

TRANSFER

THE STEINBEIS MAGAZINE 01|20

AUTONOMOUS MOBILITY



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DEAR READERS,

"A car that drives by itself" – a big dream, and a vision that could become reality in the coming years. This isn't something that will happen overnight, more like bit by bit, as each step of the journey gradually comes true. Assistance systems, which are already practically all around us, are using the first autonomous driving functions. Algorithms, which are capable of merging different data from sensors to form pictures of vehicles and can assess their immediate environment, are becoming more and more reliable. And this makes truly autonomous forms of mobility all the more plausible.

The focus of attention is turning increasingly to communication between humans and machines: How can a self-driving vehicle express the fact that it's safe for me to cross the street in front of it? Many of our colleagues are working with industrial partners on research and development in this fascinating field. I don't think it would be exaggerating to say that the "auto-mobile" is about to be re-invented.

But one thing we mustn't lose sight of is that "autonomous vehicles" are not just about automotive technology. It's important to develop suitable operational infrastructure, including so-called Car2X communication. This will involve looking into and adapting potential business models. Will people actually want to own their own self-driving vehicles or will this all, almost in passing, somehow result in ownership scenarios based on groups of users? And last but not least, these developments raise important legal issues: Who is responsible if one of these vehicles does something wrong?

Dear readers, we're used to driving our own cars and sitting at the steering wheel ourselves. Our cities and transportation infrastructures are set up this way; entire branches of industry depend on this for their existence. The sweeping transformation that will be made possible by self-driving vehicles and other forms of autonomous transportation cannot and should not be rushed. One thing that still needs to happen is for all sections of society as a whole to discuss and understand these new formats of technology – as well as the opportunities and threats they entail. So let's start with a small step: In this edition, Steinbeis experts take a detailed look at the topic of autonomous mobility. They do this by presenting the projects they are working on and adopting a position on key questions of our time. I wish you a fascinating read!

With kind regards,



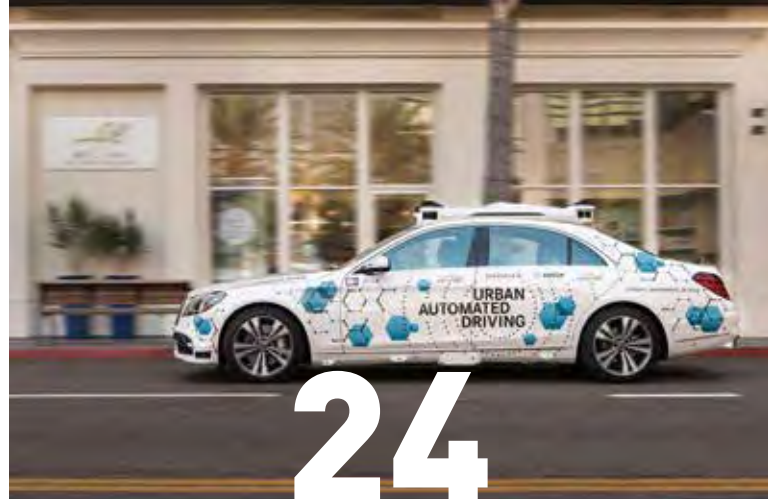
PROF. DR. PETER NEUGEBAUER
[author]



We regret to announce that Prof. Dr. Peter Neugebauer passed away shortly after writing this editorial in April 2020. We would like to express our sincere condolences to his family and friends.

Prof. Dr. Peter Neugebauer was in charge of the Steinbeis Transfer Centers for Automotive Testing and Automotive Engineering at Karlsruhe University of Applied Sciences, where he worked in a variety of fields related to vehicle diagnostics, electronics development and testing, and embedded software. He was also managing director of the Institute of Energy Efficient Mobility at the university and professor of vehicle electronics.

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AUTONOMOUS MOBILITY

Like most people, you've probably sat in a car or bus and wondered what it will be like traveling around in several years or decades.

Getting from **A TO B** without actually steering a car yourself, relying on a vehicle to take on the most important aspects of driving itself ... the kind of **SCENARIO** you see in lots of modern science fiction films. Yet the stuff of the far-off future also now seems to be almost **WITHIN REACH**. What **OPPORTUNITIES**, but also what **CHALLENGES** will these developments pose for us? How important will it be for society to change the way it thinks?

All Feature Topic articles of this issue can be found on the following pages.





“THE BIGGEST CHALLENGE WILL BE THAT ROUTINES AND CONVENIENT PRACTICES WILL NEED DISMANTLING”

AN INTERVIEW WITH PROFESSOR DR.-ING. JOCHEN BAIER AND PROFESSOR DR.-ING. OLIVER TAMINÉ, EXPERTS AT MOBILITY AND LOGISTIC, THE STEINBEIS TRANSFER CENTER

Mobility is undergoing a transformation. But where is the journey taking us? What should we expect the future of mobility to look like? And will the future we envisage actually be achievable? TRANSFER spoke to Professor Dr.-Ing. Jochen Baier and Professor Dr.-Ing. Oliver Taminé, both closely involved in the topic of sustainable mobility and mobility concepts. The two experts are convinced that the propensity of people to try new things and break the mold will be just as important as the actual technologies that will shape the future of mobility solutions.

Hello Professor Baier, hello Professor Taminé. The future of mobility looks autonomous, safe, sustainable, gentle on the climate, efficient, and affordable. Is this a future that is actually achievable?

Jochen Baier:

Let's start with autonomy. Autonomous driving is not something that's going to happen from one day to the next, it will be an evolutionary process. Getting from

Level 2 autonomy (with lane departure warning systems or automatic parking) up to Level 3 (with the vehicle driving itself in certain situations) and Level 4 (with the system driving continuously) and then Level 5 autonomy (with no driver input required anymore, or even a steering wheel) will still take many years.

The second consideration is security. As vehicles and the infrastructure become increasingly connected, more risks arise.



AUTONOMOUS MOBILITY IS NOT SOMETHING THAT'S GOING TO HAPPEN FROM ONE DAY TO THE NEXT, IT WILL BE AN EVOLUTIONARY PROCESS.

se, for example due to 5G and the interfaces it connects up. IT security will lead to new challenges, so things like attacks on vehicles from hackers become conceivable. On the other hand, sensors and algorithms will make autonomous vehicles safer than they are now.

The other point you asked about is sustainability. The state government of Baden-Wuerttemberg has come up with an extremely fitting definition for sustainable mobility by setting a target: Transportation should largely shift to renewable energy by the midway point of the century, and new formats of mobility should be promoted. This will also contribute to a culture of multimodal transportation.

Oliver Taminé:

If we think about mobility options that are better for the environment, there are a number of energy sources that can be used without causing harm – water, wind, and sunlight. Solar energy and the wind can be harnessed with wind turbines and photovoltaic equipment in separate locations, so they can be used directly for environmentally friendly transportation.

Making mobility efficient is first and foremost about the efficiency levels, which are much lower with combustion engines than with electric motors. So future mobility will be much more efficient, and it will also be more energy-efficient than mobility is today. Planning will also become a lot more efficient thanks to certain forms of IT, such as artificial intelligence.

Last, but not least, there's the question of affordability. A number of factors have to be taken into account here. For instance, electric motors are more straightforward to build and they involve far fewer parts than combustion engines. Furthermore, fossil fuels are always more difficult to source so they will become even more expensive in the future. So in that respect, we can expect prices to go down. But what we can't predict is the impact that growing demand for electricity will have on prices, or the demand for the resources that will be required, such as lithium or cobalt.

For transportation to operate autonomously and sustainably, not only does it require the right technology, it also needs a change of thinking in society. Where do you think the biggest challenges will be with all this?

Oliver Taminé:

The biggest challenge will be that routines and convenient practices will need dismantling. People won't always need their own car. Sharing concepts are a perfectly viable option, especially in inner-city areas. There could be a lot of robotaxis around in the future and for many, they'll be a viable alternative to owning your own car. In rural areas, electric vehicles will replace cars with combustion engines mainly because of personal infrastructures – garages, carports, and/or solar panels.

Jochen Baier:

We're already seeing more and more cars being squeezed out of cities. This

is where future mobility will go more in the direction of bicycles and, first and foremost, efficient municipal transportation. In rural areas, it's extremely expensive to offer municipal travel everywhere. Approximately half of all expenses are for personnel. So autonomous buses offer one potential way to reverse the trend in public sector travel in rural areas. This technology could significantly expand mobility options.

You spend a lot of time looking at the topic of mobility management. What requirements are arising in this area as a result of the current trend toward autonomous mobility?

Jochen Baier:

Mobility management can basically be broken down into business and public sector mobility management. For businesses or employers, it opens up many potential opportunities: Examples of this are company-owned, autonomously operated cars and autonomously driven shuttle buses taking workers to and from work. Business mobility management is an important ingredient of company operations, so it will become an increasingly important instrument in attracting and retaining workers.

Oliver Taminé:

The requirements that affect public sector mobility management are goals, transportation planning, and reliability. The goals of public sector mobility management in the future – especially if it's based on autonomous technology – will mainly revolve around travel po-

licies, although environmental factors will also play an increasingly important role. Examples of this are zero-emission and, if necessary, autonomous vehicles in inner-city areas: Transportation planning has to carefully consider the fact that environmental planning will also play a more central role in urban planning. The reliability of mobility concepts will also be an extremely important factor in an age of autonomous driving, since new concepts will only become established if they have been sufficiently evaluated and are continually available.

The pressure to change is already particularly noticeable at municipal transportation companies due to the skills gap – especially driver shortages. Autonomous vehicles would bring improvements in this area.

The mobility of tomorrow will be dictated by individualization, connectivity, urbanization, and neo-environmentalism. What changes will mobility management need to undergo today to be in tune with the trends of tomorrow?

Jochen Baier:

Today's mobility is shaped by personal car ownership. Of course cars are highly versatile and ideal for individuals, but on average we only use them for one or two hours a day. The autonomous mobility options of the future will have to take this liberty into account. If people want individual solutions, in essence this need could or already can be met by offering

car sharing. For example in urban areas, parking zones can be managed carefully to limit the number of cars owned by individuals. But one aspect that it's important to consider in this is that the different modes of transportation depend on high levels of connectivity. If people switch to a different form of transportation, it has to be quick and information on the 'chains' of transportation has to be transparent and accessible to passengers. This should also apply to rural areas. From an environmental perspective, future mobility must be 100% achievable using renewable energy. This is where politicians have an important role to play, because mixing electricity sources with coal-fired power is not enough for people who want sustainability.

Oliver Taminé:

Overall there are two conceivable scenarios: a large number of privately owned autonomous vehicles, continuing to be only used occasionally; and publicly owned autonomous vehicles, or ones on a shared basis.

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IT'S ALL ABOUT NETWORKS

MOVING CLOSER TO AUTONOMOUS DRIVING IN THE LAKE CONSTANCE REGION

Autonomous driving is not an entirely new concept. Autonomous vehicles have already been used in farming, manufacturing, and dockland areas for quite some time. Logistics centers are increasingly turning to driverless vehicles. While these examples demonstrate the potential of autonomous driving on private property or restricted areas, preconditions are substantially different when it comes to driving on public roads and a lot of progress is still needed in technological, legal, and social terms. Steinbeis Enterprise IWT Wirtschaft und Technik is working in collaboration with the city council in Friedrichshafen and the company ZF Friedrichshafen AG on an initiative called the Friedrichshafen test bed. The project allows the city north of Lake Constance to assess, accompany, and move forward with the development towards autonomous driving in the public realm.

The SAE classification system describes the development towards autonomous driving on six levels. These range from fully manual vehicles driven by an actual driver, to driver assistance, semi-automation, and fully automated systems. By law, cars in Germany are only allowed to drive on public roads up to Level 2 – i.e. on a semi-automated basis with the driver always being in charge. Shifting up to full automation will require a large number of technological increments entailing comprehensive testing and simulation. Other factors such as future mobility concepts, legal frameworks, user requirements, and acceptance also have to be taken into account.

WRITING MOBILITY HISTORY IN THE LAKE CONSTANCE REGION

Friedrichshafen is destined to become a city of future mobility solutions and thus a location for testing and further developing automated and connected driving. Ever since the first Zeppelin airship took to the skies over Friedrichshafen, companies by the lake have been closely involved in transportation topics.

The region north of Lake Constance is home to industries along the entire transportation supply chain, from aeronautics to the automotive industry. As a result, the mobility sector is extremely important to the region to this day. As part of the Friedrichshafen test bed initiative, IWT Wirtschaft und Technik, a member of the Steinbeis Network, is looking at ways to forge networks between companies and other regional stakeholders working in the field of mobility, thus making an important contribution to the innovative power of the wider area north of Lake Constance (Bodensee-Oberschwaben).

Any change in mobility preferences brings about sweeping changes in technology, infrastructures, and related areas. It also entails a fundamental change in culture and society; in turn, this creates stronger demand for new mobility concepts. Changes in mobility are thus not a new phenomenon. Nonetheless, the entire industry has been undergoing radical change for some years now. This is clearly reflected in the issues that have arisen relating to



First route

Current Route

Inner city

Pedestrian zone

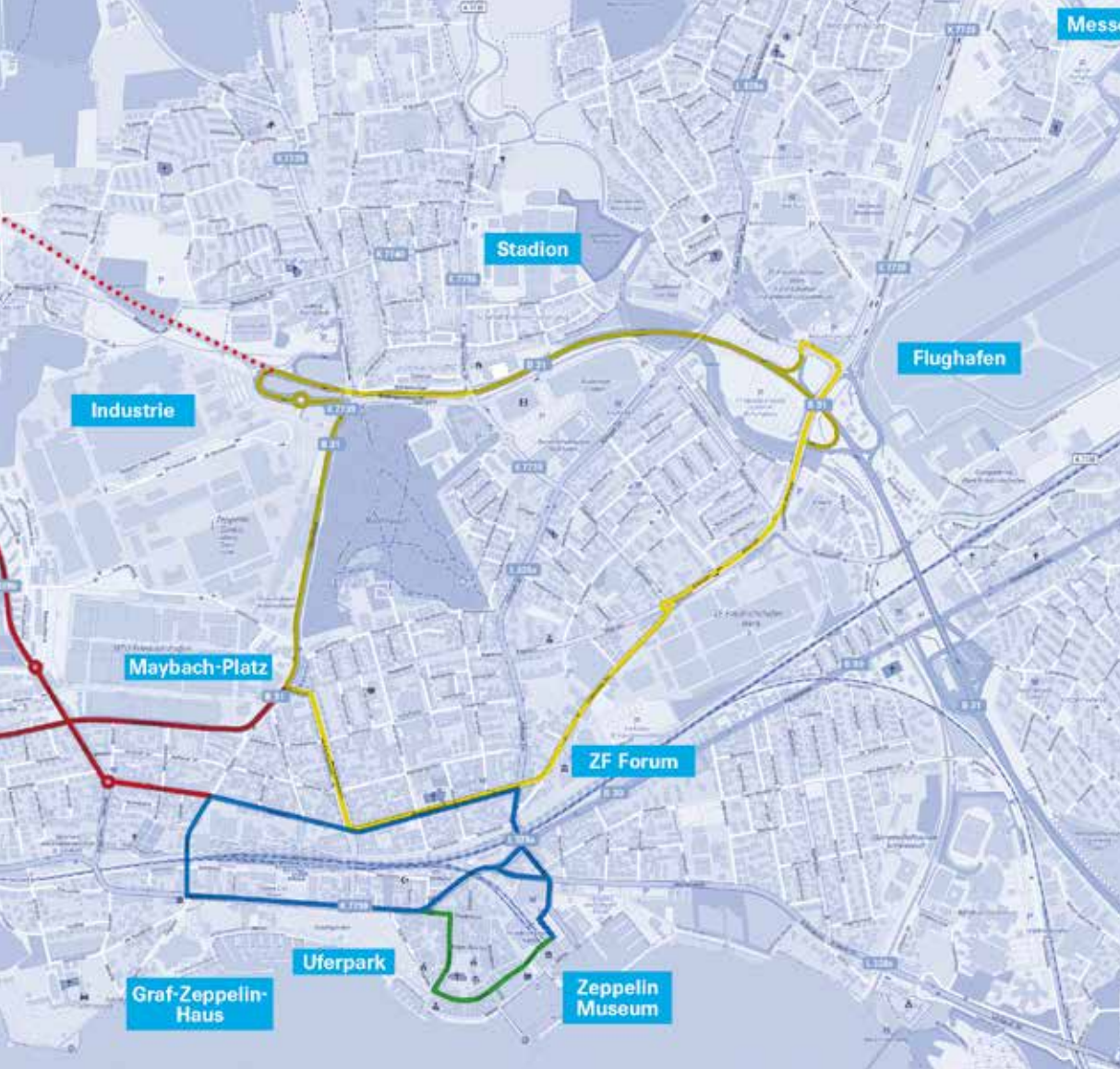
Extension

To the university campus

Infrastructure implementation in planning

climate protection, fuel economy, emissions, financial, and time factors as well as technical transformation due to increased interconnectedness of humans, things and devices in terms of digitization and automation. At the same time the need and demand for mobility is increasing.

Mobility should always be available to everyone. This right to mobility requires new traffic concepts, such as intermodal and multimodal transportation, the "last mile," car sharing, carpools, etc. The increasing level of connectivity of people, technologies and infrastructures is an important factor. These changes pose both new challenges and opportunities



Current and planned routes covered by the test bed

to industries and people. For the Lake Constance region, the IWT is helping with these changes as part of a concept called “The Mobility of the Future”, spanning several projects, initiatives, and measures, one of which is its open laboratory – the “test bed for automated and connected driving in public realm,” or for short: the Friedrichshafen test bed.

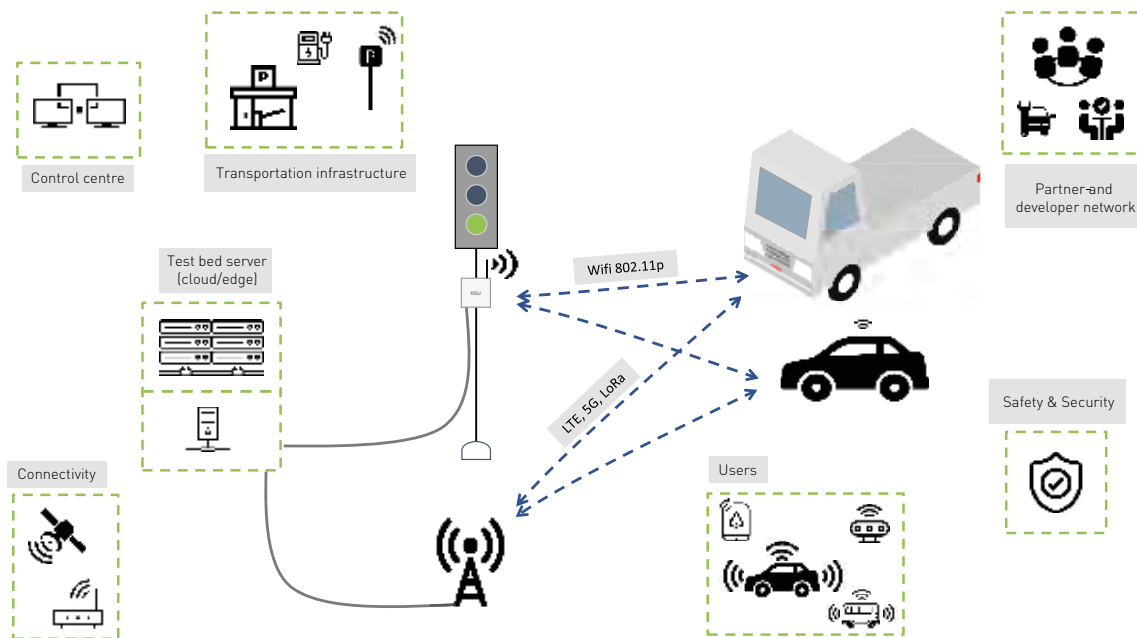
THE FRIEDRICHSHAFEN TEST BED: CONNECTED AND AUTOMATED IN THE PUBLIC REALM

The test bed has officially been registered as “digital test bed for connected and automated driving” with the Federal Ministry of Transport and Digital

Infrastructure (BMVI) since 2018. It includes a federal highway running through the city, significant parts of downtown Friedrichshafen, and the pedestrian zone. The city council has also approved an extension to connect the university campus at Fallenbrunnen with the IWT, the Baden-Wuerttemberg Cooperative State University (DHBW), and Zeppelin University.

The test route measures 5.5 kilometers, running through the city center with a link to route 31 federal highway (B31). The route (see Image 1) also runs past a variety of industrial zones (yellow line, launched in 2018), through the city center (blue line), through the pedestrian

zone (green line), and to the university campus Fallenbrunnen (red line). The test bed thus covers different types of areas and traffic factors that are important for testing and trying out technology in public traffic – e.g. roads with different speed limits from walking pace in the pedestrian zone to 30, 50, and 80 kph zones, city roads, a federal highway, and a tunnel. The route running through Fallenbrunnen campus is also equipped with testing infrastructure provided by DHBW Ravensburg on the Friedrichshafen technology campus, thus offering companies, universities, and communities the possibility to not only to test new types of technology, but also to accelerate development.



Connected and automated driving (V2X) – schematic diagram. Source: authors

The Friedrichshafen test bed is already equipped with roadside units (RSU) which can be used for testing purposes. These RSU are part of the signaling equipment, sending current and future traffic light phases (SPaT messages, i.e. Signal Phase and Time) and digital road topology data (MAP messages). These RSU form part of the research and testing, as is the ETSI ITS-G5 extension. The DHBW Ravensburg unit based on the Friedrichshafen technology campus also has a lab vehicle with its own RSU and onboard unit (OBU). These play an important role in vehicle communication when it comes to data exchange between vehicles moving around within the network, and they are also used as part of projects conducted with DHBW students and professors. The aim of these joint projects is to develop new concepts, to come up with innovations, and to research and try out emerging technology. A demonstration module for OBUs has been fit-

ted onto a DHBW vehicle. Its job as the first application setup was to receive RSU signals on the Friedrichshafen test bed. In a next step, information and signals will be presented on a display panel.

CREATING VALUE BY WORKING TOGETHER

The complexity of future autonomous driving – and thus the complexity of the current test bed – lies in the number of interfaces between individual systems, sets of equipment, and stakeholders. This “system of systems” requires close coordination between individual nodes within the network. Road users, infrastructures and vehicles continuously exchange data and information. Allowing vehicles to drive autonomously in the future requires real-time exchange of authenticated and reliable data.

To implement projects in practical terms, the IWT is focusing on collaboration with

a variety of stakeholders from small and medium-sized enterprises to major corporations, universities, public enterprises and organizations, and others. Collaboration is open in terms of participation and the topics covered, spanning different sectors of industry and disciplines. The priority when it comes to [ongoing] development and innovation is to test, simulate, research, and develop concepts for vehicles to communicate with each other, as well as focusing on the technical infrastructure.

To identify further topics, IWT organizes meet-ups of the “connected car” working group on a regular basis, to which regional and other interested companies, researchers, developers, and scientists are invited. The research focuses on communication between different vehicles and the technical infrastructure (vehicle-to-X communication, or V2X). Issues or topics subsequently discussed and adopted in projects include appli-



FRIEDRICHSHAFEN WAS ALMOST DESTINED TO BECOME A CITY OF FUTURE MOBILITY SOLUTIONS AND A LOCATION FOR TESTING AND INTRODUCING AUTONOMOUS DRIVING.

cations and/or specific use cases in the context of smart infrastructure (IoT, IoE), control centers for autonomous driving, digital applications aimed at improving mobility systems, developing new mobility formats, concepts, and services, the testing and development of new technologies, cross-sector collaboration on mobility topics, and issues relating to user requirements and user acceptance. Other research topics include data models, big data analysis and linked data, and specific technological developments carried out on sensors, actuators, and microprocessors. Another important factor is how established future-

ready technology is applied within the context of transportation, with topics such as artificial intelligence, machine learning, AR and VR, and secure and authenticated data transfer.

The Friedrichshafen test bed has deliberately been set up as an open initiative to ensure it remains accessible to business enterprises, universities, and communities. As a result, it represents an open opportunity to test, simulate, and collaborate on technology, especially for small and medium-sized enterprises. Openly exchanging ideas and sharing technology between universities, com-

panies, industry, and the community plays a decisive role in innovations that will one day be part and parcel of how we will get from A to B.

Companies and universities are welcome to take part in this project. For further information, visit **testfeld-friedrichshafen.de**.

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“YOU HAVE TO SET UP THE SYSTEM IN SUCH A WAY THAT IT TAKES ECONOMIC, ENVIRONMENTAL, AND SOCIAL FACTORS INTO ACCOUNT”

AN INTERVIEW WITH PROFESSOR DR.-ING. MARKUS STÖCKNER, STEINBEIS ENTREPRENEUR AT THE STEINBEIS TRANSFER CENTER INFRASTRUCTURE MANAGEMENT IN TRANSPORTATION (IMV)

Autonomous driving is about a lot more than just vehicles that operate autonomously. The transportation infrastructure also has to meet new requirements. Professor Dr.-Ing. Markus Stöckner, an expert at the Steinbeis Transfer Center for Infrastructure Management in Transportation, spoke to TRANSFER about tasks that have to be taken on and the challenges that have to be overcome.

Hello Professor Stöckner. What demands does autonomous driving place on transportation infrastructure?

I think first you have to determine what the term autonomous driving actually means. Do we mean semi-autonomous driving, or do we really mean fully automated driving in complex project situations and/or complex driving scenarios? On a fundamental level, the more demands placed on automatic driving, the more demands are placed on the infrastructure. There are three important aspects to this: the road space with its particular geometry, “roadside equipment” – things like signs and light signals – and then the technology for transmitting information using mobile

networks. The road space must be clearly defined and recognizable. This can be achieved for example with road markings, which already provide important orientation when finding your way around during conventional driving. You’ve probably been driving along a section of highway yourself when the lines suddenly disappeared. Depending on how fast you’re traveling, it doesn’t take long to lose your bearings. It’s different with autonomous driving because the visibility requirements regarding road markings are even higher. The same applies to recognizing and locating traffic signs. Vehicles also need digital models of road spaces to gain their bearings. For example, they’re fitted with rotating lasers to generate high-precision models for comparison and orientation purposes. But the problem comes with costs, not just in terms of initial outlays but also for maintenance so they continue to function over time. The inevitable consequence of this is that asset management systems will need to be developed.

It would be impossible to imagine driving without traffic lights or road signs. What will it be like for self-

driving vehicles? Will “analog” roadside equipment be replaced by other systems for autonomous driving?

It will also be impossible to imagine driving in the future without such equipment. For the moment, the existing equipment is enough for the more straightforward systems. Vehicles with so-called driver assistance systems are already able to read signs and speed limits or help passengers maintain the right distance from vehicles in front of them. But if you think beyond the horizon, you realize that it makes sense to get things like traffic light systems to interact with vehicles. For example, it would make sense for switching sequences or traffic information to be shared so autonomous vehicles can react themselves. But if you look at the investment costs this would entail, in financial terms this is a gargantuan task.

Self-driving cars pose new challenges in terms of road safety. How important will it be to develop road networks strategically?

Public debate regarding road safety will already be a big challenge. You just need



ON A FUNDAMENTAL LEVEL, THE MORE DEMANDS PLACED ON AUTOMATIC DRIVING, THE MORE DEMANDS ARE PLACED ON THE INFRASTRUCTURE.

to look at the current accident statistics. In recent years, there have been around 3,300 deaths per annum on the roads in Germany. Justifiably, public scrutiny focuses on accidents involving people riding bikes when vehicles turn right, people driving too fast in downtown areas, or the occasional accident that's already happened with semi-autonomous vehicles. But that doesn't change the task we face of making the roads safe, which will mean significantly reducing the number of deaths and injuries – although actually they should be avoided altogether. These are fundamental ethical issues we face in society, and with self-driving vehicles we will need to discuss them again. What will happen if we have mixed traffic on the roads – non-autonomous vehicles alongside autonomous vehicles? Are we willing to accept self-driving vehicles having accidents? Sure, one could do something like reserving certain road sections for autonomous vehicles in the strategic planning of road networks. But I think we have to look at highly complex systems not just from the standpoint of technology, but also from a societal perspective before we make the answers too simple for ourselves.

In the future, the transport infrastructure should not just make it possible to use autonomous vehi-

cles, but also make things sustainable and environmentally friendly. What's the best way to achieve this?

That's a complex question, and there's no straightforward answer to it. A colleague of mine at Karlsruhe University of Applied Sciences, Christoph Hupfer, once said in an interview that "it's no use if we're standing in traffic being energy-efficient." It's a short statement, but there's many a truth in it. Just look at the traffic in a city like Stuttgart in the morning or evening rush hour. The roads are bursting at the seams and the public transportation network is also approaching breaking point. But you're no better off sitting in traffic in a self-driving vehicle. So we need to go one step further and see infrastructure as a complex system that can be optimized with different subsystems. We're already achieving this by dovetailing different municipal mobility options – using bicycles and pedestrian routes, or different sharing projects like car sharing. You have to set up the system to take economic, environmental, and social factors into account. That's our task, and beyond the usual kind of partisan thinking, there's still some room to find a happy medium because we're going to have keep on this journey to work up new mobility concepts. Self-driving vehicles can contribute to the overall system within the transportation infras-

tructure by optimizing traffic flows, while at the same time we do what we can to reduce the number of accidents. That will solve some, although not all of our problems. But we'll need to have all these problems fully solved for the transportation infrastructure to function properly in the future. So in those terms, self-driving vehicles do make an important contribution, even if we still have many challenges to solve – but we will solve them.

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GREENCITYLAB: VISIONARY MOBILITY SOLUTIONS TESTED IN REAL SETTINGS

ENGINEERING AUTONOMOUS MOBILITY SOLUTIONS REQUIRES
NEW APPROACHES TO DEVELOPING URBAN SPACES

Even if it is unclear how much time it will take to introduce transportation options that are genuinely autonomous, under some scenarios progressive autonomization will result in the introduction of completely new driving systems. How will this change usage behavior and the density and design of urban spaces, as autonomous cars enter more and more areas of modern life? To look more closely into this complex area, the Steinbeis Consulting Center for Technology Promotion & Project Financing has joined forces with the Ferdinand-Steinbeis-Institute, urban planners from

Green City Experience, and a variety of municipal stakeholders. Together, they want to explore the opportunities created by automated vehicles in the area of parking, loading vehicles, sharing vehicles, and logistics – while also minimizing the potential risks posed when experimenting in a public space.

Imagine no longer having to focus on tasks associated with driving while traveling in a vehicle – time takes on a completely new meaning. It could even cause people to re-evaluate where they choose to live, since long commutes

would no longer be considered a bad thing. But whether it's a regenerative or a hypermobile city, whenever a new vision comes along it creates insecurity and leaves plenty to the imagination in terms of what might happen next.

Municipal stakeholders working in transportation and urban planning currently lack important information to make a move or take decisions regarding the types of autonomous vehicles that will catch on, both in the medium and long term. For the municipal and regional stakeholders of politics, public adminis-



GREATER ACCEPTANCE THANKS TO A MULTIDISCIPLINARY APPROACH

Development of the GreenCityLab is based on a method called co-creation. This involves both stakeholders and decision-makers, spanning three phases: co-design, co-production and co-evaluation. For the first phase, the GreenCityLab is developed based on stakeholder participation (co-design). Working with local residents, different scenarios are developed, which can then be brought to life using innovative methods from the field of VR. This gives a good impression of what each scenario could look like in reality. To decide which potential option should be implemented, a working group of experts is involved and it is especially important to talk to affected stakeholders to allow their needs, wishes, and expectations to flow directly into the implementation phase. By involving different parties in concept development and discussing issues using detailed models of future scenarios based on images, the debate regarding urban development and transportation planning shifts away from planning based on ideologies, theories, and abstractions. Instead concept planning becomes an integrated approach aimed at finding solutions based on open outcomes, citizen participation, fairness, democracy, transparency, and sustainability – driven by innovative thinking in a business-friendly manner.

tration, transportation, and the real estate industry, certainty is a crucial ingredient when it comes to planning. This is especially the case when adapting transportation infrastructures and planning housing, which involves a long-term approach, also taking regulations and funding into account.

The experts from Steinbeis are planning a real-world laboratory called GreenCityLab in collaboration with their project partners. The idea is to try out highly automated and autonomous concepts in the fields of mobility and logistics in an actual downtown area of a city. Ideally, they will use the Schwanthalerhöhe district of Munich for the GreenCityLab. Roughly 30,000 people live in the area.

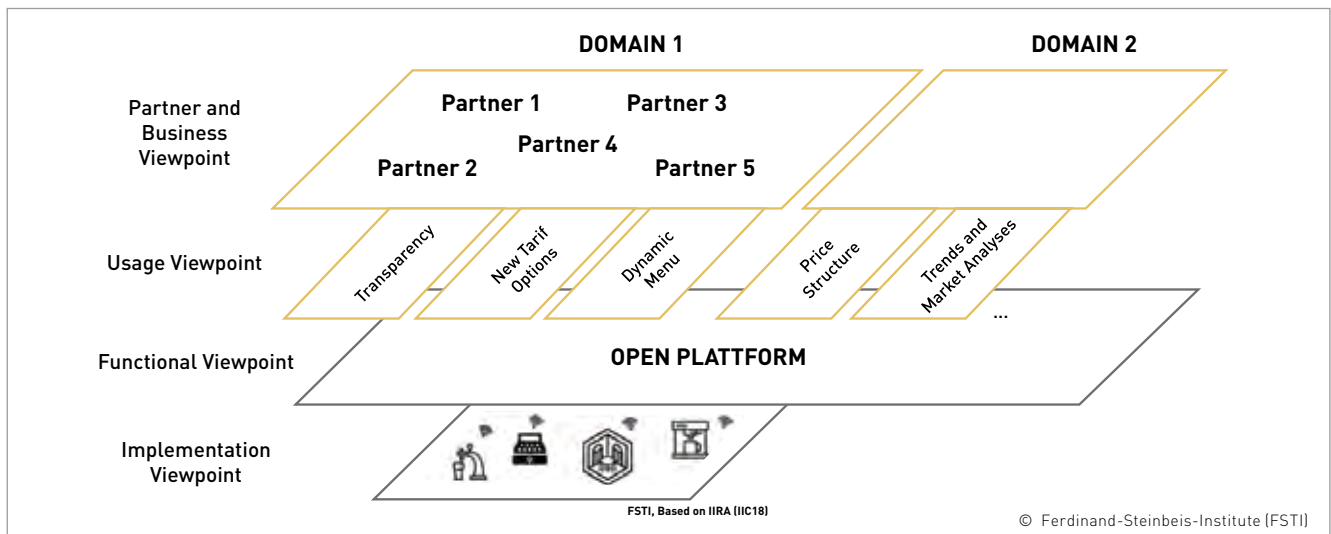
What's innovative about the approach with this experimental area is that before testing the highly automated and autonomous system as a finished solution, the experts conduct a participation and feedback program using virtual reality. This allows stakeholders' explicit

expectations of the future to be used as a basis for planning. The process makes it possible to ensure that product development and testing of the product in the GreenCityLab focuses more closely on key issues. It also makes estimating the market potential of innovative mobility solutions much more specific, because a real-world laboratory is a test site and test market in one.

This gives municipal stakeholders a reliable foundation for assessing the nature and timing of any influences autonomous driving may have on the planning of parking lots, cycle tracks, crossroads, sidewalks, interchanges, etc., and this enables them to be better prepared.

Two key instruments in securing the success of the GreenCityLab initiative are gaining higher acceptance for the new solutions (based on an interdisciplinary process using virtual reality) and setting up an open platform for a multithematic, inter- and multimodal mobility system.

Once different scenarios have been programmed into the system, these can be "experienced" directly on location using a VR headset. For example, users can simply walk around the district. The system can be used in any location and thanks to VR technology, the process is both mobile and scalable. The VR simulation opens the door to a new approach to information sharing. Actively experiencing something in a digital space makes it possible to look at things from a whole variety of perspectives, and this creates a better understanding not just



↑ Levels of the cross-domain ecosystem

of the project itself but also of other stakeholders.

After the VR simulation, users are surveyed and probed for ideas and further questions. This creates an increasingly detailed picture of future expectations and wishes. The project team can then pull all feedback together, process it, use these insights to set priorities and, ultimately, implement specific scenarios in the GreenCityLab.

AN OPEN PLATFORM FOR USE AS A MULTI-THEMATIC, INTER- AND MULTIMODULAR MOBILITY SYSTEM

Thanks to emerging ICT (AI, 5G, blockchain), it is now possible to integrate innovative transportation technology into actual infrastructure on location. To do this, an end-to-end connected ecosystem is set up and put through its paces, involving not only key partners from industry and research but also a broad selection of pooled services, delivering benefit under different application scenarios. Users can then be allowed to try out different urban mobility

options themselves on an app. This opens the door to new fields of application and business potential, and it's important to ensure that these are translated into economically viable concepts.

Laying down open standards as a fundamental requirement not only ensures that opportunities can be exploited with respect to connected mobility solutions and urban development, but also allows any other stakeholders in the ecosystem to exchange ideas and use data provided for their services, in all areas of the system. "This enhances interoperability, enables new business models, and raises the competitiveness of all companies involved," explains Steinbeis expert Oliver Damnik.

Data-driven services aimed at new value creation scenarios can be developed on all levels of the automation pyramid, also making it possible to control physical objects used in the urban transportation infrastructure – with processes and IT systems consistently focused on this infrastructure. By using existing platforms and combining these with

functionalities offered through platforms operated by stakeholder companies and state bodies, it becomes possible to develop further solutions, resulting in an integrated ecosystem based on open internet technology.

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“IT’S IMPORTANT TO PUT TECHNOLOGY TO THE BEST POSSIBLE USE, TO SAVE TIME, MAKE THINGS MORE FLEXIBLE, AND FOSTER SUSTAINABILITY”

AN INTERVIEW WITH SVEN GÖTH, CEO & FOUNDER OF THE DIGITAL COMPETENCE LAB



Sven Göth, an expert in the future worlds of work and living, believes that for companies to remain successful in the future, they have to think about the future now. Göth took a look at the future of mobility for TRANSFER. He feels certain that it will be shaped by a whole variety of new mobility options, even if a difficult journey lies ahead not just for companies but also for consumers. The ideal blend of mobility options will boil down to the right infrastructure, people, and their mobility requirements at each specific location.

Hello Mr Göth. You spend a lot of time looking at the issues that affect the future. What do you think the future of mobility holds for us? How autonomous will mobility be?

I imagine the future of mobility, thinking specifically 10 to 15 years from now, to be a question of location and perspective. Rural areas will be totally different from urban centers with respect to the mobility options on offer. IT infrastructures and the volume of people wanting to travel will dictate the availability of different options. Everyone seems to be talking about Mobility as a Service at the moment, but it's a one-off idea and you can't promise to deliver something like that across the board in a country the size of Germany. We're most likely to have access to a new selection of mobility alternatives in the big cities, and this raises a question: What will the blend of travel options be like in the future

and – depending on what this looks like – will I still need my own car? Ownership will drop significantly compared to usership in this area. We're already seeing signs of this happening today, but things are still not positioned properly when it comes to efficient or user-optimized implementation. Similarly, we need clear statements regarding mobility – on a political and public level – such as what will happen in the cities. The reason I say this is that there are certain issues that still need to be addressed to plan the infrastructure for a high volume of users, especially if we want to meet expectations when it comes to service, sustainability, and convenience. So mobility will become extremely diverse in the next decade. We're already seeing some big differences in the mobility options offered within states and certain cities. In some areas there are autonomous buses, trains, and cars driving around, or

cities that are highly digitalized, but there are others where people won't travel around without their cars.

Are German businesses prepared for these developments? And what about consumers?

Prepared? Yes and no. On the one hand, the carmakers, the cities, and the politicians are making moves to establish the right conditions for the mobility options of tomorrow. But on the other, people are still quite confused about the change that's coming and the consequences it will bring in terms of credible implementation. I see the same thing happening with consumers. The adoption rate is still quite manageable in the cities, where there's a good offering of alternative solutions, although some services like e-scooters and ride-sharing (like MOIA) can have limited capacities, so this weakens the user benefit



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and ultimately reduces usage levels. There's not yet the right mixture of mobility options, which you need in an urban setting to make proper use of the system, just as you do in rural areas. And this situation will be different in every city since the infrastructure, population, and mobility requirements are also different. What we need to do now is start testing and trying out different alternatives in suitable settings to plan mobility for the future based on experience. I think ultimately, there'll be a variety of public transportation options, especially in the cities, since this is where you can achieve the most synergies and the most important data you need for public transport is already coming together there.

Most people think about autonomous cars when you ask them about autonomous vehicles, but there are also autonomous trains and autonomous aircraft. What role will these modes of transport play in the transportation ecosystems of the future?

From a general perspective, aside from airborne vehicles, autonomous trains are probably the field autonomous mobility can be achieved the most quickly in. They already have fully autonomous trains running in the railway network in

Japan. Drones also offer tremendous potential, in a number of areas. For instance, they can improve the flow of traffic going from downtown locations to the airport. Drones can also be useful in efficiently moving certain objects around. The boss of EHang, the drone producer, flies to the office in Shenzhen every day. But to do this, you need the right regulatory framework. It's also important in such areas to define how these solutions should be used in terms of certain criteria such as sustainability, the benefits, and planning horizons. In some areas, I see the progress that's being made as extremely positive, although it won't be that expedient if everyone's flying around in their own private drones in the future. That's not my vision of the future. Mobility is a fundamental aspect of our day-to-day lives. It's important to put technology to the best possible use, to save time, make things more flexible, and foster sustainability. Ultimately, alternatives enrich the eco-

system if they deliver the best possible benefit for all stakeholders in a given location. This is where doing things like integrating Hyperloop into the railroad network becomes conceivable. I don't think we'll be lacking in alternatives when it comes to mobility options, even autonomous mobility. I envisage an exponential leap forward in developments over the next ten years, because the most important technologies have all reached a level of sophistication for us to work on leveraging their potential together, or enhancing their potential. Quantum computing will also have a big impact on mobility, because it will make it possible to simulate and improve traffic flows in parallel.

What do you see as the biggest challenges in making autonomous mobility a reality?

That's an easy one: networks, security, and our faith in technology!

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“OUR VISION IS TO CREATE SAFE, SUSTAINABLE, AND FASCINATING MOBILITY”

AN INTERVIEW WITH DR. ANDREJ HEINKE,
VICE PRESIDENT OF CORPORATE FORESIGHT AND
MEGATRENDS AT BOSCH

Dr. Andrej Heinke's job at Bosch is to make the seemingly impossible possible. He makes plausible assumptions about the future and travels the world investigating them. As a result, he is highly familiar with the topic of modern travel solutions – mobility – in both theoretical and practical terms. Heinke talked to TRANSFER about the road safety aspects of autonomous and automatic driving, the changes these will necessitate when it comes to infrastructure, and autonomous flying. Despite many risks and challenges, he strongly believes that autonomous mobility will be safe and efficient in the future.

Hello Dr. Heinke. How important are “autonomous” factors for the mobility concepts of the future, especially given Bosch's slogan: Invented for Life?

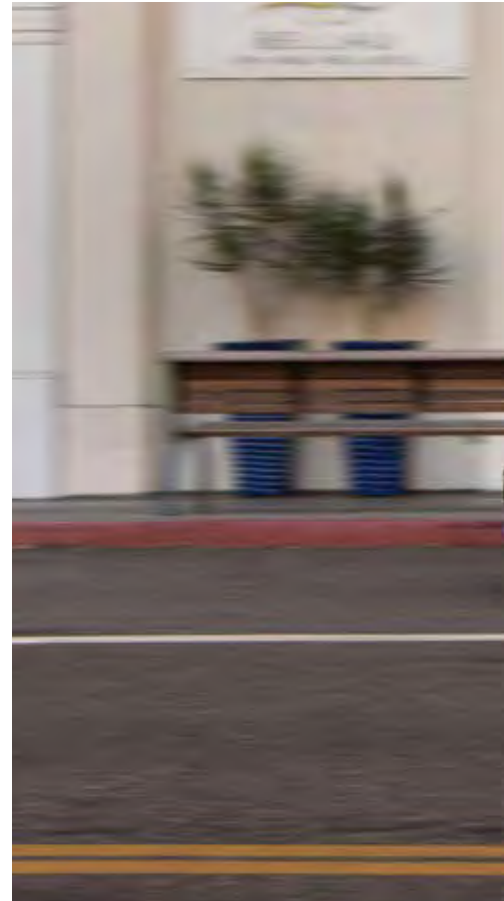
Bosch's aim with automated driving is to make the roads safer. Nine out of every ten accidents are caused by human error. Providing drivers with specific help in unclear situations or completely taking on the task of driving for them can save lives. Also, existing resources like space, time, and energy can be used more efficiently because if you get high enough market penetration of automated vehicles they can be synchronized more.

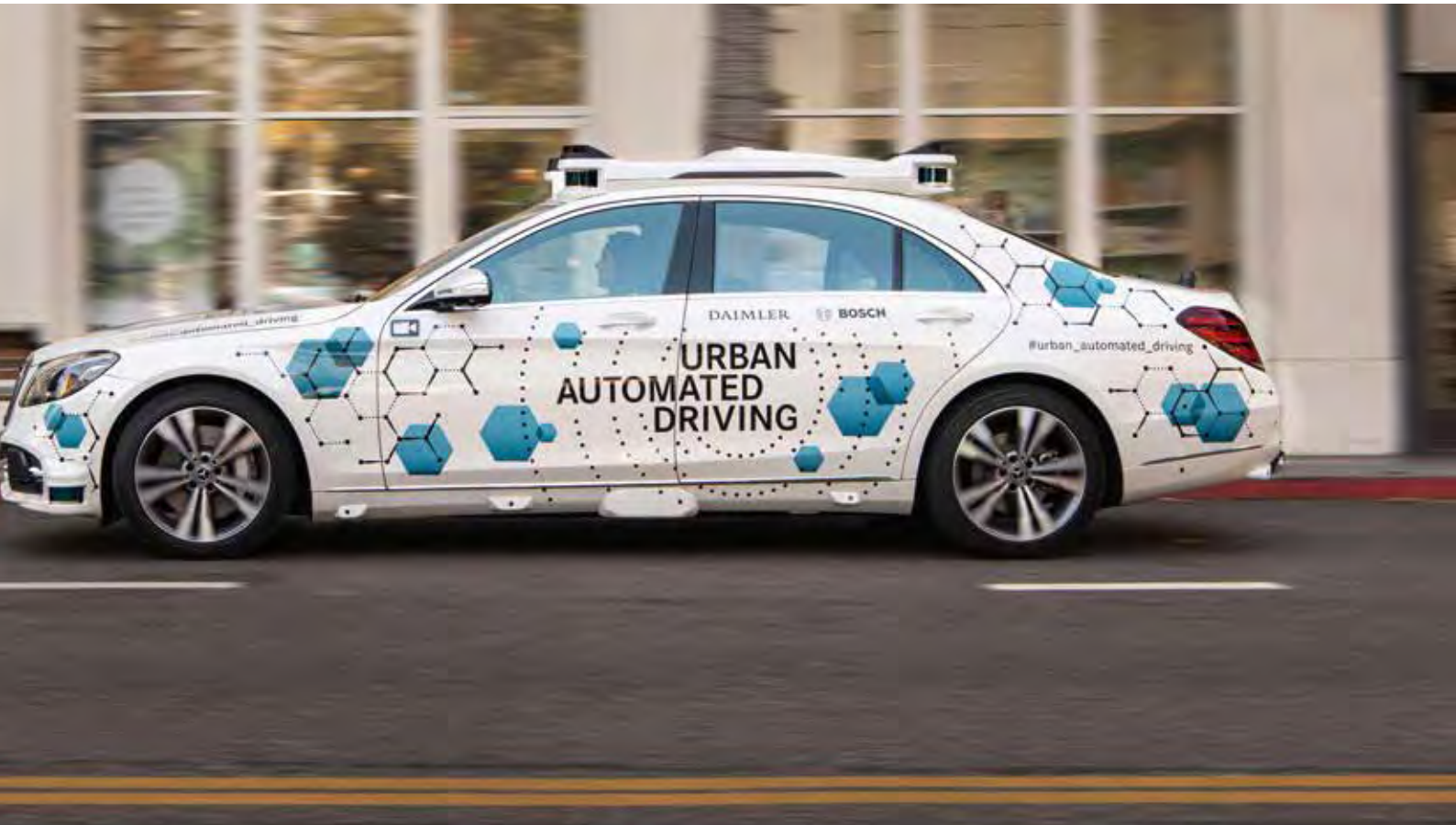
The population is growing so there's more traffic on the roads. By 2050, there could be three times more cars on urban roads. According to an international survey conducted by Capgemini, the management consulting company, one in two consumers would like to drive an autonomous vehicle that takes the task of driving off their hands and steers them through traffic. Bosch is currently developing a variety of solutions for personal travel and goods transportation. Our vision is to create safe, sustainable, and fascinating mobility. To do this, we need solutions to be personalized, automated, electric, and connected.

The CEO of Bosch, Volkmar Denner, defined the strategic direction when he said that Bosch is more than cars. We're leveraging the entire technical scope of the corporation to introduce innovative mobility solutions – things like connected parking, automated driving, or apps for multimodal transportation and electric vehicles. Not only do we make driving easier, safer, and more comfortable than it's ever

been, cars are becoming a new kind of fully connected assistant. Bosch's portfolio means that it's prepared for different types of developments like no other technology and service company.

The first step toward autonomous driving has already been taken at Bosch. Since 2019, cars have been able to find their way without being driven to parking spaces in the garage at the Mercedes-Benz Museum in Stuttgart, and then park themselves. This makes it possible to fit up to 20 percent more vehicles into the same area. This form of automated valet parking has been made possible by intelligent parking garage infrastructure supplied by Bosch. The system revolves around community-based parking: Bosch takes on the search for a parking space by allowing cars to automatically notify the cloud that their ultrasound sensors have detected empty parking spaces as they





Practical test in California © Bosch

drive past. Drivers are then shown the nearest empty parking space on their navigation devices and they're guided straight there – which saves time, fuel, and frustration. At the same time, this helps reduce air pollution and traffic jams in urban areas.

What do you see as the biggest challenge in turning motor vehicles into actual “auto-mobiles”?

Understanding the opportunities and threats involves a lot of factors. Let me give you an example. Bosch and Mercedes-Benz have been working together on the development of automated driving solutions for cities and have started a pilot project in San José in Silicon Valley looking at hitch-a-ride services using apps. This involves an automatically driven S-Class Mercedes-Benz. Under the supervision of a safety driver, autonomous cars travel back and forth



A flying taxi © Bosch



↑ Open technology: affordable and minimized-emission mobility using mixed propulsion from Bosch © Bosch

between the district of West San José and the center of the Californian city, along the main travel artery of San Carlos Street and Stevens Creek Boulevard. The test should provide Bosch and Mercedes-Benz with further invaluable insights for developing their automated driving systems in keeping with SAE Level 4/5. The business partners also expect to gain an understanding of how to integrate autonomous cars into intermodal transportation systems, drawing on the example of public transportation resources and car sharing.

Autonomous cars can potentially improve safety with their permanent 360-degree monitoring systems, especially in heavy inner-city traffic, and because they travel in a uniform manner they can improve traffic flow. For automatic driving to become everyday technology, it has to be reliable and function safely. It's not just about the automated vehicle itself winning people over, but also how it dovetails with urban transportation.

As more and more autonomous driving is introduced, human failings will be central to how quickly new technologies gain traction, especially during the transition phase – things like people nodding off at the wheel, getting distracted, or not using their seat belts. To avoid hazardous driving and, if possible, accidents, cars will therefore no longer just monitor the roads, but also the driver, the front-seat passenger, and others in the vehicle. Bosch has developed a new system for monitoring car interiors with cameras, plus artificial intelligence (AI), which should be ready for mass production in 2022. That's when safety technology will become standard in new vehicles in the European Union, doing things like warning drivers if they're tired or getting distracted. The EU commission expects its new safety requirements to save more than 25,000 lives by 2038 and avoid at least 140,000 serious injuries.

Looking inside the vehicle will also solve a fundamental problem experienced with

autonomous cars. This is because to transfer the responsibility for driving back to the driver after traveling on a highway, for instance, a car needs to be sure that the driver isn't sleeping, reading the news, or writing emails on a smartphone. If you fall asleep for just three seconds at 30 kph or look at your smartphone instead of the road, you'll have traveled 42 meters in the meantime – running blind. Many people underestimate how dangerous that is. A study by DA Direkt and infas quo found that roughly ten percent of accidents are caused by distractions or fatigue, and the number one distraction overall is the smartphone. The Bosch system for monitoring car interiors uses an in-built camera in the steering wheel to detect if the driver's eyelids are starting to drop, or he's distracted, or his head is turned to the front-seat passenger or someone on the back seat. Thanks to AI, the system uses this information to work out what's happening. Depending on the preferences of

the car manufacturer or statutory requirements, it warns the driver if he's not paying attention, recommends he take a break, or even slows down the vehicle. The new Bosch system also thinks about driver comfort. The interior camera detects who is sitting in the driver's seat and adjusts the rear-view mirror, seat position, steering wheel height, and infotainment settings to individually stored preferences. The camera can also be used to control the infotainment system with hand gestures or the eyes.

Automatic mobility is not just restricted to certain vehicles – it's already been introduced to some vehicles on tracks. Airplanes are also starting to go autonomous. How long do you think it will take for this to become a reality?

Most airline passengers don't realize how little of the time the pilots are actually still flying the aircraft themselves. In a survey quoted in the New York Times, airline captains flying Boeing 777s were recorded as saying that on the average flight they only control the airplane for seven minutes – and that was in 2015. With Airbus aircraft, it was even only three minutes. Pilots do the take-off and landing, and the rest of the time they're monitoring the autopilot. Some of the very latest combat aircraft and all drones can either be flown automatically or allow themselves to be controlled remotely. Airbus is testing commercial aircraft in research simulators with just one pilot in the cockpit. It's still not known whether this idea will enter airline operation – and if so, when. But if things can be made safer versus flying with two pilots in the cockpit, it will be introduced quickly. Human error is the main cause of air accidents. AI systems will translate instructions issued by air traffic control into text, without misunderstanding anything, and multispectral on-board camera systems will be even

better at reading taxiing signs and identifying obstacles on the ground, day or night. To do this, Airbus is testing a laser system based on lidar. The taxiing, take-off, and landing stages will probably be automated first.

But there are also risks involved when you automate things. Pilots have already become so dependent on autopilots that they're beginning to forget fundamental procedures, ignore them, or even unlearn them because too much responsibility is being delegated to automatic systems. You just need to think about how dependent you become on the navigation system in your car. Who still uses a map these days, or simply drives an unfamiliar route based on intuition?

New mobility concepts require changes in the infrastructure. What do you think the most important milestone will be for this?

Transportation options will always be more varied in cities. People walk, ride bicycles or electric bikes, travel by bus or train, or use their own cars – and in the future they'll also ride in autonomous vehicles. In urban areas, autonomous flying taxis or drones could be used to transport people or urgent products and medicines. All of these applications need powerful sensors and control systems, and these also need to conserve as much energy as possible. This is precisely where the publicly backed OCEAN12* project comes in, which involves 27 partners from all around Europe from the fields of semiconductor technology, electronics, aeronautical technology, and automotive engineering. Together, the aim is to develop sensor systems to use in autonomous driving and flying. Bosch heads up the 14 organizations that make up the German consortium. Together, the project partners will develop different types of energy-efficient components by the end of 2021. These will capture and

process data on the immediate surroundings of cars and airplanes. This will include sensors monitoring the surroundings of vehicles, lidar or radar sensors, and microprocessors for processing information. The electronics will convert recorded data into control commands for downstream components. These could be car brakes or steering systems, or units controlling the engine of a flying taxi.

Bosch is also taking steps to address another requirement that affects new mobility concepts: the use of high-resolution maps. To do this, shares have been bought in the maps company HERE Technologies in order to work together on a manufacturer-independent solution. The idea is that vehicles should share traffic information gathered by their sensors so that maps can be updated in real time. There are also potential fields of application for such solutions beyond the transportation space – such as connected factories, where accurate maps of indoor areas can help automate and coordinate material flows.

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AUTONOMIZATION: REALITY OR (STILL) FICTION?

THE PRINCIPLES BEHIND AUTONOMOUS AIRCRAFT

“We know what you want” – the tagline used by author Marc-Uwe Kling in his novel, *QualityLand*, for an online e-commerce platform called *TheShop*. Data evaluations predict what customers actually want – consciously or subconsciously. Products are then sent to them by drones, without even needing to place an order. And as they open the package, the “unboxing” is filmed. This video is then immediately posted online through a platform called *Everybody*. Finally, customers rate their experience on a touchscreen held up by the drone. [1] We’re not a million miles away from this sci-fi scenario, especially given current rates of technological development. Companies like Amazon and DHL are already working on a reliable system that will make it possible for drones to make deliveries.

The term for the underlying principle that will make such concepts possible is autonomization. According to Kant, autonomy was tantamount to “sensible self-determination,” whereby the freedom to make decisions is subject to certain rules. Autonomy is measured according to a specific environment – the place in which individuals define themselves or act with self-determination in order to fulfil their sense of purpose. It thereby revolves around individuals’ norms and rules. [2] When systems interact with their environments, they organize themselves without relinquishing self-determination. Systems use interactions with their environment to expand their sphere of influence and they exploit potential through multi-dimensional interactions. They attempt to achieve self-defined goals by deciding which data to use, by processing and evaluating unstructured data, and by adapting decision-making structures. They strive to safeguard their own power to act and, if possible, extend it. According to scientific definitions, autonomy can be extended to include the ability to remain functional in unknown environments. This ability is referred to as robustness and it necessitates a certain ability to self-organize.

From a holistic standpoint, systems are driven by macro-level goals of self-optimization and self-preservation. There are three features of an autonomous system that can be derived from this. The system’s actions are self-determined and self-organized, and it has the power to take action; to achieve this, a system gives itself an identity or is provided with one by a system designer; and it interacts within a trusted network according to global governance dictating system interactions. [3]

The Ferdinand-Steinbeis-Institute’s definition of autonomization in the area of

business information systems is the implementation of (sub-)processes in business according to these three features. For this to work, different types of digital technology and information systems can be used, and these facilitate systems comprising agents whose role is to make use of autonomous processes. This is the case if, for example, an autonomous smart home system orders something by itself, books medical appointments, or adjusts the air-conditioning in a house to make things comfortable for occupants. The system organizes things itself to achieve this and interacts with stakeholders in a



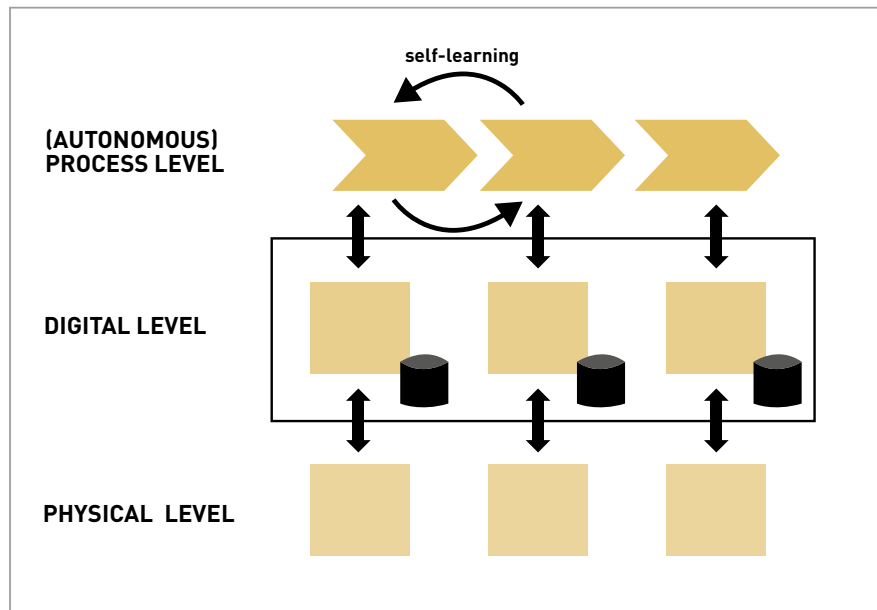
“ACCORDING TO KANT, AUTONOMY IS TANTAMOUNT TO ‘SENSIBLE SELF-DETERMINATION,’ WHEREBY THE FREEDOM TO MAKE DECISIONS IS SUBJECT TO CERTAIN RULES”

trusted space at home using its own identity. It carries out valuable transactions itself and reacts flexibly to unknown situations according to consistent system behaviors.

Introducing autonomous processes requires a large volume of data which then needs to be analyzed. With data-driven approaches, models are developed based on heterogeneous, multi-dimensional data records. These are required to make the information available that is needed to make decisions and thus carry out processes autonomously. Compared to mathematical methods, data-driven methods make it possible to assess larger volumes of data spanning multiple factors – the type of information generated by the advent of the internet of things. In comparison to automation, with autonomous (sub-)processes, unstructured decisions have to be made. Systems decide for themselves which factors and information sources should be included to make a decision.

These may differ depending on the context and time factors and different outcomes may be achieved for different clients despite similar maximization premises. This contrasts to structured decisions, whereby the same outcomes may be achieved for different clients despite similar maximization premises. Technologies such as deep learning and distributed ledger offer potential ways to achieve the principle of autonomization. The FSTI is looking into these technologies in order to develop concepts aimed at autonomization. Accordingly, experts at the FSTI interpret the three features of autonomization thus:

- **Self-determination:** Systems define their own goals and (sub-)processes for achieving goals in keeping with their own rules and standards.
- **Self-organization:** This comprises the selection of factors and data sources for unstructured decision-making,



↑ Autonomization: model showing different levels

processing and evaluating large volumes of multi-dimensional data, and adapting the system's own decision-making structures (= self-learning).

- **Ability to take action:** This refers to how systems implement decisions while interacting with their environment and safeguard their robustness.

People want to come up with systems for introducing autonomous processes in many areas. But it is difficult to work out whether they mean autonomous, automated, or digital systems when they say this, because there are so many different definitions.

DRONES – AUTONOMOUS AND AUTOMATED

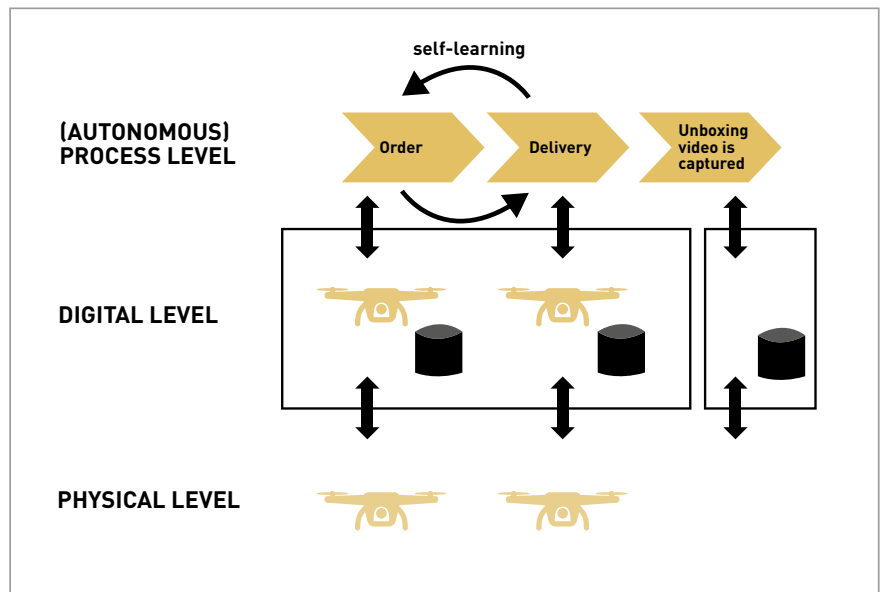
According to Nicholas Horbaczewski, the founder of Drone Racing League, drones will have the same ability to cause disruption as smartphones. They can transport objects short distances into areas that are difficult to access. From delivering packages to helping with medical emergencies, there are a variety of ways to use drone technology. [4]

In the future, collaborative drones could become components within systems that will take on a variety of tasks according to the principles of self-determination and self-organization. As unmanned aerial vehicles (UAVs), drones offer an important complement to manned aircraft because they can be used for dangerous missions, but also monotonous tasks. Examples include using UAVs to access remote locations in disaster areas, carry out inspections, or transport goods in bad weather. [5] The aim in the future will be to raise the automation levels of manned aircraft to provide pilots with support, or even take on tasks as autonomous UAVs. Accordingly, airspace will be a mixture of manned aircraft and UAVs. This will require coordination mechanisms, and progress will be dictated by the maturity levels of emerging technology.

The system architecture of a UAV comprises one or several on-board computers containing software for controlling flight electronics. The number of on-board computers depends on the required level of modularity and partition-

ing. There are also sensors and actuators on board to allow drones to be steered and propelled. Then there is a special unit for interpreting sensor data. Defined actions are then carried out by actuators. Drones also contain communication systems so they can interact with other objects or units on the ground. They have special systems for carrying out controlled landings in an emergency. [6] In his novel, Marc-Uwe Kling expands this physical level of drones by adding a digital level so they can immediately make complex decisions based on data models. On the digital level, the flight system in QualityLand uses different types of digital drones and other data sources to carry out autonomous processes – including weather data, a shopping database, and a platform called Everybody. Each step of the process, from ordering to shooting the unboxing video, is self-selected, self-organized, and carried out by the system itself, which has the power to act as it needs to. Events within this process are not fixed according to a rigid timeline; the system plans steps itself to adapt to the changing situation – it's a self-learning system.

Projects like Uber Elevate and Uber Air will allow Uber to experiment with air transportation for the next five years.



↑ Autonomous flying (schematic representation)

Uber's aim with Uber Elevate is to operate flights between fixed points using autonomous and electric technology. Uber Air is an on-demand service offering flights on adaptable routes. [7] Such projects require further development when it comes to autonomization, however, in order to provide suitable autonomous aircraft.

Technological concepts such as the internet of things, artificial intelligence, and data processing will also need fur-

ther development. Nonetheless, the situation is less complicated with autonomous aircraft compared to developing autonomous road vehicles, because airspace is highly regulated – there are fewer unknown variables to take into consideration (like pedestrians). [8] One thing we can be sure of, however, is that some things will never change: "Could you possibly look after these two packages for your neighbors?" [1]

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- [1] Cf. Marc-Uwe Kling, *QualityLand*, Ullstein Buchverlage GmbH, 2018, Seite 18
- [2] Cf. Kant 1968, BA 87, Buss 2011
- [3] Cf. Littlewood 1996, Froese, Virgo and Izquierdo 2007
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- [6] Cf. <https://www.dglr.de/publikationen/2018/480238.pdf>
- [7] Cf. <https://www.adweek.com/brand-marketing/uber-elevate-ambitions-flight-sharing>
- [8] Cf. <https://www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/>, <https://www.itworldcanada.com/blog/5-trends-on-gartners-hype-cycle-for-emerging-technologies/423379>

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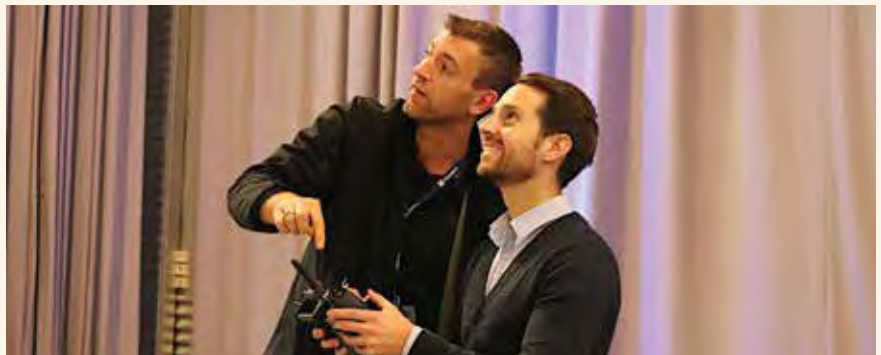
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GRASPING TECHNOLOGY: EXPERIENCING AUTONOMOUS FLYING HANDS-ON

FERDINAND-STEINBEIS-INSTITUTE ORGANIZES EVENT TO PROMOTE WIDER PUBLIC ACCEPTANCE OF NEW TECHNOLOGY

Let's Talk Technology* – this was the invitation sent by the Ferdinand-Steinbeis-Institute (FSTI) to readers of the 2/2019 edition of Steinbeis TRANSFER magazine. Going by the motto #techourfuture, since November 2018 experts from Steinbeis have been working on a project called Technologie*Begreifen (Grasp Technology) backed by the Baden-Wuerttemberg Ministry of Economic Affairs, Labor, and Housing. The aim of the initiative is to foster more openness to future technological developments. Just now, was tried out on November 16, 2019, when the FSTI organized its first #techourfuture event on "The Future of Autonomous Flying – Over the Country and People" at the Technik Museum Sinsheim.



The aim of the #techourfuture initiative is to foster an understanding of technology among the general public to allow people to make informed decisions regarding future developments. The experts at Steinbeis are not attempting to convince others that all new technolo-

gies and the products they lead to are good per se, but instead encourage everyone to think more about and become more involved in new technologies, before they jump to conclusions or are swayed by one-sided reporting in the media, for example.



WHY “TECHNOLOGY*”?

Most emerging technology is not just based on an individual form of technology, instead it results from different technologies merging into one. For example, with autonomous aircraft that may be a combination of lightweight materials, AI control mechanisms, and energy-efficient technology. The word Technologie* in the German title of the initiative is about combining any number of technologies to come up with new applications – resulting in different societal and business models.

The #techourfuture initiative is about sharing knowledge beyond the realms of technological know-how and encouraging people to make their own minds up about the nature and use of new technology – and thus play an active role in helping to shape the future. The experts at the FSTI are setting up panel sessions to discuss certain topics, providing an experimental forum to introduce members of the public to recent technological developments, not only in ways that are understandable to laypersons, but also in an objective and factual manner.

One important priority for the FSTI as a research institution is not just to share knowledge, experience emerging technology, or shape visions of the future, but also to evaluate technology acceptance from a scientific perspective. Pre-

vious research findings have shown that reservations about new technology – especially the increasing prevalence of digital solutions and autonomous systems – can be explained by a concern that people perceive a “loss of control.” (For further information, see also page 50)

Around 50 people of different ages and professional backgrounds responded to the invitation to come to Technik Museum Sinsheim and “talk technology.” The forum on November 16, 2019 was the first #techourfuture event, this time looking at The Future of Autonomous Flying – Over the Country and People.

Over the course of the day, the participants watched live demonstrations and even got to try out the very latest tech-

nological developments, such as a helium-filled aircraft called h-aero® and the Emqopter delivery drone. The event location was set up with a series of “tech stops.” These allowed visitors to find out more about the current and future application areas for unmanned aircraft and talk to experts from different specialist fields about the fundamentals, opportunities, and risks of flying objects. In the afternoon, the visitors were invited to take part in workshops and “get creative” by going through their own application scenarios and visions of the future of autonomous flying.

Their findings were demonstrated afterwards in short video presentations and discussed by the experts at the event. The event was moderated by Mirko Drotschmann, alias MrWissen2go



("MrKnowledge2go"), who also introduced the audience to interesting examples and discussed intriguing issues relating to autonomous flying.

The FSTI received positive feedback about the event. The participants completed a post-event survey and gave particularly high scores to the way the technology topics were presented, the interaction with experts, and the possibility visitors were given to add their own ideas and visions. Around 80 percent of the participants said that the event had improved their understanding of the application opportunities for the technology.

The majority of respondents also confirmed that they now have a better grasp and overview of the technology looked at during the day. Some participants suggested that more time should be set aside for the interactive sessions with the #techourfuture experts, and FSTI will ensure this is the case at the next event on June 26, 2020 on the Pforzheim University campus. The next #techourfuture day will deal with the future of medical technology, explore the impact Technology* has on our health, and discuss any changes that are likely to happen when it comes to healthcare systems.

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TO REGISTER ONLINE FOR THE SECOND #TECHOURFUTURE EVENT AND FIND OUT MORE ABOUT THE INITIATIVE, GO TO WWW.TECHOURFUTURE.DE



#TECHOURFUTURE NOV 16, 2019 | TECHNIK MUSEUM SINSHEIM AUTONOMOUS FLYING TECH TOUR

Tech Stop: People Transportation | Prof. Dr. Michael Decker, Karlsruhe Institute of Technology (KIT)

What if we could simply fly to work? Flying cars are no longer the stuff of science fiction movies – they could also solve our traffic problems! But is the technology ready yet? And what impact would this have on life in the city or people in rural areas? What are the possible application scenarios? Maybe private flying cars? Or perhaps flying taxis? Answers to these questions and many more were provided at the People Transportation tech stop.

Tech Stop: Delivery | Marvin Bihl, Emqopter

The Delivery tech stop was presented by Emqopter, a young company that deals with the production and development of autonomous technology used in unmanned flying robots. These include the delivery drones made by Emqopter itself – the first of their kind in German airspace. These drones are capable of transporting small parts autonomously, flexibly, and efficiently. The Delivery tech stop allowed visitors to find out more about the complex collision avoidance technology surrounding delivery drones and techniques used to identify suitable landing areas. It was also an opportunity to experience a delivery drone at close quarters.

Tech Stop: Safety and Regulation | Simon Kennert, Baden-Wuerttemberg Ministry of Transport

Who is actually responsible for controlling autonomous drone traffic, and where should autonomous aircraft be allowed to fly? To understand these issues, one has to look closely at the fundamentals of legislation and understand risk assessment. These were the topics looked at by the Security and Regulation tech stop, including the legal framework for operating unmanned aircraft.

Tech Stop: Earth Observation | Dr. Csaba Singer, Hybrid-Airplane Technologies

Can autonomous aircraft help protect the climate and the environment? Visitors to the Earth Observation tech stop were shown how environmental issues can be dealt with by using flying technology (which is also sustainable in itself). Dr. Csaba Singer explained how h-aero® devices combine the advantages of a helicopter with those of an airplane and a balloon. Not only can they take off vertically (unlike an airplane), they can also turn mid-air “on the spot” and hover. Experts from h-aero® were also on hand to answer questions on the many different usage scenarios of sustainable weather monitoring and explain how the technology can even be used for the early detection of forest fires.

Tech Stop: General Aviation | Vincenz Frenzel, Institute of Flight Mechanics and Controls, University of Stuttgart

From Stuttgart to Atlanta – without a pilot? The General Aviation tech stop allowed visitors to find out everything to do with current developments in the field of automation with a bearing on general aviation. Firstly, the reasons for automating certain processes were explained, including the possibilities this creates. Then Vincenz Frenzel explained the difference between autonomous flying and highly automated flying. To explain current developments more vividly, a short video was shown on landing aircraft automatically in general aviation.

Tech Stop: Military Use | Dr. Olaf Theiler, Bundeswehr Planning Office

A “third eye” for the troops – the military use of drones and unmanned aerial vehicles (UAVs): Introducing drones to military operations instills fear among many people, but it is also misunderstood. This is partly due to the complexity of the topic and the myriad potential usage scenarios. For the German Federal Armed Forces, or Bundeswehr, drones are crucial for defense purposes, but others with a disregard for international law and the constitution see completely new potential in drones as an offensive weapon. The Military Use tech stop dealt with three topics. Olaf Theiler illustrated the complexity of the topic, from reconnaissance drones steered by humans to “automated” attacks from swarms of drones. He then showed how the Bundeswehr and other military forces currently use drones for reconnaissance purposes, early warning systems, and air support, also providing an overview of anticipated developments. And finally, the tech stop was a good opportunity to show video sequences demonstrating the concerted use of autonomous aircraft.

“PUBLIC ACCEPTANCE IS IMPORTANT IN ESTABLISHING EMERGING TECHNOLOGY IN THE LONG TERM”

AN INTERVIEW FOR TRANSFER MAGAZINE
WITH ENTREPRENEUR DR. CSABA SINGER



Imagine you could analyze any location on Earth from the stratosphere, or closer, using a device that works on wind and solar energy. Imagine internet access and communication throughout the whole world at a much lower cost, creating much less space junk than is possible with current satellites. Imagine economical, unmanned aircraft completing the kinds of extended missions that currently have to be undertaken by manned helicopters and airplanes. To do this, the solution would need to be adapted – and adaptable. This was the challenge taken on by Dr. Csaba Singer with an unmanned aerospace system called h-aero®. Singer was invited to the #techourfuture event in Sinsheim as an expert guest. We met up with him for an interview for TRANSFER magazine.

Hello Dr. Singer. You're already achieving some visionary things with your aerospace system. Why do you believe it's important to inform society about future technologies in parallel to your work, and make sure others are on board?

Similar to becoming disenchanted with politics, people can become disenchanted with technology, and this can hamper emerging technology achieving widespread adoption. People have a tendency to be skeptical about change – unless, that is, something new results in something becoming much easier. That's exactly what I believe you have to show people ... that "something new" also does something valuable for society and is

useful for every individual – and that fuels acceptance. But to do that, you also have to explain things to people because new technology often comes hand in hand with even more complexity, so it isn't necessarily understandable to some people.

What kinds of concerns do you encounter in your work regarding emerging technology?

Reservations about our technology aren't so much the problem. If anything, the problem we have relates to people's reservations about the drone technology of our competitors. There's something threatening about their technology; drones are loud and there's a

feeling that people are being watched or spied on. Then there were the questions we were asked at #techourfuture in Sinsheim: Why are you even allowed to fly over people? And what's the difference between your flying device and a drone? You could see this as a kind of prejudice, but that's precisely why we always take demonstration materials with us so we can explain things to people and try to allay their fears.

Do you also encounter the same fears people have with drones, that your carriers could be misused?

Not yet, no. But of course this is an important issue for us: How can we arrange our sales model so that we know



where our carriers are being used and what they're being used for? One thing we have been asked is if the carrier can be shot down, and what would happen then. Interestingly, the issues are more about how the carrier functions and not really what it might end up doing. What this shows is that the technology isn't well-known enough. I could even imagine the majority of people comparing our technology to a children's balloon or something like that – rather than a satellite or carrier system operating in the space between satellites and unmanned aircraft.

Which requirements are already met by your h-aero®, and what are your visions for the future?

The h-aero® is an all-rounder; it can carry different kinds of loads and be used in a wide variety of regions and conditions. At the moment, we're focusing on industrial inspection indoors. We're joining forces with other partners to work on concepts. The system is in a position to work out distances

between people, and in times of the COVID-19 pandemic it can issue warnings via loudspeakers. Another application scenario is carrying out inspections on tankers. Until now people have had to climb down into the inside of vessels through hatches and despite poisonous gases, inspect welding seals after oil has been let out.

One thing we can't do with the h-aero®, and we'll probably never do, is use it to rescue people after avalanches. Drones are much more weatherproof for doing that, so they're also much more universal. For example they can carry thermal cameras to spot heat traces and zoom in on areas where someone's buried under snow.

But if you think more about future application scenarios, you could even move into satellite systems, just at a lower altitude. The ESA has been releasing Sentinel satellite data via the Copernicus program. It's open data and some of it goes down to a pixel resolution of five meters. Our system offers signifi-

cant added value when it comes to earth observation. For example, it can watch bush fires, predict harvests, or be used for pest control purposes in forests. These examples also point to one of the dilemmas we face. We have so many application options that we keep getting questions from all kinds of people. But we need to focus. At the moment we're concentrating on events and the media. We also want to do this to promote public acceptance for our technology. When an h-aero® flies over a city, ideally that already generates a certain degree of awareness among the population.

You can then kill two birds with one stone. You have a use case, and at the same time you generate awareness and this creates acceptance among the general public.

We're consciously doing it this way, even if we can't always get this message across to investors. Ultimately, we'd like to highlight how important public acceptance is in establishing emerging technology in the long term. A good ex-

ample of this at the moment is nuclear energy. Public acceptance hasn't played a role in establishing this technology until now. And now we're seeing what happens as a result. At the same time we're seeing how important a lack of public acceptance is compared to the actual potential of a technology. For example, wind farms also offer huge potential in cities. But if the urban population doesn't accept this technology, at the end of the day no wind farms will be built. Political attention is clearly focusing on the next elections.

It's interesting that you're focusing specifically on acceptance. There are lots of recent examples that show public attitudes aren't seen as a priority.

This also has something to do with the fact that I wrote my PhD at the German Aerospace Center, at the Institute of Engineering Thermodynamics (ITT), and later at the Institute of Solar Research in Stuttgart. The ITT has been awarded lots of contracts by the Federal Government to look more closely into the topics of sustainability, renewable energy

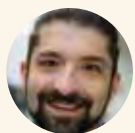
sources, and social acceptance. But another thing that makes this important has to be that the specific technology we're dealing with here is of a more general nature – we're plucking technology from different fields to develop a new flying concept.

If resources were no object, what invention would mean the most to you on a personal level?

Wow, that's a great question. The spontaneous answer would have to be a beaming device, and the ITER fusion reactor – that wouldn't be bad. In terms of time scales, given the lifespan of the human species, I wouldn't expect to benefit from this much myself though. As a young business founder, I'd like to get h-aero® technology to the point whereby our carriers can be used for a tenth of the cost of satellite technology and make earth observation and industrial processes much more straightforward and less expensive. This is our area of focus at the moment. I'll keep all the other patents I've got going around in my head to myself for the time being!

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THE H-AERO® FLYING SYSTEM

h-aero® is an unmanned aerospace system that pulls together the traditional concepts of airplanes, helicopters, and balloons to eliminate the drawbacks of such systems. The aerospace system is made from hi-tech materials (fiber composites, canvas, and high-density foil). The aircraft has solar cells mounted above and below the large hull, and it can be flown on autonomous missions around the clock. In an emergency, the structure functions like a parachute. CEO Dr. Csaba Singer already broke even with his hybrid airplane – still a fledgling, yet already the winner of multiple prizes – in the second quarter of 2019, despite his company, Hybrid-Airplane Technologies GmbH, only operating in civilian markets. The firm is part of an initiative called #1000Solutions, which was launched by the aviation pioneer Prof. Bertrand Piccard as part of the Solar Impulse Foundation. The Solar Impulse Foundation pursues the Global Goals of the UN with the aim of solving key international problems sustainably. Solar Thermal Energy Systems, the Steinbeis Transfer Center run by Csaba Singer, also offers solar thermal plant development, holistic energetic consulting, computer-aided component development, business coaching, seminars, and lectures on solarthermics.

THE DRONE ALWAYS RINGS TWICE

WHAT POTENTIAL DO DRONES OFFER WHEN IT COMES TO AUTONOMOUS DELIVERIES?

How will parcels be delivered to us in the future – by robots or maybe drones? Emqopter from Würzburg is already looking into the technology of tomorrow and investigating a variety of individual and made-to-measure drone technologies. Marvin Bihl, Managing Director of Emqopter, talked to TRANSFER about the regulatory hurdles that will need to be overcome and different ways to gain broader acceptance among the general public. As an expert in this field, he was also at the first #techourfuture event looking at “The Future of Autonomous Flying – Over the Country and People”.



In December 2013, founder and CEO of Amazon Jeff Bezos was taking part in 60 Minutes, a TV show on CBS, when he announced that Amazon was planning to deliver parcels using fully autonomous drones in the future, even though he was fully aware that there was no regulatory framework for such an undertaking at that time. Bezos pre-

sented a report on a device called an Oktokopter, which would be automatically loaded with a package in a warehouse, would leave the warehouse autonomously, fly to the customer, land in the front yard, deposit the package by itself, and then return to base again. At the time, he said fully operational deliveries using drones would be realis-

tic, at the earliest, by 2015. In the meantime, Amazon – the world's biggest public company – is estimated to have invested several billion American dollars in researching and developing delivery drone technology. It has already presented its fourth generation of unmanned aircraft systems (UAS's) for transporting goods. This has made Amazon one of the first companies to actively look into this area, but it is now by no means the only one. For example, firms like Alphabet, Alibaba, DPDHL, JD.com, and a slew of other corporations are involved in delivery drone projects. This is also a reflection of the potential offered by this technology, especially when it comes to the “last mile” of the logistical process.

REGULATORY RESTRICTIONS

Considering the regulatory hurdles that currently affect UAS's in outdoor areas, this technology could become even more important in the future. For example, until now it has only been permissible to use delivery drones adhering to certain specifications in terms of size, weight and technical features, and only on pre-defined routes approved by the relevant state aviation authority. The amount of time it takes to gain approval for such flights varies, depending on previous experience with this topic with the aviation authorities, and also on current capacities. This makes it virtually impossible to imagine achieving adaptable and sensible route planning in real time, especially in the way it is required for delivering parcels to private households. Things become even more difficult if a UAS needs to operate on a cross-border basis and thus falls under the jurisdiction of different aviation authorities. Accordingly, using a delivery drone for the last mile in Germany is only possible on direct routes between two fixed points. This makes the technology interesting for regular and urgent deliveries going from A to B.

EMQOPTER DRONE DELIVERS CONSIGNMENTS IN BUILT-UP AREAS

This was the use case for which Emqopter developed the first fully autonomous delivery drone, operating regularly in open skies over Germany in urban areas. The system is based on the principle of full redundancy: If anything goes wrong or a component fails, there is another component that can click into operation seamlessly to replace it, or at least ensure the system “fails safely” – for example by breaking off the mission, returning to base, or carrying out an emergency landing in a safe place.

The average drone cuts delivery times by two thirds and saves 20% on running costs compared to transporting a

consignment by car. On top of that, delivery drones are fully electric, so they don’t produce emissions. At the same time, they lighten the load on transportation infrastructures, especially in metropolitan areas.

The full commercial potential offered by using drones for the last mile remains unexploited until now. Companies like Amazon believe there is potential in versatile, needs-based deliveries – typically found in B2C markets. To exploit this potential, the EU has agreed uniform regulations for UAS’s in commercial areas.

Collaborative airspace has been set up, going by the name U-space, the aim of which is to make it possible for manned and unmanned aircraft sys-

tems to share flying routes. Drones can be located anywhere within the European cellphone network simply by inserting a SIM card. By merging this information with the radar data on manned aircraft, shared airspace can be coordinated. UAS’s will also be assigned a remote ID so that they can be clearly identified at any time. The idea is also to grant take-off permission through a traffic management system in real time by introducing uniform rules for required specifications affecting the approval protocols of individual missions. The first phase of U-space implementation started in 2019 once operational principles for the service were established. U-space should be fully operational and enter service in 2035.

“RAISING PUBLIC ACCEPTANCE OF AUTONOMOUS FLYING OBJECTS IS EXTREMELY IMPORTANT TO US”

AN INTERVIEW WITH MARVIN BIHL

Hello Mr. Bihl. Why do you believe it is important to inform society about future technologies?

On the one hand in order to create knowledge, and on the other hand to gain acceptance. Knowledge is important to ensure that the best technology is adopted by society as desired. There are a number of examples of inferior technologies gaining the upper hand in the past, mainly because the public were virtually misinformed. On the other hand, particularly with a disruptive form of technology like unmanned aircraft systems, it’s important to gain acceptance among the general population. It’s only

human for people to reject things they don’t know yet. That’s why I believe that the information you provide society with has an influence on the technologies that are adopted. If you think this one through, you realize that to a certain extent providing information is also tantamount to enabling people to decide which directions things should go in.

What kinds of concerns do you encounter in your work, not just from business clients but also from consumers?

There are three main concerns that keep coming up: noise emissions, data pro-

tection, and possible criminal action. With data protection, the main concern is that a system might be able to gather personal information or it might ask for data that could be used against uninformed parties, either to cause them harm or to make money out of them. That could be things like pictures or video data gathered while flying along roads, over private property, or industrial land. Another concern is whether autonomous flying objects could be used by terrorists. When we hear these concerns, we explain that compared to cars on regular roads, the system performs better in noise emissions testing and it adheres to data protection requirements.

What that means is that on-board cameras are only used to capture images of the location in the air. This is for safety reasons and no data is recorded or gathered on people on the ground. The recordings made by the system don't capture anything of a personal nature anyway. For most people it stands to reason that a system like this needs to capture camera images so it can see what's happening in the air around it. You can compare this to a pilot sitting in the cockpit using the window to look around. That doesn't mean he's watching what people are doing underneath him in their gardens. Of course there's always a danger that drones could be used for criminal activities, but the chances of that happening are much less likely than they are with a car.

If it were up to you, where and how would you use autonomous flying objects? And in which situations would you not use them?

I'd actually use them in all situations where it makes economic sense, or makes sense for societal reasons – or both. I wouldn't use them in situations where there's a "disadvantage" for the majority of people. A specific example of this would be transporting medical goods. If you're transporting urgent blood samples for analysis or for providing a patient with quick treatment, the advantages certainly outweigh the disadvantages seen by some people because of the noise and traffic caused by objects flying around in the sky. By the way, this was an example provided by the participants at the #techourfuture event in Sinsheim. For example it became clear there that such applications would be accepted for medical logistics but if a standard DHL parcel is delivered in the middle of the yard, that wouldn't be so well accepted at the moment. Of course you have to remember that the last mile is also important for transporting medicines. Acceptance will grow step by step and at the end of the day, noise emissions do really play

a big role because they're lower than those of cars in normal traffic. It's a question of what you're used to. People have grown up with cars on the roads. I've probably been seeing drones taking off and landing in the back yard down the road for five years now. It won't be an issue for the next generation. Acceptance will be on a sliding scale, from the less common transportation of medical items to Amazon parcel deliveries, so things will develop step by step – even if some people don't accept it yet.

In terms of universal use, I think it should be possible to have a regulatory framework in place relatively quickly. I wouldn't like to predict timings as far as achieving economic efficiency and public acceptance are concerned, but we can be certain that it will involve smaller deliveries at first. I personally think multicopter systems are likely to be used in urban areas as they're more efficient. They're reliable, extremely versatile, they can take off and land extremely precisely, and they don't need much space.

Do we need special laws for UAS's used in air transportation?

Yes, and there are moves underway on a European level to introduce uniform rules. It will be important to control how airspace is used collaboratively between manned and unmanned aviation systems. If I have a drone and want to fly with it from A to B, I'll be given a flight corridor and flight altitude by air traffic control, as well as take-off and landing times, just like you do now with manned aircraft. The airspace will be subject to uniform controls and the systems will be able to communicate through a central setup.

Of course there's a danger that drones will be used for malicious purposes, but there's less risk of that happening than with something like a car. That's where using collaborative airspace will be helpful. If somebody's up there non-collaboratively, they'll be detected in the air-

space pretty quickly. If he starts out collaboratively and then does something hostile contrary to his original intentions, he can be tracked. That's not possible with a car.

What are you and your company doing to gain broader public acceptance for your technology?

The techourfuture event is an example of our activities in this area. We're also gaining more acceptance from local residents through our projects with customers. For example, we organize a kind of integration workshop. It's broken down into two phases. The first phase is about informing residents or bringing them up to speed. To do this, we invite all local residents to a presentation of the project and the system or technology. For the second step, we organize a design thinking workshop which allows us to address the specific questions and concerns of residents and provide them with insights into technological developments. Raising public acceptance of autonomous flying objects, especially delivery drones, is extremely important to us.

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“IT’S IMPORTANT TO REALLY MAKE SURE EVERYONE’S ON BOARD WHEN IT COMES TO THE TECHNOLOGY OF THE FUTURE”

AN INTERVIEW FOR TRANSFER MAGAZINE WITH MIRKO DROTSCHMANN – ALIAS MRWISSEN2GO (“MRKNOWLEDGE2GO”)

Have you ever wondered which technology will have an impact on our lives in the future? Do you feel skeptical about future technology? Or do you not think about it because you simply don’t know enough about it? Knowledge is important when you want to make your mind up about something – as Mirko Drotschmann, alias MrWissen2go can tell you. It’s a topic he thinks about every day on his YouTube channel. In November 2019, Drotschmann moderated the first #techourfuture event on the future of autonomous flying for the Ferdinand-Steinbeis-Institute. The event took place at Technik Museum Sinsheim. TRANSFER talked to Drotschmann about the importance of future technology.



Hello Mr. Drotschmann. Why do you believe it is important to inform society about future technologies?

When you’re informed and know the facts about future technology, you’re fundamentally more open to it. In Germany we tend to be more conservative when it comes to technological advancement. So important and comprehensive information is essential to open people up to technology so they don’t immediately dismiss it or feel opposed to it, but see things optimistically. That’s why it’s important to really make sure everyone’s on board when it comes to the technology of the future.

What kinds of concerns do you encounter in your work regarding emerging technology?

It depends which technology you’re dealing with and especially which area it involves. If it’s about mobility, most people are open to topics – things like autonomous driving and even autonomous flying. But it’s different with a topic like medicine – lots of people tend to be skeptical when they hear this topic and they find it hard to believe that internal organs coming off a 3D printer could really become part of everyday life one day. People are more cautious when it’s about their own bodies or what they

eat. But as a rule – and I don’t think this is surprising to anyone – younger people are much more open to things than older people.

Where and how would you personally use autonomous aircraft, and in which situations would you not use them?

That’s a really tricky question. I’ve often thought about that. If I had an autonomous car, I’m pretty sure I’d get into it and travel from Berlin to Munich. But if I had an autonomous airplane, I’d probably think twice. Sure, you can also belt along in an autonomous car at 180kph.

But the way I see it, something's less likely to go seriously wrong traveling in an autonomous car than in an autonomous aircraft. So I'd only use that kind of technology if I had an emergency pilot on board who'd jump in if something went wrong. I think that's also the solution that will be needed for the transition period in the coming years – before we start depending on airplanes that aren't even steered by people. They've already got those sorts of things in other areas, like vehicles traveling on tracks, but there are fewer risks in that kind of area if something happens.

If you were given a free choice, which technology would you like to see introduced in the future?

I'd go for a technology that reduces suffering and misery in the world – I mean material suffering and misery, which is usually caused by a lack of food or not enough water. For example, I've spent time in Kenya and I've seen with my own eyes how people have to walk miles and miles to fetch water for their village. So if there's a technology that would make it possible to obtain water at a low cost, or nutritional meals, that would be awesome.

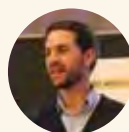
The absolute ideal would be a technology that could turn trash into usable food. Technology already exists to turn

salt water into drinking water, although even this could benefit from an improvement or two to raise general living standards in the world. I think this is a technology that's really necessary and it's on a higher level than things like transportation and maybe even medicine. Although advanced and affordable medicine would really help a lot of people, especially in poorer countries. I'm thinking of people who have eyesight problems and can't afford glasses.

There must be ways to come up with a modern technology that can provide help in this area without costing too much. What people should concentrate energy on when it comes to technological advancement is thinking about the poorest people and bringing them on board. I'm not trying to lecture people on morals; I just find it important. This isn't about coming up with amazing science fiction scenarios, but helping people, especially those who really need it.

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REFUSE TO CRASH – AUTOMATION IN CIVIL AVIATION

THE INSTITUTE OF FLIGHT MECHANICS AND CONTROLS AT THE UNIVERSITY OF STUTTGART CONDUCTS RESEARCH INTO THE CHALLENGES FACED WHEN PROGRAMMING AIRCRAFT TO FLY AUTONOMOUSLY

Under current arrangements, pilots have full responsibility for aircraft while flying, operating all systems by taking in information, planning actions and carrying them out. Actually steering the airplane is usually carried out by electrical and mechanical systems operated by the pilot. The next step in this process is fairly obvious: It would be advantageous if an aircraft could monitor and steer itself by designing systems that can communicate with one another directly. The aircraft would then refuse to go beyond its safe operating range, and in critical situations it would withdraw control back from pilots to protect itself. For many years, the University of Stuttgart has been researching in the field of automation of aeronautic devices used in civil aviation. Vincenz Frenzel, scientific assistant at the Institute of Flight Mechanics and Control at the University of Stuttgart explains which ideas remain a vision, and which have already become reality. Frenzel was also a guest speaker at the first #techourfuture event.

According to one definition, autonomy is a "state of self-determination [...] and the freedom to make decisions." In the case of aeronautics, it is especially important that this is not the case. Nothing unforeseen should happen, system must not act independently, and artificial intelligence does not have to get involved. A more fitting definition for such a device would be "highly automated," since the actions of aeronautic devices should be based on predefined rules and algorithms, that should be entirely reliable and carried out by certified systems.

With airplanes, such systems are described as "refuse to crash" – or "systems in command" rather than the "pilot in command." The idea of such systems is to compensate for certain human weaknesses: distractions, fatigue, illness, emotions, insufficient accuracy or optimization, or poor decision-making. In essence, many of-the-shelf drones already fly by themselves and prevent

themselves from crashing. Drone pilots merely issue commands or set waypoints, and drones fly from point to point without getting themselves into danger.

WHY DEVICES ARE AUTOMATED

There are a number of different motivations for automation depending on the aircraft type. People want to automate air taxis to cut the cost of travel. By replacing the pilot with an additional passenger, payment of crew salaries can be avoided. Depending on the aircraft configuration, almost twice the payload can be transported (freight or passengers) at a lower cost. Often, it is actually not even possible to steer an air taxi manually if it has a large number of engines or control panels, so that a control system is required anyway.

In General Aviation, i.e. private and commercial flying not including airlines and charter flights, the aim of automation is to reduce the requirements placed on

pilots and for pilot training. This can improve aircraft sales and enhance the safety of private aviation.

Airline traffic today has a high degree of automation since pilots already have a large number of support systems at their disposal. But because the main cause of airline accidents is still human error, there are developments to further reduce the number of pilots on board aircraft – for reasons of safety, pilot shortages, and economy. The first area in which this will be tried out is air cargo, to avoid posing threats to airline passengers.

Automated flying moved beyond mere technological issues some time ago. This was made possible by the increasing use of fly-by-wire systems, where signals are transmitted in cables wires to control aircraft electronically. This technology has been in use in the airline industry for decades. To achieve even higher levels of automation and extend to new areas of application, the



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technology will need expanding, however, and certification will be required. By that point, legislators can also address the legal questions that are still open.

THE REQUIREMENTS FOR AUTOMATED AIRCRAFT SYSTEMS

Before introducing newly developed automation systems, it has to be ensured that they are reliable. If necessary, safety requirements have to be revised and then certified. In addition, the right infrastructure has to be put in place for communicating with air-traffic controllers. In uncontrolled airspace, new monitoring systems – such as Detect And Avoid systems – will identify obstacles and prevent aircraft from endangering one another. In an emergency, it must be possible to steer these airplanes from the ground, which in itself poses new challenges.

WORK ON AIRCRAFT AUTOMATION AT THE UNIVERSITY OF STUTTGART

In 2015, a fully automated aircraft was showcased at the University of Stuttgart

as part of a project called Fly Smart, itself part of LuFo IV, the federal aeronautics research program. The mission of the aircraft, which was classified under EASA class CS-23, was also to complete a fully autonomous take-off and landing without the support of conventional ground-based navigation.

Specialists at the University of Stuttgart are also coordinating test sites for energy-efficient, electric, and autonomous aircraft in Baden-Wuerttemberg. The first test flights took place in 2019 and further comprehensive research is planned for 2020. The project is being spearheaded by the Institute of Flight Mechanics and Control. The Institutes of Aircraft Design, Aircraft Systems, and Navigation at the Faculty of Aerospace Engineering and Geodesy at the University of Stuttgart are also involved in the project, as are a number of other partners from industry, such as Volocopter and Thales. The test site is receiving €1.3 million of funding from the Baden-Wuerttemberg Ministry of Economic Affairs, Labor, and Housing

and its aim is to prove and demonstrate new technologies and concepts.

The researchers are not without their visions: “Within decades, you might be sitting happily in the front row, where the cockpit used to be, soaking in the view. Until that point, you’ll simply rely on updates from the flight deck,” predicts Vincenz Frenzel.

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NUMBER ONE PRIORITY: PROTECT THE TROOPS

THE OPPORTUNITIES AND RISKS ASSOCIATED WITH USING AUTONOMOUS AIRCRAFT FOR MILITARY PURPOSES

Drones are now being used by the majority of armies in the world, especially in the West where they are considered indispensable. The primary application for most drones is reconnaissance on all kinds of missions: strategic, operational, and tactical. Like any other kind of military instrument, using drones offers advantages but also presents risks. **TRANSFER** spoke about both sides of the coin, how to deal responsibly with these issues, and a variety of other topics with Dr. Olaf Theiler, the section head of future analysis at the Bundeswehr planning office. Our interview took place at the #techourfuture event on the future of autonomous flying.



There are currently a variety of drone models on the market for military use, all matched to different application scenarios. There are large devices such as the Global Hawk produced by Northrop Grumman; this is used for strategic reconnaissance purposes and is sent on long-haul flights at high altitudes during monitoring missions. For operational missions, typically medium-altitude drones capable of flying for up to 50 hours are used, such as the IAI Heron produced in Israel. Then there are a multitude of smaller drones, which are primarily used for tactical, near-range reconnaissance. A good example of this is the LUNA drone used by the Bundeswehr (the German Federal Armed Forces). With a wing span of roughly four meters and a two-meter fuselage, it is relatively large and has a reconnaissance range of approx. 100km. In the meantime, there are also a whole host of smaller drones for providing short-term local reconnaissance data, from miniature UAVs (unmanned aerial vehicles) to na-

no-drones. The Bundeswehr uses the EMT Aladin in this range; it has a wing-span of approx. 150cm. There are also even smaller versions on the market, some no bigger than the palm of a hand, although the range and flight duration they offer is correspondingly lower.

AREAS OF APPLICATION FOR MILITARY DRONES

All of these reconnaissance drones are primarily intended to protect soldiers during military operations. They make it possible to monitor areas and routes without risking the lives and limbs of military personnel. Drones can also be used to accompany transportation missions and patrols, and thus protect personnel from ambushes. Some countries use drones for offensive operations, however – in other words they use armed drones, which can be steered remotely to attack moving targets. The best-known examples of this are the US Predator drone, which has already

been withdrawn from service again, and its successor, the Reaper.

A variety of military forces and intelligence services use comparable systems due to their enhanced accuracy during weapon deployment, although that is not the case in Germany or with the Bundeswehr. In the fall of last year, and for the first time ever, the German government agreed to buy drones for the Bundeswehr that could, in principle, be armed, but must not be procured with the corresponding weapon systems. This effectively means that for the foreseeable future, the Bundeswehr will continue to only use drones for reconnaissance purposes.

One of the main motivations for using remotely controlled drones is to protect military personnel, since many of these kinds of reconnaissance operations tend to pose a high risk to troops. Remote-control drones can also be used for extended periods of time compared to conventional aircraft or helicopters, which



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have to return to base after a relatively short time to top up with fuel.

Given the increasingly complex nature of military operations and crisis areas, underscored by the strong desire to protect military forces, particularly among European countries, doing away with all of the different types of drones would now be unimaginable for military forces in the West.

ONLY TO BE USED FOR ETHICALLY JUSTIFIABLE REASONS

Two potential risks are usually highlighted in the context of drones. One argument that is often heard is that the physical distance between drone pilots and their potential targets reduces emotional stress, essentially making weapon deployment, perhaps even as an act of war, easier and more likely. On the other hand, it is known that using drones to deploy weapons makes it possible to capture much closer images and thus gain a direct impression of a target com-

pared to simply flying past in an aircraft or working from an artillery position.

As a result, drone pilots can also be placed under extreme emotional stress in such situations. In democratic countries, using weapons in this way always requires parliamentary approval. This would appear to make it unlikely that just having the capability to use drones for military operations will reduce inhibitions (although this concept does not apply to deployment by the secret services, who sometimes use drones instead of military personnel).

On the other hand, people sometimes suspect that drones are just a precursor for killer robots – they are just paving the way for the kind of autonomous weapon systems you see in Hollywood blockbusters like Terminator. Currently, neither “strong AI” nor “actual autonomy” (the ability to make independent decisions) will be achievable in technological terms for the foreseeable future. Similarly, handing over control to ma-

chines would be an undesirable situation for both military and political leaders.

Accordingly, all military forces in the West, including the Bundeswehr, currently emphasize that all military action must be subject to human intervention and thus any decisions made must be ethically justifiable and legally verifiable. It is inevitable that military and technological developments will result in certain systems being made automatic, simply because of the accelerating pace of the battle field. This is especially likely to happen with defense weapons, but it is unlikely that targets will be selected by machines in the foreseeable future – so we are unlikely to see autonomous killing.



“INFORMATION CAN AT LEAST HELP GIVE FUTURE DEVELOPMENTS A CHANCE”

AN INTERVIEW WITH DR. OLAF THEILER

Hello Dr. Theiler. Why do you believe it is important to keep society informed about future technologies?

Emerging technology often comes with a hype, so you get these exaggerated expectations and fears coming in through the media, and this usually has a negative impact on expectations among the general population – even before a technology has had a chance to prove itself in use. What then follows is rapid over-regulation and this hampers meaningful development in the long term, in society as a whole, because of short-term and fragmented resistance and the fear of losing control. Information, or to be more accurate actual dialog, about emerging technology can at least give future developments a chance.

What kinds of concerns do you encounter in your work regarding emerging technology?

Basically when it comes to the Bundeswehr and military security policy, the fear that something could be misused becomes the benchmark for judging a new technology. It's mainly an emotional reaction, and it often prevents people from thinking about an issue rationally or considering the real strengths and weaknesses of a promising technology.

But what's worse is when some vague possibility – that one of these technologies might be used for unethical rea-

sons – actually prevents us from stopping others misusing technology, even through perfectly legal means, for example because a certain issue becomes a political no-go.

Where and how would you personally use autonomous aircraft, and/or in which situations would you not use them?

Neither strong AI nor actual autonomy will be with us in the foreseeable future. So inevitably, the application areas for partly autonomous aircraft will remain limited. They can be programmed to fly a route from A to B, fly the route independently, and avoid potential obstacles on the way. There are myriad ways to use this in civil applications, even if it can't give us answers to the problems of mass transportation. In military applications, you can't assume that any objects you need to avoid will be passive; you have to assume there'll be an enemy trying to actively disrupt your flight or even completely down the flying object. Under such circumstances, limited autonomy can only be used in very narrowly defined situations. Transportation in the hinterland, away from the front line, is conceivable, or peacetime operations at home, or maybe even transporting wounded personnel back from operations.

But getting actively involved in combat – using weaponry autonomously, with

no human control – would not only be unjustifiable in ethical terms, it would hardly be of any use in military terms, partly because such systems are much too easy to disable or target.

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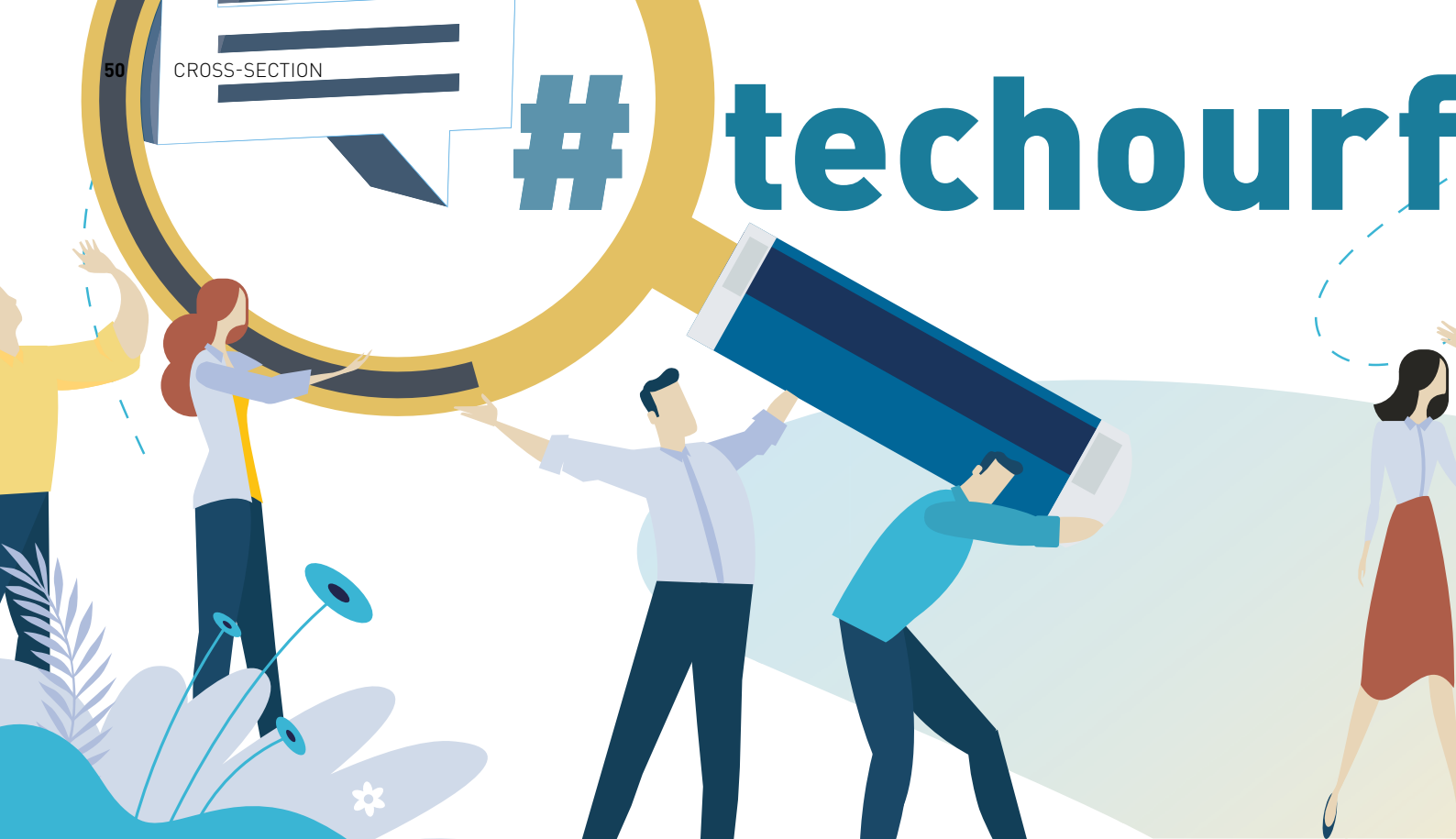
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LOSS OF CONTROL AND ACCEPTANCE FOR TECHNOLOGY

THE FERDINAND-STEINBEIS-INSTITUTE INVESTIGATES WHY TECHNOLOGICAL DEVELOPMENTS OFTEN “GET THE COLD SHOULDER”

Baden-Wuerttemberg is generally considered a technology state in Germany – extremely open to technology, especially if it's new. But it still has its technology sceptics and sometimes people are openly hostile to technology. Given the current backdrop of digital transformation and sweeping technological change, there is therefore concern that the acceptance for technological novelties is waning in certain areas of the economy and society – if there is not enough acceptance, perhaps the competitive edge will be lost when it comes to innovation. As part of the #techourfuture initiative sponsored by the Baden-Wuerttemberg Ministry of Eco-

nomic Affairs, Labor, and Housing, the Ferdinand-Steinbeis-Institute (FSTI) has started looking into the issue of technology acceptance in Baden-Wuerttemberg.

The experts at the FSTI set up panel sessions to discuss certain topics and provide an experimental forum to introduce business and members of the public to recent technological developments. Aside from sharing knowledge and discussing people's practical experiences with new technology, one of the main ideas of the sessions is to conduct a scientific assessment of technology acceptance.

NEW TECHNOLOGY MAY BE REJECTED DUE TO A FEAR OF LOSING CONTROL

The starting point for the project was the realization that reservations about new technologies frequently stem from a concern that there will be a perceived loss of control, especially with technology involving digital solutions and autonomous technology. This is initially connected to the way control is passed between two different parties. The cause of this loss of control may be other parties or of course a technology to which control is transferred (even in part), but there may also be quite normal situa-

uture



tions or factors that imply control will be lost. There are also different scenarios under which a transition of control may take place, for example control can be lost voluntarily or involuntarily. Or there are instances in which something that was previously uncontrolled will become controlled (by another entity) at a certain point in time.

One thing that also needs to be considered with these different scenarios is whether people who are affected by certain situations are given the right to intervene. One also needs to remember that by definition, technology or technical systems came into being as a result of human enterprise and creative energy; accordingly, they were also made available, set up and sold within the context of specific people or groups of individuals. One has to look at specific circumstances and consider whether technology results in control being handed over to people or groups of people, because this has substantial implications on the degree to which a loss of control may be perceived as such. Autonomous agents

such as Siri and Alexa, which are capable of taking control of situations as independently acting individuals, are particularly important in this context.

USING A CYCLICAL MODEL OF CONTROL AS AN EXPERIMENTAL BASIS

The FSTI is using a cyclical model of control (and thus a cyclical model for the loss of control) as a basis for the research being carried out for the #techourfuture initiative. If a person understands or has an overview of a technology or a technical system, this arms them with fundamental knowledge (abstract or technical) that helps control such a technology; being able to (partially) control technologies and technical systems generates practical experience in dealing with something – and in turn, this raises the degree to which something is understood, etc. The FSTI experts are therefore looking at this issue from the point of view of a control cycle, in which a person has to at least understand or control the underlying

principles of a technology or technical system in order to perceive a status of control. If at any point this control cycle is interrupted, the person can no longer (or only insufficiently) understand or control a technology or technical system, and this can lead to a state in which they feel they have lost control, expressed through reservations, concerns, or fears.

This FSTI concept also includes techno-sociological considerations. If autonomous technology somehow starts to play a role in decision-making in an area previously reserved for humans, the instrumental relationship between humans and technology becomes an interactive relationship; the technology evolves into a partner and co-decision-maker as part of a cooperative process, which now takes place within a distributed, hybrid system (Weyer 2006). A key aspect of this loss of control (and many others), induced by technology and technical systems, is that technical functions are transferred/transmitted from helpful, manageable, and accepted applications to risky or threatening applications,

for example with military technology, monitoring technology, or when elections are interfered with (Heinrich Böll Foundation 2019).

This raises a question: If there is an interaction going on, or if there is a decision-making process, and a technology becomes more involved or takes control, does this impact the people who are involved in the process to the extent that it affects their ability to intervene, i.e. the chance of them taking action or shaping events? The FSTI experts also asked if this is linked to a greater loss of control and whether this reduces people's ability to intervene or control a situation. It is often found that the more autonomous technology and technical systems become, the less likely people are to participate and this furthers the broader exclusion of human beings from decision-making processes in hybrid or entirely autonomous systems. Further developments in the automation, autonomization, and hybridization of technology, systems, and processes thus result in people being less likely to be allowed to intervene or take control, and this tends to coerce them into adapting to "guidelines" laid down by technology (Weyer 2006). From a technological and social point of view, there is therefore scientific support for the subjective perception of a loss of control.

FIRST INSIGHTS: PREVIOUS EXPERIENCE IS DECISIVE

This concept model regarding a loss of control is the cornerstone for empiri-

cal experiments taking part at the #techourfuture sessions. The people taking part in the events correspond to the target group of a quantitative empirical survey, which is based on standardized questionnaires. An initial look at the findings of the first #techourfuture forums, which took place in Sinsheim in 2019, already points to a number of interdependencies. It can already be expected that there will be significant differences between various sociodemographic groups when it comes to any perception of a loss of control resulting from new technology. Measurable differences can be found for factors such as different gender groups, age groups, education levels, and occupational groups. Concern regarding a loss of control is average to strong across the entire group in the experiment, so it is neither extreme nor marginal. There is one important influence, however: the degree to which people have previous experience with a particular new technology. In particular, respondents are less likely to feel a loss of control if they have a basic understanding or general overview of a certain technology. This also applies to indications relating to the safety and reliability of a new technology. There is however a rapid rise in concerns regarding any loss of control if there is uncertainty regarding how to use information acquired while trying out a new technology, particularly with respect to safety.

The target group felt very positive about the comprehensive and interactive approach to different technology issues at

the #techourfuture sessions. The participants were also extremely positive about the information supplied by the experts, who were relevant and credible, as well as their pertinent and understandable examples. There was also positive feedback about the possibility to enter into discussions with the experts and other participants at the sessions, and the fact that there was sufficient time and space.

Combined with output from the next #techourfuture sessions, these results will allow the FSTI experts to determine important points of reference for possible recommendations regarding technology acceptance. These will be used to develop guidance for future events relating to the goals of the Technologie*Begreifen initiative (Grasp Technology). They will also make it possible to design instruments and procedural models for identifying and lining up new technologies to be used in business and society.

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WELDED SAFE AND SOUND

STEINBEIS EXPERTS DEVELOP NON-HAZARDOUS AND ENVIRONMENTALLY FRIENDLY PROCESSING AND MACHINE TECHNOLOGY FOR PRODUCING WELDING POWDERS

It is already four years since Intelligent Functional Materials, Welding and Joining Techniques, Implementation – the Steinbeis Innovation Center in Dresden – reached a first milestone in its development partnership with Bavaria Schweißtechnik from Unterschleißheim. In 2016, the project partners developed a production-safe technique for submerged arc-welding heavy-walled aluminum components. The process made it possible to develop laboratory-scale powder formulations for welding aluminum alloys in reproducible quality, also achieving melt-off rates of up to a factor of eight. But there were also drawbacks with the process – certain ingredients in the formulation were potentially hazardous to operators, the process posed greater risk to the environment, and it caused more corrosion damage to apparatus and machinery. Reason enough for both partners to address these disadvantages by working further on the process as part of a ZIM project sponsored by the German federal government.

The aim of the project was to develop and introduce a user-friendly, environmentally friendly processing and machine technology for reliably manufacturing welding powder to be used in the submerged arc welding of aluminum. The innovative part of the project was a “single chamber reactor” – a concept allowing all key subprocesses needed to produce the finished welding powder to be carried out fully automatically inside a closed reaction chamber, without posing a threat to operators or the en-



The components of the single-chamber reactor, individually produced using plasma powder weld cladding based on defined material alloys:
a) Individual components of the receptacle – base plate and pipe segment,
b) The agitation mixer featuring rods mounted on the front of a plate, produced in a 3D additive process using micro-plasma powder weld cladding



The single-chamber reactor pilot plant, developed and constructed to produce welding powder for aluminum submerged arc welding: a) The overall pilot plant in operation, b) The pilot plant shortly after a dummy run carried out for evaluation purposes

vironment due to emissions. The market demand is there, and the importance of light metals is rising continuously – especially thick-walled aluminum components.

AGGRESSIVE CHEMICALS AND EMISSIONS IN MANUFACTURING

One reason for the problems experienced with powder formulations until now is that they include chemicals that are aggressive and abrasive. This makes it impossible to work with powder formulations in the types of production facilities that were available until now. Emissions and mechanical or chemical harm caused by processing powder mixtures result in so many impurities and damage to iron components used in machinery that it was no longer possible to achieve the required processing standards. The potential hazards meant that the project team had to set up its own production chambers to make the welding powder, taking care to keep incompatible powders well away from other

materials. It was also important to develop a production technique that would be 100% safe for workers, machines, and the environment. Equipment would have to be capable of producing materials to a high standard that would not only be ready to use right away, but would also produce virtually zero emissions.

WELL PROTECTED THANKS TO THE SINGLE-CHAMBER REACTOR AND PLASMA POWDER COATING

This was the challenge taken on by the experts at Steinbeis and Bavaria Schweißtechnik. The welding powder used in aluminum submerged arc-welding processes comprises a mixture of materials containing various proportions of minerals, salts, chlorides, and fluorides. This makes it extremely hazardous to operators and harmful to the environment. The chloride and fluoride ingredients are particularly aggressive in chemical terms. As a result, a number of special safety precautions are

required when producing powder – such as using the single chamber reactor. The idea with this technology is that all key steps of the production process take place within an enclosed container so that – as far as possible – all potential contact with the outside air or machine operators can be avoided. The manufacturing process involves feeding in raw materials, crushing, mixing, agglomeration (adding binding agents), and heat treatment (drying). Only once all of these steps have been completed can the powder blend be tipped out onto a filtering screen.

The chemically aggressive and abrasive nature of the powder ingredients during crushing and mixing can result in heavy corrosion and wear to components. As a result, the Steinbeis experts added a plasma powder coating to the surfaces of individual components of the single chamber reactor. To do this, they used wear- and corrosion-resistant iron, nickel, and cobalt-based alloys as a matrix material

with embedded hardening materials in the form of vanadium carbide. The team examined and tested several material mixtures and powder blends.

PUTTING FUNCTIONAL COMPONENTS THROUGH THEIR PACES

After several rounds of testing, the project team identified a suitable combination of materials to provide a protective layer. The experts then assessed the corrosive and abrasive performance of materials. To provide a corrosion medium, a specially prepared solution of electrolytes was used. This was made from the main ingredients in the powder containing chlorides and fluorides. The functional components of the pilot plant were produced using the same materials, technology, and construction principles as the original concept, so the device included a receptacle and an agitation mixer with small rods mounted on the front of a round plate. Both the receptacle and the mixer come into contact with the welding powder during production. As a result, they were plasma powder-coated to protect their functional surfaces from wear and corrosion. A segment of plasma powder-coated pipe was pressed into shape using a remodeling and compression process to achieve the required rounding and dimensions. The coated sleeve on the pipe was cooled using nitrogen and the base of the receptacle was heated so that the two components could be joined and form-fitted in such a way that no cracks remained inside material layers or the base element.

The second functional part of the pilot plant – a round mixing plate with pro-

truding rods – was produced additively using 3D micro-plasma weld cladding. To do this, 15 millimeters of pre-heated steel were used as a base substrate so that the part could be deposition-welded from above using multi-layering. The base substrate was then removed using a mechanical process before milling the base plate of the mixing tool, complete with rods, out of the layers that had been generated. Not only has this significantly improved the tool life of the functional components produced for the pilot plant, it has also ensured that the production method used for making the welding powder is safe and can be reproduced without having to pour materials from one container into another. The entire process can also be kept separate from operators and the environment.

Systematic experimentation enabled the project team to put the single reactor pilot plant through its paces and conduct testing and assessments of the process. Aside from checking the smooth functioning and reliability of the entire pilot plant, the experts observed operational parameters and processes for any damage to the protective layers. They also monitored the performance of peripheral components in terms of resistance to dust and emissions. The project team can now confirm results: The single-chamber reactor pilot plant has achieved its required function and is capable of producing welding powder for use in aluminum submerged arc-welding processes. It has also performed successfully in practical application.

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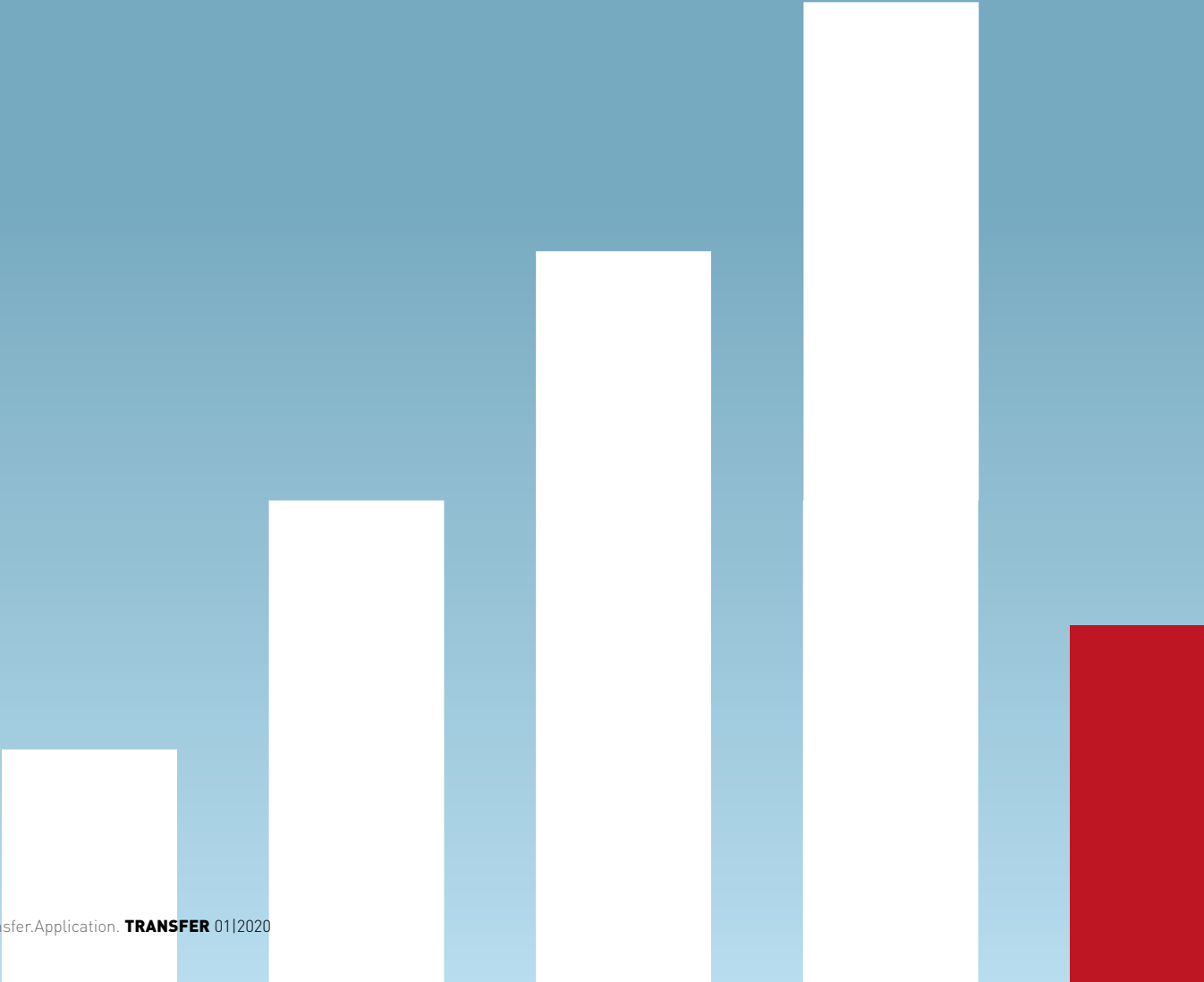
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“IN GERMANY, PEOPLE LIKE TO SEE FAILURE AS BEING AT FAULT.”

AN INTERVIEW WITH BERT OVERLACK,
MANAGING DIRECTOR OF BERT.OVERLACK GMBH

Bert Overlack managed a company that operated throughout Europe for over 20 years, during which time it expanded and went from strength to strength. But then, in 2011, the market suddenly dried up; his company entered insolvency and for the first time he worried about his livelihood. But Overlack isn't the sort of person to let something like that get to him. He now consults entrepreneurs who want to take the plunge like he once did, accompanying them on a journey that some people and companies tend to look down on. Working in partnership with TEAM U-Restart, and riding on the back of a Steinbeis Network project, Overlack is developing a concept on behalf of the Baden-Wuerttemberg Ministry of Economic Affairs, Labor, and Housing, the aim of which is to give “re-starters” a helping hand. In an interview with TRANSFER magazine, Overlack explains the thinking behind the project, highlighting why it's imperative that failure gains public acceptance in Germany.

Hello Mr. Overlack. Our life – at work and at home – is a series of successes and failures. Why do so many people find it so difficult to accept failure in Germany and simply learn from it?

We live in a society driven by success, so it's normal for people to gravitate more toward examples of success. So much importance is attached to commercial success in our society that sometimes people like to pretend failures don't happen. I think that's a mistake. But just so I'm not misunderstood: I don't have anything against success, or successful people for that matter. I'm quite happy to be successful myself. But success and failure are just two sides of the same coin. So I think there's something wrong with simply ignoring one side of that coin. We can learn from success and failure – in fact sometimes we learn more from failure. But if failure

gets stigmatized and frowned upon, people who do fail won't want to stand by what's happened to them. And that's a missed opportunity to learn something.

I'm sure cultural factors also have something to do with this. At school you're taught to do everything you can to avoid mistakes. The Prussian kings introduced Germans to this idea that the army, public servants and schools should all be absolutely perfect. The rest was the result of the Industrial Revolution, which taught us that people and factories should run like clockwork and if possible not make any mistakes. This resulted in processes like quality management and rationalization. Individual creativity was generally looked down upon; instead people were expected to fall in line and adhere to rules and instructions. Non-conformance or even failure didn't match the expectations of the system.



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SUCCESS AND FAILURE ARE TWO SIDES OF THE SAME COIN.

Sometimes when a company fails or more specifically a startup goes wrong, it still feels like it's almost stigmatized by our German culture. Why do you think that is?

In Germany, people like to see failure as being "at fault." You're "at fault" if you default on a loan – so you're indebted to someone. What that almost suggests is that being insolvent is about defaulting on something; it's negligent or even criminal. Yet we know from the statistics that on 95% of occasions that's not actually the case. In most societies, debtors became outcasts or were at the very least stigmatized.

Of course, this also has something to do with our desire for success and feelings of status, recognition, and respect that go with success. We live in a highly materialistic world, so failure and the material losses that go hand in hand with failure result in a loss of status, disrespect, and even stigmatization. Our points of reference are not people, with their strengths, weaknesses, successes, and of course their failures – but their material successes. Lots of people are scared of being excluded from their social surroundings – I was scared about that in 2011. And unfortunately there were people who deliberately tried to avoid me. Maybe I also tried avoiding them. But for that, there were lots of people who realized that my company insolvency was a one-off, and for them

my successes, my skills, and my experience were much more important.

Can a "culture of failure" help change this perception and our attitude toward failure?

I believe it can. Our culture is already starting to change. The younger generation come at this topic from a completely different angle. For them, the possibility that something might fail is quite normal. Between 70 and 90% of all startups fail within the first three years. It would be reckless for any business founder to assume it can never happen to them. There are too many obstacles in the way and imponderables. In a world of uncertainty – or to use the modern term for it, VUCA – success isn't something you can plan on. Too many things change too quickly to do that. Companies have to adapt much more quickly to changes in the business environment compared to the old days – the world really is more volatile, uncertain, complex, and ambiguous.

One thing I've also noticed is that older people are now opening up a bit. I regularly get people coming up to me after my talks, accomplished businessmen, who thank me for explicitly pointing out that there'll be sleepless nights, fear and anguish, and worries, and that's all part of running a business. I've yet to meet an entrepreneur who's not had a bumpy ride. And often, it was a lot more

down to chance that someone didn't run into financial difficulties – rather than something they were good at or something they did right. Failure has a lot to do with happenstance. We're so used to striving for perfection. It's the yardstick for everything Made in Germany, something we've come to expect of our products and services. But these days we have to be more agile, quicker, more adaptable, more flexible – so it's quite possible that an assumption we made yesterday no longer holds true today. Does that mean an idea was a failure, or that a project team or entrepreneur failed? Of course not. We're just learning that there's no guarantee of success, for anybody.

A culture of failure does make distinctions when it comes to the causes of failure, however. There are different kinds of mistakes or failure. For me there are two factors that keep coming up in this respect: how predictable an occurrence or outcome is, and how avoidable something is. So if I could have predicted and could have avoided a certain outcome, like something going wrong in production, but I didn't do anything about it, was that intentional or just laziness? Of course, neither is okay. But with an innovation project, some outcomes are neither predictable nor avoidable. That's just the nature of such projects, so managers have to deal with them completely differently. Then the key point is that fail-

ure can be an experience that people learn from. And the best way to do that is to accept it, think about it, and draw conclusions from it.

Startups and funding get a lot of attention in the media. What's it like with re-starters? How important are they to the German economy?

Re-starters have played a relatively minor role in German economic policy and funding programs until now. There's no category to slot them into. But there are some crucial differences between re-starters and first-time business founders. They have to come to terms with emotional losses and the loss of identity you have when a business fails, so they can learn from the experience. It takes time, and support is needed with this process. Studies have shown that on average, re-starters that learn from their experiences tend to be more successful when they start another business than first-time entrepreneurs. Despite all the rally cries of the motivational experts, that doesn't mean it goes without saying, and it depends on certain conditions. One condition is that you acknowledge the failure you experienced, that you reflect on it, and that you talk about your experience. And that takes time and a willingness to face up to your own emo-

tions – fear, anger, a sense of guilt, or self-doubt.

This is one of the reasons why we're so pleased that the Baden-Wuerttemberg Ministry for Economic Affairs took on the topic of re-starters and second-chance entrepreneurship last year, and that they asked me and my partner, TEAM U-Restart, to develop a concept for providing re-starter businesses with the right support and offer them a series of ten re-starter training sessions. By the way, this project is a follow-on from the European Danube Chance 2.0 initiative, which was managed in Germany by the Steinbeis-Europa-Zentrum in Karlsruhe and Steinbeis 2i. They've provided us with a lot of support through the Steinbeis Network.

You also know from your own experience what it's like when a company fails, but you still had the courage to start again. What advice would you give to someone in this situation right now, someone who's thinking of giving it another go?

Have the courage to do what's necessary. Facing your past experiences, coming to terms with the fears, the feelings of guilt, and self-doubt, and understanding what happened – that takes courage, because often it's painful. It

takes courage to rediscover your self-belief, to find you do still have self-worth, to summon up the energy to start again. And it takes courage to accept what happened to you, all the things you've realized, the insights, and then talk openly about the things you learned from the experience. One thing I've worked out is that talking about this is not half as bad as you thought it would be. If anything, I've received a lot of encouragement and even gratitude that I talk so openly about something that obviously needs talking about – lots of people have had to go through this. It was what motivated me to write a book about my experiences (German title: „FuckUp – Das Scheitern von heute sind die Erfolge von morgen“) and share what happened to me with others. The more we all talk about our mistakes and experiences with failure, the easier it becomes for everyone to accept that these things happen and learn from our experiences and what happened to others. And then we'll have achieved what's meant by a culture of failure and learning. I play the piano and I love improvising, so I can really relate to what Miles Davis said: "It's not the note you play that's the wrong note. It's the note you play afterwards that makes it right or wrong."

DARING TO "RE-START"

The Baden-Wuerttemberg Ministry for Economic Affairs has launched a pilot project aimed at developing a concept for supporting companies and giving them a second chance. Working in partnership with TEAM U-Restart, re-starter training will be offered as part of a series of ten pilot workshops running from March to May 2020. The support that is important for re-starters will be identified, as well as the best way to integrate this into startup funding already offered in Baden-Wuerttemberg. The aim is to exploit the potential offered by getting a second chance.

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ENTERPRISE COMPETENCES X.0: MASTERING DIGITAL TRANSFORMATION

A LOOK BACK AT THE 2019 STEINBEIS COMPETENCE DAY

Describing organizational competences as the cornerstone of long-term business success is nothing new – especially in times marked by one series after another of technology trends, convergence, continual change, increasingly connected systems, and the broader presence of digital technology. But what core competences are required to deal with such challenges? Indeed: Can transformation be learned? These are just some of the questions that were examined at the Steinbeis Competence Day in Stuttgart on December 5, 2019.

What competences do companies and organizations require to manage the challenges of digital transformation? How should they deal with ever-shortening technology cycles, the interweaving of different functions and areas of influence, increasingly rapid change, the rising importance of the platform econ-

omy, and digital technology now invading almost all key areas of entrepreneurial undertaking? A variety of experts from science and business examined these issues at the 2019 Steinbeis Competence Day, not only drawing on the findings of recent research but also by looking at examples of business practice.

THE JOURNEY TO BECOMING A SMART ORGANIZATION: HOW TO MAKE A SUCCESS OUT OF DIGITAL TRANSFORMATION

In her opening talk at the event, Prof. Dr. Claudia Schneider from Ludwigsburg University of Applied Sciences explained the prerequisites and success criteria of digital transformation within organizations. Organizations generally walk a tightrope between trying to achieve reliability (through predictable outcomes, rules, guidelines, the fulfilment of customer expectations, a stable working environment, targets, re-



sponsibilities, etc.) and trying to remain adaptable (flexibility, reacting to changes in the environment, dealing with complexity and ambiguity, giving people enough room to assume personal responsibility, decentralized decision-making, etc.). Due to the nature of digital transformation, organizations must be prepared to completely reinvent themselves – and do this regularly – without necessarily having to change the workforce or technical infrastructures, even during ongoing operations. Accordingly, organizational development has to be holistic – smart business models require smart processes, and in turn, these need to be designed by smart people. And smart people need smart organizations if they are to work effectively. To systematically map the different dimensions of such an approach to organizational development, the so-called digital maturity model can be used. Using the municipal construction department in Herrenberg as an example, Schneider illustrated the opportunities and challenges of such a process for areas of public administration.

In conclusion, she explained that digital transformation is a fundamental process of change that can only succeed if certain criteria are met. For a start, the people who lead the organization need to be convinced by the concept and support transformation with conviction – and this requires “a lot of staying power.” People at the top of an organization provide a role model for the others within it to look up to, so people at the top should also be the first to “go digital.” It is also important for all stakeholders within an organization to take responsibility for their own areas. Digital transformation within an organization is therefore not something that should be delegated to staff functions. People working in an organization also require the right skills to deal with new demands – and this is a plea for specific skills development. In addition, Schneider explained that the right resources need to be made available, since digital transformation takes time, money, and human resources! During the transition period, organizations still have to operate on two levels, keeping the

“old” world in place while setting up the “new” one.

Schneider also highlighted that – as with any transformation process – opposition, fear, and insecurity are to be expected. It is therefore extremely important to provide sufficient “time to readjust” so that new ideas can be properly understood and developed. This necessitates all-round transparency, involvement, and communication, because ultimately there should be no “bypassing” of processes – people should not be allowed to resort to old working practices and systems.

A KEY COMPETENCE OF THE 21ST CENTURY: LEARNING HOW TO UNLEARN THINGS

In the next talk, Sven Göth, futurist and founder of the Digital Competence Lab in Hanover, zoomed in on the challenges and drivers of digital transformation, offering an extremely compelling explanation of the growing importance of exponential transformation and how, in



times of change, this leaves less and less room for incremental adaptations. Göth pointed to four key drivers of current change: exponential growth in computing capacity; the emergence of huge volumes of data (including the internet of things); real-time transmission rates through the internet; and artificial intelligence. In his talk, he provided a number of memorable examples of how recent developments threaten to deceive or manipulate us, although they also offer advantages and benefits. These developments include robots, the shift away from human decision-making toward machine-supported decisions, autonomous vehicles, 3D-printed house construction, 3D-printed human organ production, telemedicine, holomedicine, impacts on the world of work, the decreasing relevance of location and time with respect to work, and the decreasing relevance of work performance and work controls.

As a result of these trends, a certain core competence is required: the ability to learn to unlearn. Another question that needs asking is which criteria we

will use to measure or assess the future – according to what's normal, natural, or human, or according to usefulness, damage, or side effects? Evaluating the future and thus also digital transformation thus becomes a question of personal perspective.

Based on this realization, Göth pointed to the following elementary competencies for transitioning from the known to the unknown: the ability to innovate, team spirit (especially given the shift away from full-time workers to the gig economy), the ability to change (a willingness to start with people who want and can change), digitalization capabilities (in order to understand the changing world), and finally the ability to assume responsibility (a willingness to make decisions, even if some people are then "left behind"). Göth concluded by appealing to the audience to work together in shaping the future.

THE STEINBEIS ECC X.0 AND THE NEED FOR TRANSFORMATION COMPETENCE

The third talk of the day was given by Dr. Michael Ortiz, project manager for business development at Steinbeis headquarters and director of innovation and transfer management research at the Ferdinand-Steinbeis-Institute in Stuttgart. Ortiz introduced the audience to the Enterprise Competence Check X.0 (ECC X.0), a new software tool at Steinbeis for analyzing the competences held by an organization with respect to digital transformation. He started by revisiting the classic ECC, which has already established itself as an instrument for the qualitative analysis of enterprise competence. The ECC highlights how digital transformation and increasing convergence between structures, systems, and technology are driving fundamental change. It also demonstrates that this not only poses a variety of new challenges to businesses and other stakeholders in the economy, but also to politics and society in general. For some time now, business models closely based on data and information have not just been found in the digital space. Even established companies with a focus on classic business models are now



turning to data-driven optimizations or even completely new, information-driven value creation scenarios. This realignment of business activities does, however, require a strong degree of flexibility and a willingness to embrace change – organizations need the right “transformation competences.”

The new ECC X.0 makes it possible to conduct a detailed qualitative assessment of these transformation competences held by a company or organization. Aside from looking at competences in terms of how people deal with the drivers of transformation, the ECC X.0 also assesses how they cope with the changes these drivers bring about. To do this, the previous ECC has been expanded to include a fifth competence level: transformation. To understand drivers, the ECC X.0 looks at the digital data competence of a company and its ability to use different types of data to forge connections both inside and outside the organization. This also entails looking at capabilities the model calls ecosystem competence. The analysis also includes a dimension for changes

brought about by these drivers in order to analyze the digital culture of the company, its ability to add value, and the digitalization level of the business model. When using the ECC X.0, organizations can decide if they would prefer to use a standalone version, which focuses exclusively on understanding transfer competences, or whether they would like to include other competence levels from the classic ECC model. These may help understand transformation competences within the company on a more holistic level.

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After the talks, the audience were invited to be the first users to try out the tool and gain an impression of the instrument themselves. Experienced Steinbeis experts showed how the new instrument offers companies and consultants an opportunity to move successfully into the future. There was also detailed discussion about practical experiences in using different types of software tools to analyze companies.

For further information on the Steinbeis Enterprise Competence Check, go to **steinbeis-ukc.de**.

Information on the Steinbeis Enterprise Competence Check X.0 is available at **steinbeis-ukc.de/ukc-x0/**.



BECOME AN INNOVATION CHAMPION!

BADEN-WUERTTEMBERG MINISTRY OF ECONOMIC AFFAIRS, LABOR, AND HOUSING
OFFERS FREE CONCEPT CHECKS TO SMES AND STARTUPS

Do you run a business or are you a researcher? Looking for funding or a partner for an innovative product, service, or a new business model? If you are, the free innocheck-bw initiative offered by the state of Baden-Wuerttemberg may be just what you're looking for. Offered by experts at the Steinbeis-Europa-Zentrum and Steinbeis 2i GmbH, the aim of "innochecks" is to allow SMEs and startups to find the right EU funding program.

The initiative focuses on offering encouragement and support to enterprises and startups in Baden-Wuerttemberg in accessing funding. It was set up by the Baden-Wuerttemberg Ministry of Economic Affairs, Labor, and Housing with the support of the Steinbeis-Europa-Zentrum and includes a website (www.innocheck-bw.de) to allow firms and startups/scale-ups to check the viability of their innovative concepts by completing a questionnaire. Companies are then given recommendations and useful tips tailored to their requirements. The website also provides important pointers regarding suitable national and European funding instruments, relevant links to further sources

of information, and contacts to other experts offering advice on innovation initiatives.

The European Union has introduced a body called the European Innovation Council (EIC), whose aim is to encourage more companies within Europe to innovate and be willing to take risks – and thus stand firm in a market increasingly shaped by emerging technology. The EIC should ensure that scientific findings in Europe result in the setting up of new companies and that these can companies be "scaled up" more quickly, also on a broader basis. Two funding options are available for the pilot phase of the program: Pathfinder and Accelerator.

Together, they manage a budget of more than €1 billion for the last two years of the Horizon 2020 program (2019-2020). A further initiative offering funding is the Fast Track to Innovation program.

FUNDING THROUGH PATHFINDER

Pathfinder offers funding for radically new research, potential market innovations based on disruptive technology concepts, and technologies of the future. Up to €4 million of financing is available per project (technology readiness level (TLR) 2 to 4). Support is given during the early phases of scientific and technological research and development, including the proof of concept



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phase involving prototypes. The aim is to help companies validate technology and assess its market viability. Pathfinder is open to all kinds of innovators, universities, research institutions, and business enterprises, but especially startups and SMEs. Projects must involve three partner organizations from three different member states or associated countries.

FUNDING THROUGH ACCELERATOR

The Accelerator instrument promotes the commercialization of highly innovative projects of TRL 6 or higher, offering a total of €2.5 million plus mixed financing (private equity) of up to €15

million per project. This makes it possible to offer startups and SMEs seed financing to support development and innovations to the point where ideas may be of interest to private investors. Funding enables companies and startups to scale up, especially if their projects are unlikely to attract the interest of banks. Under the Accelerator, one-off grants are available to cover market introduction costs.

FUNDING THROUGH FAST TRACK TO INNOVATION

Fast Track to Innovation (FTI) provides funding for groundbreaking technological or service-related innovations based

on interdisciplinary or trans-sectoral principles (TRL 6), especially market-centric products, processes, services, and business models. Funding ranges from €1 to 3 million per project (60% of overall budgets go to industry). The FTI program is targeted at SMEs, larger companies, universities, and research institutions. Between three and five of the project partners should be from member states or associated countries.

The support measures receive financial backing through the Baden-Wuerttemberg Ministry of Economic Affairs, Labor, and Housing.

SUBMISSION DEADLINES FOR THE FUNDING PROGRAM

Pathfinder:

- May 13, 2020
- June 23, 2020

Accelerator:

- May 19, 2020
- October 7, 2020

Fast Track to Innovation:

- June 9, 2020
- October 27, 2020

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www.steinbeis.de/su/2017
www.steinbeis-europa.de

Concept checks: <https://www.innocheck-bw.de>



The Steinbeis team using the developed test rig.

AIRTIGHT ISN'T ALWAYS AIRTIGHT

STEINBEIS EXPERTS DEVELOP TEST RIG FOR MEASURING CLEANROOM EQUIPMENT.

VDI standard 2083-19 lays down clear guidelines for the airtightness of seals used in cleanrooms. It even defines a process for checking and categorizing the airtightness of cleanrooms, equipment, and components. To stay within certain limits, it is important to consider the housings and covers of integrated components such as socket outlets and smoke detectors. Experts at the Steinbeis Transfer Center for Energy, Environment and Clean Room Technology in Offenburg have developed their own test rig for conducting quantitative assessments on the airtightness of individual components. The rig makes it possible to determine which components are suitable for using for which airtightness categories.

It is important to obtain reliable information on the airtightness of components used in the ceilings, walls, and floors of cleanrooms in order to adhere to specific specifications laid down for different cleanroom classifications. Often, a single component such as a socket, smoke detector, lighting unit, or door becomes a sticking point during final inspections and makes it difficult to meet approval criteria.

“A socket letting in 0.9 cubic meters of air per hour doesn’t sound like a lot. But if you have several sockets installed in a room it’s easy to exceed permitted values, i.e. the airtightness requirements for the overall room,” explains Steinbeis Entrepreneur Michael Kuhn, adding, “and there aren’t many component manufacturers or wall and ceiling suppliers capable of providing reliable measurements on the air permeability of individual components. Developing a test rig to do this job was just the next logical step.”



↑ Test rig for conducting quantitative assessments on the airtightness

Smoke detector in test ↘



STEINBEIS TRANSFER CENTER ENERGY, ENVIRONMENT AND CLEAN ROOM TECHNOLOGY

Fields of business

- Validation and inspection/approval measurement
- Special projects (commissioning, optimization, simulation)

Services

- Innovative and manufacturer-independent advisory services
- Measurement, testing, and assessment of buildings/rooms and technical equipment
- Flow optimization using flow simulation (CFD) and flow visualization
- Virtual commissioning using digital twins and on-site commissioning
- Optimization of buildings/rooms and technical equipment with a focus on functionality, performance, and energy efficiency
- Planning and running of specialist training courses

A TEST RIG FOR INDIVIDUAL COMPONENTS

No sooner said than done. The experts at the Steinbeis Transfer Center developed a test rig that quickly came up with the required results. Their device makes it possible to test individual components and measure differential pressures of between -500 Pa and +500 Pa up to airtightness class 7. Measurements are captured in an inspection report complete with an evaluation certificate. Faults are not only caused by design parameters. Sometimes components may be badly assembled. To check for this, the Steinbeis experts also go back to component drawings to see if equipment is assembled correctly and mounted with proper seals.

Using test rig measurements taken without involving manufacturers allows cleanroom operators and building owners to generate reliable data that can already be used for planning purposes. This makes it possible to eliminate potential problems in advance, often saving a major amount of time and effort searching for leaks later down the line or having to retrofit seals. The test rig developed by the Steinbeis Transfer Center for Energy, Environment and Clean Room Technology also provides manufacturers with a method for taking reliable and independent measurements of their components.

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“LIGHTWEIGHT DESIGN ALLOWS US TO GIVE CITIES BACK TO THE PEOPLE”

AN INTERVIEW WITH DR. WOLFGANG SEELIGER (LEICHTBAU BW) AND BEATE WITTKOPP (TRANSFERWORKS BW, THE STEINBEIS TRANSFER CENTER) ABOUT THE FUTURE POTENTIAL OF LIGHTWEIGHT DESIGN

Lightweight design offers plenty of potential – as underscored by a 2019 study issued by Leichtbau BW, the biggest lightweighting network in the world. The study looks at the role played by “Lightweight in the Urban System.” TRANSFER met up with Dr. Wolfgang Seeliger, managing director of Leichtbau BW, and Beate Wittkopp, Steinbeis Entrepreneur and member of the Leichtbau BW advisory council, for an interview.

Dear Ms Wittkopp, dear Dr. Seeliger. Could you start by giving us a quick overview of the main thrusts of the study?

Wolfgang Seeliger:

Lightweight design offers 50 percent material weight savings, you use 40 percent less energy in the mobility sector like the delivery of goods, and there are reductions of up to 60 percent in terms of the effects caused by urban heat islands – our study identified that these positive benefits are already possible today if you use lightweight design in an urban setting. A great deal of the current discussion on sustainability is about closed-loop recycling. We are talking about enormous flows of resources here. For example, the construction industry creates roughly 50 percent of all waste and uses around 40 percent of all resources. If you just think about the potential savings, you can see why lightweight design offers a solution to this problem.

We now have an indicator model that gauges the sustainability of an urban quarter as early as during the process of the request for proposal. The model does not look at individual buildings or

sections of buildings, but instead it assesses the sustainability impact of integrating several functions in one building, as well as planning and construction processes spanning across different disciplines. It is a complement to existing indicator models, such as the system used by the German Sustainable Building Council (DGNB) – so you can assess entire urban areas by looking at the big picture.

Beate Wittkopp:

The study could not have come at a better time. Not only is it an enrichment to preparations for IBA27 [editors note: “IBA” is an acronym for “Internationale Bauausstellung”; in English “International Building Exhibition”; it is organized by the regional council of the city of Stuttgart], it also makes specific recommendations regarding project implementation. One factor which makes this study so special is the aforementioned indicator model. We finally have a robust basis for changing the way cities are planned in the future, introducing more elements of resource efficient lightweight construction. The idea now is to develop this model into a measurement system so it can be applied in the real world.

What role do you think lightweight design will play as a planning feature of future cities?

Beate Wittkopp:

Problems tend to stand out more in cities, which is why there is more pressure to do things differently there. But cities are already in place. So we need to work out if there is any room to maneuver, which is where lightweight design can make such a big difference. The timing is ideal because the IBA27 is a special opportunity to develop concepts by working on an interdisciplinary level, and for forming new alliances. Projects can be implemented that set an example, and we can try things out in certain areas and experiment.

Wolfgang Seeliger:

Lightweight design allows us to give cities back to the people. Cities become more pleasant to live in. Until now, open areas like the streets, parking garages, and parking lots have belonged to cars. This is where lightweight design comes in, acting like a catalyst. The study shows that first and foremost, we need to think across sectors. What do I mean by this? Fields such as modern mobility, urban infrastructure, and architecture should

not be seen as separate entities. What we need to do is to merge different sectors of the construction industry and adopt an integrative approach when it comes to developing concepts, planning, and finally building cities. This is the only way to maximize the potential savings.

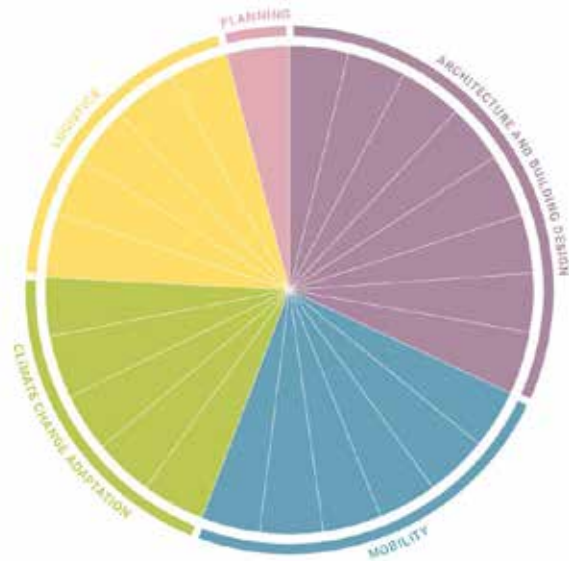
So what needs to be done for that to happen?

Beate Wittkopp:

We have to take into account the fact that cities also compete against each other as economic zones and places to live.

Wolfgang Seeliger:

Definitely. Although there is a lot of interplay between these things. One of the reasons Berlin has been so successful as a city of entrepreneurs is that it holds appeal for young and hip people. Berlin was and still is "in" and it has leveraged that fact as an economic asset. If you look at Berlin now, though, in terms of urban development it is anything but appealing. But now we have the ingredients that allow us to make cities more pleasant to live in again. Let me give you an example. The ILO is a prototype for an innovative lightweighting vehicle. It only weighs a third in comparison to a conventional vehicle and – which is much more important – it only occupies a quarter of the area. Imagine what the city of the future would look like if you reverse the equation and 75 percent of the space taken up by traffic were freed up? We could give this space back to the people. There would also be integrated logistics solutions based on lightweight vehicles, using last-mile distribution systems integrated directly into buildings. This would also affect how goods are delivered within cities, in ways that are more compatible with people, and more efficient, and that also make it possible to free up space. This reverses the famous weight spiral and pushes it downward, and the savings would trigger other (secondary) impacts which in



To assess lightweight design principles in an urban setting, a catalog was drafted for the study containing different indicators in five categories. These formed the so-called Lightweight Design Index for the study. The "Conventional: Urban" scenario (without the word "lightweight") describes typical construction practices of today – as a result, reductions in required resources are not to be expected.



The illustration shows potential savings on the Lightweight Design Index for a multifunctional hub application scenario. The white areas represent lower resource requirements compared to conventional construction methods within each individual category.



THE CONSTRUCTION INDUSTRY CREATES ROUGHLY 50 PERCENT OF ALL WASTE AND USES AROUND 40 PERCENT OF ALL RESOURCES.

turn would reduce the consumption of resources in a kind of positive feedback loop.

And how do we get to this city of the future?

Beate Wittkopp:

In my opinion, dealing with this question shows how much potential exists to be innovative by approaching things on an interdisciplinary level and using overlapping models. It sheds a completely different light on modern construction. But this transformation requires wide-

spread participation and a high level of personal identification of the population with changes. I believe that the best way to deal with most of the problems that arise when you move to a future-ready habitat – one that really is sustainable

– is to work on solutions across different sectors of industry.

Wolfgang Seeliger:

What the study really highlights are the opportunities and potentials offered by

LIGHTWEIGHT DESIGN MEETS VR IN A NEW APP

Leichtbau BW has just released a free App (iOS/Android) with an augmented reality function that you might like to try. To try the feature out on this article, install the app and tap on the Augmented Reality button directly from the main menu. Focus your smartphone camera on the cover of the study (opposite) and prepare for a surprise...

You can also download the app by going to

www.leichtbau-bw.de/ios or
www.leichtbau-bw.de/android

The app is only available in German.



a holistic approach. What I mean by this is that we have to stop looking at disciplines like road construction, building construction, and transportation within urban areas as separate entities; we have to think of them as an integrated part of the overall urban process. One example described by the study, which really illustrates the topic of functional integration well, are multifunctional hubs. These are types of buildings that unite several logistical functions, and because they are used in different ways they do not take up much space. Materials travel shorter distances and they are shipped via several carriers, so the first thing these hubs do is to reduce city traffic. But they also offer different types of buildings and different living options for new target groups. For example, micro-apartments not only help to shorten carriage drives, they also limit the amount of space used in urban areas. With multifunctional hubs, energy supplies can also be made multifunctional and self-supporting. One way to extend this and create further synergies would be to introduce flexible building formats, like co-working spaces, fablabs, or urban farming on rooftops.

Beate Wittkopp:

The only way to exploit the tremendous potential to make savings in urban design and really achieve a circular economy in the way it is meant – in terms of resource management and material recycling – will be to develop connected usage scenarios and introduce the highest possible material standards.

Current developments in industry, such as digitalization, smart production, and connected systems, are resulting in convergence as established borders evaporate and areas that were previously separate start to merge. What impact will this have on lightweight design within the context of urban systems?

Beate Wittkopp:

A huge impact! For example, we can transfer expertise from the automotive industry in the region to urban development, and achieve genuine innovation on the roads.

Wolfgang Seeliger:

These developments are a huge opportunity for the region, because these trends are dealing with our core competences. And when I say core competences, I do not mean traditional ones like carmaking or mechanical engineering – I am talking about the ability of these fields to create highly complex products, based on logistics and manufacturing processes that depend on one another and are closely intertwined. The excellence cluster at the University of Stuttgart is actually already dealing with the task to transfer this core know-how into urban design. The cluster is called Integrative Computational Design and Construction, and its aim is to use machines to automate major sections of the construction process and make it more productive, and also form a direct link between planning, pre-production, and the construction process itself – which is not possible without deep-seated digitalization, affecting all parts of the process. The way I see it, this project paints a picture of the potential way forward for the region in maintaining its competitiveness, especially if the traditional sectors of commerce are no longer as viable as they are right now.

Lightweight design is a significant factor when we are talking about sustainability. What challenges can this sector of industry expect to be confronted by when it comes to urban design, and what should be done about them?

Beate Wittkopp:

We need to improve living standards in urban areas without negatively affect-

ing the surrounding areas. And that will only work if we succeed in exploiting the potential offered by buildings – for example the infrastructure – but also make more effective use of green spaces in the city and close material circles.

Wolfgang Seeliger:

The challenge we face in the cities is that we will have to offer more housing and living space to more and more people. Around two billion of the people on earth are currently in their childhood. Professor Werner Sobek has estimated that we would have to rebuild the entire world of 1930 to create enough housing and infrastructure for the generation of people that is currently growing up. If we want to do that with "German standards", we would need roughly one thousand billion tons of concrete and brickwork. This number is not just inconceivable, we would not be able to produce the resources to do this. Lightweight construction is a sustainable technology by itself because you only use the amount of material you actually need. We have to seize the huge potential offered by lightweight design to save resources – we have no other choice.

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LESS TALK, MORE ACTION!

RE-THINKING THE ENERGY INDUSTRY

STEINBEIS EXPERTS JOIN FORCES WITH THE IMPACT FARM AND ORGANIZE A SPRINT COMPETITION ON BEHALF OF TWO ENERGY AGENCIES AIMED AT IDENTIFYING NEW WAYS TO DIGITALIZE THE ENERGY INDUSTRY

What do you get if you cross global trends like data-centric digitalization and sustainability with agile working practices? What is the real potential offered by data generated by smart meters? Will COVID-19 become a driver of crisis-proof digitalization? And are there sufficient safeguards in place to protect critical infrastructures? One thing all these questions have in common is that they show how important digital solutions will be to the energy industry in achieving the transition to alternative energy sources. They also revolve around the topics tackled by a Berlin-based startup called The Impact Farm, which is working in collaboration with the Steinbeis Consulting Center for Innovation Management and Intelligent Networks on an agile competition called the #enerthon20. Its motto: The power of data unleashed!

The two project partners are organizing the Enerthon under the patronage of German energy agency dena and the French energy agency ADEME. The international competition, which lasts four weeks, will see companies placed into categories by topic before firms invite data analysis and application experts to look into the digitalization challenges they currently face in achieving the green energy transition. Experts may

apply to work on briefs within individual categories. COVID-19 has made business continuity management and digital solutions even more important as a topic, especially for operators of critical infrastructure.

In a nutshell, companies will outline the challenges they currently face when analyzing or re-using data, and experts will be given four weeks to work on solutions and functioning prototypes. Their ideas will then be taken back to the company and developed further within a real business setting so they can be optimized. Actual products will be made to measure by the experts in keeping with the requirements of the customer – not the other way around!

The Impact Farm (TIF) was founded as a startup in 2018. It describes itself as a “deep tech company builder” and offers data science and business intelligence expertise to medium-sized manufacturing companies. One method it applies is the 100-day sprint. Customers provide a digitalization challenge with a bearing on data, and TIF develops an idea from this challenge and turns it into a minimum viable product (MVP). To plan the Enerthon concept, this expertise offered by The Impact Farm was combined with an understanding of energy sector needs

– for the Steinbeis Consulting Center for Innovation Management and Intelligent Networks, this is core brand know-how. The experts working at the Steinbeis Enterprise have a background in science and business, and offer made-to-measure staff training offering direct value to companies, particularly when it comes to innovation, secure business processes, and sustainability. To maximize knowledge-sharing between companies, the Steinbeis Enterprise is also offering in-house staff training to go hand in hand with the Enerthon initiative. The focus of training will lie in projects currently undergoing implementation with a bearing on digital transformation, innovation, and sustainability reporting. The Steinbeis Consulting Center is a partner of the Baden-Wuerttemberg Cooperative State University Center for Advanced Studies.

HOW THE ENERTHON WORKS

“Our goal with the Enerthon is not to bring in interdisciplinary teams, or even virtual teams, and just get them to present lots of cool slides for the weekend and show off their concepts. It will be

more about developing functional prototypes. They’ll be given a four-week sprint and the prototypes will be assessed, given awards, and taken back to the companies for introduction,” explains Dr. Christian Schweizer, Steinbeis Entrepreneur at the Steinbeis Consulting Center for Innovation Management and Intelligent Networks, highlighting the aims of the competition. To ensure this happens within the right time frame and the process adheres to professional standards, the team organizing the competition is focusing on experts currently working in this area, people who “get things done,” and specialists who can work together virtually – an approach which is also more “crisis-resistant.” These experts will collaborate with a company – a sponsor prepared to reveal a data issue or allow the experts to examine a challenge they face with data quality. Together, they will refine a set of issues relating to a certain target group, start with a general idea, and then work this up into a specific question to be solved by the experts within four weeks. The application form went online in April and is open to would-be participants until October 4, 2020. TIF

and the Steinbeis experts are also setting up virtual and physical teaser events across Europe with the aim of selecting as many high-quality applicants as possible, all of whom should have at least three years of professional experience. Sponsoring companies can also propose their own in-house interdisciplinary teams if they like.

The Enerthon will open with a kick-off event in Paris on October 19, 2020, which of course will also be staged virtually. At the event, the teams will be presented with a specific challenge in their selected category. They will then go back to their companies to work on prototypes, which will then be presented to a jury comprising prominent experts from politics, science, and the energy industry at the DENA convention in Berlin on November 16-17, 2020. During these two days, they will also be expected to field questions on cost-effectiveness, security, and development strategies. After the presentations, a jury comprising experts and the firms that acted as sponsors of each challenge will decide which concepts should be implemented or moved forward into further development.

Given the current situation with COVID-19, the competition has its finger on the pulse – new approaches to distributed collaboration are flexible and allow specialists to be brought in as and when necessary. They also offer certain benefits when it comes to making companies more crisis-resistant. Which is exactly where the Enerthon comes in. Unleash the power of data!

#ENERTHON20

Benefits to you and your company

- Rapid development of ready-to-implement concepts with minimal resources
- Recruitment: direct access to data science experts
- Opportunity to showcase company expertise
- Insights into issues and potential solutions at other companies
- Staff training options, new ideas/working practices

Benefits to you and your team

- Opportunity to forge networks with other data scientists
- Chance to meet companies with relevant issues; strong emphasis on digital solutions/data science
- Inspiration and personal development

More on the competition: www.enerthon.com

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HYDROGEN FUEL CELLS WILL POWER THE FUTURE OF E-MOBILITY

STEINBEIS 2i SUPPORTS PROJECT PARTNERS OPTIMIZE AUTOMOTIVE FUEL CELL SYSTEMS

Fuel cell technology is ready for widespread use in the automotive sector, a belief shared by the partners of INN-BALANCE, an innovation project funded by the EU working on improvements of enhanced, series production fuel cell systems for automotive applications. The EU project is focusing on auxiliary components, so-called Balance of Plant (BoP) components, used within fuel cell systems. To do this, the partners are developing new technologies and concepts, such as different ways to provide hydrogen and oxygen to fuel cells, innovative heat management and monitoring concepts to ensure smooth functioning of the overall fuel cell systems. As a partner in the project, S2i is responsible for the communication and dissemination of the project findings.

There is much potential to improve BoP components, especially in terms of how components interact with each other. The aim of the INN-BALANCE project is to deliver high-performance BoP components best suited for their integration in fuel cell systems. This will improve the efficiency, reliability and costs of fuel cell powered vehicles and boost hydrogen mobility.



THERE IS MUCH POTENTIAL TO IMPROVE BALANCE OF POINT (BOP) COMPONENTS CURRENTLY USED WITHIN VEHICLE FUEL CELL SYSTEMS.

BoP components are essential for the performance of fuel cell systems. They control the fuel cell system and regulate the amount of hydrogen in the fuel cell stack. The first step taken by the project partners was to determine the most important parameters of the BoP components used within fuel cell systems, to analyse the interaction between the different components, and come up with an overall system design. Similarly, the designs of the fuel cell stack housing and the anode, cathode, and a cooling unit modules were defined.

The cooling module is responsible for the thermal management in the fuel cell stack, which has a crucial impact on water management, performance, and the operating life of fuel cells. It ensures that BoP components are always kept at the right temperature and, if required, direct heat into the car interiors.

The INN-BALANCE team has also improved the flushing method of the anode module by using an integrated injector and ejector system that raises stack efficiency and keeps hydrogen losses to a minimum. Because the system is more compact, it requires less space and saves energy as it no longer relies on a mechanical recirculation pump. The next step was to test an air compressor prototype and combine all data gathered from the components to create a robust model for calculating costs.

A ROADMAP FOR LONG-TERM COMPONENT TESTING

Some project partners have already conducted initial lab tests on the new components. The next step will be to keep optimizing component designs based on the results of this testing before sending the re-engineered parts

to PowerCell, a Swedish fuel cell manufacturer that will test the performance and compatibility of components with the rest of the system on a test rig. Testing is scheduled to take place by mid-2020.

“The tests allow pinpointing flaws in the individual components’ design and in the system architecture, thus telling us exactly where to put our focus in re-engineering. Our goal is to deliver components that in terms of durability and lifetime do not lag behind pieces in conventional cars” explains Thibaud Mouton, project coordinator at Fundación Ayesa in Spain.

SUPPORT WITH MARKET INTRODUCTION FROM CHINA

In July 2019, China Euro Vehicle Technology (CEVT), a company belonging to

THE CONSORTIUM

INN-BALANCE has received funding from the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) and is coordinated by the Spanish partner Fundación Ayesa. Further project partners are:

- Brose Vehicle Components
- China Euro Vehicle Technology AB
- Powercell Sweden AB
- Deutsches Zentrum für Luft- und Raumfahrt e. V. (DLR)
- Universitat Politecnica de Catalunya
- Steinbeis 2i GmbH
- Celeroton AG
- AVL List GmbH

the Geely Holding Group joined the project, thus expanding the technological know-how of the consortium by bringing internationally recognized manufacturing expertise on board. CEVT will provide access to its compact modular architecture (CMA) to simulate integration of INN-BALANCE components in an actual car.

Installing the components into the CEVT vehicle platform will make it possible to observe how the overall system performs, also in terms of efficiency and reliability.

"The platform already serves manufacturing of conventional cars today and could do the same for future Fuel Cell Electric Vehicles, using the components of INN-BALANCE.", says Benjamin Harwood, who leads the INN-BALANCE activities in CEVT. "At CEVT we are ex-

cited to be a part of this project and contribute to setting manufacturing standards for future Fuel Cell Electric Vehicles", he adds.

The project partners expect to present their findings beginning of 2021. Insights gathered from the vehicular platform simulation will prepare the way for the commercialization and exploitation of INN-BALANCE components in products ready to go into series production.

FOCUS ON HYDROGEN

Steinbeis 2i is also involved in other projects focusing on hydrogen technology:

- EU Project: COSMHYC
Innovative compression systems for efficient hydrogen vehicles
- EU Project: COSMHYC XL
Innovative hydrogen compression solutions for heavy duty vehicles
www.cosmhyc.eu
- EU Interreg Project: H2SHIPS
Accelerating the introduction of hydrogen technology in the shipping sector
www.nweurope.eu/projects/project-search/h2ships-system-based-solutions-for-h2-fuelled-water-transport-in-north-west-europe/
- EU Project: FCHgo!
Introducing schoolchildren to hydrogen. Looking for new ways to teach children about energy
www.fchgo.eu

For further information, go to **www.steinbeis-europa.de/branchen-und-projekte/nachhaltige-mobilitaet.html**.

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EXPERTS.KNOWLEDGE.SHARING.

NEW RELEASES FROM STEINBEIS-EDITION

Sharing our know-how with you.

Steinbeis-Edition, the publishing arm of the Steinbeis Foundation, regularly publishes works reflecting the scope of the Steinbeis Network's expertise. Spanning a broad spectrum of topics, these publications include individual papers, series, magazines, conference proceedings, and works linked to specialist events. All titles can easily be ordered via our online shop at: www.steinbeis-edition.de.

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MEDIATION – QUARTER I EDITION, 2020 WAR AND PEACE GERNOT BARTH, BERNHARD BÖHM (ED.)

→ WWW.STEINBEIS.DE/SU/0941

Aside from climate change, resolving violent conflicts in many parts of the world at the moment – such as Ukraine, Syria, Yemen, and Afghanistan – is one of the biggest global political challenges of our times. Not only are whole countries affected by issues of war and peace. We also encounter these issues every day in the underlying antitheses of conflict and resolution. This includes conflict with other people, but also conflict within ourselves.

In this edition of *MEDIATION*, our specialist magazine turns the spotlight on “war and peace.” Read about topics such as why the unpredicted actions of hybrid warfare can be so threatening, the prerequisites that need to be fulfilled for conflicting parties to be willing to enter negotiations or mediation, and the extent to which revisiting the past in one's thoughts can help solve conflict. Other fascinating articles in this edition of the magazine include:

- War and peace – or just quiet before the next storm
- When everything's over, the battle can commence
- Love in times of war
- War and peace – an inner experience
- You should also trust your intuition!

In addition to the focal topic, a number of other interesting topics and ideas are looked at in this edition. For example, in an obituary of Joseph Duss-von Werdt, who died in October 2019, co-editor of *MEDIATION* Bernhard Böhm shares some extremely personal thoughts on one of the greatest pioneers of conflict resolution. There are also articles on how municipal authorities can work alongside citizen groups on managing the demands of climate change, plus an article on Roman Müller-Böhm (FDP Party), currently the youngest member of the German Bundestag, and why he is skeptical about the regulatory certification of mediators.



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INTEREST MANAGEMENT IN THE HOUSING INDUSTRY A THEORETICAL AND EMPIRICAL STUDY

ANDREAS FILSER | HEINZ REHKUGLER, MARCO WÖLFLE (EDS.)

→ WWW.STEINBEIS.DE/SU/1477

The financial structures of housing companies in Germany revolve around long-term credit with fixed interest rates. Businesses have had positive experiences with such arrangements in the past, because adopting a long-term strategy makes it much easier to plan with certainty. Despite this, consciously managing interest rates can not only be expected to provide help when it comes to reducing existing risks, it also makes it easier to improve net financial outcomes. This doctoral thesis introduces a method based on defined processes for systematically capturing, quantifying, managing, and monitoring interest rate risk at residential management companies. The focus lies in identifying the potential of a specific business to generate returns or encounter risk, as well as quantifying "loss factors" based on a model using interest rate structures. The aim of this method is to map and model the characteristics of the interest rate management system used by the housing industry based on factual information. The paper also defines the practical requirements of benchmarking and looks at an instrument for calculating the ability of one's own company to deal with risk.



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LEADERSHIP. PERSONALITY. INNOVATION. EDUCATION AND RESEARCH AT SIBE

WERNER G. FAIX, STEFANIE KISGEN, JENS MERGENTHALER

→ WWW.STEINBEIS.DE/SU/1249

The publication "LEADERSHIP. PERSONALITY. INNOVATION. - Education and Research at SIBE" is an affirmation of the essential nature of the institution School of International Business and Entrepreneurship (SIBE). It is certainly not the first time that the authors have considered the principles of SIBE. This text is based on the many publications listed in the bibliography. It is a provisional, decidedly preliminary conclusion of all our previous reflections. This document is intended as a basis for designing our research and development as well as point of departure for future reflections and discussions about the nature of our institution. The text thus meets the requirements of the German Wissenschaftsrat (German Council of Science and Humanities) that every university must define its original concept of teaching in a statement of principles (Lehrverfassung). Although this publication was written and published by the authors, the foundation for the ideas that inspired us to write it and all previous editions originates from everyone who works in, with and above all, at our university. Thus, the authors wish to directly thank all these people for their thoughts and actions. It is they who make the institute of higher education what it is: a reality with added value for society.



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INTERNATIONAL BUSINESS LAW PROJECTS VOLUME 1

EVA FELDBAUM, STEFANIE KISGEN, WERNER G. FAIX (EDS.)

→ WWW.STEINBEIS.DE/SU/1249

Legal profession of today is not conceivable without a special expertise in the field of International Business Law. SIBE's Handbook intends to offer a solid knowledge basis herein with numerous contributions of experts, in accordance to the study schedule of the LL.M. program in International Business Law of Steinbeis-SIBE. It addresses to the participants of the LL.M. program and, moreover, to all lawyers with the professional focus in international business affairs. The Handbook refers to all the major fields of International Business Law, such as International Contract Law, European Law, Commercial Law, Antitrust Law, Competition Law, Corporate Law, Mergers & Acquisitions, Insolvency Law, Compliance, International Economic Law (incl. WTO), Public Economic Law, Capital Markets Law, Corporate Taxation Law, Labor Law, Residence Law, International Civil Procedure and Mediation, all fields with a strong international perspective.

PREVIEW

EDITION 02|2020

Feature topic

Operation 4.0: Data-Enabling Tech in Healthcare

Scheduled publication date: September 2020

Have you ever wondered what medical practice will look like in the future? Robots carrying out surgery instead of humans, new medicines capable of curing deadly diseases, and diagnostic procedures that will allow us to spot diseases before they even take hold. For this to become reality, one important factor will be colossal volumes of data – information that can be quickly gathered, analyzed, and shared. In a nutshell, this is also an area where digital transformation will be decisive. Depending on the specific area of application, new drugs or methods might be discovered. We may also gain more comprehensive pictures of individual patients. This will make it possible to offer patients the right treatment at the right time. However, systematically analyzing health data is not without risk. The next edition of TRANSFER will explore both the opportunities and the challenges of data-enabling technology in the healthcare sector, also introducing you to the anticipated developments of future medicine.



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EXTRA EDITION IN 2020

Scheduled publication late May

We live in unusual times, posing new and unknown challenges on a number of fronts – in economic, societal, and personal terms. In a special edition of Steinbeis TRANSFER magazine we present projects at our Steinbeis Enterprises that are not only aimed at finding solutions, but also allow the Steinbeis Network to provide a helping hand in getting the economy moving again. For more information, go to **www.transfermagazin.de**.

SCHEDULE OF EVENTS

Our Steinbeis events for specialists are an opportunity for experts from the fields of science, academia, and business to discuss current issues relating to business competence, engineering, and consulting. Want to make sure you don't miss a future event? Simply add your details to our online distribution list:

→ **STEINBEIS.DE/ONLINEVERTEILER**

For further information, go to **WWW.STEINBEIS.DE/VERANSTALTUNGEN**.

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The platform provided by Steinbeis makes us a reliable partner for company startups and projects. We provide support to people and organizations, not only in science and academia, but also in business. Our aim is to leverage the know-how derived from research, development, consulting, and training projects and to transfer this knowledge into application – with a clear focus on entrepreneurial practice. Over 2,000 business enterprises have already been founded on the back of the Steinbeis platform. The outcome? A network spanning over 6,000 experts in approximately 1,100 business enterprises – working on projects with more than 10,000 clients every year. Our network provides professional support to enterprises and employees in acquiring competence, thus securing success in the face of competition.

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