

vision

On the Road to **VISION ZERO**

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LIFE IN THE FAST LANE

How the company is moving up a gear in China

.....

DRIVEN BY VISION

ZF presents tomorrow's vehicle technology today



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Identifying digital trends, providing docking stations for start-ups – ZF does these things. New formats for getting acquainted can help here.

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On the
Road to
**VISION
ZERO**

We are shaping
the future today
– safely and
efficiently.



How significant is vehicle safety to the mobility of the future?

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THE FUTURE BELONGS TO ELECTRICALLY AND AUTONOMOUSLY DRIVEN VEHICLES. YET WITHOUT CONSIDERABLY IMPROVED VEHICLE SAFETY, NEITHER SELF-DRIVING CARS NOR E-MOBILITY WILL BECOME WIDELY ACCEPTED.

The path is predetermined for active safety systems: if something is currently an assistance system, it will soon evolve into a fully automated driving function. The role of passive safety technology, on the other hand, is frequently underestimated.

Particularly during the transition phase, systems such as seat belts and airbags remain of critical importance until traffic is fully networked. The benefits of such systems go beyond merely protecting vehicle occupants; they also have a significant influence on social acceptance of autonomous driving and the establishment of e-mobility.

If autonomous vehicles do not offer the same level of protection as conventional vehicles, they will not become widely accepted. Only a driver who feels completely safe will surrender control to a self-driving car. To this end, we must find new solutions, because the occupants will take advantage of their new-found freedom and neither their position nor their activities can be predicted. This produces completely new challenges in terms of positioning airbags and securing seat belt systems. We must also deliver concepts in the area of e-mobility. For instance, we must find better and more cost-effective ways of protecting batteries in the crash zone.

I am completely convinced that wide social acceptance of mobile megatrends is very closely linked to the solving of the safety issue. ZF will play a key role here. That's because the company has a portfolio like no other, ranging from classic mechanics to self-learning software. By intelligently networking our skills, we are able to create systems that take us closer to our goal step by step: "On the Road to Vision Zero."

Dr. Stefan Sommer
CEO ZF Friedrichshafen AG



Ferry Porsche, the designer of the legendary Porsche 356 Roadster, would certainly have had a ball in the new Porsche Panamera 4 E-Hybrid. After all, the sporty limousine has the power of two hearts. In perfect harmony with one another, the Porsche V6 biturbo petrol engine in the new Panamera 4 E-Hybrid works alongside the electric motor incorporated in the new 8-speed dual-clutch transmission – both from ZF. If desired, the plug-in hybrid will transport its passengers ultra-quietly on local, emission-free journeys with a range of approximately 50 kilometers using purely electrical power. If maximum dynamism is required, the 100-kilowatt peak output of the electric motor will lend additional power to the 243-kilowatt combustion engine. Even engineer Ferry Porsche would probably have been surprised that power and efficiency go together so well.

Turn to page 42 for more details on the new ZF 8DT dual-clutch transmission.

ZF MOMENT

Twice the fun

facts and figures



Safety

Life is pretty dangerous

OUR EVERYDAY LIVES SHOULD BE AS SAFE AS POSSIBLE WITHOUT MISSING OUT ON ALL THE FUN. CURIOUS AND SERIOUS FACTS ON THE SUBJECT OF SAFETY.



SATURDAY NIGHT LOW

In the night from Saturday to Sunday, just before five o'clock in the morning, the concentration of road users appears to reach its low point. At exactly that time, the number of road fatalities in Europe is higher than on other days of the week.

SENIORS IN ROAD TRAFFIC

75%

of all road traffic accidents involving senior citizens are also caused by them. Cross-roads in particular are a problem.

0/365

ONE YEAR ZERO

In these large cities there were no fatal traffic accidents in the period of at least a year between 2009 and 2015.

Country	City	Population
	Espoo	270,744
	Aachen	245,885
	Almere	198,823
	Le Havre	172,807
	Uppsala	149,245
	Alexandria	139,966

USING UP CREDIT ON YOUR LIFE ACCOUNT

Whether a person's life lasts 80 years or ends earlier all depends on the risks they take. American scientists have developed a method of assessing the risk of various activities. It is based on a unit of risk known as the micromort (MM). **It is defined as a one-in-a-million chance of death.** If we do nothing out of the ordinary,

our base level is 34 MM per day. A parachute jump will increase the level by 7 MM, while climbing Mount Everest costs 35,000 MM, reducing our life expectancy by around three years.

Micromorts make it possible to compare risks that have nothing at all to do with one another.



6 MIN IN A CANOE
(ACCIDENT)



10 KM ON A MOTORBIKE
(ACCIDENT)



370 KM IN A CAR
(ACCIDENT)



1 YEAR OF WATER IN MIAMI
(CANCER CAUSED BY CHLORINE)

1 MICRO-MORT



100 BARBECUED STEAKS
(CANCER CAUSED BY BENZOPYRENE)



0.5 L WINE
(CIRRHOISIS OF THE LIVER)



1.4 CIGARETTES
(CANCER, HEART DISEASE)



40 SPOONS OF PEANUT BUTTER
(LIVER CANCER CAUSED BY AFLATOXIN B1)

LONGER DRIVE, SMALLER RISK

1960

19,762,845 MILES

The distance that someone in the USA can statistically drive without suffering a fatal accident.

2015



88,495,575 MILES

7

Feeling versus danger

Text: Stefan Schrahe

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WHETHER WE FEEL SAFE OR NOT IS A HIGHLY SUBJECTIVE THING. MANY PEOPLE PERCEIVE CRIMINALITY OR TERRORISM TO BE THE BIGGEST THREAT, EVEN THOUGH LACK OF EXERCISE IS OBJECTIVELY MUCH MORE DANGEROUS. A LOOK AT OUR NEED FOR SAFETY, PARADOXICAL BEHAVIOR, AND THE OPPORTUNITIES FOR TECHNOLOGY.

1,600

Around 1,600 US citizens died on the roads between October 2001 and September 2002, because they wanted to avoid the risk of a terror attack in the air.



The thermometer shows 32 degrees in the shade and the humidity is more than 80 percent. The eleven-hour flight from Frankfurt to Phuket has taken its toll on the young family. Three-year-old Emma's mood is correspondingly bad. The best option is to take a taxi to get to the hotel quickly and head straight for the pool, but the yellow and red cars have no child seats and the buses don't even have seat belts. Should they just get in anyway and hope that they arrive in one piece? Or stay true to their principles and endure a 30-minute walk? Stress, heat, and a mountain of luggage quickly ensure that this time there will be an exception to the rule of not driving a single meter without a child seat.

Most people would probably have made a similar decision, while others would have stuck to their principles. Safety is simply anything but objective. Even though our desire for safety is deeply rooted in each and every one of us – the American psychologist Abraham Maslow classified safety in his famous hierarchy of needs as the second most important foundation after basic physiological needs – safety-related decisions are also always a case of weighing up the situation and individual perception.

After all, what exactly is classed as dangerous and how dangerous is it? The difference between objective dangers and their subjective perception is huge. People react particularly sensitively, for instance, when several persons appear to be in danger at the same time. It is a relic from the Stone Age when the sudden death of many people in early societies would have endangered the survival of the rest of the group. Frequent deaths of individuals, on the other hand, were part of normal everyday life.

THE INFLUENCE OF SOCIETY

The model still holds true to this day: in the aftermath of the attacks on September 11, 2001, many people switched from the plane to the car. Faced with the collapsed towers of the World Trade Center and the evoked terror risk, a plane trip seemed to be too risky. As a result, the number of road traffic accidents increased: insurance mathematicians calculated that around 1,600 US citizens died on the roads between October 2001 and September 2002, because they wanted to avoid the risk of a terror attack on a plane.

“Many people are scared of the wrong things.”

ANDREAS HENSEL
president of the Federal Institute for Risk Assessment

TRUST IN TECHNOLOGY

“Most people are barely able to carry out a personal risk assessment, because they haven't systematically learned how to do so. Nonetheless, the individual wants to be able to control the risks to which they are exposed. Accordingly, many people are scared of the wrong things,” says Andreas Hensel, president of the Federal Institute for Risk Assessment, describing irrational fear. The irrationality manifests itself in the person's own behavior. We react hysterically to supposedly immediate dangers such as terror and suppress real risks such as diseases for reasons of convenience, even though unhealthy eating and lack of exercise threaten our physical integrity most of all – at least in industrialized and emerging nations. While our ancestors were still concerned with finding food and a warm cave in the daily battle for survival, our safety is mainly threatened by too much sugar, fat, and sitting around.

A person's gut instinct generally reigns. A subway station at night appears to be more threatening than a Sunday ride on a motorbike. That's because, like the large majority of car drivers, we believe that we are always in control and are capable of safely managing a vehicle in any traffic situation –

even though the statistics clearly disprove this. Sometimes it is the force of habit that comes out on top, which can be observed every year as soon as the temperatures start rising again. While parents meticulously make sure that their children's cycle helmets fit perfectly, they themselves fly along the overcrowded cycle paths without the lifesaver on their heads – even though the risk of serious injury and death is around 60 percent lower for helmet wearers. The head protection is considered uncool primarily among 17- to 30-year-olds – only one in ten people wears one.

SUPPOSED SAFETY

The cycle helmet also demonstrates the difficult balance between a person being in control themselves and relying on technical equipment, institutions, or other people. Road traffic is a complex system with many safety mechanisms and the helmet is just one of several factors. A person's own behavior – such as how closely they drive past parked cars – plays as much of a role as the ecosystem in which people move around. In the Netherlands, for instance, a well-developed cycling infrastructure, considerate car drivers, and a commitment to the bike in all walks of life create an environment in which cyclists can get around safely.

MASLOW'S HIERARCHY OF NEEDS

Basic needs such as food are right at the top of Maslow's hierarchy of needs. In second place is the desire for safety in the form of health and having somewhere to live. Only then is there room for social relationships, freedom, or self-actualization.



RAISE AWARENESS OF RISKS

Internationally renowned risk researchers such as Professor Ortwin Renn and Dr. Piet Sellke are calling for an improvement in the ability of young people to assess risks. Even children should systematically learn how to approach their health, finances, and digital media so that they can tell the difference between real and supposed dangers. A study published by future researchers at the TU Berlin in spring 2017 also confirms how important this is. It predicts that by 2030, "insecurity as a part of everyday life" will be less and less accepted. At the same time, the scientists stress that, if nothing happens, most people will lack an awareness of real dangers and risks. This is a problem insofar as irrational fears could also have huge political ramifications.

That's because, depending on the perceived threat, we accept restrictions on our freedom and are even grateful when experts objectively classify dangers. When the lifeguard hoists the red flag, we stay out of the water. If there is an avalanche warning, we respect the closure of ski slopes and lifts. If our perceived safety is endangered, freedom becomes a secondary consideration. This makes it all

the more important to be able to tell the difference between real and perceived threats – and realize that the idea of one hundred percent safety will probably always remain an illusion, although this is not inconsistent with the aim of always designing something to be as safe as possible, whether a car, bike, or an entire infrastructure.

PRESCRIBED SAFETY

There is a tradition in the fact that this safety is often ensured through laws or technical requirements. At the same time, there is always the issue of the tension that exists between the benefits, over-regulation, and restrictions on personal freedom. Is it a good idea to impose a general ban on smoking or monitor the electronic communications of all citizens, because they may be planning to commit crimes? The gap that exists between ideas

of personal freedom and prevention is also evident in the debate on the right to possess a firearm in the USA, in widely differing views on video surveillance in public spaces, and in the different speed limits and blood alcohol concentration limits for drivers in many industrialized countries.

Fortunately, the benefits can sometimes be clearly demonstrated: when Germany introduced a fine for driving without a seat belt in 1984, the number of people who failed to buckle up was reduced from 40 to 10 percent. The result: in the following year, 10,784 fewer people were seriously injured and 1,176 fewer people were killed. The latest WHO report on road safety also shows that regulations are often necessary to bring about sensible changes in behavior. The document examines the monitoring of legal regulations governing speed, the requirement to wear a seat belt, and blood alcohol concentration limits for 180 countries and compares them with the accident figures. "Many high-income countries have managed to break the link between rising motorization and road traffic deaths, with some managing to dramatically reduce such deaths. These achievements are the result of making infrastructure safer, improving the safety of vehicles, and implementing a number of other interventions," says the WHO report. Continuing innovation is helping to prevent accidents and protect vehicle occupants and other road users all over the world – today and in the future.

THINK TANK AGAINST HACKERS

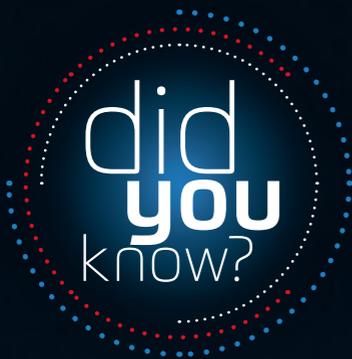
Technology creates safety, but can also be a source of new dangers. Whether traffic management systems, energy suppliers, industrial enterprises, or Facebook users, wherever data flows, hackers are waiting to pounce. Cyberattacks cause damage in the region of 450 billion US dollars worldwide, but they are not only a threat to private individuals or companies, but are increasingly also a danger to the political system. Getting to the bottom of the attacks is looked on with mistrust and the persons responsible often remain in the shadows. The independent American think tank RAND (Research AND Development) is calling for the establishment of an international and independent organization to analyze the cyberattacks and uncover the persons responsible. A panel of IT experts, scientists, and lawyers could bolster online defenses, thwart attacks, and introduce measures to hold the perpetrators to account. Data streams have long since been crossing borders, so a secure online world is essential for our global lives and businesses. Since networked mobility in particular is becoming increasingly important to ZF, special teams are working on the data security of components, vehicles, and complex systems.



No swimming: when experts assess risks, we stick to the rules.

If our perceived safety is endangered, freedom becomes a secondary consideration.





Better protected by technology

WE ONLY NOTICE TRAFFIC LIGHTS, AMBULANCES, AND GUARDRAILS WHEN THEY ARE NOT THERE. A LOOK AT MILESTONES IN ROAD SAFETY.

ORDER AMONGST CHAOS

Complete confusion reigned on the streets of London in 1868. A gas-powered traffic signaling system was installed but exploded after a short while. The first electric traffic lights entered service on August 5, 1914, in Cleveland, USA – with red and green lights. Three-color signals were first seen in Detroit and New York in 1920.

A driving error – and nothing to stop the vehicle from plummeting down the ravine. Only in the 1930s did the Americans begin to build guardrails out of wood, stone, and mortar. On the median strip in particular, the guardrails prevented contact with traffic traveling in the opposite direction. From the 1950s onward, many countries started constructing traffic medians from steel profiles that gave way in the event of a crash. There are now concrete protective walls that not even trucks can penetrate.

TÜV, MOT, AND CONTRÔLE TECHNIQUE

Worn brakes, dim lights – many countries around the world prescribe technical inspections to protect road users from unsafe vehicles. Finland introduced the system back in 1917, Germany in 1951, the UK in 1960, and France in 1992. Exhaust emissions testing is also often part of the inspection. In the USA the federal states themselves determine the content and frequency of the inspections. Massachusetts started the wheels in motion back in 1926 with voluntary tests.



RENDEZVOUS AT THE SCENE OF THE ACCIDENT

BLACK-AND-WHITE PAINTING

The idea of the crosswalk, or zebra crossing, originated in England, because car drivers were unwilling to stop voluntarily for pedestrians wishing to cross the road. In 1949, 1,000 zebra crossings were painted on the roads during "Pedestrian Crossing Week". Two years later they were enshrined in law along with the rule that pedestrians have the right of way and cars are not permitted to park nearby. Pedestrians in Germany didn't enjoy the same rights until 1964.

A professional emergency medical service evolved in the 1960s. The philosophy: get to the injured persons quickly and then get them to the hospital as soon as possible, often resulting in transport trauma. Nowadays, doctors and ambulance crews treat the injured at the scene and only take them to a hospital afterwards. In Europe it is common for the emergency doctor to be brought to the scene in a car separately from the ambulance (known as the rendezvous system). If the doctor doesn't have to accompany the patient to the hospital, they are immediately ready for the next job. The USA, Canada, and the UK rely on clinicians known as Emergency Medical Technicians (EMT).



SPEED TRAPS

The first speed limit of 10 mph set in England in 1861 was designed to slow down people racing around on foot or horseback. When it was raised to 20 mph, monitoring speeds became a problem, which is why the Automobile Association opposed incorrect speed estimations from 1905 onward. It would be another 51 years before the first traffic radar unit was introduced in Germany to take objective speed measurements. The Telefunken VRG 2 was used from 1959.



BLOW, PLEASE

As far back as 1872, it was illegal to ride a horse while drunk in England. Yet it wasn't until 1931 that a practical method was developed for proving that someone was unfit to drive – in the form of the drunkometer invented by the American biochemist R. N. Harger. The device collected a car driver's breath sample directly into a balloon and pumped it through an acidified solution of potassium permanganate. The bigger the color change, the more alcohol in the breath sample.

Between chance and strategy

In the short film *Save Kids Lives* by the renowned French director Luc Besson, the protagonists make it to school in one piece. This certainly isn't a given: every day, 500 children around the world die in road traffic. In developing nations in particular the number of victims is increasing hand in hand with the growing motorization trend. What can be done to stop having to lament 1.2 million road traffic deaths and around 50 million serious injuries every year? What

Mobility in Nigeria means poorly maintained roads and vehicles, lots of motorbikes, and barely regulated areas for pedestrians – in other words, traffic is a battle for survival. In 29 percent of fatal accidents, the cause is excessive speed and the driver's failure to adapt to the situation. Just 60 percent of motorbike riders wear a helmet, even though it is prescribed by law. There are hardly any traffic checks. The attitude is rooted in the culture and fatalistic in character:



The walk to school is perilous for many children in Africa. Traffic lights, crosswalks, school crossing guards – not here.



Modern industrialized nations are using high technology to make mobility safe for all road users.

GROWTH WOULD BE INCONCEIVABLE WITHOUT MOBILITY. YET 1.2 MILLION PEOPLE DIE IN ROAD TRAFFIC ACCIDENTS EVERY YEAR. WHETHER FOR CHILDREN IN NIGERIA, CYCLISTS IN SWEDEN, OR TRUCKERS IN THE USA, ROAD SAFETY IS A GLOBAL MATTER AND STILL DIFFERENT EVERYWHERE.

Text: Christine Kordt

Paint peels off the wooden hut in the middle of the African housing settlement. A boy in a sleeveless T-shirt comes out with his rucksack and greets his friend. Together they run through the dusty labyrinth of huts and two other children join them – this is the walk to school in Southern Africa. Heavy traffic races past them on the four-lane main road. The first sprints across and makes it to the median strip. The other four also gradually make it across. The task of running the gauntlet between pickups and trucks is repeated on the opposite lane. Traffic lights, crosswalks, school crossing guard, or cars that slow down for children? Not here.

protects pedestrians and cyclists as well as vehicle occupants? Assistance systems and autonomous driving? Or perhaps speed limits, traffic circles, and cycle lanes? While in many countries in Africa there are ramshackle vehicles on the road with worn tires, new cars in highly developed countries are equipped with ESC and airbags as a matter of course. The aim of the Global NCAP-led campaign "Stop the Crash" – in which ZF is also involved – is to give countries all over the world access to safety technology. "Technology such as ABS for motorbikes, ESC, and blind spot detection can make a real difference," says David Ward, chairman of the campaign. "Regulating their installation by law is the best way of reducing the number of road traffic fatalities."

A BATTLE FOR SURVIVAL IN NIGERIA

With 20.5 road traffic fatalities per 100,000 inhabitants, Nigeria's roads are very unsafe. By way of comparison, 10.2 people die per 100,000 in the USA, 4.2 in Germany, and 2.7 in Sweden.

Survival is predestined and thus a matter of fate rather than behavior.

A DECADE OF ROAD SAFETY

In 2011, the United Nations General Assembly declared a "Decade of Action for Road Safety" (2011–2020). The aim is to halve the number of road traffic fatalities by 2020. Every country is called upon to develop appropriate measures and the UN's five-point program is designed to help them achieve this. Based on this, Nigeria has launched a road safety program. One of the aims for 2018 is to record 50 percent fewer road traffic fatalities than in 2007. Monthly reports are showing progress in a number of areas, with free driver training courses, stricter prosecution and punishment of offenses, regular road inspections, alcohol and speed checks, and inspections of vehicle fleets and school buses. Since mid-2016, there has been a requirement for all commercial vehicles to be fitted with a speed limiter. Free safety checks and more inspection centers are designed to improve the technical state of the vehicles.



"Save Kids Lives" –
a film by Luc Besson
savekidslives.fia.com

SEAT BELT DODGERS AND HIGH-TECH

Yet there is also room for improvement in industrialized countries. A particularly high number of car drivers die in the USA – almost four times as many as in Sweden in relation to the size of the population. Individual wrongdoing is often the cause. Only in Canada do more accidents happen under the influence of alcohol. The USA is in third-last place among industrialized nations when it comes to using seat belts and 38 percent of children killed in cars were not buckled up. Drivers distracted by cell phones now account for one in ten accidents. Even though the number of road traffic deaths is falling in the USA, it is falling at a much slower rate than in other industrialized countries.

Dr. Debra Houry, director of the National Center for Injury Prevention and Control in the USA, also sees this: “It is important that we do not compare ourselves with the past, but rather with our potential. Other countries with high incomes have better outcomes, so we can also do things better.” She recommends buckling up, eschewing alcohol, and sticking to the speed limits. At the same time, the USA is putting its faith in high technology. Columbus, Ohio, has been awarded the status of “Smart City” in a competition funded with 40 million US dollars. Innovative technology is being integrated into a traffic system there for the first time, including autonomous and networked vehicles and intelligent sensors.

In March 2016, practically all car manufacturers undertook to install automatic emergency braking assistants by 2022 in all new passenger vehicles built for the American market. Other programs are examining the potential of vehicle-based systems such as collision warning based on radar and options for car-to-car communication.

METICULOUSLY PURSUING A VISION

A comparison with Sweden shows how diverse the approach to greater road safety is even among industrialized nations. The Scandinavian country has been committed to “Vision Zero” since the end of the 1990s. The fact that Sweden is now leading in road safety matters is primarily down to the philosophy of Vision Zero: since people make mistakes, but the human body can only withstand limited

mechanical forces, the environment must be adapted accordingly. Results of the consistent implementation of the philosophy include structural separation of the opposing directions of travel on highways, separate pedestrian and cycle lanes, and car-free play zones. If it is not possible to separate the different areas, pedestrian safety has priority over car traffic – by way of speed limits, for example. Together with higher safety standards in cars, planning measures, and a vast network of traffic surveillance cameras, it has been possible to significantly cut the number of seriously injured car drivers outside cities. Furthermore, almost 100 percent of occupants wear seat belts.

Sweden is meticulously pursuing its vision and has set itself interim targets for 2020. The plan includes equipping motorbikes with ABS, and constructing guardrails on the median strips of highways. Yet to be included in the plan are measures such as the wearing of helmets for cyclists and the observing of speed limits. The country is also falling short of its target to cut the number of seriously injured people. That is why many measures are now focusing on protecting weaker road users in cities.

“Vision Zero” – no road traffic fatalities – has long since evolved from being a regionally restricted aim to being a global goal and each country must develop its own individual strategy on the way to achieving this goal. Yet consistently implemented regulatory measures around the world and quantum leaps forward in the area of vehicle safety are also needed to move closer toward the vision. This may take the form of the obligatory warning beep when an occupant hasn’t buckled up or sensor-aided assistance systems.



STOP THE CRASH PARTNERSHIP

“STOP THE CRASH” is an international initiative committed to road safety all over the world. ZF supports the organization.

www.stopthecrash.org

Vision Zero has long since evolved from being a regionally restricted aim to being a global goal.

The right product for each market



VISION ZERO IS A GLOBAL AIM. EVERY COUNTRY MUST DEVELOP ITS OWN STRATEGY TO ACHIEVE IT. BRIAN LOH, VICE PRESIDENT OF ACTIVE SAFETY SYSTEMS, EXPLAINS HOW ZF CAN CONTRIBUTE HERE.

As a global systems supplier, how is ZF able to meet the diverse safety requirements of different regions?

ZF develops products designed to increase safety for everybody. Our technology is scalable based on regional market needs. In the case of advanced driver assistance systems (ADAS), for instance, we provide both comprehensive options including multi-sensor fusion, trifocal camera and advanced radar systems as well as standalone camera or radar for markets that are not yet mature enough for such solutions. We serve the whole spectrum of active and passive safety needs from low end to premium end.

How does ZF determine each market's technology needs?

We constantly monitor the market drivers: legal regulations and customer requirements. We also participate in working committees that develop regulations for a given region. There is a global interest in

increased vehicle safety with differences from region to region. In Europe, for example, there is more emphasis on urban driving while in the U.S. it's more about long-distance. When it comes to drivers' awareness of safety systems, advertising also plays an important role and drives the correspond-



The S-Cam 4 fulfills the requirements of the new Euro NCAP test protocols.

ing demand. This phenomenon has a positive effect: the more widespread a technology is, the less expensive it can become.

How do regulators and technology leaders like ZF work together to make traffic safer for everyone?

We want to make vehicles and

roads safer as quickly and efficiently as possible, which means it doesn't always make sense to wait for regulations or safety provisions to take effect. Technology development is advancing much more quickly than legislation. Governments like the U.S. also understand this, which is why they ask vehicle manufacturers, for example, to voluntarily agree to implement an automatic emergency braking function by 2022.

The speed at which advanced technology is being developed and tested is increasing rapidly. How are companies able to keep up with this pace?

ZF is currently expanding its competencies in the area of simulation because hardware and software simulations enable us to work much faster. When we look at Level 3 and 4 automated driving, we may have to implement industry-level cooperation with other suppliers. This will help us improve data collection, reduce testing costs and facilitate objective benchmarking.

Relaxed and Safe on the Road to the Future

ELECTRO MOBILITY AND AUTONOMOUS DRIVING OPEN NEW POSSIBILITIES FOR VEHICLE OCCUPANTS BUT ALSO REPRESENT A WHOLE NEW RANGE OF REQUIREMENTS FOR VEHICLE SAFETY. TODAY, ZF IS ALREADY WORKING ON INNOVATIVE PASSIVE SAFETY SYSTEMS TO MAKE THE MOBILITY OF TOMORROW A SUCCESS.

Text: Stefan Schrahe

Sylvester Stallone solved the problem in his own way as detective John Spartan in the American science fiction movie *Demolition Man*, which takes place in 2032. Apparently hacked by his nemesis, his self-driving, flying patrol car is sent hurtling into the front window of the police headquarters. But just before impact, the vehicle interior fills with hardening foam, a fictitious feature, which surrounds the cop so as to help prevent serious injury.

Conventional safety technologies such as airbags and seat belts were apparently too antiquated for the makers of the 1993 movie. *Demolition Man* was revolutionary in its assumption that autonomous vehicles would require new safety concepts.

SAFETY: SUCCESS CRITERION FOR THE MOBILITY OF TOMORROW

But what is the point of new safety concepts if autonomous driving is supposed to minimize accidents? Even in the age of self-driving vehicles, and especially during the transitional period, accidents cannot be ruled out entirely. Safe, automated systems at each stage can improve on human abilities across all cognitive levels, from seeing and quick decisions to initiating a response. According to experts, however, it will be another 15 years or so before fully automated driving becomes a reality. Frank Laakmann is sure of one thing: "Occupant protection systems won't



disappear with the launch of automated vehicles. Instead, they'll need to be further optimized." When it comes to developing safety concepts, the Engineering Director of Occupant Safety at ZF needs to take into account the fact that autonomous vehicles will be sharing the roads with a greater number of person-driven cars for quite some time. Highly effective passive accident protection will therefore remain an important issue for decades to come.

NEW FREEDOM REQUIRES NEW SYSTEMS

At the same time, the challenges associated with safety technology will increase significantly. "Vehicle drivers have been sitting in a defined position for more than a century – their hands on the steering wheel, their feet on the pedals, and their eyes looking ahead. That made it possible to develop a largely standardized architecture for occupant protection," says Swen Schaub, Senior Manager of the Engineering Strategy for Occupant Safety Systems at ZF. But new occupant protection concepts will be necessary to help ensure safety in autonomous vehicles. "The most important argument for new safety concepts is the expanded range of design options in the interior," Schaub adds.

That is because self-driving vehicles offer much more comfort as well as more time for other activities. Sitting positions are no longer defined: rotating seats :

are meant to allow occupants to sit next to and facing each other, with the backrest up or reclined for relaxation.

In a study, ZF examined the effects of different sitting positions on the protective function of conventional restraint systems, including operating a tablet in the usual driver position as well as the driver's seat turned sideways or to the back. All the scenarios reveal that safety systems perform differently to varying degrees. If the driver's seat is turned 180 degrees, some protection systems are no longer practical. "Autonomous vehicles won't be able to establish themselves without

passive safety that exceeds today's standards," says Dr. Stefan Sommer, Chief Executive Officer of ZF, in reference to the mobility of the future.

PARTNERSHIP FOR GREATER OCCUPANT SAFETY

Studies have found that safety systems need to be integrated more thoroughly into the overall interior concept. For example, airbags may no longer be limited to the steering wheel and instrument panel in the future but will also be installed in the roof and seat back. The goal is to help ensure passenger safety at all times,



When the driver is reading or working on the way, safety belts and airbags still need to render full protection in this altered situation.



Whether passenger car or people mover: autonomously driving vehicles of the future have special demands for occupant protection.



SMALL, BUT STILL FOCUSED ON SAFETY



Thanks to ZF occupant protection, even mini car BEHICLE has the chance to achieve top results in crash tests and to provide the safety standards of a compact car.

It is important to ZF that also minicompact car occupants can enjoy transportation that is both efficient and safe, which is why the Group is a member of the BEHICLE consortium. The acronym stands for "BEst-in-class veHICLE" and describes an existing electric microcar that, with the corresponding measures, should achieve a result of four to five stars in the Euro NCAP rating. And that would be a first, as standard microcars never achieve more than one or two stars.

ZF's contribution focuses specifically on the occupant protection systems. For the driver's seat, which is positioned in the center, ZF engineers

have constructed a unique four-point seat belt with seat belt tensioners attached to the roof and two buckles at the seat.

In conjunction with structural improvements to the vehicle body and other measures, the BEHICLE has the chance to achieve the maximum value in tests based on the Euro NCAP protocol. The microcar therefore offers the same safety standards as the full-size subcompact car. More importantly, with five stars, its safety standards exceed those of minicompact cars that, due to their approval as four-wheel microcars, are not tested in the same way.

whether they are sitting or reclining, which is why ZF has entered into a non-exclusive partnership with interior specialist Faurecia.

"Faurecia, with its knowledge of interior and seat systems, and ZF, with its expertise in sensors, seat belt, and airbag systems, can provide vehicle manufacturers with suitable offers," says Sommer. The initial results of the collaboration, which kicked off in May 2017, can be seen at IAA just four months later – in a seat with integrated seat belt systems and airbags by ZF, which in this configuration represent new functions.

But it is not only the megatrend of autonomous driving that makes brand-new safety concepts essential. Electromobility will also require a new way of thinking, as increasing electrification of the power train is leading to new vehicle architectures. Because range continues to be a key success criterion, every cubic centimeter of space in the vehicle will be used for the battery. Because batteries can pose a safety risk in crash-relevant areas, they need to be carefully protected. Cameras, radar, and lidar provide important information: they are capable of detecting a potential collision and activating external airbags potentially milliseconds before impact, helping to protect both the occupants and the sensitive batteries.

CREATING TRUST THROUGH SAFETY

It is extremely important that the technologies on which the future of mobility is based do not compromise on safety. After all, the general public responds with great sensitivity to problems with new technologies. For instance, a single deadly accident involving an autonomous vehicle in the United States in 2016 received a great deal of media attention around the world, generating doubt about the technology. At the same time, all of us around the world respond, with far less attention to thousands upon thousands of deaths in car accidents involving person-driven vehicles every year. Occupant protection expert Laakmann is aware of the challenge: "Our customers want to maintain trust in their brands when they launch automated vehicles. That means they need to offer systems that help to protect people even in the new scenarios."

According to Swen Schaub, the fact that ZF develops technologies for autonomous driving and has components for electric drives in its portfolio is a benefit and will help the company consolidate its position as a technology leader in safety systems: "We're working on networking sensor and processing functions for the intelligent control of safety features. The future belongs to these cognitive safety systems."



"Wrong-way Inhibit" is the name of a newly developed assistance function designed to prevent drivers from taking wrong turns on freeways.



His latest project is on four wheels and looks like a normal family MPV. Beneath its production bodywork, however, around 100 engineers working under Jung have left hardly any component in its original state over the past 18 months. The result is known as the "Vision Zero Vehicle" – a vehicle that takes the company a big step closer toward achieving its aim of zero accidents and zero emissions. It is a concept vehicle packed with innovative driving and safety functions essentially based on intelligently networked ZF systems that are already available. As such, it can drive in either assisted or automated mode. At the same time, the Vision Zero Vehicle is capable of local, emission-free journeys thanks to a fully electric drive system incorporated in an extraordinarily versatile rear axle – both also ZF products. The fact that the innovative vehicle is a family MPV is also part of the concept. After all, parents in particular pay a great deal of attention to safety and environmental aspects.

updated cloud map data linked to the GPS navigation device, but also visually via the three-lens camera mounted on the front windscreen known as Tri-Cam. There is also the information supplied by the AC1000 radar system, which is also a product of the technology company.

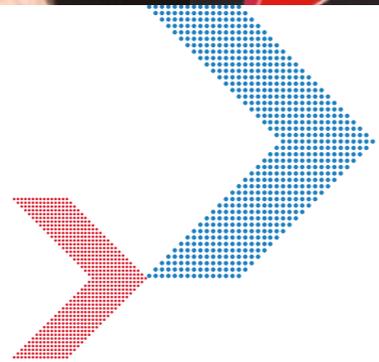
The bright yellow "STOP – WRONG WAY" signs are now very close. When Jung switches on an indicator and turns the wheel as if intending to turn here, the new "Wrong-way Inhibit" assistance function is automatically activated: clear visual warning signs appear on the central touch screen in the center console and in the smaller display on the dashboard, backed up by alarm tones. The engineer deliberately ignores the signals and sticks to his course. Shortly afterwards the active ZF seat belts vibrate on his upper body and the steering wheel can only be turned in the wrong direction by using greater force. Jung turns off all the same.

Now the vehicle takes control: despite pressing on the gas pedal, the vehicle slows down, because the fast-reacting IBC (Integrated Brake Control) from ZF intervenes. The MPV steers itself to the outer right-hand edge of the roadway. The Vision Zero Vehicle ultimately comes to a halt with its automatically activated hazard lights. If an escape area is available or the reverse gear is engaged, the system allows the driver to drive safely along the edge of the road away from the danger zone. "With our system on board, nobody would find themselves becoming a wrong-way driver due to a brief blackout," says Jung with confidence.

Driven by vision

ZF IS USING THE VISION ZERO VEHICLE TO SHOW HOW INTELLIGENT NETWORKING CAN ALREADY SIGNIFICANTLY IMPROVE SAFETY AND CUT EMISSIONS. AT THE SAME TIME, THE CONCEPT VEHICLE IS DEMONSTRATING THE TRANSITION FROM ASSISTED TO FULLY AUTOMATED DRIVING.

Text: Achim Neuwirth



Wrong-way drivers? That's always somebody else. Or is it not? The fact is that one brief moment of distraction, poor visibility, fatigue, or wrongly interpreting a navigation command is all it takes to end up driving in the wrong direction on the freeway or highway, particularly when on unfamiliar terrain. "Accidents involving wrong-way drivers end fatally much more often than other types of crashes, because the vehicles here mostly crash head-on at high speed," says Dr. Steffen Jung, project manager and development engineer at ZF.

EARLY PREVENTION OF WRONG-WAY DRIVING

So how does it all work in practice? The vehicle quietly purrs around the test track with engineer Jung behind the wheel. His colleagues have recreated typical traffic situations on the extensive site, such as road surface damage and signs for road work or a freeway entrance ramp.

In the distance the no entry signs for a freeway exit ramp are now visible. The Vision Zero Vehicle has long since been aware of them, partly due to high-precision, constantly

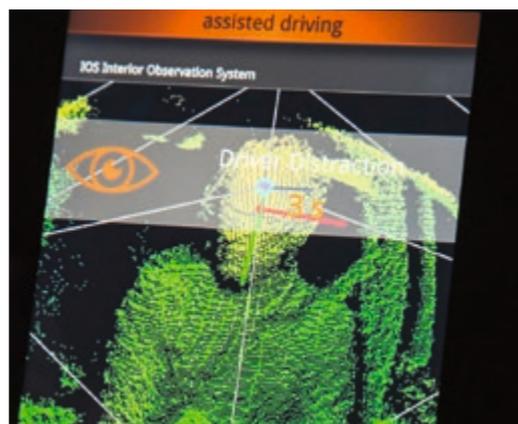


SAFE INTERVENTION WHEN DISTRACTED

The journey continues around the test track. Jung suddenly moves as if to search for a certain function on the entertainment system. His eyes are firmly fixed on the center console. This is registered by a so-called time-of-flight (ToF) interior camera. It works using infrared technology, identifies objects in 3D, and, unlike digital video systems, it even functions perfectly in the dark. This is yet another innovative assistance function in the Vision Zero Vehicle produced by the engineers at ZF. It is known as "Driver Distraction Assist". Jung's eyes have already been looking away from the road for more than two seconds. A tight bend is ahead of him. Driver Distraction Assist initially warns him using a multimedia approach: visually via the displays, acoustically via the infotainment system and haptically by actively tightening the seat belt.



If the driver hasn't looked at the road ahead for a longer period of time, this is detected by the interior camera mounted on the mirror (camera photo, right). In such cases, "Driver Distraction Assist" takes over and warns the driver.



tem that warns them and provides corrective intervention if necessary is extremely useful," says Jung.

GOOD COOPERATION BETWEEN MAN AND MACHINE

Mistakes are human. Around 90 percent of all traffic accidents are attributable to human error, so the vision of zero accidents can only become a reality when all means of transport are networked and travel autonomously with humans as merely passengers. The Vision Zero Vehicle can do both: it can support the driver with assistance systems or drive itself. One of the biggest

tion is now the second most common cause of accidents after excessive speed," says development engineer Jung, providing the answer. According to an investigation conducted by the Allianz Insurance Group, distracted drivers were responsible for 350 fatal accidents in Germany in 2015; in the USA the annual figure is ten times as high, according to information published by the National Highway Traffic Safety Administration. "Drivers are completely unaware of the length of time they spend driving blind due to various distractions and the extent to which they are endangering themselves and other road users. A sys-

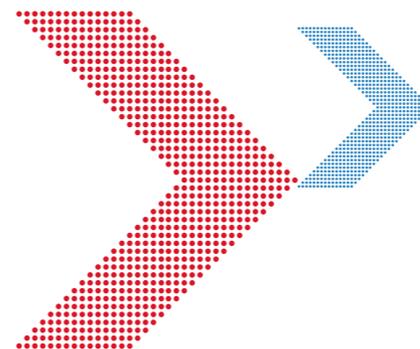


FULLY ELECTRIC AND EXTREMELY AGILE

Another highlight of the innovative vehicle is its drive and chassis technology. With 150 kilowatts (equivalent to approximately 204 hp) the electric motor on the Vision Zero Vehicle provides more than enough power for a family's everyday needs – and all emission-free on local journeys. Equally impressive is the compactness of the drive system. Including gearbox, differential, and power electronics, the electric motor fits inside the new, modular mSTARS rear axle system developed by ZF. The acronym mSTARS stands for modular Semi-Trailing Arm Rear Suspension. mSTARS is a groundbreaking multi-link axle system that offers maximum flexibility. It ultimately allows car manufacturers to produce virtually all classic and alternative drive concepts on one model platform in a simple and modular manner – from the rear-wheel and all-wheel drive concept to axle hybrids and the fully electric system like the one on the Vision Zero Vehicle. This is an attractive concept given the uncertain target figures for purely electric vehicles. The AKC (Active Kinematics Control) rear axle steering can be combined with every version as an additional module. The steering angle of the rear wheels on the Vision Zero Vehicle has been increased from three degrees to a maximum of eight degrees. This improves the vehicle's agility and allows it to perform change maneuvers that feel particularly comfortable for the occupants thanks to the lateral offset.

The overall experience of the Vision Zero Vehicle ultimately only leaves one thing left to be desired – that functions and systems like these will be found on production vehicles as soon as possible. ZF has already established the foundations for this to happen.

ZF has incorporated a number of different functions and systems in the Vision Zero Vehicle for greater safety and efficiency.



challenges is ensuring that control of the vehicle is smoothly handed back to the human. What happens if the driver simply fails to react? "With the Vision Zero Vehicle we are demonstrating how the transition phase from assisted to autonomous driving can be safely achieved," says Dr. Gerhard Gumpoltsberger. He is the head of innovation management at ZF's central advanced development unit.

After the testing round in "assisted driving" mode, Steffen Jung then switches to "automated driving" by simultaneously pressing two buttons on the steering wheel, before

leaning back in the driver's seat with folded arms. Steering, accelerating, braking, staying in lane – the Vision Zero Vehicle can do it all by itself. Shortly afterwards, the displays inform Jung of road work ahead. There are rows of pylons here – the lane markings have been pasted over. Via information sent from the cloud, the vehicle detects that the complex situation requires the intervention of the driver. Jung is now given precise information on the display, telling him the time in seconds and the distance in meters remaining before he has to take over control of the vehicle. Even though the road work site is getting ever closer, Jung continues to leave his hands off the wheel and his feet off the pedals. He also doesn't react to the warning tones, the vibrating seat belt, and the momentary braking maneuvers. The algorithms therefore decide to bring the vehicle to a stop at the next safe location – in this case in an emergency bay.

Greater intelligence for the car of the future

HOW THE VISION ZERO VEHICLE ASSISTS THE DRIVER

Even before setting off, the occupants in all the seats are reminded to buckle up, while simultaneously increasing their comfort. The active buckle lifter (ABL) moves upward as the passengers get into the car. A new ABL design has made its debut on the rear seat of the Vision Zero Vehicle: it is able to detect when integrated child seats are being used and will move the buckle high enough so that even in this situation the child can comfortably buckle themselves in or an adult can do it for them.

Wrong-way Inhibit can actively prevent wrong-way drivers. This function can promptly identify potential wrong turns, provide early warnings with increasing intensity, and bring the vehicle to a stop even without the cooperation of the driver.

Driver Distraction Assist can detect whether the driver is distracted. The function gives a corresponding warning and assists the driver in an emergency until a potentially dangerous situation has passed.

Predictive Safety: the occupants are given tactile information in anticipation of a potentially dangerous situation. By tightening the seat belt they are moved into an optimally safe position. The secure hold as a predictive measure actively protects the driver above all else and prevents any undesirable steering reactions.



HOW THE VISION ZERO VEHICLE MAKES AUTOMATED DRIVING SAFER

The Vision Zero Vehicle informs the driver at an early stage of any road sections where **automated driving** is possible. The driver then presses two buttons on the ZF steering wheel and the autopilot takes over.

With **Comfort Maneuvering** fast lane changes almost feel like a smooth straight drive for the occupants. This is particularly important for fully automated driving, because the vehicle occupants aren't focused on the road the whole time and are able to occupy themselves with other things. Accordingly, heavy steering maneuvers, for example, can feel unpleasant. From a technical perspective, this requires the interaction of ZF's electric power steering (EPS) at the front and the AKC rear axle steering system at the rear. The vehicle passes an obstacle without the usual turning motions as the front and rear wheels steer in parallel.

The **human-machine interface (HMI)** on the Vision Zero Vehicle is designed to make the transition from automated to assisted driving mode as safe as possible. If the vehicle approaches complex situations such as road work sites on freeways, it informs the driver about them in several stages and with sufficient time to react. If the driver fails to take control of the wheel, the function brings the car to a stop in a safe place.



The modular rear axle system mSTARS – used as a basis for flexible drive system options.



Can react faster than the driver in an emergency: the Integrated Brake Control (IBC).



A secure hold: the seat belt tightens as a preventive measure with ZF's ACR technology.



How drivers experience the wrong-way driver inhibiting technology from ZF
www.zf.com/wrong-way-inhibit



How the car detects distracted drivers and subsequently reacts
www.zf.com/driver-distraction-assist



How the car avoids obstacles
www.zf.com/comfort-maneuvering



A long-standing East-West partnership

CHINA CONTINUES TO BE ONE OF THE MAIN ENGINES OF AUTO-INDUSTRY GROWTH, DRIVEN PRIMARILY BY SAFETY AND E-MOBILITY SYSTEMS. THE ZF GROUP IS FURTHER REINFORCING AN ALREADY STRONG POSITION IN THE CHINESE MARKET BY INVESTING HEAVILY IN DEVELOPMENT AND PRODUCTION FACILITIES.

Text: Christine Kordt

He's working late again, which means he's already missed the last suburban rail train. But Xiaopu Xing isn't bothered. On one of the many rental bicycles available at ZF's Shanghai office, he takes just five minutes to pedal to EVCARD – one of the city's 2,800 electric car rental outlets. He then drives 15 miles home in what a recent review by online magazine "smartShanghai" called the "poor man's Tesla" – one of the smallest electric cars produced by Chinese automaker Roewe. When he arrives, he plugs the car into a charging station near

his apartment. "The acceleration is great, it's good fun to drive," he says. At ZF, the 28-year-old sales engineer specializes in electric drivelines.

CARROTS AND STICKS

China continues to be one of the main engines of growth in the auto industry. In particular, experts are expecting huge growth rates in new safety technologies and electric mobility. China is already the world's biggest market for electric vehicles – in 2016, sales rose by

2
DEVELOPMENT CENTERS

6
BILLION EUROS IN SALES

13,700
EMPLOYEES

48 Facilities

239
AFTERSALES SERVICE NETWORKS

Milestones

1980

First supply and marketing contract of transmissions

1995

Foundation of first manufacturing enterprise in Liuzhou

2005

ZF establishes the head office for the Asia-Pacific region in Shanghai, along with an Engineering Technology Center.

53 percent to over 500,000 units, according to a recent study by Germany's Center of Automotive Management (CAM). According to current government plans, New Energy Vehicles (NEVs) should account for 40 percent of all newly registered vehicles in China by 2030 – equivalent to around 15 million new vehicles a year running on plug-in hybrid systems or all-electric motors. "There's plenty of evidence that China will remain the leading market for e-mobility by some margin," says Stefan Bratzel, Director of CAM. This is no accident. Given Western manufacturers' unbeatable lead in combustion engine and transmission technologies, China's manufacturers regard electric propulsion as the country's best chance to draw level with today's technology leaders. To boost development, consumers were offered huge public grants for buying electric. Now the government is phasing out these subsidies in favor of quotas and restrictions. Thus electric cars are exempt from driving bans imposed to counter traffic jams or smog. And in Beijing, first-time registrations are issued to electric vehicles immediately, whereas buyers of vehicles with combustion engines must wait for their coveted license plates to be awarded by lottery. In some cities, there are exclusive lanes for electric vehicles to avoid traffic jam, and the government is also planning to impose electric vehicle quotas on automakers. "Almost all OEM are looking for ways to earn money from e-mobility," explains Xing. "Customers are interested in us because we're on the spot, offer solutions for car and commercial-vehicle applications, and cover the full range of modular hybrid and all-electric drive systems."

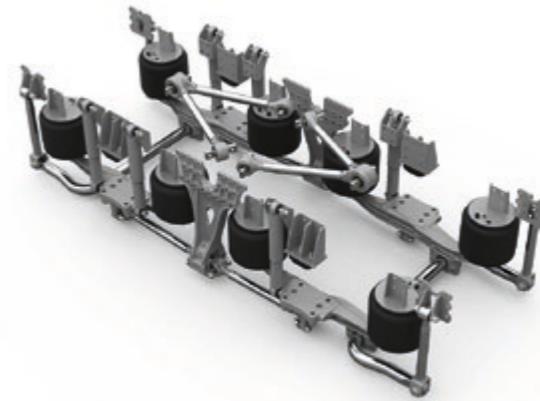


Smart solution: ZF employee Xiaopu Xing regularly hires an electric car.

KEY SAFETY TECHNOLOGY

In the near future, China will also set benchmarks for safety standards. The introduction of C-NCAP 2018 will be a very clear signal: China is easily chasing the European and US legislation anymore, but developing own standards according to the actual situation in the local market. New vehicles will be tested against additional criteria such as pedestrian protection and active safety. In particular, tests will focus on automatic emergency braking (AEB) systems and their ability to react to other vehicles as well as passers-by. "New cars that fail to meet these standards or the program's stricter side-impact protection requirements are very unlikely to achieve the top five-star score," says Chris Wu, ZF's Engineering Director Occupant Safety Systems for the Asia-Pacific region. "As the company with the most comprehensive portfolio of safety technologies in the entire automotive supply sector, we're in an ideal position to provide Chinese automakers with all the help

they need to prepare for C-NCAP 2018." ZF is already supplying intelligent mechanical systems such as fast-reacting integrated braking systems like IBC (Integrated Brake Control), full 360-degree airbag protection, active seatbelt systems and electrically powered steering. These are now being joined by camera and radar systems for environment recognition, as well as driver-assist functions like Electronic Stability Control (ESC), the AEB system mentioned above, emergency evasion systems, and ZF-developed networking innovations such as the X2Safe algorithm. "Together, all these systems enable vehicles to see, think and act – the basis for both highly integrated safety and autonomous driving," highlights Wu. But to deliver top standards



The air-sprung AIRTRAC rear-axle system was developed especially for heavy trucks. The first Chinese customer is Foton.

of protection, it is vital that these systems should be individually customized for specific vehicle models. Thanks to a state-of-the-art test sled facility at the company's Tech Center in Anting in the northwest of Shanghai, ZF can perform crash tests that are specifically tailored to the Chinese marketplace. "For many years, we've been working very successfully with Chinese OEM to integrate our safety systems into the latest model generations," confirms Wu.

LARGE-SCALE INVESTMENT

ZF has been operating in China since the early 1980s. Over the intervening period, the country has become one of the company's most important regional markets. To continuously strengthen its position in the Chinese market, ZF has invested more than one billion euros in local development and production facilities over the last five years. For example, ZF has just finished a major expansion project at the company's Engineering Center in Shanghai. Based in the city's Songjiang district, the expanded facility will enable ZF to adapt new developments to Asia-Pacific markets

faster than ever before. Engineers at the Center mainly work on driveline and chassis technology for a wide variety of applications, focusing on e-mobility in particular. One of the latest examples of ZF's successful localization strategy is an application for the TraXon automatic transmission system for commercial vehicles. Together with ZF's new AIRTRAC rear-axle system, the TraXon transmission has just entered series production in the Auman EST-A long-haul truck manufactured by Foton – China's new "Truck of the Year".

OMNIPRESENT ELECTRIC BUSES

The days of rattling traffic are past – today, traffic just hums. Noise levels in Chinese cities have radically improved. Modern electric motorcycles and e-buses purr quietly through the streets of Beijing and Shanghai. Recently, Yue Wang, who heads ZF's E-Mobility Systems House for the Asia-Pacific region, has also started traveling by bus – and really enjoys it. As a competence center in the region, the system house develops highly integrated electric drive axles to an optimum level. "E-buses are much more relaxing for passengers," he explains. "They're also quieter and cleaner for local residents." The automotive expert joined the company back in 2002 and since then, has played an enthusiastic role as one of ZF's e-mobility masterminds. In his view, electric drive mileage and the lack of a charging infrastructure are the two main obstacles to acceptance.

Unlike Germany, electric buses are already ubiquitous in China and an integral part of the public transit system. And in five years' time, China's network of charging stations should be much denser than it is now – plans are afoot to build 800,000 charging points. Once that happens, Yue Wang can easily imagine changing over to an electric car. Meanwhile, the parking lot in front of the ZF building is already prepared for e-day, with charging stations for customers and employees.

Yue Wang heads the E-Mobility Systems House Asia-Pacific. He rates e-buses because they are quiet, clean, and comfortable.



Locals respond faster

ZF BOARD MEMBER PETER LAKE TALKS ABOUT CHANGING MARKETS AND CUSTOMERS, AND ABOUT THE COMPANY'S LOCALIZATION STRATEGY.

Text: Andreas Neemann



What's the current state of the global automotive market?

At the moment, the situation is generally positive. Apart from some unfortunate trends confined to the Brazilian and Russian markets, sales of and demand for automotive technology are relatively strong. For technology companies like ZF, this is a good moment to make the most of opportunities for growth, but also to get ourselves really fit for the challenges of the future.

What do these challenges look like for ZF?

We need to make some big investments – and that's what we're doing, using the income from today's business to finance the development of tomorrow's technologies. Above all, this means finding attractive, future-proof solutions for tomorrow's mobility needs. These include things like electrifying the driveline, or developing advanced driver-assist systems for automated and eventually autonomous driving ...

Peter Lake

The native of London has been a member of ZF's Board of Management since October 2015, where he is responsible for the Corporate Market function as well as the Asia-Pacific and South America regions. Starting in 1978, he worked in various positions for previously independent supplier Lucas (later part of TRW), then in 2004, started working for TRW Automotive as Executive Vice President, Sales & Business Development.

... although that's only one of the challenges, isn't that so?

Absolutely. Others include the dramatic transformation of the entire industry landscape, along with the players – development partners and prospective customers alike. New, heavyweight players are maneuvering for positions in key future technologies. People often talk about the software giants in Silicon Valley, we're seeing some powerful alliances and combinations in specialized areas. Here I would mention Intel and Mobileye, with their outstanding expertise in interpreting image data.

How are customers and markets changing?

First of all, the term "customer" is becoming increasingly complex – that's already clear. We'll undoubtedly continue to have traditional automotive customers in the future. But we'll also have new kinds of customers, such as mobility providers and business start-ups. They may only be placing modest orders now, but that will soon change. At the same time, customers in growth regions and emerging markets have very specific requirements.

But that's not all, is it?

No, because customers are responding to the technology revolution in different ways. Some of them are building up their in-house expertise, so that – as far as possible – they can develop their own future technologies. Others are showing more interest in partnerships with external systems suppliers. We're pursuing a simple strategy: to provide all our customer segments with exactly what they need, from components to complete systems through to turnkey solutions for autonomous driving.

What are the key prerequisites for successful engagement with growth markets?

I like to differentiate between growth markets, because high tech can be just as attractive as best cost. In the Asia-Pacific region in particular, customers are really hungry for high-tech products. If we want to exploit the growth potential of markets in the Far East, we must speed up our supply of innovations to the region.

Let's take a look at China's billion-dollar market. How is ZF positioned there?

In terms of introducing new – and especially all-electric – drive systems, China's automotive market is setting an impressive pace. Here, of course, government incentives have also played an important role. But in the electric mobility segment, China is now a leading market, no longer just an emerging one. So the country offers exceptional growth prospects for automakers. However, it also has very high expectations of us suppliers!

Because the country doesn't just offer great prospects for e-mobility ...

Indeed – there's also a huge need for various active and passive safety solutions. You just have to look at the changes in China NCAP regulations. Starting next year, they'll be evaluating advanced pedestrian protection, emergency braking and side-impact protection in much

greater depth. And vehicles without those features will find it almost impossible to get the top five-star rating in China NCAP tests. ZF is in a great starting position for doing business there in the future. By way of example, I'll just mention our Electronic Stability Control (ESC) with brake assist, or our side-impact airbags.

How are you planning to convert these opportunities into actual business?

Whether you're talking about China or anywhere else in the world, the solution is the same: more localization. We've realized that we simply must be on the spot. That's why we're offering more and more local engineering services, as well as research and development. This will enable us to tailor many of our products to local target market needs at high speed. At the same time, we'll be faster to pick up new ideas from China. That's precisely what OEM are expecting of a partner like us – that we work closely with them to develop technologies for series production.

So in real-world terms, what is ZF's localization strategy for China?

We've invested heavily in expanding our R&D operations there. A few months ago, we inaugurated our expanded Tech Center in Shanghai. By 2022, we should have another 600

or so engineers working there. Put that together with the nearby Tech Center for Safety Technology in Anting, and ZF's engineering footprint in China will soon fit perfectly with our already highly localized production network.

Does this mean you're targeting business with Chinese OEM in particular?

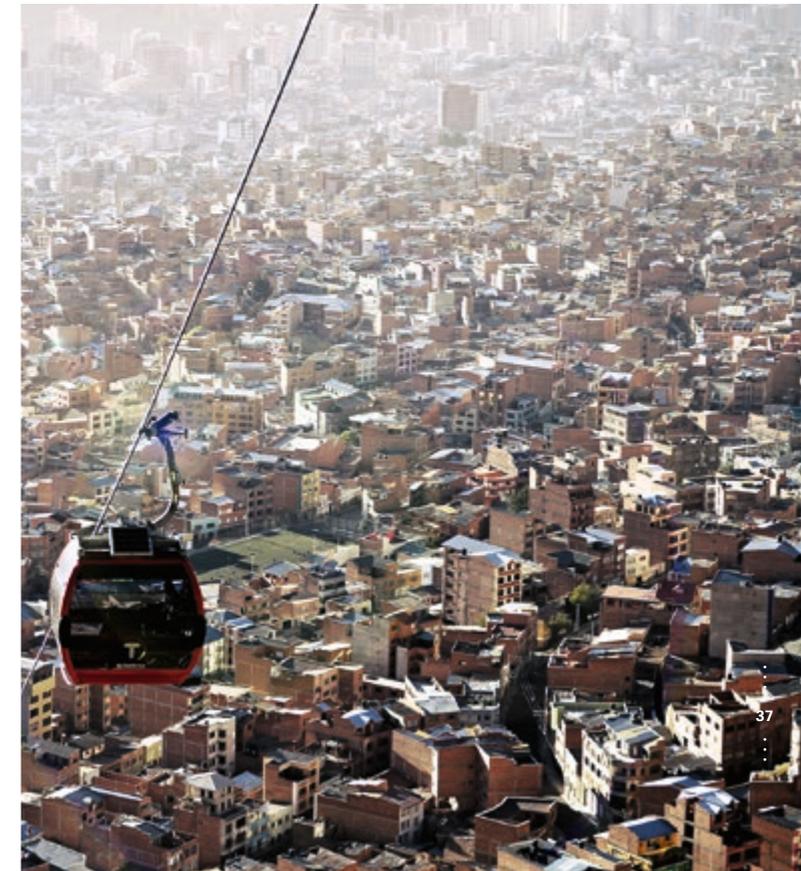
It means we're targeting growth. In view of the successes of Chinese OEM in e-mobility and the SUV segment, they really are highly attractive customers. With our technology, we can help them achieve their ambitious plans for expansion and growth.

“We can rapidly tailor products for local target markets.”

Smart and networked



FLYING HIGH: in the Bolivian capital La Paz, cable-car systems bridge the impassable ascents between the different parts of the city.



INTELLIGENT MECHANICAL SYSTEMS FROM ZF ARE ALSO TEACHING INDUSTRIAL APPLICATIONS HOW TO SEE, THINK, AND ACT. YET THAT IS ONLY THE START. THE NEXT STEP TOWARD A NETWORKED WORLD IS KNOWN AS AUTOMATED OPERATIONS.

Text: Kathrin Wildemann

Digitalization can be so simple: a credit card-sized Bluetooth smart tag is all it takes to breathe intelligence into an old plow. It records the operating time and provides the tractor with information on the type of trailer attached. ZF has developed three versions of the BLE tag for the openmatics data platform deTAGtive. In conjunction with a smartphone, they not only determine the location, but also monitor criteria such as temperature, humidity, light, and acceleration. Their range of applications is just as wide – they simplify production processes, monitor delivery conditions of sensitive consignments, and much more besides.

Traceability systems like deTAGtive are one of the trends with which digitalization is revolutionizing the world of industry. “Wind farm operators, construction vehicle owners, and railroad companies expect intelligent solutions from us to streamline their processes and

improve the efficiency of their systems,” says Dr. Klaus Geißdörfer, head of the industrial technology division. “Synergies with our automotive division allow us to give industrial customers fast and innovative answers to the demands of digitalization.” The long-term aim is known as Automated Operations: several networked systems work together and perform complex tasks independently – artificial intelligence makes it possible.

PREVENTION IS BETTER THAN CURE

One important step is intelligent performance management: systems continuously monitor their own status, optimize the operating conditions, and provide information on their condition in good time so that any maintenance work can be planned. As such, the operator has a constant overview of the situation and can even search for the causes of any faults via remote diagnosis. A control unit equipped with arti-

cial intelligence such as the supercomputing platform ZF ProAI developed in conjunction with Nvidia can ensure that the application even draws the right conclusions from the gathered information by itself and reacts accordingly.

As a comprehensive cloud solution for evaluating huge data streams, the ZF cloud provides another key fundament for Automated Operations. “Thanks to our telematics platform Openmatics, we have long-standing experience in the management of large amounts of data,” explains Openmatics managing director Thomas Rösch. “We are going even further with the ZF cloud: users can also include external information, store it in a protected area, and evaluate it in real time with high-performance analysis tools. At the same time, the ZF cloud is flexible in terms of the size and scope of the services, making it interesting to smaller customers such as start-ups.”

With such technology, ZF is already gearing up for a future in which a tractor will hook up its trailer by itself or bring in the grain unmanned as part of an autonomous harvesting fleet.

Below are three examples of areas in which industrial technology from ZF is improving efficiency and sustainability.

CABLE-CAR SYSTEMS – PUBLIC TRANSPORT AT LOFTY HEIGHTS

Cable-car systems are becoming ever more important as a means of transport in urban settings: they transport passengers from A to B independently of traffic jams, narrow old town streets, and steep terrain and are less complex to build than rail vehicles. In the Bolivian capital La Paz, several such cable-car systems have been connecting parts of the city situated on the



Modern industry is networked and works smartly on land and water.

mountain slopes with one another since 2014 – with ZF gearboxes. A 30-kilometer-long integrated network is set to be in operation there by 2019. The ProVID performance management system from ZF makes such cable cars more reliable: in order to minimize downtimes, maintenance work can be planned in advance so that it is not performed during operating hours. The ability to network with other infrastructure systems in an intelligent cloud-based platform creates a wide range of options in the area of public transport in particular. In future, for example, a cable-car system can use information on the capacity utilization of trains, buses, and parking lots to identify passenger congestion trends and request the right number of cable cars accordingly – or slow down the running speed in order to cut operating costs.

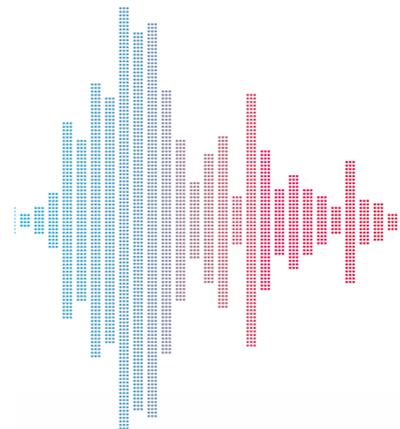
WIND POWER – GREATER EFFICIENCY FOR WIND FARM OPERATORS

Wind energy is still on the increase. Since repairs at a height of 80 meters are particularly complex, it is crucial for the efficiency of a wind park to achieve the maximum possible performance without reducing the service life of the gearbox. That is why ZF uses a neuronal network of sensory technology to allow its gearboxes to ascertain whether they are being operated within the permissible load limits. In doing so, the system doesn't take its cue from the nominal power, but rather from the actual load, allowing the gearbox to generate the maximum possible amount of power at all times, while at the same time independently reducing harmful vibra-

tions. A specially developed performance management algorithm uses the data from the cloud to calculate the remaining service life. The cloud solution provides the option of also including external data in the operations planning. This allows operators to plan maintenance on calm days, based on the weather forecast, or they can decide the extent to which the gearbox operates at its load limits, irrespective of the electricity price.

AGRICULTURAL MACHINERY – WHEN THE TRACTOR KNOWS WHAT'S WHAT

Agricultural machinery is especially suited to the early use of autonomous driving, because it moves around on farms and in fields away from other traffic – a perfect example of Automated Operations. Safety is key here. An autonomously driving tractor must be able to identify the farmworker who suddenly comes out of the barn with one hundred percent reliability. Equipped with six cameras, the ZF Innovation Tractor has the ability to keep a close eye on its surroundings when the vehicle automatically hitches onto a specific trailer or moves around the farm while being controlled via a tablet. If a pedestrian walks in between the trailer and the maneuvering tractor, the Pedestrian Detection function immediately stops the vehicle. Radar and lidar sensors could also be added to agricultural machinery in future to provide a 360-degree field of vision: the artificial intelligence supercomputer ZF ProAI provides the necessary processing power to evaluate the data in real time and thus allows the vehicle to understand its surroundings and react accordingly.



SPEAKER'S CORNER

Dr. Holger Schmidt is a specialist in the digital economy. He gives talks, writes for the Handelsblatt, and teaches at the Technical University of Darmstadt.



A race for 5G

COUNTRIES AROUND THE WORLD ARE WORKING ON FAST NETWORKS – THE KEY TO AUTONOMOUS DRIVING. GERMANY CAN BARELY KEEP PACE, BECAUSE A PAST MISTAKE IS NOW COMING BACK TO HAUNT IT.

What do underground telecommunications cables have to do with autonomous driving? Not a lot at first glance. After all, the cellular network is ultimately responsible for the large amounts of data exchanged between the vehicles and infrastructure at very high speeds. Preparations for upgrading this infrastructure to the required 5G network are in full swing in many countries. In the USA, for example, the Telekom subsidiary T-Mobile wants to establish a nationwide network by 2020. In China, too, the major network operators want to activate the new networks in three years.

Consequently, the German transport minister Alexander Dobrindt has issued the following statement: "5G is becoming a key digital technology. We want Germany to be a leading market for 5G and the first country to provide a nationwide network."

There is a problem, however: 5G can only fully exploit its speed potential if fiber-optic cable is fitted in the base units of the cellular radio masts. This cable is used to send the data quickly to the servers at the back end. It is a factor that most countries are systematically taking into consideration. China, for example, is set to lay around 90,000 kilometers of high-speed cable by 2018, providing broadband coverage to all urban regions and 90 percent of the country's land area, according to figures published by the news agency Xinhua. In the USA, the telecommunications company AT&T is expanding its fiber-optic service. No fewer than 12.5 million house-

holds in 67 urban regions are set to be connected to a "100 percent fiber-optic network" by mid-2019.

In Germany, meanwhile, Deutsche Telekom is using copper instead of fiber-optic cable and upgrading its outdated networks with VDSL Super Vectoring – considered by experts to be bridging technology at best. Furthermore, state subsidization of the copper technology, which is not gigabit-compatible, means that the more expensive fiber-optic upgrade is often not competitive.

As such, Germany is already languishing in 17th place when it comes to digital infrastructure in Europe. Things look even bleaker in terms of future technologies: "Germany comes in at number 28 out of 32 European countries when it comes to upgrading to fiber-optic cable as an important transmission technology," confirms the Fraunhofer Institute.

From the perspective of the German automotive industry, the cable problem could endanger one of the most important future projects on the domestic market: autonomous driving. That's because according to the federal transport minister's strategy paper "5 Steps to 5G", all main transport routes and at least 20 major cities in Germany should be equipped with 5G by no later than 2025. To this end, Germany wants to allocate the necessary 5G frequencies in 2018 – unilaterally, if need be, and before a Europe-wide allocation of frequencies. The hitherto oft overlooked fact that the wrong cables are in the ground could be a sticking point.

ZF is a member of the 5G Automotive Association. This consortium of telecommunications companies and automobile manufacturers develops solutions for networked mobility.

Strong in times of **change**



At the ZF Pitch Night more than 50 start-ups from 15 countries presented their ideas at the company's headquarter in Friedrichshafen.

INNOVATION IS A CRITICAL COMPETITIVE ADVANTAGE IN THE AGE OF DIGITAL TRANSFORMATION. ON THE LOOKOUT FOR NEW IDEAS, ZF RELIES ON INSPIRATION FROM WITHIN AND WITHOUT.

Text: Jan Wienrich

The whole story began with an accident. After Dr. Malgorzata Wiklinska crashed into a car while riding her bike when she was the head of the ZF's Denkfabrik think tank, she came up with the idea of X2Safe, an intelligent algorithm that can warn vulnerable road users such as cyclists, pedestrians, and motorcyclists about a potential collision via smartphone or smartwatch. A few months later, the ZF Denkfabrik presented the algorithm at the Consumer Electronics Show (CES) in Las Vegas.

X2Safe is an example of how an employee's idea can lead to a new product at ZF at start-up speed. The company isn't leaving anything to chance as it creates competitive advantage with digitalization. "The transformation is not only affecting our products, services, and technologies, but also our culture," says

Mamatha Chamarthi, Chief Digital Officer at ZF. In order to usher in this change in culture, the company also seeks inspiration externally through events such as ZF Pitch Night, for example, where more than 50 start-ups from 15 countries presented their ideas at the company's headquarters in Friedrichshafen. "At Pitch Night, we brought young, creative minds from the international start-up scene directly to the company to share their best ideas," explains Wiklinska, now the head of the digital ecosystem and strategic partnerships at ZF.

EXTERNAL ECOSYSTEM

Now, the winners of ZF Pitch Night are working alongside ZF engineers to turn their ideas into innovative solutions. The Canadian start-up, Acerta, developed an algorithm using predictive analytics to proactively detect cog failures in

Room for creativity: in the Digital Innovation Space developers and IT specialists work together on new business models.



wind turbine gearboxes. This solution is spreading virally across the all business units. Another project that emerged from the Pitch Night is being developed in conjunction with Gefasoft. The Bavarian company from Munich, Germany, is digitalizing shop floor management at the ZF plant in Saarbrücken. This solution will likely be deployed at other ZF manufacturing facilities in the near future.

In February the company also announced a cooperation arrangement with the Californian company Plug and Play, a start-up accelerator from Silicon Valley, and a partnership with the growing innovation platform Startup Autobahn, part of ZF's over-all Global Innovation Hub strategy.

INTERNAL INGENUITY

Yet ZF is also making the most of its employees' potential. The company has established an internal ideas competition for them known as the "Digital Innovation Challenge". This gives all employees the opportunity to turn their digital ideas into reality outside

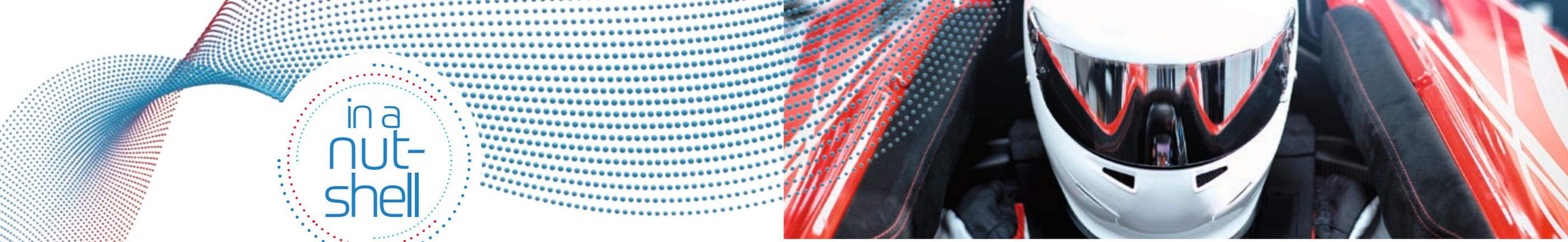
of any hierarchical levels or departmental restrictions. The aim of the challenge is to further digitalize products and services, business processes, manufacturing and shop floor, and the workplace. "The challenge has surfaced powerful ideas that we plan to implement in an agile way. We plan for our employees to work closely with our ecosystem to continue to rapidly prove the business benefits of these digital ideas. Then, we will scale the resulting solutions, working closely with divisions and functions to maximize business outcomes for ZF," says Mamatha Chamarthi.

"The transformation is not only affecting our products and technologies, but also our culture."

MAMATHA CHAMARTHI

ZF Chief Digital Officer

ZF has also created the "Digital Innovation Space". In this colorful, creative space, collaborative teams from development, IT, other business units, and external partners can all work together on digital business projects. The Car eWallet project came from the Digital Innovation Space in conjunction with UBS, and it uses blockchain technology to simplify on-the-go charging of electric cars. The concept was unveiled for the first time in January 2017 at the CES. Details on specific features will follow at the IAA. This demonstrates that ZF successfully employs various approaches in its search for digital innovations.



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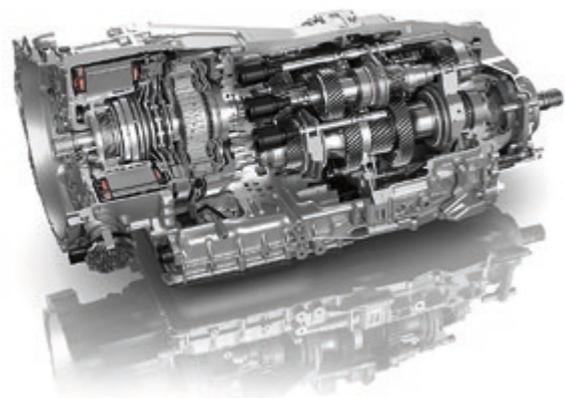
BILLION EUROS

This is the turnover generated in the first six months of 2017. ZF reported a turnover of 17.8 billion euros during the same period last year. The company's earnings before interest and taxes (EBIT) also increased to 1.2 billion euros. As such, it also recorded an improved EBIT margin of 6.6 percent, despite higher investment in R&D. The management of ZF is currently forecasting a turnover of more than 36 billion euros for the whole of 2017.

Eight plus E

Electrically powered dynamics and emission-free local driving are made possible by the optional hybrid version of the new 8-speed dual-clutch transmission (8DT). The e-motor integrated in the clutch bell housing produces 100 kW and can accelerate the Porsche Panamera 4E Hybrid to speeds of up to 140 km/h using purely electric power. Other hybrid functions such as recuperation or boost mode are also possible.

The new ZF 8DT is available in four different versions: standard, all-wheel drive, hybrid, and all-wheel hybrid. The developers were able to reduce the power loss by up to 28 percent and further optimize the already very fast transmission times. What all four versions have in common is a combination of lightning-fast gear changes with outstanding efficiency and a high level of comfort.



Combines performance, comfort, and emission reduction: the hybrid version of the ZF 8DT.

“The future of car making may lie in modules like this.”

AUTOWEEK, USA,
on the mSTARS axle from ZF

ZF races at elite level

Correct use of the clutch is crucial in Formula 1. Red Bull Racing relies on ZF Race Engineering for optimal power transmission with no spinning tires. The Formula 1 clutch from Schweinfurt offers optimal performance combined with minimal dimensions. At approximately 1,800 grams, the high-tech component weighs around ten percent less than a commercially available clutch, but has to transmit more than 1,200 newton meters of torque on a diameter measuring approximately eleven centimeters. With titanium housing and carbon facings, only the finest quality materials are used.

The teams Scuderia Ferrari, Sauber F1, Sahara Force India, Scuderia Toro Rosso, and Haas F1 also use high-tech shock absorbers from ZF Race Engineering.

There is a tradition of Formula 1 at ZF. Teams equipped by ZF have thus far racked up nine world titles in the Formula 1 constructors' championship, eight of which were won by Michael Schumacher and Ferrari alone, and more than 130 race victories.



The Formula 1 clutch from ZF Race Engineering only weighs around 1,800 grams.



A flourishing system landscape

ZF is establishing an ever closer cooperation network in order to drive change forward in the mobility sector and quickly react to new market demands. This network is known as the Vision Zero Ecosystem. It involves the company entering into strategic partnerships and joint ventures and acquiring minority shareholdings in primarily young, highly-specialized businesses. The aim of all these activities is to develop innovative solutions for the market at high speed.



The Vision Zero Ecosystem covers the needs associated with "Zero Accidents" and "Zero Emissions" – two major issues of the future.

With the interior specialist Faurecia, for example, ZF is developing modern interior concepts that are both flexible and safe. Extremely important for autonomous

driving is the supercomputer equipped with artificial intelligence, ZF ProAI, based on a platform developed by cooperation partner Nvidia. ZF has acquired a 40 percent stake in Doubleslash Net-Business so that it can also supply the software required for networking vehicles. Two other minority shareholdings in Asytx and lbeo are aimed at further developing radar and lidar sensors. In the joint venture e.GO Moove, ZF is working with the start-up e.GO Mobile AG on a fully electric, autonomously driving

people and cargo carrier. Another joint venture with the three partners Magura, BrakeForceOne, and Unicorn Energy is designed to generate new technological ideas in the area of micro-mobility. The latest addition to the Vision Zero Ecosystem is Hella. This strategic partnership focuses on camera systems, image recognition, and radar sensors for advanced assistance functions.

A keen eye

The Opel Insignia sets new standards in its class – not least thanks to its state-of-the-art assistance systems. The front camera from ZF plays a key role here. Advanced camera solutions are used in safety features such as Forward Collision Warning, Following Distance Indication, Lane Departure Warning, and Lane Keeping Assist. The camera-based forward-looking collision warning identifies the closest object in the vehicle's path and calculates its position and change in size.



The monocular camera from ZF provides image information for numerous assistance systems.

Emission-free across the fjord

A spectacular site and part of the UNESCO World Heritage site: the Nærøyfjord. The new sightseeing ship on which tourists have been able to explore the Norwegian landscape as of recently is just as spectacular. Thanks to the design, all passengers aboard the Vision of the Fjords have a perfect view. Equally impressive is the engine: the powerful ZF 2050 marine transmission unit is capable of transmitting more than 1,000 hp of motor power. Up to 450 passengers can travel comfortably, safely, and in an eco-friendly manner thanks to the ZF technology. The low weight and parallel hybrid drive system set new standards in terms of energy efficiency. The ship is powered by purely electric means during sightseeing trips, while additional diesel engines increase its range over longer distances.



The ZF 2050 marine transmission unit also makes clean hybrid technology available to ships.

“ZF has come up with a clever solution: a funky looking bag mounted to the side of each seat.”

WIRED, USA, on the center airbag concept by ZF.



This is no small car



New comfort and safety features are possible thanks to the electronic power steering with column drive system.



Nothing can unsettle the new VW Polo that easily. It has more assistants on board than ever before. The electronic power steering (EPS) by ZF with column drive system makes driving safer and more comfortable. With its modular and scalable architecture, it is designed for vehicle segments A to D and steering rack forces of up to 12 kN. It also cuts both fuel consumption and CO₂ emissions and supports automated driving.



ZF-HIGHLIGHT

ZF ENABLES VEHICLES TO SEE, THINK, AND ACT WITH THE AID OF ACTIVE SYSTEMS. THE AKC REAR AXLE STEERING CONCEPT IS PROVING TO BE PARTICULARLY VALUABLE.

Safety, dynamism, comfort – AKC (Active Kinematics Control) rear axle steering enhances pretty much everything that car drivers appreciate about their vehicle. Electromechanical actuators positioned on the tie rod of the rear axle allow the rear wheels to adopt a steering angle: if agility or maneuverability is required, the rear of the vehicle steers against the lock of the front wheels. Particularly at high speeds the rear wheels steer in the same direction as the front wheels.



The electromechanical actuator of AKC sits on the tie and rod of the rear axle.

The latest benchmark in the area of maneuverability is a ZF test vehicle based on the Ford F-150: the pickup can steer on the rear axle at an angle of up to twelve degrees. The result: the rugged vehicle, which is over six meters long with a wheelbase of 3.5 meters, glides gracefully around tight courses like a small car.

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