capabilities of humans," says Frank Kirchner of the German Research Centre for Artificial Intelligence (DFKI) in Kaiserslautern.

Even today, humans routinely work hand in hand with robots in hybrid teams, supported by intelligent assistance systems. The

factory of the future is flexible, safe and capable of producing anything from mass production runs to single units with optimal resource utilisation.

The potential of AI in the medical field is demonstrated by the digital heart twin. Thirty to 50 % of patients undergoing cardiac resynchronization therapy (CRT), in which a pacemaker is implanted, do not respond to the treatment. The digital heart twin uses artificial intelligence to assess the chances of success more accurately and plan the treatment with greater precision before the procedure is carried out.

Curiously, the pioneer of the human-machine team was none other than the defeated chess genius Kasparov: this combination, he says, is capable of beating the fastest computer working on its own. In Greek mythology, the centaur combines the intelligence of a human with the speed of a horse. So-called centaur systems are at the centre of all developments with which companies aim to enhance their productivity through artificial intelligence: in administration as well as in production or sales.

Mattias Ulbrich, the new Chief Information Officer (CIO) at Porsche since September 2018, sees artificial intelligence as a cornerstone of the IT strategy: the aim is not to displace human work, but rather to complement it effectively. "Artificial intelligence increases productivity all along the entire value creation chain," says Ulbrich. "In the future, people will therefore have more time to focus on essential tasks." Ulbrich sees these typical essential activities as including finding creative solutions, leading discussions and making the right decisions in complex situations: "Just as physical strength no longer determines who is a good worker in production, purely formal qualifications will likewise be much less relevant in the future."

Together with all departments, in a first step Ulbrich identified suitable fields of application for AI technologies. In the procurement and finance departments alone, more than two dozen potential applications were picked out. The Porsche Digital Lab in Berlin is also forging ahead with the issue. "But there is a big difference between what is potentially possible and the actual need for stable systems for ongoing operations," says Ulbrich. For example, the use of AI methods only makes sense where there is high-quality data available: "We span the gap between two worlds."

Porsche is investing in its own centre of AI expertise. The aim is to assemble 30 to 40 experts over the coming two years. The goal is by no means an easy one; qualified personnel in this fast-growing field are scarce and highly selective. Ulbrich is nevertheless optimistic. His drawing card: the way in which Porsche aims to use AI both in the vehicle and in processes of the factory of the future.

Take the example of motor racing: in June 2018, a Porsche 919 Hybrid Evo pulverised the 35-year-old lap record for the Nürburgring's Nordschleife by almost a minute in spite of changes to the "green hell" in the intervening years that made it even more demanding than it already was. Spoilers on the rear of the race car that could be adjusted on the fly ensured optimal downforce in every section of the track. Simulating in advance all of the geometries and adjustment options of the spoilers, not to mention their reciprocal effects on each other, as well as the course characteristics using conventional methods would push even high-performance computers to the very limits of their capabilities. Porsche developers therefore rely on machine learning – and are making motor racing history in the process.

The procedure, tested on the toughest race track in the world, says Ulbrich, will eventually be applied to the management of the entire

Even today, humans routinely work hand in hand with robots in hybrid teams, supported by intelligent assistance systems. The factory of the future is flexible, safe and capable of producing anything from mass production runs to single units with optimal resource utilisation.

soon as the engine starts making odd sounds, a system of this sort provides a warning before damage occurs.

"Every mechanical system has its own acoustic fingerprint," says Claudio Weck, an employee at the Digital Lab. "Deviations are almost always indications of a significant change in the system behaviour." However, it is not easy to detect such deviations in a loud environment such as a production hall. Acoustic vibrations overlap each other – rather like the waves on a lake when a stone plops into it. For this reason, sound analysis with conventional, computer-aided analytical methods quickly reaches its limits unless conducted in a sound-proof acoustic laboratory. The capabilities of neural networks, by comparison, were tested by the team using the coffee machine. They later presented the findings of their work at a Porsche in-house fair. The results literally clicked for one production manager. In vehicle assembly, many electrical contacts must be connected. In some cases, the engagement of the connector can only be heard through the typical clicking sound. Although the entire vehicle electrics are tested after assembly, in certain borderline cases an electrical contact is established even where the connector is not fully engaged. With the idea from the lab, a system for sound analysis can provide absolute certainty.

The sound detective has a plethora of other potential uses as well. A test bench at the Porsche Development Centre in Weissach tests the proper functioning of the electrically retractable exterior mirrors. The test runs in continuous operation. And it's not just the stability and smooth motion that are being examined. The sound pattern should also remain constant – a demanding and time-consuming task for the person manning the test bench. With an AI system, the employee could leave the listening station and prepare the next endurance test.

Joachim Deisinger is the person responsible for virtual vehicles at Porsche. One of the goals is to reduce the number of construction phase vehicles by half by 2025. Construction phase vehicles are real prototypes, partly built by hand, for tests in the development phase. Now those prototypes will be replaced by virtual models in a step-by-step process. This not only saves time and money, but is also good for the environment by using fewer resources. And that, particularly with regard to automated driving, is an absolute necessity. It is estimated that roughly 240 million test kilometres would be required to validate all situations

AI-based image-recognition software is highly developed. However, the sounds that a system makes often reveal more about its condition than its appearance. If you seed an AI system specialised in pattern recognition with typical sound patterns, it can detect deviations and sound the alarm.

company. Data already determines many management decisions. In most cases, those decisions are based on the past or uncertain forecasts. Real-time data can enhance the quality of those decisions. In view of the abundance of information, such a system to assist top management would be unthinkable without AI methods.

Another form of support for human work is being investigated by Porsche Digital Lab. One of the research specimens in this case is a coffee machine. The background: AI-based image-recognition software is highly developed. However, the sounds that a system makes often reveal more about its condition than its appearance. If you seed an AI system specialised in pattern recognition with typical sound patterns, it can detect deviations and sound the alarm. Just as a careful driver stops as

that such a vehicle can get into. Every model would have to circumnavigate the globe some 6,000 times before it had taken on every hurdle – "simply impossible," says Deisinger. His answer: simulation.

There is, however, a critical difference between physical and digital prototypes. A real car hits the race track for dynamic testing. In crash tests it hits the wall – it's an all-rounder, a jack of all trades. Digital prototypes, by contrast, are specialists. For crash tests, for example, so-called finite element models are used. In finite element models, all of the vehicle's components are broken down into very small geometric elements. This makes it possible to calculate with great precision the forces within the vehicle structures in an impact with a defined obstacle. For vehicle dynamics development, a complete chassis is mapped in a multi-body simulation and then tested on virtual circuits. In this manner, developers build 18 different digital prototypes for each new Porsche model.

AI systems gain currency particularly in scenarios involving large volumes of data, which is a defining characteristic of virtual development. It begins as soon as the data is gathered. A Porsche consists of 10,000 to 15,000 individual components, manufactured by individual departments and a multitude of suppliers. The design data for each individual part is stored in a file management system, with qualified engineers entering and structuring the data – a tedious and unproductive job. "What if we automated such processes using artificial intelligence?" asks Deisinger. "We're creating space for creativity."

It is now paying dividends that Porsche invested in digital development at an early stage. Tests with real and virtual prototypes generate huge volumes of data from which insights can be gained using AI methods. This opens the door to a multitude of potential AI applications. They reduce the number of actually driven test kilometres and improve product characteristics. Machine learning can help generate elements like drag coefficient-optimised vehicle geometries such as the rear wing of the 919 Evo. And the procedure can be applied to series development as well. Neural networks make it possible to examine a larger number of geometric variants for their potential suitability without the computing time going through the roof. Data analysis of real and virtual tests becomes a simpler affair as pattern recognition enables faster detection of salient deviations from the target and average values.

Artificial intelligence is, however, by no means infallible. While supercomputers can rapidly process huge amounts of data for statistically significant correlations, they cannot identify causes and effects if they were not defined by a person in advance. Harvard Law student Tyler Vigen founded a website that publishes spurious correlations. According to the numbers, the number of civil engineering doctorates in the US correlates to per capita consumption of mozzarella. A human immediately knows: pure coincidence!

One fundamental problem is the quality of the data that is used to train neural networks. An AI system identified a husky as a wolf because all of the images showed wolves in snow – including the one with the husky. The system was not able to explain its decision.

For vehicle dynamics development, a complete chassis is mapped in a multi-body simulation and then tested on virtual circuits. Developers build 18 different digital prototypes for each new Porsche variant.
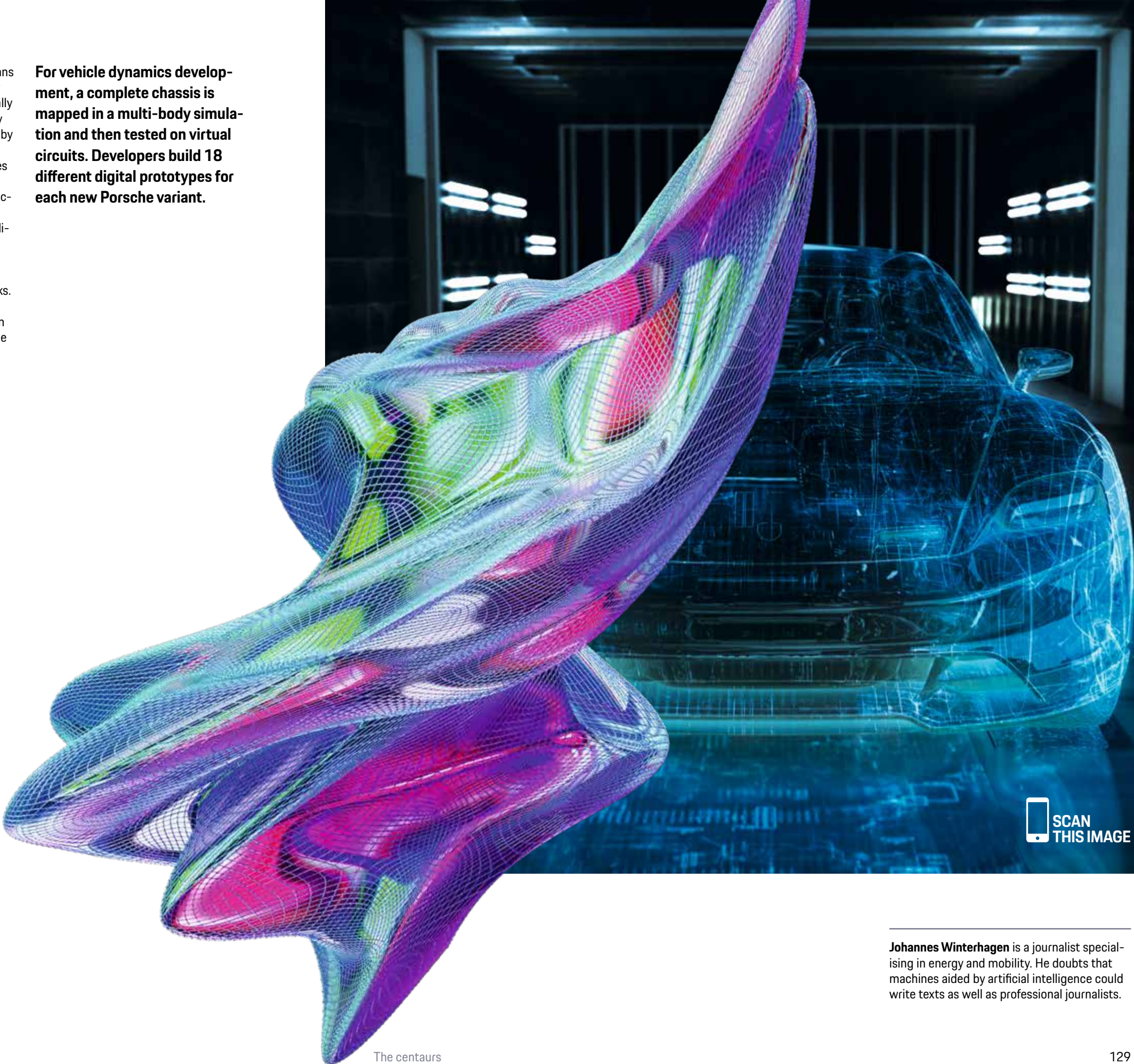
SCAN
THIS IMAGE

Johannes Winterhagen is a journalist specialising in energy and mobility. He doubts that machines aided by artificial intelligence could write texts as well as professional journalists.

The centaurs

#Blockchain
and sustainability

by Jakob Vicari
@vicari

**Blockchain is used in many business sectors.
It is now set to resolve previously unresolved problems of society.**

The courier easily opens the luggage compartment of a parked car. He places a package inside and closes the lid, which then locks itself. The owner of the car had earlier granted the courier a temporary access authorisation – without a key, but with maximum security. The owner now receives a message on his smartphone, in real-time, telling him that the parcel has been delivered.

Unlocking a car for a specific person, on a specific day, at a specific time: Porsche is the first car manufacturer to implement blockchain technology in a vehicle and test it successfully. Porsche is working in cooperation with the Berlin-based start-up company XAIN, which specialises in intelligent industrial applications. In just a few months, interdisciplinary teams were able to configure a Porsche Panamera with an energy-efficient mining process by XAIN.

XAIN
@XAIN_AG

"We can use blockchain to transfer data more quickly and securely, giving our customers more peace of mind in the future, whether they are charging, parking or need to give a third party temporary access to the vehicle." […] @Porsche

27 Feb 2018

Tested application cases range from locking and unlocking via an app to new business models through encrypted data logging. Blockchain technology makes the sensitive issue of "access to the vehicle" faster and more secure: access authorisations can be sent to different smartphone users without any risk. Since the blockchain does not involve any detours via a server, the authorisation check is six times faster than usual.

The blockchain can also record the vehicle data reliably and securely, for predictive maintenance or autonomous driving, for example. Since vehicles are becoming increasingly networked, exchanging data with each other, this essential communication must be designed to be as well protected against tampering and manipulation as possible. Hacker attacks are nigh on impossible, thanks to the decentralised storage of data.

Originally developed to create digital currencies like Bitcoin, and intended for business models and processes for which there are as yet no other digital solutions, blockchain could change entire industries from the ground up – and much more: the technology is also setting the pace with regard to sustainability.

Some people see blockchains as continuously extendible chains of data records, which are used together in a network of computers, i.e. not stored centrally but with decentralised distribution. For Australian tech expert Jamie Skella, they are simply account books: as soon as a data transaction takes place between a sender and a recipient, a new item is entered in the account book.

Traceability, transparency and protection against tampering – the blockchain's sophisticated code creates the most important interpersonal currency digitally: trust. As soon as a data record is added to the chain, it is almost impossible to make changes. Anyone who participates in the blockchain holds in their hand a complete directory of all transactions ever made and all transactions to come. Blocks, data packages or transactions that have already been saved are sealed. Skella explains it like this: "John gives Sue money. Thousands of people are watching. They confirm that John has given Sue the money. As soon as confirmation is received from the majority of members, the transaction is saved in a data block and, from that point on, can no longer be changed; it remains in the blockchain for as long as the Internet exists." If anyone was to claim something different later on, the chain would know that they were lying.

Jamie Skella
@JamieSkella

Without trust, human cooperation ceases; progress ends. Yet interpersonal and institutional trust is eroding.

What if new systems enabled censorship resistance, permissionless participation and radical transparency?

That is the grand social experiment now underway: #Blockchain.

06 Jul 2018

Transparency is the key to the chain, but there is a mystery surrounding the chain itself: the inventor's identity is still unknown.

Using the pseudonym Satoshi Nakamoto, his manifesto was published in October 2008, disguised as a scientific essay looking into the problem of all currencies: how is it possible to prevent digital money from simply being copied and then spent twice? The solution he developed: blockchain. No longer would institutions like the state or the banks control money, but rather citizens with equal rights using their computers. On 3 January 2009 at 6.15 pm GMT, Nakamoto launched his own currency, which everyone has heard of by now: Bitcoin.

The unprecedented rise of this cryptocurrency and its subsequent extreme crash do not belie the fact that blockchain is a platform that can be used for all areas of the economy and society – regardless of sectors and cultures. Blockchain is like an encrypted logbook of events. Supporters believe that it can become the operating system of a transparent society. In addition to artificial intelligence and the internet of things, blockchain is considered to be a third technology that is blurring the boundaries between the virtual world and the real world.

SkyNet
@OpenSingularity

The short term drop in #cryptocurrency price does not reflect any change in how impactful #blockchain technology will become. What matters is that we focus on the technology and adoption rather than the price, and build out a sustainable and adopted ecosystem for the long term

20 Nov 2018

Now it is starting to answer complex social questions. With its help, companies can check whether their requirements in terms of sustainability are being met across the entire delivery chain. At the same time, blockchain promises solutions to some of the most serious problems of our time: corruption, financial inequality and the regulation of access to information. Blockchain intensifies the fight against hunger, controls financial risks, helps safeguard human rights and create fair working conditions – it promises a future in which every physical product is digitally embedded in its own history. It allows us to see clearly where a product has come from and who has processed it, in what way, where and when.

Supply chains are extremely complex and, due to the frequently ramified and barely controllable supplier structure, are only semi-transparent. Blockchain switches on the light here. It begins when a producer registers the products he has produced in an app.

Once this is done, all the steps taken by a specific product can be traced, based on its digitally specified history. And nothing more than a smartphone is needed to do it. This democratises the process: it can be used anywhere in the world, even in less economically developed regions.

Blockchain connects tea farmers from Malawi with buyers in the English retail sector. It tracks the production of a designer jumper from alpaca farmers in the Andes to a pop-up store in Denmark, and, in supermarkets, answers the question of whether a food product has been produced under fair working conditions and how significantly its production and transport affect the environment.

And it does all this phenomenally quickly. A team in the USA set itself the task of tracing a package of chopped mangos back to its origin. The team took exactly 6 days, 18 hours and 26 minutes. The blockchain was able to check the fruit's journey from a farm in Mexico to the US supermarkets in 2.2 seconds.

ARWEN SMIT
@ArwenSmit

I think there is something profound about the idea of creating new markets with morality as starting point. #blockchaingovernance

26 Jul 2018

More efficient production, modified through blockchain, could also have a significant impact on sustainability. "Almost every economical gain in efficiency also promises improved sustainability," said Gilbert Fridgen, a business economist at the University of Bayreuth and founder of the Fraunhofer Blockchain Lab.

The prerequisite is comprehensive documentation of the process and the ability to retrieve the information in real time. This direct traceability enables monitoring and an immediate response, e.g. the support or cancellation of a supplier relationship, if a contractually defined criterion is not met.

Software governs this brave new world, and humanity shifts into the background. If you take humanity out of play entirely, you end up with a forest that manages itself sustainably. It fells trees at exactly the right time and organises their resale.

Science fiction? Terra0 is the name of an interdisciplinary forestry project funded by the German Federal Ministry of Education and Research. Researchers want to find out the extent to which blockchain can be planted in forests. They are developing a spectacular code chain that collects and evaluates data in a section of forest and organises itself. Satellite images show which trees are diseased and must be felled. Autonomous drones distribute new

seed. Terra0 was launched by three students in Berlin as an art project. In the meantime, the Forschungszentrum Informatik (FZI Research Center for Information Technology) in Berlin is coordinating the programme.

terra0
@_terra0

New #terra0 project: Flowertokens is an experimental project centered around the tokenization and verification of natural commodities, and a first attempt at creating a combined crypto-collectible physical asset.
flowertokens.terra0.org   #flowertokens

05 Jun 2018

"Sustainable blockchain will only be successful if companies cooperate," says Fridgen. The keyword here is platooning: this is when several vehicles drive very close together in convoy, communicating with each other autonomously – without a central coordinator.

To ensure that nothing happens, sensor data shoots here and there in real time. This allows the vehicles to drive closer together, saving fuel in the slipstream – an attractive model, which is both economical and ecological.

Platooning is organised and accounted for using blockchain. "There are advantages for every car, except for the one in front," said Fridgen. "But the vehicles could compensate for that through a blockchain transaction." All vehicles have a wallet that the coupled car pays into. When switching to a different formation, the car in front can reuse the credit it has earned.

IOTA, an acronym comprising "Internet of Things" and "Tangle", goes one step further. Machines join forces for the purposes of sustainability. The project builds on the next generation of blockchain. Tangle links several chains together, instead of simply stringing blocks together.

In the internet of things, connected devices process transactions together. Take the example of autonomous e-mobility: at the charging point, the charging pedestal and car communicate with each other and interact independently. "Blockchain establishes trust between the machines," said Fridgen – which is the basis of the "Machine Economy".

Used properly, blockchain holds immense potential. It can contribute to greater sustainability – but it cannot satisfy this demand by itself just yet.

Jarrad Swain
@jarradms

If #blockchain uses too much energy: Surely the answer is not to limit our technology – it's to improve our energy efficiency.

13 Nov 2017

The constant generation of new blocks devours computing power – and thus energy. The Bitcoin network alone, currently the most computationally intensive blockchain, devours 60 terawatt hours of electricity per year – the equivalent of the energy consumption of the Czech Republic.

And who's responsible for this immense energy consumption? The so-called miners. These computers compete to solve hash-tag puzzles – whoever calculates the right value first can enter a new data block with transactions in the blockchain. In return, the respective miner receives a reward from the network, paid in Bitcoin.

However, many public blockchains are based on energy-saving proof-of-concepts. With the proof-of-stake consensus mechanism, transactions are validated using the user's capital rather than burning computing power. Geothermal energy in Iceland or hydro-energy in Austria are favourite energy sources for Bitcoin mining.

Blockchain technology might still be in its infancy, but its contribution towards a sustainable future is already clear: in energy networks, for autonomous driving, in transparent delivery chains or even put to use in the fight against poverty and climate change. That's the power and strength of blockchain technology: a tool that was developed by progressive thinkers, for progressive thinkers. They might come from different sectors. But their solutions turn industries upside down – including in terms of sustainability.

However, business economist Fridgen warns against measuring blockchains solely based on their direct energy consumption: "If you don't include the intermediary institutions, you're also eliminating their computer technology, office buildings and employee journeys to work."

People of Blockchain
@pplofblockchain

Blockchain could be the starting point for creating a new society. #blockchain #peopleofblockchain #tech #bitcoin #ico #iot

30 Oct 2017

Dr Jakob Vicari is a scientific journalist and creative technologist. His focus: the journalism of things. He brings together issues from the economy, biology and technology for various magazines and daily newspapers.

ZUFFENHAUSEN

Vision: Zero Impact Factory

The heart of Porsche beats in Zuffenhausen. Porsche has had links to this site for 80 years. The company continues to be managed from the striking brick building in Plant 1, just as it was at the very beginning in 1938. Around this historical ensemble, Porsche has grown strongly.

The number of employees has risen from the original 176 in 1938 to more than 30,000 today, more than 11,000 of whom are based in Zuffenhausen. What began as a site the size of a single sports field now covers some 670,000 square metres — the size of 62 football pitches.

"The decision to build Porsche's first fully electric sports car, the Taycan, in Zuffenhausen, led to the largest construction and expansion project in the company's history," reveals Albrecht Reimold, Member of the Executive Board for Production and Logistics. "Our main plant is being expanded to create a smart facility that is ready for the automotive production of the future." Old, inefficient and less environmentally friendly buildings are being replaced by new, resource-efficient units — all without interrupting or holding up series production.

Making innovative use of the space forms an integral part of this project in Zuffenhausen. The production of the Taycan in the new assembly and logistics hall, and in the body shop, takes place over several levels. The assembly process proceeds from top to bottom, moving down to the ground floor where the new sports cars roll out of the hall following their final inspections. The technical systems that control all of the production processes are housed in the basement. The result is a logistical and space-saving masterpiece.

Sustainability plays a key role. The Taycan is being produced in Zuffenhausen on a CO_2-neutral basis. All Porsche sites are already using green energy. In keeping with the move into electromobility, Porsche is also focusing on further measures. The company's heat and electricity supply has been switched to biogas, eliminating another several thousand tonnes of CO_2 emissions every year. Covering 42,000 square metres of roof areas with plants has also made a positive contribution to the local climate.

"Our vision: a Zero Impact Factory with no environmental impact," states Reimold. "And it's not just about the CO_2 balance sheet. We consider the environmental aspect in its entirety, also thinking about our use of resources, waste issues and mobility around the site." The first steps into the future have already been taken.

ENERGY
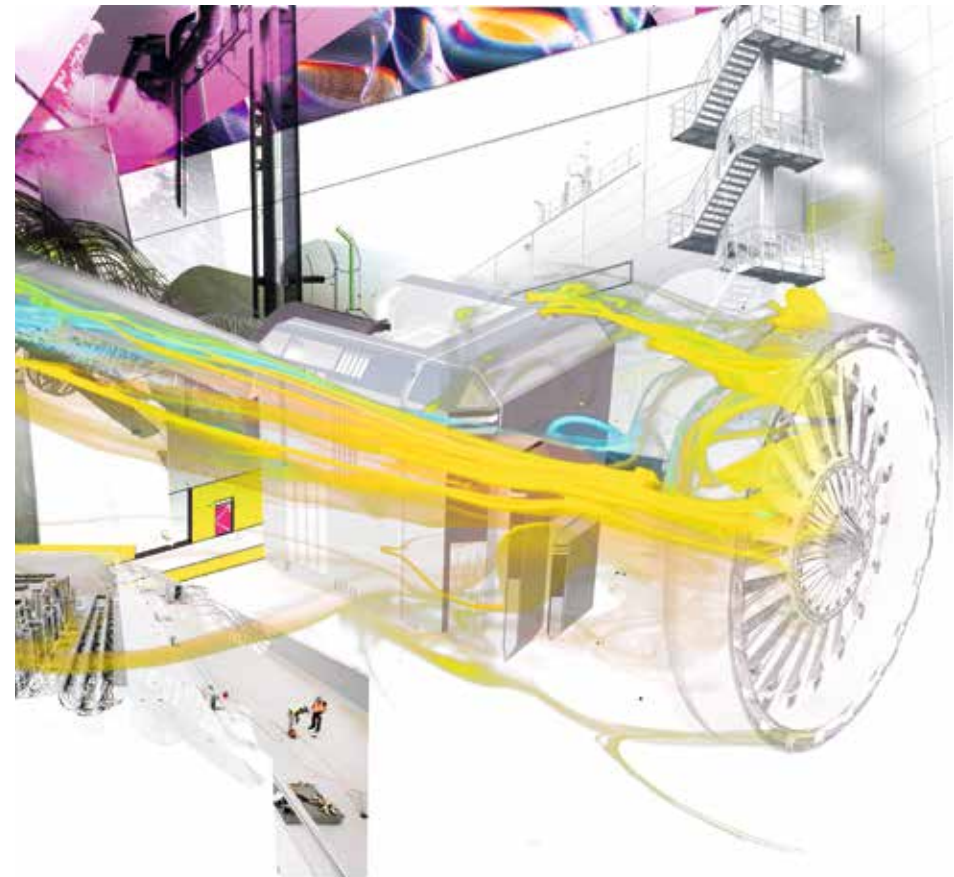
Porsche is focused on smart energy use that conserves resources. Its paint shop provides one example of this goal being put into practice. Using regenerative afterburning (RNV) means that less gas is needed to purify the exhaust air. The result is that less unused energy is released into the environment, while a high proportion of the waste heat is utilised during the drying process. In figures: RNV saves 750,000 kilowatt hours per year, which equates to 319 tonnes of CO_2 emissions.

Water is a valuable commodity. Using water economically is a key element of Porsche's environmental activities. Closed-loop systems, multiple use and the careful handling of waste waters all have an important role to play. Hydropower is generally viewed as a future-proof and clean way of producing energy. At Porsche's main site in Zuffenhausen, CO_2-neutral electricity will be supplied via hydropower as a matter of course in future.

WATER

GREEN ELECTRICITY

Clean energy is a top priority for Porsche. 100 % of the energy purchased for all of its sites already takes the form of hydroelectricity. In 2019 two new cogeneration plants were installed at the main plant in Zuffenhausen. These convert biogas into heat and electricity.

SCAN
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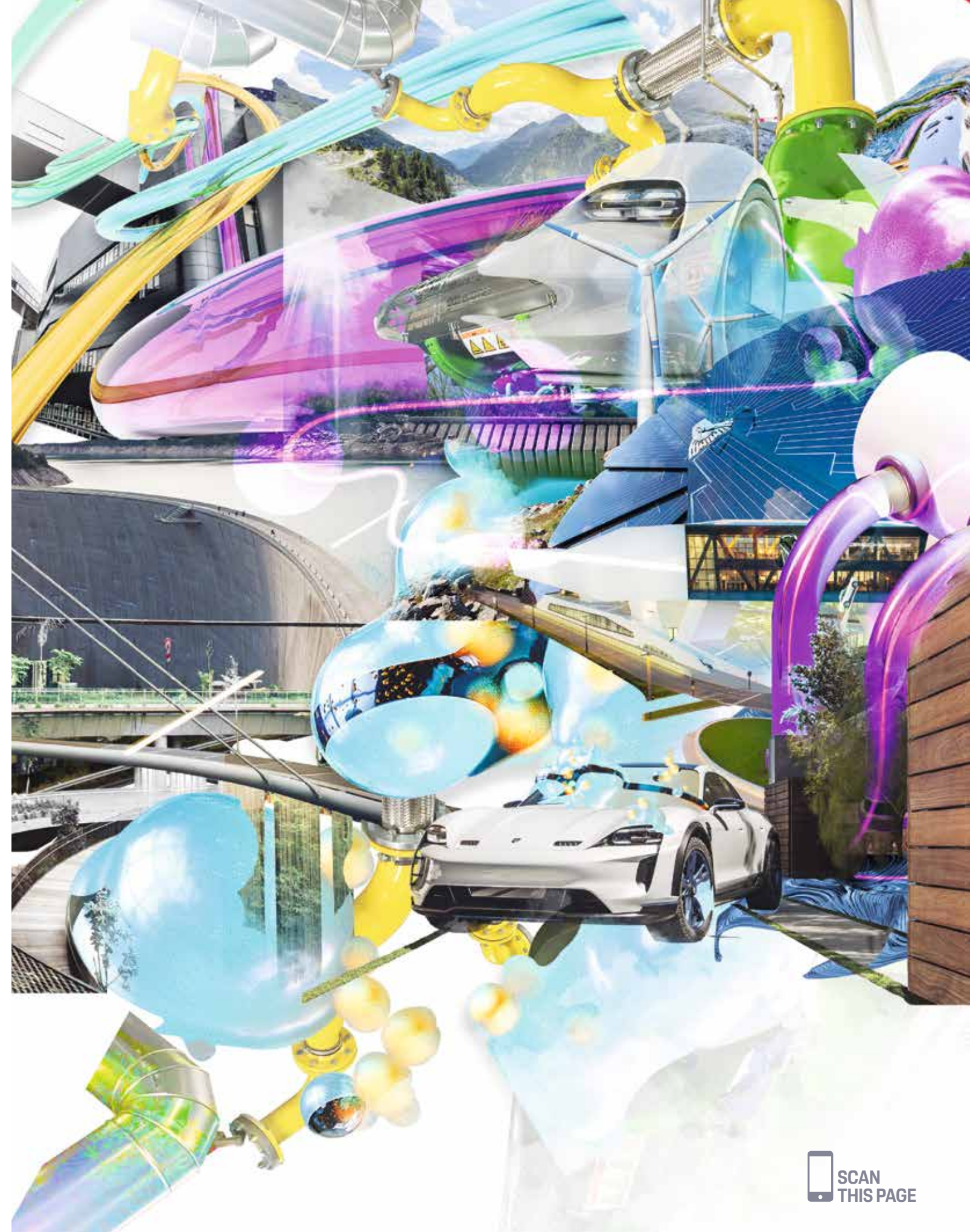
NOISE
PROTECTION

Noise is everywhere. It is one of the forms of environmental pollution that affects people the most. It is a stress factor that must be taken seriously as it can have a considerable impact on health. This is why Porsche is particularly committed to targeting noise. A new noise barrier, along the 250 metres of the northern edge of Plant 2, significantly reduces sound emissions in the local area, cutting out background traffic noise in particular. Another noise protection measure relates to the delivery and loading zone for the new Taycan. Moving this entire operation inside has greatly reduced noise levels.
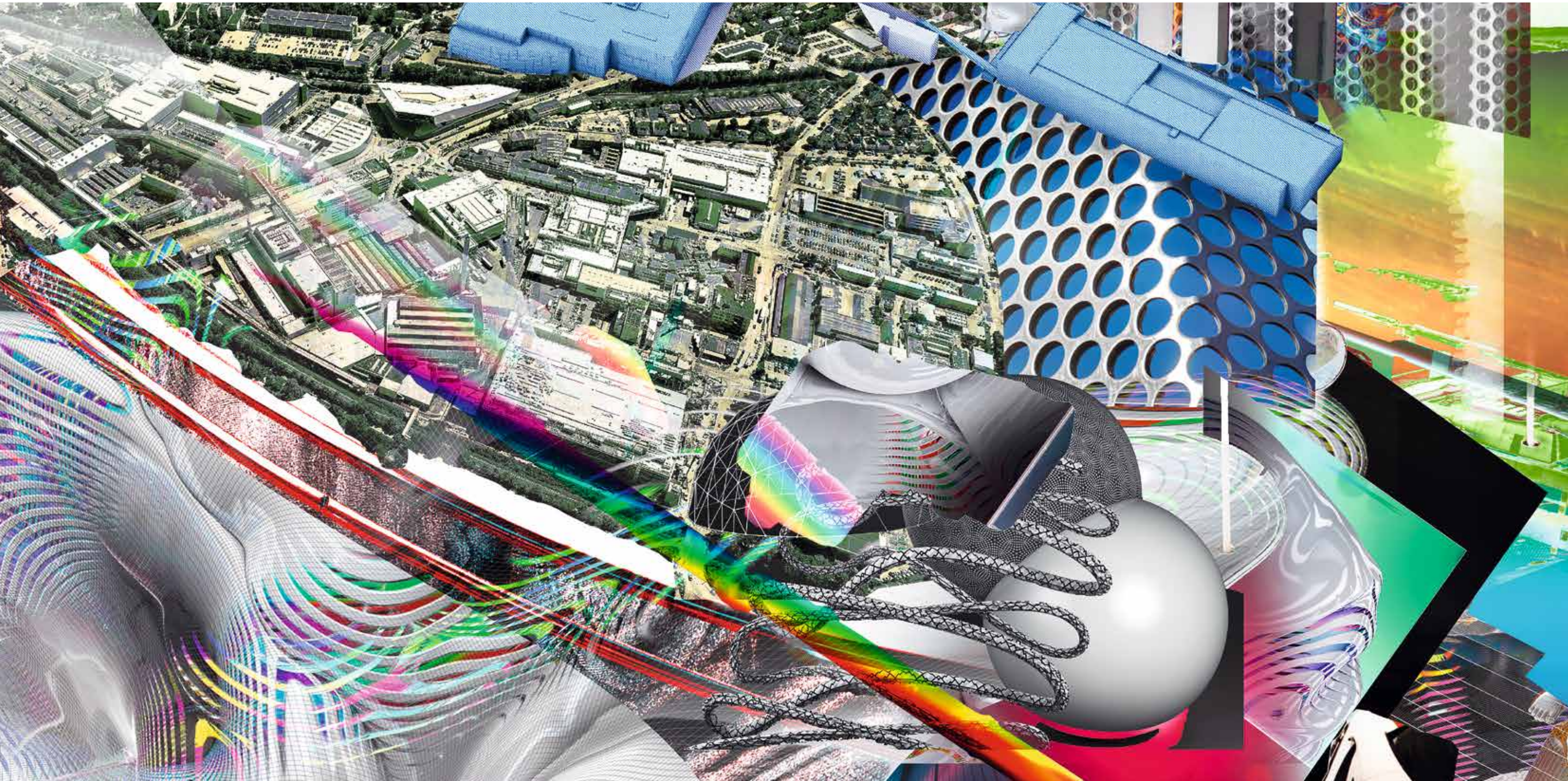
EMISSIONS

Zuffenhausen is well on course to becoming a zero emissions site. For example, Porsche is testing the use of innovative aluminium panels on the façades of its buildings. A special titanium dioxide coating is designed to reduce nitrogen dioxide levels dramatically. The coating acts as a catalyst, breaking the pollutant particles down into harmless water and nitrate when exposed to sunlight and even low humidity. During an initial pilot project, Porsche is testing the NO_x-absorbing high-tech façade over a surface area of 126 square metres. Even on this scale, about the size of ten parking spaces, the panels are doing the job of ten trees. If the pilot project proves successful, greater use could be made of these "NO_x façades" in Zuffenhausen. Meanwhile, the regenerative afterburning in the paint shop is also benefiting the environment, as the release of solvents is minimised and large quantities of natural gas are saved thanks to the energy recovery process.

James Dawe is a visual artist and illustrator who specialises in mixed media collage. His digital distortions and 3D experiments use themes ranging from fashion to football.