

Innovation, Creativity: Fascination Forschung!

The key societal importance of the research university, as shaped by the famous education reformer Wilhelm von Humboldt at the start of the 19th century, can hardly be overstated. Equally important, however, is the evolution of this model toward the technical research university. These remarkable institutions are a German success story with international impact. A technical research university reaches beyond the academic to enable engineers and scientists to transform their ideas into useful, economically feasible products and innovative processes; even into new realities. As such, they have helped propel Germany to the ranks of the world's technology leaders. This indeed is what the world knows as "German Engineering".

The Technical University of Munich (TUM) has made a particular contribution to the advancement of Germany's technology capabilities. In the 150th year since our foundation, we pay tribute to our pioneers whose inventions have changed the world. One such example is Carl von Linde, who discovered the principle of machine refrigeration and made it commercially viable. Linde AG was our first spin-off (in 1879) and has long since grown into an international success story – now employing around 57,000 people. Overall, in the last thirty years alone, TUM has inspired over 1,000 startups, creating jobs for more than 15,000 people today. This includes eight companies listed on the US technology index NASDAQ – joined in 2011 by TUM spin-off Celonis, now valued at over 1 billion US dollars (classifying it as a "unicorn").

This present edition of *Faszination Forschung* introduces students and scientists who, inspired by TUM's hallmark entrepreneurial spirit, are feeding their research findings and inventions into the innovation pipeline. In other words, transferring them to real-world use cases in industry and business. This spirit is something we actively promote right from day one at TUM, giving students the freedom to try out new ideas and live their passion as they embark on the research adventure. The renewed world-beating success of TUM's Hyperloop team in this July's global competition provides impressive confirmation that the next generation has not only been gripped by "Faszination Forschung", but is also carrying it forward into the fascinating world of entrepreneurial opportunity. In addition, it demonstrates the benefits of integrating students into our network of experts and mentors.

But we wouldn't be a proper university if we did not also seek to understand the theory behind successful entrepreneurship. Our Entrepreneurship Research Institute (ERI) investigates the entire entrepreneurial process: from founding



a venture, through development and growth all the way to the equally important exit phase. Findings from entrepreneurship research can teach business founders how to avoid mistakes and recognize opportunities. "We want to bring an entrepreneurial spirit into the TUM departments and faculties," declares Nicola Breugst, an ERI professor.

The ERI is part of the Entrepreneurship Center on the university's Garching Campus, run by TUM in partnership with its affiliated Center for Innovation and Business Creation – UnternehmerTUM GmbH. Inaugurated in 2015, the Entrepreneurship Center offers technology-driven spin-offs a unique infrastructure to pursue their goals. This includes MakerSpace, a high-tech workshop, which provides access to machinery, tools and software for building prototypes as well as for small-series production. It also acts as a hub for the creative startup community. And TUM.International GmbH – THE UNIVERSITY COMPANY – brings TUM's knowledge and competency to the international stage. ▶

This is flanked by TUM's incubator, which provides a perfect stage to nurture young companies and prepare them for market entry through office space, advisory services and coaching. UnternehmerTUM also runs its own venture capital fund to assist technology startups with go-to-market financing.

Personally, I am fascinated by the creativity, drive, perseverance and courage of our entrepreneurs. This is a fitting point to mention our latest "unicorn": After a new round of financing in summer 2018, Celonis is now one of Germany's most successful startups, valued at over 1 billion US dollars. Its founders met during their studies at TUM. In 2015, I had the pleasure of presenting this company with the Presidential Entrepreneurship Award, which is endowed with 10,000 euros. All the startups that have won this prize since 2013 are profiled in this edition of *Faszination Forschung*: Fos4X, Dynamic Biosensors, Celonis, Orcan Energy, Konux and NavVis. Each one has written its own success story – all underpinned by TUM's support as a true entrepreneurial university.

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Many startups are currently exploring topics such as artificial intelligence (AI). They typically focus on how digitalization is transforming industry and business. For information systems specialist Helmut Krcmar, the combination of products with service components – ideally tailored to the individual customer – is the defining innovation of the digital age.

Needless to say, company founders who continue their research and teaching at TUM play a particularly strong role in shaping our entrepreneurial spirit. Leading by example, they strengthen the university's entrepreneurial culture and pass on their experience and enthusiasm to the next generation.

Arne Skerra, for instance, is one of the world's leading protein designers. With his team, he has repeatedly developed inno-

ventions in the field of protein biotechnology, several of which have been commercialized through new companies. Planning for his next spin-off is under way, this time based on proteins that can be switched on and off by light.

TUM's entrepreneurial flair also shapes life at its Institute of Medical Microbiology, Immunology and Hygiene, where Dirk Busch and Markus Gerhard are clearly showing that the seemingly contradictory worlds of basic and applied research can, in fact, be seamlessly bridged. Gerhard's company ImevaX is now conducting a clinical trial on what will likely be the first vaccine against *Helicobacter pylori* stomach bacteria.

Even the most ingenious of inventions requires a large helping of determination and resilience to make it to the implementation stage – as Albert Sepp, a civil engineer at the Laboratory of Hydraulic and Water Resources Engineering, knows only too well. Years ago, he came up with an idea for a shaft power plant that would make hydropower more eco-friendly without disrupting the shore area or its habitat. In 2019, the first of these plants is due to go on stream. With this truly innovative idea, Sepp and Laboratory Chair Peter Rutschmann have not only demonstrated an impressive sense of how water flows, but they have also won over numerous skeptics along the way.

Fritz Frenkler's Industrial Design course aims to equip Master's students with an entrepreneurial approach to design, bringing them together with startup teams under the umbrella of the Design Enterprise module. Here, designers work with young scientists and engineers to develop the corporate identity of a new venture through its products or services.

Curiosity is anchored at the heart of our corporate identity. We offer a work environment that promotes creativity and innovation – providing fertile ground for world-class research that leans intuitively toward practical applications. This is a place where innovative product ideas can grow. The TUM culture gives its students and researchers the courage to venture into uncharted terrain by actively embracing the risk of failure that comes with research rather than avoiding risks. No risk – no fascination. High risk – high reward.

As we proudly celebrate our 150th anniversary, we expect an ongoing future of scientific excellence, entrepreneurial inspiration and youthful enthusiasm.

I hope you enjoy this edition of “*Faszination Forschung*”. Be inspired and motivated by the entrepreneurial spirit revealed on these pages.



Prof. Wolfgang A. Herrmann
President