Issue Nr. 5

Mindshift

Impulses for change – TUM Campus Heilbronn

Puzzle piece

On the way to Heilbronn 3.0

Page 4

Podiums

Focus on global supply chains

Page 13

Privacy

Can we turn back the targeting wheel?

Page 6

Personalization

An interview about the shopping behavior of the future

Page 32

TUM Campus Heilbronn of the Technical University of Munich

Contents

Issue Nr. 5

4 **Vision | Cover story**
The Dieter Schwarz Foundation extends its commitment to the expansion of TUM Campus Heilbronn

6 **From research**
Three exciting topics, one common denominator: highest relevance

13 **Linked to the world**
TUM Campus Heilbronn becomes a center for international cooperation and exchange

17 **TUM in the region**
Solutions that are scientifically proven and entrepreneurially viable

25 **The transparent university**
In focus: the leaders of tomorrow

30 **Short notes**
More facts about TUM Campus Heilbronn

32 **Interview**
Prof. Martin Meißner talks about the supermarket of the future

35 **Imprint**

Dear Readers,

The publication of our fifth Mindshift issue could hardly have come at a better time. With the pandemic state of emergency behind us, we now look with pride at TUM Campus Heilbronn, which in the winter semester 2022/2023 has become, more than ever, a place of encounter, exchange, and innovation.

At the same time, we are looking ahead – to the future of TUM Campus Heilbronn, to which we dedicate our cover topic. With the new endowment agreement of the Dieter Schwarz Foundation, we are not only gaining the *TUM Heilbronn Data Science Center* as an elementary puzzle piece and innovation driver. The endowment agreement also includes 10 additional professorships for the campus and funding for top international researchers. In this way, we not only achieve a high pace of project development, but also, in the future, we will have the necessary funds to delve into topics and areas that have hardly been researched yet.

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The topic of artificial intelligence in particular concerns us not only now, but also in the future.

In this way, the Dieter Schwarz Foundation is honoring the development steps we have taken so far with regard to the establishment of the university in the region. Scientific impulses from Heilbronn are now being heard all over the world – thanks to the outstanding work of our professors. Some of them get their well-deserved stage in the current Mindshift. And reading it, it becomes clear that the topic of artificial intelligence in particular is something that concerns us not only now, but also in the future.

And the same regarding our collaborations with top international universities such as HEC Paris, Hebrew University, Oxford University, or the regional cooperation with Cork County. They pay off in identifying common themes, leveraging key technologies, and learning from each other. Read more about this in the current issue of Mindshift.

Networking is not only taking place in the area of research, however. Collaboration between TUM in Heilbronn and business representatives from the Heilbronn-Franconia region is also gaining momentum. Discourse formats such as *TUM Talk* or *TUM Connect* make this just as clear as our involvement in the Alliance for Transformation and the Innovation Park AI (IPAI).

I wish you an inspiring read!

Prof. Helmut Krcmar
Founding dean (2018-2020) and representative of the president
for TUM Campus Heilbronn

From left to right: Prof. Helmut Krcmar, Prof. Thomas F. Hofmann, Prof. Reinhold Geilsdörfer, Silke Lohmiller, and Prof. Peter Frankenberg announce the extension of the foundation contract.

The next big piece of the puzzle

The Dieter Schwarz Foundation expands its commitment to the further development of the educational campus – and thus initiates the next phase on the path toward Heilbronn 3.0

Reflecting on the development of TUM Campus Heilbronn, the idea of a jigsaw puzzle is an apt metaphor: piece by piece, a visionary picture has been coming together since the opening four years ago. In the fall of 2022, those responsible for this development now unveiled another centerpiece that links many things and makes even more possible.

"The new endowment agreement for the further expansion of TUM in Heilbronn fits seamlessly into our plan to establish a powerhouse here for shaping the digital transfor-mation," says Prof. Helmut Krcmar, founding dean (2018-2020) and representative of the president for TUM Campus Heilbronn. The Dieter Schwarz Foundation intends to finance 10 additional professorships with a minimum term of 30 years for the academic center on the Neckar River – and thus primarily advance the fields of data science and artificial intelligence. The necessary equipment and infrastructure are part of the funding. In accordance with the TUM Fundraising Code of Conduct, there are no conditions attached.

An education location for the digital age

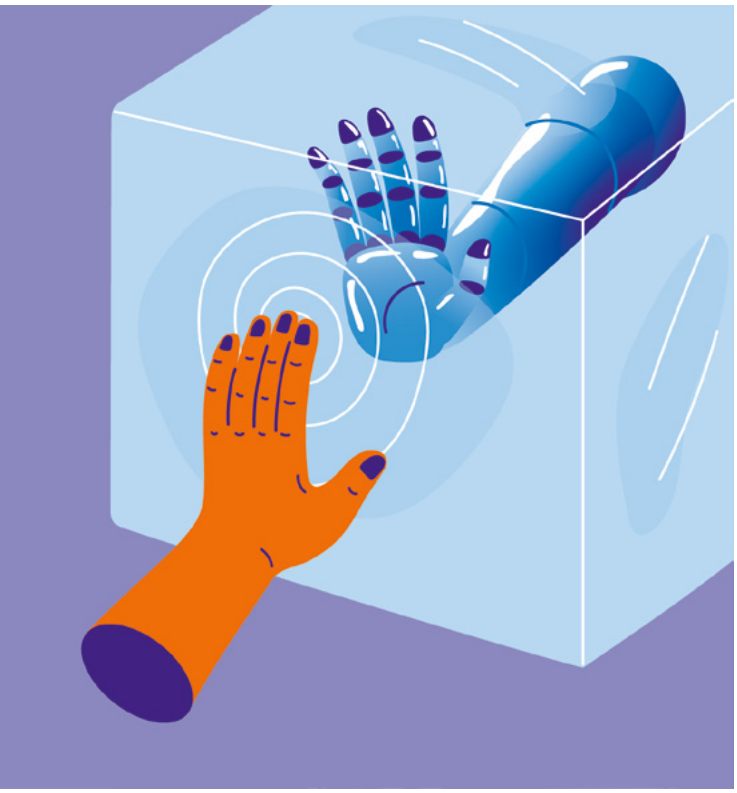
"For the Digital Age" is the motto of the initiative. Inspired by the construction of the AI Innovation Park Heilbronn – a lighthouse project worth millions – the *TUM Heilbronn Data Science Center* is now being built on the educational campus. The previous pillars of TUM in Heilbronn – digital transformation, family businesses and information engineering – are thus supplemented by a fourth, which fits perfectly into the academic profile and mission of the educational campus: to teach interdisciplinary skills at the

interface of management, technology, and computer science. At the same time, this fourth pillar reflects the Dieter Schwarz Foundation's goal of creating real added value for the region's economy. Prof. Reinhold Geilsdörfer, man-aging director of the foundation, confirmed this: "Our aim is to accompany the digital transformation in the region, to support transformation processes, and to promote the young talent required for this. The past has shown how well this works in cooperation with TUM."

During the press conference, TUM President Prof. Thomas F. Hofmann expressed similar satisfaction regarding the partnership with the foundation: "Its civic responsibility and its smart structural-policy approach to the development of the Heilbronn economic region are an excellent match for our own striving for quality." He added that the university had found an ideal partner in the Dieter Schwarz Foundation – for the training of future-oriented talent and for the successful design of market-oriented innovation processes, as well as in the area of research.

Research with international appeal

If you want to set global standards as a university location, you have to convince people with research at the cutting edge. TUM and the foundation agree on this, too. That is why the new contract provides a fresh impetus for science on campus – with a focus on long-term excellence and international appeal: the *Dieter Schwarz Fellowship* is intended to bring excellent professors from all over the world to Heilbronn and, as fellows of the world-renowned *TUM Institute for Advanced Study*, build a bridge to the Garching Campus. The *Dieter Schwarz Courageous Research Grant* will also be established to promote courageous project ideas. In global competition, top international talents will thus be given the opportunity to tackle promising "High Risk – High Gain" research projects on the topic of digitalization and sustainability in collaboration with TUM. Prof. Helmut Krcmar sees this as a central building block of campus development: "This signals that our focus is on the global impact of our research and that we are inter-ested in using data science for the really big issues."



Our vision 'Heilbronn 3.0' is moving a great deal closer with the new foundation contract.

Prof. Thomas F. Hofmann – President of the Technical University of Munich

The renewed expansion of TUM Campus Heilbronn is intended, among other things, to prepare the future for the topic of "digital twins." This is because the mapping of real objects and contexts through high-resolution simulations is considered one of the key technologies of digitalization. At the chair of Prof. David Wuttke, research is being conducted into ways of using algorithms and machines to model optimization processes. If the math works out, it will be possible to rethink supply chains or entire supply systems in cities, for example. The newly founded *TUM Heilbronn Data Science Center* is to become a central point of contact for such experiments in the future. ●

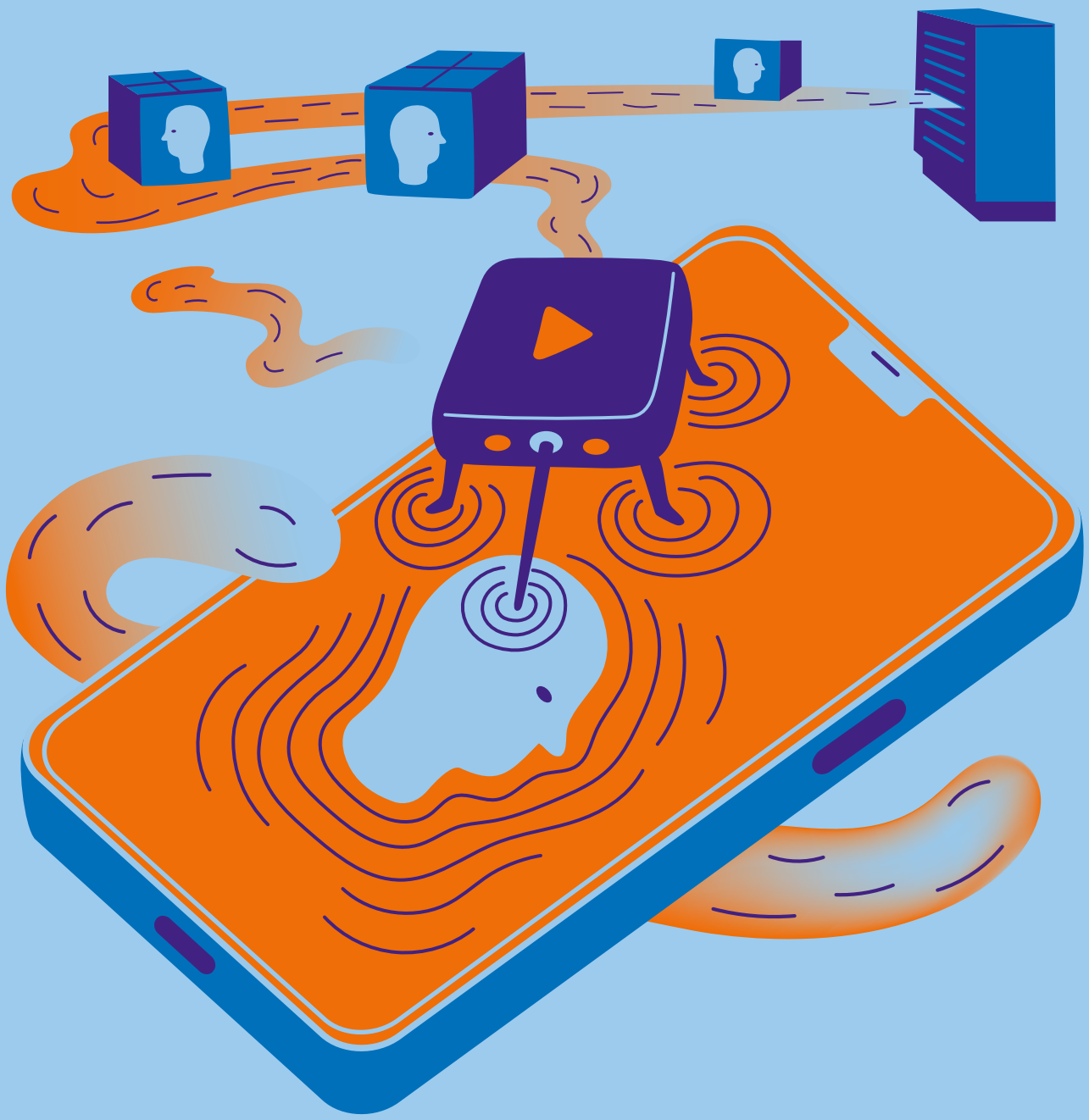
An overview of the expansion of TUM Campus Heilbronn:

Ten new endowed professorships

Establishment of the cross-faculty TUM Heilbronn Data Science Center

Dieter Schwarz Fellowship (international visiting professorships)

Dieter Schwarz Courageous Research Grant (research funding)



Can we turn back the targeting wheel?

The majority of all apps are financed by advertising – drawing on personal data. The implications for consumer and data protection are serious. A new TUM study shows what a change would mean for the market

"The train has long since left the station." Whenever we think we no longer have a handle on a trend, this metaphor comes up. The topic of advertising seems to fit in perfectly here. Whether it's on websites, social media, or apps we use every day: everywhere, providers are fighting for our attention. And the battle is hard-fought. Because gone are the days when the same internet advertising reached nearly everyone – regardless of their preferences, life realities, and consumer behavior. Today, pretty much every bit of ad content is directly related to what we're interested in. Behind this are not the clairvoyant abilities of cunning marketeers, but a pretty clever piece of technology – so-called trackers.

These trackers – which go unnoticed, much like bugs or tracking devices – attach themselves to the browsers and apps of our end devices and thus get to know us better every day. A person who has just read online reviews of the Red Hot Chili Peppers' new album can be served targeted advertising by the record company Warner Brothers Records with the help of trackers. And that's just the beginning. App developers have perfected targeting and are taking the conflict between free consumption and privacy to the extreme.

Paying with your own data

For smartphone apps that at first glance cost nothing or next to nothing, there are basically three means of earning

Jens Förderer holds the professorship for innovation and digitalization at the Heilbronn Campus.

money: number one is classic ads in the app itself. Then there are in-app purchases, which are often used in games. Users are lured by appealing branding, graphics, and gameplay concepts, but quickly discover that the game in question is fun primarily when content is purchased. By the way, slot machines work in a very similar way: the addictive potential lies largely in the belief that the more you bet, the more you win – and the more fun you have playing the game.

The third and now probably most popular monetization option is targeting. Here, too, users do not pay with money. Instead, their own personal data serves as a ticket. In step one, the app obtains consent to view and evaluate surfing behavior, location, photos, or messages. Advertisers and advertising networks then pay to be allowed to use the resulting data pools. This allows conclusions to be drawn about user interests and advertising to be played to people who are most likely to be interested. Sounds like a fair deal at first. Doesn't it?

An advertising world without targeting

"Targeting is quite controversial," says Prof. Jens Förderer from the Chair of Innovation and Digitalization at TUM Campus Heilbronn. "What looks like a win-win situation at first glance basically encroaches deeply on people's privacy. That's because the data collected is not infrequently sold to advertising networks, which use it to create person-al profiles." We are talking about virtual profiles that include age, gender, place of residence, interests, and much more. Many about whom such information is available know nothing about it – and have no control over where their data ends up.

Doctoral student Tobias Kircher conducts research at TUM Campus Heilbronn on the topic of ad targeting.

Consumer protection initiatives and political actors are therefore increasingly pushing for a legal ban on targeting. But what would happen then? Together with his doctoral student Tobias Kircher, Prof. Förderer has addressed this question and examined the consequences in a study: what impact would a ban have on app development?

To paint as accurate a picture as possible, the Heilbronn research team opted for a comprehensive quantitative study using data from the Android app platform. In 2019, Google had banned personalized advertising in children's games, but not in other apps. To forecast the consequences of regulating the entire market, the duo examined data from children's game providers and compared it with apps that were not affected. They recorded which apps were discontinued, how many updates a provider released, and whether the provider made any price changes.

Drastic drop in apps and new developments

The result: "After the targeting ban, the industry saw a massive app die-off," says Kircher. "We estimate that more than 3,000 offerings were discontinued within a year." Reg-ulation also had a significant impact on developments, with a 17 percent drop in updates. Young providers were particularly affected. But not exclusively. "We had expected a decline in app development," Kircher points out. "But the fact that popular apps were also affected then surprised us."

Based on the study results, the conflict between data protection, supply, and user behavior in the app market becomes clear. Revenue from personalized advertising is essential for the development of smartphone apps. Users must be aware that a ban on targeting massively restricts app diversity. At the same time, provider companies face the challenge of making their business models less dependent on advertising revenues. If a ban does indeed come about, we are likely to see a new market. The number and quality of offerings would change. And possibly also how we pay for smartphone apps. For the good of our privacy. ●

When AI responds to reward

Deep reinforcement learning is one of the most exciting research topics in the field of artificial intelligence. The technology could offer great benefits for companies in the future

Modern household appliances make our everyday lives much easier. And when something is wrong, they even communicate with us. Cryptic error codes usually provide an initial indication of where the technical problem might lie. In some cases, a search query on Google helps, and the error can be fixed by hand. But there are also those where customer service has to come in to get to the bottom of the cause.

Let's take a look at the repair service provider's specialist in charge. When planning her workday, she asks herself two questions: what spare parts do I pack? And which route do I take to process as many orders as possible? The challenge: both factors are mutually dependent. Because of the error codes or the large variance in possible causes, there is a risk that the predicted number of spare parts will not be sufficient. If this is the case, an unscheduled visit to the workshop has to be undertaken, or another on-site appointment has to be scheduled. As a result, not only is the patience of everyone involved strained – the profitability of the company also suffers.

As of today, there is no solution to this problem – and certainly no efficient algorithm. Instead, the responsible employees fall back on their professional experience. But humans cannot, of course, take all variables into account in their planning. So the question arises: How can such decision-making processes be optimized in the future?

Deep reinforcement learning holds great potential

The answer to this question is artificial intelligence. All over the world, science and industry are pinning great hopes on what is known as deep reinforcement learning (DRL) – a combination of deep learning and reinforcement learning. This AI method requires less expert knowledge than the classical programming of problem-specific solutions. Only the problem to be solved is defined in advance. Based on historical data sets, the AI simulates various scenarios in an interactive learning environment. For the execution of previously defined tasks, it receives immediate feedback in the form of a "reward" or "punishment." Through this trial-and-error function, the AI independently learns which actions lead to the maximum reward and thus to the best possible task performance.

So much for the theory. In industrial practice, however, deep reinforcement learning has hardly been used so far. The reasons for this are complex: the AI method only works if companies provide a correspondingly broad database. This is often not available. In addition, DRL is extremely computationally intensive, and implementation is associated with a high level of effort. So it needs a high-performance IT infrastructure and competent employees. And last but not least: it is not uncommon for companies to have significant reservations about DRL. There is simply a lack of understanding of how the AI

method culminates in a functioning strategy. So how can these issues be resolved to unlock the potential of DRL technology in the near future?

Workshop provides ideas, insights, and feedback

This question was part of a workshop that brought interested parties to TUM Campus Heilbronn last fall. The thematic focus of the three-day event was the application of deep reinforcement learning to dynamic decision-making problems in inventory management, transportation, manufacturing, and healthcare.

> **The exchange was great. But perhaps even more valuable was meeting so many new people who bring exciting new ideas to the field.**
>
> **Prof. Willem van Jaarsveld** – Chair of Stochastic Optimization and Machine Learning at Eindhoven University of Technology

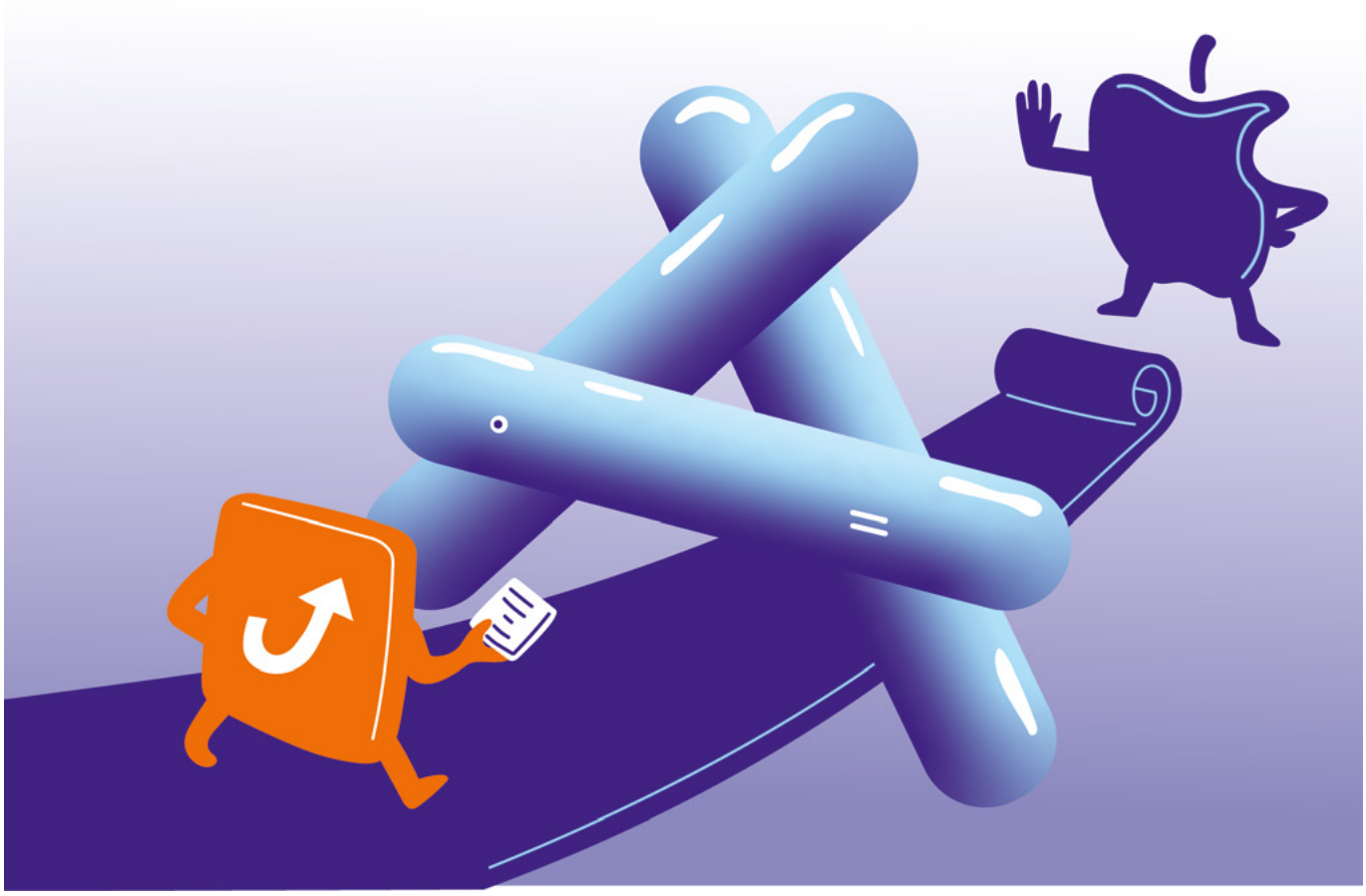
Led by a TUM trio consisting of Prof. Gudrun P. Kiesmüller and Prof. Jingui Xie from the TUM Campus Heilbronn and Prof. Stefan Minner from TUM campus in Munich, about 30 high-ranking international experts discussed the current state of research and how the method can be used in operations management in the future. Several doctoral students from the TUM School of Management, TUM School of Computation, Information and Technology, and other international universities also had the opportunity to present their work and subsequently exchange ideas with the experienced researchers. An enriching experience, as Yihua Wang, TUM Ph.D. student from Munich, confirms: “I received valuable feedback and thank the organizational team for this fantastic event.”

At the end of the workshop, it was clear to all participants that deep reinforcement learning opens up completely new possibilities for companies. In the future, it will be possible to optimize or automate processes that were previously considered too complex for software, in a variety of application areas. New and promising ideas have been developed, especially with regard to problems with large action areas. However, in order to exploit these potentials, the prerequisites must be created, and there are still some challenges to be overcome. Collaborations between science and industry are needed, as are good expertise and structured data provided by companies. Only in this way can DRL be implemented and further developed in practice. ●

International guests at the Heilbronn Campus: experts exchanged ideas on deep reinforcement learning.

Apps, Apple, and the App Store

From games to fitness trackers to streaming services: in the App Store, there is a suitable app for almost everything. But how does Apple decide what is allowed on the platform and what is not? Prof. Jens Förderer and doctoral student Michaela Lindenmayr got to the bottom of this



"But there is one more thing" – with this almost magical phrase, Apple founder Steve Jobs announced the first iPhone in 2007. With it, the California company created a product that not only became a mega-seller, but also revolutionized an entire industry. The recipe for success: a well-functioning touch display and an intuitive operating system based on mobile application software – or apps for short.

Apple didn't invent apps, but it did establish them. Today, the technology group relies 99.99 percent on external developers. The bottom line is that Apple opens the door

to innovation, ideas, and business models, but must act as a strict gatekeeper to keep the quality in the App Store high. Prof. Förderer and Michaela Lindenmayr from the Chair of Innovation & Digitalization at TUM Campus Heilbronn have analyzed how this balancing act works and derived recommendations for other platform operators. We summarize the most important findings.

Quality, quantity, and network effects

Apple iOS is the world's second-largest platform for application software, behind Android. With more than two million programs, the App Store covers a very broad and differentiated range. In doing so, Apple takes advantage of network effects: the large number of apps provided is an incentive for consumers. This in turn makes it attractive for developers to make their content available. Both sides benefit.

So the more apps, the better? Yes and no. Because the quality also has to be right. If bad apps get out of hand, the line between high-quality and low-quality content becomes blurred for users. It is then no longer worthwhile for providers to invest in good quality. The result: the market fails and the platform fails.

Best practice: what platform operators can learn from Apple

Apple has taken a number of measures to ensure quality. The so-called Code of Conduct defines the required framework conditions for app developers who want to distribute their products via the App Store. A continuous app review process ensures that external apps meet the requirements. Using automatic filters and manual inspections, Apple regularly checks whether the requirements are being met. In the event of a violation – such as the unauthorized use of customer data or an inferior layout – measures are initiated.

In concrete terms, this means that the app in question will not be published in the App Store until further notice. Developers then have a chance to correct the deficiency and resubmit the app for the review process. In the case of a gray area, Apple involves the Executive Review Board. If there is still a need for clarification, the company communicates directly with the providers. In the case of illegal violations – for example, pornographic content or content that glorifies violence – charges are filed.

Digital change and the progress of technologies are forcing platform operators to regularly check their control systems for applicability and up-to-dateness. The results from Förderer and Lindenmayr show that it pays to involve external provider companies in this process and to coordinate the set of rules with them. Following the Apple example, this increases the acceptance of updates. The pioneer uses programs and events for this purpose and presents innovations at annual conferences.

"Such measures keep the Californian tech giant at the top," believes Jens Förderer. Because the fact that the app offering is decisive for the success of a platform has been proven in the past by Palm (later HP), RIM, and Microsoft – through their failure. If an application is ruled out, alternatives are needed. If the offer is no longer right for consumers, this can lead to consumers turning their backs on the brand. The path to the competing product from Samsung & Co. is then not far away, and any network effects are lost. A broad and differentiated offering – as in the case of Apple – reduces dependencies on individual apps and developers.

The analysis by Förderer and Lindenmayr shows that Apple's success story involves much more than a stylish device, a hip brand, and a simple operating system. Seamless quality management, networking formats, and constant collaboration with the app community have played a significant role in the international success and reputation of what is probably the most valuable brand in the world. ●

5

steps to platform success, according to the app store model

A transparent and structured set of rules

Control of compliance according to clear guidelines

Firmly defined measures in the event of non-compliance with quality criteria

Avoidance of dependencies, thanks to diversity of offerings

Checking the control system for applicability and up-to-dateness

How supply chain finance leads to greater resilience

The Supply Chain Finance Hub 2022 in Heilbronn provided new insights into effective strategies

Last year's Supply Chain Finance Hub on the topic of "Increasing Resilience with Supply Chain Finance" shed light on the subject. Once again, top-class experts from business and academia accepted the invitation. Together with around 200 interested parties from 25 countries, they discussed how global supply chains and thus the global economy can be made more stress-resistant in the future.

The virtual TUM event series was moderated by Prof. David Wuttke, Professor of Supply Chain Management at TUM Campus Heilbronn. "We need innovative approaches to tailored resilience that are as individual as companies' supply networks," Wuttke emphasized. "Companies need to understand their supply processes in detail, have a good understanding of the flexibility of their networks and also the limits of the same in order to better manage the unexpected."

More liquidity in the supply chain

This is where supply chain finance comes in. Like an apple supports health, SCF supports the functioning of supply networks. Purchasing companies extend payment terms in the event of a crisis and still pay their suppliers. Interim financing is provided by a financing partner. For suppliers, the improved creditworthiness of their customers results in an interest rate advantage. This extra liquidity stabilizes supplier relationships and thus increases the ability to act and the flexibility of a company and its trading partners. In the end, this increases resilience – and risk management benefits.

"The requirement to be able to react flexibly to unforeseen events will lead to a rethinking of risk management," predicts Prof. Wuttke. This, he says, requires harmonizing the flows of goods, information, and finance along the supply chain, as well as balancing the often competing goals of "efficiency" and "resilience." "On this issue, each company must find its own balance. Supply chain finance, however, can help to establish it," Wuttke sums up.

In current studies, Prof. Wuttke himself is investigating the extent to which innovative financing concepts for suppliers can lead to greater resilience. At the interface of management and technology, he is also researching in a project funded by the German Research Foundation (DFG) how, for example, the use of blockchain technology can support these approaches. ●

At ARCS 2022, researchers shared their thoughts on the computers of the future.

Heilbronn hosts the world

For more than 30 years, the *International Conference on Architecture of Computing Systems* has stood for cutting-edge research in the fields of computer architecture and operating systems. Last fall, TUM Campus Heilbronn hosted the conference for the first time

132,000 terabytes of hard disk capacity and 14 quadrillion mathematical operations per second: in September 2022, the new supercomputer “Levante” was inaugurated at the German Climate Computing Center (DKRZ) in Hamburg. The researchers based there are pursuing a major goal: they want to use the computer to create a digital twin of our planet so that they can make even more accurate climate predictions.

But where there is light, there is also shadow. In the case of Levante, this means electricity consumption – and not in small quantities, either. With a connected load of around 2 MW, the result is an annual consumption of 18 GWh. Before the war in Ukraine, this corresponded to electricity costs of around five million euros. The price for 2023 will be significantly higher. Even for the sake of the climate, it may not be possible to raise this amount of money. In view

of rising energy prices, the question therefore must be asked: how can these complex computer systems be optimized so that they work even more efficiently (and save electricity) in the future?

TUM Campus Heilbronn as host of ARCS 2022

This question was part of many of the presentations and discussions at the *International Conference on Architecture of Computing Systems (ARCS 2022)*, which was held for the first time in Heilbronn from September 13 to 15, 2022. Conference Chair Carsten Trinitis, professor of computer architecture and operating systems at TUM Campus Heilbronn, welcomed renowned experts from around the world. “ARCS is a conference with great international appeal,” explains Prof. Trinitis. “For our expert communities, it provides the optimal setting for face-to-face exchanges, sharing inspiring ideas, and promoting bold approaches. Groundbreaking change, after all, sometimes requires thinking outside the box.”

The topics discussed in Heilbronn are forward-looking, with technologies perhaps not ready for the market for another 20 years. In addition to energy efficiency, the topics include organic computing, i.e., the use of self-organizing systems that dynamically adapt to the respective environmental requirements. Structures and methods of biological and other natural systems serve as models. For this, *ARCS 2022* has a so-called Special Track, usually a parallel program to the main part of the conference. “We wanted to promote and have in the program a topic that is not yet mainstream,” emphasizes Prof. Martin Schulz, Chair of Computer Architecture and Parallel Systems in the Department of Computer Engineering in TUM School of Computation, Information and Technology, who co-chaired the conference with Prof. Trinitis. “How else is it going to become mainstream one day if it’s not discussed in expert circles?”

There are roughly two approaches to all topics, Prof. Schulz explained: some try to make the most of the existing architecture of computer systems and optimize their software for it. The others want to develop new architectural concepts. “This is precisely the area of tension at the conference,” says Prof. Schulz. The hope, of course, is that corresponding ideas from the experts about future architecture will eventually catch on with manufacturers.

Into the future with quantum computers

In one area, these hopes are particularly high: the subtitle of *ARCS 2022* was “Quantum Computing: The Dawning of a New Age?” Although not too many conference presentations touched directly on the topic yet, this prediction may be more comprehensive than originally thought. That’s because work on quantum computers exhibits precisely the kind of peculiarity that is lacking in other fields. “There is an intense exchange between the manufacturers of quantum computers and users,” explains Karen Wintersberger, a conference participant and physicist at Siemens. “We hope to use quantum computers in the future to optimize production," she adds. After all, those are the use cases that involve a lot of data and complex computing operations. However, current quantum computers are still too underpowered, i.e., they need considerably more qubits (elementary computational units of a quantum computer – editor’s note), and they do not yet function without errors.

When the great hopes will be confirmed is written in the stars. Perhaps in the end it will not be the quantum computers themselves that herald the new age, but the cross-border and cross-disciplinary collaboration that has been raised to a new level on the occasion of the hoped-for quantum leap. ●

Off to new shores!

No one is an island. This proverbial phrase by the English poet John Donne alludes to the human need for social closeness. But it also applies to TUM Campus Heilbronn

To enrich its own research and teaching and to create added value for the regional economy, those responsible at TUM in Heilbronn have been focusing on international exchange and networking since 2019. Since then, partnerships have been initiated with some of the world's most renowned universities. And the math is working out. Because the results show how much everyone involved is benefiting.

"TUM in Heilbronn is like an academic startup," says Daniel Gottschald, Managing Director of TUM Campus Heilbronn gGmbH. "We test, research, and build bridges to the surrounding industry to inspire, learn, and become part of the regional ecosystem. Hence, it's only natural that we follow the same ambition in terms of international partnerships."

> **To be successful today, you have to seek collaboration with like-minded people.**
>
> **James Fogarty** – Regional Director, Cork County, Ireland

One example is the exchange with County Cork, Ireland. As the crow flies, it is a good 1,300 kilometers from Heilbronn. But it feels much closer. The challenges are similar, the population structures are comparable, and both share the goal of transferring scientific findings to the regional economy. Those responsible in Heilbronn and Cork have recognized this – and in 2022 took the first steps in a collaboration that is set to last for a long time.

"I don't think a region or a university can survive on its own in this day and age. You have to cooperate," says Cork County Regional Director James Forgarty. He is in close communication with the two local universities, UCC and Munster Technical University. They, too, are expected to benefit from networking with TUM – especially when it comes to using technology and the possibilities of the digital age.

Linkages at key junctures

There have already been collaborations with the French HEC since 2020 – with students from both locations at the heart of them. Annual visit opportunities have been available for them since then as part of the Summer School. Those enrolled in the Master's in Management & Innovation can also embed stays abroad at the HEC as a regular part of their curriculum.

Initial talks are underway with the Hebrew University of Jerusalem on cooperation in the area of startup promotion and culture. And finally, scientific collaboration with the renowned Oxford Internet Institute is also in full swing. Since October 2021, the two educational facilities have been conducting joint research on the major topic of artificial intelligence, also focusing on essential aspects beyond technology – such as the social, ethical, and societal implications. Interested parties have already been able to marvel at the initial progress and findings in webinars, some of which are open to the public.

In short: at the Heilbronn Campus, things are moving toward the future with seven-league boots – not least thanks to a steadily growing academia and the latest partnerships. No one wants an isolated island life here anymore. A line just before the end credits of the classic movie "About a Boy" sums it up: "Some are parts of island chains. Beneath the surface of the sea, they are clearly connected." ●

The CDT team celebrates its anniversary, from left to right: Prof. Jens Förderer, Prof. Sebastian Müller, Prof. Martin Meißner, Prof. Jingui Xie, Prof. Gudrun P. Kiesmüller, and Prof. David Wuttke.

Added value for the region

Four years ago, the *Center for Digital Transformation* was launched as part of TUM Campus Heilbronn. A lot has happened since then

When founding a startup, the most important thing is to create clear added value with the idea. After all, if there is sufficient demand, the signs are good that the young company will develop successfully in the long term.

The Center for Digital Transformation (CDT) of TUM School of Management, which celebrated its third anniversary at TUM Campus Heilbronn in the summer of 2022, has grown according to this principle. The team, led by CDT Director Prof. Gudrun P. Kiesmüller, researches issues surrounding digital transformation, and its challenges and opportunities. From the very beginning, the goal of the center's six professorships has been to develop scientific solutions and thus generate direct benefits for business and society. The new findings also flow directly into teaching. This, in turn, has a major impact on the region, as students carry their know-how into companies as specialists and managers. A successful model that has proven itself and still has a lot of potential, given the young history of the campus.

Interface between business and research

In the meantime, the first master's graduates have completed their studies at TUM Campus Heilbronn. "The city has gained an important educational factor with the center," emphasizes Prof. Kiesmüller. In addition, the CDT has become an important interface between companies in the region and research.

> **We want to build a bridge between the companies in the regionand the findings of research.**
>
> **Prof. Gudrun P. Kiesmüller** – CDT Director and Professor of Operations Management

And the challenges are many. Shortly after the opening of the CDT, the emerging COVID-19 pandemic became a historic turning point – for companies as well as for research. That is why the potential for the best possible collaboration is currently being explored, says Prof. Kiesmüller. The goal here is to actively collaborate on projects with companies from the region. The talks held so far have already revealed a lot of potential. In addition, the researchers at the CDT are conducting a survey on supply chain issues, spare parts logistics, and digital transformation with the *Supply Chain Monitor Heilbronn-Franken* to identify the challenges and trends that particularly affect companies in the region.

Center promotes knowledge transfer and networking

With its work, the *Center for Digital Transformation* provides the optimal framework. It is based on fundamental and application-based research that is constantly being developed through close collaboration with partners on campus and renowned partner universities.

For Prof. Kiesmüller, one thing is certain: "Knowledge transfer is very important to us." That's why the CDT regularly hosts workshops with leading scientists and also networking events with companies. One example is the *Supply Chain Finance Hub*, which was held for the fourth time in October 2022 as a virtual event with high-profile panelists led by Prof. David Wuttke. Most recently with 200 participants, including managers and executives from companies and banks as well as researchers and students from 25 countries.

But participation in external events in the region is also an important component of this knowledge transfer. *StartupCity meets Experts* is, without a doubt, one of these important events. Here, Martin Meißner, member of the CDT and Professor of Digital Marketing at TUM Campus Heilbronn, among others, gave interesting insights into his research on the topic of "eye tracking" last year.

Quo vadis, CDT?

Under the motto "For the Digital Age," TUM Campus Heilbronn continues to push ahead with its expansion. "With the addition of the professorships *TUM School of Computation, Information and Technology (CIT)* and the *Data Science Center*, we will also be working more closely with computer scientists in the future," says Prof. Kiesmüller. "This opens up completely new possibilities for us, for example with regard to the fields of data science and artificial intelligence." One of the next steps will be to build a comprehensive network with companies in the Heilbronn-Franconia region. "Our research offers a great deal of added value that we want to make available to companies in order to jointly master the challenges of digital transformation," she adds.

One current project at the CDT, for example, deals with the topic of natural language processing. Here, a team led by Prof. Sebastian Müller, Professor of Finance, is using methods that, with the help of machine learning, are able to automatically take into account the semantics and context of a text. This may one day make it possible for companies to identify relevant competitors simply by comparing annual reports or their websites. ●

Facts and figures about the CDT

Three main research areas

Impact of digital technologies on companies and the economy

Digital platforms

Data-driven decision making

Six professorships

24 Ph.D. students (**55%** international, **45%** female)

Collaborations with renowned universities worldwide, such as ETH Zurich (Switzerland), HEC Paris (France), University College London (UK), TU Eindhoven (Netherlands), and Lund University (Sweden)

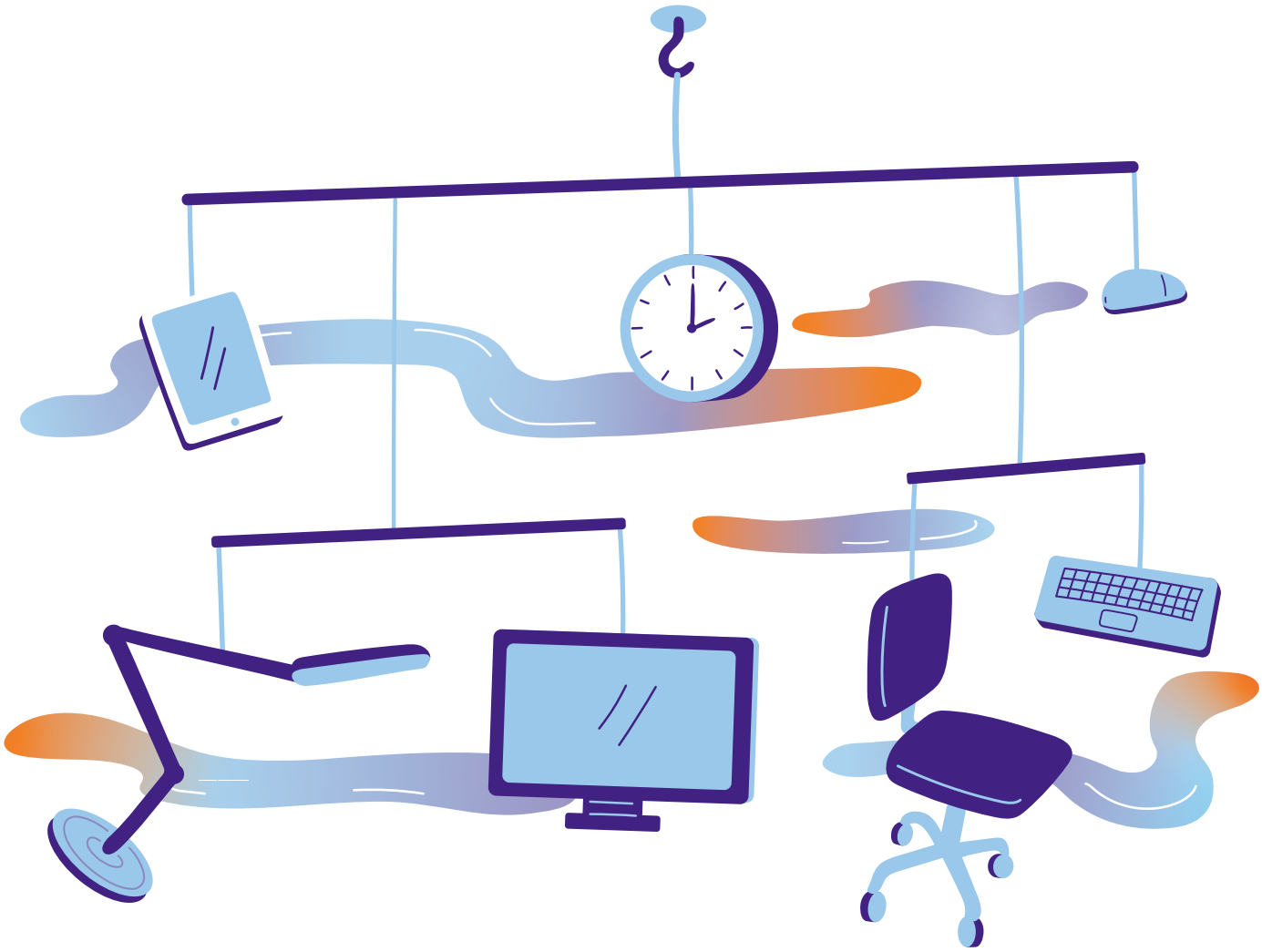
The “child penalty”: punishing those who have children?

Those who want to return to work after the birth of a child often experience their own family situation as an obstacle – the so-called child penalty. TUM Campus Heilbronn wants to promote discourse between companies and families anew

Balancing child and career: anyone who masters this task deserves an accolade – especially in our meritocracy. Prof. Philipp Lergetporer from the *Global Center for Family Enterprise (GCFE*) at TUM Campus Heilbronn sees a distorted picture here that could have an influence on employers’ decisions: “Compared with fathers, mothers are significantly more likely to have childcare responsibilities, which can also affect work processes in the company.” While almost all fathers work full-time, a particular lack of childcare options ensures that two-thirds of working mothers resort to part-time options. But even in the application process for relevant jobs, women with children are often at a disadvantage.

Employers resist part-time positions

Part-time positions are not particularly popular in many companies. When a full-time position is split between two part-time positions, there are double non-wage costs.



Employers also fear a poorer workflow that could result from the lack of coordination between the two positions. If both job-sharers are parents, it is also difficult to staff the afternoon hours, because many childcare programs are not designed to be full-day.

In Germany, 66 percent of employed mothers work part-time, but only 7 percent of fathers.

(Source: Federal Statistical Office, 2022)

What companies can do

"The social norm that mothers are more likely to take a back seat in working life is unfortunately hard to change in the short term," says Prof. Lergetporer. But for companies that create flexible offerings, there is an opportunity to take on a pioneering role and gain an advantage in the recruitment of new workers. For young people, family-friendly conditions are enormously important when choosing their employer.

Companies need to ask themselves this question: how can we help working parents master the balancing act between family and work? For Prof. Lergetporer, in addition to new working-time models, the key lies in expanding childcare options. "One important step is to make more daycare places available," he says. However, he adds that it is crucial to make it possible for families from middle- and lower-income groups, in particular, to send their children to daycare. Up to now, these groups have been much less likely to make use of childcare services.

Many companies are prepared to face up to the problem and are introducing countermeasures. But real solutions have not yet been found. And this is reflected in the statistics. TUM Campus Heilbronn would like to help raise awareness of the issue on both sides – so that a solution-oriented discourse can be found – and so that the child penalty for working mothers will soon be a thing of the past. ●

Spotlight: supply chain

The third *TUM Talk* focused on causes, adjustments, and future strategies around supply chains

"We are in a global systemic crisis." – With these emphatic words, Prof. Thomas F. Hofmann, President of TU Munich, opened *TUM Talk 2022*. The reason: global supply chains have become unbalanced in many places in recent years. So how can they become more resilient in the future?

This question was the linchpin of the renowned expert format. This year's *TUM Talk* was moderated by Prof. Helmut Krcmar, founding dean (2018-2020) and representative of the president for TUM Campus Heilbronn. The approximately 130 guests experienced a lively and intensive exchange among top-class speakers from science and business.

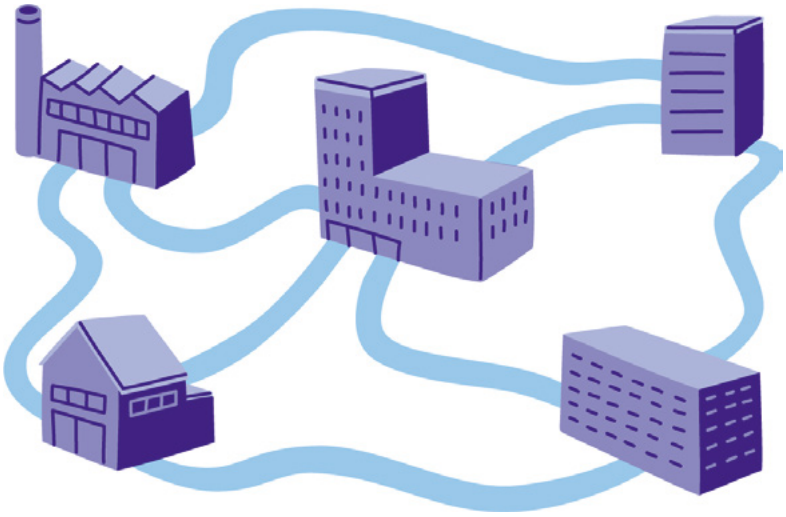
Clemens Fuest, president of the ifo Institute, emphasized right at the beginning: "We are in a situation that we have never had before in terms of the overall economy." The reactions of companies to this are diverse, as the conversations on and off the podium made clear. However, they agree on the necessary approach: resilience is flexibility. There was also agreement from the panelists, such as Laura Karbach, member of the board at RECARO Aircraft Seating, and Katja Burkert, Chief Information Officer at the Heilbronn-based sports retailer INTERSPORT. Burkert emphasized, "A close, transparent exchange with our dealers and a new logistics center helped us to react flexibly to changes."

"Resilience is the immune system for companies"

On the science side, supply chain expert Prof. David Wuttke from TUM Campus Heilbronn delivered an exciting keynote speech. He compared the task of companies with the human body's own defense system: "Resilience is the immune system for companies. It needs continuous and targeted strengthening to protect itself from unknown risks in the long term." Companies and their challenges are as individual as their own bodies, Wuttke emphasizes: "Tailored resilience is needed." Digital technologies can provide support here. If these are used smartly, resilience can grow substantially and efficiently. ●

The TUM Talk contributes to the important transfer between science and business in the region.

“This is our home!”



One signature, one sign: as a new partner, TUM Campus Heilbronn expands the regional *Alliance for Transformation*

The *Alliance for Transformation* of the Heilbronn-Franconia region functions according to the principle of solidarity and was founded more than two years ago with its sights set on the future. The focus is on supporting small and medium-sized enterprises. Even before the outbreak of the COVID-19 pandemic, regional businesses were facing a wide range of challenges – from digitalization and the mobility revolution to the increasing shortage of skilled workers. The COVID crisis has further complicated the situation. To remain competitive, companies must adapt existing business models to the current situation, make investments, and train existing staff. The *Alliance for Transformation* supports this process by networking companies with the region’s key players.

”

We want to help shape change, because this is our home!

Daniel A. Gottschald – Managing Director of TUM Campus Heilbronn gGmbH

Together for the region

Since 2022, TUM Campus Heilbronn gGmbH has been a partner of this alliance in order to contribute to the sustainable competitiveness of the region here as well. It’s a win-win situation. Because TUM Campus Heilbronn uses its membership for networking and professional exchange in a regional and international context. The social, political and economic players in the network, in turn, benefit from further projects, the acquisition of additional resources and the reinforcement of network effects.

Daniel A. Gottschald emphasizes: “Due to the steadily growing university operations at the educational campus, an international student body, globally networked scientific excellence, and, last but not least, our growing regional commitment, TUM Campus Heilbronn has itself been part of the regional transformation now since 2018. By joining the Alliance for Transformation, we are taking on further responsibility for Heilbronn and the region.” ●

“Future Atlas” 2022

Every three years, the economic research company Prognos AG publishes the “Future Atlas.”

In the ranking of German regions with the best prospects for the future, the Heilbronn district ranks 10th, as it does, as well, in the category “Strength.”

In the area of “Competition and Innovation,” the Heilbronn district is even good enough to achieve 6th place.

Dialogue, not monologue

Discussing digital transformation topics with experts from TUM Campus Heilbronn – that's what the networking format *TUM Connect* is all about

Put a box on the ground, climb up on it, and loudly express your own opinion: at Speaker's Corner in Hyde Park in London, everyone has been allowed to do this by law for 140 years. Among many others, prominent figures such as George Orwell and Karl Marx are said to have spoken to passers-by here. Now, the spirit of Speaker's Corner is also making its way to TUM Campus Heilbronn and is at the heart of the *TUM Connect* event series, where anyone with something to say is allowed on stage. Fortunately, things are not quite as chaotic as they sometimes are in Hyde Park.

Following the successful launch of *TUM Connect* in November 2021, the focus of the follow-up event, on October 27, 2022, was on the topic of digital transformation. Three experts – Prof. Helmut Krcmar, Prof. Heinz-Theo Wagner, and Dr. Christoph Geier – began the event by sharing their theses on sustainability, mindset, and innovation in 90 seconds each. Participants from a wide range of industries then came to the stations and discussed with the experts. After 30 minutes, the change to another station was announced.

The walk-in ivory tower

At *TUM Connect*, participants can share their experiences and ask questions in direct contact with researchers. But the exchange with colleagues from the business world also yields valuable insights: are there similar challenges in other companies? And how do they deal with these challenges?

At the event, the professors talk to people outside the science bubble about their research interests and thus learn about new perspectives. They don't prepare scripts or slides in advance. This is because the focus here is not on imparting knowledge, as is usually the case, but on the exchange between science and practice, which is so important for TUM. "With networking formats like *TUM Connect*, we are a walk-in ivory tower and make a tangible contribution to the region," emphasized host Daniel A. Gottschald, Managing Director of TUM Campus Heilbronn gGmbH, in his welcoming speech. TUM Campus Heilbronn particularly invites regional partner companies to actively network with the university and thus acts as an academic startup.

In search of a wealth of experience

Learning with and from each other – that is the focus of *TUM Connect*. Through discussions with the participants, the experts at TUM Campus Heilbronn were able to gain valuable insights into which topics are particularly important to the region. Future events will build on this. However, it remains to be seen whether anyone will climb onto a box to express an opinion.

Dr. Christoph Geier (r.) in discussion with a TUM Connect participant.

At TUM Campus Heilbronn, working professionals also refresh their knowledge as part of the Continuing Education programs.

Goodbye, pain points!

The *TUM Institute for LifeLong Learning* helps companies in the region meet the challenges of these times. Ambitious employees can get fit for the future with these three courses

Business Design & Innovation

The business world is spinning faster and faster. This increases the pressure on companies to adapt chameleon-like to new circumstances. What does it take? Innovations. However, these mean risk and uncertainty – which must be dealt with.

This is exactly where our *Business Design & Innovation* training program comes in, using a transparent model to structure a company's innovation processes. The result: a validated draft decision for the management, with which the gap between the first idea and sales can be bridged.

Healthy leadership

Even Friedrich Schiller knew that "it is the mind that builds the body." However, since the number of work days lost due to mental stress has risen sharply in recent years, the topic has received unprecedented attention – in people's personal lives as well as in the workplace.

How to recognize mental stress? How to overcome prejudices and build better structures in the company? That's what *Healthy Leadership* is all about. The goal of the 16-week program is to reduce absenteeism and promote the mental health of employees. To this end, managers are provided with tools that can be applied immediately.

Lunch Academy

Bundled know-how from various industries – that's what the *Lunch Academy* of the *SME Competence Network* offers its partners. Short guest lectures guarantee the perfect lunch-and-learn format for employees of medium-sized companies.

In 2022, two TUM experts had the opportunity to share their knowledge: Dr. Christoph Geier and Prof. Dr. Martin Meißner. While the former's "Decathlon with an (Un)certain Outcome" was about digital transformation, Prof. Meißner gave insights into eye tracking research and the newly built laboratory in Heilbronn for this purpose. That's what a nourishing lunch break tastes like! ●

Summer of knowledge

International, cross-campus, connecting: the summer continuing education opportunities at TUM Campus Heilbronn put young researchers on the road to success

Consciously and constantly looking beyond one's own limited perspective provides impetus and opens up new insights. This is precisely what the *TUM & HEC Summer School* is known for, which was offered as a virtual event for the second time last year. The students gained in-depth insights into two exciting topics of digital innovation: startup entrepreneurship and industrial transformation.

An intensive academic program that lived up to its promise: participants praised the diverse selection of topics, the inspiring impressions, and the opportunity to meet people from all over the world. A face-to-face event is planned for 2023 in Heilbronn.

On the road to academic excellence

The *Ph.D. Summer School*, which was held on campus for the first time this summer, received similarly positive feedback. The course series consisted of contributions from our professors on diverse topics, such as the economics of digitalization or empirical sustainability analysis.

The cross-campus learning opportunity also offered great networking potential: "The *Ph.D. Summer School* brings together Ph.D. students from all TUM institutions – and offers a unique opportunity to learn with and from each other," reflects participant Rossella Rocchino. She participated in the first week as one of the first scholarship holders of the *TUM Academic Training Program (ATP)*.

The offer is considered a unique selling point, as TUM is the only university in the Heilbronn-Franconia region that trains doctoral students. The self-declared goal: to build up expertise and knowledge and bring them to the region. ●

More time for the important things

How can capital-market-relevant information be extracted from qualitative text data? A new tool simplifies the analysis and identification of annual reports and competitors

Anyone who invests in individual shares wants to be well informed about the companies to which they are entrusting their money. Annual reports are a valuable source of information. They can provide information about the issues management is dealing with and the risks the company is exposed to. Investors can also find company-specific information on sustainability or digitalization.

However, much of the information was already available in the previous year and was already priced into the market. “Investors are therefore basically interested in new information,” explains Prof. Sebastian Müller, Professor of Finance at TUM Campus Heilbronn. However, manually reconciling two consecutive annual reports is extremely time-consuming. This also applies to searching for specific topics using word lists.

> **Reading hundreds of pages of annual reports every year is time-consuming and inefficient.**
>
> **Prof. Sebastian Müller** – Professor of Finance at TUM Campus Heilbronn

Qannual: invest efficiently thanks to quantitative analysis

Thanks to advances in natural language processing, there are now new methods for addressing these issues. Prof. Müller is conducting research on this together with his doctoral student Christian Breitung. “In current projects, instead of word lists, we use modern methods that are able to take into account the semantics or context of a text with the help of machine learning,” says Prof. Müller. “These are pre-trained language models that can be adapted to different application tasks. With the help of these models, it is possible to identify those sentences in annual reports that contain semantically new information. They can also be used to assign sentences to specific topics, without the need for word lists. Combined, this makes it possible to identify new information on a particular topic.”

To exploit the potential of the method, Christian Breitung developed the Qannual tool together with TUM alumnus Felix Alexander Müller. This gives users access to the current as well as past annual reports of more than 9,000 companies. In addition to annual reports, Qannual now also offers quarterly reports. Users can selectively display individual sections of an annual report. Sentences with semantically new information are highlighted by default.

With the help of these functions, annual reports can be analyzed much faster.

Christian Breitung – Ph.D. student at TUM Campus Heilbronn

Added value for German companies

Currently, Qannual mainly lists U.S. companies. In the future, however, companies from other countries will also be added. This could result in new opportunities for German companies. The tool offers several functions that simplify the analysis and identification of competitors. Using the "company finder" function, users can search specifically for listed companies that offer a certain product. Subsequently, the respective annual reports can be clustered according to specific topics using the semantic search.

"Thanks to advances in text analytics, however, completely new fields of application are also conceivable," says Breitung. In addition to identifying companies with similar business models or risk profiles, it would also be conceivable to forecast sales using a text-based determination of market sentiment.

One of the hurdles to analyzing international capital markets is the nature of language. Multilingual models can be used to identify topic-related information even across national borders. This opens up completely new possibilities for research at TUM Campus Heilbronn. For example, Prof. Müller's team can analyze whether investors from different countries price certain information differently. ●

A moment for the history books: the first graduates leave TUM Campus Heilbronn.

A new phase of life begins

It was a special day in the history of our campus. With both joy and sadness in our hearts, we look at the farewell of our pioneers – the first graduates

The first sentence, the first pages, the first chapter. The beginning of a book often decides whether we read on and, full of curiosity, get involved in the promise of a good story. If the introduction is successful, we look forward page by page to the further course of the plot and ask ourselves, What will happen to the protagonists? What awaits them in the next chapter?

We at TUM Campus Heilbronn are also part of such an exciting story. It began four years ago, and since then countless chapters have been added semester after semester. These chapters are about young people from all over the world who leave their home countries and decide to study in Heilbronn. As pioneers, they experienced highs and lows with the startup TUM Campus Heilbronn and

with their new home in Baden-Württemberg. We are all the more pleased when these chapters have a happy ending.

Last summer, the first two master's classes at TUM Campus Heilbronn were officially bid farewell at a large graduation ceremony. Decked out in hats and gowns, the graduates accepted their certificates as newly minted Masters in Management. In 2018 and 2019, these 28 young people mustered the courage to enroll at our recently opened university location. We are very grateful for this leap of faith. The new alumni have decisively shaped the beginnings of the campus with their commitment and ideas.

TUM alumni talk about the beginnings and their impressions

The stories of Gayatri Gautham, Mohammad Hashem, and Hafsa Kazmi are perfect examples of this. In an interview with the "Heilbronner Stimme," the three TUM alumni gave interesting insights into their student days in Heilbronn and how they see the development of the location.

> **At first, the professors still commuted from Munich to Heilbronn and spent entire days with us here on Mondays and Wednesdays.**
>
> **Hafsa Kazmi** – TUM alumna

"Arriving in Heilbronn was a huge culture shock," recalls Hafsa Kazmi. Born in Pakistan, she had previously studied in the Turkish metropolis of Ankara, a conurbation with a population of around 5.7 million. This was no comparison to the tranquil city on the Neckar River, which Hafsa explored within three days. In retrospect, however, the clearly structured environment gave her the opportunity to settle in very quickly. Gayatri Gautham from India was also surprised at the start of the 2018/2019 winter semester. She had expected a university where everything was already in place. However, the fact that this was not the case was not a bad thing, as she says: "Heilbronn was bigger than I had expected, and I was very impressed by the campus." Mohammad Hashem from Morocco adds, "In the beginning, everything was still in the development phase. But it's really super how fast the university has grown."

In particular, all three alumni praise the good support they received from the students. "We got a lot of attention, and our problems were solved quickly," says Gayatri. Together, they have filled the campus with life and shaped it, for example by founding the first student council. Hafsa points out, "We put a lot of effort into developing the site and giving feedback on what was working well and what wasn't."

How TUM Campus Heilbronn has changed

Number of students
2018/2019: ≈ **40**
2022/2023: ≈ **570**

Number of professorships:
2019: **3**
2022: **11**

Number of Ph.D. students:
2019: **1** at CDT
2022: **24** at the CDT and **18** at the GCFE

Study programs:
Bachelor in Management & Technology (since 2020)
Bachelor in Information Engineering (since 2021)
Master in Management (since 2018)
Master in Management & Innovation (since 2018)

Come to stay

With their master's degrees, the door to a new phase of life opens for the three young people. While Mohammad Hashem is moving to Cologne for work, Hafsa Kazmi and Gayatri Gautham are adding a new chapter to their story in the Heilbronn-Franconia region. "I still feel comfortable here and have never regretted coming here," Gayatri concludes. ●

> **I first had to Google Heilbronn.**
>
> **Mohammad Hashem** – TUM alumnus

Career Factory: insights into Germany's Silicon Valley

In the jungle of entrepreneurial diversity, in the labyrinth of seemingly endless possibilities, choosing an employer often comes down to a metaphorical roll of the dice. The *Career Factory* at TUM Campus Heilbronn aims to remedy this situation and offers students and companies a joint platform for exchange, networking, and inspiration

The future belongs to graduates with interface skills – this mantra hovers over the age of digital transformation and also over the Heilbronn-Franconia economic region. Students at TUM Campus Heilbronn are currently experiencing it: their skillset is in demand like never before. At the same time, graduation brings with it the agony of choice – and with it the need for help in making a decision.

At least, that's how those responsible at the campus see it. A new exchange and information format is designed to help. And so, last summer, the *Career Factory* took place for the first time on TUM campus in Heilbronn. Six hours were allotted for students to experience a somewhat different kind of speed dating in the campus auditorium. Instead of potential life partners, they got to know various economic players in the region, networked if they were interested, and were able to weigh various career options. Among others, representatives of the Tii Group, Bechtle AG, RECARO Aircraft Seating and the Schwarz Group were on site with information booths – in order to establish contact with the international young talent of their industry, but also to inform about requirements, realities, and development plans. Germany's Federal Employment Agency also had a booth, where students could get tips and information on how to write a successful résumé (CV).

In addition to the information booths, the *Career Factory* had an attractive stage program up its sleeve: presentations by company representatives were interspersed with an improv theater in which students were asked to act out various pitfalls and faux pas of everyday working life together with actors and actresses.

Apparently, the offer hit a nerve: more than a hundred participants – and thus about a quarter of the enrolled students – took advantage of the opportunity and sought exchange with potential employers. This is one of the reasons why the *Career Factory* is to be held annually from now on. But there are other arguments as well.

Because Heilbronn, as a business location, also benefits from networking: "Of course, we want you to stay here in the region after graduation. After all, Heilbronn is ideal for starting a career," emphasized Campus Managing Director Daniel Gottschald in his opening speech to the students. Addressing the attractive working conditions of the competition in the American Silicon Valley, he noted: "The Heilbronn region has just as much quality, innovative character, and development potential to offer. Making this reality clear, showing our students appropriate paths, and breaking down prejudices – the *Career Factory* can make an important contribution to this." ●

Learning from losses

Jörg Roßkopf shared valuable career tips. Afterwards, he took time for a round of table tennis.

As part of the *Learning from Legends* event series, table tennis world champion Jörg Roßkopf was a guest at TUM Campus Heilbronn

"I wanted to become one of the best players in the world." – Jörg Roßkopf has undoubtedly achieved this goal. With his doubles world championship title in 1989, he roused the sport of table tennis from a deep sleep and made it popular in Germany. This was followed by silver and bronze medals at the Olympic Games and several European championship titles.

But there are two sides to every medal. Successes also include setbacks. During his visit to TUM Campus Heilbronn, Roßkopf talked to students about the highs and lows of his career and gave them tips on how to deal well with defeats.

Get up, keep fighting, get better

"The most important thing is to feel that you have given your best," the pro advises the TUM students. If you haven't won despite everything, you have to admit to yourself: "The opponent is simply even better." "Still" is the key word here. Because after defeat, it's a matter of getting up, fighting on, and getting better. "In life, you can't just keep going up and up." When you reach a limit, something has to change. So Roßkopf changed places and coaches again and again in his career in order to move on and learn new approaches.

Professionally, the table tennis pro has little to do with the TUM course content. But discipline, perseverance, motivation, and a good way of dealing with failure are also crucial in a professional career. *Learning from Legends* gives TUM students the chance to experience famous personalities up close and learn about their lives. ●

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A look into the crystal ball

What will our shopping behavior look like in 10, 20, or 30 years? Professor Martin Meißner reveals this to us in an interview with "HANIX" magazine

Our shopping behavior – at least when we shop online – is now tracked seamlessly. When we look at products, other products are suggested to us that (even better) suit us and our needs. In real life, on the other hand, we all move through the same shopping worlds in the familiar discounters and retail chains – not a trace of individualization. But that could change – thanks to new technologies such as augmented and virtual reality.

At TUM Campus Heilbronn, intensive research is being conducted on the topic of "personalized shopping." First and foremost: Martin Meißner, Professor of Digital Marketing. We talked to him about the shopping of today, tomorrow – and the day after tomorrow.

Professor Meißner, how do you go about your research into customer behavior in the supermarket?

In both the digital world and the real world, we use eye tracking to measure eye movements. To do this, we have virtually recreated a supermarket shelf. As in a "normal" supermarket visit, test subjects can "pick out" goods, look at them from all sides, and then decide for or against a product.

The same shelf with the same products is also in our lab. By using eye tracking, we can compare behavior in both environments and thus better understand purchasing decisions.

What are the benefits for consumers, and what are the benefits for suppliers?

Our scientific research is always about learning more about people's preferences in order to create an optimized offer from the company side. This is the basic principle of marketing – the principle of capitalism, in a positive sense. By knowing and understanding people's desires and interests, we can personalize the shopping experience. For example, virtual notices can pop up to warn people with allergies about certain ingredients. Consumers who want to make their shopping sustainable can see how many miles a product has traveled before it landed on the shelf. Recommendations from acquaintances can also be displayed virtually. All of this is information that becomes available by wearing augmented reality glasses.

What about data protection with all the information collected?

Of course, the technology also has its downsides. In addition to information about our shopping behavior, biometric data can potentially be stored, making us identifiable. Eye movements not only tell me where someone is looking. I also know how someone is moving and could determine from this whether the person is mobility-impaired. Theoretically, it is also possible to measure heart and breathing rates. This even goes so far that you could determine if a person has heart disease. On the other hand, some heart attacks could of course be detected and prevented at an early stage.

In principle, data protection is a major problem. The question is always this: who uses the data, and for what purpose? The crucial thing is that we use these new digital environments exclusively for the benefit of our society.

Let's fast-forward 10, 20, 30 years: what might the supermarket visit of the future look like?

Now that's the famous look into the crystal ball. When I think of the shopping worlds of the future, I imagine it like this: ideally, consumers will have the choice of bringing their own augmented reality glasses or using those of the supplier. Virtual cues are only played when I want them to be. I can customize the virtual environment to add value for me. I can arrange goods as I wish and even ban entire products – such as alcohol or things containing sugar – from the range.

Shopping trips with friends who live several hundred kilometers away could also be possible in the future. And that's not all.

Many large American companies – such as Apple and Meta – are currently working on bringing out the first augmented reality glasses. However, devices suitable for everyday use do not yet exist. Whoever defines the standards here also has data sovereignty with them. Politicians usually react only after companies have created facts and defined standards. Unfortunately, there is this time lag. So at the end of the day, we don't know, or at least we don't know exactly, what the future will bring. But with our research at TUM, we are trying to get a little closer to it, step by step. ●

Prof. Martin Meißner puts the shopping experience of the future under the microscope.

By understanding people's preferences and interests, we can personalize the shopping experience.

Prof. Martin Meißner –
Professor for digital Marketing

Imprint: Mindshift is a publication of TUM Campus Heilbronn of the Technical University of Munich **Publisher:** TUM Campus Heilbronn, Bildungscampus 9, 74076 Heilbronn **V.i.S.d.P.:** Prof. Dr. Helmut Krcmar **Editorial office:** Kerstin Besemer (kerstin.besemer@tumheilbronn-ggmbh.de), Kerstin Arnold-Kapp (kerstin.arnold-kapp@tumheilbronn-ggmbh.de) **Authors of this issue:** Dr. Thomas F. Hofmann, Prof. Dr. Helmut Krcmar, Prof. Dr. Reinhold Geilsdörfer, Prof. Dr. Jens Förderer, Prof. Dr. Gudrun P. Kiesmüller, Prof. Dr. Jingui Xie, Prof. Dr. David Wuttke, Prof. Dr. Willem van Jaarsveld, Prof. Dr. Carsten Trinitis, Prof. Dr. Martin Schulz, Prof. Dr. Sebastian Müller, Prof. Dr. Martin Meißner, Prof. Dr. Philipp Lergetporer, Daniel A. Gottschald, James Fogarty, Caroline Hoffmann, Michaela Lindenmayr, Tobias Kircher, Christian Breitung **Design and production:** IAN In A Nutshell GmbH, Augustenstraße 52, 80333 Munich, E-Mail: info@nutshell.de **Printing:** Oeding Druck, Braunschweig **Circulation:** 1,500 copies **Image sources:** Illustrations – Doro Spiro: cover, back cover, p. 2, 5, 6, 11, 19, 20, 22, 25, 27, 32; Terzo Algeri: p. 8, 34; Nico Curth: p.4, 21, 23, 28; Matt Stark: p. 10, 14, 15, 17, 24, 31 **Status:** December 2022

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