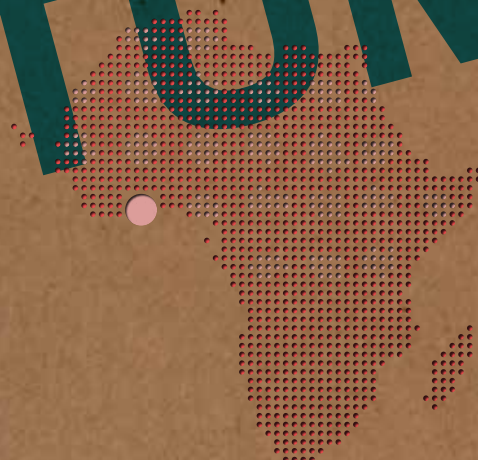




TUM

Partnership for Innovation
and Sustainable Development

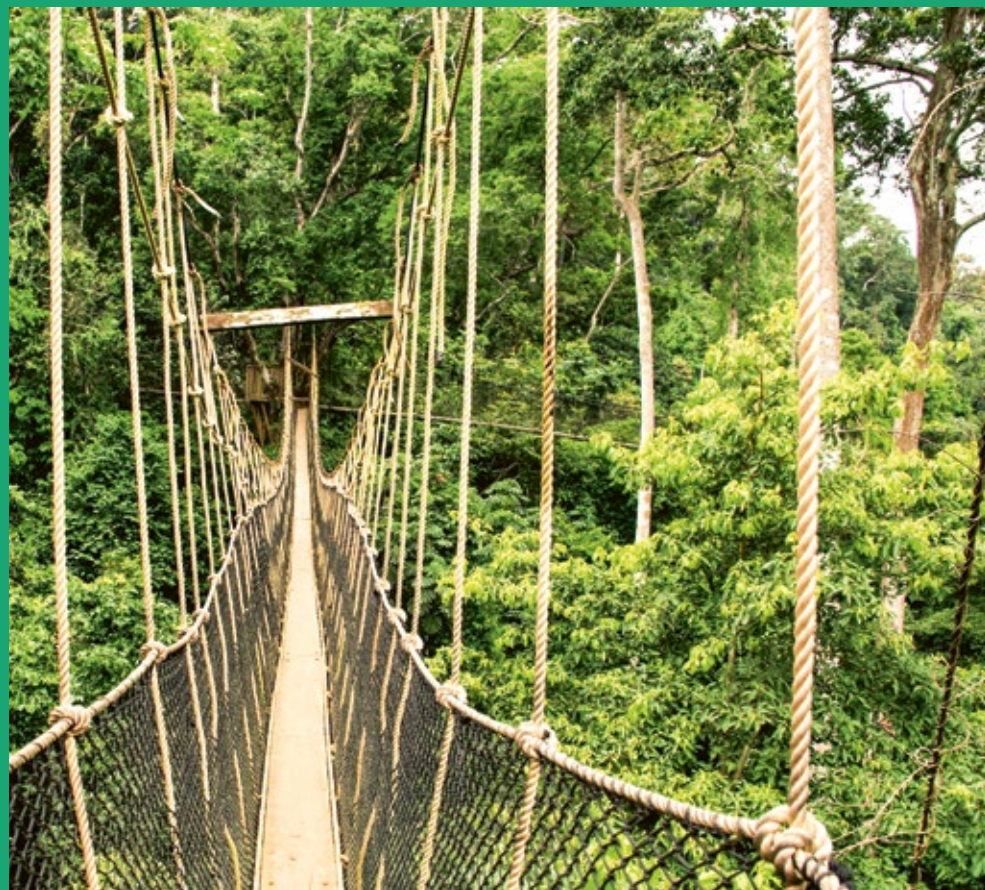
KNUST TUM
KNUST TUM



KNUST TUM

It started with the development of an all-wheel drive for rural Africa. Today, Kwame Nkrumah University of Science and Technology (KNUST) and the Technical University of Munich (TUM) are joining forces to create a Partnership for Innovation and Sustainable Development, particularly related to water, energy, environment, mobility, and global health.





06

10

11

12

13

15

37

41

42

Editorial

Introduction

Our Vision

Cooperation Platform

Thematic Clusters

Project Highlights

Our Impact

Contact

Imprint

Editorial

“Kwame Nkrumah University of Science and Technology is a leading scientific and technological University in Africa. Its unique mission is ‘to provide an environment for teaching, research and entrepreneurship training in Science and Technology for the industrial and socio-economic development of Ghana, Africa, and other nations.’

KNUST is ranked by the U.S. News & World Report as the best university in Ghana and West Africa, 14th in Africa and in the top 47 % globally. As Ghana’s premier science and technology university, KNUST is proud to pioneer new ideas in teaching, research, and entrepreneurship with TUM to the benefit of both institutions and our communities. Generating ideas and exchanging knowledge in innovation and technology, we are jointly creating a partnership, which addresses the challenges of our times and adds value to society.”

Prof. Kwasi Obiri-Danso

Vice-Chancellor of Kwame Nkrumah University
of Science and Technology



6

7

Editorial

“The Technical University of Munich stands for excellent research and teaching and for a fertile entrepreneurial ecosystem, which facilitates the transfer of technological innovations to society.

This expertise is of high relevance for Africa, a continent with tremendous future potential. In order to tap into this potential, we are tackling global challenges by joining forces with strong partners. Building on the successful technology and education initiatives with KNUST, we are committed to advancing our strategic partnership for innovation and sustainable development.

We look forward to jointly educating young talents, who will move industrial and socio-economic development forward with technical innovations and a bold entrepreneurial spirit.”

Prof. Thomas F. Hofmann

President of Technical University of Munich





KNUST – TUM

a partnership in scientific, technological, and entrepreneurial excellence

- **TUM – The Entrepreneurial university combines technological and scientific excellence with interdisciplinary research acting with an entrepreneurial spirit.** TUM is one of Europe's leading universities and committed to delivering new solutions to the global challenges.
- **KNUST is a leading scientific and technological university in Africa.** Its unique mission is “to provide an environment for teaching, research and entrepreneurship training in Science and Technology for the industrial and socio-economic development of Ghana, Africa, and other nations”.
- **Building on a successful relationship, KNUST and TUM act together as change agents in the world** combining capacity development with direct action aiming at an immediate as well as sustainable impact.

Funded under the Excellence Strategy
of the Federal Government and the Länder:



10

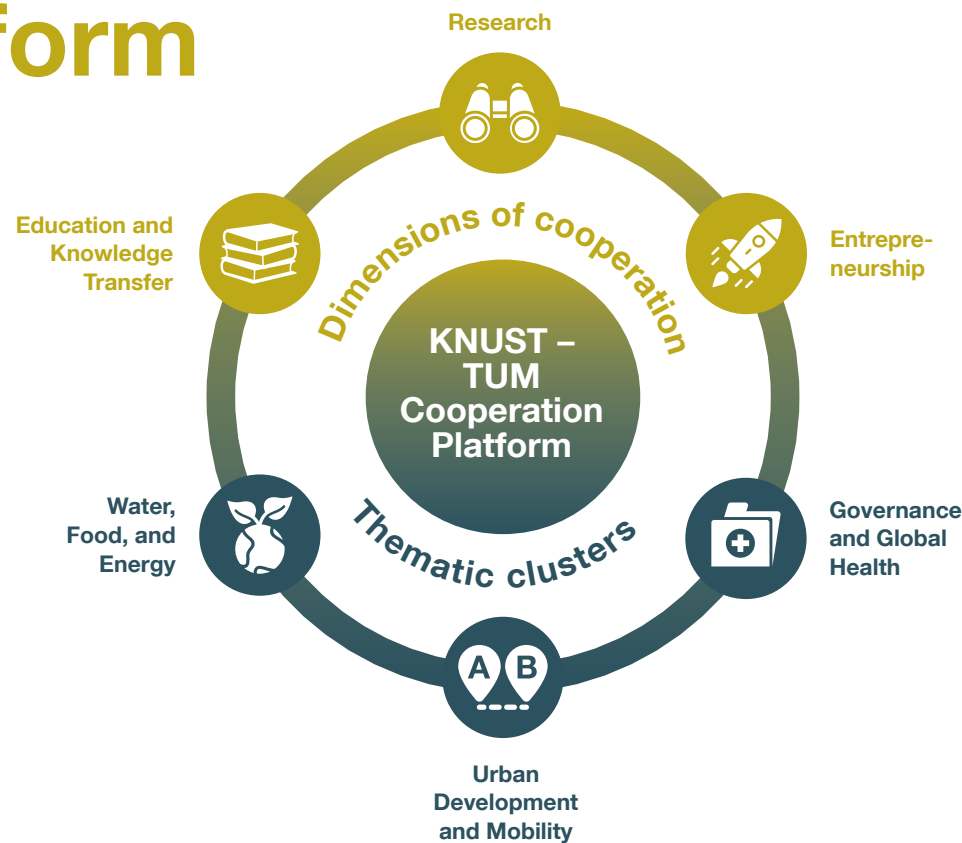
11

Our Vision

- A KNUST – TUM strategic partnership combining innovative teaching, research, technological expertise and entrepreneurship, addressing local needs and engaging German and Ghanaian stakeholders, e.g. industry, NGOs, ministries, church organizations.
- Promotion of intra-African cooperation: creation of a continental nod bundling expertise and findings from joint projects, offering connecting points for further project development in Africa.
- Promoting digitization in cooperation: creation of a joint virtual platform, sharing best practices and creating visibility for joint projects.
- An interdisciplinary and participatory approach for innovating impact-oriented solutions for sustainable development in Ghana comprising the clusters:

Water, Food, and Energy
Urban Development and Mobility
Global Health and Governance

Cooperation Platform



12

13

Thematic Clusters Projects



Water, Food, and Energy

SEED – Sustainable Energies, Entrepreneurship, and Development
Sustainable management of e-waste
Urban Water-Energy-Food Nexus
Mathematical model for malaria life cycle induced by floods



Urban Development and Mobility

Cooperation Center KNUST – TUM
aCar mobility project
ADLAND – Advancing collaborative research in responsible and smart land management
AFRICA – Aged FRugal Innovation Cum Application
Blockchain land registration innovation



Global Health and Governance

One health – impact-orientated research and education
Medical partnership, focus surgery
Research network on responsible AI
Women's health and cervical cancer prevention in Ghana
Sterilizers for medical facilities in rural areas



Building site visit in Kumasi: Prof. Rexford Assasie
Oppong (left), Dean of International Programmes Office,
receives Prof. Julianne Winkelmann (middle), Senior Vice
President for International Alliances and Alumni, during
TUM delegation visit to KNUST
© Vanessa Grünhagen, TUM Global & Alumni Office

Project Highlights

AFRICA – Aged FRugal Innovation Cum Application

16

KNUST Contact

Prof. Michael Poku-Boansi

Department of Planning

TUM Contact

Prof. Thomas Bock

Chair of Building

Realization and Robotics

The AFRICA project aims to implement decentralized smart solutions for independent living and social participation for older persons through cost-efficient innovation.

Numerous senior citizens in Sub-Saharan Africa have no choice but to continue to work as long as they are physically able to. The AFRICA team, consisting of researchers and students from different academic backgrounds at TUM and KNUST, examines the productivity of the elderly, knowledge transfer, education, and the use of complex production and assembly knowledge in the context of an aging society. In the scope of the THINK. MAKE. START. program, ten postgraduate students of both universities will work together in order to develop concrete concepts to improve the social security and quality of life of the elderly in Africa.

1 Widespread and independent working in an aging society, based on cloud manufacturing

© C. Schlegelmilch

2 Responsive engagement of the elderly, promoting activity and customized healthcare

© Rongbo Hu

3 Architecture students planning vernacular architectural settlements at KNUST in Ghana

© Prof Michael Poku-Boansi



1



2



3

ONGOING
PROJECT

Cooperation Center KNUST – TUM

KNUST Contact

Prof. Rexford Assasie

Oppong, PhD

Department of Architecture

Dean, International

Programmes Office

TUM Contact

Prof. Francis Kéré

Chair of Architectural

Design and Participation

KNUST and TUM are in the midst of planning a Cooperation Center in Ghana to foster the great collaboration potential between the two partner universities.

In 2018, KNUST and TUM entered a sustainable and strategic partnership, engaging in future-oriented fields and developing new formats of collaboration in teaching, researching, and entrepreneurship. In order to guarantee a fruitful exchange of ideas and experiences, a Cooperation Center is being planned and designed at the KNUST campus in Kumasi to provide space for workshops, lectures, and discussions. With the support of the Bavarian State Chancellery, the international project team consisting of experts from both partner universities has started the planning process by engaging in interdisciplinary academic exchange.

ONGOING
PROJECT

18

1 Choosing the site
of the future Cooperation
Center, December 2019

© IPO KNUST

2 KNUST – TUM
Workshop in Ghana,
September 2019

© Courage Kpodo (KNUST)

3 KNUST – TUM
Workshop in Ghana,
September 2019

© Courage Kpodo (KNUST)



1



2



3

Medical technology for local needs

KNUST Contact

Dr. Joshua Ampofo

College of Engineering

Dr. Mohamed Mutocheluh

College of Health Sciences

TUM Contact

Prof. Petra Mela

Dr. Markus Eblenkamp

Fabian Jodeit

Chair of Medical

Materials and Implants

As a measure to enhance infection prevention, TUM and KNUST scientists are working on sustainable sterilizers that can be produced locally and implemented in small medical facilities.

Due to the lack of infrastructure in rural areas in Sub-Saharan Africa, many patients are treated in small medical health centers that have no working sterilization unit for their materials. With the support of the Bavarian State Chancellery, the broad knowledge of Ghanaian experts is applied in a joint project, which focuses on the tailored development of sterilizers. These will be adapted to the special environmental conditions considering the handling and supply of equipment. The next planned steps are a microbiological contamination study in a reference hospital and project-specific student exchanges.

1 The goal is to develop sterilizers that can be implemented even in the smallest medical facilities

2 Signing of MoU between TUM and Ethiopian partners regarding medical technology development

© Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

3 1st African-German Networking Days on Medical Technology organized by TUM in Addis Ababa 2019

© Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)

20



1



2



3

ONGOING
PROJECT

Urban Water, Energy, and Food Nexus

KNUST Contact

Prof. Michael Poku-Boansi

Department of Planning

TUM Contact

Prof. Jörg E. Drewes

Dr. Daphne Keilmann-

Gondhalekar

Chair of Urban Water

Systems Engineering

Urban Water, Energy, and Food Nexus initiative sets out to establish a joint research and teaching program for TUM and KNUST.

The Urban WEF Nexus research initiative is being conducted at the TUM Chair of Urban Water Systems Engineering and has been supported by the Bavarian State Ministry of Environment and Consumer Protection since its establishment in 2017. WEF focuses on water reclamation with integrated resource recovery as a key to sustainable urban development in Africa, Asia, and Bavaria. Building on the collaboration basis that formed the Nexus core group, an upcoming KNUST – TUM workshop, which is funded by the TUM Global Incentive Fund, will be the starting point for a joint research and training program of the initiative.

1 TUM Urban WEF Nexus case study city

© Daphne Keilmann-
Gondhalekar

2 Urban-rural interface as an object of WEF Nexus analysis in Ghana

© Markus Disse

3 A class being taught at KNUST

© Walter de Vries

22



1



2



3

ONGOING
PROJECT

Cervical cancer prevention in Kumasi

KNUST Contact

Dr. John H. Amuasi

Department of

Global Health

TUM Contact

Prof. Stefanie J. Klug

Chair of Epidemiology

Cervical cancer is the leading cancer-related cause of death among women in Ghana. Improved access to and availability of cervical cancer prevention offer new treatment options.

During a two-day workshop in Kumasi, organized by the TUM Chair of Epidemiology, clinicians, researchers, health care workers, and students explored the question of how to improve cervical cancer prevention and treatment in Ghana. Key points of the discussion were the availability and affordability of HPV vaccination and screening. As a main outcome of the workshop, collaborative research and capacity building strategies will be developed to support efforts to improve cervical cancer prevention and treatment in Ghana. This planned collaboration will also include student exchange between KNUST and TUM.

ONGOING
PROJECT

24

1 Prof. Klug teaching a seminar at KNUST

© Sandra Weinmann

2 First day of the Workshop "Cervical cancer in Ghana"

© Sandra Weinmann



1



2

From right to left:
Prof. Andrea Winkler,
Dr. John Amuasi, Prof. Stefanie
Klug, Prof. Marion Kiechle

Blockchain for land registration

KNUST Contact

Dr. Frank Gyamfi-Yeboah

Department of Land

Economy

TUM Contact

Prof. Walter Timo de Vries

Chair of Land Management

Blockchain is a technology with high potential to make land registration more transparent and effective. Starting with a workshop in Ghana, this project is geared for in-depth research on blockchain.

Blockchain is a data structure that records transactions. Whilst currently mainly used in cryptocurrency transactions, there is a potential to apply it to land transactions. The uptake of blockchain may contribute to the establishment of a more effective land market. This will not only support the administration of land transactions, but also provide an incentive to the pioneering work of private firms. The first step is a workshop focusing on existing legal and institutional frameworks for land registration in Ghana and the pros and cons of the uptake of blockchain in this regard. This will foster both a research and policy agenda in this field.

PROJECT
IN INITIATION

26

1 Expanding land market in Kumasi

© Walter T. de Vries

2 Collaboration between Chair of Land Management at TUM with Department of Land Economy at KNUST

© Walter T. de Vries

3 Department of Land Economy at KNUST

© Walter T. de Vries



1

2

3

Sustainable e-waste management

28

KNUST Contact

Prof. Kwasi Preko

Faculty of Physical and
Computation Science

TUM Contact

Prof. Magnus Fröhling

Chair of Circular Economy

Together with KNUST, the TUM Chair of Circular Economy aims to develop strategies for more sustainable e-waste management in Ghana considering the local environment, health, and safety conditions.

The number of electrical and electronic appliances at the end of their life cycle is increasing globally. Large quantities often end up in Sub-Saharan Africa, exported as waste or goods with short life spans. These export streams affect local e-waste management systems, which are often complemented by an informal recycling sector that provides work at the cost of the environment and people's health. A KNUST – TUM consortium, together with governmental and societal stakeholders, works on a framework that unites the benefits of both sectors. Specific issues will be addressed in third-party funded projects to establish a joint long-term collaboration.

1 Visit by a TUM

delegation led by Senior
Vice President Prof.

Winkelmann to KNUST

to advance the strategic

partnership for inno-

vation and sustainable

development

© Dr. Harald Oik

2 Developing strategies

for more sustainable

e-waste management

© shutterstock/corgarashu



1



2

PROJECT
IN INITIATION

Malaria interdisciplinary research initiative

30

KNUST Contact

Prof. Divine Ahadzie

Department of the Centre
for Settlements Studies

Dr. John Humphrey Amuasi

Global Health Department

TUM Contact

Prof. Markus Disse

Dr. Jorge Leandro

Chair of Hydrology and
River Basin Management

In order to set up a joint malaria research program, KNUST is holding a seminar together with TUM and other partners in 2020.

Flooding is the most common natural disaster worldwide. While it is often associated with economic damage, it also has a wide range of health impacts including the outbreak of infectious diseases.

In this context, a malaria research initiative is being conducted at the TUM Chair of Hydrology and River Basin Management, aiming to build a wider partnership between TUM, KNUST, the University of Tübingen, Stellenbosch University, and the Center of Medical Research Lambaréné. The goal of the joint project is to develop a mathematical model for the whole life cycle of malaria induced by hydrological events.

1 Faculty of
Pharmacy at KNUST

© Markus Disse

2 Hydromechanics
laboratory at KNUST

© Markus Disse

3 West African Science
Service Centre on
Climate Change and
Adapted Land Use
(WASCAL) Building
at KNUST

© Markus Disse



1



2



3

PROJECT
IN INITIATION

Research network on responsible AI

32

KNUST Contact

Ing. Dr. Jerry John Kponyo

Faculty of Electrical and
Computer Engineering

TUM Contact

Prof. Dr. Christoph Lütge

Dr. Caitlin Corrigan

Institute for Ethics in

Artificial Intelligence (IEAI)

A regional approach to the responsible use of AI is a key topic for those working on sustainable development. KNUST and TUM researchers aim to promote interdisciplinary collaboration on this topic.

Organizations working on the Sustainable Development Goals set by the United Nations General Assembly are increasingly focused on AI-based technologies due to their promise to improve well-being and, in turn, reduce poverty. However, the specific impacts of these technologies often remain unknown. The transnational nature of AI technology also implies a growing need to understand how it may affect different societies. In light of this, researchers of KNUST and TUM's Institute for Ethics in Artificial Intelligence are developing a network of scholars to join forces on the topic of responsible AI, with a focus on sustainability in the context of Africa.

1 Launch of the Institute
for Ethics in Artificial
Intelligence

© Andreas Heddergott

2 IEAI researcher tours
the Faculty of Electrical
and Computer Enginee-
ring at KNUST during
the kick-off meeting
in Ghana

© Laud Ammah

3 Project research assis-
tant of the TUM Institute
for Ethics in Artificial
Intelligence (IEAI), Laud
Ammah, meets with
Dr. Jerry Kponyo and
his team at KNUST for
the kick-off meeting

© Laud Ammah



1



2



3

PROJECT
IN INITIATION

Clean energies for all

KNUST Contact

Prof. Rexford Assasie

Oppong, PhD

Department of Architecture

Dean, International

Programmes Office

TUM Contact

Prof. Dr. Frank-Martin Belz

TUM School of Management



One billion people worldwide lack access to electricity. To tackle this grand societal challenge, the new TUM SEED Center will collaborate with eight leading partner universities in the Global South.

The long-term TUM initiative focuses on research, teaching, and knowledge transfer in Sustainable Energies, Entrepreneurship, and Development (SEED). It fosters international mobility, academic exchange, and capacity building in the Global South. A key element is the co-creation of 'Living Labs', providing clean energy and fostering entrepreneurship. In addition to KNUST in Ghana, the SEED network includes partner universities in Ethiopia, Kenya, Namibia, Uganda, India, Indonesia, and Peru. The alliance is part of the DAAD's exceed program from 2020 to 2024, funded by the German Federal Ministry for Economic Cooperation and Development.

PROJECT
IN INITIATION

34

1 Students from St. Rupert Mayer High School measuring the composition of biogas

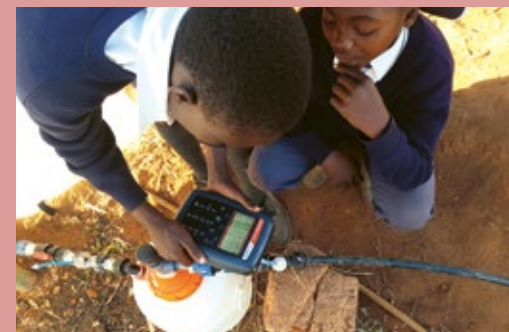
© Sojan Prajapati

2 A student of St. Rupert Mayer High School transporting freshly produced biogas to the local hospital's kitchen

© Sojan Prajapati

3 Maintenance of the photovoltaic system by the local gardener, Itai

© Stephan Baur



1



2



3

1 Potential application field for the electric car that meets the requirements of the rural population in sub-Saharan countries

© Lehrstuhl für Industrial Design / TUM

2 From sketch to production: one of the first design drafts of the aCar prototype

© Lehrstuhl für Industrial Design / TUM



1

Our Impact

The aCar project shows in an exemplary manner how African-German cooperation in science can create innovative, impactful, and sustainable solutions on both sides:



2

aCar – sustainable mobility for rural Africa

KNUST Contact

Dr. Joshua Ampofo

Department of
Mechanical Engineering

Dr. Samuel Dodoo

Department of Physics

TUM Contact

Prof. Markus Lienkamp

Matthias Brönnner

Institute of Automotive
Technology

Prof. Fritz Frenkler

Chair of Industrial Design

Prof. Wolfram Volk

Chair of Metal Forming
and Casting

With the participation of KNUST, TUM developed the aCar, an all-wheel-drive electric vehicle for rural Africa. This milestone was the base for the strategic partnership established in 2018.

It started as a research project, which was then funded by the Bavarian Research Foundation: the construction of a coherent concept vehicle to address the mobility challenges of the rural population and, as consequence, enable the people to get access to health care, education, and information. The international development team tested the technology in Ghana and customized the aCar for local application scenarios and conditions. Today, EVUM Motors, a spin-off company originating at TUM, is starting the aCar production in Germany. International production in developing countries is set to start in 2021 and further fields of application for electric vehicles in Africa are being researched at the Green Innovation Centers, funded by the GIZ.

1 The aCar team
at the International
Automobile Exhibition
in 2017 in Frankfurt

© Institute of Automotive
Technology

2 Vehicle testing at
KNUST: Range test

© Max Eiba

3 Vehicle testing
at KNUST: User
acceptance test

© Institute of Automotive
Technology

38



1



2



3

Let's shape the future of our partnership together!

Engage with the KNUST – TUM Partnership for Innovation and Sustainable Development! We are inviting companies, governmental as well as non-governmental organizations, and further societal stakeholders to become actively involved in our partnership.

Connect with us to exchange ideas and take advantage of our broad portfolio of research, education, and entrepreneurship activities.

40

41

Contact

Technical University of Munich
Arcisstraße 21
80333 Munich

Prof. Dr. Juliane Winkelmann
Senior Vice President
International Alliances and Alumni
juliane.winkelmann@tum.de



Imprint

Publisher

Prof. Dr. Thomas F. Hofmann | President of the Technical University of Munich

Editorial office

TUM Global & Alumni Office

Person responsible according to the German Press Law

Dr. Harald Olk

Design

KW NEUN Grafikagentur | www.kw-neun.de

Contact

Vanessa Grünhagen | TUM Global & Alumni Office | Arcisstr. 21 | 80333 Munich, Germany
Tel. +49.89.289.22165 | E-mail: gruenhagen@zv.tum.de | www.international.tum.de

Printing

SYLVIA LERCH | Material & Produktion | Schöttlstr. 16 | 81369 Munich

Paper

Printed on FSC certified paper | Cover: Muskat, Inner part: PlanoJet®

Print run

1.000 copies

KNUST international.tum.de/knust/ TUM
KNUST TUM