

ABOUT

TRUST

THE MAGAZINE OF THE TÜV SÜD GROUP 03 — 2022



Add value.
Inspire trust.



Focus: **NETWORKS**

Mushrooms are an impressive interweaving of life that only works in cooperation. An issue about the value of networks—on rails, streets, at work and around the globe.

ABOUT TRUST

DEAR READERS,

At the beginning of the year, when we decided on networks as the motto of the last issue of ABOUT TRUST in 2022, nobody had any idea how topical the term would become. Russia's attack on Ukraine and its consequences have shown us over the past months how vulnerable our networked infrastructure, global supply chains and transport routes are. It's also made clear that we can only tackle major challenges together. Issues including the energy transition, our security of supply chains and preserving peace cannot be handled by any actor alone and require close networks between reliable partners.

One contribution to this is Germany's new Supply Chain Act, which we examine in our cover story. Starting in 2023, it obliges companies to ensure compliance with minimum standards—for instance with regard to working conditions—in their own business activities and in those of their suppliers. In this way legislators have created a framework that will ultimately ensure greater prosperity, and thus stability, worldwide.

In closing, I'd like to add something more personal: this is my fifty-eighth and final foreword for our company magazine. In a few days, not only will another year come to an end, but there will also be a change at the top of TÜV SÜD. I've had the privilege to lead the company as chairman of the board for more than fifteen years—and to contribute to making it more global, more diverse and, indeed, more networked today. I wish my successor and the remaining executive board continued good fortune and just as much success as we've had in the past years.

Sincerely yours,



**PROF. DR.-ING.
AXEL STEPKEN**

Chairman of the
Board of Management
of TÜV SÜD AG

03 2022

CONTENTS

06

A FORTUNATE CHAIN REACTION

The new German Supply Chain Act poses challenges for companies. But in the end, the benefits could outweigh them.

14

“WOMEN NEED A DOUBLE NETWORK”

What really gets you ahead on the job? A conversation about weak and strong ties, and their effects on career opportunities.

20

THE EUROPEAN DREAM

The EU wants to get more freight onto railways. A lot of money will be spent on expanding the rail networks in the coming years to achieve this. About this mammoth undertaking.

28

INFRASTRUCTURE MADE SMART

Renewable energies are changing the demands placed on electricity networks. We explain what needs to be done.

30

OVER-THE-AIR OVERHAUL

Many cars are like rolling computers these days—and regularly receive updates. But what about security?

14



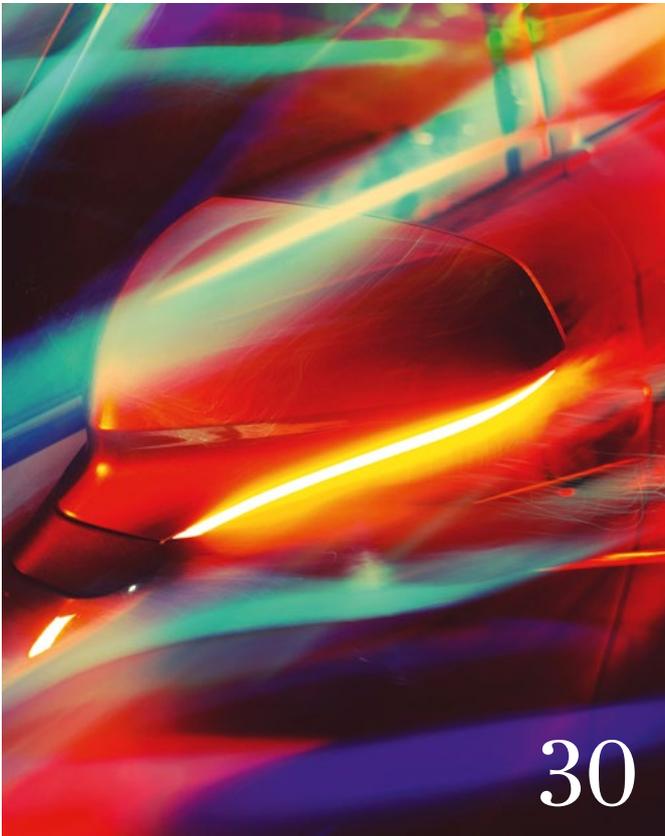
— Doubling up. Women network differently than men.

- 04 — *In Brief*
- 18 — *Inside View*
- 27 — *Vision*
- 34 — *Picture This*

Focus

NETWORKS

— No limits. The car of the future can be overhauled via updates.



30



ABOUTTRUST.TUVSUD.COM

You can find even more articles on the ABOUT TRUST content hub. For instance, find out about how ecosystems exchange information with each other using chemical substances and communicate without language or the internet over the Wood Wide Web.

PUBLICATION DETAILS

PUBLISHER TÜV SÜD AG, Westendstraße 199, 80686 Munich, Germany | Owner: TÜV SÜD e.V. (74.9%), TÜV SÜD Foundation (25.1%), Westendstraße 199, 80686 Munich, Germany | Project Director and Editor-In-Chief: Jörg Riedle | Contact: +49 89 5791-0, info@tuvsud.com | **REALIZATION** muehlhausmoers corporate communications gmbh, Invalidenstraße 112, 10115 Berlin, Germany, info@muehlhausmoers.com | Project Director: Florine Geller | Editor: Nils Wischmeyer, Lars-Thorben Niggehoff | Art Director: Aine Gibbons | Image Editor: Charlotte Zellerhoff | Editorial Staff: Felix Enzian, Julius Fiedler, Katrin Brahner | English Translation: Anthony B. Heric | English Editing: Penelope Krumm | **PRINTING** G. Peschke Druckerei GmbH, Taxetstraße 4, 85599 Parsdorf, Germany

The contents of the magazine are protected by copyright law. The magazine is printed in a climate-neutral manner and on paper from responsibly managed forests.



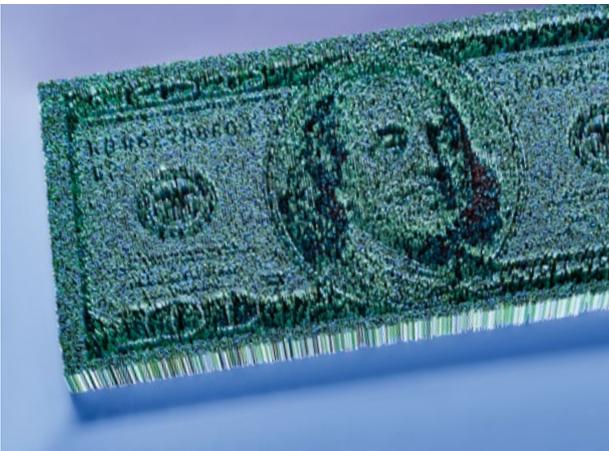


CHANGE IN COMPANY LEADERSHIP

TÜV SÜD AG will have a new chairman of the management board in the new year: Dr. Johannes Bußmann (at right) will succeed Prof. Dr. Axel Stepken on January 1, 2023. Stepken, aged 64, has been a member of the TÜV SÜD Management Board since 2002 and its chair since 2007. Bußmann was most recently the chairman of the Executive Board at Lufthansa Technik AG. Prior to that, Bußmann, aged 53, had been in charge of Human Resources, Engine & VIP Services at Lufthansa. The aerospace engineer began his career as a product engineer at ABB Mannheim. In 1999, he joined Lufthansa Technik as a development engineer in Product Management and Development. In 2001, Bußmann was promoted to sales manager for Asia and Australia, first at the company headquarters in Hamburg and then in Singapore in 2003. In 2005, he became head department manager for Marketing and Sales before being appointed division manager for Equipment Supplies in 2007 and then division manager for Engines in 2011.

NATURE NEEDS NETWORKS

Even schoolchildren learn that nature preserves can be very important for protecting global biodiversity. But are there enough conservation areas in the world? A new study led by Angela Brennan from the University of British Columbia in Canada has measured the interconnectivity of these protected sites. The study examined how medium-sized and larger mammals move through the world—and where new nature preserves would have to be established to expand existing ranges. The unsurprising results show that important connection routes between protected areas are threatened by human intervention or interrupted by settlements. The study's authors find that humankind needs to create new protected areas and connect old ones for better species protection.



SWIFT TESTS DIGITAL CURRENCIES

Central banks worldwide are working on creating digital versions of their currencies because of increasing competition from cryptocurrencies such as Bitcoin. The problem is that there are international issues to be resolved with the new technology, including exchanging between digital currencies or exchanging them into traditional currencies. The international bank network SWIFT has now conducted an initial test run of this, with participation from the German Bundesbank, the Banque de France and several other major banks. Additionally, more sophisticated testing is planned for next year.



PLATINUM FOR SUSTAINABILITY

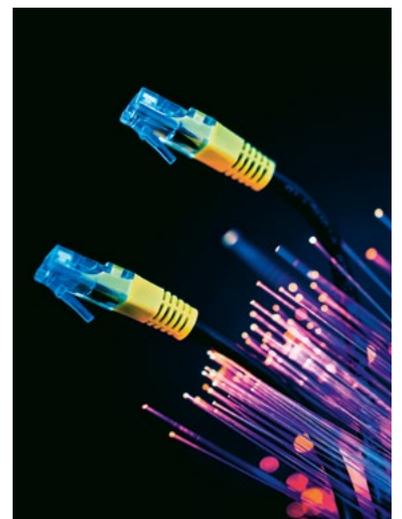


How sustainably and responsibly does a company operate? In order to objectively determine this, various organizations and providers have developed methods with which they independently certify companies and thus establish comparability. One of the best-known of these types of ratings is the EcoVadis CSR, in which TÜV SÜD achieved platinum status this year. This makes TÜV SÜD one of the most sustainably operating companies among all industry participants in the four subject areas of environment, labor and human rights, ethics, and procurement. The EcoVadis assessment methodology is based on international standards for sustainability, including the Global Reporting Initiative, the United Nations Global Compact and ISO 26000. Responsibility for sustainability management is located directly at the top with the TÜV SÜD Board of Management. CFO Prof. Dr. Matthias J. Rapp coordinates all the measures and is pleased about receiving the recognition: “The topic of sustainability has always been strongly anchored in our corporate DNA. The measures that were intensified a few years ago have fallen on fertile ground throughout the entire company and we’ve been able to do a great deal very quickly. It’s nice to see that recognized from outside.”

29

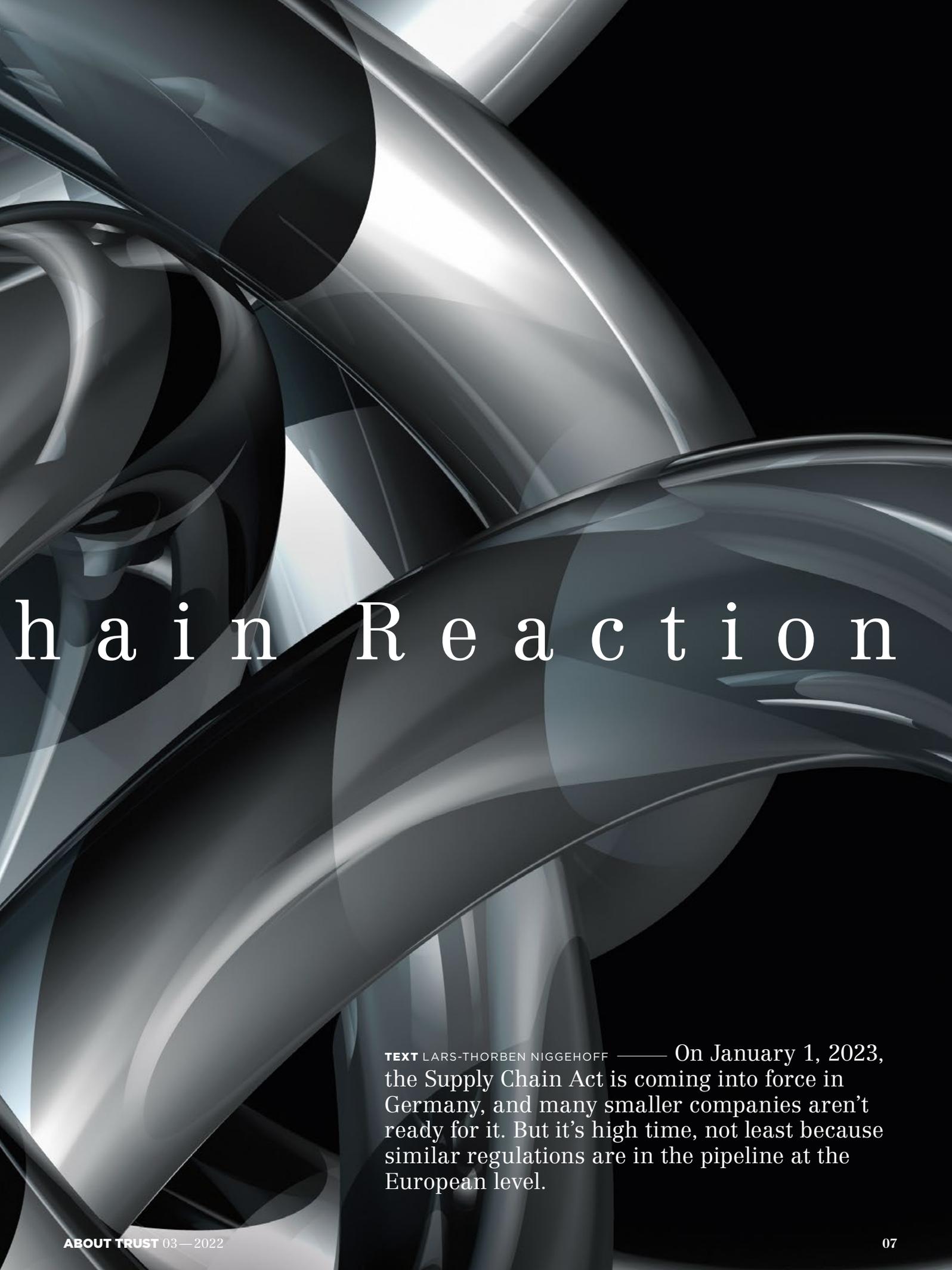
PERCENT

According to the market research company TeleGeography, the amount of global data traffic on the internet increased by 29 percent between 2021 and 2022. What sounds like a steep increase is actually more of a normalization after the boom triggered by the pandemic. In 2020, the first year of the pandemic, global data traffic increased by about 47 percent compared to the previous year as a result of contact and travel restrictions. In general, over a multi-year period, internet traffic grows by around 30 percent annually.





A F o r t u n a t e C



h a i n R e a c t i o n

TEXT LARS-THORBEN NIGGEHOFF — On January 1, 2023, the Supply Chain Act is coming into force in Germany, and many smaller companies aren't ready for it. But it's high time, not least because similar regulations are in the pipeline at the European level.

It got a bit lost in the shuffle, what with the ongoing corona pandemic at the time, but in June 2021, the German Bundestag passed a law that could help redefine the fundamental ethics of the German economy. The Supply Chain Act (*Lieferkettensorgfaltspflichtengesetz*, or LkSG in German) requires companies in Germany to ensure compliance with certain standards in their supply chains, including basic working conditions, as of January 1, 2023.

This isn't the first set of regulations like this, but it is the most comprehensive to date. It involves extensive reporting requirements and additional responsibilities, which will now fall to German companies. They will need trained employees, functioning processes and a knowledge of their own supply chains that goes well beyond mere geography. It's a tight program, but doable within 18 months, right?

In fact, a few company owners have probably been caught off guard by the looming deadline. Many aren't even aware that the LkSG is relevant to their firms, because they fall below the employee thresholds—3,000 in 2023, and 1,000 in 2024—set out in the law. Only about 600 companies will be affected in 2023, which rises to around 2,900 by 2024.

Yet these guidelines are deceptive. That's because many smaller firms supply larger ones, which will pass these reporting requirements off onto their suppliers. So, on January 1, if these smaller companies want to provide informed answers about their supply chains to their larger clients, they'll need to get started on that now.

It's a process that is generating interest not only in Germany. Governments are working on similar regulations worldwide. How Europe's largest economy manages to implement them could end up being a beacon for other countries.



FROM DHAKA TO ANKARA Due to the guidelines, production might shift more towards Europe again.

HOW THIS CHANGE CAN SUCCEED

The LkSG comprises a total of nine due diligence requirements that companies must implement. These include setting up a risk management system, conducting regular risk analyses, establishing complaints procedures and documenting all of these processes. The due diligence obligations don't just apply to direct suppliers—indirect ones must also be kept in mind if the company has “substantiated knowledge” of possible human rights violations there. The whole thing will be monitored by the German Federal Office for Economic Affairs and Export Control (BAFA in German), which will receive the companies' reports and will also impose penalties if necessary.

This requires a lot of bureaucratic effort. Larger corporations will be able to handle this more easily. For smaller companies, however, a certain amount of preparation will be necessary. “Many don't even have sustainable procurement policies, meaning there's no transparency with regard to their data,” says CEO Yvonne Jamal at the JARO Institute for Sustainability and Digitalization. This will need to change soon. That's because many smaller and medium-sized enterprises (SMEs) are direct suppliers to larger companies, which will insist that these SMEs also screen their own suppliers, which are also part of the overall supply chain.

Thus the SMEs, which aren't really directly targeted by the law, will now have to train employees,

analyze their own supply chains and establish risk management systems. They will have to make up for shortcomings for which they themselves are partly responsible, as Jamal explains: “The issue was there before, but it just didn't have any urgency for the companies because the added value wasn't clear to them.”

For many SMEs, the LkSG is also challenging because they lack the market power of larger corporations to enforce standards all across the globe. In spite of this, companies could work together within industries—if permitted by antitrust laws—and face suppliers with greater combined market power. Still, Jamal recommends communicating with them on an equal footing and offering support.

There are already examples of this. For instance, the supermarket chain Aldi Süd already issued new guidelines regarding working conditions in its own supply chain in early 2021. The discounter, headquartered in western Germany, has its eye on food production in particular. Aldi Süd wants to support its supplier companies in identifying forced labor, preventing it and, if necessary, making amends. In addition, the company also carries out its own so-called social assessments directly at production sites. Cooperation and control are running in tandem.

Overall, many SMEs seem to be worried about what's ahead. “But we have to allay their fears for the time being, not least because there were many untruths told during the legislative process on the part of some interest groups,” Jamal says. Too few of the positive aspects were communicated. Moreover, the companies would not be left to their own devices in implementing the rules. Many industry associations and the BAFA provide information and recommendations for action. “There are also quite a few NGOs and other organizations that provide assistance,” Jamal





**“We could begin to see a certain
amount of de-globalization.”**

JENS KILIMANN, SUPPLY CHAIN EXPERT AT THE MANAGEMENT
CONSULTING FIRM BAIN & COMPANY



**Companies should help suppliers
during this changeover,
but they are under no obligation to do so.**

says. She recommends using all of these tools. “The companies need clear goals and then they can measure their achievements against meaningful metrics.” A certain urgency is now called for. And as Jamal warns, the run on supporting institutions has already started: “Our institute, for instance, can barely keep up with the slew of inquiries at the moment.”

So companies are making an effort. Not least because it is now part of their due diligence, as Christoph Küffner, a research associate at the Chair for Supply Chain Management at the University of Erlangen-Nuremberg (FAU in German) explains: “Misconduct in the supply chain has also entailed risks for companies in the past.” For the company’s own reputation, as an example. According to a study by the EU Commission, investors also expect companies to operate in a correspondingly above-board manner.

THE RIGHT COMPROMISE

The Supply Chain Act is intended to provide reliable control systems on the one hand, while not stifling the economy on the other. It’s a delicate balancing act, even if you only consider German enterprises. The challenges are considerably greater in poorer regions. There, suppliers will have to make some significant improvements to continue supplying German companies. Jens Kilimann, a supply chain expert at the management consulting firm Bain & Company, has concerns: “We could see a certain amount of de-globalization.” Companies in the textile industry, for example, might think twice in the future about producing in far-flung countries with supposedly dubious reputations, such as Bangladesh. “Production might then be transferred to Turkey,” he speculates. The problem is that the textile industry in Bangladesh is one of its economy’s main supports and could thereby be severely damaged.



DECEPTIVE PARADISE Terrible working conditions can sometimes also be found in Europe, for example in agriculture.

Similar warnings were issued in early 2022 by the Kiel Institute for the World Economy (IfW in German). The authors of an expert report concluded that the LkSG would hit the most productive and fairest companies in developing countries. It is precisely the companies that export to the West that pay higher wages and taxes than those that produce for domestic markets. According to the IfW, if these companies were now forced to close, nothing would be achieved in the struggle against human rights abuses.

This would be a consequence that surely no one wanted to achieve with the LkSG. The law itself states that “enablement should take precedence over withdrawal.” This means that the German companies shouldn’t terminate contracts with suppliers, but instead should support them in getting better and in offering better working conditions. However, this is not a requirement, just a suggestion.

Yet Kilimann does see possibilities for preventing such collateral damage with minor adjustments to the law. “For instance, you could compile a whitelist of countries where the risks are low,” he suggests. Then again, countries that might seem to be unproblematic at first glance offer no guarantees. “Even in Europe, too, we sometimes see conditions that are reminiscent of modern-day slavery,” says Küffner of the FAU. Working conditions on some vegetable plantations in Spain, for instance, can be terrible.

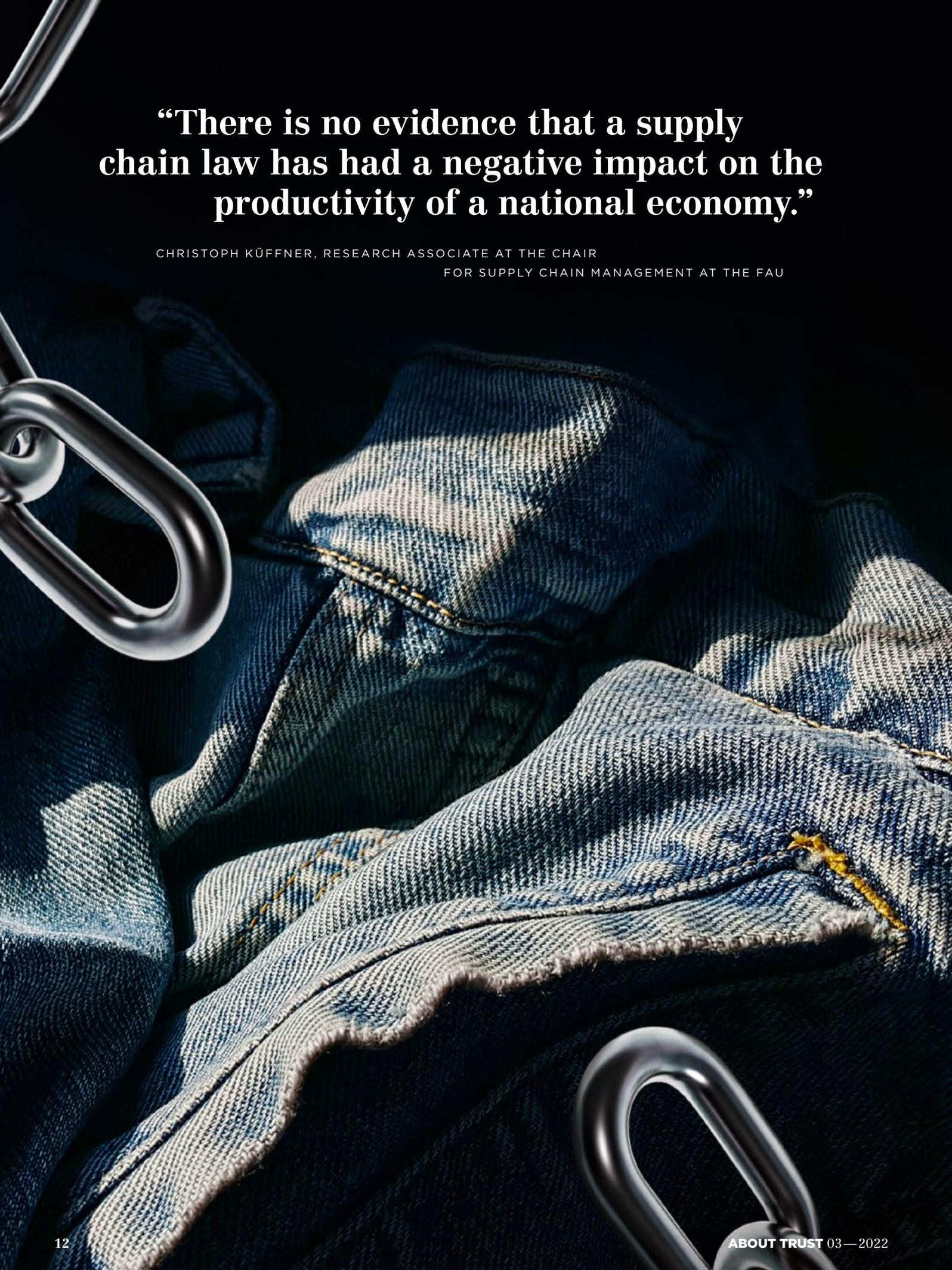
In the end, SMEs will have to search for solutions together with their suppliers, solutions that benefit both sides. In case of doubt, this usually works better than pressure tactics. The medium-sized company Haas & Co. Magnettechnik, for instance, based in Wiesbaden, Germany, has been working together with its Chinese suppliers to improve working conditions in rare-earth mining, another traditionally risk-filled industry. Implemented measures include emergency switches on the machines and repairs to the workers’ accommodations. The added expense ended up being a worthwhile investment: the improved conditions significantly reduced turnover in the workforce and production quality also increased.

A law on supply chains is always going to be a search for compromise: companies must still be able to function properly, but the law as written must also bring about noticeable changes. As Küffner explains, this will only happen if companies really dig deep into their supply chains. “Of course, a big German corporation—for instance from the automobile industry—already controls its first-tier suppliers,” he says. “And, in turn, these first-tier suppliers certainly control their direct suppliers.” Yet the real problems are often found much deeper in the supply chain. “It starts getting interesting at about tier twelve or tier twenty,” he says. So to truly have a comprehensive effect, control must be exercised in the supply chain all the way down to these levels.

Küffner advises companies to remain calm: “There is no evidence that a supply chain law has had a negative impact on the productivity of a national economy.” Examples come from regulations in Great Britain, France and the Netherlands. Küffner’s FAU colleague Christopher Münch even sees opportunities for a sort of shock therapy. “We



PHOTOS: Getty Images/Makal086 (chain); Getty Images/Helmut Hess (orange); Getty Images/siculodoc (oranges); Getty Images/Bim (plantation)



“There is no evidence that a supply chain law has had a negative impact on the productivity of a national economy.”

CHRISTOPH KÜFFNER, RESEARCH ASSOCIATE AT THE CHAIR

FOR SUPPLY CHAIN MANAGEMENT AT THE FAU

also saw it with Covid: all of a sudden, things that had been ruled out for years were possible, like for instance working from home,” he says. The Supply Chain Act could lead to similar breakthroughs for a more socially equitable economy.

THE EU FOLLOWS

The European Union is also working now on its own supply chain regulations. It’s still just a draft, but it has a lot going for it. Firstly, the group of companies affected will be expanded significantly—companies with at least 500 employees or 150 million euros in annual sales will be subject to the guidelines. Companies in so-called risk industries—including the textile or chemical industries—might even be affected even if they have lower company figures.

The EU proposal also provides for the possibilities of civil liability for companies, an aspect that didn’t make it into the final version of the German law. This means that if a company causes damages due to non-functioning supply chain control procedures, it will have to answer for them. The EU proposal also includes due diligence for environmental obligations. These have hardly played a role in Germany, unless they arise in direct connection to human rights violations.

This aspect is something that the FAU’s Münch views as very important. “My hypothesis is that if a supplier attracts attention because it doesn’t treat its employees well, you can assume that its environmental protection measures are also crap,” he says. “I think it’s a mistake that this hasn’t been included in the current law.”

Management consultant Kilimann has mixed feelings about the planned EU directive. “The EU requirements would mean yet another significant complication for companies,” he warns. Some 13,000 companies in the EU would be affected. “We must be



EXAMPLE AND WARNING Much has already been undertaken to make supply chains more transparent in the textile branch. Opinions differ on whether enough has been done.

clear: it will lead to decreasing efficiency and less value creation,” he says. And consumers would notice: “In many branches, the textile industry for instance, the margins are extremely tight. There’s barely any cushion.” Higher prices are likely to result. “And then customers will probably decide to shop elsewhere.”

A NEW ECONOMY?

Shouldn’t a new economy be built on fairness? Proponents of the regulations tend to view them as a necessary correction for undesirable developments. FAU expert Küffner sees it as the end of an economic era. “The focus on shareholder value has meant that, over the years, companies have always gone to where production is cheap, with all the consequences that entails,” he says. Stronger protections for the environment and human rights will change this equation. Accordingly, it’s now in a company’s own best interests to examine their supply chains. “The reason that they are so complex is based on decisions made by businesses to gain competitive advantages in the context of globalization,” JARO’s Jamal says. Those who earn money globally can also take on responsibilities around the globe.

TÜV SÜD AUDITS SUPPLY CHAINS

Keeping a close eye on supply chains? TÜV SÜD has been supporting companies in making their supply chains more transparent and more sustainable for years. By 2026, TÜV SÜD itself will only receive deliveries from companies that meet the expectations set out in the Supplier Code of Conduct. A Global Human Rights Officer is responsible for implementing the obligations arising from the LkSG and monitoring Group-wide LkSG risk management. In many countries, TÜV SÜD offers supplier audits. These run the gamut from compliance guidelines to environmental and human rights aspects to procurement of raw materials. Companies can also be certified by TÜV SÜD depending on the branch and company focus.

EFFICIENCY The international ISO 28000 standard for supply chain security management systems primarily looks at product safety and on-time delivery.

HUMAN RIGHTS A certification to the BSCI Code of Conduct considers worker participation and worker protection, prohibits discrimination, requires fair payment, protects health and worker safety on the job, and forbids child labor.

TRAINING Customers can also keep an eye on their supply chains with training courses from the TÜV SÜD Academy, which is currently offering a seminar focusing on “The new Supply Chain Act in practice.”



“WOMEN

need

a double

network”

Sociologist Brian Uzzi explains why our casual acquaintances lead to success at work and why women benefit less from this than men.

Brian Uzzi, a professor at Northwestern University in Chicago is always eager to talk about his favorite research subject: network theory, which examines social structures, often using the aid of mathematical models. He's spent decades researching the question of how various social ties affect our lives and our economic success, and in particular how this differs for women and men.

Mr. Uzzi, you study the concept of strong and weak ties between people. What is this all about?

UZZI There are strong ties, for instance to family and close friends, and weak ties, for instance to general acquaintances. There's also a third category: missing or invisible ties. This can include a neighbor who I nod to in greeting out on the street in the morning. We speak about missing ties because network models usually don't take these into account.

So there are close and less-close relationships to our fellow human beings. This sounds trivial at first. What interesting insights result from this for an individual's success?

UZZI The most interesting aspect of it is certainly that the weak ties are more important for a person's success than the strong ones. Sociologist Mark Granovetter described this back in 1973 in his book *The Strength of Weak Ties*, one of the most influential works in this field.

Acquaintances are more important than family? That doesn't seem to make sense at first.

UZZI If you think about it a bit, it's logical. Our strong ties are to people who move in the same social circles as we do, so at work that would be for instance co-workers from the same department. Weak ties are to people who work at different companies, possibly even in different industries. We get new information from these types of people that we would otherwise never hear about. We find out which company is currently hiring new people or laying off staff, how much can be earned in other jobs. So, through weak ties, we collect market information that fills in some of our blind spots. This allows us to identify new career opportunities, both in our own company and in companies that we may not know about—and better prepare ourselves for salary negotiations.

Is a fifty-year-old paper actually suitable for explaining the modern working world?

UZZI The theory has proven to be really robust. Recently there was a large analysis based on contacts on the professional social network LinkedIn that largely confirmed the concept. It showed that the weak links—meaning those where you had just one friend in common—were much more likely to lead to a new job opportunity than those with people with whom you shared many more, say 25 contacts. Social networks are at least as relevant today in explaining economic outcomes as the offline networks that Granovetter analyzed fifty years ago. The new study shows that the theory is keeping pace with the changing working world.

Can the theory be expanded thanks to data from social media?

UZZI This has led to an interesting new aspect. It's been shown that a connection with ten mutual contacts is twice as likely to lead to a new job than a connection with only one mutual contact. This means that strengthening a social tie does help up to a certain point, after which it decreases: an inverted U-shaped curve. In practice this means that moderately weak ties have the greatest effect, even greater than very weak ties.





How can that be explained?

UZZI We have two opposing effects here. Firstly, weak ties bring us new and useful information. Secondly, we mainly help people we have something in common with. This can be something as simple as the fact of sharing the same birthday. The moderately weak ties are precisely at this sweet spot: these people have information that we don't yet have, but also have a little in common with us—so they are willing to help.

Is a professional social network really appropriate for analyzing this theory? For example, I'm not connected to my family and close friends on LinkedIn, so they don't count.

UZZI That may be, but that applies to most everyone using that network. A bigger problem with the study was that it didn't look at gender. Yet gender has a huge impact on the effect of weak ties, which I was able to show in a separate study.

Can you explain that?

UZZI First off, weak ties promote better job placement for both men and women. However, women need something else for this effect to take hold: strong ties to other women. A recent study that I conducted with colleagues shows this very clearly once again. We looked at the placement of university graduates, particularly in STEM fields. It showed that all other things being equal, women graduates only get the job if they also have strong ties to other women.

Why is that?

UZZI The reason for it is notorious discrimination. Women are asked different questions in job interviews, are treated differently than men. This makes them uncomfortable. It lowers their performance in the interview, which is then readily used to weed out women applicants. This finding builds on the original proposition of the strong/weak ties theory because it can be used very well to explain inequalities in career mobility.

To what extent are women helped by strong networks with other women?

UZZI Only there do women receive the necessary preparation for such interviews. They can be warned what type of questions are coming. They can be helped to prepare because other women have had similar

“The most interesting aspect of it is certainly that the weak ties are more important for a person's success than the strong ones.”

experiences. But this is the type of personal experience that we're more likely to share with closer friends. This isn't something you'd get from weak ties.

And men don't need this?

UZZI No, men don't need this type of double network for their career paths.

So women need a network of weak ties and another of strong ties to other women. How do you set up a good network in the first place?

UZZI Setting up a network of weak ties is difficult mainly because it goes against our instincts. Friends of friends often become friends of our own. We want that psychologically, that is how we feel comfortable. But this creates a sort of echo chamber of connections, echoing the same information over and over. The benefit for our own careers here is correspondingly minimal.

Can social networks help combat this effect?

UZZI They basically reinforce it. Social networks push us into echo chambers because of their famous algorithms. On the other hand, they also make it easier to meet new people. This is the crucial point for creating new weak ties: you have to continually renew your own network, especially when you're having success. That's because success can become a trap. When two authors co-write a book together and it becomes a bestseller, the likelihood that they will collaborate again increases exponentially. The likelihood that the success repeats itself, however, does not.

“Kill your darlings,” is that the idea?

UZZI You should continually be looking to include many different perspectives in your own network. Let's say you were working in finance. In that case, it would certainly be good for you to know people in as many banks as possible: one at Goldman, one at Deutsche Bank and so on. You should pay attention to that. Then you should also look for contacts in other industries. Why not someone from the tech sector?



PHOTOS: Getty Images/brightstars (lead image); Unsplash/Mike Kononov (buildings); private (portrait)

But how do women get a network of strong ties to other women? After all, traditional networking events are more likely to produce weak ties.

UZZI That's right. If you're part of a women's network, you initially create a lot of weak ties. These then help you to get to know the market. But your acquaintances from these networks don't tell you how to act as a woman. Translating these weak ties into strong ties requires work. You need to create some sort of shared experience.

So invite people to lunch?

UZZI No, that's not enough. It has to be something where you reveal something about yourself and your personality. The effects of running groups have been well researched. Someone who joins one is more likely to create strong ties with the other members. The effect is enhanced if you're working towards a common goal, like a race for example. This effect isn't just observed in a professional context, it's similar with families. If you visit your parents and cook a meal together, it has a greater effect than just sitting on the couch watching television.

Can too many weak ties also become a problem?

UZZI In fact, at some point, accumulating more and more weak ties stops doing any good. Someone who has fifty weak ties to others is no more successful

than someone with ten. And weak ties don't motivate people to change job positions, either. After all, you don't speak with these types of people every day, just every so often. So you aren't getting market information every day that might make you nervous. I see the weakness of social network analysis more in the fact that it focuses predominantly on how networks influence success. Failure, in turn, hardly plays any role at all. Not every job interview I get thanks to my weak ties is successful. But previous research suggests that it's the strong ties that sustain you through various unsuccessful attempts. So weak ties are far from a panacea for career planning.

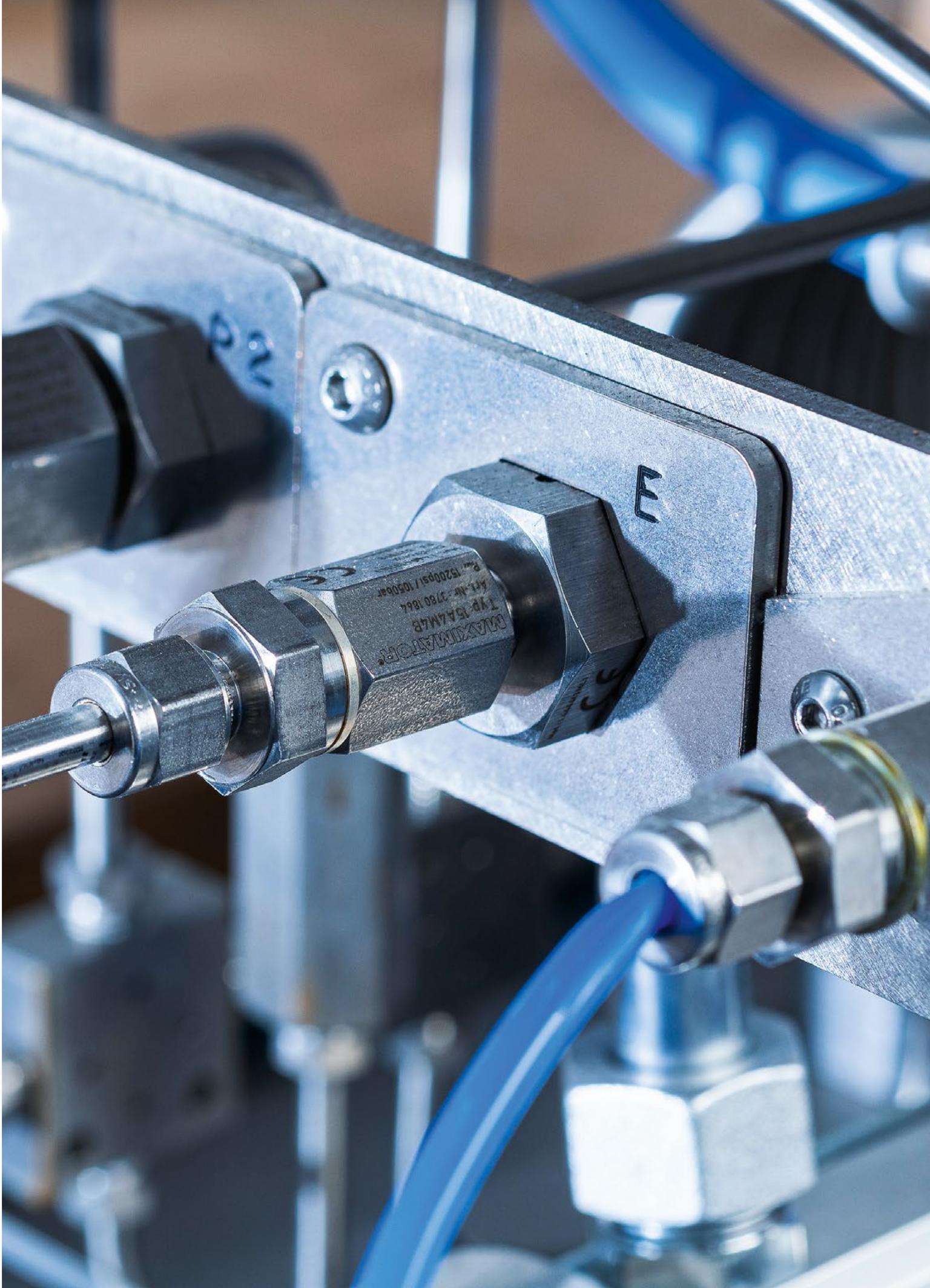


— *Personalia*

Brian Uzzi is the Richard L. Thomas Professor of Leadership at the Kellogg School of Management at Northwestern University. He also co-directs the Northwestern Institute on Complex Systems. In addition to teaching, he has advised a wide variety of companies and organizations, including McKinsey, PWC, Google, Microsoft and the World Bank. He holds an MS in social psychology from Carnegie-Mellon University and a Ph.D. in sociology from SUNY Stony Brook.







MAXIMATOR®
119-1544MB
Art.-Nr. 3780 1864
Pmax. 15200psi / 1050bar

EF

CC

— *Inside View*

“The future belongs to **HYDROGEN**”

Working on a truly innovative topic is a dream for every engineer. In our laboratory, near Munich, we're testing whether materials and components are suitable for use with hydrogen—chemically speaking, H₂. In this way my team and I are actively working on advancing the energy transition.

Hydrogen as an energy source has been a big topic in many fields for years now—not just since the current energy crisis. Especially in the area of mobility, there will be a lot of useful areas of application in the coming years. That's because whenever very long distances must be covered or very high performance and availability are required, hydrogen will soon replace diesel fuel and the rest. Trucks, buses, construction equipment and garbage trucks powered with hydrogen, even hydrogen-powered locomotives, will soon play a role in our mobility. Industrial companies are also desperately seeking alternatives to fossil energy sources such as natural gas and oil.

What many people don't know is that hydrogen has very specific properties. Every material and every component that comes into contact with it—from a vent to a complete pipeline—must therefore be specially adapted. For instance, hydrogen can cause certain materials to become brittle, which means



DETAILED WORK Each component test is an individual case. TÜV SÜD also simulates years of wear and tear.

that a pipe could break after a certain amount of time. Gaskets and seals can also develop problems with hydrogen. That's why existing pipelines, such as those through which natural gas is transported, cannot easily be converted for use with H₂.

Right now, there's a very intensive search for new hydrogen-compatible materials, also in order to replace current expensive solutions. Stainless steel, for example, is well suited as a material. However, there are always supply issues with certain alloy elements, so alternatives are needed.

For many smaller and medium-sized manufacturers that are currently developing solutions, we're their first point of contact. We test their innovations to find out whether they're suitable for the respective area of application. First we look to see if there is already a standard that we can apply for that particular situation. This is very often the case, especially in the automotive sector.

Otherwise, each component test is a one-off case. We really have to take a close look at the specific application the part is intended for. How high will the pressure be, what temperatures will it be exposed to, how long will it be in use? Then, to simulate embrittlement and aging effects in the lab, we are using our methods to subject the materials and components to wear and tear that would normally take years.

I'm certain that the future belongs to hydrogen. The only factor inhibiting its breakthrough is its availability—but that will be changing massively in the coming years.

— **MARTIN SEKURA** heads TÜV SÜD's Hydrogen and Fuel Services Business Development department and is responsible for the company's hydrogen testing lab.



The Europ



e a n D r e a m



TEXT JULIUS FIEDLER **PHOTOS** ILKAY KARAKURT ——— Transporting goods throughout Europe by rail is fast, dependable and environmentally friendly. Yet different standards and gaps in the network still hamper cross-border rail traffic. This is about to change.

North of Basel, Switzerland locomotive driver Markus Palm has to bring his train to a stop. The locomotive—painted red, 19 meters long, weighing 84 tons and with 7,600 horsepower—has come to a halt on this rainy Thursday afternoon because the signal next to the tracks close to the German-Swiss border is showing red. The locomotive of the RheinCargo freight company is pulling twenty tank cars holding mineral oil. Tonight, they must first reach a large corporation’s tank farm and then go to a chemical company, where their contents are urgently required.

Yet Palm is just sitting here, and it’s not the first time. “I know this spot,” Palm says. “You often have to wait for faster trains, like a high-speed Intercity Express, to pass by. I’m not going to call up the dispatcher and ask what’s going on or when I can move on.” He just waits. After another ten minutes have passed, though, he does begin to wonder, taps the button next to the train radio display to reach the local signal tower, and grabs the black telephone receiver. And in fact, Palm has to let a passenger train pass before he can get out of the station area and back on his way. Once it’s rushed past on the tracks next to him, he can once again push forward the small, black control lever that he’s had his left hand on, and set his train back into motion.

It was just twenty minutes. However, these twenty minutes are emblematic of where hiccups still remain in the European dream, where improvements need to be made in European rail transport—and why the EU is currently investing billions to make rail an environmentally friendly alternative for even more transport around Europe. According to the German Environmental Protection Agency, freight trains emit seven times less greenhouse gas per ton-kilometer than a truck. So far, so good. Except that the European rail network has a problem: although it is quite extensive, it is too underdeveloped in many places to handle all the freight and passenger trains. Every day this leads to stress and delays and prevents rail companies from fully exploiting this great potential. Yet it’s urgently needed. The EU wants to transfer heavy freight traffic from the roads to the rails to help meet numerous climate goals, doubling rail freight traffic by 2050 com-

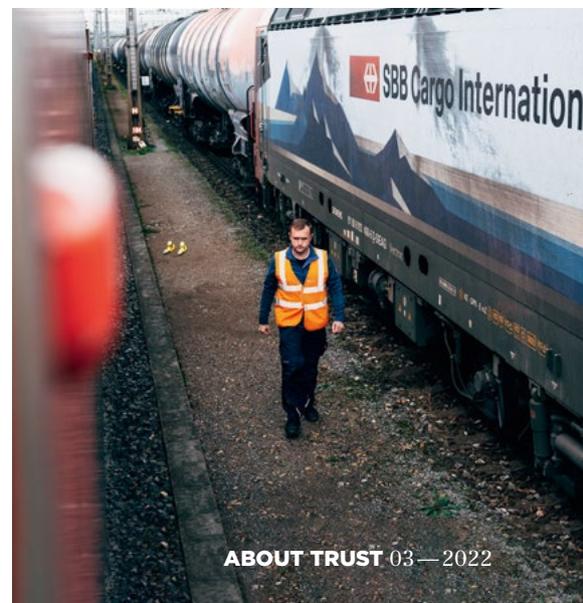


pared to the volume in 2015. Today, the amount of freight transported by rail in Europe is around 400 billion ton-kilometers, about 20 percent of the total. Across Europe, more trains need to be on the rail network, the trains need to be longer, and the rail infrastructure must be expanded. And the various different standards need to be brought into harmony.

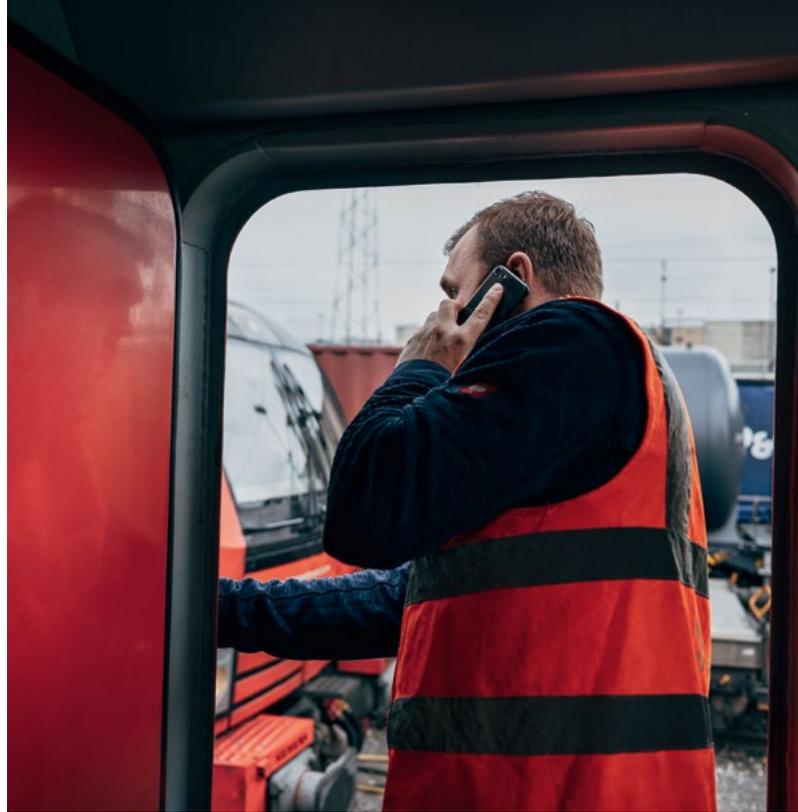
To accomplish this, the EU has developed the idea of a Trans-European transport network, or TEN-T, which includes high-speed and conventional rail. To this end, it is defining the infrastructure needed in Europe to optimally connect the continent for transport and trade. At the same time, it is setting up an incentive program for EU funding, the Connecting Europe Facility. If everything works out as Brussels has envisaged, the year 2050 could bring, for rail, a realization of the European dream: no borders, no barriers, one continent. 

PREPARING FOR DEPARTURE

Before a freight train can depart, locomotive drivers like Markus Palm must check everything again. Walking through the track bed is part of their daily work. If everything’s fine, Palm pushes the lever forward, and away they go.







COORDINATION REQUIRED

Freight trains must halt time and again, for instance to let high-speed trains pass. The fastest way for drivers to find out when their journey can continue is by telephone.

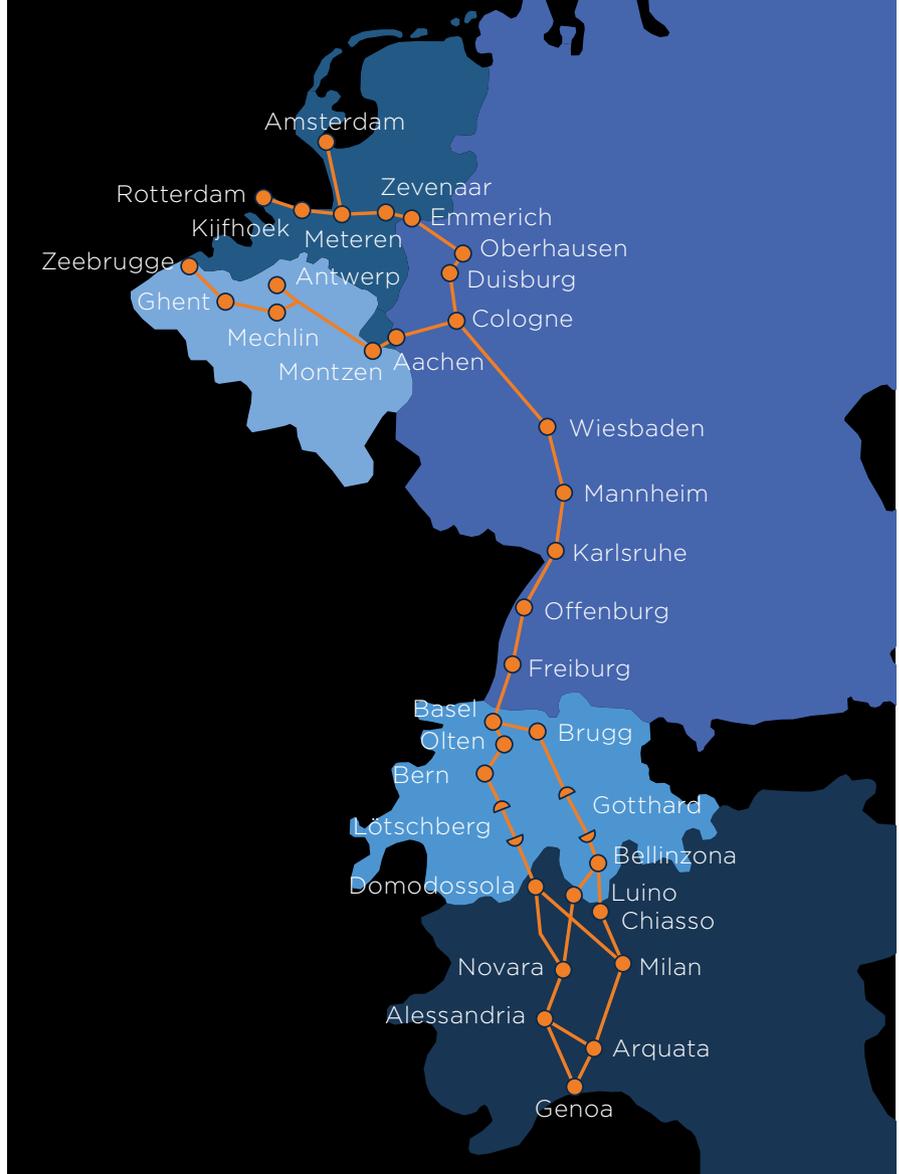
RAIL IS BEST

Locomotive driver Palm shows how important this cross-border traffic is. On this late summer's day, he's driving his train along one of the main arteries for rail freight traffic. The Rhein Valley railroad between Basel and Karlsruhe is part of the Rhine-Alps Corridor. It leads from the Dutch and Belgian port cities of Rotterdam, Antwerp and Bruges, through the industrialized belt along the Rhine, via Basel through Switzerland, and down to Genoa on the Italian Mediterranean. The goods arriving via ship at the big ports in Europe's west and south are then transferred to the railways and distributed throughout the continent.

Rail is the best choice, particularly for bulk goods such as timber, construction materials, ballast, chemicals and fuel. Of the some 5,000 freight trains that travel on the German rail network every day, around half of them cross at least one national border—all the while reducing greenhouse gas emissions compared to road haulage, for example. A freight train can replace up to 52 trucks—and thereby reduce the amount of carbon dioxide accordingly.

The EU has defined eleven freight corridors, or routes, that are particularly important for transporting goods across Europe—yet almost all of them suffer from gaps that need to be closed in order to build a rail network upon which European companies can safely and securely load and ship their products.

To best make this possible, it's essential to verify and inspect the components and also the infrastructure. One person who knows a lot about this is Gregor Supp from TÜV SÜD. "In our Rail Business Unit, we certify individual components such as rails, ties and even rail-fastening systems," Supp explains. "Furthermore, we also do inspections as a notified or designated authority." For this, there are international standards that must be complied with for the majority of applications. Supp and his eleven-member team carefully check whether the components being put on the rails comply with these standards. In second and third steps, they also scrutinize the theoretical specifications. For Supp, though, what's important is how this dovetails with things in practice: "We're naturally out on location a lot to validate every-



EUROPE'S MAIN ARTERY

The Rhine-Alps Corridor is one of the most important freight routes in Europe. It runs from Italy to the Netherlands and is currently being upgraded.

thing as it's actually being used," Supp says. "On the track bed, several of our experts are usually on the road for a few days and take a close look at everything." It starts with drainage conditions, includes the state of the gravel bed and ends with checking whether all the components have the required certifications. "It's important that we work accurately because the safety of the infrastructure depends on it," Supp says. Overall, there are more than 400 multidisciplinary experts at TÜV SÜD who verify, certify and inspect rail applications in every conceivable facet, right down to the safety systems and along every part of the life cycle.

ELIMINATING BOTTLENECKS

It's this sort of work that benefits people like Markus Palm. Out the right-side window of his locomotive, we've been passing areas leveled by bulldozers, with occasional construction vehicles and mountains of gravel here and there. The route Palm is taking is one of those bottlenecks where cross-border trips often get held up and the delays can sometimes stretch for hours. "But something is happening here, as you can clearly see of late," he says. South of the city of Müllheim, Germany, two new sets of tracks are being built next to the existing line. By 2035, the route between Basel and Karlsruhe will have a third and fourth track along its entire length, some of which will be able to handle high-speed traffic

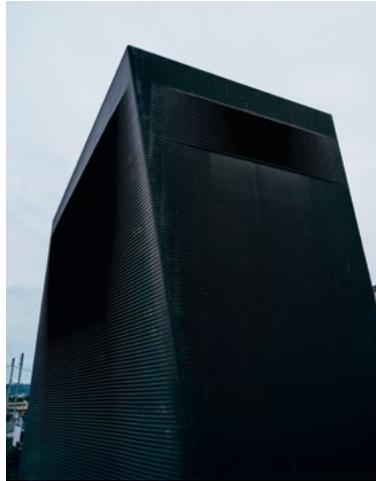
of up to 250 kilometers per hour. The slow freight trains and faster passenger trains will then be able to use different tracks. Freight customers will receive their deliveries more reliably and travelers will be able to reach their destinations more quickly. The EU is contributing up to 311 million euros to the TEN-T project for this section of the expansion.

UNIFORM STANDARDS

The purposeful expansion of railway infrastructure in Europe isn't the only thing the EU is aiming for with its initiatives. The network will also be harmonized to simplify cross-border journeys. This is particularly vital for freight traffic, due to its exceptional international importance. Until now, the railway networks of individual member states have been strongly nationally oriented, for instance in terms of gauge. In Spain and Portugal, the distance between the rails is 1.668 meters, making it considerably wider than the standard gauge of 1.435 meters used in the rest of Europe. Border-crossing trains must be "re-gauged," meaning transferred to train chassis with the appropriate gauge. There are also differences in the electrification systems; the voltage in the overhead lines that supply electric locomotives with power differ from country to country. Germany, for instance, uses 15 kilovolts, while in France it's 25. Train safety systems across the countries of Europe, which are of course essential for the security of train operations, are also largely incompatible. The safety systems can determine whether a train has stopped at a stop signal and, if it hasn't halted, can trigger emergency braking to prevent trains from colliding (as just one example). Germany uses the Indusi, LZB and PZB systems, while France uses Crocodile and the Netherlands ATB.

To deal with these different systems, rolling stock manufacturers and railroad equipment manufacturers have found sometimes complicated solutions. For passenger and freight trains, it may be that the locomotive gets swapped out at the border. There is also the possibility of equipping locomotives and multiple-unit railcars with different "country packages," although this, too, is complicated over the long run.

To better network these system bit by bit, the EU has introduced what is known



POSITION INDICATOR

Small box, big effects: the ETCS system makes it possible to better utilize routes—without sacrificing safety.

as the Technical Specifications for Interoperability, or TSI. Among other things this includes specifications for infrastructure, rolling stock, rail noise and accessibility. Yet it cannot eliminate all the differences. For instance, the TSI for energy describes four different electrical systems that exist side by side. Nonetheless, the regulations are intended to

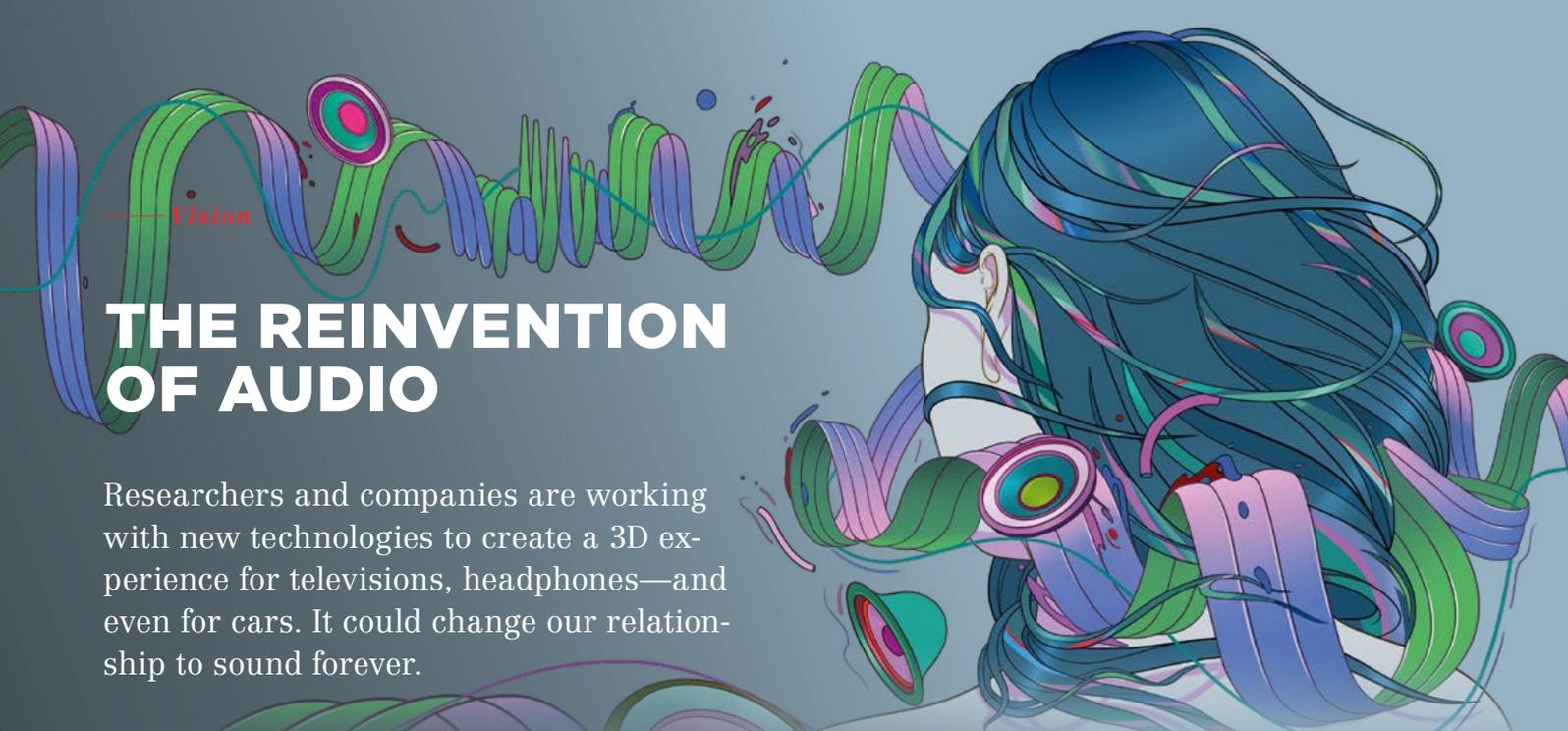
limit further national distinctions while still creating as much standardization as possible.

SAFETY TECHNOLOGY IS CRUCIAL

Palm is now driving his train at a leisurely pace, with no major traffic jams. During the journey along the section currently being expanded, every now and then he points out yellow boxes the size of shoe cartons, located in the middle of the tracks every few meters. "Those are Euro balises, part of the ETCS system that will come online when the upgrades to the line have been completed," he says. ETCS, the acronym for European Train Control System, is the biggest harmonization project on the European network. The different national train control and safety systems are going to be replaced by a European standard, with Switzerland also involved. The new system could allow up to 30 percent more capacity without one new meter of tracks being built—at least that's what the rail industry and politicians hope. This is to be achieved through better communication between the tracks and the vehicle. In conventional systems, the lines are divided into blocks upon which only one train at a time is allowed. While the block is occupied, no other train is allowed to enter it, even though there would be enough space for a second train. With ETCS transponders, the train is constantly transmitting its position and the trains will thus be able to follow each other at closer intervals than before. The EU hopes to implement this by 2050 as well.

To date, only around 20 percent of the 42,000 rail vehicles in Europe are equipped with this new standard. But by 2030, half of the vehicles on the important lines will have ETCS onboard units. One sticking point is the financing, which can cost a few hundred thousand euros. ETCS equipment is already mandatory for new railcars running on border-crossing lines, and the EU plans to create incentives for outfitting older vehicles.

Markus Palm's locomotive isn't yet equipped with ETCS, but will be. He's made relatively good progress today and will arrive in Frankfurt at around half past midnight. At that point, his shift ends. The next day, he'll board another freight train and drive it across the continent that is trying to become ever better interconnected.



THE REINVENTION OF AUDIO

Researchers and companies are working with new technologies to create a 3D experience for televisions, headphones—and even for cars. It could change our relationship to sound forever.

It can be found in every cinema, in front of every television and in every Dolby Surround system: the sweet spot. This is what scientists call the place in the room where the sound is at its best. The bass is gorgeously deep, the high and mid-range tones are perfectly adjusted, and the instruments are all coming from exactly the right direction they should be. But then something happens that can ruin the entire listening experience: we move. With this movement, the sound deteriorates until it seems that all the music is just coming from the speaker closest to us.

This is precisely the problem that scientists have been researching for decades, and they have found several solutions in their laboratories to achieve a better sound experience. The problem is that under real conditions, the use of modern technologies has usually been almost impossible; the setup was too complex, for instance in a home theater. Yet in the past several years, big tech companies and researchers, including some in Germany, have made great strides towards solutions and today can project concert experiences into your living room that always sound amazing—no matter where you sit. This opens up new application areas for home theaters, headphones and even beyond the entertainment sector, for instance when parking a car.

This revolution began several decades ago, when researchers started looking for alternatives to the stereo format. The problem with this format is the sweet spot, which occurs because sound engineers store sound waves digitally on a channel-by-channel basis when mixing music. The different channels are broadcast from different speakers, and where the wave fronts meet is where the sound has the perfect balance for the listener. To create the perfect results at home, listeners would have to have the exact same set up in their living rooms as the sound engineer had, which is nearly impossible. This problem can be solved by wave field synthesis, which says that it is possible to simulate sound sources in the middle of a space by superimposing artificial sound

waves from a large number of different sources such as loudspeakers. A clever algorithm calculates exactly where these waves meet and what sound they produce. The result: the tones of a violin always sound as if they are coming from the front right side, no matter where you're standing in the space, and the further you move away from it, the quieter it gets. "We have a paradigm shift here: we create object-based sound in such a way that it seems as if we're in the middle of the stage," says Head of Virtual Acoustics Christoph Sladeczek at the Fraunhofer Institute for Digital Media Technology.

This paradigm shift has triggered a revolution, albeit in fits and starts at the moment. A real wave field requires hundreds of loudspeakers, which isn't feasible outside of laboratories. In recent years, however, scientists have managed to create a virtual wave field by using algorithms and existing speakers to create an experience much like an actual wave field synthesis. In large venues such as the Zurich Opera House, audiences can now listen to concerts as if they were sitting directly onstage.

People are also sensing these changes on a much smaller scale. Since increasing numbers of music pieces, films and television series are now being recorded in an object-based way, it is now worthwhile for companies to jump on this bandwagon and promise listeners a 3D aural experience. Dozens of startups and large tech companies are working on this and a number of products have already hit the market. For instance, Apple is using these recordings for its Spatial Sound. When this setting is turned on in headphones, the source of a sound always seems to remain in the same place. As the listener slowly turns, it first sounds as if the violin is coming from the front right, then from next to them, and then from behind them. Headphones don't use wavefield synthesis to achieve this, but binaural synthesis. This is based on the idea that our ears can assign directions to certain sound frequencies. When a set of headphones imitates this sound, it sounds to us as if an object is either in front of, next to, or behind us. As Sladeczek says, "What we're looking at is a completely new way to experience music and audio."

Sladeczek also believes there are many potential fields of application well beyond just the entertainment industry. For instance, cars are being equipped with increasing numbers of speakers to help the acoustics channel play a more important role in a vehicle that is already flooded with visual inputs. In the future, the 3D experience could assist with parking. Instead of just beeping when a car is backing up towards an obstacle, a much more sophisticated system could show people how the relation of the object to the car changes depending on how they turn the steering wheel or step on the brake. "It would change a lot of things," Sladeczek says.

INFRASTRUCTURE

TEXT NILS WISCHMEYER **ILLUSTRATION** ANDREA MANZATI ——— Regional and renewable: the energy transformation doesn't just mean saying farewell to fossil fuels, but is also leading to more decentralized energy supplies. To ensure that the grid remains stable, electricity infrastructure needs to get smart. We explain how these smart networks work.

FROM CENTRALIZED TO DECENTRALIZED

Our power grids are centrally structured. Up until now, a few large power plants with a stable base load have been feeding electricity into the grids, through which energy is often transported to distant consumers. Photovoltaic systems and wind turbines are changing this structure. Electricity production is now susceptible to greater fluctuation because sun and wind power vary with the weather—and it's becoming more decentralized because former consumers are now increasingly also producers in this network.

REMOTE CONTROL

Energy suppliers and network operators are responding to the challenge by combining smaller photovoltaic and wind power plants to form larger virtual power stations. This will help mitigate periods of both overproduction and underproduction.



THE NETWORK: DRIVEN BY DATA

Thanks to algorithms and electronics, the centrally located computing center can now observe real-time changes in the demand for power and the feed-in on the network, and can switch the latter on or off precisely to the minute as needed. This is known as a smart grid.

RE made smart



BASE LOAD: VIA SWITCH

The base load is the minimum demand for power on the network that must always be met. To ensure that sufficient power remains to meet this base load in the event of fluctuating feed-in from wind turbines, for example, a smart grid depends on biomass, hydropower and, for the transition period, additionally on conventional power plants and batteries. An algorithm recognizes this and switches them on when too much volatility is measured.

FOR HOUSEHOLDS: THE SMART METER

In homes and apartments, the change is most clearly seen in smart meters, which for example make remote meter reading possible. Users can then schedule certain tasks for lower-price hours, when electricity consumption is lower overall. This can include charging an electric car late at night instead of during the day, for instance. Along with their roles as consumers and producers, households can also store electricity in larger-scale battery systems.



OVER-THE-AIR Overhaul

TEXT FELIX ENZIAN — Just like magic: vehicles today can be equipped with new functions via over-the-air software updates, making visits to a mechanic or a dealership a thing of the past. However, before car manufacturers can fully exploit the future potential of these technologies, safety issues must first be resolved and suitable approval procedures established.

A construction transporter is driving through unpaved terrain. So that the truck can handle the territory, the fleet manager books more engine power: very easily, with just the click of a mouse. When the job is done, he sets the engine back to its original factory settings—once back on regular roads, the engine has enough standard horsepower, which also uses less fuel on the normal routes. Functions that can be turned on and off as needed are also popular in regular passenger cars. For example, on a trip to the mountains for skiing in the family SUV, the all-wheel drive or seat heaters can be activated. Or a commuter upgrades her car with an autopilot function, taking off the strain of driving during rush hour. Updates transmitted to the vehicle over the air (OTA)—via the internet or a cellular connection—could make this possible, and these types of scenarios could become reality in just a few years.

“Over-the-air updates represent a true revolution for the automotive industry,” says Steffen Rilling, an automotive expert at the management consulting firm Oliver Wyman. Enormous benefits are expected for both manufacturers and drivers alike. For instance, vehicles wouldn’t have to be brought to the mechanic any longer to repair digital components. The owners aren’t the only ones who would save time and trouble. Expensive recalls for

entire model series would become unnecessary if faults could be rectified after the fact via OTA updates. In addition, vehicles could be “rejuvenated” with new functions over their entire operating life, something smartphone and computer users have

“Over-the-air updates represent a true revolution for the automotive industry.”

STEFFEN RILLING, AUTOMOTIVE EXPERT
AT THE MANAGEMENT CONSULTING
OLIVER WYMAN

long been accustomed to. Even older used cars could be upgraded with new functions so long as the manufacturer maintains the model with updates.

NEW THINKING

But is it really that easy to improve a vehicle with the click of a mouse? The most basic components—including the battery, engine, drivetrain, brakes and steering—can only be changed via software to the extent that the installed hardware allows. “To fully exploit this technology, vehicle models will have to be designed differently in the future than they have been in the past,” Rilling says. “In the past, vehicle manufacturers defined the performance re-

quirements for a model and then looked to see which components they could use to implement these requirements as cost-effectively as possible. In the future, many car models will get higher-quality and more powerful hardware installed at the factory, even if this initially may not be utilized to its fullest extent. This way manufacturers are keeping the options for extensive updates open. This is a new way of thinking.” Economic considerations play an important role in this. The automotive industry is targeting digital business models, such as those familiar today from video streaming or software offerings: in the future, vehicle users will buy certain functions either through subscriptions or on demand. The industry hopes this will generate billions of euros in continuous revenues to supplement the already very lucrative after-sales business.

Over-the-air updates are already an everyday thing, particularly for electric vehicles and premium cars. Volkswagen recently used this method to equip its own ID series and electric models from its Audi, Skoda and Cupra subsidiaries with new Software 3.0, which enabled more charging power and a greater range for the battery, an improved voice control feature, and new graphics and indicators on the displays, among other things. For the Mercedes-Benz A class, an OTA update added some minor conveniences to the





cockpit, including music streaming via Tidal and Amazon Music. Hyundai also provides its electric Ioniq 5 with maps and infotainment updates over the air, for example.

So far, such improvements have mainly been limited to purely digital applications. The reasons for this aren't just technical. In Europe, the UNECE R156 regulation requires manufacturers to implement and certify a management system for software updates to obtain type approval. However, the increasing complexity of the software driving functions and the need for higher-frequency data processing are creating new challenges, making it necessary to revise existing processes for type approval and safety verification of vehicles. At TÜV SÜD, Christian Pahlke, Head of Future Vehicle Technologies in Germany, is researching new solutions to use virtual simulation methods to support the validation of safety-relevant OTA software updates. His goal is to establish legally recognized procedures for virtual homologation—the granting of approval by an official authority. This will also be of great importance for autonomous driving in the future. “With traditional processes, it would be challenging to realize homologation for autonomous vehicles at SAE Level 4 in an efficient and ongoing manner,” he says.

HOMOLOGATION FOR SOFTWARE UPDATES

Before a new vehicle model receives type approval and can be put out on the market in Europe, the manufacturer must have completed millions of test kilometers. This is the only way it can document that the vehicle is safe to drive in a wide variety of road and environmental conditions in almost every conceivable traffic scenario. Then, before the model can be officially approved,



SAFE INTO THE FUTURE

Updates are playing an increasingly important role for cars. Christian Pahlke, Head of Future Vehicle Technologies at TÜV SÜD is working on suitable approval and testing procedures for vehicle software.

an expert opinion from technical service providers such as TÜV SÜD is also required. “This process also applies for safety-relevant OTA software updates,” Pahlke says. “But while new vehicle models are only introduced to the market and have to be homologated every three to six years, OTA updates are expected at a frequency of every few weeks or months in the future. That’s why we need a new, accepted and recognized homologation approach for validating safety-relevant OTA software updates between manufacturers, technical service providers and regulatory authorities. These procedures must be both as fast and as dependable as possible.”

This is exactly what TÜV SÜD is researching right now. “The homologation process itself will remain, however some process stages are to be automated or digitized,” Pahlke says. While some tests must still be physically carried out, he notes: “The bulk of the safety-relevant software updates could be simulated and tested. Aside from leading to quicker and more efficient findings, this also makes it possible to check the enormous variance and complexity.” Furthermore, the main vehicle inspection will also need to be updated and expanded to include test criteria that do justice to the digital inner workings of current and future vehicles.

COMPUTER ON WHEELS

Establishing suitable testing and approval procedures is just one of the major hurdles on the path to a constantly updatable vehicle. There are also major technical problems that manufacturers must solve in vehicle architectures. Electronic controls and digital functions in vehicles have been on the rise since the 1990s, but the overall process has been somewhat haphazard. “There are an estimated 100 million lines of software code in a vehicle today,” automotive expert Rilling explains. “However, they are distributed among about a hundred different control units. This enormous complexity makes it very difficult to efficiently update multiple functions at the same time with a single update. Manufacturers will only be able to get a handle on this through a centralized system. Like smartphones, vehicles need an overarching operating system to which all the other software application can dock.”

Some automakers purchase these technologies from partners, for instance the Android system from Google, which now has a version especially for vehicles. Other manufacturers, such as Volkswagen,

PHOTOS: Lara Freiburger (portrait); Getty Images/Artur Debat (car)

BMW and Mercedes-Benz, make the effort to develop their own operating systems. “This has the advantage for them that they can supply this important interface to the customer themselves and integrate it into their own value chain,” Rilling says. “Carmakers today are faced with the challenge of also having to become software companies. Their future viability depends on it. For them, this transformation is even more far-reaching than the switch from traditional combustion engines to the new alternatives.”

A great deal is expected of the car of the future. It should be able to drive itself, recognize and avoid dangers, and always be up to date in terms of functionality and safety via over-the-air software updates. The feature that could make all of this possible is called connectivity.

“Without an effective approach to virtual homologation of software updates, it will be very difficult to implement future vehicle innovations.”

CHRISTIAN PAHLKE, HEAD OF FUTURE VEHICLE TECHNOLOGIES AT TÜV SÜD

The vehicle’s connection to its environment via sensors, mobile communications and the internet is a prerequisite for highly automated driving and for the OTA updates. “Connectivity is both an opportunity and a threat because it is also a safety risk for vehicles,” TÜV SÜD’s Christian Pahlke says. “Even comparatively non-critical systems such as infotainment can be a gateway through which cyberthugs could hack a vehicle’s safety-relevant functionality.” To ensure the safety of vehicles in the future, the TÜV SÜD expert is currently focusing on the development of automated and digital process steps for homologating vehicle software. “Due to the topic’s complexity, we can only take a step-by-step approach to developing the right solutions.”



EVERYTHING IN FLOW

Cars will change over their service lifespan because their range of functions can be updated via new software.



PHOTOS: Lisa Edl

— *Picture This*

In English they say you can't compare apples and oranges; in other languages it's apples and pears. Austrian photographer Lisa Edi has done it anyway—and creates a seemingly perfect unity of those fruits in her picture. She is by no means alone in her idea of combining apples and pears. Back in the 1980s, an apple-pear hybrid was developed at the Max Planck Institute for

Plant Breeding Research in Cologne, Germany. However, the new fruit variety wasn't terribly fruitful. But with seeds from this first experiment, scientists at Osnabrück University of Applied Sciences were able to resume research on this "papple" in 2015. Aside from apparently having better flavor, the hybrid may also be more resistant to diseases and pests. This is a clear advantage for sustainable cultivation since fewer pesticides will need to be applied. Consumers will

still have to be patient before they can get a taste of this apple-pear hybrid, since it could take another ten years before the new fruit variety is actually ready for the market. Until then, Edi's still life is probably the closest we'll get to imagining it. In her photo series *Beyond Category*, she turns a whole range of everyday concepts on their head by creating curious combinations—for instance of knitting needles with strings of gummy candy instead of yarn.



Can **TREES** in a
forest **COMMUNICATE**
with each other?



Trees are interconnected via vast underground systems. Read more online: ABOUTTRUST.TUVSUD.COM