

TUM Agenda 2030

Innovation through talent, excellence and responsibility

Imprint

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TUM in Bavaria

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- 6 Science & Study Center, Raitenhaslach
- 7 Student Research Center, Berchtesgadener Land
- 8 Limnological Research Station, Iffeldorf
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By pursuing its ambitious TUM AGENDA 2030, the Technical University of Munich (TUM) is transforming research, innovation and education while creating a progressive university family that embraces change and works to make the world a better place. This vision will make TUM a global hub of knowledge, create incomparable learning experiences, and focus on responsible innovations that meet the needs of society and nature.

With our TUM Agenda 2030, we are ideally positioned to face the future. We have an unconventional mindset free from the constraints of individual disciplines and schools of thought, we are entrepreneurial in spirit, and we are focused on socially responsible innovation.

“People are at the heart of our aspirations. Following our reform concept of, ‘human-centered engineering’, we are introducing the scientific and technical excellence of TUM into the world of ideas discussed in modern society.”

PROF. THOMAS F. HOFMANN

In our pursuit of responsible innovations that benefit society, we are expanding the concept of engineering, opening it up to the humanities and social sciences by incorporating society’s values, needs and expectations into developing technologies. We are shifting from introverted silo mentalities to open, collaborative teams. We draw on the intelligence of the entire TUM family and mobilize our global partners. And we strive to supercharge our most powerful driver of innovation: our people!

At TUM, a university with a profile of expertise unmatched anywhere in Europe, we consider ourselves to be obligated by the fundamental goal of the United Nations. We strive to make a significant contribution to preserving health, treating illnesses, creating a sustainable world, and shaping a successful digital transformation. To this end, we research the very fundamentals of our existence, the molecular codes



of life, and the astounding diversity of the natural world. And we search for groundbreaking solutions to the greatest challenges facing our society.

Being successful in this new decade will require an open culture of innovation. We are therefore making TUM a central player in an innovation ecosystem made up of research institutes, enterprises, technology companies, incubators and startups. Our inquisitive, open-minded students play an active role in this work as a valued source of ideas.

With deep roots in our native Bavaria, we achieve academic excellence and gain our innovative power by recognizing the individual talents, wide-ranging experience and diversity of the people in our TUM family. They are the key to our mission for the future. It is a future I am looking forward to.

With my best regards,

A handwritten signature in blue ink, reading "Thomas F. Hofmann". The signature is fluid and cursive, written on a white background.

Prof. Thomas F. Hofmann,
President of TUM

TUM Global

EuroTech Alliance

- 1 Danmarks Tekniske Universitet
- 2 Technische Universiteit Eindhoven
- 3 École Polytechnique Fédérale de Lausanne
- 4 École Polytechnique
- 5 Technion – Israel Institute of Technology
- 6 Technical University of Munich

Flagship partners

International locations and strategic initiatives

www.international.tum.de/en

Collaborations

150+

partner universities worldwide

350+

Erasmus partnerships across Europe

Partner universities

■ <10 ■ <30 ■ >30

Milestones

1868

King Ludwig II of Bavaria founds the Polytechnische Schule München as a catalyst of industrialization.

1893

Graduate Rudolf Diesel develops the engine that will come to bear his name, based on an idea he had as a student.

1928

Hans Fischer synthesizes blood's red colorant, hemin, in a test tube (Nobel Prize, 1930).

1956

The Programmgesteuerte Elektronische Rechenanlage München (PERM) is developed. It is the fastest computer in the world at the time.





As part of our TUM.Africa Initiative, we are forging long-term partnerships in the key areas of teaching, research and entrepreneurship on the African continent.

1985
Robert Huber unlocks the secrets of photosynthesis (Nobel Prize, 1988).

2000
The world's first minimally invasive heart valve operation is performed.

2014
Researchers map the human proteome.

2018
The source of an extragalactic neutrino is identified for the first time.

What Drives Us

Sustainable innovations for humanity, society and nature



Fishbowl discussion between postdocs and professors in the ceremonial hall at Raitenhaslach Abbey near Burghausen

Sustained dynamic of regeneration

Five guiding principles represent the networking of all disciplines and the transformation of TUM from a subject-focused institution to a University of Excellence based on system integration.

1. We are creating an internal structure that promotes innovation. We are transforming our internal structure from 15 distinct faculties to an academically dynamized matrix organization that promotes innovation. At the core of this new vision are seven schools that cover the entire portfolio of major scientific domains. Situated at the interfaces between these schools, Integrative Research Institutes connect the methods, tools and knowledge of different disciplines and address system-wide challenges and far-reaching future-focused issues with transdisciplinary approaches to research and teaching.

We are fostering collective creativity. Establishing the TUM Institute for Advanced Study (TUM-IAS) has created a gateway for TUM to the world of interdisciplinary cutting-edge research. Through the Munich Data Science Institute and the Munich Design Institute, we are establishing data sciences, design thinking and design aspects as key integrative actors in our innovative research and teaching agenda. TUM Innovation Networks and their transdisciplinary teams draw on the university's collective creativity to explore high-risk yet promising areas of innovation and help them to reach critical mass.

2. We are integrating the humanities and social sciences. We are significantly expanding our portfolio of technically-oriented humanities and social sciences in the new TUM School of Social Sciences and Technology. We are enabling domains to build their own profiles and, in keeping with our guiding principle of *human-centered engineering*, are providing them with sufficient integrative valency and educational capacity to benefit the natural, engineering, life and economic sciences as well as the field of medicine. This lays the foundations and delivers the

academic excellence for our mission of *responsible research and innovation*, while also providing a third dimension to our entrepreneurial spirit.

3. We are instigating a paradigm shift in teaching. Under the leadership of the new TUM Center for Study and Teaching, we are accelerating the transition from *one-size-fits-all* education towards a more personalized *mix-and-match* range of studies. We tailor our programs of study to the competence profiles required in professional careers (TUM Professional Profiles) and use innovative education technologies (TUM EdTech Center) to convey new knowledge to students ever more effectively.

4. We are connecting people across disciplinary, institutional and generational boundaries. We supercharge the most powerful driver of innovation – people! We strive to connect the youthful enthusiasm of school pupils and our international student body's thirst for knowledge with the specialist talents, experience and open networks of our teaching staff and contributors – across disciplinary and cultural boundaries. We are turning TUM into a creative space that enables bright minds from the worlds of science, business, politics and society to gather and pool their talents, exchange ideas, inspire one another, challenge one another, upskill and collaborate in promising fields of innovation, with the common goal of shaping the world of tomorrow.

Cutting-edge research centers

In 2019, TUM was awarded the title of “University of Excellence” for the third time in succession. We are the only technical university to achieve this feat since the contest’s introduction by German federal and state governments in 2006.

TUM works with its partners to examine the highly relevant scientific issues of our time through research of the highest international standards in its Clusters of Excellence. These clusters enhance TUM’s global profile as one of Europe’s best universities and a leading technical university.

e-conversion. This Cluster of Excellence researches stable, efficient, sustainable power supplies and networks existing research expertise in nanoscience and energy science in the Munich region. It focuses on ultra-fast energy conversion processes in different technologies – from photovoltaics to (photo)electrocatalysis to battery technology. It generates insights that make it possible to design and synthesize energy materials with atomic precision.

MCQST. The Munich Center for Quantum Science and Technology combines research from the fields of physics, mathematics, informatics, material science, chemistry and cosmology with the aim of gaining a profound understanding of quantum-mechanical phenomena and thus advancing the fundamental components, materials and concepts of quantum

technologies. Its interdisciplinary research ranges from analyzing entanglement in many-body systems to developing a new generation of quantum-based devices and sensors – such as scalable quantum computers, sensors for precise measurements, secure communication systems for everyday use, nanosensors for living cells, and novel quantum materials.

ORIGINS. The evolution of the universe is one of the greatest mysteries humankind has faced. Origins is a Cluster of Excellence dedicated to unraveling it. It connects scientists and researchers from the fields of astrophysics, astrobiology, biophysics and particle physics to examine the fundamental phenomena of planet formation and the emergence of the first prebiotic molecules.

SyNergy. The Munich Cluster for Systems Neurology researches how neurological diseases like multiple sclerosis and Alzheimer’s develop. Due to the highly complex nature of the human nervous system, numerous processes can influence the emergence of neurodegenerative diseases. This Cluster of Excellence follows an interdisciplinary approach drawing on systems biology, bioinformatics, systems neuroscience and clinical neurology.

www.exzellenz.tum.de/en

Prof. Elisa Resconi and her team observe neutrinos that reach Earth from outer space. She is part of the successful ORIGINS Cluster of Excellence.





The Women of TUM network promotes international exchange between women in business and science, such as at this event held in 2016.

A global hub of knowledge:

Lifelong learning

In an age of social change, we are turning TUM into a lifelong education partner supporting professionals. We are creating a global hub of knowledge to which not only alumni but also other specialists from the fields of business, politics and society can return as “adult learners” to upskill through educational opportunities rooted in science.

The world is in a state of flux – with enormous consequences for the world of work and the requirements each of us will have to meet in future. We are therefore initiating a fundamental transformation in teaching, moving towards lifelong, continuous learning. We help professionals to refresh their skills profiles, expand them through modular learning, and overcome the future challenges posed by a changing labor market in a responsible and effective manner.

Our courses focus on interdisciplinary fields, such as management and leadership, and build on the many years of experience of our teaching staff at the TUM School of Management. However, rather than simply copying typical business schools, in the TUM Institute for LifeLong Learning (TUM IL³) we are creating a novel institution fit to meet future demands. Our customized range of studies uniquely integrates state-of-the-art skills from our extensive portfolio of engineering

sciences, natural sciences, life sciences and social sciences, as well as the field of medicine – supported by the latest learning methods and innovative (often digital) formats.

What is more, TUM IL³ also organizes internal professional development opportunities for our staff. This ranges from helping all our staff to develop interdisciplinary skills and promoting our professors’ teaching and leadership skills to offering a training program for our non-professorial teaching staff.

As an entrepreneurially minded and socially responsible university, we perceive TUM IL³ as a key lever with which to set a course for the future.

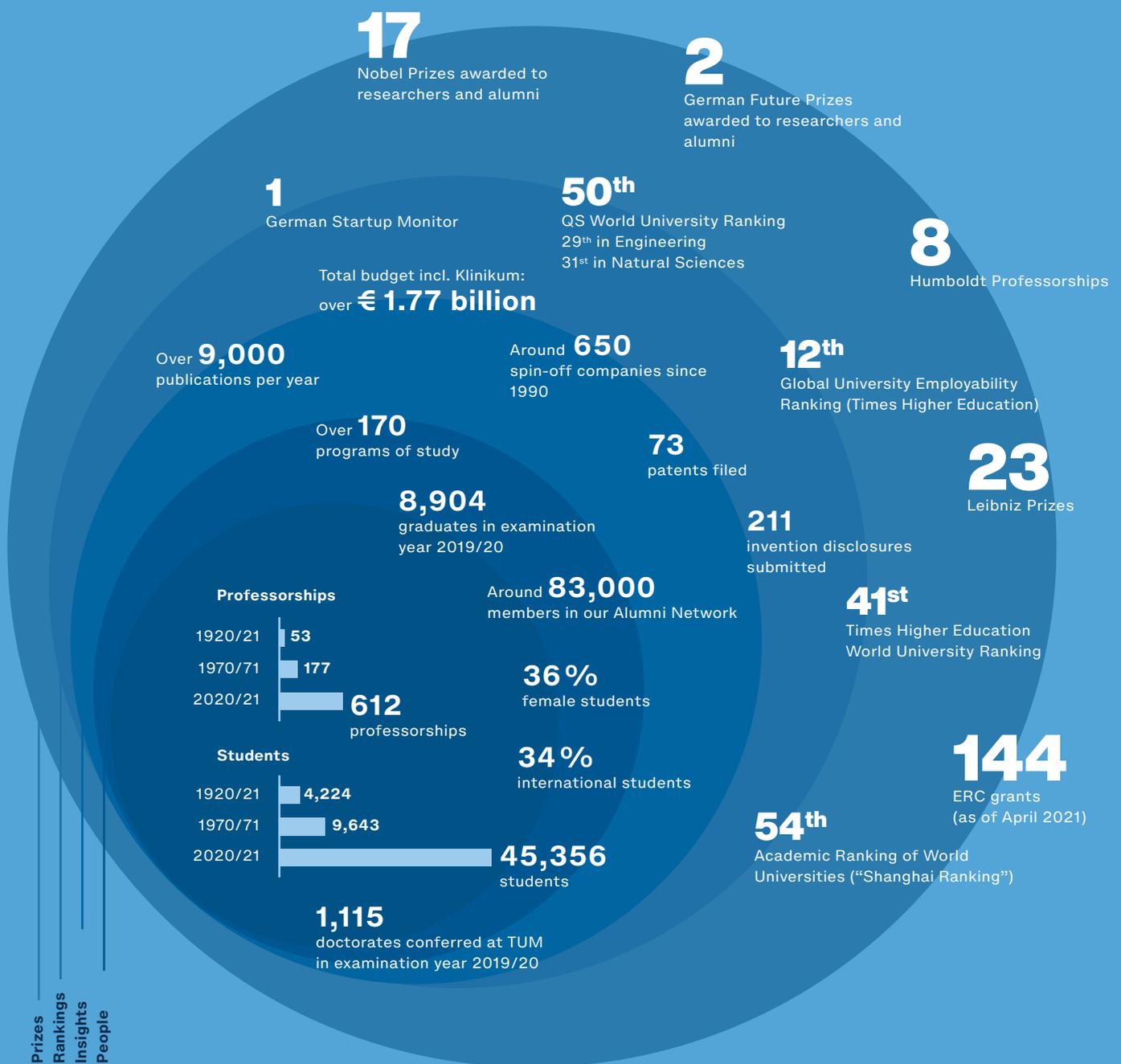
i TUM Institute for LifeLong Learning

The aim of the TUM Institute for LifeLong Learning is to promote advanced education rooted in science in fields such as management and leadership for international professionals from the worlds of science, business and society. By adopting innovative education formats, the TUM Institute for LifeLong Learning equips internal and external leaders with the skills they need to overcome current and future social challenges in a responsible and effective manner.

www.tum.de/en/lifelong-learning/

Our Successes

Facts and figures



We Are Shaping the Future with an Integrative Systems Approach

From a faculty-based system to a modern matrix organization

We are “updating” the DNA of the Technical University of Munich, 150 years after its foundation. The matrix organization we will establish will comprise seven schools and integrative research centers, explicitly targeting trans-disciplinary innovations in teaching and research.

Narrow, limited faculty-specific teaching and research programs are no longer able to keep pace with the need to develop systemic skills to compete in future. Efficiently creating system-integrative cooperative alliances is a decisive success factor when it comes to exploring as yet uncharted, interdisciplinary areas of science. For this reason, we are transforming our organizational structure from the current 15 faculties, which have grown gradually over time, to a matrix structure that will promote innovation.

We are creating **seven schools** with departments covering the entire portfolio of major scientific domains, which will serve to form an identity and provide calibration within international scientific communities. These schools are:

- TUM School of Computation, Information and Technology
- TUM School of Engineering and Design
- TUM School of Natural Sciences
- TUM School of Life Sciences
- TUM School of Medicine and Health
- TUM School of Management
- TUM School of Social Sciences and Technology

Situated at the interfaces between these schools **Integrative Research Institutes (IRI)** will address system-wide challenges and wide-ranging, future-focused issues through transdisciplinary approaches to research and teaching. By making this change, we are exploring new methods to focus intellectual abilities in highly promising fields of innovation, in the hope that cross-school, mission-driven collaboration will yield a visible impact in international competition. Examples include biomedical engineering, robotics and machine intelligence, energy systems, process engineering, biotechnology and sustainability.

This goal is also served by the **TUM Innovation Networks**. This new format of collaborative research brings together academic talent from different disciplines more efficiently than ever before through a bottom-up approach, thereby ►

encouraging them to adopt visionary research approaches, explore genuinely uncharted scientific territory and test out its potential for development – before anyone else has dared to do the same.

By adopting the new matrix structure, TUM is also responding to the need to modernize our teaching. It is a historic reform: we are moving away from *one-size-fits-all* education towards more personalized, feedback-based *mix-and-match* programs of study with the flexibility to meet the evolving demands of global job markets (**TUM Professional Profiles**) and do justice to our students' talents and motivations. Supported by digital teaching and examination formats (hybrid learning), this approach will ensure issues are addressed in detail while identifying interdisciplinary applications, continuously forge connections to the humanities, social sciences and economics, while remaining compatible with lifelong learning and development.

Through this overall strategy, we will replace introverted silo mentalities with collaborative networks in research, teaching and innovation, bringing together the combined intelligence of the entire TUM family and our global partners.

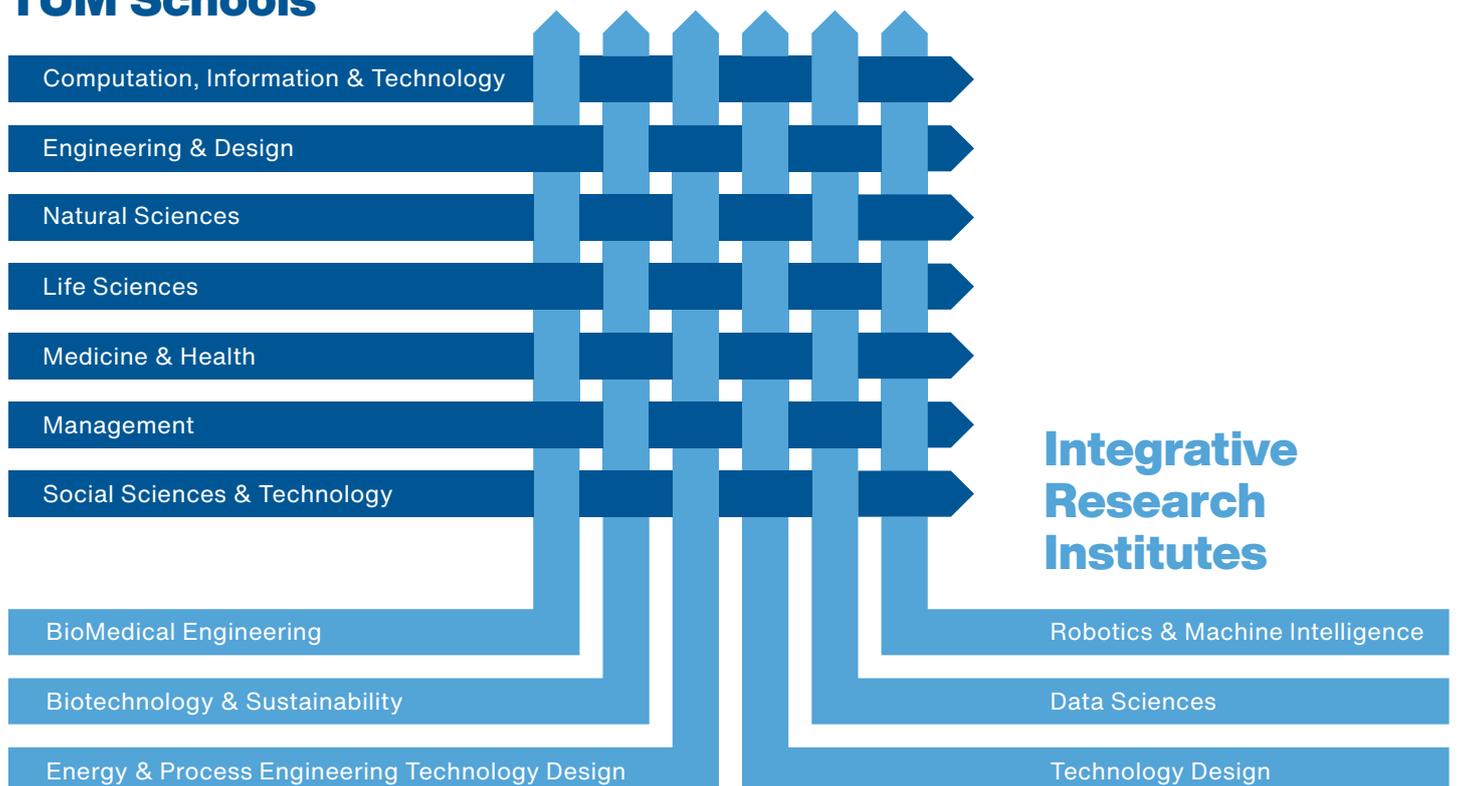


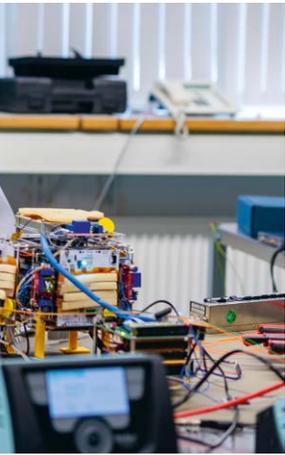
Astronautics research will now also take place on the TUM Campus Taufkirchen/Ottobrunn

i Munich Data Science Institute (MDSI)
 The breathtaking progress in data generation, data utilization and computing architecture have triggered a paradigm shift in the world of research. Machine learning and artificial intelligence (AI) have brought about technological innovations and will revolutionize our society in various dimensions. This is the focus of research at the MDSI.

www.mdsi.tum.de/en

TUM Schools





TUM Science and Study Center Raitenhaslach



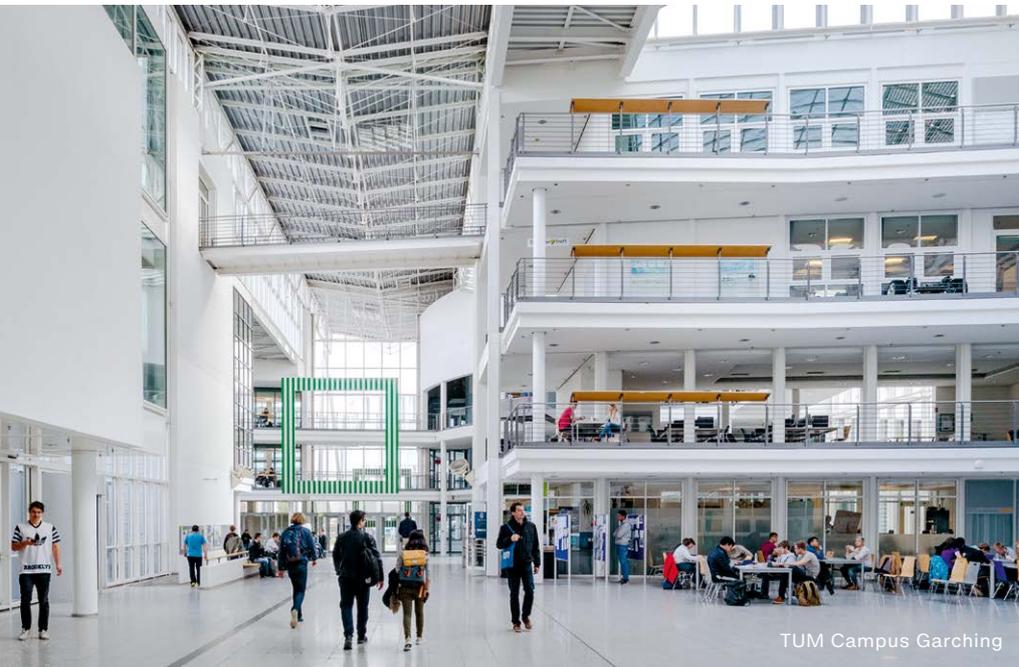
TUM Asia Singapore



TUM Campus Straubing



TUM Campus Downtown Munich



TUM Campus Garching



TUM Campus Heilbronn



TUM Campus Weihenstephan

We Foster Entrepreneurial Talent

With 70 to 80 technology-based spin-off companies per year, TUM is on course to become the European start-up champion

And the stage is set for even more start-ups in future: TUM is further strengthening its collaboration with partners from the world of business and applying the results of our basic and applied research in market-oriented innovation processes and technologies.

Following our conviction that integrating young founders in an inspiring scientific environment is the most promising way to ensure that technology-based start-ups have an enduring impact on social change, we are striving to secure a leading position in Europe for our innovation ecosystem. In addition, as part of the TUM Entrepreneurship program, we are working with the **TUM Entrepreneurship Research Institute** and our affiliated research institute **UnternehmerTUM** to provide enduring support for the establishment of growth-focused and technology-based companies – from the ideation phase through to their foundation and successful market positioning and into their growth phase.

In doing so, we have become Germany's leading higher education institution for start-ups. Every year, we bring about 70 to 80 tech start-ups to market. TUM start-ups attracted more than €1 billion in investments in 2019.

In conjunction with UnternehmerTUM and with the aim of becoming a European leader in the foundation of growth-oriented technology start-ups, we have begun to surround the university with a network of innovation centers and incubators. The **TUM Venture Labs** are aimed at developing deeptech startup families around selected technological focal points. They provide the necessary development environment – from the technical and social infrastructure to entrepreneurship coaching and support from networks of businesses and investors.

This has given rise to an entrepreneurial mindset that attracts students interested in founding their own company to TUM and actively supports them, from the initial idea to the foundation and through to market launch. To facilitate this, we network with our alumni and emeriti, who act as ambas-

sadors with a global sphere of influence, and connect with our many collaboration partners, who significantly broaden our reach.

www.tum.de/en/entrepreneurship

Innovation catalysts

TUM Entrepreneurship Center

From the initial idea through to the growth phase, the TUM Entrepreneurship Center offers extensive support and services to technology-oriented company founders. This includes MakerSpace, a high-tech workshop equipped for prototype construction and small-series production, as well as office spaces and workstations in the TUM Incubator.

TUM Venture Labs

What are the aims behind the new TUM Venture Labs? To promote entrepreneurial spirit and entire families of start-ups in key technological fields – and thereby position the Munich metropolitan region as the European start-up champion.

www.tum.de/en/venture-labs

UnternehmerTUM

A team of 240 staff supports young founders. They support start-ups from the initial idea through to the IPO, offering their expertise on company setup, market entry and financing. UnternehmerTUM has already produced many successful start-ups.

www.unternehmertum.de/en

Munich Urban Colab

Munich's Schwabing district is home to TUM's new creative quarter. Spread across five stories and 11,000 square meters, it offers space for workshops, fitness studios, winter gardens and, above all, more than 250 start-ups.

www.unternehmertum.de/en/about/munich-urban-colab



A Fresh Perspective – and Sustainable Action!

Sustainability and organizational development in research,
teaching and innovation



In future, we want to gauge ourselves more closely against what we do to promote sustainability in our society – at economic, ecological and social levels. Of course, we will expand our research and teaching activities in modern agricultural and plant sciences, bioeconomics and the fields of energy, mobility and climate research, searching for innovative solutions to promote the sustainable development of our planet. However, we also aim to make sustainability a more integral element of our own organizational and campus development. Future generations of students will favor studying and working at a university that leads by example

– by making energy savings, increasing resource efficiency, and reducing greenhouse gas emissions and environmental pollution as far as possible. These very considerations were among those incorporated into the concept for TUM's Friedrich N. Schwarz Research Station, which allows us to explore the Alpine ecosystem and trial new forms of scientific teaching. Given its significance, we have anchored the topic of sustainability at the heart of our university in the form of the **TUM Sustainability Office**. We hope that the **TUM Sustainability Taskforce** will help us to reflect self-critically on our actions, highlight where action is needed,

A view of the central meteorological tower in one of the parcels of rainforest land used by the AmazonFACE research project.



and implement targeted projects and effective measures so that TUM develops more sustainably – across all levels: teaching, research, innovation, administration and, of course, the development of our locations. In doing so, we aim to play our part in creating not only a sustainable society but also a more resilient economy, an issue that has increasingly come to light in the current global crisis.

www.tum.de/sustainability

Examples of sustainable TUM projects

i AmazonFACE

This international project researches the impacts of climate change in the rainforest. FACE stands for “Free Air CO₂ Enrichment”, the term given to a technical experimental set-up that generates a defined concentration of carbon dioxide outdoors.

www.lsai.wzw.tum.de/en

i View into the Future (BLIZ)

How will ecosystem services and biodiversity develop in Bavaria? The interdisciplinary collaborative project BLIZ develops new scenarios for sustainable ecosystem management in Bavaria. Its aim is to develop specific guidelines and assess possible uncertainties.

www.bayklif-bliz.de

i TUM Straubing Campus for Biotechnology and Sustainability (TUMCS)

Developing sustainable technologies and guiding commercial implementation – two major topics brought together by the TUM Straubing Campus, which acts as an Integrative Research Institute of the Technical University of Munich in cooperation with the Weihenstephan-Triesdorf University of Applied Sciences. This requires specialists in natural and technical sciences, chemical scientists, biotechnologists and engineers who also have a broad understanding of economic and social coherences, as well as economists who speak engineers’ language.

www.cs.tum.de/?lang=en

i Werner Siemens-Chair of Synthetic Biotechnology (WSSB)

Carbon fiber components are extremely lightweight and robust. Until now, producing these components has required crude oil. In the Green Carbon project, the Werner Siemens-Chair of Synthetic Biotechnology at TUM collaborates with partner businesses to produce the material sustainably from algae and yeasts.

www.department.ch.tum.de/en/wssb

Our Mission

We are committed to making sustainable, innovative progress for the benefit of humankind, nature and society

Moving forward with inquisitive minds

Change remains our constant. We learn from our experiences and scrutinize the consequences of our actions. We are geared to addressing new challenges and seizing opportunities to promote the sustainable development of scholarship, ecology, the economy, health, and social relationships – in turn generating joy, motivation and performance power that drives us forward.

A focus on people

In an age of technological change, we must reflect on the consequences of our actions and research with due regard to all economic, ecological, social, political, and ethical implications. We pursue innovations not for the sake of technological progress but for the good of humankind and to preserve a livable environment. The principle of *human-centered engineering* pervades our research, innovation and teaching.

Teams, not silos

We are reorganizing our internal structure to improve our efficacy, moving from a faculty-based system to a matrix organization that promotes innovation, comprising schools, departments and interdisciplinary research centers. In doing so, we aim to convert strategic development potential into innovations with greater efficiency, accelerate the foundation of spin-offs, and improve our operational agility to ensure we are fit to face the future.

A culture of lifelong learning

Our teaching focuses on the competence profiles required in the employment markets of the future. We are constantly developing our teaching and training concepts. As a lifelong learning partner, we seek to ensure the continued professional success of our own staff, our alumnae and alumni, plus specialists from the fields of business, politics and society, by offering continuous training and education firmly rooted in science.

i Our mission statement

You can find more information about our vision, mission, core values and guiding principles at:

 www.tum.de/mission-statement
