

# tomorrow

Experiencing technology with Schaeffler



**There you go!**

Why tackling challenges with a positive, bold and dynamic attitude is so important

## Agility; - [ə'dʒɪl.ə.ti]

Agility or nimbleness is an ability to change the body's position efficiently, and requires the integration of isolated movement skills using a combination of balance, coordination, speed, reflexes, strength and endurance.<sup>1</sup>

Business agility refers to rapid, continuous, and systematic evolutionary adaptation and entrepreneurial innovation directed at gaining and maintaining competitive advantage. Business agility can be sustained by maintaining and adapting the goods and services offered to meet with customer demands, adjusting to the marketplace changes in a business environment, and taking advantage of available human resources. In a business context, agility is the ability of an organization to rapidly adapt to market and environmental changes in productive and cost-effective ways.<sup>2</sup>

Sources:

<sup>1</sup> Wikipedia, The Free Encyclopedia. Retrieved 14:21, March 22, 2021, from <https://en.wikipedia.org/w/index.php?title=Agility&oldid=1010314819>

<sup>2</sup> Wikipedia, The Free Encyclopedia. Retrieved 14:22, March 22, 2021, from [https://en.wikipedia.org/w/index.php?title=Business\\_agility&oldid=1009493630](https://en.wikipedia.org/w/index.php?title=Business_agility&oldid=1009493630)

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## Dear readers,

This year's first issue of our technology magazine "tomorrow" is focused on "agility."

But what does "agility" really mean? When searching for a definition you'll soon find synonyms such as "nimbleness" or related words like "flexibility." Are these correct definitions? Agility, no doubt, requires a high level of nimbleness and flexibility. But there's more to agility than that. Above all, it's a mindset. Those who think and act with agility are proactive and aware of their own strengths. Agility means anticipating, thinking ahead and being able to adjust to new circumstances quickly. It's a prerequisite for shaping the future and that's exactly what we're committed to at Schaeffler. It's the reason why agility, alongside efficiency and innovation, is one of three priorities supporting our corporate strategy. We strive to not just react to a changing world but to play a positive part in shaping it. That's the goal of our Roadmap 2025.

Admittedly, the transitions between the definitions are fluent, even in a practical sense. Our new mechatronic rear wheel steering system, for instance, that we describe for you in detail on pages 58/59, makes for very agile vehicles from an initial perspective. It's an important mechatronic evolution but, even so, merely marks another milestone of an agile process aimed at forming Schaeffler into a particularly innovative pioneer of future mobility. That vision and reality will overlap sooner or later is evident in an impressive photographic document showing GM prototypes from the 1950s on pages 26/27. Much of what was science fiction back then has since become a reality or is at least about to do so. Some things have remained in the realm of imagination. But even the pursuit of tracks that will prove to be wrong is part and parcel of agile processes – the art lies in recognizing a wrong track early on.

An example of how we shape the future: That's what our new Central Laboratory will be that's currently under construction at Schaeffler's headquarters in Herzogenaurach. "tomorrow" provides some exclusive insights into the project (starting on page 78). Our goal is to concentrate our



competencies in selected basic areas and to interlink them more intensively than before to pave the way for new pioneering technologies – perhaps even of the kind that may be found in space someday. This may happen sooner than we think, considering the current upbeat spirit in space exploration. More on that starting on page 72.

Since agility calls for women and men of action, we'd be remiss if we didn't write about some of them in an issue of "tomorrow" focused on this trait. Meet highly creative globetrotters (page 20) or the German world-class solo sailor Boris Herrmann (page 28). On board of his sailboat, he demonstrates not only agility galore but farsighted commitment to marine research and climate protection in equal measure.

Dear readers, as John Steinbeck once wrote: "Life consists mainly of the fact that you have to cope with the unexpected." In the spirit of these words, I wish you successful encounters with the unexpected supported by the requisite agility.

**Klaus Rosenfeld**  
Chief Executive Officer

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# Global

A glimpse of the world

## A large park for small animals

Pollination is a highly agile process that nature has created for propagation in the floral world. Curiously, an important part of the actors – insects – is oblivious of their crucial involvement in the process. In their search for food, honey bees, bumble bees and company unintentionally fly pollen from flower to flower. 88 percent of the cross-pollinated plants worldwide depend on animal assistance. The economic benefit of this work on the fly amounts to an estimated one quadrillion U.S. dollars per year. However, due to human influences such as the use of pesticides, the number of pollinating insects has been decreasing worldwide for years. The decline has become so dramatic that it's posing a threat to global food supply. The European Union wants to stop this negative development and has launched a pollination initiative featuring the Pollinator Park visualized here as a lighthouse project. It's a futuristic world of engaging experiences designed in collaboration with the Belgian "archiobiotect" Vincent Callebaut that can be visited 24/7 anywhere in the world – because it's strictly virtual. Visitors travel to the year 2050, a time at which the small industrious animals have found a final refuge in the glass-domed, artificial world of the Pollinator Park. They're invited to explore insect pollination and experience a description of what the Earth would look like without pollinators. A visit is highly recommended.

**2000**

**bee species** exist just in Europe. A tenth of them is threatened with extinction.

**1.8 billion**

**jobs** in farming would be lost worldwide if humanity lost its pollinating insects.

**1.2**

**grams** (0.04 oz). That's how much bumble bees weigh. Their wing area is 0.7 cm<sup>2</sup> (0.1 sq in). Due to the high flexibility of their wings, they're able to fly in spite of these unfavorable proportions.

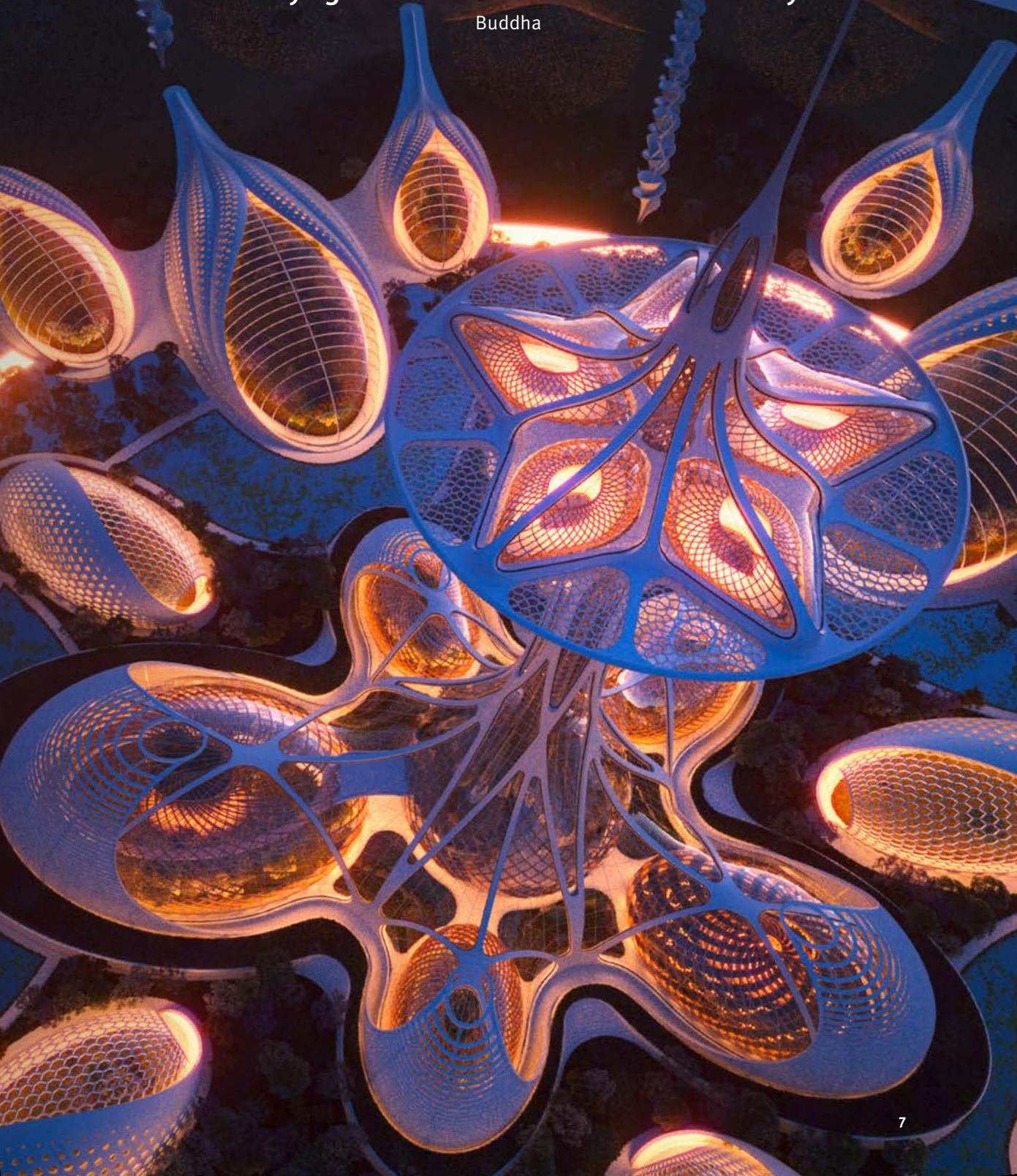
**1/3**

**of all foodstuffs** require insects as pollinators.

Click here for a tour of Pollinator Park – the simulation can be accessed using a web browser on a desktop computer:  
[ec.europa.eu/environment/pollinator-park\\_en](http://ec.europa.eu/environment/pollinator-park_en)

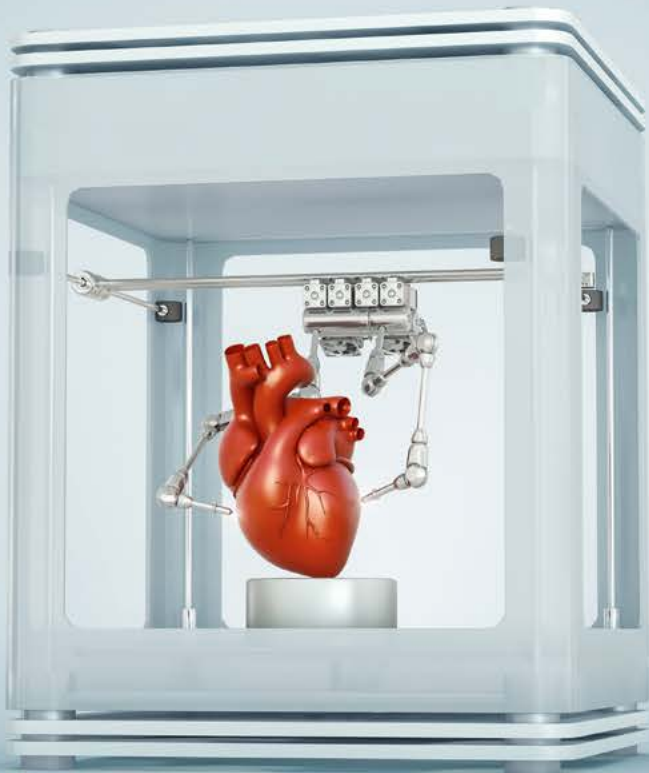
**» If you want to increase your prosperity, you should take bees as an example. They collect the honey without destroying the flowers. They are even useful for the flowers. Gather your wealth without destroying its sources and it will increase steadily**

Buddha



# 360° Agility

Facts, figures, oddities – a 360-degree view of the focus topic in this issue of “tomorrow.”



## Health as printed matter

Agile production processes are increasingly accelerated by additive manufacturing methods such as 3D printing – even in medical device technology. Bioprinting is the name of a technique enabling bio inks with cellular structures to be produced from stem cells using a **layer-by-layer method to print skin, tissue and even organs.** This is how in 2020 an Israeli team of scientists created a heart the size of a cherry consisting of cells, blood vessels and ventricles. **Such techniques using hybrid bio ink are also already in use for 3D printing of knee cartilage replacements.** In laboratory tests with pig cells, a team of U.S. scientists found out that the cells were able to propagate and remain viable while the structure itself retained its biomechanical stability. 3D printing propels pet prosthetics to more advanced levels as well. **New hind legs for dogs, paw replacements for cats or artificial beaks for birds:** Printed prosthetics significantly reduce production time and costs. When a specific joint doesn't work from the get-go, it can be adjusted within just a few hours.

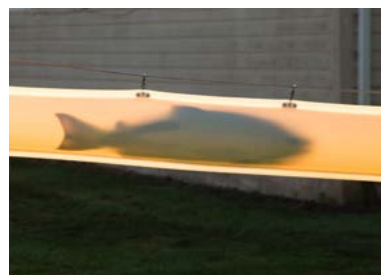


## Power to go

Green hydrogen is an important component in the context of energy transformation – not least in the realm of mobility. However, the lightest of all elements is both highly energetic and volatile. Storage and transportation pose a challenge and one approach to overcoming it is binding hydrogen in **liquid organic hydrogen carriers (LOHCs)**. These LOHCs are easy to handle. The Bavarian Hydrogen Alliance, in which Schaeffler is actively involved, is planning to open the first LOHC filling station before the end of 2021. A team at Fraunhofer Institute in Dresden has proposed another interesting approach: The scientists there intend to **bind hydrogen in a paste**. “With our power-paste, hydrogen can be chemically stored at room temperature and released again as needed,” says research scientist Dr. Marcus Vogt. The plan is to fill the paste into changeable cartridges and subsequently mixing it with tap water on board of the vehicle. This approach is particularly intriguing because only half of



the hydrogen is supplied by the paste and the other half by the water. Vogt: “The paste has a tenfold energy storage density compared to batteries.” This makes it attractive even for micro vehicles.



## Pneumatic tubes for fish

Just one agile thought out of the box can solve a problem with an idea that had originally been intended to serve a totally different purpose. That’s exactly what Whoossh did. The American company normally produces vacuum systems for handling fruit or frozen food. But why haul only cold and not live fish, considering the growing worldwide demand due to dams in more and more rivers obstructing the passage of salmon and company? **The fish are sucked into the tube system by a slight vacuum** and spat out again above the obstacle unharmed. Whoossh and away. Awesome.

## Metamorphosis



Men morph into women, children mutate into octogenarians, and beauties into beasts – all with just a few mouse clicks. With its MetaHuman Creator, the American software firm Epic Games wants to accelerate the animation of virtual characters. While digitally animating a character with realistic gestures and facial expressions used to take months, it only takes a few hours with the MetaHuman Creator, according to Epic Games. If the development continues at the current pace, we’ll soon be able to party with realistic virtual friends and family members at home. Ever since corona has struck, if not earlier, we’ve known that there’s definitely a demand for that.

## Words to remember



» *Just don't give up trying to do what you really want to do. Where there is love and inspiration, I don't think you can go wrong*

Singer Ella Fitzgerald

» *The biggest risk is not taking any risk ... In a world that is changing really quickly, the only strategy that is guaranteed to fail is not taking risks*

Facebook founder Mark Zuckerberg

» *In order to be irreplaceable one must always be different*

Fashion designer Coco Chanel

» *If you're doing something the same way you have been doing it for ten years, the chances are you are doing it wrong*

Inventor Charles Kettering

## Green packaging

Sustainability has been a high priority for decades at Schaeffler, a listed family-owned company, where it drives agile attitudes and practices. Even simple ideas can have amazing effects in this context. Here's a case in point: Together with drive technology manufacturer Flender, Schaeffler employees have developed a **returnable packaging system. So-called SMART boxes** now replace the former non-returnable crates for bearings of various sizes. As a result, more than 25,000 of the non-returnable containers are supposed to be eliminated – just for shipments to Flender, resulting in a projected CO<sub>2</sub> reduction of roughly 50 percent. A great idea that's meant to catch on as discussions with other customers are underway now.



## Walking like on rubber

What if the flood of plastic waste could be turned into something useful? Arguably, everyone would say that would be a great thing. **Kenyan engineers have put this thought into action and are now converting plastic waste into cobblestones.** They sort the waste by colors, shred it and mix it with sand and pigments, followed by compressing it. The inventors have plenty of raw material to work with as 500 metric tons (551 short tons) of plastic waste per day are generated just in Nairobi. The operation produces up to 1,500 stones daily at low costs. Consequently, plastics, as a material that many of us (erroneously) regard as a one-way product, get to lead a flexible afterlife. Scan the QR code for additional information.



# Vision 2050

Those who cross boundaries in their thinking view the future as being more than an extrapolated Now. In the web project billed as 2050.earth, futurists develop visions of what the world might look like in 30 years' time. Here are a few examples:

Geneticists will reanimate extinct creatures because they have access to their DNA.  
**Probability\*: 100%**

Humanoid robots will win a match against the human FIFA World Cup Champion.  
**Probability: 80%**

No more defecation. There will be nanotechnology procedures to insert genetically modified microorganisms that will decompose stool in the intestine.  
**Probability: 40%**

The political decision-making system will be split into two parts – automated (AI) and civic (human). Machines will be making all decisions where the human mind cannot be impartial.  
**Probability: 80%**



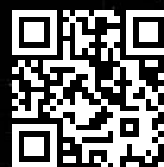
With just one injection and synchronization with Google Lens mobile image recognition, people will be medically monitored 24 hours a day to detect and immediately treat physical or neurological disorders.  
**Probability: 60%**

AI-controlled air fresheners will link with an "odor database" to psychologically influence workers.  
**Probability: 100%**

Genetically modified bacteria will be working on construction sites instead of humans and cumbersome machines.  
**Probability: 90%**

Neuromorphic computers will emulate the work of the human nervous system. Digital entities will be able to make decisions on behalf of their owners and take care of routine matters.  
**Probability: 70%**

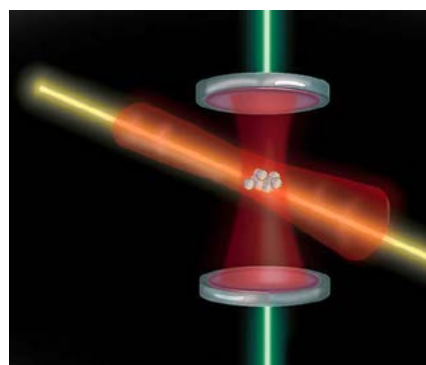
How are we going to live and eat? What kind of jobs are we going to have and what will happen to the Earth? Scan the code to explore some exciting forecasts for the years of 2030, 2040 and 2050.



\* determined based on votes cast on the 2050.earth website

# 9,192,631,770

times per second. That's the oscillation frequency of the extremely agile cesium 133 atom that has been used as the standard for ultra-accurate atomic clocks since 1968. **The maximum variation in 15 billion years is one second.** Now scientists have discovered a way of measuring time with even greater accuracy: an optical atomic clock (pictured). Instead of a cloud of randomly moving atoms it uses quantum-entangled ytterbium atoms. This reduces noise interference during frequency measurement and the clock would be inaccurate only by around 100 milliseconds in 13.8 billion years.





# Resetting the focus

Motion and mobility are key factors of mastering global challenges. Success decisively depends on the capacity to reimagine and progressively shape both areas. That's what Schaeffler has been doing for more than 70 years. However, to remain a real pioneer, the company has to transform itself in line with a changing world – and become more agile.

By Volker Paulun

In its Roadmap 2025, Schaeffler has defined a maxim to guide its actions: The family-owned company with a strong tradition of innovation strives to be no less than THE preferred automotive and industrial supplier to a demanding clientele – worldwide.

With the invention of the cage-guided needle roller bearing, Schaeffler has been at the forefront of shaping motion and mobility right from the beginning. Rotational motion as well as linear motion. In automobiles just like in machines, wind turbines or other industrial applications. Agile thinking and acting are deeply rooted in the company's DNA. Dr.-Ing. E.h. Georg Schaeffler, who in 1946 founded the company together with his brother, Dr. Wilhelm Schaeffler, was a highly creative innovator himself. However, Georg Schaeffler invented not only the cage-guided needle roller bearing but filed patent applications for a total of 70 inventions in his lifetime.

But Georg Schaeffler not only developed technical progress but marketed it with equal agility. Together with his brother, Wilhelm, and a well-filled suitcase of samples he'd knock on the doors of potential industrial customers and present his innovative bearing solutions. His trailblazing drive was soon to be rewarded by a rapidly rising number of applications and users. From 1953 on, there was no newly produced car in the still young Federal Republic of Germany anymore not using bearings from Schaeffler as standard components.

70 years later, around 60 Schaeffler parts on average are installed in every passenger car produced around the world. In 2020, Schaeffler filed 1,907 patent applications with the German Patent and Trade Mark Office, which earned the company the runner-up's spot in the ranking of Germany's most innovative companies for the eighth consecutive time, superbly proving the company's agility once again.

## Schaeffler's definition of agility

Agility is an attribute that begins in the mind, not on a piece of paper. For us, agility means anticipating and delivering what our customers need. Agility means being adaptable, flexible, and able to work fast when required. We see continuous improvement, collaboration within flexible teams and project structures, and a high level of judgment as critical success factors for sustainable value creation in ever more dynamic environments.



Win-win: digital applications and Industry 4.0 solutions are opening up new markets for Schaeffler while accelerating in-house processes

### Proactive behavior in disruptive times



**» A high level of flexibility and adaptability is becoming increasingly important**

Klaus Rosenfeld,  
Chief Executive Officer

While these are impressive statistics, they're no reason for the company to rest on its laurels. Schaeffler's senior management is aware of the necessity to pursue a path of continuous further development in an increasingly dynamic and complex environment with rapidly changing customer needs. The Roadmap 2025 sets the course on which Schaeffler intends to be guided by three strategic priorities: Innovation, Efficiency and Agility. CEO Klaus Rosenfeld comments in this context: "We're living in very challenging times of fundamental changes in our social, geopolitical and macroeconomic environment accompanied by considerable uncertainties. Long-term planning is difficult in many areas. Even from a short- to long-term perspective, a high level of flexibility and adaptability is becoming more and more important for sustaining and expanding our competitiveness." Schaeffler's fortes – Innovation, Superior Quality, Comprehensive System Understanding and Manufacturing Excellence – have been established over the course of decades and form the solid foundation for change. Customers and their needs always take center stage in this context.

One of Schaeffler's major advantages: As an integrated automotive and industrial supplier, the company has specific means of realizing synergies and accelerating processes. For instance, there's a wide variety of overlaps between the various business

segments of the three divisions, Industrial, Automotive and Automotive Aftermarket. The utilization of identical materials and components, the application of consistent production technologies and pooled purchasing of raw materials are just some examples.

Going forward, the objective is to put heightened emphasis on cross-divisional economies of scale and synergies in pursuit of continuous process optimization. In line with this effort, Schaeffler is intensifying the technology and knowledge transfer between its divisions across all four regions (America, Europe, China and Asia), which is intended to produce considerable benefits for the

further development of system understanding and market expertise as well. Another element is the new Central Laboratory that's currently being built at the Herzogenaurach headquarters (more on this starting on page 78).

In the context of its strategic realignment, Schaeffler systematically addresses five forward-thinking trends in which the company sees opportunities for future success: Climate Change, New Mobility, Demographic Change, Data Economy and Autonomous Manufacturing. All of these are areas that are going to decisively shape global transformation in the coming years and decades.

## “Milestone in our innovation strategy”

### **Alone you're unique, together you're strong.**

Guided by this motto, the German innovation platform STARTUP AUTOBAHN facilitates partnerships between large corporations and start-ups – with the aim of accelerating the development and time to market of new technologies in increasingly innovative, efficient and agile ways. Schaeffler is a new “anchor partner” of the platform. “As a global automotive and industrial supplier, we want to pioneer motion to advance how the world moves. STARTUP AUTOBAHN is perfect for Schaeffler and an important milestone in our innovation strategy,” says Uwe Wagner, Chief Technology Officer at Schaeffler. The collaboration with start-ups enables Schaeffler to identify growth markets more rapidly while continuing to develop its core business with strong partners to offer innovative, sustainable forward-thinking technologies.

**STARTUP AUTOBAHN has connected 30,000 start-ups to date.** Since the platform was established in 2016, more than 320 pilot projects have been developed. The network, headquartered in Stuttgart, is present in China, India and Singapore. “It provides a place to meet existing customers and a large number of suppliers as well as new part-

ners and exciting companies that have the technologies relevant to us. We see the further digitalization of our products, services and production processes in particular as a source of major opportunities for innovation – for both the automotive and industrial sectors,” says Prof. Dr.-Ing. Tim Hosenfeldt, Senior Vice President of Research and Innovation and Corporate Technology.



An agile network: STARTUP AUTOBAHN has developed more than 320 pilot projects since 2016

# For a better India

On a fast track to becoming an economic superpower: with agile thinking and advanced technology, India might be ranking among the world's top three economies by 2030.

*By Andrea Neumeyer*

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India is determined to bridge the gap between a developing and a high-tech nation. The subcontinent is planning to become a “Bridgital Nation,” which is a telling portmanteau of bridge and digital. The goal is an ambitious one because there’s still a gap between poverty and prosperity that needs to be closed by a growing middle class.

India’s key to broader prosperity lies in the Fourth Industrial Revolution – according to a proposition presented at the World Economic Forum by two top executives, Natarajan Chandrasekaran, Chairman of Tata Sons, and Roopa Purushothaman, Chief Economist and Head, Policy Advocacy at Tata Sons.

From shopping to work to travel to healthcare – there’s hardly any area of life that’s untouched by digital advances. Chandrasekaran and Purushothaman predict that major opportunities for India will evolve from the advance of technology. “We believe that if applied properly, it will lead to more jobs and better jobs – an approach we call Bridgital,” the two top executives explained at the 2020 World Economic Forum in Davos.

## **Skipping development steps**

The advantage of India and of other developing countries over industrially advanced economies is that the markets do not have to go through a fundamental structural transformation because, to a large extent, firm structures have not been formed yet and in some sectors not even markets have. For instance, 190 million adults in India are still without bank accounts. Technologies and services such as smart banking could create new markets whose stakeholders develop needs that in turn create more new jobs. Not least because in India, unlike in industrial nations, efficiency does not (yet) play such a decisive role, analyze Chandrasekaran and Purushothaman. But that is to change as well.

“In India, 77% of workers currently participate in the informal economy – working on farms or in low productivity jobs like construction or running small local shops. They earn about \$160 a month on average. For this vast informal pool, a contextual



**22** existing additional languages, alongside Hindi and English, serve as official languages at regional levels.

**1.3 million**

people are employed by **Indian Railways**, which makes it the world's largest employer. Indian Railways hauls more than eight billion passengers and more than one billion metric tons (1.1 billion short tons) of cargo per year.

**7%**

of India's gross domestic product is generated by the **automotive sector** – as much as in the EU.

**\$10 billion**

Google is planning to invest this amount in India's **digitalization** in the coming 5–7 years.

**In 2016**

India banned the use of 500- and 1000-rupee notes that used to account for 86% of cash as part of its plan to lead the country on a path towards a **digitalized and cashless society**.

technology intervention could boost productivity and wages, thereby improving livelihoods,” the two experts write in their paper.

Dharmesh Arora, Schaeffler CEO for the Asia/Pacific region that also includes his native India, views the subcontinent as being on a positive path as well (see also interview on the right): a young population, a stable democracy and important infrastructural investments including in renewable energies are going to further improve the economic upswing.

### From digital to bridgital for a better life

Modern technologies can also decisively help improve the frequently still precarious living conditions in India. Looking at healthcare, for instance, Chandrasekaran and Purushothaman write that it will take a further 600,000 doctors and 2.5 million nurses to close the access gap. “The doctors we do have spend a quarter to half of their time on activities that anyone else could accomplish: filling prescriptions, logging appointments, administrative paperwork. With a Bridgital intervention, we could change how doctors work. Many pre-diagnosis activities currently undertaken by doctors could be turned into a checklist programmed on to a kiosk, a handheld tablet, or even a smartphone. These could be used by someone without a clinical background, but who has received three to four months’ training on the technology, freeing up the specialist medical team to treat more patients, while giving jobs to those less skilled.”

The two experts mention another example: Virtual consultations with patients in remote areas could

## » Freeing up the specialist medical team to treat more patients, while giving jobs to those less skilled

Natarajan Chandrasekaran and  
Roopa Purushothaman

provide “access to primary care to the 65–70 percent of Indians who currently struggle for it.” This approach could bridge “more than 80 percent of the gap in doctors India will need by 2030.”

### 30 million new jobs

Looking at six selected sectors – including transportation, healthcare and the judiciary – a Bridgital reimagining could lead to 30 million jobs, according to Chandrasekaran and Purushothaman: “In truth, we already have what it takes to create more and better jobs. We also have the capability to improve and make better use of the existing skill levels of our people, especially once we tailor digital approaches and technologies to our needs. We need to stop thinking of humans and technology as competing for the same work and instead realize that using both together will definitely be more powerful than either alone.”

---

Due to modern technologies,  
30 million well-paid jobs  
could be created in India in  
the coming decade



## 4 questions for ...

**Dharmesh Arora, Schaeffler Regional CEO  
Asia/Pacific**

**What was the advantage of integrating India into the Asia-Pacific region, as Schaeffler did two years ago?**

Some of India's key customers, both in the automotive and industrial sectors, are based in Japan and Korea. They have a global footprint with a dominant presence across India and South East Asia. Integration of India will help build better and coordinated approaches to those customers. India is both a huge market and a source of tremendous resource – be it talent, technology or manufacturing capacity. Integration opens up new opportunities of collaboration among the region for the benefit of all. Our employees across the region will have new opportunities to learn from each other and grow mutually.

**The region you take care of for Schaeffler is considered the most agile economic area in the world ...**

Asia Pacific is one of the key drivers of the global economy with high-growth markets like India, Indonesia, Thailand and Vietnam as well as the mature and innovating markets like Singapore, Japan, South Korea and Australia. Over the years, we have built excellent market positions, customer relationships and a technology footprint in the region. Countries in the region have also emerged as the main development hubs and hotspots for new technology and innovation in areas like Robotics, Industry 4.0, New Mobility, Digitalization and Clean Energy. These developments coupled with rapid economic growth in the region provide huge opportunities for Schaeffler.

**How strong do you think the Indian market is in particular?**

India's GDP today is roughly \$3 trillion, expected to grow at a healthy 7% annually and become the third-largest in the world by 2030. A large population – one of the youngest in the world – a stable democracy and rising per capita income make it a very attractive market. The country's push on infrastructure development, increasing power generation and diversifying its energy source



towards renewables, improving competitiveness of the manufacturing sector and rising mobility needs will drive sustained growth for years to come. Global and Indian automotive OEMs have a very strong presence in the country, they engineer and manufacture products locally. It is already one of the largest producers of two-wheelers, agricultural tractors and trucks. Schaeffler has operated in India for over 5 decades and we have built a very strong customer connection that is supported by a very capable local footprint. Customer sectors like two-wheelers, motor vehicles, agricultural tractors, railways, wind and raw materials in particular present very attractive growth opportunities for us.

**What is your long-term vision for the Asia/Pacific region?**

Asia/Pacific is an exciting region with many possibilities. I hope we can build a robust business in the market by making the most of the opportunities around us. Today, about 13 percent of Schaeffler Group's revenue comes from Asia/Pacific. I envision this contribution to increase further, not just in terms of revenue and sales but also in areas of innovation and creative solutions that address the pressing needs of our customers and society in general.

# Off to new shores

Acting with consistency, thinking with agility, responding with flexibility: Those pursuing ambitious goals must be sure not to let unforeseen situations throw them off balance. These globetrotters have mastered the art of planning as perfectly as the art of adaptation.



## Facts + figures

**Travel time** 1,119 days,  
from March 15, 2016 to April 7, 2019

**Countries traversed** 33

**Distance covered** 95,000 km (59,000 mi)

**Offers of support, worldwide** 1,685

**Media coverage** More than  
2,000 online articles, 150 radio  
interviews, 50 TV appearances and  
hundreds of newspaper articles

# Electric trip around the world

“Sustainable Adventurer.” That’s what it says on Wiebe Wakker’s business card, and justifiably so: On March 15, 2016, the then 29-year-old Dutchman embarks on his journey around the world – always in search of a socket because the globe-trotter travels the 95,000-kilometer (59,000-mile) route taking him through 33 countries and ending in Australia after roughly three years in an electric car he’s converted himself. Wakker’s audacious idea: the energy that Blue Bandit, his bright-blue VW Golf Variant station wagon, needs every 200 kilometers to keep going should exclusively be supplied by supporters along the way. “Plug me in” is how the e-globetrotter dubs his project and related website on which people from around the world can offer their help in the form of electricity, food or accommodation even before the journey has started. His plan pans out: whether in Norway, Poland, Turkey, the United Arab Emirates, India or Malaysia, Wakker finds people in all parts of the world who are willing to help and invite him to charge his Blue Bandit or to spend the night and share a meal with them. Heart-warm-



ing as well as crazy encounters plus organizational and technical challenges of all kinds become the congenial adventurer’s constant companions. His journey included everything “from a dinner with sheikhs in Dubai to an exploding charger in India,” says Wiebe Wakker. Not even once during his entire trip he’s forced to plug his car into a public charging station. Reaching his final destination, Sydney, turns out to be a particularly touching experience. On his last stage, on April 7, 2019, a convoy of other electric cars escorts him – made up of people who in some cases have been following his adventurous trip around the world from day one and who support his idea of sustainable mobility. One of the things the Dutchman has demonstrated with his adventure is that even a road trip around the globe does not necessarily have to harm the environment!

[plugmeinproject.com](http://plugmeinproject.com)



# Happy in a tiny home

Kerstin Bürk, who uses the moniker “Körmi Körmet” for herself and her DIY label, invests some 1,000 euros and around 300 hours of work in converting her agile Italian Piaggio Porter minivan. With the modifications to which she applies her skills as a crafter, Körmi transforms the former transporter of the Rottweil municipal utility company into a moving space wonder. Patscho, as she calls her tiny home on wheels, works like a multifunctional pocket knife. Though measuring merely 2.2 square meters (24 square feet), the cargo space of the minivan provides the accomplished architect with everything she needs on her Atlantic coastal trip: stowage space, a place to sleep, privacy and protection. By pulling, pushing and folding, various multifunctional modules can be used as shelves, a table or a place to sit, while the tailgate provides protection during al fresco cooking and dining.

In 2017, Körmi embarks on her trip with Patscho, planning to travel for two or three

months – always along the coastal waters. The small orange-colored eye-catcher with its small 60-hp engine achieves a top speed of 134 km/h (83 mph). Once on the road, Körmi realizes that “the quest for bliss has become the very essence of my journey.” So, the two months turn into two years. Returning to the bare essentials made her come home richer than she was when she started her trip, she says. “Rich in terms of creative energy, inner strength, peace and contentment!” Patscho is treated to a few upgrades, too, as Körmi crafts a few additional shelves and a rooftop terrace during her journey. Back at home, she summarizes, sorts and writes about her experiences and asks a friend to illustrate them. The result is her book “Happiness is Homemade” encouraging readers to become aware of their own creative agility and energy and taking their happiness into their own hands – literally speaking.

[koermi-koermet.com](http://koermi-koermet.com)



## Facts + figures

**Travel time** 2 years

**Countries traversed** 6 (along the Atlantic coast: from Ireland to Morocco)

**Distance covered** 35,000 km (21,750 mi)

**Piaggio Porter minivan** (model year 2009), called Patscho



Perfect use of space can turn even 2.2 square meters (24 square feet) into a cozy home

## Hitchhiking without a tractor unit



### Facts + figures

**Travel time** 3 months (2010)

**Countries traversed** 8 (from Utrecht to Istanbul)

**Distance** 3,700 km (2,300 mi)

**Tow-bars used** 53

You need a good sense of humor! Plus, plenty of patience and confidence. At least you do if you travel like the theater-maker Tjerk Ridder and the journalist Peter Bijl. The two Dutch adventurers take a three-month journey across Europe – in a travel trailer but without a car to pull it! “Tow-Bar Wanted” is what they call their project that in 2010 takes them from Utrecht to Istanbul.

Here’s the story: Ridder wants to show that individuality isn’t everything. The opposite is true because you need others to go ahead in your life, according to the caravan hitchhiker, who’s seeking to manifest this metaphor. So, what better way would there be to do that than travel with a caravan that you can only get around in with the trailer hitch-hikes belonging to others?



[tjerkridder.com](http://tjerkridder.com)

## Leaving the comfort zone



On foot and without money from Munich to Tibet – Stephan Meurisch puts this totally crazy idea into action. He quits his job, clears his apartment, packs his backpack and embarks on his march – always eastbound. When Meurisch, an electrical engineering technician by trade, arrives in Tibet on October 31, 2015, he’s traversed 13 countries in four years, has walked 13,000 kilometers (8,080 miles)! And has acquired an awesome amount of knowledge – about body language, trust, hospitality and, not least, about himself. As a self-employed “long-distance hiker, adventurer and coach,” his mission today is to encourage people to be agile – and to occasionally leave their comfort zone in the process.

[stephanmeurisch.de](http://stephanmeurisch.de)



### Facts + figures

**Travel time** March 11, 2012 to October 31, 2015

**Countries traversed** 13 (from Munich to Tibet)

**Distance** 13,000 km (8,080 mi) – on foot

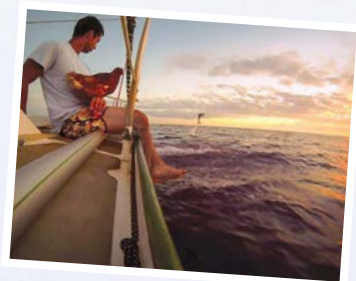
# With a hen and hindrances

What a trip: Guirec Soudée fulfills his most fervent wish in December 2013 when the then 21-year-old Frenchman sets sail on his own steel sailboat he calls Yvinec – like the peninsula in Brittany from which he hails. At some point in time, he takes a hen called Monique on board that will keep him company during his adventurous circumnavigation of the globe. When the young man leaves France, he's already invested a lot of time and effort in his project because the boat he's finally able to buy after years of working in various and sundry jobs is in a miserable state of repair. Yvinec's hull is so rusty that it's as thin as cigarette paper in some places, Guirec describes his boat in the book about his maverick sailing adventure. No one believes that this boat will ever be seaworthy, let alone be able to cross the oceans. No one except Soudée, who's convinced that you can't achieve anything in life unless you're a positive thinker.

His adventure will prove him right: With his 11.70-meter (38-foot) steel boat, Guirec Soudée sails around the world in eleven stages, always accompanied by the "red beauty," as the adventurer calls his feathered friend. From Brittany through the Bay of Biscay to Tenerife, from there across the Atlantic to the Caribbean. Afterwards

he heads for Greenland, fascinated by the Northern Lights, and spends the winter there before traversing the dangerous North West Passage, first circumnavigating North and then South America and sailing back home via South Africa and the Lesser Antilles. In these five years, he's crossed the Atlantic three times, got stuck in the ice for 130 days, mastered lulls, storms, icebergs and waves as high as a house, done casual jobs time and again to secure his continuing journey, and seen the most fabulous landscapes. And Monique? What special feats did Guirec's unusual female companion perform on the trip? The sea-worthy animal laid more than 1,000 eggs for the sailor. Delicious!

[guirecsoudee.com](http://guirecsoudee.com)



## Facts + figures

**Travel time** December 2013 to December 2018

**Route** around the world in 11 stages

**Distance** 45,000 nautical miles

**Steel boat** Yvinec; length: 11.70 m (38 ft); width: 3.70 m (12 ft); weight: 9,000 kg (9.9 short tons); built in 1985

A good read: "The Hen Who Sailed Around the World" is the title of the book about Guirec Souée, Monique and their crazy trip around the world





# Commitment instead of pity



The man's a fighter. In 2009, Sven Marx is 42 and a diving instructor when he's diagnosed with a brain tumor. While after the life-saving surgery the Berliner is shocked to find out that he'll require long-term care, this doesn't keep him from cycling around the world eight years later. In 17 months, Marx traverses 30 countries covering a distance of 32,000 kilometers (20,000 miles) on a bicycle tailored specifically to suit his needs. "Giving up was never an option. Mooning about the life you used to have doesn't do you any good," says the passionate cyclist – even though this type of transportation has its pitfalls. The most treacherous one strikes when the spiky seeds of an indigenous plant in Mexico puncture his tires eight times – on a single day! He's since published a book

about his journey that shows what Sven Marx is at heart: an adventurer with a disability who spreads optimism and is untiringly committed to supporting inclusion projects worldwide. Hats off to him for such spirit!

[sven-globetrotter.com](http://sven-globetrotter.com)



## Facts + figures

**Travel time** 17 months  
**Countries traversed** 30 (start and finish Berlin, in between Russia, Japan, Australia, the United States and France, among others)  
**Distance** 32,000 km (20,000 mi)  
**Bicycle** Patria Junior, matte black with toothed belt drive



# Shopping for experiences

## Facts + figures

**Travel time** 111 days  
**Countries traversed** 8  
**Distance** 3,392 km, with 30,000 meters of elevation gain  
**Shopping cart** Ms. Molly, equipped with puncture-free wheels, rainproof wrap and an umbrella as sun and rain protection for the "driver"



Christian Zimmermann has already traversed Australia in an off-road vehicle and on a bicycle. And now? The logical "downgrade" is walking. That, however, poses the problem of how to haul 30 liters of water plus luggage exceeding the capacity of a backpack. The Swiss finds the solution in packing a shopping cart ("Ms. Molly, the trolley") and embarks on his 3,000-kilometer (1,864-mile) march. The idea was so bizarre that Zimmermann would revive it in 2020. Right in the middle of corona year one, he pushed Ms. Molly – weighing 90 kilos when packed to the brim – from his native Switzerland all the way to Moscow. The robust basket lady mastered all hardships without a single defect except for her aversion to muddy trails, rough terrain or stairs. None of these, though, were able to stop this unusual pairing.

[global-av.ch](http://global-av.ch)



## The author

**Christel Trimborn** didn't have to think twice when the opportunity to write this story about globetrotters presented itself because the journalist specializing in wanderlust can hardly wait for her itchy feet to hit the road again. In her mind's eye, she's already far away, climbing in the Alps, ambling around Corsica.

# In motion

Innovations in the course of time

## Firebird I (1953)

- First gas turbine car in the United States
- Design from aeronautical engineering
- Lightweight body made of fiber glass reinforced plastics
- Propelled by a gas turbine acting on the rear wheels via a transmission
- 370 hp at 13,000 rpm
- One of the first cars to have been optimized in a wind tunnel



## The future back then

Alternative drive concepts, new types of controls or self-driving vehicles – these are subjects that have been fueling the imagination of automotive engineers not only in our day and age. All of them can be found in this photograph that's more than 50 years old. It shows three General Motors concept cars from the 1950s whose interiors and exteriors as well as their propulsion systems were inspired by a new age in aviation: the age of jet aircraft. Even the name of these futuristic cars – Firebird – matched their styling and engineering design featuring bubble canopies as cockpits, joystick controls and turbine propulsion, all taking cues from jet fighters. The visionaries from Detroit led by GM's legendary chief designer Harley J. Earl (the gentleman in the picture) installed a display instead of a rearview

mirror with a rear-mounted camera supplying the images. But the most stunning highlight, no doubt, was the fact that the Firebird models II and III were able to drive autonomously using an "auto guide." Two coils near the front wheels would receive electronic impulses from a cable buried in the road, convert them into steering commands and keep the car on course. Old television commercials feature a "dream highway" on which drivers are cruising completely relaxed in autonomous mode, radioing a glass tower from their cockpits that transmits traffic information and the best route to a screen in their Firebirds. The key driving data were accessible on this screen as well. A vision of the future that was to become a reality only half a century later due to digitalization.

» *There will be vehicles that will not be pulled by any animal and drive with incredible force*

Leonardo da Vinci

### **Firebird II (1956)**

- Autonomous driving by means of buried electronic conductors
- Lightweight titanium bodywork
- Design featuring a jet look with turbine shafts at the front
- Plexiglass canopy as the cockpit
- Independent suspension with automatic ride height adjustment
- Weather and traffic information displayed on a screen
- Electric gearshift
- Individually controllable air conditioning system

### **Firebird III (1958)**

- Fiber glass body with seven wings and fins
- Generative gas turbine engine
- Door is opened with an ultrasonic key
- Steering and braking using a joystick in the center console
- Autonomous driving mode
- Cruise control
- Automatic lights including emergency lighting



# Wind of Change

Only when the human, nature and technology triad is in perfect harmony will sailors stand a chance of finishing the Vendée Globe. Mental agility is a key skill in the world's toughest non-stop regatta that Boris Herrmann was the first German to take part in. Here's the story about the stormy fascination exuded by solo sailing and a race that's even bigger than sailing around the world: the fight against climate change.

*By Björn Carstens*

## 24/7 agility

The wind whips the sea spray across the boat. Somewhere in the middle of nowhere, south of the 40th parallel, Boris Herrmann's Seaexplorer is tossed around by high waves in the "Roaring Forties." That's what sailors have dubbed the dreaded area in the Antarctic Ocean that the Vendée Globe front runners have reached after roughly three weeks. That the professional ocean sailor from Hamburg stoically stays the course in the roaring waves may sound to landlubbers just about as impossible as nailing jelly to a tree. To the circumnavigators tackling the Vendée Globe in November 2020 it doesn't. The 33 women and men are accustomed to defying the whims of the sea. Spending weeks on end in solitude on the oceans, ready to act 24/7, solo sailors have to make decisions to the beat of the waves confronted with "Roaring Forties," light breezes and veritable lulls, treacherous currents and potential collisions with flotsam and mighty marine mammals – or with fishing boats. Boris Herrmann collides with one of them at night-time in the Bay of Biscay, 90 nautical miles before the finish. None of his umpteen warning systems has emitted a beep, so the two boats collide. The crash doesn't leave Herrmann shipwrecked, so he goes on to finish the race with the mortally wounded Seaexplorer at reduced speed. After 80 days at sea, the skipper himself has more than pushed his limits as well, especially since the last-minute incident has washed overboard his stimulating thoughts of potentially claiming victory.

80 days without stopping. Constant mental and physical agility, day and night. Pondering options and making choices, observing and musing. That pushes the limits even of first-rate athletes in top shape like Herrmann. The slightest mistake or a brief moment of inattentiveness spell danger. Shipwrecked sailors are not uncommon in the Vendée Globe. In all nine competitions combined, dozens of entrants have been forced to retire. The DNF rate is nearly 50 percent and some of the sailors did not survive the race.

Boris Herrmann has mastered the Everest of the Seas, as the Vendée Globe is sometimes called. It's a challenging balancing act between adventure, a research project and a race. "I may be reminding myself to be more cautious in one instant

# 80

days, 14 hours,  
59 minutes and  
45 seconds: this is

how long it took Boris Herrmann to sail around the world in the Vendée Globe, which earned him the fifth spot in the final standings.

# 21,638

nautical miles (approx. 40,000 km/ 24,900 mi) is the minimum distance to be covered by the non-stop sailors on their way around the world. One nautical mile equates to 1,852 m (6,076 ft). The nautical mile is calculated from the Earth's circumference. 40,000 km (24,900 mi) are divided by 360° and 60 minutes = 1,852 m (6,076 ft). In the end, Herrmann sailed more than 50,000 km (31,068 mi) around the world.



At a speed of up to 75 km/h (47 mph) the Seaexplorer whipped across the oceans, faster than many motorboats

and, a moment later, not be willing to lose any miles. I'm engaged in a permanent internal dialog. I keep grinding until I'm on my last legs, try to sleep, try to eat, but I constantly have to deal with questions like: wouldn't the third reef be better?" Herrmann reported during the regatta.

The most crucial question that keeps coming up for him is "what am I going to do when?" In management seminars of the business world, this is known as an in-basket exercise: setting priorities, being flexible, keeping a cool head, making the right choices to prevent shipwrecking. Boris Herrmann didn't wreck his ship. Because he pushed his limits, like on that day at nightfall during the

» You're thinking about something all the time, that permanently occupies the mind

Boris Herrmann

first half of the race when he's forced to climb the near-30-meter (98-foot) mast to loosen a defective mount in spite of his intense fear of heights. Solo sailing is also a continuous inner battle against oneself.

## The Seaexplorer – packed with sensors

### Facts + figures

**Launch** August 2015  
**Length** 18.28 m (60 ft)  
**Width** 5.70 m (19 ft)  
**Draft** 4.50 m (15 ft)  
**Weight** 7.6 metric tons (8.4 short tons)  
**Mast height** 29 m (95 ft)  
**Windward sail area** 290 m<sup>2</sup> (3,120 sq ft)  
**Downwind sail area** 490 m<sup>2</sup> (5,275 sq ft)  
**Speed max.** 40 knots (nearly 75 km/h; 47 mph)

**Whale pinger** That's the name of a small round glass cylinder in the bulb keel that emits signals with a range of about one kilometer (0.6 miles) alerting whales to get out of the way.

**Oscar** in the mast top is designed to prevent collisions with flotsam. When, based on infrared pictures, an AI system linked to the autopilot detects objects on the water surface from a 1,000-meter (0.6-mile) distance, the boat will autonomously circumvent them.

**Load measuring pins** are installed in the rigging. Once a threshold is reached that's still clearly below maximum load, an acoustic signal alerts Herrmann.

**Fiber optic cables** are routed through the foils, measuring the curvature in six places.



# Around the globe by autopilot

Is solo sailing like Formula One on water? That's certainly a permissible comparison because sailing in lockstep with technological progress has become faster and faster. Boris Herrmann's boat, the Seaexplorer, has nothing in common anymore with an old yawl. It's a high-tech watercraft made of carbon fiber reinforced plastics (CFRP) – super-lightweight and specifically tailored to suit the needs of solo sailing around the world. It's a yacht of the IMOCA 60 class sailing with the latest generation of hydrofoils ever since it was extensively converted during the winter before last. Hydrofoils are U-shaped, extensible blades that, as the boat picks up speed, lift the hull out of the water like wings would. The foils serve to increase speed by clearly reducing friction resistance.

The Seaexplorer is not kept on course just by the skipper but with the help of an autopilot, assisted by satellite technology, which is the most important instrument on board. It ensures that the boat autonomously sails in the right direction. Due to the diversity of their tasks, solo sailors actually have no time anymore to steer the boat themselves. Autopilot systems are typically installed below the deck in a space of some six square meters (65 sq ft) protected by a sprayhood.

## Trim is solely the sailor's choice

Solo sailors perform a large part of their work on computers in the rotatable control center that looks like an aircraft cockpit. This is where the sailor downloads weather data twice a day, and checks and programs the navigation software. By contrast, the manual work of sail trimming (grinding), just like calculating the course, is strictly the sailor's job. The regulations prohibit external help. Although the technical gadgets make life easier for Herrmann, they won't make any decisions for him. Herrmann still has to choose the right sail setup himself based on wind force and swell.

A solar system and hydrogenerators supply the electric power for the on-board electronics. The hydrogenerators are reminiscent of outboard



Boris Herrmann had plenty of grinding to do during the regatta while operating his four winches on board

engines that, like small rear turbines, are pitched into the water current and produce energy – carbon-neutral energy of course. State-of-the-art radar systems, a hermetically sealed crash box, two survival suits and two inflatable life rafts provide safety. However, a specially tailored seat that equalizes all of the boat's movements ranks at the top of the list of the modifications on board, according to Herrmann: "I can sit there, watch the monitors, eat and when the boat moves around a lot it's simply the best place to wedge yourself in – it doesn't take a lot of physical exertion to stay put," he says.

# 130 kg (287 lbs)

of spare parts were on board of Boris Herrmann's boat, including CFRP plates, a piece of mast track, electrical and electronic parts, a drift anchor, etc., plus a 30-kg (66-lb) spare rudder.

»» *The Vendée Globe is a race we would like to win, the race against climate change is the one we must win!*

Maxim of Boris Herrmann's Malizia team

## A floating mini lab

The Vendée Globe provided joy not only to sailing enthusiasts but climate scientists rejoiced as well. First of all, about the safe arrival of the sailors and then about the wealth of new data collected that are normally hard to come by. Although container ships with measurement equipment on board supply data, too, they usually navigate the same routes over and over. By contrast, the Vendée Globe takes the contenders through the Antarctic Ocean and the southern Atlantic, which are still blank areas on the carbon map. To change that, a piece of measuring equipment on the Sea-explorer continuously logs data about the water's CO<sub>2</sub> and salt content, and temperature.

The purpose-built, energy-saving mini ocean lab that tips the scales at merely 17 kilos (37 lbs) – costing approx. 50,000 euros – is connected to a water circuit in the boat's keel through which seawater continuously flows. "The readings are logged every 20 seconds," said Peter Landschützer from the Max Planck Institute for Meteorology in Hamburg in an interview with the German news magazine Der Spiegel. The oceans, he explained, are an important indicator of climate change processes because they store a substantial amount of the carbon dioxide from the atmosphere. Precisely



In the control center: a specially fit seat tilts when the boat lists by up to 45 degrees

speaking, about 25 percent of anthropogenic carbon emissions. If they didn't, global warming would be even more severe. Every ten days, Boris Herrmann would send data to the scientists at home per satellite transmission. The readings were uploaded into the SOCAT (Surface Ocean CO<sub>2</sub> Atlas) database, which is an incredible data record of the global carbon cycle. Initial analyses have already been made and one of them says that the Antarctic Ocean stores comparably more carbon than other oceans – an exciting trend, Landschützer says, that merits more detailed investigation. In a manner of speaking, Boris Herrmann's mission was just the starting signal to an ultra-marathon: the fight against climate change and education is one key to it in Herrmann's book. The Ocean Challenge school project co-developed by his team, Malizia, with worldwide school partnerships is a matter close to Herrmann's heart that he plans to pursue even after the Vendée Globe. A new, super-innovative and sustainable yacht is already in planning, too. The adventure continues.

# 2,688

**kilometers** (1,670 miles). That was the maximum distance to the nearest shore during Herrmann's circumnavigation – arguably the loneliest place on Earth. Even the ISS orbits the planet merely 408 km (254 mi) above it.

# 2,000

**meters** (6,560 feet). That's the depth to which the **mini submarine Argo** can dive that Herrmann released at sea and that's supposed to deliver findings about carbon transportation in the deep sea.





At the finish, Herrmann celebrated with two flares in his hands and was welcomed by friends and team-mates on dinghies

## Power napping at sea

When do you get to sleep during a 24/7 mission? On 80 and more days in a row? The Vendée Globe sailors' solution is extreme power napping, a sleeping strategy that used to boost even Leonardo da Vinci's creativity. The universal genius purportedly slept only 15 minutes every four hours. And dolphins use an exciting method as well: they let just one of the hemispheres of the brain go to sleep and keep the other one on stand-by. Regatta pro Boris Herrmann sleeps a maximum of 60 minutes at a time per day during the Vendée Globe. However, these morsels add up to a total of six hours per day.

Sleep expert Dr. Holger Hein has been decoding Herrmann's "internal clock" for more than 20 years: After many small periods of rest, Boris Herrmann is typically about as refreshed as anyone else after a normal night's rest, he told the Hamburger Abendblatt newspaper, because even normal sleep is frequently dissected by brief, usually non-remembered wake phases. "So, ultimately, Boris didn't do anything differently than all of us. It's just that he didn't continue sleeping right away like we do during a normal night." Much more important than sleeping through the night is the depth of sleep and therefore its regenerative effect, Hein explains. That's why Boris Herrmann has trained himself to zone out as soon as he closes his eyes. Hein classifies this gift in the "Owl" category because owls are a lot more flexible when it comes to their sleep patterns than the classic early riser. One of Herrmann's training methods while driving a car is actually taking a nap when the traffic lights turn red and having the honking horns of the cars behind him wake him up. Now who else could have come up with an idea like that ...

# 80

**sequentially numbered packets** with food, most of it freeze-dried space food, ready to eat by adding hot water, were Herrmann's on-board rations. Plus, some fruit and cheese, all amounting to 130 kg (287 lbs), and three small bottles of whisky – one for each Cape circumnavigation.



After 80 days, Boris Herrmann was in for a fiery arrival.

# 500 years of circumnavigation

The first trip around the Earth started in 1519. The sailing expedition begun by Ferdinand Magellan took three years. Today, it takes the International Space Station (ISS) 92 minutes to circle our planet.



## The Earth

**Circumference** 40,075 km /  
24,901 mi (Equator)

**Total surface (in millions)**  
510.0 km<sup>2</sup> / 196.0 sq mi (100%)

**Water surface (in millions)**  
360.6 km<sup>2</sup> / 139.2 sq mi (70.7%)

**Land surface (in millions)**  
149.4 km<sup>2</sup> / 57.7 sq mi (29.3%)

## Circumnavigations of the Earth in days



**1093**

**By sailing** The first-ever circumnavigation took place from 8/10/1519 to 9/6/1522, led by Ferdinand Magellan, who died on the voyage. Only one of his five three-masters made it.



**940**

**By cycling** Thomas Stevens circled the planet on a penny-farthing from San Francisco (USA) to Yokohama (Japan) from 4/22/1884 to 12/17/1886.



**762**

**By car** Clärenore Stinnes was the first person to achieve this feat in a production car (Adler Standard 6): 5/25/1927–06/24/1929. Her route: Berlin, Moscow, Beijing, Japan, USA, Argentina, Berlin.



**492**

**On foot** To date, Heine Stupp is still the person to have walked around the Earth once faster than anyone else in spite of having used a train on some of the stages. Start/finish: Munich. **Period: 7/31/1895–12/5/1896.**



**157**

**By air** In 1924, the U.S. Air Force achieved this feat for the first time using three single-engine biplane aircraft. These Douglas World Cruisers traveled from 4/24 to 9/28.



**80**

**By electric car** In 2016, eleven teams tried to equal Jules Verne's novel "Around the World in 80 Days," breaking the world circumnavigation record for e-cars using vehicles of the Tesla brand.



**71**

**By solo sailing** Since 2005, Ellen MacArthur has been the fastest female solo sailor having circumnavigated the world. Since 2016, François Gabart has held the world record: 42 days, 16 hours, 40 minutes.



**35**

**By airship** LZ 127 Graf Zeppelin traveled 49,618 kilometers (30,831 miles) on its global tour from 8/1 to 9/4/1929. Powered by five V12 engines from Maybach, it reached a speed of 128km/h (80 mph).



**2.8**

**By ultralight aircraft** Steve Fossett was the first pilot to perform a non-stop solo flight, from 3/1 to 3/3/2005: 36,900 km (22,930 mi) in 67 hours with a single jet engine and 10,200 liters (2,695 gal) of kerosene.



**1.3**

**By supersonic jet** The 1995 round-the-world record set by the Concorde has remained unbroken: 31 hours, 27 minutes, 49 seconds. 36,784 km / 22,856 mi (New York–New York), six refueling stops.



**0.08**

**By spaceship** Yuri Gagarin was the first human to circumnavigate the Earth in outer space: on 4/12/1962, in his Vostok 1 capsule, he completed one orbit of Earth in 108 minutes.



**0.06**

**By space station** Since 11/2/1998, the International Space Station (ISS) has been orbiting the Earth. At a speed of 28,000 km/h (17,400 mph) one orbit takes 92 minutes. In 2016, the ISS had completed 100,000 orbits.

# Top or flop

Whether companies are successful or crash decisively depends on agile action and strategic decisions, as shown by the following six examples.

*By Lars Krone and Volker Paulun*



# Lego



## Bricks on a roller coaster ride



The history of toy giant Lego begins with a couple of clever decisions. In 1932, when the world economic crisis has just arrived in Denmark, carpenter Ole Kirk Christiansen starts making wooden toys instead of high-priced furniture. Their name is Lego, derived from the Danish Leg godt (“play well”). In 1946, Christiansen proves his strategic prowess once again when he buys the country’s first plastics injection molding machine and switches from wood to plastics. 1949 sees the first little bricks with the characteristic studs tumbling out of the machine. Today, statistically speaking, every human being possesses 136 Lego bricks. Every day an incredible 200 million of them are produced. Lego is a cash machine – that temporarily stalls.

In the 1990s, computers start conquering children’s rooms. Lego tries to interlink digitalization with the colorful bricks but proceeds with excessive fervor. Classics like the Duplo series of large bricks are discontinued. They’re succeeded by high-tech products without relevance to the company’s core competency and that don’t find favor with customers. Following record losses (120 million euros), a new management team changes tack in 2004. Lego revives classic products and includes licensed ones (Harry Potter, Star Wars, Super Mario) in its portfolio, plus some digital toys here and there. In 2018, the large Chinese market discovers Lego. In 2020, Lego reports record sales (5.9 billion euros) and earnings (1.7 billion euros) again.

# British Leyland



## Going bust with joint forces



Rover, Triumph, MG, Austin, Daimler or Jaguar: All of these brands made automotive history for many decades, but in the 1960s are struggling with slumping sales and low earnings. The solution: a merger forming the British Leyland Motor Corporation in 1968. The statistics of the new automotive giant are impressive: with more than 170,000 employees the corporation is the fourth-largest employer in the island state and deemed to be its biggest exporter.

The anticipated success story, however, turns into a series of flops, failures and fumbles. As early as at the end of 1974, the corporation faces insolvency and is nationalized to save it – albeit without success. The German weekly news magazine Der Spiegel provides a fitting analysis: “There are too many workers working at too many plants using machines that are too old to produce too many obsolete models that, to top things off, are suspected of unusual trouble-proneness worldwide and increasingly hard to sell – if they could even be delivered at all.” British Leyland turns into British Painland. In addition, strikes paralyze production and a high pound rate spoils necessary foreign growth. Two billion pounds of taxpayer’s money have fizzled out and the numbers are turning into a deeper and deeper red. In the 1980s, the brands are discontinued or sold off. British national pride prevents the sale of the commercial vehicle business to General Motors, but not the corporation’s complete collapse in 1988.

# Fujifilm



## Radical transformation



The Japanese photography corporation Fujifilm starts in 1934 – and has been changing ever since. Unlike its two (no longer) major competitors, Agfa and Kodak, Fuji develops new additional business segments early on. In the 1950s, the corporation produces Japan's first computer and, starting in 1962, digital printing systems (today Fuji Xerox). When digitalization arrives in the photography sector, Fuji quickly jumps on the band wagon. The Japanese are deemed to be the inventors of digital radiography. Fuji develops LCD displays and produces sensor technology for digital cameras from 2000 on. In 2020, Fuji announces a record in image resolution: 400 megapixels! Even so, the end of analog photography in the early 2000s is a major blow to Fuji as well, but CEO Shigetaka Komori makes the best of the situation. His strategy: Analog photographic film has a lot to do with chemistry. 20,000 chemical components and compounds are stored in in-house laboratories. One of them is collagen, a protein on which the photosensitive layers of film and photographic paper are based. However, it also provides the connective tissue of our skin with support and firmness. Fuji takes advantage of this knowledge and in 2007 launches the Aсталift skincare product series. Other healthcare products follow and in combination with IT products in the healthcare sector become Fujifilm's sheet anchor. In 2020, Fuji launched Corona drugs and rapid tests – further proof that agile action can be an entrepreneurial savior.

# Nokia



## It could have been far worse



Founded in 1865 as a ground wood pulp mill and evolved into a conglomerate (tires, energy, among others) by the early 20th century, Nokia at the beginning of the 1990s starts conquering the cell-phone market that's still young at the time. The Finns set technology and design standards and capture a world market share of 50 percent. With the Communicator product series, Nokia becomes a smartphone pioneer. In 2007, Nokia achieves record sales (51. billion euros) and is one of the most valuable companies in the world (market capitalization 211 billion euros). The value of the company's name alone is assessed at 28 billion euros compared to Apple's mere nine billion. But then the iPhone appears ... Apple's pocket-size computer scores with wiping customers by featuring a touch screen, app structure and intelligent camera integration. Other manufacturers are pursuing the same idea with the Android operating system. And what does Nokia do? Relies on the strength of its brand and hardware expertise but keeps losing ground with it software. When Nokia forges an alliance with Microsoft against Apple and Android it's too late. The market has already been divided. In 2016, Nokia's cellphone business is sold off to China. Today, Nokia is a world market leader again, albeit in the field of network technology. In addition, the Finns are successfully active in the healthcare sector. Total sales in 2020 was 22 billion euros.



# New York Times

Successfully digitalized



Digitalization has swept through the publishing world with a wide broom. Around the globe, newspapers and magazines have disappeared, printing houses have shut their sliding gates for good, and editorial teams have shrunk to a minimum or totally imploded. The same applies to circulations and earnings, and all because news can be accessed in real time and for free on the web. However, the New York Times (NYT) established in 1851 proves that honorable journalism is still a way of earning good money.

Even though its logo may appear a bit stiff, the strategy of the publisher on Eighth Avenue isn't. In 2015, the executive editors align all processes with the digital issue. At the same time, NYT concentrates on what it does best: delivering quality journalism. Shareholdings that don't fit the bill are sold. Readers appreciate the combination of time-tested quality and new agility. They're even willing to pay for it, and increasingly so: At the beginning of 2021, NYT surpasses the 7.5-million mark of digital subscriptions, whereas the printed issue is below 500,000. Amazingly, one in ten online readers lives outside the United States. By 2025, the online readership is planned to double to ten million, two million of them foreign subscribers. Additional money is made with the content marketing business producing content for channels like Netflix and Spotify. The stock market honors this success: the value of the time-honored publishing house has quadrupled since 2016.

# Pan Am

Crash of an airline icon



On October 19, 1927, the first Pan Am aircraft takes off: a small floatplane. The company climbs quickly. 1931 sees its first intercontinental flight. In 1955, Pan Am lands a coup that rings in the jet era by ordering 20 Boeing 707 and 25 Douglas DC-8 aircraft from the drawing board. The competition is left behind by this bold mass order since all production capacities for the new jets are blocked as a result. When Boeing launches the Jumbo Jet, Pan Am is again the first airline to order it. The sky seems to have no limits.

But that's not the case. The descent begins at the end of the 1970s. Deregulation of the U.S. airline industry hits Pan Am hard. The strict separation between airlines with domestic and international service is abolished and puts Pan Am that has been operating internationally in a tight spot. In order to offer important feeder service, the company acquires the domestic carrier National Airlines in 1979. The excessive acquisition price sends Pan Am into a tailspin. First, the company sells some of its real estate and subsequently some intangible assets: lucrative Pacific routes. In 1988, Pan Am becomes the victim of a terrorist attack: Flight 103 is destroyed by a bomb above Lockerbie, Scotland, shortly before Christmas. Fear starts spreading that Pan Am as an iconic U.S. airline might become the target of further attacks. Bookings are in decline and in 1991, Pan Am finally crashes into insolvency. Delta Air Lines picks up the usable debris. Pan Am's glorious name today belongs to a railroad system.

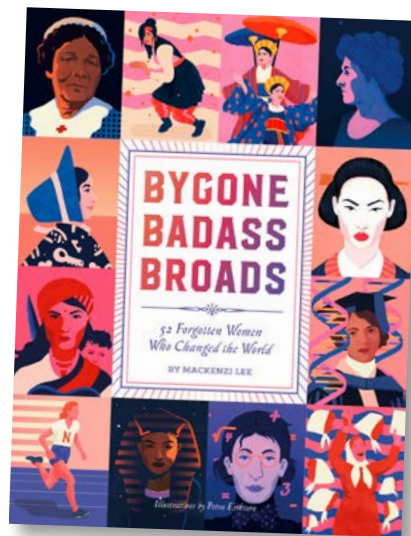
# Pages packed with ideas

Creative artists, courageous founders, stellar scientists: World history is full of outstanding women and men who have shaped our lives. Their biographies are more inspiring and riveting reads than many works of fiction.

52 true heroines

## Women of power

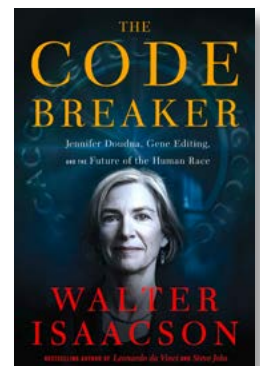
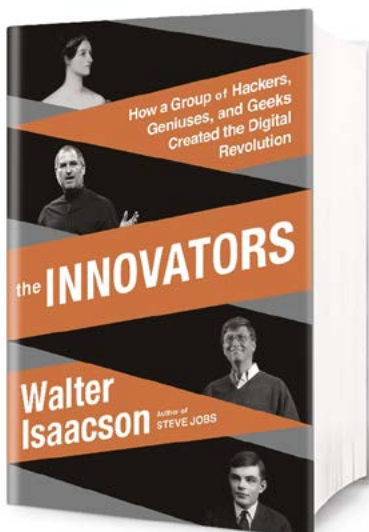
From the founder of the first modern university to courageous freedom fighters to the woman who conquered leprosy: Many historic heroines are hardly known. Lee MacKenzie tackled the task of changing that in her book **Bygone Badass Broads** (Abrams & Chronicle Books) presenting 52 legendary heroines and their true stories – action-packed, informative and a kaleidoscopic appeal to women to never doubt their own greatness.



Inventors, explorers and entrepreneurs

## Visionary thinkers

Plenty of good reads by Walter Isaacson, the king of captivating biographies (Einstein, da Vinci, Franklin, Jobs). His new book **The Code Breaker** (Simon & Schuster) is dedicated to Nobel Prize winner in chemistry Jennifer Doudna. The results of her research – an easy-to-use tool for gene editing – might change the future of humanity. In **The Innovators** (Simon & Schuster), Isaacson portrays the masterminds of the digital revolution: from Ada Lovelace to Konrad Zuse to Apple's legendary founder Steve Jobs. He looks at inventors and adventurous entrepreneurs who permanently produce ideas and drive developments.

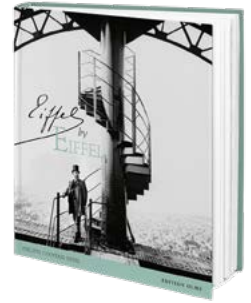




## An engineering genius

## The magician of iron

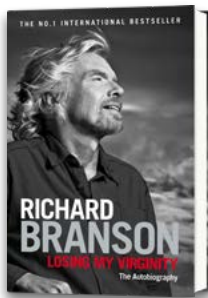
He built Paris's world-famous, uncontested landmark, but the achievements of Gustave Eiffel (1832–1923) by far exceeded this tower bearing his name. Commissioned to plan the construction of a railroad bridge in Bordeaux as a young engineer in 1856, Eiffel went on to create more than 300 architectural masterpieces that can be found in all parts of the world. Moreover, Eiffel was a versatile developer of the industrial age and is regarded as the “father” of modern meteorology and an acknowledged aerodynamics expert. Featuring partly unpublished archival material in his biography **Eiffel by Eiffel** (Edition Olms), his descendant PhilippeCoupérie-Eiffel invites readers to join him on a journey of exploring the genius's work.



## Dyslexic and a billionaire

## The unconventional tycoon

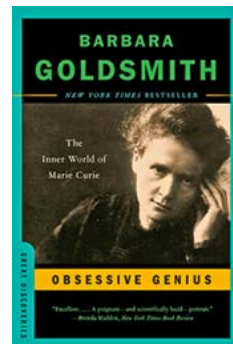
In 1968, at the age of 16, Richard Branson quit school. Three years later, he opened the first Virgin records store on London's Oxford Street and shortly afterwards closed his first mega deal with the Virgin Records label, laying the foundation for Branson's Virgin Group that today employs more than 50,000 people in industries like music, aviation and rail transportation. In his bestsellers **Losing my Virginity** and **Finding my Virginity** (Virgin Books), the agile multi-talent covers the period from 1950 until today.



## Devoted until her dying day

## The passionate researcher

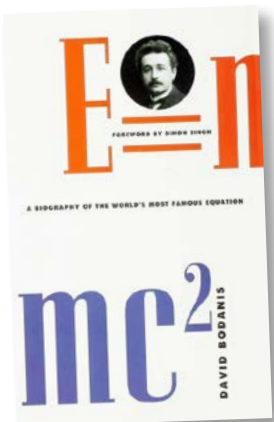
Marie Curie was an obsessed scientist whose career broke all records. She was the only woman to have received two Nobel Prizes and the first-ever female to have been awarded this accolade. Her investigations in the field of radioactivity broke new ground. During the research for her book **Obsessive Genius: The Inner World of Marie Curie** (W. W. Norton & Company), journalist Barbara Goldsmith reviewed historic documents that are still “hot” today: diaries, letters and records of an exceptional scientist and woman who was willing to sacrifice her life in pursuit of her passion.



## A gripping tale of Einstein's famous theory

## The “biography” of an equation

Generations have grown up with the knowledge that the equation  $E=mc^2$  has changed our world, albeit without having understood it. From the atomic bomb to the cathode ray tube of televisions to carbon dating of pre-historic paintings – the equation rules just about everything. In his book  **$E=mc^2$ : A Biography of the World's Most Famous Equation** (Bloomsbury USA), David Bodanis describes one of the greatest scientific discoveries – and wraps this complicated theory in an unusually good story.



# Here and now

Living with progress

## Schaeffler in the DTM with womanpower

An agile mindset is a precondition for progress – applied to motorsport, this means promoting not only technological innovations but protagonists, too – in this case, female protagonists. Together with its partner, ABT Sportsline, Schaeffler helps increase the number of women in motor racing. In the DTM’s season opener at Monza in June, Sophia Flörsch, a Schaeffler brand ambassador, will be driving a third 585-hp Audi R8 LMS for the ABT squad alongside Mike Rockenfeller and Kelvin van der Linde, backed by concentrated womanpower: for the first time, Schaeffler and ABT – currently the most experienced and successful DTM team – are deploying Laura Müller, a female race engineer, and Maike Frik, a female team manager, to support their female driver. “We share Sophia’s enthusiasm for technology and view her as an important role model for girls and women pursu-

ing their goals with talent, dedication and ambition,” says Matthias Zink, CEO Automotive Technologies at Schaeffler, about the 20-year-old who had a serious accident in the 2018 Grand Prix in Macau, raced there again in 2019, and was recognized for it with the prestigious Laureus Award in the “comeback of the year” category. Flörsch is the eleventh female race driver in DTM history – and Schaeffler’s second female brand ambassador. Carrie Schreiner (22), one of the most successful women in German motor racing, supported the development of Schaeffler Paravan’s Space Drive drive-by-wire technology last year with commitments in the “high-speed laboratory” of motorsport. “It’s conspicuous that more and more women are getting a foothold in racing. I think a lot is happening there at the moment,” says Sophia Flörsch. And Schaeffler helps shape this progress.

### 4 facts about women in STEM professions

Source: United Nations

## 30%

of all **research scientists** in the world are women, with 46 percent of them in Central Asia accounting for the largest proportion.

## 15%

of all **leadership positions** in science, engineering and technology worldwide are occupied by women.

## 27%

was the **proportion of women** in natural science and engineering professions in 2020.

## 3%

of the **students** in the fields of IT and data communications are women. In mathematics, it’s 5% and in engineering 8%.



### Pionierinnen@Schaeffler

The technology group’s Pionierinnen@Schaeffler mentoring program addresses female students, particularly those majoring in STEM subjects, to actively further their development. The QR code will take you directly to the program’s website.



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# Every step counts

Apple's founder Steve Jobs was regarded as one of the most agile technology masterminds of our time. His advice for boosting creativity: walking. For good reason because exercise and fresh air keep body and mind in good repair.

*By Andrea Neumeyer*

Trailblazing ideas al fresco: Apple's founder Steve Jobs would take regular walks across the campus in Cupertino together with his chief designer, Jony Ive. However, the legendary electronics entrepreneur did not use his walking meetings strictly for brainstorming purposes but would often surprise people that came to see him for the first time by inviting them to join him for a walk. That made it possible for Jobs to immediately tell how the other person adapted and responded to unusual challenges: an agility test at a walking pace. Facebook's founder Mark Zuckerberg is known for conducting job interviews while walking as well. Former U.S. President Barack Obama and Google's CEO Sundar Pichai love walk-and-talk meetings, too, even as threesomes, foursomes or fivesomes.

Business icon Richard Branson knows that "if you stand up, you'll find that decisions get made pretty quickly" and even likes to take things a step further with a walking meeting, adding that "another positive about meetings outside the boardroom is a lack of fancy tools, and instead an emphasis on real communication." In London, he'd take strolls around the canals of Little Venice, because "there must be something about water that gets my creativity flowing."

The personal experiences of top-level executives have long been underpinned by scientists recommending a quick freshness kick by fitting some exercise into a working day. Just a 20-minute walk or a brief run will stimulate mental agility for more than an hour because exercising supplies the brain with more blood and oxygen. Plus, brief exercise

## Recommended times for weekly exercise (adults)



breaks have psychological advantages by making us feel stronger and nimbler. This in turn enhances our self-confidence and mood, and therefore has positive effects on mental swiftness and concentration.

Sports in general are conducive to physical and mental fitness (see info elements above and right). The attractive part about walking or hiking is that they require no special gear, skills or a specific fitness level. Plus, it's easy to fit short walks, such as walking meetings à la Jobs, into our daily routines.

### Walking accelerates the brain's evolution

In evolution, it was the urge for spatial movement that initially triggered the formation of nervous systems and, building upon them, brains and their

## Zero Hour P.E.

This is what Dr. John J. Ratey, a U.S. psychiatrist, called a fitness project he introduced at several high schools in Naperville, Illinois, in the late 1990s. Before classes started in the morning, the students would work out in their personal high-performance range for one hour. As a result, the P.E. unit made the students not only fitter but also smarter. The rate of overweight students dropped from 30 to 3 percent. In an international knowledge test of eighth-graders, students from China, Japan and Singapore by far outperformed other U.S. participants – except for the girls and boys from Naperville, who took sixth place in math and even the world's top spot in natural sciences.

# »» *Walking is man's best medicine*

## Hippocrates

continuing development. Scientific tenor assumes that primordial humans made ever new cognitive leaps especially by switching to upright posture and gait. Bipedal gait made it possible for humans to see and experience the world from different perspectives. At the same time, they were able to use their hands, which were no longer needed for locomotion, for carrying children, weapons or food. Each of the newly acquired experiences promoted the development of the human brain further and further – and, consequently – technical progress as well.

That walking makes us smarter is a belief held even as far back as in Ancient Greece, by the Peripatetics (“given to walking about”), who’d generally philosophize while walking. But why is walking so physiologically and psychologically valuable? In a nutshell, it’s because it tasks our entire locomotor system – including our brain. Walking requires a coordinated interaction between muscles, breathing and equilibrium. Diverse muscle groups must be coordinated in a matter of milliseconds. Using imaging technologies such as MRT, scientists have been able to analyze brain activity and identified a high level of complexity during these automated dynamic processes.

Neuroscientists have found out that while walking (and during other forms of physical exercise) distant regions in the hippocampus between episodic thinking and spatial orientation are rewired. These cognitive processes keep the brain fit, promote agile and creative thinking and enhance memory.

Facebook inventor Mark Zuckerberg is a firm believer in the power of motion as well. “I’ve found running is a great way to clear my head, to get more energy, and to find time to think about challenges

I’m working through at Facebook and our philanthropy,” he wrote. “When I’m traveling, running is a great way to explore a new city and kick jet lag before a packed day of meetings.”

### **Walking instead of over-revving**

Efficient decision-making processes are a key element of agile thinking. This is another aspect in which our brain is trained while we walk or jog – most effectively when we move around on unknown paths that, ideally, are packed with obstacles. Such terrain continually forces us to make choices. Even more challenging are fast-moving ball, team or combat sports such as tennis, football or boxing, in which athletes have to permanently choose new moves and usually within fractions of a second. That’s agile thinking in the high rpm range.

By the way: In spite of the urge to move, body and soul shouldn’t constantly be active in the red zone. Men and women whose professional and concurrent sporting activities are constantly ruled by the maxim of “higher, faster, wider” run a risk of over-revving in an intoxicating cocktail of dopamine, serotonin, noradrenaline and endorphins the brain keeps refilling. This sensory overload erodes our ability to concentrate. When that happens, agile thoughts are swept off the tracks that lead to success like a train that’s traveling too fast. That’s why it’s better to throttle back and walk instead of running for a change.

During the German Management Run event, health expert Florian Glück commented, “This is about balance or the alignment of several disciplines: nutrition, relaxation – both mental and physical – and exercise, with the latter not necessarily having to be performance-driven. A training regimen aligned in this way considers the executive as a complex system – and helps him or her learn how wonderful relaxing units without pressure can feel, too.”

### **Enjoyable exercise is especially inspiring**

The lack of pressure during a relaxing hike is what makes this activity particularly valuable for our brain. This, at least, says Professor Gerd Kempermann. In experiments with mice conducted in 2007, the neurologist demonstrated that in the group of animals running voluntarily twice as many

newly formed nerve cells in the brain survived as in the group of those who had to be motivated to move. Kempermann concludes that an enjoyable hike by choice provides to the hiker what a forced long march deprives the soldier of. And there's another thing that his investigations and those of other neuroscientists suggest: that the specific rhythm of walking has a positive effect on the

brain's activities. The jurist, philosopher and humanist Michel de Montaigne, one of the great masterminds of his time, summarized all this as far back as in the 16th century: "My thoughts fall asleep when I sit. My mind does not move forward unless I set my legs in motion." So, go ahead and walk to spark your cognitive skills.

## 3 questions for ...

**Hanna Peter-Regar,**  
**Vice President, Schaeffler Academy**



**We've read a lot about the correlation between a healthy body and a sharp mind in this article. The latter, no doubt, is important for being set to tackle the challenges of technological change. This takes us to Schaeffler and the question of how the company promotes its employees' ability to think and act with agility.**

As a learning & development center the Schaeffler Academy pools all of its related activities across international borders. Included in its extensive offering, for instance, is the Fit4Mechatronics qualification program we developed in-house. The training sessions address colleagues in the purchasing, sales, engineering design, application engineering or software development functions irrespective of whether or not they have any prior knowledge in this field. In our training courses, they're able to expand their mechatronic and technical know-how as well as their personal skills.

### **How are the courses structured?**

Fit4Mechatronics was developed by experts from various functions and consists of some 100 training modules for diverse target groups. The modules covering trending subjects in the field of mechatronics create a dynamic training landscape from which the participants individually select suitable training modules according to their personal needs. In collaboration with subject-matter experts, we've already developed four learning paths: systems engineer, systems test manager, electromechanical engineer and technician in the system environment. Periods of practical work are scheduled between the training sessions.

### **What objectives does Schaeffler pursue with such learning and development activities?**

The jobs at Schaeffler are going to change significantly in many areas such as manufacturing and development. That's why in view of technological change, training, learning and development, and professional reorientation are central action fields on our transformation journey. Our training programs help employees expand their mechatronics and engineering know-how as well as their personal skills because employees with first-rate qualifications are a decisive success factor in global competition – today more than ever before. Our learning and development portfolio addresses all employees – from apprentices to senior executives. Our aim is to retain our skilled staff and offering our employees opportunities to develop and change jobs within the Schaeffler Group. That is particularly important to us in this context.

# Expert know-how

Customers have to master challenges on a daily basis and Schaeffler offers them customized solutions – here are six examples of agile activities performed by the automotive and industrial supplier around the world.

*By Alexander von Wegner*

## Optimally lubricated

### Customer

Dongfang Electric Corporation, a Chinese manufacturer of wind turbines

### Schaeffler's challenge

The 10-megawatt wind turbine operating in the wind farm at Fujian Jinghua Bay is one of the largest wind power systems for offshore applications. In spite of harsh conditions, a minimum availability of 25 years with minimized maintenance requirements had to be ensured for the wind turbines. To avoid downtimes, Schaeffler supplied an optimal lubrication solution and suitable bearings.



### Schaeffler's solution

Schaeffler emphasizes long grease service life. The Arcanol Load460 performance lubricant is designed for high loads, low start temperatures and wide temperature ranges. Its high water and corrosion resistance makes it particularly suitable for typical offshore environments with high humidity and salinity levels. The amount of required lubricant is crucial as well and Schaeffler's experience in applications for diverse settings pays off in delivering the right solution. A long lifecycle of the bearing is another aspect. For special designs of the main shaft bearing, a bolt cage is used.

### The customer's gain

- Optimal maintenance cycles and reduced grease consumption with a six-month relubrication interval
- Reduced system downtime probability and related costs of up to 1 million euros (replacement of the main shaft

bearing: 800,000 euros plus 200,000 euros due to loss of 2.2 million kWh of generated power)



Mounting the taper roller bearing inner ring



# Clean air

## Customer

An automobile manufacturer

## Schaeffler's challenge

At an automobile plant, 255,000 vehicles per year leave the factory halls in which a large number of people are employed, requiring appropriately sized ventilation systems. Failure of a fan system due to imbalances, bearing failure or incorrect lubrication results in costly production downtimes. The project specified the development of a holistic concept for fan systems including a reduction of CO<sub>2</sub> emissions and early detection of damage by intelligent condition monitoring.

## Schaeffler's solution

In collaboration with its certified distribution partner Altmann Industrietechnik, Schaeffler implemented a condition and lubrication monitoring solution, a 3D motor slide and conversion from V-belt to toothed belt drives. The ProLink



## Here and now

Schaeffler know-how on board: modernization of the venting systems at the plant of a renowned automobile manufacturer

CMS multi-channel condition monitoring system monitors all bearings, belts and the motor. Two automatic lubricators consistently supply the bearings with the right amount of grease. The patented 3D motor slide enabled the conversion from V-belt to toothed belt drives and ensures optimal running conditions. Simple loosening of the tensioning unit allows the belt to be replaced while the mutual alignment of the drive pulleys remains constant throughout.

## The customer's gain

- Longer bearing life and higher system availability
- Avoidance of unscheduled downtimes and failure costs of up to 145,000 euros
- Annual savings of 62 metric tons (68 short tons) of CO<sub>2</sub> and 22,591 euros for electric power and maintenance

# Rolling without fail

## Customer

A regional train operator in Asia

## Schaeffler's challenge

Schaeffler's Asian customer is a local public transportation and regional train operator. Low maintenance costs and high train availability are crucial. Downtimes and delays incur costs and result in financial penalties. In daily operations, the company's personnel inspect the gearboxes and wheels of all wheelsets including axle and gearbox bearings, which are overhauled or replaced as needed. The technical solution has to ensure reliable and precise checks while minimizing downtimes.

## Schaeffler's solution

Schaeffler developed an application-specific condition monitoring test rig for railroad car gearboxes and axlebox bearings. The required SmartCheck sensors are simply attached to the components to be monitored by means of magnets. These and other sensors measure vibration, temperature, speed and bearing end position. Via a SmartController, the data are transmitted directly to a touch-screen control panel, an external monitor, and alarm and data processing systems. The system is also suitable for checking correct installation following a bearing replacement.

## The customer's gain

- Reliable and highly precise condition monitoring
- Simple and full integration in the customer's infrastructure
- Ease of use
- Gearbox inspection without dismantling and oil change
- Bearing inspection without dismantling and seal replacement
- Avoidance of image loss and statutory financial penalties in the event of downtimes or delays



The condition monitoring test rig accommodates complete railroad car wheelsets

# Frost-proof

## Customer

C. u. A. Heiderich GmbH, a company in the conveyance technology sector

## Schaeffler's challenge

C. u. A. Heiderich GmbH had to manufacture and deliver heavy-duty rope sheaves for a shaft-sinking facility within less than six months and Schaeffler was contracted to develop cable sheave bearings within this tight time frame. Besides the time pressure and heavy loads of more than 91 metric tons (100 short tons) acting on the heavy-duty elevators the area of deployment posed a special challenge: in Belarus, the system has to reliably operate even at temperatures of minus 20 degrees centigrade (-4 °F). In such conditions, the required notched bar impact strength can only be achieved by a special material.

## Schaeffler's solution

Schaeffler opted for using FAG SNS plummer block housings and spherical roller bearings with a cylindrical shaft seat. The decisive criteria were the design envelope, load and operating conditions. The housings consist of a special version of the spheroidal graphite cast iron material with low-temperature suitability. The standard gray cast iron typically used might break at low temperatures. Schaeffler draws on experience with spheroidal graphite cast iron in North Canada, Europe and Russia. The engineers re-dimensioned the bearings for the heavy-duty elevator and filled them with a low-temperature grease that will not reach its limits even at minus 20 degrees centigrade (-4 °F).

## The customer's gain

- High operating reliability due to robust design
- On-time start-up due to good delivery performance
- Ensured bearing life due to use of spheroidal graphite cast iron



Waiting to be installed: rope sheaves with Schaeffler bearings



The inner bearing ring is heated on the shaft using an inductor, which facilitates removal

# Quick change

## Customer

Asia Cement Public Company Limited, one of Thailand's major cement manufacturers

## Schaeffler's challenge

It normally takes the customer about 30 days to overhaul a large raw mill gearbox (6 shafts, 5 gear sets, 2 or 3 large-size bearings per shaft). In addition, a large-size coupling has to be removed and reinstalled. Due to the complexity and size of the gearbox, the overhaul process is highly time-intensive. Schaeffler's mounting experts faced the challenge of reducing the time required for overhauling.

## Schaeffler's solution

Schaeffler's mounting experts analyzed the overhauling work especially with regard to the very large components that need to be heated for removal and installation. To achieve the objective of cost minimization, the high-efficiency Schaeffler Medium-Frequency-Technology heating device with flexible inductors was chosen. All bearings and other gearbox components were safely, precisely and rapidly removed and reinstalled for inspection by a gearbox specialist. This solution is suitable for all applications and industries using similar large-size bearings.

## The customer's gain

- Clearly reduced downtime and lower production loss (-50% each)
- 50-percent reduction of manpower costs (incl. gearbox specialist)
- Total cost savings: 315,190 euros
- Increased occupational safety due to elimination of work with open flames or oil baths

# Resisting extreme loads

## Customer

Nam Anh Technology Construction Equipment Co. Ltd., a technology company in Vietnam for infrastructure projects

## Schaeffler's challenge

Some 900 kilometers (560 mi) away from Vietnam's capital, Hanoi, a dam with a length of 947 meters (3,106 ft) is currently under construction. Following its completion in 2022, the level of the Trà Khúc River will be regulated by 19 radial gates, each of which is 37.8 meters (124 ft) long. The objective is to improve the environment around Quang Ngãi city and to create transportation waterways to the neighboring cities. In spite of the high water pressure and enormous lock weight unilaterally acting on the spherical plain bearings, the lock gates must still be able to slide at low speeds to reliably open and close the gates. Under these conditions, it's near-impossible to general a lubrication film in the load zone.

## Schaeffler's solution

Schaeffler supplied 76 maintenance-free spherical plain bearings, each weighing 28 kilograms (62 lbs), to Vietnam. Located in their outer rings is an ELGOGLIDE

fabric consisting of Teflon, supporting fibers, a resin matrix and anchoring on the steel support element. As a result, the design requires no lubrication and withstands high loads and temperature fluctuations. An additional seal protects the bearing from contaminants. The solution enables low-friction and torque-free transfer of the loads.

## The customer's gain

- Long life in spite of extreme bearing pressure of 150 N/mm<sup>2</sup> to which the spherical plain bearings are subjected
- High functional reliability and low maintenance costs
- Holistic engineering support by Schaeffler in all project stages



Thanks to ELGOGLIDE, the Schaeffler bearings withstand extremely high loads and require no maintenance

# Agile attraction

The mobile Drifting Coaster weighs 300 metric tons (331 short tons) and travels from one carnival to the next – unless corona stops the centrifugal fun in its tracks. Here's a pre-pandemic peek behind the scenes of a great logistical feat.

By Hans Pieper

Carnival operator Mike Ahrend is currently using the corona-induced break to spruce up his rides. Especially a recently added Ferris wheel requires attention. Actually, he can hardly wait for the green light being given for the tractor trailers to roll out of their halls, heading for the next venue where the rides will be set up. Just like in winter 2019 for the “Hamburg Winterdom” fair, their last deployment for the time being.

Flashback to those November days nearly a year and a half ago when Mike Ahrend is running nervously up and down in front of his Drifting Coaster. The members of the TÜV Nord safety team will be arriving in just a few minutes to carefully inspect his roller coaster. Meanwhile his son, Marlon, protected from the rising sun by a large hat, checks the track just behind the station one more time. After the rain in recent days, the weather will be good again right in time for the opening of the Hamburg Winterdom. Mike Ahrend looks at his watch. The fair will begin in six hours and the next few minutes will determine whether or not the cars of the Drifting Coaster with their swinging seats will be zipping up and down the blue tracks.

At the same time three days ago, Mike Ahrend, his son Marlon, and ten helpers started installing the thrill ride, initially by aligning the track section that’s permanently welded to a steel structure with the first part of the chain. This “start box” is the starting point for the installation of the attraction with a size of 43 by 22 meters (141 by 72 ft).

### Steel tube foundation on bumpy ground

Using a mobile crane operated by 19-year-old Marlon, the steel supports for the basic structure are subsequently staged for assembly. Several workers wearing hard hats immediately gather around the components and connect the beams with experienced moves. Colors and numbers on the parts ensure that everything will be joined correctly.

In this way, a grid is created within just a few hours that will safely support the roller coaster. This is no mean feat because the fairground is anything but even. Using a laser measuring device, the crew constantly checks if the beams are oriented in a truly straight line. Sturdy piles of wood underneath

the structure help compensate for irregularities in the ground, with some of the differences amounting to nearly one meter (3.3 ft).

### The track must be fit for coasting

Installing the roller coaster is a tough, strenuous job but the workers perform it without complaining even when the first raindrops fall. Meanwhile Mike and Marlon Ahrend are carefully watching the installation process, observing even the tiniest detail. “We must never forget that we’re hauling people here, so safety is of paramount importance,” explains Mike. In the background, the first support beam for the track is erected. In the late afternoon, the first track is hovering above the steel structure to the place where it’ll be securely bolted to it. The total of ten trucks carrying not only the tracks but also the cars, the ticket booth and the entire technology for the roller coaster are unloaded little by little over a period of three days. The Ahrends organize the entire transportation and logistics effort themselves and own all the vehicles. They all have to run as reliably as the roller



The boss, Mike Ahrend, supervises the installation and directs his ten workers



Ten trucks in total haul the roller coaster parts to the site: a huge jigsaw puzzle made of turns, cars and supports. Large boom cranes lift the components, some of which weigh several tons, into position. The whole installation takes three days

coaster they carry. Should any of the tractor trailers break down while hauling the hardware to the venue the whole system would grind to a halt (see interview on the next spread).

### Truck-compatible layout

“The key prerequisite for the layout of a transportable roller coaster is that the track sections fit in the trucks. No matter how attractive an inversion or turn may be, it won’t do me any good if I can load the truck with just one track,” Mike Ahrend explains on day two when more and more track sections are installed in their places. The value of being one of a kind is another key factor and the Drifting Coaster has it in more ways than one. While its layout takes strong cues from a classic Wild Mouse coaster, the cars have a significant special feature: they can swing outwardly in corners by as much as 120 degrees. In addition, the ride can be both forward and backward. That’s

why the Drifting Coaster is kind of a treat particularly for roller coaster enthusiasts, and even more so because it’s being set up at the Hamburg Dom fair for the first time. The roller coaster’s age is rather unusual, too, because the attraction manufactured by the French company Reverchon was built only in 2016. Most transportable roller coasters, primarily due to their costs, are clearly older. Compared to the equally thrilling smaller attractions that whirl their riders around and up into the air in gondolas, a mobile coaster is more complex, takes longer to set up, and requires more space and more trucks for hauling it.

However, the coaster’s scarcity value is helpful. “When you bid for a place at a carnival, your chances of closing a deal are much higher when you can offer something that’s unique and a crowd-puller,” says the boss prior to coordinating the insertion of the track on which the roller coaster cars sit into the structure. He’s been traveling with various

carnival attractions for 30 years and obviously takes pleasure in the Drifting Coaster, his latest acquisition.

On the morning of installation day three, the Drifting Coaster already looks like it's finished, although a number of details, such as the large LED wall that's later supposed to attract visitors, are still missing. The team takes a short break and father and son retreat into their motorhome to grab a bite to eat.

### On tour for ten months

From March to December that year, they're constantly on the road, traveling from fair to fair, while juggling carnival schedules and costs because not only the installation, operation and maintenance of the roller coaster are costly. Transportation accounts for a major share of the expenses incurred as well. That's why father and son try to head for venues in close proximity of each other although that's not so easy because local governments make their decisions at different times and at varying speed. At the end of the season, after the Hamburg Winterdom, not a single venue has been confirmed for the coming year.

Even so, the two enjoy their life on the road. "That's simply my dream job. I really like traveling, installing and operating the rides and all the places I get to see," says Marlon. Their home base is in Hanover. During the winter the family's three attractions are stored and thoroughly serviced on the 50,000-square meter (538,000-square feet) complex. For almost three months, there's almost a quiet period and it's also the only time of year where the family can take a vacation. However, quitting this business or settling down with an amusement park like some of their colleagues have is not an option for either Marlon or 49-year-old Mike because they're far too attached to their coaster and life on the road.

### The TÜV team has arrived

Just when the company's boss Mike has started a conversation with another ride operator four employees from TÜV Nord show up. The first thing they do is check the paperwork. Is everything okay with the approval? Have the prescribed maintenance jobs been performed? Afterwards,

## Roller coaster records

In the 17th century, Russians erect artificial hills on wooden structures. Affluent citizens in particular would slide down the ice-covered tracks, many of which were elaborately decorated. These structures are regarded as the **forebears of modern roller coasters**.

Leap the Dips from 1902 at Lakemont Park in Pennsylvania (USA) is the **oldest wooden roller coaster still operating today**.

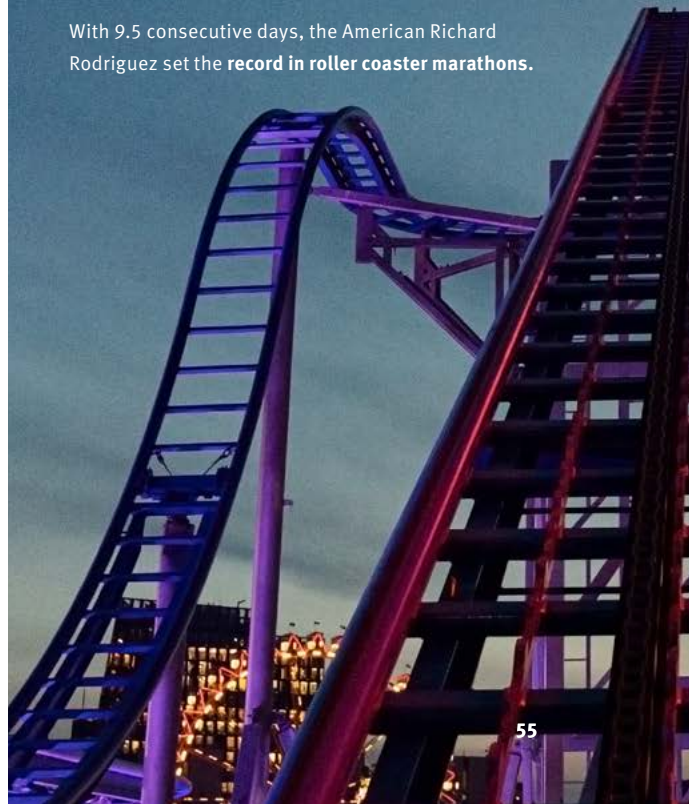
With a height of 139 meters (456 ft), Kingda Ka at Six Flags Great Adventure Park in the United States is the **world's tallest roller coaster** with a drop of 127 meters (418 ft).

The **steepest roller coaster in the world** is in the United States as well: the TMNT Shellraiser at Nickelodeon Universe Theme Park takes its riders downhill at a maximum vertical angle of 121.5 degrees.

The cars of the Formula Rossa roller coaster at the Ferrari World in Abu Dhabi reach a top speed of 240 km/h (149 mph) – setting a **world speed record!**

The **world's longest roller coaster** is in Japan: the Steel Dragon meanders through Nakashima Spa land on a distance of 2,479 meters (1.54 mi).

With 9.5 consecutive days, the American Richard Rodriguez set the **record in roller coaster marathons**.



the inspectors look at the structure, tracks, cars and, with special scrutiny, the brakes. All of this is in Mike Ahrend's interest as well. "If there's anything that's not okay, I'd like them to find it. Of course, we also perform very careful inspections ourselves, but you can't always catch everything. That's why I'm glad about someone else taking another careful look."

Meanwhile his son has joined him. Both appear to be tense. If the inspectors should find a major defect that would mean not only that they'd missed something essential but that the Dom fair would be opened without them. Aside from the financial loss they'd suffer a tarnished image because when a coaster can't be opened word gets around among the event organizers, too. But Mike Ahrend doesn't have any real safety concerns. "Unlike amusement parks, we take the whole coaster apart once a week or every three weeks and look at all the components. Nobody does that there. And if you look at the number of incidents at carnivals in relation to the number of visitors compared to those at amusement parks, the carnivals have a clearly better track record."

After one hour, the TÜV team has finished its visual inspection of the cars and track. No safety-relevant defects were found. Only some minor things need to be improved such as replacing a metal washer on a retainer. Marlon Ahrend starts the

roller coaster for the first time on that day. Four cars move out on the track, one after the other. "We'd still like to take a look at the block brakes," says one of the TÜV inspectors. Mike Ahrend stops one of the cars just in front of the station. The system immediately detects the occupied section and sequentially closes the brakes on the track. Like pearls on a string, all cars stop just like they should. The TÜV team is satisfied. The Ahrends are visibly relieved. The first guests will arrive in four hours.

### Waiting for the next event

Three weeks later, the roller coaster is dismantled piece by piece and loaded onto the truck, followed by a long, unexpected and involuntary break. Corona lockdown.

Mothballed, the roller coaster rests in the large storage hall in Springe near Hanover waiting for its next deployment, which the Ahrends can hardly await. "We have to stick it out and, of course, want to continue," says Mike Ahrend a year later. With the first relaxations of the restrictions in sight, the carnival operators are champing at the bit. They're dying to return to the hauling, installation and dismantling activities of their rides and even to feeling the nervous tension just before a carnival opens.



### The Drifting Coaster: Facts & figures

- Manufacturer** Reverchon
- Operator** FTE Ahrend (Hanover)
- Year of manufacture** 2016
- Weight** approx. 300 metric tons (331 short tons)
- Area** 43 by 22 meters (141 by 72 ft)
- Height** 16 meters (52 ft)
- Track length** approx. 480 meters (1,575 ft)
- Top speed** approx. 50 km/h (31 mph)
- Maximum capacity** 5 cars with 20 seats



## 3 questions for ...

**Quirin Großmann, Vice President  
Strategic Business Unit Heavy Duty**



**From roller coasters to fresh milk – commercial vehicles are a crucial connecting link in running supply chains. At Schaeffler, the commercial vehicles sector is constantly gaining importance, too. What are the reasons?**

At the moment, the market is massively changing, which opens up new potential for us as a supplier. This is primarily due to increasingly stricter emission standards, worldwide. The EU wants to achieve a 30-percent reduction of the sector's CO<sub>2</sub> emissions by 2030. The United States, particularly California, are progressively tightening their standards in the coming years as well. In China and India, the emissions issue is subject to increasingly critical evaluation, too. We intend to decisively support the achievement of ambitious targets with innovative products. In this context, we draw on successful Schaeffler developments especially for passenger cars and adapt them to the commercial vehicles sector.

**What areas does Schaeffler focus on in particular?**

Like in the passenger car segment, we're pursuing a multi-pronged approach. For one, we aim to reduce harmful emissions of classic IC engines by optimizing the combustion process, for instance through variable valve timing systems. Electrification using 48-volt hybrid systems is another measure. In the area of fully electric mobility, we focus on both battery-electric solutions and the great potential of fuel cell technology. Irrespective of the type of propulsion system, we're able

to reduce CO<sub>2</sub> and/or increase range through further optimizations within the powertrain. Aside from the emissions issue, autonomous driving is an attractive field for Schaeffler. Here, we offer a key technology in the form of our Space Drive drive-by-wire system.

**What is of particular importance to commercial vehicle customers?**

Compliance with increasingly stricter emission limits is the manufacturers' top priority. With its systems and products, Schaeffler supports them in reducing emissions, complying with limits and avoiding potential financial penalties. The high quality of our products and the related reliability is another factor where we can score with both OEMs and end users. In the long run, a long-lasting component reduces not only the total cost of ownership but also protects against unexpected downtimes. The latter are not just annoying, but cost the manufacturers and users of vehicles money and reputation. From a long-term perspective, digitalization and automated driving will become more and more important for optimizing customers' business processes and increasing safety.



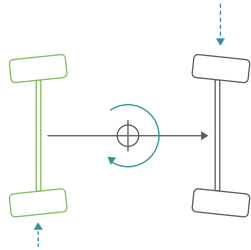
Schaeffler has aligned e-motors and power electronics with the requirements of commercial vehicles. Scalable in speed and torque, high-voltage solutions can be optimized for central drives or e-axles. 48-V e-motors use concentrated winding for compact design, compatible with standard powertrains

# Smartly steered

Higher maneuverability, more agile handling – a detailed look at Schaeffler's new Rear Wheel Steering.

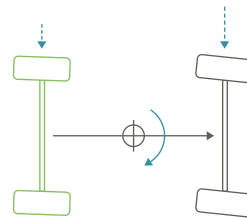
## Benefit: Agility

The space available to automobiles in the world's steadily growing big cities is becoming increasingly scarce. That's why cars have to become more agile. The mechatronic Rear Wheel Steering system assists in enhancing agility. By **turning the rear wheels in the opposite direction** to the front wheels at low speed, it **reduces the turning radius** and **helps drivers pull into parking spaces**.



## Benefit: Driving Stability

At higher speeds (from approx. 60 km/h / 37.3 mi), the mechatronic Rear Wheel Steering system turns the rear wheels in the same direction as the front wheels. The **equidirectional steering** assist enhances **stability, handling** and ride resulting in higher **safety**. Moreover, sporty drivers get to enjoy a higher level of **driving dynamics**.



At the heart of the system is a planetary roller gear with high efficiency, reduced friction and fast response.

Schaeffler's Rear Wheel Steering features a low maximum system weight of eight kilograms (17.7 lbs), enabled by the use of lightweight technologies.

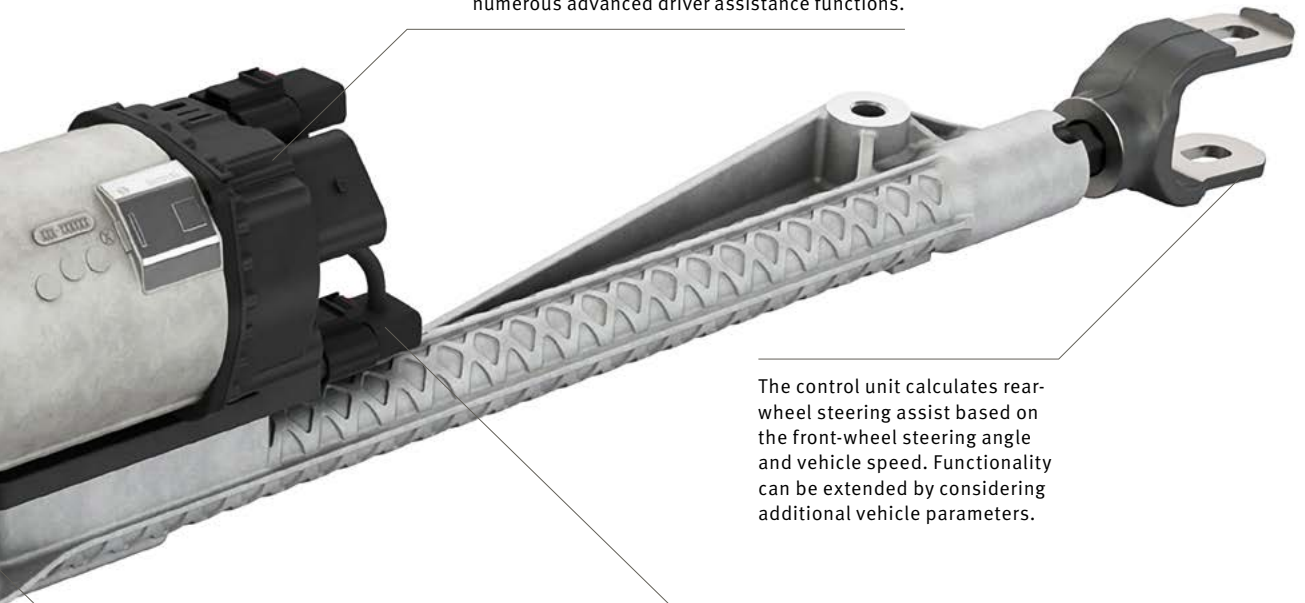
The acoustically optimized design is beneficial especially for use in low-noise electric vehicles.

High active actuating force of up to 15 kN.

»» *Intelligent Rear Wheel Steering technology is a key milestone in our journey to becoming the technology partner of choice for mechatronic chassis systems*

Matthias Zink,  
CEO Automotive Technologies at Schaeffler

Schaeffler's cooperation partner, Bosch, contributes the steering control unit to the system, which combines the control unit and electric motor in one component. Bosch supplies the software for the operating system and Schaeffler the application software. The scalable and modular design of the steering control unit enables interlinking with numerous advanced driver assistance functions.



So-called “self-locking” ensures that the rear-wheel steering system’s behavior is predictable at all times, irrespective of the operating mode.

The control unit calculates rear-wheel steering assist based on the front-wheel steering angle and vehicle speed. Functionality can be extended by considering additional vehicle parameters.

Thanks to an innovative security concept, the mechatronic Rear Wheel Steering system is protected against cyberattacks. Over-the-air (OTA) technology supports functions and updates.



# Garages gearing up for change

Unplanned vehicle downtimes are costly and time-consuming – or outright nerve-racking. Around the world, the experts from Schaeffler Automotive Aftermarket assist customers with tailored repair solutions and services that, in spite of growing complexity, are provided at an increasingly faster pace using digital technologies.

*By Alexander von Wegner*

Rally legend Walter Röhrl has a way with words reflecting equal virtuosity as his way with the throttle and the steering wheel. According to one of his famous quotes, “You can’t treat a car like a human being. A car needs love!” Besides tender loving care this entails the need for a spare part here and there and when the clutch, chassis, engine or transmission are acting up, the experts from Schaeffler Automotive Aftermarket come into play.

In reality, the seemingly straightforward task of procuring replacements involves a whole host of challenges increasingly calling for agile action. It starts with the rapid technological development and change in the automotive industry requiring considerable flexibility and adjustment. Within less than the coming decade, the majority of new cars may have been converted to electric mobility.

## **Good training means better repairs**

To stay up to speed, Schaeffler Automotive Aftermarket concentrates all garage-related services

under the REPERT brand and assists garage operators with training programs, repair information and the necessary specialty tools. “Repairs on automobiles are becoming more and more complex and require knowledge of all the vehicle systems,” says Sven Olev Müller, Director REPERT at Schaeffler Automotive Aftermarket.

While brand-bound garages receive their requisite know-how through OEM training programs, independent outfits have to pursue their own paths to keep the knowledge of their personnel at competitive levels.

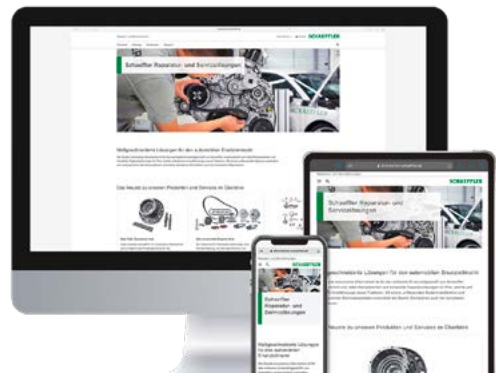
Therefore, Schaeffler Automotive Aftermarket has initiated new support concepts together with industry partners. Schaeffler actively assists garages with on-site training programs that have been substituted by online sessions since the pandemic started. “In more than 250 of such sessions, we reached more than 13,000 participants in 2020 alone and just in Europe,” emphasizes Sven Olev Müller. In addition to events with open attendance, there are workshops focused on subjects for a limited group of pre-registered participants

to ensure maximum interactivity and quality for everyone.

## Intelligently combined repair solutions

As well as on training programs and know-how, Schaeffler Automotive Aftermarket's customers have to be able to rely on spare parts supply and supporting services ranging from diagnostics to ordering. That's why, in addition to product information of the LuK, INA and FAG brands, the REXPERT support portfolio encompasses full parts catalogs, diagnostics, repair and service guidelines, installation videos and a bonus program, all of which are available from the same-named online portal or the mobile app.

Beyond the spare parts required for replacements, Schaeffler offers intelligently combined repair solutions and numerous supporting services as illustrated by this example: All spare part kits are put together as needed. As complete solutions, they contain not only the required key component such as a clutch plate but all the necessary accessories like screws, seals and sleeves



The web, the cloud, the app – Schaeffler Automotive Aftermarket is continuously expanding its digital offering

as well. All components are optimally coordinated with each other as a prerequisite for fast, professional and perfect parts replacements.

Schaeffler Automotive Aftermarket offers its services not only in the core business of passenger cars but also in the commercial vehicles sector and for farming equipment. Especially the light trucks segment represents a considerable growth market due to the booming local distribution business of delivery and parcel services.

## Ask the cloud

Advanced cloud solutions are a central element supporting agility and performance in a rapidly changing environment. Since February 2019, this software platform has been subjected to continuous further development at Schaeffler. "The aftermarket cloud is our foundation for merging our previously separate online activities and delivering integrated digital services to our customers," says Hamid Derakhshanmanesh, Head of Digital Program.

The Aftermarket cloud is the central tool for future digital interaction with dealerships and garages. In addition to the REXPERT online garage portal, this particularly pertains to the website that was relaunched in 2020, now integrating daily updates of all catalog data. The catalog data of the nearly 40,000 articles are taken from Schaeffler's in-house Product and Service Platform (PSP) and serve as the primary data source for the online catalog.

# 3

main drivers impact the spare parts business: a **globally growing number of vehicles** especially in the vehicle age group between 7 and 12 years that's lucrative for the aftermarket, **the generally increasing average age** of existing vehicles, plus **the growing complexity of vehicles**. These factors lead to a rise in repairs requiring noticeably more advanced repair solutions for garages. Schaeffler Automotive Aftermarket anticipates the largest increase in vehicles and related repair demand by 2025 in the Greater China region that's marked by a growing and aging vehicle fleet.

Users can systematically find the right spare part and are concurrently provided with all the important pertinent details. Retailers will be able to use several personalized services on the future online customer portal of the website. In addition, garages will benefit from simplified participation in the bonus program on the newly launched REXPERT garage portal because the Schaeffler QR code will enable digital capturing of bonus points. “With the Schaeffler QR code, we’ll have an individual code on each single packaging unit, which will make the path from the spare part to a customer-specific digital offer a walk in the park,” says Hamid Derakhshanmanesh. Using this holistic approach, Schaeffler has put itself into a perfect position today for meeting its customers’ requirements of tomorrow.

**Further information and access to 8,500 technical documents: [rexpert.de](http://rexpert.de)**

## CARUSO

Together with industry partners, Schaeffler Automotive Aftermarket is engaged in driving digital vehicle connectivity and non-discriminatory data access and is actively involved in the CARUSO digital data marketplace. As a central platform for the independent spare parts market, CARUSO provides harmonized vehicle data, thereby connecting data suppliers and users.

Schaeffler Automotive Aftermarket offers its services not only for passenger cars, but also for commercial vehicles and farming equipment.



# Outlook

Technology for tomorrow



## Airport to go

Ever since Berlin's failure-ridden BER airport's story, not only Germans have known that new airport construction projects can devour nearly 15 years of work from the ground-breaking ceremony to completion and incur costs in the billions beyond the original budget. That's not exactly a perfect example of agile project management. The airports of the future for air taxis and delivery drones might be a different story. They're supposed to be flexible and mobile, and look similar to those in this visualization: sci-fi-like landing pads, aka hubs, that can be installed and moved within a few days to places where they're more urgently needed such as crisis zones, large-scale public events, heavily congested cities, and so on. For Schaeffler, the drone market has high potential. Besides supplying bearings and electric motors for the VTOL (vertical take-off and

landing) systems, the people at the global technology group can imagine delivering entire propulsion units for them. By the end of 2021, Urban Air Port, a British start-up, and Hyundai are planning to open the world's first pop-up airport for delivery and passenger drones in Coventry, UK. After a drone has touched down on an elevated platform (with a diameter of just 14 meters / 46 ft), it's dropped into a hangar, where the batteries are recharged with solar energy and the flying taxis can take up passengers. The project's initiators refer to it as a zero-emissions airport. Critics of the idea say that it's too complex and costly, and that plain markings, normal charging columns and a simple hangar would cost a lot less while delivering greater value. Other forward-thinking concepts for agile cities can be found starting on page 66.





» *Feet, what do I need  
you for when I have  
wings to fly?*

Frida Kahlo,  
Mexican painter 1907–1954

**Forecast number of  
passenger drones to  
be deployed worldwide**

Source: Roland Berger

<b>5,000</b>	<b>45,000</b>	<b>160,000</b>
2030	2040	2050

# “Incentives are better than bans”

In the wake of the unbridled growth of cities, we’re going to see an evolution of urban mobility and logistics. Transportation in the city will have to reinvent itself – and is in the process of doing so. Harry Evers is the managing director of the 2021 ITS World Congress in Hamburg, the leading international industry event for smart transportation systems. Hop on for a tour of exploring the mobile future.

*Interview: Björn Carstens and Volker Paulun*

## **Why do metropolitan regions have to reimagine mobility?**

*In the wake of the unbridled urbanization of our planet, the world is “becoming a city.” Up to 100 million people might be living in the metropolitan region of Lagos, Nigeria, by 2100, according to some forecasts. And urban residents want to remain mobile. New ideas have to be put into action to meet this need in increasingly cramped conditions. That’s the only option. Urban transportation has to contribute its fair share also to the “green deal,” in other words to becoming carbon-neutral, plus reducing noise and other stress factors, which requires new thinking in terms of mobility besides other aspects. Stakeholders are obviously willing to engage in this process, as shown, for instance, by the existence of events like our ITS World Congress in Hamburg at which policymakers and other players representing society, business and science will get together to discuss specifically these topics and challenges, experience practical examples, and develop ideas for Smart Mobility and digitalization of transportation.*

**Does the fact that every city has a unique character and challenges mean that unique mobility concepts are needed, or do universal solutions exist?**

*There are solutions that, based on developments, experiences, technologies, business models and political strategies and regulations, can be applied to and used by various cities and regions. They probably account for 60 to 80 percent of all existing concepts that can be derived from tests and real-world laboratories.*

## **What factors have to be considered in concept modifications?**

*First of all, the existing infrastructure and the financial situation. The technological development level of the region, along with urban planning, social and cultural requirements, plays a role as well. The need to carefully gauge the wishes and needs of the local population is another very important factor. You’ll never be able to hit the bull’s eye at once in all of these respects – arriving at an optimal solution always requires some readjustment and further development.*

**Sharing systems for cars, bikes, electric and conventional scooters, plus ride sharing services and carless zones – in Hamburg, for instance, various Smart Mobility and digitalized transportation projects are currently being field-tested. What findings have been obtained with them?**

*These projects have generally produced very good findings, although practically any experience in a*

*pilot testing program is positive – even if it should actually be rated negatively, because analyzing concepts and ideas just theoretically does not achieve the set objectives. What matters is their practical application on the road in an exchange with users – and by that I explicitly mean not only technical aspects and operational implementation. Exploring people’s acceptance of the applications and involving them in the process is at least equally important. Our experience has shown that it always takes a while for users to adopt new offerings – which may be shorter or longer, depending on the age group.*

**Many new mobility concepts have a question mark about their economic viability attached to them. Where’s the money for transportation transformation supposed to come from if normal revenues don’t cover the costs?**

*When it comes to infrastructure and urban development the required budgets will largely have to be appropriated by policymakers. The acquisition*

### Urban travel using diverse means of transportation

Bus or train, scooter or (shared) car? But why “or?” It’s the “fluid” switching between diverse means of transportation as shown in this Audi vision that makes a new form of mobility so attractive. A close-meshed network of hubs at train stations or in residential areas is an important prerequisite. Even more important is a cross-provider app enabling users to plan, book and pay for their trips across all means of transportation.



## Autonomous urban travel

More than 300 different forward-thinking shuttle concepts are currently being tested around the globe. HEAT in Hamburg is one of them. The self-driving vehicle with a length of five meters is supposed to be hauling up to ten passengers through ten selected neighborhoods fully autonomously in the near future – maneuvered by on-board sensors and Car2X communication. Drive-by-wire systems like Space Drive from Schaeffler Paravan are technical prerequisites.



## Underground urban travel

Modern subway lines frequently incur “astronomical” costs of some 300 million euros per kilometer. Not all cities can afford such investments. That’s why in all of Africa only Cairo in Egypt and Algiers in Algeria have an underground metro network. The Asian island republic of Indonesia, with 264 million inhabitants ranking in fourth place of the world’s most populous nations, received its first subway only in mid-2019, a 16-kilometer section in the capital city, Jakarta, with construction costs amounting to 2.6 billion dollars. In other cities such as Rome the subsoil prevents a close-meshed metro network.



*and provision of comprehensive data – which, by the way, I feel is a crucial factor of mobility transformation – has to be another predominantly official undertaking so that project developers and providers of mobility services will have unrestricted access to the data. However, the technical and operational implementation of new mobility services should be left up to the private sector. Whenever private-sector initiatives prove to be conducive to achieving stated objectives but cannot immediately be implemented in cost-effective ways, the public sector has to investigate if political, structural or financial support is necessary. Ultimately, citizens always foot the bill – either through taxes or through ticket and purchasing prices. I think that’s only fair because in the end all of us are responsible for meeting the climate goals as a task for society as a whole.*

***In spite of available alternatives, many urbanites aren’t switching from cars to other forms of transportation. Will regulatory actions such as speed limits, reduction of and price increases for parking spaces or city toll fees be necessary to transform transportation? Or should a further improvement of alternatives be pursued?***

*All of the aspects you mentioned are parts of a big “tool kit” that can – and actually has to – be used if we want to reduce CO<sub>2</sub> emissions. But generally speaking, it’s always better to establish a change in mobility behavior by means of incentives rather than bans. Even at this juncture, we can tell that more and more citizens view carbon-neutral mobility as a strong incentive. Going forward, this mindset will be reflected in people’s choices of transportation and related travel behavior. Citizens will soon realize that sacrificing the use of their own cars is not tantamount to sacrificing good and convenient mobility – and may even be an improvement especially in urban areas, both in terms of convenience and costs – and for the environment anyway.*

***That said, will the automobile be phased out?***

*To avoid this risk, the automobile as an element of mobility has to keep reinventing itself and seek and find its place in a city’s mobility mix. The automobile is always in competition with other mobility systems and the industry will have to embrace this challenge in the future even more so than in the past. Let’s face it, this challenge includes the reassignment of public space in the interest of quality of life and amenity value in cities and neighborhoods,*

## »» *The automobile as an element of mobility has to keep reinventing itself and seek and find its place in a city's mobility mix*

Mobility expert Harry Evers

*which reduces the space available to cars. However, we shouldn't ignore the fact that in many parts of the world the automobile, for instance in sprawling cities in North America, is still a backbone of mobility due to a lack of public transportation alternatives. This is where the automotive industry can make a key contribution to achieving climate goals with zero-emissions powertrain technologies.*

***In the context of transforming transportation toward a carless society and in addition to an extensive mobility offering, how important is a cross-provider app enabling users to plan, book and pay for a trip from the point of departure to the desired destination with a single click?***

*That has to be the goal. In Hamburg, like in other cities, such an app connecting conventional local public transportation with new "mobility as a service" offerings combined with short bus and train service intervals is the core element of a forward-thinking transportation strategy. Switzerland is already doing this on an interurban level in an exemplary way with a ticket system for all transportation operators. Failure to achieve this in Germany would have detrimental consequences. Unfortunately, firmly established structures that we definitely have to crack are obstructing rapid progress of this development.*

***Biking and walking are the cheapest and most eco-friendly forms of getting from A to B. The shorter the distances, the more attractive are both. That's why planners favor the urban development concept of the segmented city in which residents have access to anything they need in everyday life within 15 minutes. Is that a model that should catch on?***

*Yes ... but it will take time because urban development is a marathon. However, I'm sure that in the future we're going to see more neighborhoods again where people can take care of all the things that they need in daily life locally. The corona pandemic and the resulting mobility restrictions plus the experience of working from home have noticeably intensified this trend.*

### **The ITS World Congress visits Hamburg**

From October 11 to 15, 2021, urban mobility will be showcased in Hamburg. The Hanseatic city and the Federal Ministry of Transport will co-host the event that ranks among the leading international platforms in the field of intelligent transportation systems and services (ITS). Since 1994, experts from transportation, logistics and IT have been meeting at the annual ITS World Congress in different major cities to engage in an exchange of ideas and to test examples from the field. Previous hosting cities have included Seoul, Sydney, London, Beijing, New York and Tokyo.

[itsworldcongress.com](https://itsworldcongress.com)

**Many big cities are grappling with major topographical challenges such as hills and rivers, while in others the subsoil does not permit construction of subway systems. Are cable cars or similar concepts a key to the solution?**

*In hilly cities like La Paz, Bogotá and Mexico City, cable cars have proven to be efficient alternatives that can be established in cost-effective ways. Ferries, especially those that operate autonomously and with zero emissions, can be a good complement to an urban mobility mix as well.*

**What about drones? Flying taxis in particular seem to be rather unpopular. For good reason?**

*You know, I basically evaluate and approach new topics and technologies with an open mind. Immediately rejecting ideas without investigating if they merit a chance to prove themselves is counter-productive. “Urban Air Mobility – UAM” not only refers to flying taxis that have a clearly defined application and significance in the context of a general transformation of mobility. Uncrewed drones that will be able to render valuable, socially-relevant services in countless applications will be a lot more important. Take, for instance, the transportation of tissue samples or other medical cargo between hospitals currently being tested or the delivery of pharmaceuticals in regions with less developed infrastructure like Africa enabling vital supply services. Other potential uses include traffic monitoring and control*

*functions or early warning systems of forest fires. Such applications with social relevance will ensure that drones will be meeting with generally high acceptance by the population.*

**What hurdles will driverless vehicles such as Hamburg’s HEAT shuttle project have to overcome before they can be used across the board?**

*First of all, aside from their technical development, legal approval is an important hurdle. In 2016, an amendment to the Vienna Convention on Road Traffic paved the way for this technology on a global scale. However, many countries are still lacking an extensive and effective regulatory framework. Germany has now declared itself a pioneer and plans to become the first nation in the world to migrate vehicles from research into the real world. According to the Federal Ministry of Transport, 2022 is targeted for bringing vehicles with autonomous driving functions into regular service. With HEAT, Hamburg is currently gathering valuable experience supporting this aim. Among other things, more than 30 traffic lights have been equipped for Car2X communication in the public traffic space and tested on a proving ground in various projects. In autonomous and connected driving, on-board sensors and lidar and radar systems additionally assist the vehicles, which also communicate with their surroundings. The new 5G mobile communications standard will be used there as well and*



## Urban cargo hauling

Businesses and people in future mega cities have to be supplied with goods – therefore, urban logistics has to pursue new pathways just like passenger transportation does. In port cities like Hamburg, systems such as the hyperloop or maglev trains can rid the roads of container traffic – even in interurban hauling. For pallet-size shipping, experts are investigating the use of XXL-size underground pneumatic tube systems.



### Airborne urban travel

So-called Urban Air Mobility (UAM) is going to conquer the airspace in metropolitan areas. Electric drones are going to haul both cargo and people from A to B, fast and without traffic jams. A mix with other means of transportation, as shown here with the Schaeffler Mover, is conceivable as well.

*container transportation and an underground XXL-sized pneumatic tube system for rapid transportation of palletized goods are just some examples of the demonstrations.*

***A final question: will an agile transportation policy have to drive mobility of tomorrow or will forward-thinking concepts and ideas automatically gain traction?***

*It always takes both: continuity and a policy framework, plus an exciting story of a concept that makes sense to people and is desirable. Transformation, no doubt, will only be achievable with the full backing of the whole population.*

*enable further applications. There's still a way to go in many technical and regulatory areas and I really hope that, considering the consistency with which we've been testing and validating future mobility solutions so far, we'll be successful in that area, because this much is clear: autonomous vehicles are going to make a significant contribution to road safety. In 2019, 91.4 percent of all accidents involving personal injury in Germany were attributable to human error.*

***The massive increase in delivery traffic is posing a growing challenge to urban mobility. What ideas exist in that area?***

*Urban logistics faces similar challenges as passenger transportation and is addressed by corresponding approaches: zero-emissions powertrains, autonomous driving, efficient and reliable mobility. Both areas will therefore be mutually supportive in their evolution. A number of exciting relevant projects will be presented at the ITS Congress. As a port city with a large proportion of delivery traffic, Hamburg is an ideal test bed for innovative solutions in real-world service. At the ITS Congress, we'll also be able to showcase special reference projects and ideas: a hyperloop system for hauling cargo, an autonomous magnetic levitation train for*

### The interviewee



**Harry Evers** is a degreed engineer and as a freelance consultant has been focused on innovative technologies and applications relating to mobility for more than 30 years. Since 2018, as the managing director of ITS Hamburg 2021 GmbH, a subsidiary of the city of Hamburg, he has been responsible for preparing and organizing the World Congress.

# Sky busters

Space exploration has been a technological trailblazer from the outset. Now it's receiving an extra boost by powerful private-sector competitors and innovative start-ups.





By Lars Krone

Flying to the stars has always fascinated humans. Even as far back as in the second century AD, Lucian of Samosata, the most renowned Syrian satirist in Antiquity, in a “True Story 1” wrote about a trip to the Moon. Jules Verne’s novels “From the Earth to the Moon” (1865) and “Around the Moon” (1870) were worldwide bestsellers. The stories that were seen as purely utopian at the time would become a reality due to rapid technological progress less than 100 years later.

But rather than romantic notions of space and adventurism the contest between the United States and the Soviet Union was the dominant driver. The “space race” between the two Cold War superpowers was mainly about prestige and clout, culminating in the American Apollo missions that actually took humans to the Moon in the years between 1969 and 1972. The effort and costs invested in these projects were so huge that only nations could shoulder them. As many as 400,000 people, for instance, were involved in the Apollo program the costs of which amounted to far more than 100 billion U.S. dollars.

### The private sector is conquering space

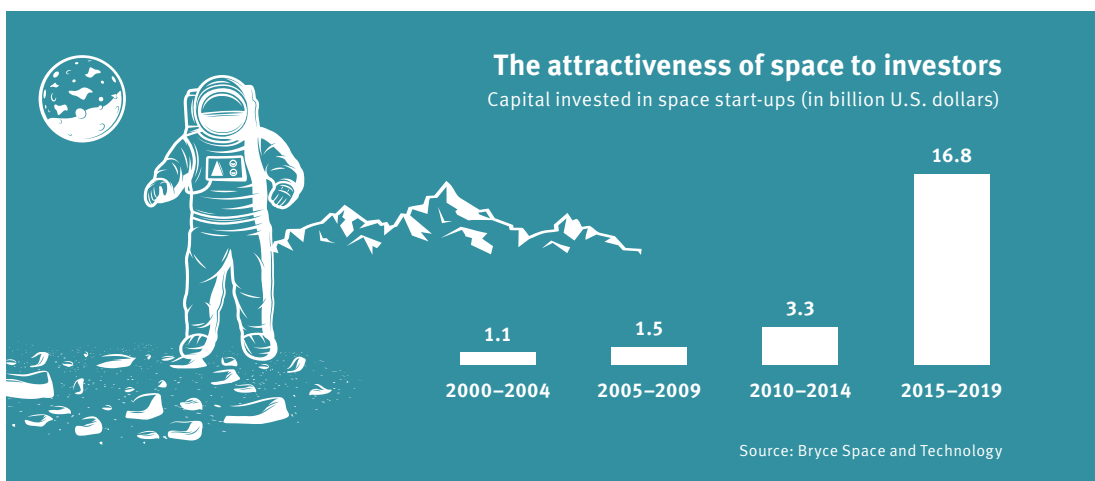
However, when the Cold War ended, if not earlier, space exploration changed course. The importance of costly, crewed projects was decreasing while the demand for launch and satellite systems was steadily increasing. NASA and company have

long ceased to be able to cover this demand and private-sector companies have established themselves on the market. Even as far back as in 1997, the launch sites in Florida saw more commercial than government-contracted rocket launches for the first time.

The number of satellites illustrates the magnitude of the demand for launch systems. Whereas in 2018 around 1,900 satellites were orbiting the Earth, at the end of 2020 there were 3,372 – an increase by 77 percent. A look at the sales figures illustrates the economic importance of the space sector as well: in 2019, the space industry generated 366 billion U.S. dollars in sales revenue, according to statistics of the German Economic Institute (IW), and the Morgan Stanley investment bank estimates it to increase to more than one trillion U.S. dollars by 2040.

### From an IT driver to a beneficiary

The strides made in information and communications technology (ICT) are the key factor accounting for the rapid rise of private-sector space activities. “Fifty years ago, it was space that paved the way for the ICT industry. It is now the ICT industry which is setting the pace in the space industry. The dynamism of the ICT sector is far higher than in the traditional space industry, driven by a short generation cycle of 2 to 3 years, highly competitive and innovative pressure in mass markets, and the increasingly broader digitalization of the global economy and the private world,” says a study



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**Years** after its so far last recruiting campaign, the European Space Agency (ESA) is looking for astronauts again, hoping that the proportion of female applicants will be clearly above the previous rate of just 16 percent. For the first time, the search also explicitly includes applicants with physical impairments. Applications can still be submitted until May 28.

commissioned by the German Federal Ministry for Economic Affairs and Energy (BMWi). In the digital age, space exploration is the key to forward-thinking technologies such as autonomous driving, communications, Industry 4.0 and Big Data applications. For the power of judgment and the capacity to act in the context of foreign and defense policy and for climate protection, it's indispensable.

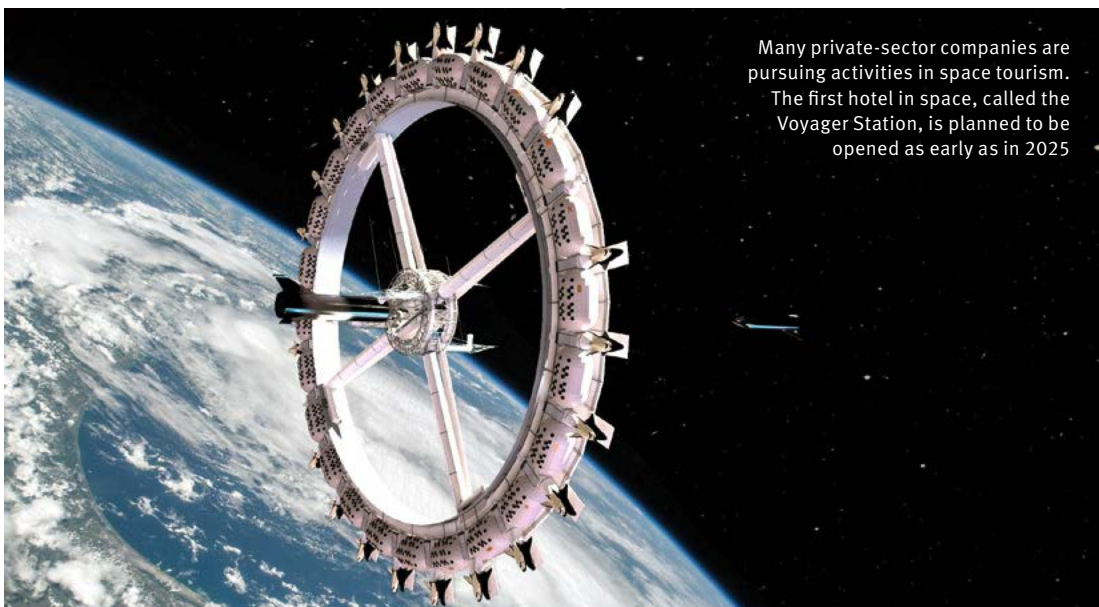
By now, private-sector companies have become fixtures in space exploration and revolutionized it to some extent. Their advantages include greater agility and innovation than the former, sluggish government space agencies. "Many founders of the American NewSpace companies come from the

IT industry and use the experience and financial means generated from their previous start-ups. Their business philosophy is characterized by the focus on developing products and services in line with demand, challenging the status quo, promoting innovative ideas out of the box, strictly adhering to costs," the BMWi study continues.

SpaceX is regarded as a flagship company. Founded in 2002 by Elon Musk, the Americans are pursuing ambitious goals such as the Starlink project with which the billionaire and electric car pioneer is planning to establish satellite-based world-spanning broadband internet access. By the middle of March 2021, SpaceX has launched as many as 21 rockets with nearly 1,600 satellites into orbit. The pace at which the company has been proceeding is impressive, with the network being enlarged by 120 satellites per month. Plans are for placing into low Earth orbit a total of 12,000 satellites with laser links between them for inter-satellite communication of data received from ground stations within the next few years.

## Rockets from 3D printers

With its Falcon and Falcon Heavy models, SpaceX has become the world leader in terms of rocket launches by now, having displaced the previously established Arianespace consortium. The



Many private-sector companies are pursuing activities in space tourism. The first hotel in space, called the Voyager Station, is planned to be opened as early as in 2025

benefit of the Falcons is that their components – including 3D-printed ones – are mass-produced and reusable, which clearly cuts costs. Now, even national space agencies are relying on the rockets. Since 2012, SpaceX spacecraft have been delivering cargo to the International Space Station (ISS) and in May 2020, a SpaceX Crew Dragon spacecraft docked to the ISS with astronauts on board for the first time. However, reaching for the stars continues to be Elon Musk’s big aim: SpaceX is in the process of developing reusable rockets and spacecraft intended to enable crewed flights to the Moon and later to Mars. Musk’s dream is to conduct not only scientific research and exploration for raw materials but to permanently colonize the Red Planet.

Other billionaires besides Musk who are willing to take risks have developed a fascination for space. However, Amazon founder Jeff Bezos’s Blue Origin and Richard Branson’s Virgin Galactic are still lagging behind in terms of technology. Bezos is planning a satellite network enabling broadband internet access in remote regions as well, while Branson’s Virgin Galactic space company is seeing its opportunities primarily in space tourism, also with reusable spacecraft. However, they’re planned to be air-launched by carrier aircraft to an altitude of nearly 14 kilometers (8.7 miles), where they’d be released for subsequent space travel powered by their own rocket engines and return to Earth. Online, around 8,000 people have already indicated their interest in the two-hour space flights costing 250,000 U.S. dollars and some 600 tickets have been sold to date. The candidates for the space flight include Leonardo DiCaprio and Justin Bieber, but the date on which the flights will start has not been determined yet. Going forward, Branson is already planning tourist flights around the Moon.

### Small’s big potential

Small, ambitious start-ups are seeing major opportunities of getting a foothold in space as well. While satellites used to be as large as buses and weigh several tons, today, compact mini, micro and nano satellites, some of which tip the scales at less than 10 kilograms (22 lbs.), are predominantly used. That’s a crucial criterion for price-conscious space travel considering the fact that any additional weight incurs extra costs. Currently, 30,000 to 60,000 euros per kilogram (2.2 lbs.) are charged for any rocket launch. The rapidly changing requirements and



Impressively small: the ion thrusters for satellites from Morpheus Space

framework conditions create ideal prerequisites for small, efficient companies that are able to respond to the demands of the market quickly. The Bavarian Isar Aerospace company that, with just 150 employees, is creating the first launch vehicle made in Germany is an example of such start-ups. The launch vehicle’s maiden flight is scheduled for the end of 2021. A zest for innovation is a hallmark of Morpheus Space as well. The company based in Saxony produces the world’s smallest and most efficient satellite propulsion systems weighing merely a few hundred grams. One of the objectives pursued by Morpheus Space that was founded by students at TU Dresden is to mitigate the generation of space debris and to enable more sustainable space travel. “For the first time, we provide even the smallest satellites with the means of being actively controlled and the ability to dodge collisions with other satellites,” says CEO and co-founder Daniel Bock. “As a result, they no longer pose a hazard to other satellites – these small satellites used to orbit in a totally uncontrolled manner.” Forbes magazine ranks Morpheus among the most important “Spin-offs to watch 2021.”

### Floating launch pads

Due to the requirements of the NewSpace movement, there’s a growing demand for mobile launch pads. Offshore platforms are ideally suited for avoiding conurbations, so Germany, for instance, is planning to establish a spaceport in the North Sea, a project that’s enabled by clearly smaller carrier systems with light-weight satellites. Locations close to the equator are no longer necessary due to lower system weight. “Times in the history



The reusable rockets from SpaceX land on offshore platforms – an idea that is becoming a trend

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**men and 51 women** have been sent into space by the United States so far, equating to a rate of 63.5 percent of all persons who have looked at the Earth from outer space ever since the beginning of crewed space travel in 1961. Russia, with 118 male and female cosmonauts, ranks in second place. With twelve astronauts (10 men and two women), Japan trails Russia in third place, ahead of China and Germany. Germany is the only country so far to have only deployed men on space missions.

of space travel have seldom been as exciting as these,” says Marco R. Fuchs, CEO of OHB SE, Germany’s first publicly traded technology and space corporation. “Start-ups pursuing serious plans of commercially conquering space are virtually mushrooming. As a ‘start-up with life experience’ we’re able to serve the established market and respond to new challenges in fast and agile ways.”

However, not only private-sector companies are developing new space projects. New nations are edging into the market, too. While China by now has launched several projects of its own and is planning a lunar station together with Russia, other nations have ambitious plans as well. Israeli and Indian space capsules have already reached the Moon but were unable to complete their missions. Saudi Arabia and the United Arab Emirates are planning to develop a high-tech industry of their own to prepare for a future without fossil resources. Clearly, even after centuries of dreaming about forays into the universe, the subject still has plenty of potential for imagination – or to quote Jules Verne: “Anything one man can imagine, other men can make real.”

# Flying high

With Schaeffler Aerospace GmbH, the Schaeffler Group has been an important partner for aerospace companies with a worldwide customer base for more than half a century. In 1969, the year of the first crewed Moon landing, the “aircraft bearings product division” was established at then FAG Kugelfischer with dedicated sales and development functions. The products from the new business segment soon convinced customers of their viability. In 1972, the Airbus A300 with FAG ball bearings took off for its maiden flight and in the following years the company expanded its cooperation with nearly all renowned aircraft engine manufacturers. Today, almost all aircraft use bearings from Schaeffler’s aerospace division based in Schweinfurt.

In the mid-1990s, the move into space followed, in which Cronidur 30 played a key role. The material was developed in 1991 together with VSG Energie- und Schmedetechnik Essen and the University of Bochum. Compared

to conventional bearing steel, this specially hardened high-performance steel has a variety of benefits: it has ten times longer life and surpasses conventional bearing steel in terms of corrosion resistance and elevated-temperature hardness as well, which makes it ideally suited for space applications. Since 1995, Cronidur 30 has been used in specialty rolling bearings for turbo pumps in rocket engines, including those of the launch vehicles for NASA’s Artemis project. The injectors generate pressures of up to 450 bar (6,500 psi) while the turbines in the pumps rotate at speeds of up to 35,000 rpm – without being lubricated with grease or oil because the liquid hydrogen fuel

is cooled down to a temperature of  $-200$  degrees centigrade ( $-328$  °F), which is too cold for fluid lubrication. On the other hand, these cold temperatures at least prevent overheating.

But Schaeffler is one of NASA’s important partners not only in the field of propulsion systems. For the current Mars mission that landed on the Red Planet on February 18, the company supplies parts of the Sky-crane descent module that set down the Perseverance rover on the planet’s surface. In the Artemis project that’s planned to take men (and the first woman) back to the Moon for the first time since 1972, Schaeffler is active in other areas as well. Schaeffler Aerospace, for instance, supplies parts for the Orion spacecraft.

A further expansion of the Aerospace business is emerging. “We’re observing the growing number of space projects with keen interest and, thanks to our expertise that has been growing over many decades especially in the areas of materials and manufacturing, are in discussion with many of the players,” says Armin Necker, Managing Director at Schaeffler Aerospace.



The Orion spacecraft of Schaeffler’s partner NASA is planned to fly to the Moon in a few years’ time



The Perseverance rover has been exploring Mars with Schaeffler support since February 2021

# “We activate knowledge transfer and accelerate developments”

15,000 square meters of footprint, 15 high-tech laboratories: Herzogenaurach will soon be home to “Schaeffler’s Central Laboratory,” concentrating the company’s core competencies and key technologies from quality assurance to research and development. “tomorrow” talked to one of the future landlords, Prof. Dr.-Ing. Tim Hosenfeldt, Senior Vice President of Research and Innovation and Corporate Technology, about the facility’s importance for future materials, projects and, ultimately, products.





Analytical methods (here: metal analysis using an electron microscope) and capacities will be flexibly adapted to technological change in the future Central Laboratory

*Interview: Volker Paulun and Alexander von Wegner*

**Professor Hosenfeldt, Schaeffler is making a significant forward-thinking investment at its Franconian headquarters. What does the company expect from this move?**

Last year, we announced our Roadmap 2025. It encompasses capital expenditures of 80 million euros for our new Central Laboratory in Herzogenaurach. The objective is to secure our competitiveness and future viability while strengthening our technology location in the process. Completion is scheduled for December 2023 so that we'll be able to launch the laboratory in early 2024, which means that we're going to concentrate a large number of services in one facility.

**Why are you now combining your previously separate research activities in a Central Laboratory?**

With its Central Laboratory, Schaeffler offers colleagues in research and development the opportunity to achieve solutions on a cross-functional basis. Our big objective is to develop a sustainable and carbon-neutral mobility and energy ecosystem. The Herzogenaurach site has always been the location of our core competencies in the basic research and development areas, so the Central Laboratory will be a cross-divisional technology center on the campus. With it, we intend to set standards in an industry comparison. The attractiveness of the location and its competitiveness will establish additional incentives for the region, for customers and for employees. We'll create an



Electric mobility is one of the 15 core competencies that Schaeffler is planning to actively drive in its new Central Laboratory

*active knowledge transfer due to a close-meshed network. The short distances will accelerate processes. As a result, we're going to have an agile environment that's state-of-the-art – a place for joint research and development and for intensive exchange, for sharing knowledge and for professional training and development.*

**A place for exchange? Please explain what that means.**

*The Central Laboratory will be a place of joining and experiencing project teams. Around 360 employees are going to conduct joint research work on forward-thinking topics, present new technologies and products. The future will become a tangible experience at our facility. Essentially, our cross-functional teams are made up of our existing employees. We plan to successively extend this group of people through systematic learning and development in our in-house R&D network. In addition, we also explicitly plan to intensify our collaboration with external partners and customers.*

**What diversity in research and development does Schaeffler have to cover now and going forward to live up to its claim "We pioneer motion" that's manifested in the company's new slogan?**

*As an integrated automotive and industrial supplier, Schaeffler already produces and delivers components and systems of utmost precision and quality as well as pioneering sustainability, focused on electric drives, energy storage and converter systems, hydrogen technologies plus*

*automated and autonomous systems. The Central Laboratory will encompass a unique portfolio of services combining analytical methods and specialized expertise and put us in a position to expand our innovation prowess and speed. The focus here is material, chemical, coating and nano technologies as well as mechatronics with the corresponding high-resolution measuring technologies to determine mechanical engineering, electrical engineering, chemical and physical characteristics. Due to the utilization of AI – artificial intelligence – and worldwide digital integration, we accelerate the development process in cross-functional teams within Schaeffler's globally connected research and development organization. In this context, it's very important to note that we explicitly include our customers when saying that "We pioneer motion." They're an important factor in our development processes from the initial planning step to the final outcome. This is another key aspect in our pursuit of reducing time to market.*

**Obviously, Schaeffler has been relying on laboratory capacities before. What's the advantage of a compact infrastructure?**

*At the moment, our various laboratories are distributed across the company's premises and at different locations. Concentrating them in one place facilitates systematic exchange and active collaboration. But even chance meetings can quickly evolve into constructive conversations. That's exactly what makes such a marketplace of knowledge so attractive. The move, though, has*



technical reasons as well. It enables us to create optimal conditions in terms of air conditioning, vibration isolation, infrastructure, clean-room facilities and sustainability. This is where the new Central Laboratory sets standards. For instance, we'll be able to develop and test electrochemical cells and active materials under clean-room conditions. Material and surface technologies, for example, are decisive for achieving the best cost-performance and sustainability ratio of fuel cells. We'll also have high-resolution microscopy including transmission electron microscopy that offers more than thousandfold higher resolution than light microscopy, enabling representation in the atomic range, in other words the ten millionth part of a millimeter. All of these technologies are prerequisites for fundamental transformation in transportation, industry and energy production – the major industrial questions to be addressed in the early 21st century.

**Flexibility is important not only in industrial production but as early as in research. What contributions can the Central Laboratory make in this context?**

We're setting up our new laboratory so that individual test pieces as well as components up to and including systems can be analyzed and evaluated there and we'll be able to flexibly adapt our analytical methods and capacities to technological

change. Plus, all our research and development services will be available on an interdisciplinary and holistic level because we concentrate them. As a result, we're creating the basis for agile, flexible and cross-divisional project work.

**The goal of carbon neutrality makes maximum demands on the product developers at Schaeffler. What contribution can the Central Laboratory make in this case?**

The lion's share of a tangible product's carbon footprint is attributable to the material. And the main products at Schaeffler will continue to be of a material nature even in the age of the Internet of Things and cyber-physical systems. These products are created from diverse materials and their composites. On every workday, we process the same amount of steel that's contained in the Eiffel Tower. To reduce the carbon footprint going forward, we need to develop and provide CO<sub>2</sub>-neutral steel at the best cost, performance and sustainability ratio. Based on the structures, we determine the composition and purity of the material and the component characteristics using digital prediction models. However, this applies not only to steel. Polymers, ceramics and anisotropic materials such as composites that are increasingly produced by means of additive technologies and turned into products can be calculated and manufactured accordingly. Here, our laboratory creates



»» **Our big aim is to develop a sustainable and carbon-neutral mobility and energy ecosystem**

Prof. Dr.-Ing. Tim Hosenfeldt

a concrete contribution to environmental and climate protection. When it comes to sparing use of resources, “efficiency first” is always our top priority, that’s why we develop components and systems that help save energy throughout their entire lifecycle including their manufacturing process and application. Due to this holistic approach, our products make an increasingly valuable contribution to sustainability for the customer and for society. The close collaboration between product and production development is a special forte of Schaeffler’s.

**You’re also offering your customers a co-utilization of research capacities in the Central Laboratory. What are the resulting benefits?**

Colleagues from our divisions will predominantly be using the new Central Laboratory. However, we’re sharing our services also with close external partners, who can follow analytical processes online in real time. For our analyses, we use methods of artificial intelligence, for instance in the context of automated fault detection. All of this accelerates the development process. For our Lifetime-Documents program that offers material data from stability tests in machine-readable form as a browser application, we even won an innovation award in 2020.

**Offering digital simulation techniques enabling the rapid development of applications for mass production from basic research is one of your declared goals. Will the Central Laboratory be a kind of incubator for the future?**

Let me mention a practical example in this context: If you want to optimize a complex system such as a fuel cell stack by observing diverse physical and chemical effects, you need a large number of material characteristics whose experimental determination would incur high costs and require a lot of time. We therefore emphasize modeling of these characteristics using methods of artificial intelligence (AI) to analyze design of experiment-based tests as well as data mining and machine learning methods. The “Lifetime-Predictor” tool we’ve developed uses the data from a large number of in-house and external tests to obtain predictions ranging from the selection of materials to engineering strength.

**What are these data used for?**

The material data are used in virtual simulation ranging from electric powertrains to

electrochemical cells. With their microscopically delicate structures, the complex systems of a fuel cell would require modeling in simulation at such extremes of complexity that their calculation is practically impossible. Therefore, new modeling approaches, so-called multi-scale methods, have been developed further and used for solving such simulation tasks within a very short period of time. This enables us to support the engineering designers in optimizing the packaging of fuel cell stacks efficiently and effectively even before the first prototype has been built. Above and beyond methods for efficient product development, we develop methods for system reliability and system life predictions. Going forward, we’ll therefore have to increasingly deal with interdisciplinary subjects that have not been subjected to a great deal of research so far, such as degeneration mechanisms in fuel cell systems. Ultimately, the engineering designer should directly receive a virtually obtained answer to how his or her design affects reliability and service life. All of this accelerates the processes immensely. Hydrogen electrolyzers and fuel cells are key building blocks for sustainable mobility going forward – also at Schaeffler. The Central Laboratory puts us in a position to tackle these challenges of tomorrow.



# A model facility

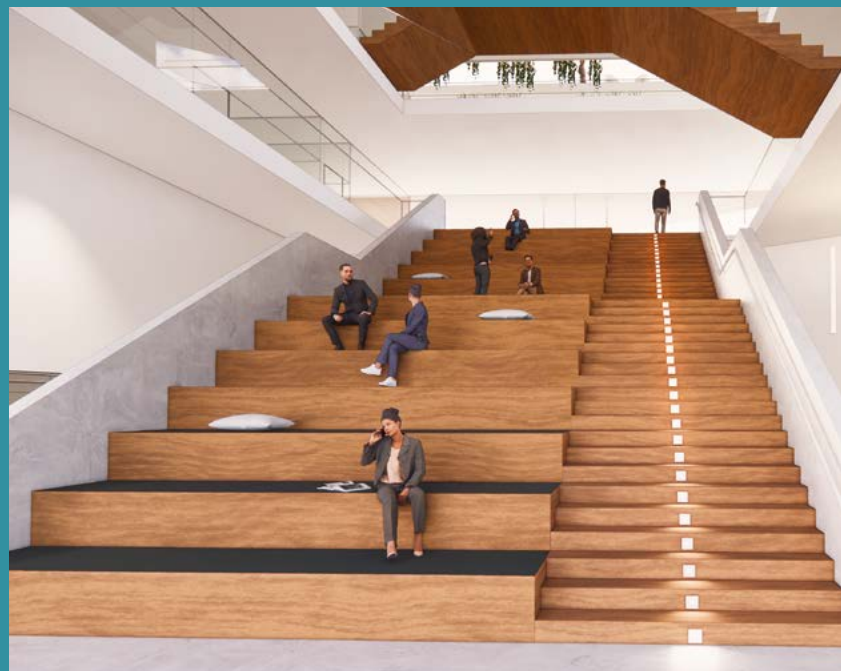
**Not just the laboratories themselves, but the facility in general**, designed by baurconsult under the responsibility of Schaeffler Real Estate Management, meets exacting standards. The German Sustainable Building Council (DGNB) certifies the Central Laboratory according to its Gold Standard. The chemical foams of the insulation materials on the roof, façade and perimeter insulation meet the requirements concerning halogenated blowing agents and are free from hexabromocyclododecane, a persistent, harmful organic substance. The flooring materials have been awarded the Blue Angel environmental label regarding risk-bearing substances and emissions.

**For construction coatings, Schaeffler emphasizes avoidance of exterior and interior VOC (volatile organic compounds) emissions** and use of solvent-free primers. For the foundation and gravel surfaces, the architects utilize materials that are focused on construction sustainability such as recycled concrete from demolition

waste, which significantly reduces the consumption of primary energy.

**Considering the sum total of these actions, the Central Laboratory assumes a leading role** compared with other laboratory facilities, office and administrative buildings at Schaeffler. These are additional aspects that make the Central Laboratory an important element of the Roadmap 2025 announced last November with which the Schaeffler Group sustainably strengthens its future viability and competitiveness. “The Central Laboratory secures ultra-modern jobs in forward-thinking fields while concurrently enhancing the attractiveness of the location and the region for customers and employees,” says Klaus Rosenfeld, CEO of the Schaeffler Group. “Moreover, it emphasizes our commitment to Germany as a business location.”

Forward-thinking, sustainable and in line with health requirements: Schaeffler’s new Central Laboratory will be home not only to high-tech jobs but also meets exacting construction standards



# A perfect pairing

After nearly twenty years of spectacular robot development and the third change in ownership, Boston Dynamics is now aiming to break even with an initial product. Hyundai Motor Group is the U.S. company's new owner. Here's a look at an unusual partnership that might be able to give new impetus to the spheres of work, recreation and mobility.





By Denis Dilba

Watching Atlas, Spot or Handle perform their feats on YouTube inspires a mix of fascination and worry. The humanoid robot Atlas easily does a handstand, skillfully rolls off, somersaults and jumps over tree logs and wooden boxes' parkour-style. Atlas overcomes rocks, roots and even snow as if it were child's play – and if the machine should fall down for a change it just gets up again and keeps going. No other humanoid robot features more advanced development or even comes close

to having the kind of dexterity and agility as Atlas. That's reminiscent of the Terminator. Atlas's four-legged colleague, Spot, is the size of a Golden Retriever and can perform feats like skipping rope, using its robotic arm to open doors or pulling a heavy truck as part of a pack, and more. In a video clip published just a few weeks ago, Atlas, Spot and the logistics robot Handle that's somewhat reminiscent of a bird even shake a leg – or wheel – on a dance floor. The adroitness and acrobatics of the robots created by Boston Dynamics in the United States equally impress laypersons



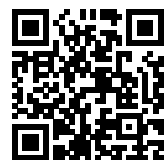
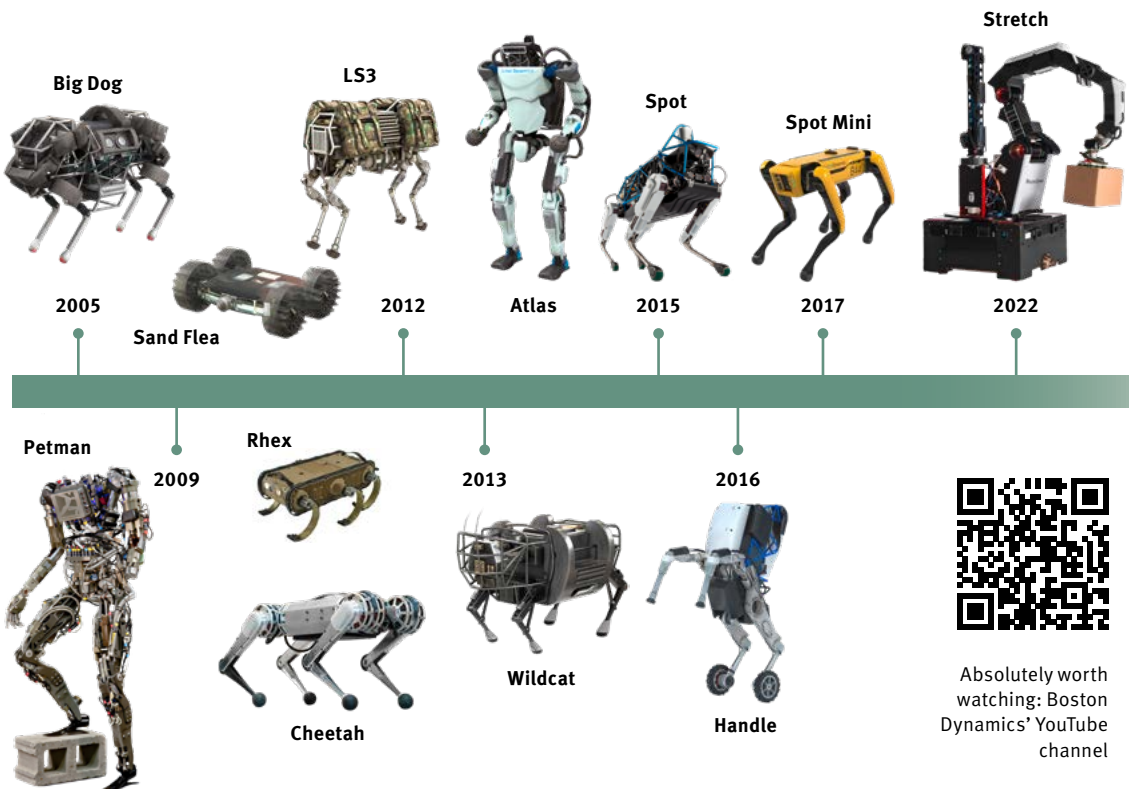
Thanks to extreme agility and sensitive sensors, the four-legged robot Spot can perform inspection jobs or haul equipment in factory halls, for example

and experts, as the millions of clicks scored by the videos of their evolutionary progress keep proving. Just maintaining constant balance during dynamic movements or regaining it after a fall used to be an impossible feat for legged robots for a long time. However, the expert world finds the learning ability of systems like Atlas even more remarkable: The robots don't need to first be fed with data about the terrain in which they move or about which path they should follow – they just start walking and then adapt their actions to the surroundings that they interpret with the help of their sensors. It almost seems as if the Boston Dynamics robots were free to go wherever they like, at least as far as one battery charge will take them. Which, as the developers admit, isn't true yet but is clearly the objective they pursue.

Like humans and animals, the robots from Boston Dynamics are supposed to have nearly unlimited freedom of movement someday. That's a nice vision, but are the currently performed gymnastics and dances really more than just technical gimmicks? Where's the benefit, where are the commercial applications? "We think that the skills inherent in dance and parkour, like agility, balance and perception, are fundamental to a wide variety of robot applications," says Aaron Saunders, Vice President of Engineering at Boston Dynamics. "Spot, through its productization, has become incredibly robust, and required almost no maintenance – it could just dance all day long once you taught it to. And the reason it's so robust today is because of all those lessons we learned from previous things that may have just seemed weird and fun."

## Robolution

Boston Dynamics' best-of-robotics



Absolutely worth watching: Boston Dynamics' YouTube channel

## Contract research for the Pentagon

Marking the beginning of a new age, Spot, the yellow four-legged robot, is the first commercial product of the company that in 1992 was founded by Marc Raibert as a spin-off of the Massachusetts Institute of Technology (MIT). Former MIT professor Raibert was previously pursuing his play instinct with no holds barred, while other robot manufacturers like Mitsubishi, ABB, Fanuc, Kawasaki, Yaskawa, KUKA and Dürr had long begun to successfully integrate their metallic helpers into the world's manufacturing processes – as highly efficient workers pursuing their monotonous activities with precision and speed. Raibert, intent on developing legged robots with the agility and adroitness of humans and animals, wanted his robots to be different. The start-up company was able to afford such costly research work with no market relevance because it found a powerful sponsor in DARPA, a research agency of the U.S. Department of Defense, early on. For the Pentagon's hotbed of ideas, Boston Dynamics, for instance, developed the Legged Squad Support System (LS3), an all-terrain robotic mule capable of carrying up to 180 kilograms (400 pounds) of military field pack over a distance of some 30 kilometers (19 miles). Atlas's predecessor, Petman, was one of the DARPA contract developments as well. The humanoid was used for testing the special clothing worn by soldiers for protection against chemicals.

Impressed by the development successes, Google's parent corporation, Alphabet, acquired the up-and-coming robotics company at the end of 2013. However, due to a lack of business prospects, the internet giant soon gave up the robotics offensive it had launched with high expectations and sold Boston Dynamics to the Japanese Softbank corporation in 2017. But the technology holding company did not find total happiness with the robotics outfit either. At the end of last year, Softbank announced that it would pass its majority stake in Boston Dynamics on to Hyundai Motor Group. As of mid-2021, the South Korean car corporation will hold about 80 percent of the robotics company that by now is valued at 1.1 billion dollars and Softbank will retain the remaining stake, according to the announcement. Meanwhile, Boston Dynamics has been continuing what the company has always been doing: developing exciting robots.

## The car that kneels down

Even before Hyundai acquired Boston Dynamics, the Koreans presented a concept vehicle that could have come from the robo hotbed as well: The mobile transformer TIGER (Transforming Intelligent Ground Excursion Robot) unites the two locomotion concepts of walking and rolling, which makes it extremely agile. The TIGER can cross not only any type of terrain but also move in any desired direction – forward, backward, sideways and diagonally. No fewer than 28 motors make for maximum agility.

So-called Ultimate Mobility Vehicles (UMV) such as the TIGER are suitable for particularly challenging applications and environments and adaptable to changing conditions. In natural catastrophes, for instance, they could be saving lives as first responders. Or they make it possible for people in wheelchairs who are unable to handle the steps in front of their home to be picked up at their doorstep. Hyundai is planning “to redefine vehicle mobility by combining robotics and rolling locomotion,” according to the company.



Forward, backward, sideways: the TIGER concept vehicle unites walking and rolling as forms of locomotion, which makes it extremely agile and versatile



Decreasing prices in spite of increasingly better technology: mobile robots are about to achieve a breakthrough on the market

Spot, the bearer of hope, has been created during this eventful period as well.

### As costly as a luxury car

Packed with sensors, it's now planned to make its breakthrough as an inspection robot and, to the tune of some 75,000 dollars per unit, generate the U.S. company's first sales. Early adopters include

the New York City Police Department, where Spot – dubbed Digidog – is deployed on scouting missions, and SpaceX, where the four-legged robot examines wrecked rockets. “Chances for a breakthrough on the market are good,” says Marc Dassler, CEO of the start-up Energy Robotics based in Darmstadt, Germany. The company that was founded two years ago is the market leader in special software that makes robots from all manufacturers smarter – including Spot. “Autonomous, mobile robots operating on oil platforms and moving around chemical plants or production halls while checking valves, detecting gas leaks or reading temperature and pressure gauges are about to make their commercial breakthrough,” estimates Dassler. The reason is simple: the systems are now economically feasible. “Hardware and sensors have become affordable and the computing power required for machine vision can be complemented by cloud computing. Plus, the high Wifi, 4G or 5G network coverage enables robotic control in real time.”

Consequently, the fact that Hyundai has acquired Boston Dynamics comes as no surprise to the robotics expert. “As a diversified conglomerate,

### Here's looking at you, Robo!

With its skinless plastic skull, its set of teeth and its conspicuous eyes with skin-colored lids, Disney's new robot comes across as a rather creepy creature. In reality, though, the nameless system marks the first step on the path toward humanoids with a lifelike look. The robot developed by engineers at Walt Disney Imagineering and robotics scientists of the University of Illinois at Urbana-Champaign and the California Institute of Technology can imitate human facial movements, especially blinking and subtle head and breathing movements. Its head, eyes and torso are controlled by a sensor installed in its chest. In this way, the robot can imitate human gaze, facial expressions and gestures and even react to external effects: for instance, when the attention of a person communicating with Disney's robot shifts to another person, the robot won't maintain eye contact but will focus on the new

situation as well – just like a human being would. Disney might be able to use the technology for future animatronic figures in its theme parks – and someday it may even be utilized alongside real-life actors in movies.



Disney is pursuing the utilization of robots from its own research lab as stuntmen and women in movies and theme parks





The logistics robot Stretch is expected to be launched in 2022. It can move up to 800 boxes per hour. Its price has not been announced yet

and factories and for service robots that can assist disabled or older people. In this promising health-care setting, human robots are to be employed in “the course of time” as well.

“This transaction will unite capabilities of Hyundai Motor Group and Boston Dynamics to spearhead innovation in future mobility,” says Euisun Chung, CEO of Hyundai Motor Group. Robert Playter, CEO of Boston Dynamics, comments on the deal likes this: “We (and Hyundai) share a view of the transformational power of mobility and look forward to

working together to accelerate our plans to enable the world with cutting-edge automation, and to continue to solve the world’s hardest robotics challenges for our customers.” The latter strongly sounds like the fans of Boston Dynamics can hope to continue seeing new members of the robotics family and spectacular videos in the new constellation as well.

Hyundai has good market access and the potential of truly making use of the technologies that Boston Dynamics offers,” says Dassler. The automaker, though, was not expecting to generate profits quickly, says Alexander Götte from the h&z business consultancy, because, “even if sales increase with Spot, they won’t come close to offsetting the development costs in the coming years.” Hyundai was not investing in products here but in technology know-how, the development of platforms and protection against disruption: “That’s why, from an external perspective, I consider the Boston Dynamics acquisition to be an excellent strategic move by Hyundai,” says the digitalization expert. Just understanding the advanced robotics technology in detail is of benefit to the car corporation, if nothing else.

### Trailblazer for new mobility concepts

“In addition, such a forward-thinking investment in robotics and related technologies increases the opportunities to attract corresponding technological know-how and young talent to the company,” says Götte. That’s exactly what the South Koreans are desperately seeking: in the long run, Hyundai is planning to cut in half the share of its sales for which the car business accounts, according to the Financial Times. 20 percent of the reductions are supposed to be offset by earnings from robotics and 30 percent by the Urban Air Mobility business. Hyundai anticipates overall growth potential in logistics and inspection robots used in warehouses

### The author



**Denis Dilba** is a journalist with a degree in mechatronics and has been fascinated with robotic developments ever since his childhood days. Not having missed any of Boston Dynamics’

videos capturing the progress of Atlas, Spot & company, he’s excited to see what the collaboration between the U.S. robotics company and the car corporation Hyundai will produce – secretly hoping for a transformer for home use.



Schaeffler in robotics – Download the info brochure



# Smarter living for seniors

Scientists are working at full stretch on the development of robots for everyday life and technical systems to keep an aging society agile for as long as possible. What's available now, what's still in the pipeline, and what issues are emerging in the process – “tomorrow” provides an overview of the current and future state.

*By Björn Carstens*



## Humanoid robots

We still have fond memories of it: the cute robot named Number 5 from the 1986 comic science fiction film *Short Circuit* that acquires knowledge at breath-taking speed. A robot made up of metal and electronics that responds with empathy in interactions with its counterparts of flesh and blood. A robot whose design has taken cues from the human body shape. In a manner of speaking, scientists have been working on the perfect evolution of Number 5 for decades, on humanoid assistance robots designed to make our daily lives easier. Especially the daily lives of a specific target group that in the wake of demographic change accounts for a steadily growing proportion

of society: senior citizens. The idea is to enable them to lead a self-determined life for as long as possible with utmost flexibility and agility, assisted by robotics and technologies based on artificial intelligence. Loading the dishwasher, fetching clothes, setting the table – there are many things that robots could handle for the generation that's 70 years and older. Robotics research has created a number of prototypes now being deployed. Is Number 6 already alive?

If so, it's just been given a different name. Robots like LIO, HOBBIT and CARE-O-BOT navigate their way through homes, reach for objects and com-

municate with humans. They can be connected to fall detection sensors. TWENDY ONE helps with household chores, CODY can wash people, DOUBLE is a remote-controlled self-driving tablet PC that can also be used for communication. ZORA sings and dances with care recipients and encourages them to engage in exercises enhancing their fitness.

### Attention-sensitive robots

However, the range of applications for all of these machines is (still) limited. Within the framework of the “JuBot – Young at heart with robots” project, Professor Holger Hanselka, President of the Karlsruhe Institute for Technology (KIT), and his colleagues are engaged in such assistant robotics research work: “We’re emphasizing a human-centric approach. Our ARMAR robots are already performing complex tasks in kitchen settings, continually learn from interactions with humans and interact with them with the help of natural speech.” However, he adds, a next step would have to increasingly focus on intuitively non-verbal communication, for instance, by humans exchanging gestures, facial expressions or even just glances with humanoid robots and the machines subsequently knowing what the human wants. “The objective is to develop humanoid robots that can anticipate that the person they’re interacting with has a need,” explains Hanselka, referring to attention-sensitive robots. This would have the important effect of significantly raising acceptance among the target group, provided that machines were to develop socio-empathic traits (see page 93).

### AI for enhanced accessibility

#### Smart glasses

They remind the wearer of individual steps to follow when cooking and baking.

#### Smart picture-taking

When taking pictures with a camera phone, AI technology recognizes the subject and compensates for camera shake. That’s beneficial for people suffering from Parkinson’s disease (PD).

#### Microsoft’s Seeing AI

Blind users are provided with a description of their surroundings on a camera phone. The app can read text, describe colors and recognize friends.

#### Smart spoons

They can compensate for the tremor in the hands of PD patients.

#### Deepfake technology

The system animates photographs of relatives that have passed away long ago and transforms old portraits into eerily winking and smiling videos.



The ARMAR robots developed at the Karlsruhe Institute for Technology (KIT) carry out complex tasks in a kitchen setting, learn from humans and interact with them using natural speech

5%

of the world population in 1950 was at least 65 years old. Now the rate is roughly 9 percent and by 2100 nearly 23 percent will be in that age group, according to forecasts. Aging societies are part of the global demographic change, which Schaeffler, in its Roadmap 2025, has also defined as a major future trend that’s associated with special opportunities.

# “Walking aids” of tomorrow

Feet that will no longer carry them or waning eyesight are worst-case scenarios for many seniors. For such scenarios, Google’s spin-off Waymo develops small self-driving vehicles for use as personal taxis that can be summoned directly to one’s doorstep with simple voice commands. The smart walking canes of the French start-up Dring with a built-in GPS chip and smartphone connection informing their users of their whereabouts and warning them if need be can compensate for mobility deficits as well. Wheelchair users might be able to get around faster with an idea from Klaxon Mobility in Austria and Voi, a Swedish company offering electric scooter rentals. The partners are working on an electric drive unit for wheelchairs and on a three-wheeled electric scooter for sitting (pictured above). The KIT-EXO-1 exoskeleton (right) developed at KIT that’s intended to intuitively amplify human abilities is heading in a different direction. Seniors could “don” the robot in the morning to remain mobile during the day.



Three-wheeled electric scooter alternative for wheelchair users (above), “wearable” robots for enhanced mobility of elderly people



» *I’d like to see us accepting little technical helpers in our everyday lives*

Professor Holger Hanselka,  
President of Karlsruhe Institute for Technology

## Back to the future

As far back as in 1932, the American scientist and inventor Edwin Land laid the foundation for Virtual Reality (VR) with a polarization filter that merged two images from different perspectives. Land, at age 82, died in 1991 – too early to enjoy the enormous evolution of his invention at an even more advanced age, as elderly people and VR have since begun forming a perfect pairing and 360-degree video headsets are increasingly gaining traction in home use, bringing the whole world into people’s living rooms: hiking through the Grand Canyon, enjoying wellness vacations, attending musicals, and more. For seniors with impaired mobility, all of these activ-

ities are possible in the virtual world. KIT President Prof. Holger Hanselka: “VR has great potential to prevent loneliness and depression in elderly people. Images, landscapes and videos from the past generate feelings of happiness, which reduces stress hormones and enhances people’s state of mind. It’s an ideal technology for seniors.” VR as a versatile therapeutic approach has enormous potential.

Examples include meditation exercises at places of longing, socializing beyond 2D mode in online conferences or using VR as a fitness tool for riding through scenic landscapes on a stationary exercise bike. Virtual visits to the doctor’s office are possible, too. Dealing with mental health issues is another focal area. The anxiety of paranoia patients concerning certain social situations in the real world was reduced by 50 percent after just one VR coaching session, according to a British study. Since VR therapies have the advantage of being automatable, patients don’t have to be put on a long “real-life” therapy waiting list anymore.



# Social robots

Social acceptance of service robots for seniors is making slower progress in Europe than in the United States or the Far East, especially if they don't look like robotic vacuum cleaners but resemble humans. In that case, expectations apparently change: robots are supposed to act proactively but without getting on the nerves of the persons they serve. The Dutch robot ethicist Aimee van Wynsberghe criticizes robotics development for putting too much emphasis on technical feasibility instead of on comprehensive human interaction. The key question must be "what should robots be doing to provide good care" rather than "what are all the things they're capable of doing"? In other words, robots as machines with emotions that prevent loneliness and may even speak the local dialect of the people they serve when asking them how they're feeling. Or taking this thought even further: holograms that make it possible for old companions to be beamed back into peo-

ple's living rooms. This, of course, entails the recurring issue that new high-tech social robots including their cameras can only fulfil their tasks if we're willing to accept a supposed loss of privacy. Talking about data protection. And what about costs? Will health insurance companies prefer to pay for robots rather than costly nursing staff someday? Obviously, the potential of robots as everyday helpers is huge but still calls for clear rules, because research is useless unless it's accepted.

**»» We have to ask ourselves: from an objective perspective, are human decisions really always better than those made by machines?**

Prof. Holger Hanselka



## 3 questions for ...

... **Greta Silver (72)**. As a best-selling author, she

**wants to liberate the world from the gray haze of age. On her YouTube channel, she reaches millions of viewers and opens the best agers market to the corporate world.**

**AI robots loading dishwashers, VR headsets that take you to inaccessible places, new mobility concepts – which technology most effectively helps your generation stay agile?**

*I don't buy technology. I buy freedom and a zest for life. Anything that helps is mega – anything that assists, facilitates, makes existing boundaries invisible and allows me to discover all-new worlds. I should enjoy using it and not feel embarrassed by it – like by a product that looks like it's come from a medical store. It's not the product that's embarrassing but its discernible mission – the "why," which is reflected in business, in products, in communication. That's the button that changes the message.*

**How can acceptance of technical aids with seniors be raised?**

*Please don't make any differences between young and old. We've been using aids all our lives, so we just continue doing so when we're older, use whatever we can get our hands on to enjoy life. My message is that stair lifts don't lead directly to the funeral home, but that they're like a Ferrari – the car travels from A to B and the stair lift upstairs and downstairs – that's all. Nobody loses their dignity just because their hips, their eyes or their knees aren't working as well anymore as they used to. This is the message that businesses should use in addressing seniors: Hey, you're no different!*

**What should be observed in the development of new technologies to meet the needs of seniors for more agility?**

*Anything that makes life easier makes sense and that's what businesses are doing already. It's just that they could communicate it in a much lighter vein. I find all products attractive that compensate for my weakness without carrying the stigma of "old" or "frail." You may not need such products all the time, but when you do, they bring fun or freedom back into life.*

# Masthead

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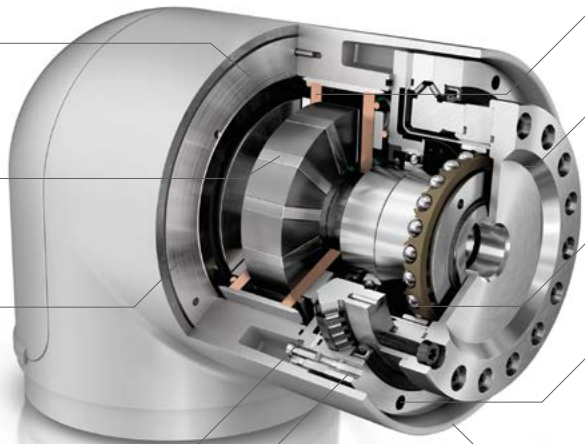
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\* Increasingly compact robots with larger working ranges and higher payloads can only be achieved with innovative and high-performance system components. For robot joints like the one shown here, Schaeffler offers a ready-to-install assembly consisting of the DuraWave strain wave gear with the XZU conical thrust cage needle roller bearing and the motor from the UPRS range.

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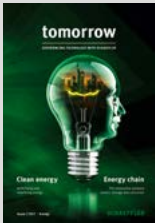
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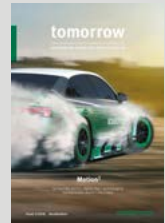
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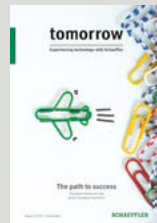
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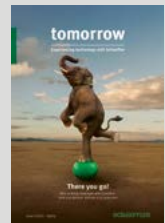
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