TRAXON TRANSMISSION SYSTEM
Tough testing in the big chill

ZF HILFT
A school report from Ghana

CDC DAMPER FAMILY
The safe, comfy way to drive

FOCUS ON INNOVATION
RESEARCH IN A GLOBAL NETWORK
100 YEARS OF ZF ON ALL CHANNELS

Wherever you are, whatever device you have to hand: plunge into the online world of One Global ZF – and experience 100 extraordinary years for yourself.

Back to the future

All around the world, you’ll find the people who have turned ZF into what it is today: a company with a great future – and an extraordinary past. Visit 100years.zf.com and review the milestones that defined ZF’s first 100 years. A timeline links together stories from the past century in informative and often surprising ways.
The automotive industry is facing what may well be some of the greatest challenges in its history. We need to design and develop increasingly efficient vehicles. First, as an effective response to climate change, and second, because lightweight, electrically powered cars and commercial vehicles will play an important role in our future by helping us conserve resources. Other global trends are impacting the industry, too. In the future, cars must integrate with the networked realities of modern life. Similarly, driver assistance systems and automated driving will significantly improve road users’ safety and comfort.

“The automotive industry is facing what may well be some of the greatest challenges in its history.”

To survive and flourish in the rapidly transforming world of mobility, modern technology companies must be agile and innovative. The key to future success is being able to invent and develop new products more quickly – and then further develop and adapt them to ever-changing market conditions. In the never-ending quest to further improve ZF products and services, the company decided to acquire U.S. auto supplier TRW Automotive. As the market leader in active and passive safety systems, TRW is the ideal match for ZF’s existing product portfolio.

The ability to respond quickly and competently to new challenges is a quality that has characterized ZF since it was first founded, allowing the company to operate successfully in the marketplace for the last 100 years. Zahnradfabrik Friedrichshafen was established in September 1915, and has subsequently evolved from a simple automotive supplier to a global technology company. The merger with TRW will enable the company to further transform itself into a world leader in systems solutions and a pioneer in research and development.

Dr. Stefan Sommer  
Chief Executive Officer of  
ZF Friedrichshafen AG
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50 A BRIGHTER FUTURE FOR KIDS IN GHANA
ZF hilft. supports education worldwide. drive pays a visit to a sponsored school in West Africa.
That yearning for the hurtling thrill of speed and acceleration – for him, that’s what cars are all about. “But acceleration can also end in sudden destruction,” muses artist Stefan Rohrer. The sculptor’s works explore the fine line between desire and destruction – works like “Turbo”, created from car, steel and paint in 2014. The artist is a ZF Art Foundation scholarship holder, and will be living and working in the ZF tower studio in Friedrichshafen until October 2015. One of his works will also appear as the centerpiece of the “ZF Art Foundation – 25 Years” exhibition (from October 23, 2015 to January 10, 2016 at the Zeppelin Museum in Friedrichshafen).
ON-ROAD, OFF-ROAD

From state-of-the-art tractor to best-of-British sports coupé – these newly launched vehicles are all equipped with ZF technology.

Aston Martin Vanquish
8-speed automatic transmission
Torque converter

The Aston Martin Vanquish is the first car to feature the 8HP Transaxle variant. In this configuration, the transmission isn’t installed directly behind the longitudinally mounted engine in the front of the car, but instead is connected to the rear axle by a transaxle shaft, resulting in a more even weight distribution. To make this possible, ZF customized the transmission housing and torque converter, and also co-developed the control software.

Deutz-Fahr 9 Series
TERRAMATIC TMT 32
TRA 32 modular rear axle

The TERRAMATIC TMT 32 continuously variable transmission has four driving modes. Supporting a top speed of 60 km/h (37 mph) at an engine speed of just 1,780 rpm, the transmission delivers a comfortable ride and exceptional efficiency in all conditions.
Audi Q7
AKC (Active Kinematics Control)
8-speed automatic transmission
Front and rear axle drive units
CDC adaptive damping system
Chassis components
Gearshift system
Electronic components

The AKC system changes the rear axle’s track (toe-in) angle, thereby enhancing the overall steering experience. When driving slowly through narrow streets, the system steers in the opposite direction to the front wheels, increasing the vehicle’s agility and reducing its turning circle. At higher speeds – that is, above 60 km/h (about 40 mph) – AKC turns the rear wheels in the same direction as the front wheels, improving directional stability and handling.

Jaguar XE
8-speed automatic transmission or 8-speed manual transmission
Torque converter or clutch system
Chassis components

Thanks to a wealth of innovative features, ZF’s new generation of torque converters delivers the very highest standards of ride comfort and efficiency. The hydrodynamic power transmission is more responsive than ever before, meaning vehicles can now be driven at very low engine speeds with the lockup clutch engaged.

Solaris Urbino
EcoLife automatic transmission
AV 132 or AVE 130 portal axle
RL 82 EC independent suspension (front axle)
CDC adaptive damping system

Whether driving stop-start routes through city traffic or making longer cross-country journeys, ZF’s EcoLife automatic transmission cuts fuel consumption in all situations, as well as reducing noise emissions.

BMW S 1000 XR
CDC adaptive damping system (BMW: Dynamic ESA)
Electronic components

The CDC system for motorcycles uses sensors mounted on forks and shocks to continually track suspension movements and trim them according to the base settings configured in the motorcycle’s electronics (such as Sport mode or Passenger mode). CDC uses the data to micro-adjust each damper in fractions of a second.
**THE POWER OF ZF**

The ZF (blue) and TRW (beige) product portfolios are a perfect fit; the combined electronics expertise will play a key role in the company’s future success.

**THE BEST OF TWO WORLDS**

ZF is acquiring U.S. supplier TRW Automotive, bringing together two highly successful companies.

“TRW is a perfect fit for our long-term strategy,” commented ZF CEO Dr. Stefan Sommer in response to questions about the takeover. TRW Automotive, based in Livonia, Michigan, is a pioneering developer and manufacturer of active and passive safety systems, as well as vehicle handling and driver assistance systems, electronic technologies and software. 90 percent of the company’s products are relevant to road-user safety. The company employs some 65,000 people around the world, with an especially strong geographical presence in Europe and North America. The acquisition will improve ZF’s future prospects and expand the company’s portfolio to cover a number of attractive segments with enormous potential. “The transaction brings together two successful companies, both characterized by remarkable performance in terms of innovation and global growth,” continued Dr. Sommer. Subject to regulatory approval, the acquisition should be completed in the first half of 2015.

**New Executive Directors**

**Global presence**

With the acquisition of TRW, ZF is expanding the company’s global presence. The Board of Management has duly appointed two new members, both of them senior managers with international experience: Dr. Franz Kleiner for North America and Peter Lake in charge of Corporate Market.

Dr. Franz Kleiner, hitherto Head of ZF’s Industrial Technology division, has been responsible for the North America region since the beginning of 2015.

Peter Lake, hitherto Head of Sales for TRW Automotive, will – subject to regulatory approval – take responsibility for ZF’s Corporate Market activities in October 2015.

**PROLOGUE**

ZF NEWS

The ZF (blue) and TRW (beige) product portfolios are a perfect fit; the combined electronics expertise will play a key role in the company’s future success.

**Driver assistance systems**

Camera and radar systems built into the vehicle monitor surrounding conditions. The data is analyzed and the driver is alerted to potential hazards.

**Occupant safety systems**

Advanced seatbelt and airbag systems use sophisticated sensing to detect crashes and adapt occupant protection according to severity and other factors.

**Chassis components**

Wheel guidance, damping, suspension, stabilizers and active axle kinematics all determine a car’s “personality”.

**Electric drives**

Compact electric motors and hybrid modules are used in electric drivelines and hybrid transmissions.

**Steering systems**

Electrically powered steering systems provide intelligent actuation for the fast-growing field of driver assistance systems.

**Electronics**

Electronics play a critical role in optimizing product functionality and quality. Power electronics are key components in hybrid and all-electric drives.

**Damping systems**

For optimizing safety and improving ride comfort. Worldwide, ZF produces around 64 million dampers each year, of which some 64 million are destined for cars.

**Axle drive units**

Modern axle drives distribute motive force between the wheels for better handling and improved safety.

**Active chassis systems**

Active systems such as Active Kinematics Control (AKC) improve driving dynamics, handling and safety.

**Engineered fasteners**

Including precision molded components, modules and vehicle fastening solutions.

**Braking systems**

Foundation brakes linked to the electronic stability control unit ensure vehicles slow down safely.

**Transmissions**

Automatic transmissions like the 8HP are international bestsellers. All ZF transmissions are managed by intelligent transmission control units.

**Body control systems**

Electronic switches and modules provide the interfaces for controlling various vehicle systems.

**Axle systems**

ZF supplies ready-to-install front and rear axle systems to customers – more than 25 million axle sets over the last 20 years.

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This year sees the hundredth birthday of ZF, first established as Zahnradfabrik GmbH in Friedrichshafen on September 9, 1915, and filed as such in the commercial register of the local first-instance court in Tettnang. Since then, the gearwheel factory has become a technology company operating on a global scale, and will be celebrating its birthday in appropriate style with employees, customers and the general public. The Anniversary year will also see the opening of ZF Forum, the company’s new head office in Friedrichshafen. The building will not only house the company’s headquarters, but also a knowledge workshop plus an exhibition where visitors can learn more about the world of ZF, past and present.

ZF and the Beijing Automotive Industry Corporation (BAIC Group) have set up a joint venture to develop and assemble car axle systems for the BAIC Group’s passenger car brands. Here, ZF CEO Dr. Stefan Sommer (left) and Xu Heyi, Chairman of the BAIC Group, are signing the relevant agreement. Production is scheduled to start this year in an industrial park located southeast of Beijing.

ZF’s AVE 130 electric portal axle (pictured above) has won the International Bus Planners Sustainability Award 2015. The jury praised the axle’s efficiency, flexibility and practicality. ZF was also the winner of the eCarTec Award 2014 – a Bavarian State Prize acknowledging the excellence of the company’s electric axle drive for passenger cars, which in the jury’s view combines maximum efficiency with minimum weight.

Vehicle equipped with ZF technology enjoyed an extraordinarily successful 2014 motorsports season across all race series, with a total of 210 victories. Especially worthy of mention are the driver and constructor trophys won in both the World Rally Championship (WRC) and World Endurance Championship (WEC) series.

For more on the ZF Anniversary, visit: 100years.zf.com
NEVER SAY NEVER

What will tomorrow’s transport systems look like? And how is it possible to rapidly incorporate innovations into many different types of vehicles? Questions to which ZF’s global research and development network is finding the answers.

By Joachim Becker
Photos: Tim Müller

Test facilities are a key part of the R&D process. Results are recorded and analyzed here in the observation chamber.
There’s a bit of 007 in every car. Over half a century ago, James Bond’s favorite boffin “Q” invented voice control and a tracking device complete with remote-control screen. And the secret agent’s Aston Martin DB5 in “Goldfinger” (1964), not to mention his Toyota 2000 GT Cabrio in “You Only Live Twice” (1967), were both well ahead of their time. But even much later, in “Tomorrow Never Dies” (1997), the way he controlled his BMW 750iL using his mobile phone still looked like science fiction to movie audiences. Two decades later, driver assistance systems with environment recognition based on cameras or radar sensors are becoming standard. Indeed, it is now possible to remote-control a vehicle using a tablet computer, as ZF demonstrated with the Innovation Truck at the IAA Commercial Vehicles 2014 trade fair.

“In the course of our long-term strategy process, we’ve identified three industry-wide megatrends: more efficient drivelines, improved vehicle safety systems and more sophisticated driver assistance systems – including autonomous driving,” says ZF’s CEO and Director of Corporate R&D, Dr. Stefan Sommer. The digital revolution means that the action accessories once beloved of secret agents have become affordable across many different automotive segments – especially when the full resources of a major enterprise are brought into play. “Some of the new features in our Innovation Truck, for example, come from joint preliminary development work with the passenger car division,” explains Dr. Harald Naunheimer, Head of R&D at ZF.
"Our cross-divisional collaboration enables us to meet some very challenging innovation targets, even for lower production volumes."

At ZF, innovations are no accident – they are part of a systematic, progress-focused strategy. Concepts invented by solitary engineering geniuses like "Q" in the movies are in reality the outcome of prolonged time and effort by hundreds of designers and developers across many divisions and subdisciplines. As well as conventional mechanical engineers, specialists in mechatronics, software architecture, materials and production processes are also involved in the various idea generation and product development stages. Not to mention all the specialists in market trends and sales analysis, with their insights into customer needs and the competition. "Innovation is largely based on cross-network communication. We leverage the ‘swarm intelligence’ of our in-house experts through a combination of facilitated process and creativity," continues Dr. Naunheimer.

Before the actual brainstorming can begin, certain parameters must be clearly defined. While corporate strategy and selected technologies form part of the equation, the future needs of ZF customers are the key factors. What modular or platform strategies are the various automakers pursuing? What local market needs are they seeking to address? The true importance of these questions is clear from the example of robot cars, a highly promising area of innovation. "In China, chauffeurs are a sign of social status for those who can afford them. This means that automated driving currently has a lower priority over there," comments Dr. Gerhard Gumpoltsberger, Head of Innovation Management in ZF’s Corporate Advanced Engineering unit. "What’s more, driver assistance systems such as active cruise control still don’t work very well in cities like Shanghai – in heavy traffic, many drivers ignore safe driving distances and squeeze into the tightest gaps."

**U.S. highways ideal for autonomous driving**

China and the U.S. are key growth markets for ZF. In 2014, the company’s success in North America was reflected by a 21 percent jump in sales to 3.7 billion euros – over four billion dollars. Sales growth in the Asia Pacific region was identical at 21 percent, although the actual sales figure was slightly lower than the U.S. at 3.6 billion euros. ZF specialists expect automated driving to flourish in the U.S. more quickly than anywhere else. More than 80 percent of the U.S. population live in vast urban centers that no longer resemble traditional cities, but are more akin to sprawling agglomerations of suburbs and dormitory towns, all networked together by 12-lane commuter
“As part of our long-term strategy process, we identify the key megatrends.”

Dr. Stefan Sommer, CEO

highways. “The broad U.S. highways with their strictly enforced speed limits are ideal for automated driving,” says Dr. Gumpoltsberger. “With commuters spending more than two hours a day on the road, autonomous vehicles could relieve much of the stress on drivers.”

In order to gain a better understanding of customer needs and wants in key growth markets, ZF market experts and new product development (NPD) specialists are constantly exchanging news and views in product strategy meetings. The ZF Development Centers in Shanghai, Tokyo, Sorocaba and Northville, near Detroit, are the main hubs for their activities. Here, they hold intensive workshops with local ZF development teams, during which they scope the latest trends and technologies with the aim of identifying potential product innovations. The results are subsequently presented to ZF’s Board of Management, divisional management and top-level development and sales committees. “Networking only works effectively when the key individuals meet in person,” comments Dr. Naunheimer, “and that’s especially true of front-end development, which usually depends on cross-functional research teams in multiple locations.”

Product and production expertise

Ideas that succeed in the marketplace are rarely the progeny of solo artists; they’re usually produced

Even the best computer simulations are no substitute for working with actual models.
Innovations at ZF

The product development process breaks down into three main phases—idea generation, front-end (pre)development and product evolution process. Phases two and three are all about fleshing out the most promising ideas and input, giving them shape and turning them into actual product concepts. Here we introduce the first phase in the process.

1. Brainstorming

**OBJECTIVE:** to generate, collate and evaluate ideas and trends.

2. Predevelopment

**OBJECTIVE:** to minimize technological risks and check technical feasibility.

3. Product evolution process

**OBJECTIVE:** to review the product’s functionality, costs, industrialization and supplier network.

**TRENDS, SCENARIOS, TECHNOLOGY RADAR**

What are the megatrends? What are the current market and technology trends? What are our customers thinking about? What’s the competition doing? Compromises must be found between an infinite number of development options and limited real-world resources.

**CREATIVE METHODS**

With the right opportunities, anybody can be creative! So ZF seeks inspiration from other disciplines, because interdisciplinary and intercultural collaboration is very useful for generating ideas.

**TECHNOLOGY SCOPECING**

Key question: what skills will we need in the future to build these products or develop these technologies?

**KNOWLEDGE MANAGEMENT**

Generating, storing and distributing knowledge that is important to the company. This is all about making knowledge more accessible and easier to find.

**NETWORKS**

Product strategy meetings and workshops take advantage of the "swarm intelligence" of stakeholders such as automakers, in-house working groups, suppliers and research institutions.

**EVALUATION**

In view of the limited data available at this stage in the process, certain things must be anticipated and subsequently prioritized: which products and technologies should or should not be followed up?

**REVIEWING**

The roadmap attempts to identify trends over the next 10-15 years by analyzing the development paths of products, services and technologies, and making predictions about future developments.

**IDEA MANAGEMENT**

Ideas for improvements and new features are generated, collated and selected. Designers and developers from various divisions and subdisciplines are involved, along with market specialists and trend scouts.

**PATENT MANAGEMENT**

Protecting the company’s technological lead is a priority. So innovation management is an important part of planning and controlling processes.
by a vast and well-conducted orchestra as part of a perfectly harmonized group effort. "Production expertise is an important complement to our market and product expertise," explains Dr. Naunheimer. Only those companies that combine their innovatory ability with local development teams supported by top-quality local manufacturing expertise are capable of bringing a technically and financially attractive innovation to global markets in the shortest possible time. And while James Bond’s innovations are generally limited to a production volume of one, ZF’s specialists must continue to optimize the components, methods and processes used in products long after the initial development phase has been completed. As innovation cycles become ever shorter, standing still is the same as going backward.

Currently, much of today’s progress is driven by the stringent CO₂ targets that have been set by many governments. Between 2015 and 2020, European carmakers must reduce their fleet emissions by five percent each year – faster than ever before. In fact, finding ways to cut down CO₂ emissions across the entire automotive supply chain has long been a top priority. "Thanks to our comprehensive understanding of systems, we’re finding ways to steadily improve our components’ efficiency and performance while also building new functions into the vehicle," explains ZF’s Head of Development. "The electric drives we’ve developed for a wide variety of applications in hybrid and all-electric drivelines are an excellent example."

More and more automotive components are turning into sensors. Linking an onboard network of sensors to actuators in the chassis can dramatically improve
Dr. Naunheimer, ZF is hoping to grow rapidly over the next few years, more than doubling sales by 2025. How are you able to support this strategy through product innovation? In the sectors we’re working in, we want to be an innovation leader, thereby creating added value for our customers. We’re constantly updating our roadmap for the future, which attempts to predict developments over the next ten to 15 years. But it’s not just about having brilliant new ideas. Our strategy is also predicated on tight control of cost efficiencies, as well as ongoing development. And that’s only possible by precisely managing the innovation process and by setting up local development teams and production facilities in close proximity to our customers.

Over the next ten years, automated driving will gradually be introduced onto our roads. Can you give us an example of how you would keep track of the costs involved in that process? Well, we’re cutting costs intelligently by replacing components with software solutions. For automated driving, for example, you need redundant systems to provide the necessary system resilience. However, instead of installing individual components twice over, you could instead start by networking together the braking, steering and driveline systems – easy enough, because all of these components are now fitted with lots of sensors. This onboard networking is allowing us to develop new functions which the individual components can’t deliver on their own. Meaning we can deploy sophisticated innovations faster across more sectors.

Is ZF intending to network onboard systems even more tightly with environment recognition systems? Certainly. We could, for example, connect cameras to the suspension. Systems like CDC would add even more tangible value for drivers if they were capable of “reading” the road in advance, instead of simply reacting to uneven road surfaces. Basically, in all our business activities, we don’t just focus on continuing to develop our main products and services, but on thinking outside the box and finding new ideas for enhancements. We call that “systems intelligence” – meaning ZF is more than the sum of its individual business units.
both ride comfort and safety margins. Just like a nervous system, the sensors deliver an ever-growing stream of data to various electronic controllers, making vehicles capable of increasingly precise self-analysis and self-control. While hardware developments in advanced chassis systems tend to be incremental, the software is increasingly sophisticated. Already, more than one fifth of ZF’s developers work on electric and electronic systems: system multiplexing and high functional density in confined spaces are particular strengths of ZF’s R&D department.

Simulations and testing
Within sight of Friedrichshafen airport, around 1,000 experts are working to build the very latest technologies into cars and commercial vehicles, construction and agricultural machinery, rail vehicles and ships as swiftly as possible. Using theoretical and experimental research methods, the Corporate R&D Center paves the way for all product development processes. Even at this preparatory stage, early prototype assemblies and components are put through stringent testing. As they test how well the prototypes work and how durable they are, the R&D specialists measure parameters such as voltages, vibrations and noise. Despite the availability of advanced CAD simulation systems, important data is still harvested from test benches and acoustics laboratories – as well as real-world test drives. ZF manages the entire product evolution process (PEP) in-house, from front-end idea generation through to the final, production-ready component that has been subjected to extensive in-vehicle testing. The ability of complex products to operate under all possible environmental conditions can only be verified in practice – which is why ZF’s close proximity to customers on every continent is a key strategic advantage. While the R&D Center in Friedrichshafen is being extended to include a new transmissions test center, similar test facilities and workshops are also being built in the U.S. and China.

In Shanghai, the number of researchers and developers is due to rise from 500 to 850 over the next few years. “This mirroring of key R&D facilities enables us to deliver innovative products differentiated by region and vehicle model at high speed and to top quality standards,” explains Dr. Naunheimer.

Over the past 100 years, ZF has developed an in-depth understanding of the way complex vehicle systems interact. The company’s global innovation network is working on the implementation of new visions around the clock. Thanks to ZF’s technological strength, the company is well positioned for the digital revolution. Sorry, Mr. Bond, but outside the movie theater, your colleague “Q” doesn’t stand much of a chance against the tightly networked ZF team. Goodbye, Mr. Bond...
SAFE,
SUREFOOTED
CORNERING

ZF was the first supplier to bring an adaptive, electronic damping system for cars to market, in the form of Continuous Damping Control (CDC). Today, the system is fitted as standard to a broad range of cars, trucks, buses, farm vehicles and even motorcycles.

By Melanie Stahr

CDC works faster than the eye can blink. Sensors collect and deliver data on current driving conditions. The electronic control unit (ECU) uses the data to calculate the best damping settings, and then adjusts the valve to produce the appropriate damping force.
s any economist will tell you, the difference between a new idea and a genuine innovation is simple: it all depends on the product’s success in the marketplace. This can be measured most clearly in terms of the volume of units produced and purchased each year. By this yardstick, ZF has every reason to be delighted with CDC. Since becoming the first company to put a continuously adjustable chassis control system for cars into volume production back in 1994, more than 18 million units have left ZF’s production line. What was once an optional extra for luxury and premium vehicles has become a standard product enjoying wide-ranging market success across all passenger-car classes. Systems adapted for commercial vehicles and subsequently for farm machinery and motorcycles have enjoyed similar success – the fruits of a research and development effort that has always taken advantage of in-house synergies between ZF business units.

Innovation with history

When a team of designers and research engineers started developing CDC toward the end of the 1980s, Mannesmann Sachs AG – subsequently acquired by ZF – already had around a decade’s worth of experience with electronically controlled damping systems. However, these were simple, manually activated systems that adjusted damper characteristics using electric motors, rather than the fast, electromagnetic systems with discrete damping stages that succeeded them. Simple adaptive governors known as threshold controllers were capable of choosing between two or three different damper characteristics depending on ambient driving conditions. But having to rely on a fixed number of predefined damper settings in response to an almost unlimited number of possible combinations of driving conditions, vehicle loads, speeds and road surfaces is always going to end in a compromise. And as the resulting choice steadfastly erred – for safety’s sake – on the side of caution, the electronic damping systems of the period often left comfort more or less literally by the roadside.

At the same time, the early system’s production process was very complex, involving the connection of two external solenoid valves to each shock absorber. As a result, manufacturing costs were disproportionately high. “As the 1980s drew to a close, we started looking for some way to reduce the electronic damping system’s production costs while at the same time...”
time improving ride comfort – without making any compromises in terms of safety,” explains Heinrich Schürr, Head of Active Damper Development. “It soon became clear that we couldn’t achieve this with a finite selection of damper characteristics. Which gave us our roadmap for future development: we needed a damping system based on a stepless or continuously variable valve, rather than a stepped valve.”

From paper to product
This epiphany cleared the way for an in-house pre-development project that required cooperation across established departmental boundaries from the very beginning. While designers considered the architecture of the new valve, research engineers worked on perfecting the interplay between the individual damper components and developing the necessary control systems. This close collaboration produced CDC solutions for cars and commercial vehicles in parallel. “We knew we’d only be able to show off the new damper’s performance to best advantage if we could also offer customers a complete management strategy,” continues Schürr, as he describes their development strategy. “At this point, we were the first supplier to take a holistic, systemic approach to suspension design; all of the other suppliers were still working at the level of individual components.” The team was effectively anticipating something that would soon become a major trend in the automotive industry – the shift of systems expertise from manufacturers to suppliers. As a result, the principles underlying the CDC development process they pioneered are still evident today: the individual components were installed in a testbed as a complete system, then subjected to a “maturing” phase during which the project team repeatedly measured overall performance while making gradual improvements to the complex interplay between damper hardware and software.

From lab to market
Finally, the system was ready for installation in presentable test demonstrators – and for the ultimate litmus test: presentation to the first end-customers. “This is always one of the most exciting stages in a product’s evolution – making the transition from the ivory tower of in-house development to prospective market exposure as we seek to stimulate customer interest,” explains Rolf Heinz Rüger, who heads the Suspension Technology business unit in the Car Chassis Technology division. “And it’s still just the same today.” In 1997, South Korean carmaker Ssang Yong was the first to seize the opportunity to differentiate its flagship Chairman model from the competition by installing CDC. Other premium cars and sportscars soon followed suit, including the BMW 7 Series, Ferrari 360 Modena, VW Phaeton, Maserati 3200 Coupé and Audi A8. “In the early years, CDC was only available as an optional extra for top vehicle models. But the technology’s performance soon impressed manufacturers enough for CDC to make a big leap forward, becoming standard equipment in top-of-the-range executive limous delivered by BMW and Audi. Of course this meant production volumes went up, setting the stage for further expansion into the mid-range segment,” explains Dr. Andreas Fink, who is responsible for the Active Dampers product line. The breakthrough into standard equipment came in 2004, when BMW fitted CDC to all 7 Series models and also regularly upgraded both hardware and software, as well as the control unit’s functional algorithms. “Over the last 20 years, electronics have become increasingly complex – but also steadily cheaper,” adds Heinrich Schürr. “Just look at the CDC control unit, for example: we started with an 8-bit microcontroller, now we’re using a 32-bit microprocessor. That’s because there’s no longer any major difference in the associated production costs, despite the fact that the upgraded processor works much better and offers us a much broader range of options.”

Continuous improvement
CDC is now in its fourth generation, and ZF has recently simplified the CDC system architecture as part of this ongoing evolution. Capturing car body movements previously involved the use of accelerometers located on the vehicle’s bodywork, which meant more assembly work for the manufacturer. These sensors are now directly integrated into the control unit. “Fewer parts means fewer assembly stages – and this in turn means less weight, less energy consumption and lower CO2 emissions,” says Dr. Andreas Fink. The result is a system that, in terms of both cost and energy footprint, is more economical along the entire production and supply chain right through to final installation in the vehicle. Even so, for a long time CDC was simply too costly to be considered for the price-sensitive subcompact car segment. The response by ZF’s engineers came in the form of CDC 1XL (pronounced “one axle”),

“It soon became clear we needed a damping system based on a stepless or continuously variable valve.”

Heinrich Schürr, Head of Active Damper Development
The key element in a CDC damper is the proportional valve. The valve’s position reduces or increases the flow of oil through the aperture, adjusting the hardness of the suspension precisely and steplessly. The process operates independently for each wheel.

an adapted version of the system that first went into production in 2014, in the Honda Civic Tourer. This modified system uses the same damper technology and system architecture as the full-size system, albeit at reduced cost.

On your bike
CDC 1XL was specially developed to compensate for the widely varying rear-axle loads that characterize subcompact cars and vans in particular, depending on whether the car is carrying a single driver or a family of four complete with luggage. But CDC has offered similar advantages to motorcycle riders since 2012 – driving, braking or accelerating under different loading conditions, with or without passengers.

"Given that a motorcycle is essentially nothing more than a single-axle car rotated through 90 degrees, the step from rear-axle solution for cars to full system for bikes was only logical," explains Dr. Fink. "When we transferred the CDC technology to motorcycles, we were able to use our existing CDC design toolkit – although of course we also had to adapt the whole system to the specific geometries of two-wheelers."

Top-of-the-range models from Aprilia, BMW and Ducati now take uneven road surfaces in their stride thanks to CDC. CDC is also helping keep passengers comfortable in buses and protecting fragile loads in trucks. ZF’s Car Chassis Technology and Commercial Vehicle Technology divisions have also collaborated closely on developing a full CDC system plus a 1XL variant for light commercial vehicles. Other developments are ongoing – and benefiting from the synergies available when several divisions work together.

“We’re currently transferring the knowledge we’ve gained from developing full systems for cars to cab damping for farm machines and trucks,” adds Heinrich Schürr. "In essence, the driver’s cab of a tractor, for example, is not unlike a car bouncing around on a separate chassis. CDC offers us the perfect system for damping down all that jolting and vibration.”

Damping by default
This steady expansion of the range of applications for the CDC system is the reason why a total of some 18 million CDC dampers have been manufactured to date. And their popularity is growing. “If we look at installation levels worldwide, our CDC technology is still only in single figures,” sums up Dr. Fink. "In terms of the technology’s theoretical growth potential – well, the sky’s the limit!” And that brings us back to the definition of innovation we explored at the start. These high production volumes are both a blessing and a curse. They’re a visible sign of the system’s success – but because it has been so successful in penetrating so many different market segments, few people now think of CDC as an innovative technology. The adaptive damping system is becoming a standard item – to the considerable benefit of vehicle occupants. ■
Successful businesses are fueled by creativity. For a technology company like ZF, creativity is essential for building a long-lasting competitive advantage.

Just for starters, he’s rearranged the furniture... Six months ago, Dr. Alexander Brem, a 34-year-old creativity researcher from Nuremberg, accepted a professorship in Denmark. And now the Professor of Technology and Innovation at the University of Southern Denmark in Odense is sitting in a large, open-plan office, surrounded by his team. He believes this arrangement improves communication and enhances creativity. Brem is viewed as one of the bright new stars on the international creativity research scene. Among other things, he finds out which creativity-stimulating techniques businesses are aware of – and which ones they actually use. "The whole subject of creativity sounds somewhat esoteric," he says. "But really, creativity is just a means to an end – ultimately, a way of improving productivity." Above all, Brem cautions against issuing simplistic, top-down commands like "Now we need to get creative!"

"It’s important to have a clear objective, otherwise employees don’t know which direction they should be thinking in," explains Brem. He’s convinced that businesses only use a fraction of their creative potential. But while very few people would deny that innovation is a key competitive advantage, the true essence of innovation is often overlooked. Every innovative value chain starts with a spark of creativity – even though most people aren’t aware of it. At the same time, creative souls have to buy into the corporate culture. Brem’s recommendation? Businesses would do better to encourage their existing staff to be creative, rather than buying in creativity from outside sources.

Leaving the comfort zone
In the world of creativity research, “Big C” is used to refer to the thought processes of known creative resources, whereas “Mini C” refers to the day-to-day creativity that permeates the life of a business. “Mini C” includes that bastion of corporate creativity, the brainstorming session. The point is to open up an empty space, focus the mind and “storm the problem”, as described by the technique’s U.S. inventor, Alex F. Osborne. All too often, however, the technique is not used correctly. The purpose of brainstorming should be to generate as many ideas as possible, collate them – and only then to analyze them. But many brainstorming sessions make the mistake of discussing the ideas immediately. And then there is an additional barrier. “The presence of a manager or supervisor inhibits creative output,” asserts Brem.
Many employees won’t dare to think the unthinkable if their manager takes part in the session. The creativity expert insists he is a fan of simple techniques. “To invent a new product, you have to leave your habitual environment. Go out into nature, or to a conference center,” says Brem. “The main thing is that you’re not surrounded by the same-old, same-old products.”

**Model and test**

Creativity is right at the top of the list of requirements for ZF engineers. The company employs more than 6,000 researchers, all working on innovative solutions for the future in eight development centers around the world. They test the validity of their ideas using simulations, models and prototypes – and, of course, by discussing them with colleagues. The company encourages in-house creativity across all divisions by making the annual Graf von Soden Invention Award. Happily, employees don’t just switch off their creativity when they leave the office or factory. For example, the idea for one of the key components in the highly successful ZF Servotronic steering system came to a ZF engineer while he was playing with his son.

Companies like Google and 3M have implemented a “20 percent time” program – basically allowing employees to spend on day a week pursuing their own projects. Google has taken things even further. Five years ago, the Internet giant set up the Creative Skills for Innovation (CSI) lab. This is where employees learn all about Google’s creativity principle – to always look at ideas from the user’s perspective. Teams in the CSI lab develop new ideas and build some of them as prototypes straight away. One of the key factors in creating an environment that encourages creativity is how you respond when things go wrong, emphasizes Frederik Pferdt, Head of Innovation & Creativity Programs at Google. “We’ve carried out studies to find out what makes teams successful. And the most important thing is, being allowed to make mistakes without supervisors or colleagues immediately using them against you,” explains Pferdt, a native of Ravensburg, not far from ZF’s home in Friedrichshafen.

**Shifting perspectives**

“Creativity is the currency of societal progress and the hallmark of success in organizations. To innovate, adapt, excel and survive, organizations depend on creativity from employees,” writes Adam Grant, author of the bestselling *Give and Take: A Revolutionary*
“Creativity is really just a means to an end – ultimately, a way to improve productivity.”

*Alexander Brem, Creativity Researcher*

*Approach to Success.* Adam Grant, a professor at the Wharton School of the University of Pennsylvania, believes in the power of creativity – especially in crisis situations. From his own research, Grant can confirm that a change of perspective is vital for stirring the creative juices. At the same time, it is important to pay close attention to the needs of others both inside and outside one’s own immediate environment. According to Grant, the best-connected individuals are also the most creative individuals. This is because ideas are less likely to come from within – generally, they emerge in response to external stimuli. Meaning the more people you know, the more stimulus you get!

*Creative crisis management*

But what does a change of perspective mean in real life? As a senior adviser at the Boston Consulting Group, Luc de Brabantere specializes in creativity within businesses. His first example is BIC, a French manufacturer of writing implements, long famous for producing cheap ballpoint pens. But although the company sought to open up new areas of business, it was unable to move forward. Only with a change of perspective did ideas start to flow. “Once management stopped viewing the firm as a pen manufacturer and revisualized it as a producer of disposable consumables, the company started mass-producing low-cost plastic goods”, explains de Brabantere. The company’s commercial future was secured by disposable razors and lighters. Another example is IBM. The IT behemoth completely realigned its operations, moving away from specific products and technologies to focus on solutions and outcomes – finding a new niche in the service and consulting sectors. Business crisis can actually help trigger the realignment process.

As it happens, one of the most creative places on the planet, Silicon Valley, owes its rise to a series of crises – the most important being the personal crisis of subsequent physics Nobel laureate Dr. William B. Shockley, co-inventor of the transistor, the building block of the Information Age. He started a company in Silicon Valley that experimented with silicon. But the project was going nowhere, and Shockley took out his frustration on his staff. Eight of his most talented employees quit. This crisis could easily have put an end to silicon-based technology in Silicon Valley. But his employees stayed in the Valley, pooled their creative ideas and founded Fairchild Semiconductor. The business drove the semiconductor boom in the Valley and ultimately became a symbol of the modern U.S. economy.

*Structured brainstorming*

Before embarking on a complex idea management program, experts recommend starting with very simple methods. From his research, Brem has found something he clearly favors as an alternative to brainstorming: the 635 method. “635” stands for six participants, producing three ideas each, which are then shared five times. The method enables even supposedly uncreative individuals to be creative. It is more structured than open-ended brainstorming and produces better results. Six people are each given a blank sheet of paper, at the top of which they are asked to write down three ideas. Then they each pass their sheet to their neighbor, who must further develop the three ideas. The final result is a mature idea that has already been processed by six minds – and may even represent a new approach that will make the company more successful.
HOW CREATIVE ARE YOU?

Take a few minutes to find out. These creativity tests are taken from Luc de Brabandere’s book *The Forgotten Half of Change*.

**Tricky task for creatives**

Using just four straight lines that pass through the center of each dot, join up all the dots without lifting your pen from the paper (need a hint? Try extending the lines to create two angles outside the virtual square).

**Orientation**

The same shape, just slightly rotated. But the image on the left shows a black rotor on a white background, while the one on the right shows a white rotor on a black background. While the smaller segments of the image are generally perceived as a shape and the larger segments as the background, if a larger segment is located on a horizontal or vertical axis, it comes into the foreground.

**Law of simplicity**

Where an image can be interpreted in two ways, the brain will always opt for the simpler interpretation. In this example, the figure on the left is seen as a cuboid drawn in perspective, while the one on the right is seen as a two-dimensional shape.

**Counting boxes**

How many black boxes can you see in the image above? Okay, so that one’s easy to solve. But how will you work out the number of black boxes in the image below? The method you used to solve the problem above doesn’t work here. You need to get creative!

**Law of proximity**

We tend to perceive elements that are close to each other as a single unit. So we generally interpret the top row of dots as six pairs. The image below it, comprising 18 dots, could be seen as three horizontal rows of six dots each, as a group of six diagonal elements of three dots each, or as three parallelograms. The law of proximity helps us recognize that the dots are arranged as diagonal elements.

**Optical illusion**

Which of the dots in the center of each image is larger? At first glance, the one inside the circle of larger dots looks smaller, but in actual fact, they’re both the same size.

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Dr. Luc de Brabandere

is a senior adviser at the Boston Consulting Group and an expert on creativity in organizations.
THE VALUE OF PATENTS

What is the true significance of patents in an age of digitization and globalization?

How can intellectual property be protected nowadays? For a technology company like ZF, these are crucially important issues.

By Markus Bruhn

F
ree software is flooding the Internet – much of it in the form of open-source programs. Nowadays, it’s easy to quickly copy a vast amount of data and transfer it to the other side of the planet. In the no-pay culture of the Web, articles by journalists and many other forms of intellectual output are often available free of charge. But what happens to the engineering innovations produced by a technology company in the Age of the Internet? They need special kinds of protection. After all, it’s easy enough to digitize and electronically transfer the design drawings for a state-of-the-art transmission. “Being the first supplier to be able to offer certain technologies to manufacturers is an important part of our strategy,” is how Dr. Alexander Vogt, Head of ZF’s Patents department, explains the challenge facing the company. And it’s that little word “first” that gives the whole game away. If a company is going to be the very first supplier to bring an innovative technology to market, it must be able to protect its creativity – using patents.

As a result of the steadily increasing proportion of IT applications in the composition of modern automobiles, technical progress has accelerated significantly. Globalized markets and the increasingly competitive cross-border conditions caused by globalization have further exacerbated the situation for technology companies. Today, it would be fair to say that it has never been more important to protect inventions from direct imitation by competitors.

Which is why manufacturers and suppliers alike make such huge efforts to protect their technical innovations by means of patents. At ZF, this is the job of the Industrial Property department, which employs around 60 people. They are responsible for ensuring that in-house inventions stay firmly in-house. “Last year, ZF filed 927 patents,” comments Dr. Vogt. Each one of those patents represents a new invention that differs from “prior art” (the proper term for existing patented inventions or known technical concepts). Each new product created by ZF normally generates a fistful of patents as a matter of course.

THE RACE FOR PATENT RIGHTS

The ultimate goal is always the same – to be faster than the competition. The Internet isn’t the only thing that places this goal in jeopardy, according to Dr. Vogt. Valuable corporate intelligence is also passed on illegally via more traditional channels. “Staff turnover alone – especially when employees move between

The second-generation 8HP has an entirely new gearset design. ZF is a leading patent applicant in the field of transmission gearsets.
companies involved in the same industry – makes it very difficult to keep new ideas secret.” In Germany, many automotive suppliers have close commercial and even personal connections – in some cases, these relationships date back more than a century. “This means a lot of expertise can leak out of a company very quickly, solely due to changes in personnel,” laments Vogt. Which is why it is so important for ZF – as a supplier – to clamp down on the migration of ideas with the help of patents.

A typical example: most recently, ZF has benefited enormously from patents on the company’s 8-speed automatic transmission, the 8HP, launched in 2009. The transmission is six percent more economical than its predecessor, the 6HP. “We’re especially strong on the core component of automatic transmissions, the gearset,” explains Vogt. The second generation of the 8HP went into production earlier this year, and the product remains unchallenged by the competition.

Software is increasingly important
Whenever ZF develops a new industrial application, an in-house patent information system checks whether the new development can be patented in some way – or whether a similar solution has already been patented. “Filing new patents is already part of the design stage for new products,” comments Vogt. The next step is for specialists at the German Patent and Trade Mark Office (DPMA) to examine the patent application. “The patent examiners assess whether an invention is genuinely novel and inventive by comparing it with prior art worldwide,” explains Petra Knüfermann, who works for DPMA. If the invention is “non-obvious” (i.e. falls outside the bounds of current knowledge), the new technical concept is protected accordingly.

Increasingly, such patents are also used to protect digital applications – even in the automotive industry. The problem: in Europe, software as such is not patentable. “In Germany, for example, accounting programs and pure algorithms are excluded from patentability,” explains patent expert Knüfermann. “As pure programming code without direct technical relevance, they are deemed to serve a purely linguistic function, hence are protected under copyright law.” Patents can only be granted on software innovations that have direct technical relevance. At ZF, for example, that would mean the digital program for controlling the operation of a transmission. “So in this case, you would patent the way gears are shifted in an automatic transmission, rather than the underlying algorithm,” adds Dr. Vogt.

Enormous effort is also put into checking that products comply with patent law, as well as trademark or copyright law – especially at international level. That’s because “patent owners must monitor the market for themselves and identify instances of patent infringement,” explains Knüfermann. In the ongoing struggle against plagiarism, ZF concentrates on copies or imitations of ZF brands in China and the former CIS nations in particular. “We work closely with our local business partners, because they know the market very well,” says Vogt. The company also keeps a close eye on electronic platforms such as Alibaba, the Chinese equivalent of eBay, because parts intended for the aftermarket are often traded there. “Much of the plagiarism happens at this stage, because the aftermarket is extremely profitable in the automotive industry – more so than the OEM business,” explains Vogt. “So of course it attracts copycats.”

Protect or share?
In the summer of 2014, electric car manufacturer Tesla positively encouraged people to copy its ideas. “All Our Patent Are Belong to You” wrote company owner Elon Musk – taking an entirely different course from ZF and every other player in the auto industry. He open-sourced all the patents he holds for his successful electric cars. So what did Musk get out of it, apart from massive press coverage? The Californian company hopes this gambit will accelerate the development and adoption of electric cars. Musk’s decision was carefully thought-out – and an exception to the rule. For industry giants like ZF, protecting inventions is crucial. “We simply couldn’t do that,” says Vogt, “because we make our living from our patent-protected exclusivity.” Which means ZF will continue to rely on employees’ ingenuity in the future – and on the continuing efforts of Alexander Vogt and his Intellectual Property team to make life difficult for copycats. ■
DARING TO SUCCEED

While ZF’s ongoing globalization strategy started in Brazil, South America was just the first phase. Today, the company operates 122 production companies in 26 countries around the world.

By Anja Steinbach

Plant(ed) among the palm trees
The company that is now ZF do Brasil Ltda. is founded. Based in São Caetano do Sul, the company produces transmissions and gearwheels for the automotive industry in Brazil.

Off to Brazil! Departing from the parent plant in Friedrichshafen, a team travels by bus to Genoa, where they will board a ship to make the transatlantic crossing.

Although ZF focused on the U.S. auto market at an early stage, the company only started production in the U.S. during the 1980s.

Photos: ZF, Urban Zintel, iStockphoto.com
The first international plant set up by ZF was the result of the company’s close collaboration with German carmakers in Brazil. Today, around 4,300 employees work at three locations in the country (Sorocaba, São Bernardo do Campo, and Araraquara). ZF’s decision to establish an early presence there has paid off: Brazil is now the world’s fourth largest auto market, only outranked by China, the U.S. and Japan. What’s more, ZF’s commitment to South America was just the first step in a highly successful globalization strategy that is still unfolding today.

ZF products held in high regard

As a reliable partner to manufacturers worldwide, ZF is constantly expanding the company’s production network. After Brazil, ZF set up plants in Europe (the U.K. and France), South Africa, North America and Asia. By 1999, some 40 percent of the company’s production sites were located outside Europe. As the production network has grown, so has the number of customer service outlets: workshops sporting the ZF logo are rapidly springing up across Italy, Spain, South Africa, Japan and Singapore. A global network is emerging.

U.S. manufacturing gains momentum

Although ZF’s decision to launch a wholly owned U.S. manufacturing operation in 1986 was taken relatively late, the company’s local operations have steadily grown since the early 1990s; ZF is...
Engaging with Japan

After setting up a dedicated sales company and wholly owned subsidiary, ZF Japan Co. Ltd., Tokyo, ZF is able to provide technical and commercial support to customers in Japan. Previously, the company spent more than 20 years building solid business relationships in the country. Further licensing agreements and affiliated companies soon follow.

1984

ZF International Pte. Ltd., Singapore is established as the first sales and aftermarket company in the South East Asia region. With a more flexible sales organization and improved services, the company aims to develop a significant presence in both the city-state and region as a whole.

Market in India

ZF Steering Gear (India) Ltd., Pune is ZF’s first company set up to manufacture steering systems in India. The move is preceded by various licensing deals for commercial vehicle transmissions and other components.

ZF’s first subsidiary in China lays the foundations for future investment projects. The country is one of the largest automotive markets in the world.
now represented in the U.S. and Mexico by 22 production companies. In 2005, ZF opened the Engineering Center in Shanghai, where products are adapted to Chinese market needs. ZF development engineers are also working on customized solutions for the South American market; so far, they have produced new tractor steering axles and modified automatic transmissions. More than 40 percent of ZF’s sales are generated outside Europe by 122 production companies in 26 countries. And the wheel keeps on turning – because globalization is far from over!

Focusing on efficient division of labor

ZF Engineering Plzeň is set up in the Czech Republic. The company’s eighth development center is manned by specialists in electronics, IT, mechatronics and design, who devise solutions for almost all of ZF’s divisions, as well as external customers in the automotive supply industry.

Committing to the U.S. market

ZF opens the company’s 15th production site in the U.S. – a new automatic transmissions plant in Gray Court, South Carolina. The company’s successful 8-speed and 9-speed automatic transmissions are both manufactured here. The new facility represents the largest single investment in the company’s history.

1993

ZF sets up the company’s first service subsidiary in Beijing, China, followed just 12 months later by ZF Shanghai Steering Systems Co. Ltd., Shanghai, a joint venture with Shanghai Automotive Industry Corporation (SAIC). The company manufactures mechanical and hydraulic steering systems.

2007

Opened in 2005, the ZF Engineering Center in Shanghai adapts products for the Chinese market.

2013

Steering systems, axles and transmissions for construction machinery are assembled in India.
In northern Sweden, a ZF team is making final adjustments to the TraXon automatic transmission system – at minus 20 degrees Celsius. Not all members of the Vehicle Test team are bothered by the cold.

By Achim Neuwirth
Photos: Joscha Kinstner
A heavy curtain of snowflakes is whirling down from the sky. The wind is whistling, the thermometer is showing minus 21.5 degrees Celsius. Welcome to Arjeplog! Here, less than 60 miles south of the Arctic Circle, biting cold is a fact of life. But for ZF test driver Marcus Haug, it still isn’t cold enough. “Conditions aren’t perfect,” he says, “although they’re pretty good.”

The ZF test team traveled to Lapland so they could put the company’s TraXon automatic transmission system through a final series of practical tests. The truck transmission is due to go into volume production in the near future – but first, it must spend some time in Arjeplog. In the automotive industry, this little Swedish town has become the go-to location for extreme winter testing – the surrounding countryside is effectively a gigantic freezer you can drive around in.

But in January 2015, temperatures here only dropped to slightly below minus 20 degrees Celsius, rather than the more usual minus 30 degrees or lower. Which means the test trucks will actually spend the night in a cold room. “Overnight, the transmission fluid cools down to minus 32 degrees, becoming thick as honey. The effect is great for testing, but unfortunately the current outdoor atmospheric temperatures aren’t cold enough to induce it,” explains application engineer Achim Chiandetti. First item on the agenda for Chiandetti and driver Jürgen Pechar: cold starts.

**Cold starts and rocking free**

Over the two-week winter testing period, the 12-speed version of the transmission will undergo stringent tests in two EURO 6 trucks. Chiandetti and Pechar are in charge of one of the trucks. Sitting in the cab, the engineer starts by using his laptop computer to check the transmission actuators, making sure their seals are still tight and their operational efficiency is unaffected; as yet, neither engine nor heating have been switched on. Then he gives Pechar the signal to start. The truck rumbles into life and Pechar drives off, quickly bringing the diesel engine and transmission up to operating temperature. As he drives, he mercilessly tortures the machinery by precisely adhering to the predefined shifting sequences he is given by the engineer sitting alongside him like his rally navigator. Just a snowball’s throw away, the second vehicle still hasn’t moved from the spot. That’s because it’s
Moving off instead of spinning on the spot: the winter testing schedule also covers the rock-free function (above). – Test driver Jürgen Pechar (top right) isn’t the only one who finds that a strong team spirit plus the right clothing are all you need for greeting subzero temperatures and short days with a cheerful smile.

a slippery spot, and the drive wheels are spinning on the icy-smooth surface, unable to find a grip. It’s a common problem for truckers parking in cold regions: the cold snow starts to melt under the warm tires of a newly parked truck, then quickly freezes solid again in the very low temperatures. If you’re sitting in a vehicle with manual transmission, you can use some clever clutch action to rock the vehicle to and fro by engaging and then disengaging the engine. But TraXon is fully automatic – so instead, it has a “rock-free” function. This engages the clutch in a higher gear, and also sets it up so it’s super-easy to control using the electronic gas pedal. While test driver Andreas Arnegger rocks the truck free, application engineer Daniel Gelder busily records all the relevant data on his laptop. Certain parameters may need adjusting later on. “We’re optimizing the assistance system now so that later, any and every truck driver will find it really easy and intuitive to use,” explains the engineer. Three electronically assisted pedal-pushes later, and the semi finally rolls free.

**Winter testing is indispensable**

Cold-related transmission breakdowns or electronic failures almost never happen up here in the Swedish snow. “They’re very rare with our transmission systems, which are already close to final production status when we bring them up here; in 2015, TraXon is continuing the trend, clearly not affected by the cold at all,” comments function developer Stefan Bemetz. The (fully equipped) workshop van is rarely required. “We’re not testing whether TraXon can perform in extreme conditions,” he continues, “we’re testing just how well it performs.” After all, in everyday operation, it makes no difference whether the automatic transmission is working at minus 30 or plus 40 degrees Celsius: the clutch and gearshift action should always meet the same consistently high standards.

Sometimes, this means the software needs tweaking. This the ZF team in Sweden do themselves, quickly and directly – usually without reference to or remote support from Friedrichshafen. If, during one of their evening debriefing sessions, test driver Arnegger mentions a detail that could be improved, his passenger Bemetz immediately notes it down on his laptop, then adjusts the relevant function module before they head out the next morning, transferring the modified software directly to the transmission control unit. Thus the improvement can be “experienced” immediately, during the next day’s testing.
“We’re not testing whether TraXon can perform in extreme conditions – we’re testing just how well it performs.”

Stefan Bemetz, Function Developer

Wouldn’t the results of modern computer simulations, coupled with cold-room testing, be just as good as costly, time-consuming winter tests? The suggestion meets with a flat denial from Bemetz. “Yes, we need all that as well, but on real-world test drives you encounter all kinds of situations you couldn’t anticipate in a virtual environment. If we gave up winter testing, you’d certainly notice it once the transmission was put into volume production.”

Repeating road tests as often as required

ZF has been conducting tests in wintry Arjeplog since 2008. On a test site that has been carefully secured against unauthorized access and observation, the team works hard from early-morning cold starts through to around 6:00 p.m. every day. “Up here, we can take advantage of a neat package of winter road conditions that offers us almost every conceivable option – from dry asphalt to snow-covered roadway; from smoothly polished ice to rough, uneven ice; from broad, circular tracks to challenging inclines,” explains test driver Marcus Haug. “The key to effective testing is that we should be able to repeat all these dynamic, real-world tests as many times as we need to, under identical extreme conditions.”
Lights on! In this almost totally white environment, headlights are especially important for clearly identifying reindeer and other hazards – not to mention the actual road.

Sitting in the passenger seat, application engineer Achim Chiandetti records every detail of each test on his laptop.

Each truck has a crew of two: a test driver, who carries out the maneuvers, and an engineer who initiates and records these maneuvers. The flat surface of a frozen lake in particular is the ideal place for a 40-ton semitrailer to break out – although today, there’s a greater risk of breaking in. At just half a meter thick, the frozen water isn’t suitable for any vehicle weighing more than nine tons.

So the team must test their trucks on other icy surfaces. “Wheels lock up very quickly on ice, so the transmission control unit must be able to recognize what’s happening and respond accordingly,” explains function developer Bemetz. The challenge for the control unit is first, to disengage much faster than usual to prevent the engine from stalling. Second, it must realize that although the wheels are stationary, the truck is still sliding, so that it doesn’t attempt to engage the transmission in a low starting gear. If it did shift into low gear as soon as the driver released the brake pedal – even though the vehicle is still sliding at high speed – the consequences could be dire. “Horror scenarios range from major clutch damage through to an uncontrollably skidding semi,” emphasizes test driver Arnegger. “Fortunately, our cold climate-aware transmission electronics always know precisely what’s required for safe driving!”

“Our cold climate-aware transmission electronics always know precisely what’s required for safe driving.”

Andreas Arnegger, Test Driver
Every winter, test centers in the far North exert an almost magnetic attraction on vehicle manufacturers and suppliers alike. Between November and March, a total of around 30,000 auto testers from some 20 countries assemble in the countryside surrounding Arjeplog, a town of just 3,100 inhabitants.

The rise of northern Sweden’s municipalities to become the world’s largest automotive winter testing ground first began in 1967, when a carmaker made the journey to Arvidsjaur to run engine tests. Those early years had little in common with today’s high standards of test driving. Back then, the developers brought their own brooms and shovels so they could shift snow off the icy surfaces. To check whether the ice was safe to drive on, they would send unmanned cars out over the lakes with their auto transmissions set to “Drive”. But as more and more specialists became aware of the region’s stable winter climate and total seclusion – ideal conditions for winter testing – a professional testing infrastructure swiftly took shape in this remote corner of Lapland, Sweden’s most northerly province.

For the ZF team, the test trucks themselves are the most precious cargo of all – which is why they drive them so carefully on public roads.
Opened in 2014, ZF’s Beijing plant assembles axles for a joint venture between Mercedes and Chinese manufacturer BAIC.

JUST-IN-SEQUENCE DELIVERY

What started 20 years ago as a special service to U.S. customers is now an international, industry-wide standard: ZF supplies manufacturers with complete axle sets.

By Andreas Neemann

It’s a trend that’s now driving the entire automotive industry: whether developing innovative products or assembling and delivering complete systems for the finished vehicle, more and more responsibility is being transferred to suppliers.

ZF became aware of this shift more than 20 years ago and recognized it as an opportunity. In the early 1990s, many international carmakers were building new production facilities. As they did so, they reviewed various processes – including the assembly of front and rear axles – and wondered whether they couldn’t be taken over in their entirety by the suppliers who had hitherto produced most of the individual components, including ball joints, control arms and stabilizer links. ZF seized this opportunity to enter the car chassis business. In 1994, the company opened a new U.S. plant in Duncan, South Carolina, dedicated to building front axle systems for the BMW Z3. Just two years later, ZF opened another plant in Tuscaloosa, Alabama. For the first time, ZF was manufacturing front and rear axle sets as ready-to-install assembly modules for the Mercedes-Benz M-Class.

Plants in nine countries

Today, the 85,000 axle sets ZF produced in that first year have turned into an annual output of 4.3 million units. Since entering this market segment, the company has assembled and delivered a total of around 27 million ready-to-install axles. For years, sales in the axle systems business have shown high double-digit growth rates; ZF now has nearly 3,800 employees engaged in car axle production. The number of plants involved has also rocketed. In total, ZF now manufactures car axle systems at 15 different sites in nine countries. Duncan and Tuscaloosa are still important resources; the Beijing plant was opened in 2014, and production started in Chennai in early 2015.

Geographical proximity a strategic priority

All of these assembly plants have one thing in common: they’re all located less than 20 miles away from the relevant production facility of the ZF customer concerned. “We deliver axle sets to customers’ production lines on a ‘just-in-sequence’ basis – each axle set individually customized to a specific car model,” says Dr. Peter Holdmann, who is in charge of ZF’s global car axle business. “These perfectly synchronized logistical processes set strict limits on how far away our plants can be located from our customers’ plants.” And that’s not all: ZF is also responsible for managing the entire car-axle supply chain – hence buys any components which the company doesn’t manufacture itself from local suppliers on behalf of the end-customer.

Partners in development

In engineering terms, the car chassis has lost none of its importance over the last 20 years – rather the
Car axle systems
Modern axle systems combine mechanical components with electronics: integrated sensors and actuators reflect the importance of electronics in, for example, ZF’s adaptive CDC (Continuous Damping Control) damping system or AKC (Active Kinematics Control) tracking alignment system.

“The worldwide success of our axle systems is the outcome of our employees’ commitment and inventiveness.”

Dr. Peter Holdmann,
Head of Car Axle Systems

Wheel carriers: they absorb all the forces generated around the wheel and bridge the space between axle kinematics and bearings.

Control arms: in independent suspension systems, they connect the wheel carriers to the car body.

Dampers: dampers suppress vibrations transferred to the chassis from the road surface and vehicle suspension.

Stabilizer links: made out of steel and plastic, this hybrid design keeps weight low.

Tie rods: they transfer the driver’s steering motions to the front wheels.

opposite, in fact. The chassis is largely responsible for the car’s ride comfort and handling, safety and energy efficiency. ZF is an attractive partner for customers in the automotive industry – not just as a specialist in assembly, but also as a highly specialized developer of car chassis systems. The challenge is, of course, to develop chassis and suspension systems that meet very precise space and cost specifications while also delivering the required handling characteristics.

In addition to traditional control-arm setups, mechatronic systems play an increasingly important role in the design of the modern chassis. Active chassis and suspension systems like the Continuous Damping Control (CDC) system or Active Kinematics Control (AKC) system for controlling rear-axle toe-in – both developed and built by ZF – give engineers much greater latitude by enabling them to reconcile apparently conflicting objectives, such as how best to combine exceptionally dynamic handling with very high safety margins plus high levels of comfort. Around the world, 135 ZF engineers are helping manufacturers develop advanced chassis and suspension systems for cars; their tasks range from developing brand-new products through to adapting existing systems for use in specific production models.
“TYPICAL” TRUCKERS?

Kings of the road – or just stressed clockwatchers? Few other occupations are so encumbered by cliches as that of the professional truck driver. The ZF Study on Truck Drivers 2.0 delivers a more differentiated perspective.

By Melanie Stahr

What trends are currently influencing logistics? And how should the industry respond to these new challenges? These are the questions explored in the second part of the study on the future of truck driving put together by ZF in collaboration with trade journal FERNFAHRER and German training provider DEKRA. The study identifies two major trends. First, the industry is becoming increasingly industrialized, with the division of labor steadily becoming more pronounced. And second, shifting values in society are also affecting professional truck driving as a career, with young drivers placing greater emphasis on work-life balance and family-friendly working conditions. To better evaluate the impacts of these trends, the study identified four driver personality types on the basis of interviews with industry experts. We describe them here, with the help of four truckers.

Vocational:

Peter Schmickler (44), Kerpen
Schmickler is a trucker through and through, a driver who loves his vehicle and easily copes with the working conditions and pressurized deadlines typical of international haulage – but doesn’t cope so well with dust gathering on his wheel rims. He’s an individualist, and loves the fact that freight company Freund in Frechen allows him to drive his truck alone. For him, the open road is home from home.

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“The reason I love driving is because I enjoy the freedom and I love nature. I’ve been working in international long-haul trucking since 1991. I’ve been to Pakistan, India, Iran, Turkey and Russia.”

Peter Schmickler

For more information on the ZF trucking study, as well as a short film profiling the four drivers, visit www.zf-zukunftsstudie.de
“For me, truck driving is like any other job – I start at six o’clock in the morning and I finish work at six o’clock in the evening. When I go home, I don’t worry about my working day; I leave my truck where it is and enjoy my leisure time. And that’s it. I start again at six o’clock the next morning.”

Christian Schulz

Rational:

Christian Schulz (34), Duisburg
Schulz drives for freight forwarding company Köppen in Duisburg, Germany, as part of a largely industrialized transport operation. Up to three times a day, he drives to the Krefeld-Uerdingen chemical park on behalf of the logistics firm, delivering tank containers to the nearby terminal. The various processes are highly automated. He doesn’t feel any strong emotional attachments either to his work or to his truck.

Accidental:

Hartmut Wolf (55), Bad Münstereifel
Wolf is one of the many career changers working in the industry. After an industrial accident, he was forced to look for alternative employment so he could continue to make a living. For shipping company Berners in Mechernich, Germany, drivers like Wolf have always formed the backbone of their fleet, especially in long-haul transportation with its irregular working hours.

Hartmut Wolf

““I enjoy my job because the company gives me regular working hours. After my day shift, I can spend time with my girlfriend; after a night shift, I can still attend appointments, for example. I couldn’t do that as a long-distance driver.”

Gordon Fickert

Aspirational:

Gordon Fickert (30), Rohren/Eifel
For the last six years, Fickert has been making regular deliveries for transport company Hermanns & Kreutz – either to Belgium, or to a transport hub for transit traffic from Munich. He’s always wanted to be a truck driver, which is why he paid for his own HGV driving lessons and license after leaving school. For him, the most important things are the freedom offered by truck driving, and at the same time, the opportunity to lead a proper social life.
A LIFELONG RESOURCE

Wind power is one of the most important sources of renewable energy. Weighing up to 70 tons, wind turbine gearboxes are buffeted by huge forces, so they need regular maintenance. At ZF, a team of specially trained service technicians is ready to spring into action anywhere in the world.

By Raymond Wiseman
Photos: Thorsten Futh
Michael Richter’s workspace, some 350 feet above the ground, is definitely cramped. The access door below the gearbox is narrow, too.
Once the gearbox has been dismantled, technicians decide which parts can be reconditioned. If it’s not possible to make repairs in the wind turbine nacelle, the gearbox – weighing up to 70 tons – must be lifted out by crane and taken to ZF’s specialist facility for maintenance.

At the heart of every turbine lies the gearbox. ZF’s aftermarket service and global repair service for wind turbine gearboxes make the company one of the two largest suppliers in the world. Some 200 people work in the company’s international service network – and it’s steadily growing. Among other places, they’re stationed in Lommel (Belgium), Vernon Hills (U.S.), Coimbatore (India) and Dortmund (Germany). One of ZF’s key unique selling points: as an international supplier servicing multiple brands, the company offers its repair and maintenance expertise for gearboxes and drive-lines built by almost all manufacturers.

**Tower-top repairs**
As a rule, wind turbine gearboxes last between 20 and 25 years. To be able to withstand the powerful forces acting on them during this period, they need regular maintenance. Part of ZF’s service offering includes a team of 25 specially trained technicians capable of servicing the gearboxes in place, inside the wind turbine itself – 100 meters or more above the ground. One of these technicians is Michael Richter from Lommel. Each year, Richter and his colleagues fly around the world several times over, climbing wind-turbine towers in Europe, Australia, Asia, and North and South America. Minor repairs can be made directly inside the nacelle, but if major repairs are needed, the gearbox...
“We’re well placed to service our own gearboxes, but we also service and repair products built by other manufacturers.”

Marcel Pooth, Head of ZF Wind Energy Service
Remanufacturing, maintenance and inspection are all carried out at ZF’s specialist workshops in Lommel.

Around 750 gearboxes, each capable of producing between 1.5 and 6 megawatts, are repaired by ZF each year.

- which can weigh up to 70 tons - must be lifted out of the nacelle by crane and driven away on a heavy-duty transporter. That can take several days of hard work.

**Testing gearboxes under load**

So the tower-top tasks performed by Richter and his specialized colleagues directly benefit the turbine operators. Every repair that can be made without using a crane and causing major delays doesn’t just save time, it also saves a great deal of money. The faster the wind turbine is up and running again, the faster it goes back to generating energy – and sales.

"A full wind-turbine gearbox rebuild can take between eight and ten weeks," explains Marcel Pooth, “including the transportation and relevant paperwork.” This means the service team must dismantle the multi-ton housing, assess the damage, check all components, overhaul certain parts and replace any others – typically bearings and bolts – that are no longer suitable for reuse. Each ZF service center has test rigs which are used to test the gearboxes under simulated loads.

**Global service**

The time-critical nature of the repair work means that a global presence is just as important as regular servicing. ZF already has a well-developed service network in Europe and the U.S., but the company also has a presence in other key markets such as India and China.
“We do third-party gearboxes, too”

Marcel Pooth, Head of ZF Wind Energy Service, talks about maintenance and remanufacturing

What is ZF’s special strength?
Our quality, without a doubt – it shows in everything, right down to the tiniest detail. That’s true of the gearboxes we manufacture ourselves, of course. But our meticulous attention to detail means we can also offer efficient, cost-effective servicing for gearboxes and drivelines built by other manufacturers. Remanufacturing – that is, overhauling and reconditioning used components so they’re as good as new – is another of our specialties. It is, after all, another way of managing resources responsibly.

What’s so special about remanufacturing?
It really is all about rebuilding something – literally re-manufacturing – because even a single manufacturer’s gearboxes usually aren’t identical; there are often technical variations. So our expertise extends way beyond our own gearboxes to cover third-party gearboxes and indeed, the entire wind-turbine driveline. The maintenance services we offer include developing processes for non-ZF products.

In which wind-power markets does ZF have a presence?
Our key sites are Dortmund in Germany, Lommel in Belgium and Vernon Hills in the U.S.. But we offer our customers a worldwide servicing network. The development of our U.S. site in Vernon Hills underlines the growth potential of our servicing business. There are now around 30,000 wind turbines in the U.S., and many of them are nearly ten years old – sometimes more. The most important factors in keeping existing wind turbines productive are inspection, maintenance and repairs. Our big advantage here is that because we have service networks in the U.S., as well as India and China, we can repair and test gearboxes on site, without first having to ship them back to Europe.
A BRIGHTER FUTURE FOR KIDS IN GHANA

In early 2013, ZF employees donated more than 550,000 euros in support of educational initiatives in four countries. Two years on, drive pays a visit to one of the sponsored schools in Ghana.
Franka Ama Yeboah is nine years old. “Science is my favorite, because I want to be a nurse, and I think science is the best way to get ready.” She’s a little shy, but talks about her hopes for the future with great conviction. Franka is in Year Four at the Finger of God Preparatory School in Madina, a suburb of Accra, Ghana’s bustling capital city.

The school is one of the beneficiaries of funds raised by a ZF hilft. campaign during 2013 on behalf of educational institutions in Ghana, Rwanda, Uganda and the Dominican Republic. ZF hilft. has been collecting donations for educational and other humanitarian projects since 2005 – total funding raised to date comes to more than 7.5 million euros (around 8.4 million dollars). In 2013, the nonprofit association handed over 557,500 euros to project partner Opportunity International in support of, among others, 71 private schools in Ghana. One of them is the Finger of God Preparatory School. “Education is one of the most basic prerequisites for enabling children and young people in these regions to escape from poverty,” explains Jürgen Holeksa, Corporate HR Director at ZF and Chairman of ZF hilft.

The school is located in one of Madina’s residential areas, away from any busy main roads. The building is surrounded by mounds of builder’s sand and towering frameworks of steel girders. But although the school is still partially a construction site, what happens in the classrooms makes it easy to overlook these structural shortcomings. Here, dedicated teachers are educating children who are genuinely hungry to learn. Fifteen children study in the English classes taught to Year Four students by Sonia Nyantekyiwah, and their enthusiasm is tangible.

“I would love to see these children grow up into future leaders. One day, I’d like to be able to say that the President of Ghana was taught at my school,” laughs Michael Okley. The 64-year-old minister is also the school’s founder. He contributed much of the funding himself. “I started in the church, which is big enough to accommodate two primary classes.” With the help of a microloan for the equivalent of 6,600 euros, provided by Opportunity International, he was able to afford a new school building with four additional classrooms. The school stands alongside the pastel-green church. Currently, seven women teachers give lessons to 130 preschool and primary-school children. Okley is planning to expand the Finger of God Preparatory School to include a middle and upper school, and eventually teach to university level.

Education is highly respected
Assurance Abudey is eight years old and attends Franka’s class. Because he lives further away, he comes to school every morning in one of Ghana’s many tro-tros.
Every day, Veronica Nartey (above) cooks for the 130 children who attend the Finger of God Preparatory School. Assurance Abudey (far right) hopes his parents will go on being able to afford the school fees.  

“With fewer children in each class, we have time to help every child fulfill his or her personal potential.”

Sonia Nyantekyiwah, teacher

or minibus taxis. He enjoys math, and wants to become an accountant. He’s hoping his parents will be able to continue to afford his school fees – the equivalent of 80 euros (about 85 dollars) a year. Pupils must also bring their own lunch money every day, equivalent to 40 cents. But even if they can’t afford to pay, they needn’t go hungry: cook Veronica Nartey comes to school every morning before six o’clock and cooks enough food for all the children – without exception.

In this West African country, education enjoys a high level of respect in society, and there are many people like Michael Okley. He is what is known as an “edupreneur” (coined from education and entrepreneur). For years, initiatives by edupreneurs like Michael have driven the development of affordable private schools in various parts of the country. Working with Ghananian partner organization Sinapi Aba Savings & Loans, Opportunity International has provided microloans to around 400 school founders.

Investments that pay off

In most cases, the school founders don’t have sufficient collateral to obtain personal loans from banks. But in any case, the assistance provided by the two organizations goes far beyond just lending money. Their intensive support for school founders includes training courses for teachers and other useful aid. All of this helps to ensure that on the whole, these schools work successfully. And the loan repayment rate is high – 98 percent of the microloans are paid off within the standard three-year period. This success also depends, of course, on the solvency of the pupils’ parents. Some schools have developed systems that make it possible for children from very low-income families to attend school. Parents can contribute by helping at the school, or by paying fees in installments or as a lump sum at a later date.

Smaller classes for greater success

In Ghana, more than 70 schools are currently benefiting from the ZF donation made back in 2013. These privately run schools are in high demand by both parents and children. For good reason – a number of studies have shown that children attending private schools do better in tests and exams than children who attend state schools. Even Ghana’s Ministry of Education endorses and supports this initiative.

The educational success enjoyed by these schools is due not least to the comparatively small class sizes. “With fewer children in each class, we have time to help every child fulfill his or her personal potential. Teachers at state schools often don’t have this
Whether learning or exercising, the children really concentrate on what they’re doing.

Two of the classes are taught in the church run by school founder Michael Okley.

“One day, I’d like to be able to say that the President of Ghana was taught at my school.”

Michael Okley, founder of the school

opportunity,” explains Sonia Nyantekyiwha. As well as English, the 25-year-old also teaches mathematics, science, ethics and religion, as well as art. A stack of her pupils’ homework books is piled on her desk in the classroom. She is a teacher through and through, who misses “her” children during the school holidays. This profound sense of commitment and enjoyment also helps inspire the children themselves. “Our teachers are really great,” enthuses Assurance.

School founder Michael Okley shows the same kind of wholehearted commitment. “It’s always been my dream to help my fellow human beings. The school has certainly expanded my horizons – I’ve learned such a lot from the children.” Now, his major goal is to put together enough money to finish building his school... and then expand it even further.

“One day, I’d like to be able to say that the President of Ghana was taught at my school.”

Michael Okley, founder of the school

In ZF’s Anniversary year, 2015, ZF hilft. is once again committed to supporting educational projects around the world. The organization’s commitment is built on three pillars: infrastructure, quality, mobility. Working together with UNESCO foundation Education for Children in Need, ZF hilft. is sponsoring the construction of 30 schools in Bangladesh, India and Sierra Leone, and funding educational materials and teacher training courses for 70 schools in China, Mexico, Nepal, Peru and the Philippines. Thanks to project partner World Bicycle Relief, schoolchildren in 100 villages in Zambia and South Africa can now cycle to school rather than having to walk for hours on foot. For the first time ever, ZF employees worldwide are invited to contribute, making “100 Years – 100 Schools” the largest educational project in the company’s history. The campaign is not confined to ZF employees; anybody is welcome to make a donation.

Scanning this QR code with your smartphone will take you to a web page where you can make your donation directly.

For more details, visit www.zf.com/zfhilft
MORE THAN JUST
RED, AMBER, GREEN

It all started in 1914, when the first “municipal traffic control system” was installed on an intersection in the U.S. city of Cleveland, Ohio. Today, traffic lights are a familiar sight around the world – and they do much more than just send out start and stop signals.

By Julia Ruge
A popular world city it may be, but London can also prove perilous for pedestrians. In 2012, 65 pedestrians were killed in the British capital and 773 seriously injured. Last fall, the city’s transport authority, Transport for London, launched a pilot project to address this alarming statistic. Induction loops just like the ones built into road surfaces to detect cars approaching traffic lights were installed under sidewalks at two sets of lights, but these loops are there to detect pedestrians rather than vehicles. If large numbers are waiting at a traffic light, the green man lights up for longer. The trial will be reviewed in spring 2015 – if the results are good, the system will be rolled out across the city.

For over 100 years, lights have been used to control traffic on roads around the world, telling vehicles and pedestrians when it’s their turn to go, and so preventing collisions between the two groups of road users. The early history of traffic lights actually predates the arrival of the motor car – and also starts in London. Back in 1868, the city authorities were already making efforts to regulate the city’s busy traffic. In December of that year, traffic police installed a rotating lantern with one red and one green light in Parliament Square. It was the birth of the traffic light! However, it used gas for fuel, which proved its undoing. A gas explosion injured the policeman responsible for operating the lantern, bringing the opening chapter in the long history of traffic lights to an abrupt end.
It was electricity that put traffic lights back on the map and kept them there. The electric traffic light installed in Salt Lake City, Utah, in 1912, was essentially the same as a modern traffic light; the only thing missing was a patent. The U.S. patent for a "Municipal Traffic Control System" was finally granted in 1918, based on a traffic light hung up in Cleveland, Ohio, in August 1914. To this day, the majority of U.S. traffic lights are suspended from elevated structures on the opposite side of the road. As a matter of fact, U.S. drivers can turn right at traffic lights – even when showing red – unless they are expressly forbidden from doing so. A regulation that can have hazardous consequences for uninitiated visitors from other countries.

**Between authoritative and decorative**

"In Germany, traffic lights are indicative (they tell you what to do); in France, they’re subjunctive (they suggest what you might do); in Italy, they’re decorative (just there to look nice),” or so the saying goes. And indeed, behavior at traffic lights varies enormously around the world. Perhaps the world’s greatest traffic-light devotees are the Danes. Denmark’s “Lyskurv” have been around since 1928. Crossing the road when the red man is lit up incurs a 135-euro fine (about 145 dollars) – so more haste, less speed in Denmark. In France, such behavior will only attract a shake of the head. Whether on the Champs-Elysées or the Place de la Concorde – in Paris, you just go for it. But be sure never, ever to glance at the oncoming traffic as you do so. In Italy, a similar approach also does the trick.

Over in Japan, it’s a case of "every man for himself", especially when the lights turn green – because they do so simultaneously for drivers and pedestrians alike. Vehicles traveling in every direction must all stop at the same time, ceding the junction entirely to pedestrians, who are also allowed to cross diagonally.

**The future is still red/amber/green**

In the future, traffic lights are set to do many more things apart from merely lighting up in red, amber or green. The induction loops in London represent a comparatively simplistic use of technology. Traffic lights are becoming smart – capable of communicating with each other, with road users and with traffic control centers. They are capable of sharing data on traffic volumes, roadworks and tailbacks, so as to improve the traffic flow and move things along more smoothly. Looking ahead, traffic lights will also be able to communicate with autonomous vehicles. And of course using traffic lights as data hubs works both ways: speeding ambulances approaching traffic lights could request them to stay green for longer.

In Songdo, South Korea, an intelligent traffic management system that is also capable of learning uses communicating traffic lights combined with a city-wide network of sensors to keep the flow of traffic safe and stress-free. Traffic movements are monitored in real time and compared with existing data. This produces realistic traffic forecasts that are used as the basis for controlling traffic across the entire city. Traffic lights can also collect other data – on particulate levels in the atmosphere, for example. And traffic lights equipped with ANPR (Automatic Number Plate Recognition) can track individual vehicles and determine how fast they are traveling. As well as providing useful data for optimizing the flow of traffic, this also means that journey logs can be compiled for individual road users. Welcome to the concept of the "transparent" driver.

All in all, then, we can expect much more of traffic lights in the future, as they build on the 100-year history they already have behind them. Over this whole period, there has only ever been one threat to the universal decision to use red for “stop” and green for “go”. In China in the 1960s, the Communist Party wished to give their official party color (red) a positive, dynamic image, so rebranded it as the signal for “go”. But the experiment ended in chaos, and the old order was soon restored.
The right person for the job!

There’s huge variety in the appearance of the figures fronting pedestrian crossing signals around the world. While Spain prefers a minimalist matrix, Denmark favors much more detail, complete with hat and stick. Some of them even have their very own modes of transport, ranging from a bicycle in Austria to a horse in Mongolia. The feelings evoked by these simple start/stop symbols were highlighted by the vigorous debate surrounding the traffic-light figures used in the former East Germany. Post-unification plans to get rid of the old, GDR versions gave rise to a major protest movement.

YEARS

have passed since energy-saving LEDs became a standard feature of traffic lights around the world.

Traffic light game

Students from Hildesheim University of Applied Sciences and Arts created a video game that pedestrians waiting on opposite sides of the road can play with each other.
THANKS A MILLION

Heard about the car that covered one million kilometers on a single transmission? A BMW 5 Series did just that with a 5-speed automatic – and emerged fresh as a daisy.

yesterday

Starting in 1990, BMW 5 Series cars were fitted with ZF’s 5-speed automatic transmission, the 5HP. As part of a somewhat unusual long-term test, engineers commissioned by Auto Bild magazine took apart a 1997 model with more than one million kilometers on the clock. The astonished experts found that the original transmission was still in place – and looked “pretty much fresh out of the box”.

and today

Today’s BMW 5 Series also comes with a ZF automatic transmission – the 8HP. The unit changes gears quickly and smoothly, and its impressive efficiency helps keep fuel consumption low. The launch of the production version of the 8HP in 2009 was followed in 2014 by the arrival of a further enhanced second generation. The new version made its production debut in the BMW 520d.
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A WORLD IN MOTION.

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