

M o m e n T U M

TUM ASIA EVENTS, HIGHLIGHTS
& ALUMNI STORIES

2023 | Edition 01

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PRESIDENT EMERITUS AND DIRECTOR'S MESSAGE



It is no hyperbole to say that students are the life and blood of our university. After two years of emptiness, the campus comes alive with students returning in full force. Finally, we are putting the COVID-19 pandemic behind us but not forgotten. On a philosophical level, this painful chapter has served to remind us how delicate the world is, with which our lives and livelihoods are greatly hinged upon, and the monumental amount of vigilance and effort required to preserve it. At the same time, the pandemic stands in many ways, a testimony to our students' remarkable abilities to navigate disruptions and surmount challenges. Despite being bereft of campus life and classroom interactions, the students managed to eke the best learning experiences out of their time at the university. Thus, the moment our graduands took the stage to receive their scrolls was exceptionally poignant for us.

With all in-person events resumed in full swing, our students are having the time of their lives experiencing the full gamut of campus life at TUM Asia. We even had the Federal President of the Federal Republic of Germany, His Excellency Dr. Frank-Walter Steinmeier visiting us at our campus!

Last December, some of our students and staff delivered a spectacular dance performance at the annual TUM Dies Academicus Day celebration before a thousand-strong crowd of TUM employees, students, alumni, friends and partners who had come together to exchange ideas and honour special achievements. We are immensely proud to see our TUM Asia community from different walks of life banding together, which perfectly embodies the cultural diversity that characterises TUM Asia.

On the heels of numerous clarion calls to accelerate climate action, countries are moving decisively to decarbonise their economies. In Singapore, with no hinterland and limited resources, the task

of achieving carbon neutrality is an uphill one, but the latest research project – Singapore's Pathway to Carbon Neutrality – that TUM Create is embarking on alongside Nanyang Technological University Singapore will provide a margin of manoeuvre for Singapore as they endeavour to chart a foreseeable pathway of alternative energy sources that would enable Singapore to ultimately reach the goal of climate neutrality.

In this issue, we feature Gunjot Kaur as one of the extraordinary TUM Asia's #womeninSTEM who found success in the male-dominated STEM field through years of honing her leadership skills to mastery. She is now helming the role of Director of Product Marketing at Infineon Technologies.

In the same vein, we shine the spotlight on a fellow student, Sudeekshna, and her sister, Smruthi, who gave up her dream to fulfil her sister's dream of becoming a successful transport planner. The trajectory of Sudeekshna and her family is truly a tale of remarkable strength and determination. Even as tragedy upends their lives, the sisters manage to steer back to the path they have already charted for themselves – a reminder of the power and purpose we can bestow upon ourselves.

You will also discover more about our alumnus Dinesh and his journey in this issue. In many ways, Dinesh's journey traversed the same story arc as many inspiring entrepreneurs. Struck by a personal episode of watching helplessly a mother grieving from the accidental deaths of her children, he devoted all his energies to improving the accessibility of healthcare in the backwaters of India. He founded Yali Aerospace, delivering drone solutions for medical, surveillance and logistics to save lives throughout the world. It is immensely gratifying to see the knowledge we teach at TUM Asia taking the permanent form of an organisation that serves the very purpose of improving lives and livelihoods.

These individuals are the kind of epics that the world needs, especially in an era where we are confronted by a multitude of complex and interconnected challenges. We are pleased to feature stories of our amazing TUM Asia community, of their incredible feats and extraordinary will to make an impact in the respective domains.

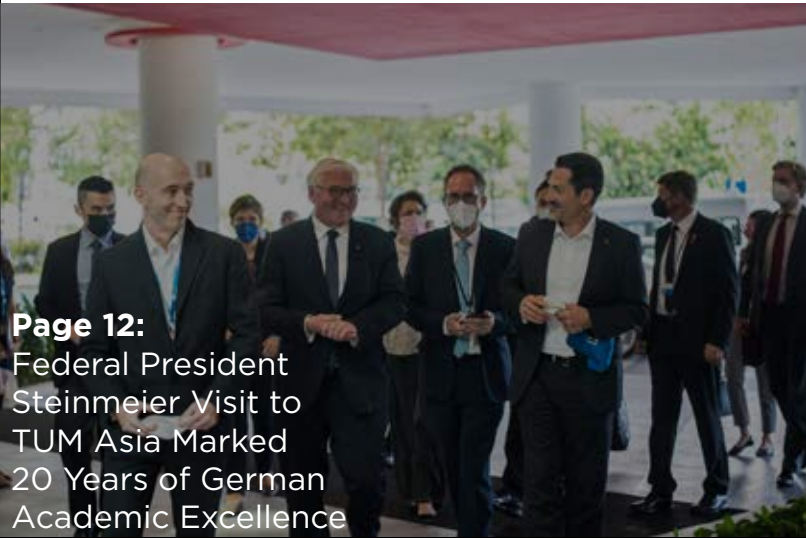
With this, we hope you will enjoy reading this issue of MomenTUM. Stay curious.

Prof. Dr. Wolfgang A. Herrmann
President Emeritus, TUM
Academic Director, TUM Asia

Dr. Markus Wächter
Managing Director,
TUM Asia



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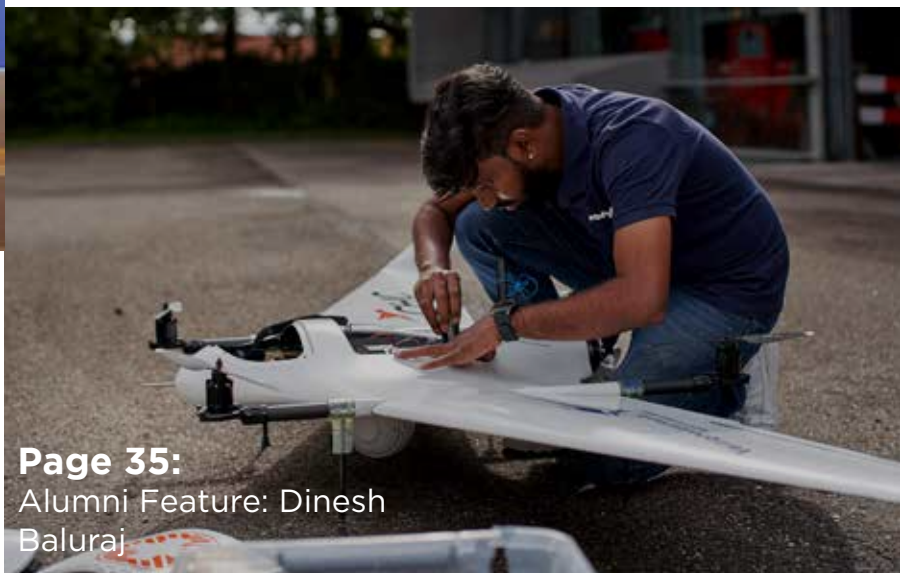
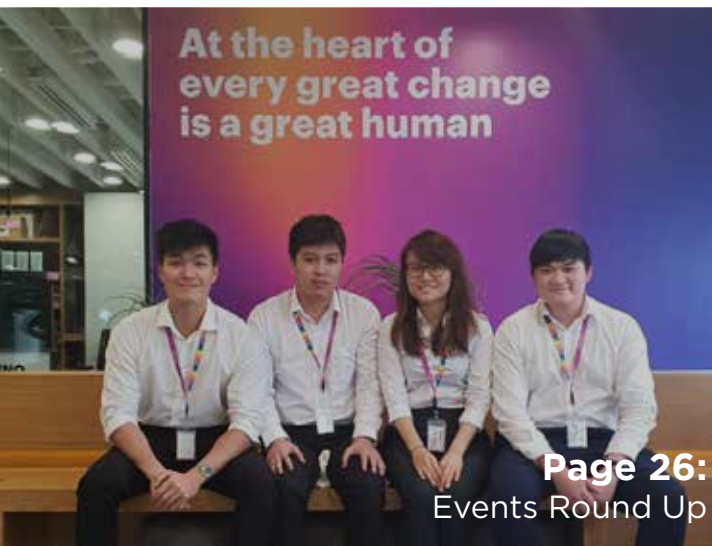
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TUM ASIA'S REVAMPED MASTER'S TO TRAIN ASPIRING ELECTRONICS AND MECHATRONICS STUDENTS IN AEROSPACE ENGINEERING

- The redesigned Master of Science in Aerospace Engineering programme conferred by TUM, will enable students with relevant electronics and mechatronics knowledge to pursue a postgraduate education and career in aerospace engineering.
- Now comprising the “Mechanics for Aerospace Engineers” module, and laboratory modules such as “structural modelling lab” and “aerodynamics modelling lab”, students will acquire the necessary foundational knowledge and skill sets and connect the disparate fields to design modern complex aircraft structures, and integrate cyber-physical systems.

TUM Asia is transforming the curriculum of its Master of Science in Aerospace Engineering programme to integrate complementary modules, enabling more mechatronics and electronics students without prior aerospace engineering

background to pursue a postgraduate education in Aerospace Engineering. The redesigned programme aims to attract more students with mechatronics or electronics background to join the evolving aerospace industry and augment

Students with electronics or mechatronics background would be able to bring their skills and knowledge to the table as a transversal aggregator by straddling knowledge from their disciplines to provide for custom solutions that can support any component.



the current pool of aerospace engineers with their skills set by developing smarter aerospace systems and integrated solutions to deliver and optimise the full spectrum of aircraft performance.

Curated in close consultation with industry experts and TUM Professors, the Master of Science in Aerospace Engineering now comprises the **“Mechanics for Aerospace Engineers”** module, designed to equip students with the necessary foundational knowledge in all aspects of aerospace mechanics and enhance their skill set required to design modern complex aircraft structures, and integrate cyber-physical systems.

In addition, lab modules such as **“Structural Modelling Lab”** and **“Aerodynamic Modelling Lab”** will enable students to master multiple skill sets through hands-on laboratory exercises and gain a holistic understanding of the complex

interplay between specialised domain areas such as aerodynamics, aeroelasticity, structures, vertical flights or rotorcraft.

Complex interplay between aerospace systems and aircraft structures

As aircrafts evolve with lighter and more flexible structures, aerospace systems too are evolving with more sophisticated intelligent systems or cyber-physical systems equipped with powerful computers, sensors that allow for autonomous flights. The complex interplay between the aircraft with its surrounding particles and the autonomous systems they are operating on presents a new set of unprecedented challenges in which conventional aerospace engineers may not be fully equipped to solve. Students with electronics, or mechatronics background would be able to bring their skills and knowledge to the table as a transversal aggregator by straddling

The addition of “Mechanics for Aerospace Engineers” module allows students of different study background to gain the fundamental knowledge in how aircraft respond to different external forces by studying statics, dynamics, materials strength, elasticity, viscoelasticity and fluid dynamics.



knowledge from their disciplines to provide for custom solutions that can support any component – interior or exterior – while taking into consideration the conditions involved to optimise aircraft performance.

“Universities have traditionally nurtured single discipline, where degrees are structured across well-defined boundaries by deep diving into a particular specialisation. As technologies advance exponentially in sophistication, we see deep specialisation and cross-fertilisation across silos of disciplines growing in prominence. Graduates are now not only required to specialise in one field, but also to be able to unite different disciplines and develop integrated solutions. With the newly revamped aerospace engineering programme, our students will be equipped with skill sets of both disciplines – aerospace engineering and electronics or robotics that enable them to tackle the complex challenges our world faces,” said Dr. Markus Wächter, Managing Director of TUM Asia.

**DR. MARKUS WÄCHTER,
MANAGING DIRECTOR, TUM ASIA**

With the newly revamped aerospace engineering programme, our students will be equipped with skill sets of both disciplines – aerospace engineering and electronics or robotics that enable them to tackle the complex challenges our world faces.

WHAT TO EXPECT: MODULES INTRODUCED IN REVAMPED AEROSPACE ENGINEERING

Mechanics for Aerospace Engineers

The addition of Mechanics for Aerospace Engineers module allows students of different study background to gain the fundamental knowledge in how aircraft respond to different external forces by studying statics, dynamics, materials strength, elasticity, viscoelasticity and fluid dynamics. Students would be able to recognise static load-bearing structures in nature and technology and can extract mechanical models from reality, classify them in terms of analysis and calculate statically determinate as well as statically indeterminate systems using the methods they have learnt. With this module, students would develop the ability to recognise mechanical issues in engineering and solve them independently.

Structural Modelling Lab

The addition of the laboratory course, Structural Modelling Lab aims to demonstrate the use of common Finite Element software tools using examples from the field of aerospace structures. The module aims to provide students with the knowledge and know-how in modelling, analysing and evaluating aeronautical structures with regard to their characteristics.

The Aerodynamic Modelling Lab

Introducing fluid dynamics modelling for aerospace applications, the Aerodynamic Modelling lab enables students to understand different models and methods available in current flow simulation tools. The set-up and execution of flow simulations as well as the analysis and evaluation of the results are discussed. Upon successful completion, participants will be able to analyse and evaluate aerodynamic properties such as forces and pressure distributions as required in the aircraft design process.



#THROWBACK: CELEBRATING 20 YEARS OF ACADEMIC EXCELLENCE

What a blast! TUM Asia marked its twentieth year of bringing German academic excellence to Singapore with a line-up of celebrations and announcements. Here is a throwback of our spectacular celebrations we have had last year.



◀ Lucky ones! Some of our students had the fortuitous opportunity to get hold of one of the TUM caps as President Hofmann tossed the caps to the gaping crowd.





◀ Mr Tan Chek Ming, DigiPen Singapore's Managing Director giving a hug to President Hofmann: The 20th anniversary dinner revisited memories of the formative years of TUM Asia with Mr Tan Chek Ming, who has been engaging TUM Asia since his days at EDB and SIT.



▲ The 20th Anniversary Gala Dinner saw many institutes and industry partners such as Dr. Ronny Sondjaja, Vice President & Head of Research, Development & Innovation (Asia) at Evonik, attending the special celebration.



FEDERAL PRESIDENT STEINMEIER VISIT TO TUM ASIA MARKED 20 YEARS OF GERMAN ACADEMIC EXCELLENCE IN SINGAPORE



- To commemorate its 20 successful years in Singapore, TUM Asia lined up a series of celebrations, culminating in an exclusive visit by the Federal President of the Federal Republic of Germany, His Excellency Dr. Frank-Walter Steinmeier.
- TUM remains the only German university to have an overseas presence in Singapore.
- TUM Asia has grown from 20 students in its first postgraduate programme - Master of Science in Industrial Chemistry - to more than 2,000 graduates coming through its doors, plying their trades in top research institutes and multinationals.
- Evolving from its roots of providing academic excellence in engineering, TUM Asia is currently spearheading research programmes in mobility and nurturing future leaders in the areas of food sustainability.



TUM Asia marked its twentieth year of bringing German academic excellence to Singapore with a line-up of celebrations and announcements that will set the stage for the organisation's strategic direction in the years to come. The series of celebrations culminated on 14 June in an exclusive visit by the Federal President of the Federal Republic of Germany, His Excellency Dr. Frank-Walter Steinmeier, to the Singapore campus of TUM. Till date, TUM remains the only German university to have an overseas campus in Singapore.

After a two-year absence of in-person celebrations, TUM Asia held its first alumni dinner event, followed by a closed-door dinner at The Fullerton Hotel in appreciation of its governmental, industry and university partners who journeyed with TUM Asia throughout the years. Students of TUM Asia were also able to meet and greet TUM President Prof. Dr. Thomas F. Hofmann over luncheon at the campus.

Prof. Hofmann said, "over the past 20 years, the formula behind TUM Asia's success lies on its collaborative approach of working with global industry leaders, academia and government bodies to provide students with world-class technical competencies and international perspectives that serve as foundations for innovation and success ahead."

**PROF. DR. THOMAS F. HOFMANN,
PRESIDENT, TUM**

Over the past 20 years, the formula behind TUM Asia's success lies on its collaborative approach of working with global industry leaders, academia and government bodies to provide students with world-class technical competencies and international perspectives that serve as foundations for innovation and success ahead. As we embark on the next chapter of TUM Asia's story, we look forward to co-create in areas of sustainability and food security.

Prof. Hofmann continued, "the COVID-19 pandemic marks one of the most devastating health crises in our times, but the remarkable speed in which vaccines were developed illustrates the power of our generation to co-innovate through the diversity of thought and multi-disciplinary collaboration among government leaders, scientists and academia to solve some of the most complex global challenges. As we embark on the next chapter of TUM Asia's story, we look forward to co-create in areas of sustainability and food security."

TUM Asia's Managing Director, Dr. Markus Wächter, said, "as a university with more than 150 years of history in higher learning and 20 years of history in Singapore, TUM Asia has developed deep know-how and established decades-long connections to effectively prepare students for the future. In the next arc of TUM Asia's journey, we look forward to harnessing unique opportunities with our partners to provide outstanding learning experiences and generate technological breakthroughs."

In the next arc of TUM Asia's journey, we look forward to harnessing unique opportunities with our partners to provide outstanding learning experiences and generate technological breakthroughs.



▲ Students of TUM Asia had the opportunity to interact with Federal President Steinmeier and shared about their aspirations in venturing beyond their home country.

Federal President Steinmeier visit

The celebrations culminated in an exclusive visit by the Federal President of the Federal Republic of Germany, His Excellency Dr. Frank-Walter Steinmeier. At the TUM Asia campus, Federal President Steinmeier learned more of the insights and guidelines of the design of taxi stands, bus stops and pick-up drop-off (PUDO) points for the future deployment of Autonomous Vehicles (AVs) in Singapore. In addition, Federal President Steinmeier had the opportunity to speak with students of TUM Asia from various countries of their aspirations in venturing beyond their home country.

TUM Asia legacy: the first foray into uncharted waters

In 2002, TUM Asia was chartered with the vision of bringing German academic excellence closer to people beyond Europe. Despite having no playbook to rely on nor having the same administrative language, TUM Asia was able to cement its global presence in Singapore under the invitation of the Economic Development Board's Global Schoolhouse Initiative. Its inaugural postgraduate programme – a joint Master of Science in Industrial Chemistry with the National University of Singapore (NUS) – saw close to 20 international students in its first cohort. Since then, TUM Asia has grown to 2,000 graduates

from more than 35 countries who established their footholds in the respective arenas.

Today, TUM remains the only German university to have an overseas presence in Singapore.

The future mobility in Singapore

In recent years, TUM Asia has evolved from its original focus of providing German academic excellence in engineering to honing innovators by nurturing creativity and talents through a combination of research and teaching. One of its research programmes spearheaded by TUM Asia is a two-year project under the Land Transport Authority and Urban Redevelopment Authority to research the current and future design of Bus Stops, Taxi Stands, and Pick-Up-and-Drop-Off (PUDO) points for the upcoming deployment of Autonomous Vehicles (AVs), in a bid to improve the mobility experiences for all users.

From engineering to mobility and food science

Apart from this, TUM Asia is looking at offering food technology and safety postgraduate programmes to hone more food scientists and technology leaders in the areas of food science to strengthen the resilience of the global food system.

THE FUTURE OF AUTONOMOUS VEHICLES: OVERCOMING AV CHALLENGES WITH DESIGN

The ease of commuting remains one of the touchstones of a vibrant metropolis today. As more people move to live in cities, many developing cities face traffic congestion issues. Autonomous Vehicles (AVs) possess great potential as a mobility solution to enhance the efficiency of traffic flow on roads as they are designed to optimise speed and distance without having to brake unnecessarily.

In the quest of finding the optimal design of pick-up -and-drop-off (PUDO) points for the future of mobility, the TUM Asia's team of designers and traffic engineers work hand in hand, conducting numerous surveys, feedback sessions, and focus group discussions to develop a set of recommendations ready for future PUDO points and the deployment of AVs in Singapore.





In Singapore, there are more than 5,000 bus stops, 305 gazetted taxi stands, and an estimated several thousand general PUDO points across the island catered for commuters who come from different walks of life with vastly different needs.

Imagine an alternative future where the roads are cluttered with a motley of vehicles – buses, cars, taxis, private-hire cars, motorbikes, and AVs. Throw morning rush hour into the mix; anyone could tell that this is a recipe for chaos.

How might we design our PUDO points that are not only ready for AVs but also suitable for commuters who come from different walks of life with vastly different needs?

The PUDO team embarked on a two-year journey, to put before Singapore a vision of autonomous vehicles on its roads.

Meaningful placemaking – keeping things inclusive

In many ways, the many constructs of modern society have been cleverly manifested in the design of PUDO points. The team’s role is to rethink the function of every feature – bollards, berths, kerbs and lane markings, wayfinding, etc. – and retrofit the current PUDO points to be AV-ready. The team profiled seven user personas: parent and child, elderly, tourist, student, office worker, visually impaired individual and person in wheelchair. In addition, an array of other interest groups that make up the project consortium ranging from representatives from National University of Singapore, Nanyang Technological University Singapore, ST Engineering, Land Transport Authority, Urban Redevelopment Authority, SG Enable, etc. participated in the feedback sessions.

Using a human-centred design approach, the team identified the needs, pain points, and preferences of each user persona throughout their journey.

Breaking functional fixedness

Different perspectives and needs produce divergent fixedness. One such feature is the bollard. Why do we require a bollard in front of the PUDO? It impedes my movement in getting on the vehicle, a wheelchair user says. Conversely, according to BCA guidelines, the bollards act as a vehicle security barrier, a type of counterterrorism measure and protective measure for commuters.

“The bollard is also used as a point of reference for bus drivers to stop the bus,” the PUDO team added.

While bollards are essential for various reasons, the current finishing materials used on bollards impede the Light Detection and Ranging (LIDAR) sensors of AVs, affecting AVs’ ability to make judgments based on road conditions.

Upon identifying the diverse and often contrasting needs of various users and stakeholders, the PUDO team recommended adding relief markings on bollards not only to provide a safe way for AVs to navigate into PUDO points by eliminating possible dynamic AV challenges but also to guide users to specific waiting points.

The final design iteration of our PUDO is a reflection of the needs and behaviour of our population from different backgrounds and the spirit of our community that encourages coexistence and consideration for all who inhabit them.



Even simple acts of nature can impede the smooth operations of AVs as they are computed to slow down when their sensors pick up obstructions such as vegetation overgrowth past the kerb.

To overcome such challenges, the team has recommended demarcating a buffer zone from the kerb that would not hinder the clarity of traffic flow of the AV into the main carriageway.

Utilising AV: creative ideas as solutions

Defining challenges in conventional ways would naturally lead to conventional solutions and often becomes a stumbling block in finding a breakthrough in the middle of the most hidden problems. Putting the users at the centre of the development solutions often leads to surprising insights and creative solutions. One classic example would be the booking of AVs.

While most service providers would typically include a booking app on mobile phones, the team did not stop there. The team had also recommended installing a booking kiosk to provide an additional way for users to make a booking, which would also provide real-time arrival timings to passengers.

“We ought to consider the constraints faced by such users as parents who find it a challenge to free their hands from carrying multiple stuff on the go or tourists who find it a hassle to download a new booking app. The booking kiosk would enable commuters like tourists or elderly who are less tech-savvy to book AVs easily,” the team added.

Envisioning the future of our PUDO

The envisioned PUDO design is not only a culmination of the needs of every user who require the use of PUDO points but also the fruition of the monumental effort the team has put in to marry the needs, potential challenges and pain points of different users, putting forth a set of design recommendations that is useful and tailored to their needs. Importantly, the final design iteration is a reflection of the needs and behaviour of our population from different backgrounds and the spirit of our community that encourages coexistence and consideration for all who inhabit them.

FROM DESIGN TO PILOT

► How the proposed PUDO design would typically look like in a shopping mall.



◀▲ A new booking kiosk, and a new booking app were some of the elements proposed to the current PUDO design. New kerb markings were also proposed that would allow users to identify the waiting area based on the vehicle/service type they are waiting for.



SOLUTIONS FOR PUDO INFRASTRUCTURE

The PUDO team identified two kinds of design elements: elements that are essential to be retrofitted for AV to operate efficiently and elements that are good to have and would complement the user experience at current PUDOs and when AVs are being deployed.



▲► Commuters with different needs - non-ambulatory individuals, visually impaired individuals, mothers with kids, etc. participated in the pilot test to measure the efficacy of the recommended designs.



PUTTING DESIGN TO THE TEST

Over the course of two years, the PUDO team ran several pilot tests to evaluate on the practicality, feasibility and usability of the proposed designs. The designs have gone through several rounds of development and feedback at co-design workshops with AV developers, users and stakeholders, culminating in a set of recommendations that is designed for public use.

TUM CREATE: CHARTING SINGAPORE'S PATHWAY TO CARBON NEUTRALITY

How the latest research project of TUM Create enables Singapore to ultimately reach the goal of climate neutrality in the next 30 to 50 years.



Well over 200 years ago since the discovery of the wondrous fossil fuel, the world has undergone a phenomenal transformation that witnesses countless breakthroughs and game changers, transforming the lives and livelihoods of many. Yet the repercussions that followed were consequently ferocious. As more fossil fuels are burnt to power economies, the carbon trapped inside these fossils is released into the atmosphere as Carbon Dioxide (CO₂). Together with other Greenhouse Gases (GHG), they emit solar radiation and warm the earth's surface, resulting in the rise of global temperature.

With the global temperature rising to almost an unbearable level, the effects of global warming are getting increasingly palpable. Droughts, storms, heat waves, rising sea levels, and thawing of glaciers are increasing in intensity and frequency, and with debilitating consequences.

By now, countries had begun to understand that they could no longer live in an ecosystem marked by the flagrant use of energy and that we had to learn the new grammar of an energy ecosystem that is sustainable, efficient and resilient.



For Singapore, the cogs have also begun to grind forward to achieve zero emissions by 2050 and stabilise its emissions to around 60 megatonnes of CO₂ equivalent (MTCO₂e) in 2030¹. In Singapore, 97 per cent of Singapore's energy demand² is met through fossil fuels and unlike other large countries with the possibility of building massive wind turbines or floating dams, Singapore lacks the land capacity to afford large swaths of land dedicated to generating renewable energy. Poised between the urgent need to reduce carbon emissions to meet its net zero emissions goals by 2050 and the lack of land resources, Singapore strives to chart a foreseeable pathway to carbon neutrality.

In collaboration with Nanyang Technology University (NTU) Singapore, TUM Create embarks on a new research project, “Singapore’s Pathway to Carbon Neutrality”, to evaluate and rank alternative pathways that enable Singapore to ultimately reach the goal of climate neutrality in the next 30 to 50 years.

In collaboration with Nanyang Technology University (NTU) Singapore, TUM Create embarks on a new research project, “Singapore’s Pathway to Carbon Neutrality: Analysis of New Technologies”, to evaluate and rank alternative pathways that enable Singapore to ultimately reach the goal of climate neutrality in the next 30 to 50 years.

Reducing demand in the transport sector

In Singapore, the total emission of CO₂ stands at 49.7 MTCO₂e. Of the total carbon emissions, transport accounts for 13.7 per cent³. Reducing energy demand in the Transport sector through the electrification of vehicles will be a needle mover. In this light, Singapore is creating more green spaces to encourage the populace to go car-lite and opt for “Walk-Cycle-Ride” modes of transport; the Singapore Government is also improving its rail and bus connectivity. The Land Transport Authority (LTA) aims to expand its current 200km rail network comprising six rail lines of 140 stations to a rail network of 360km connecting eight in 10 households within 10 minutes of a station. By 2030, electric buses are expected to make up 50 per cent of Singapore’s public bus fleet.⁴

Reducing cooling demand

Sitting just one degree above the equator, Singapore is characterised by its hot and humid weather. The sheer magnitude of air-conditioning used to cool indoor spaces is no small figure. According to TUM Create’s estimate, the total thermal energy demand for cooling in Singapore in 2019 was 75 terawatt hours (TWh). The electric

¹ <https://www.mfa.gov.sg/SINGAPORES-FOREIGN-POLICY/International-Issues/Climate-Change#:~:text=We%20will%20raise%20our,of%20our%20revised%202030%20NDC.>

² <https://www.nccs.gov.sg/files/docs/default-source/default-document-library/carbon-capture-and-storage-utilisation-technology-primer-a-summary.pdf>

³ <https://www.nccs.gov.sg/singapores-climate-action/singapores-climate-targets/singapore-emissions-profile/>

⁴ https://www.lta.gov.sg/content/ltagov/en/newsroom/2023/3/news-releases/sustaining_the_momentum_of_vehicle_electrification.html



Singapore is currently importing 100 megawatts (MW) of renewable hydropower from Lao PDR to Singapore via Thailand and Malaysia, marking the first renewable energy import into Singapore⁵.

energy required to provide this amount of cooling is equivalent to 30 per cent. The perpetual cooling of buildings in Singapore created a paradox hard to rise out of: that the more air conditioning we use, the hotter the weather becomes. As we generate more waste heat than cooling, these energy guzzlers contribute to climate change by emitting hydrofluorocarbons, chemicals that trap heat in the atmosphere.

The use of a central cooling system is not new, for many modern commercial buildings have centralised cooling systems to achieve economies of scale through sharing of the centralised chiller's capacity, which is regularly maintained to operate at its highest efficiency. The implementation of a district cooling system – central cooling plants that supply chilled water to various buildings through an underground

network of insulated pipes for air-conditioning purposes – has gained traction globally, as it not only consumes less energy and space but it also reduces lifecycle cost.

Harnessing geothermal energy

Advances in Geothermal Systems (AGS) have opened up new possibilities for Singapore to diversify its energy sources. An Intra-CREATE project undertaken by NTU and TUM Create aims to provide insights on how to best extract and deploy infrastructure and expertise in geothermal energy.

Use of solar photovoltaic (PV) – charting the roadmap for Singapore

Solar energy remains Singapore's most viable renewable energy source for generating electricity. Its proximity to the equator has

In Singapore, the Distributed District Cooling (DDC) cooling network can potentially reduce energy consumption by 17 per cent – enough to power 1665 three-room HDB households for a year. This is translated to a fall of 18 per cent in carbon emissions from energy savings and refrigerant reduction – equivalent to removing 2,250 cars from roads per year⁶.

⁵ https://www.ema.gov.sg/med ia_release.aspx?news_sid=20220623UjiFDR2aZUxy

⁶ <https://www.spgroup.com.sg/wcm/connect/spgrp/e9cb79d1-86ea-462f-a69b-c617a6817724/Taking+The+Heat+Off+Cooling+-+A+Greener+Way+to+Cool.pdf?MOD=AJPERES>

Singapore aims to deploy at least 2 gigawatt-peak (GWp) of solar energy by 2030, equivalent to powering about 350,000 households annually⁷.



afforded the country a typical tropical climate with an average annual solar irradiance of 1,580 kilowatt-hour/m²/year and about 50 per cent more solar radiation than temperate countries⁷.

On the hunt for the optimal power grid

In spite of the lack of natural resources, the region is thankfully afforded an abundance of renewable options. The increasing demand for electricity, compounded by the region's commitment to decarbonise, opens up new opportunities for countries to develop cross-border renewable energy according to demand levels and patterns through electricity trades. Singapore is currently importing 100 megawatts (MW) of renewable hydropower from Lao PDR to Singapore via Thailand and Malaysia, marking the first renewable energy import into Singapore⁵.

Diversifying energy supply

Today, nuclear power, hydrogen energy and alternative fuels have been used by various countries to produce electricity. Each source of energy has the potential to play a significant role in reducing GHG emissions and mitigating climate change. The use of nuclear power has reduced CO₂ emissions by over 60 gigatonnes – nearly two years' worth of global energy-related emissions over the past 50 years⁸, while the momentum behind the global hydrogen demand

continues in full swing. Not only is electrolyser manufacturing capacity operating nearly eight gigawatts (GW) per year, several projects to install electrolyser capacity are also in the pipeline, potentially achieving 134 – 240 GW by 2030⁹. For Singapore, hydrogen could be a game changer in decarbonising the industry by supplying up to half its power needs by 2050¹⁰.

As Singapore moves full steam ahead in decarbonising its economy, several necessary and new infrastructure to deliver energy to and from Singapore will be developed and proposed, potentially giving us a margin of manoeuvre. Naturally, these methods raise some questions in their wake. Which final energy carrier will dominate our future? What will the share of different energy carriers look like? What will the new infrastructure look like? Most importantly, which are the best options for Singapore for its energy transition?

With the “Singapore's Pathway to Carbon Neutrality” project by TUM Create searching for the missing pieces of the puzzle, these questions will slowly come to light. Regardless, we can look forward to the transformation in Singapore's energy system.

⁷ <https://www.businesstimes.com.sg/companies-markets/energy-commodities/singapore-aims-2-gwp-solar-energy-2030>

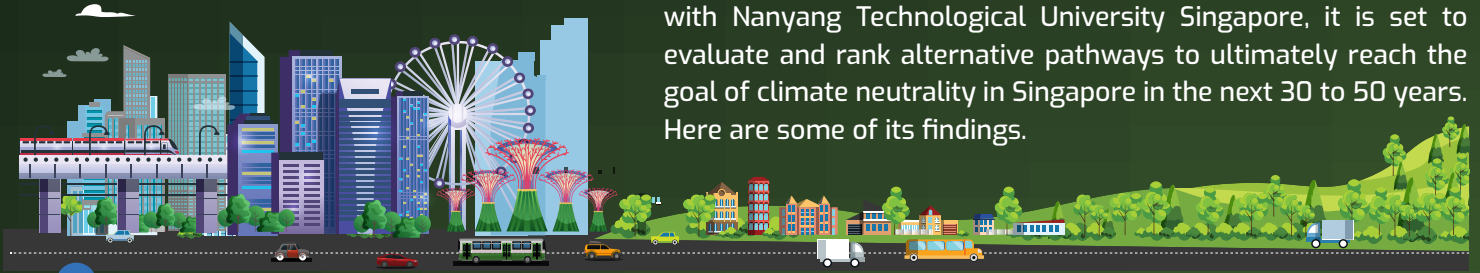
⁸ <https://www.iea.org/reports/nuclear-power-in-a-clean-energy-system>

⁹ <https://www.iea.org/fuels-and-technologies/hydrogen>

¹⁰ <https://www.mti.gov.sg/Industries/Hydrogen>

SINGAPORE'S PATHWAY TO CARBON NEUTRALITY

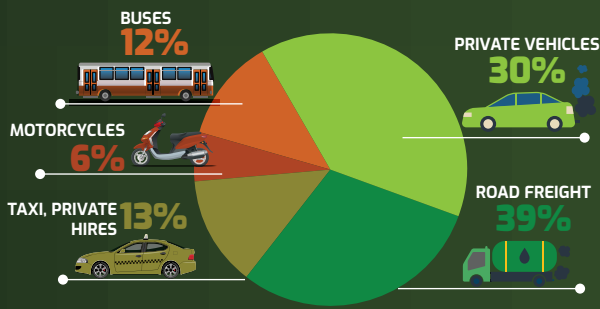
The cogs have begun to grind forward for Singapore to achieve net zero emissions by 2050 and stabilise its emissions by 65 MTCO_{2e} in 2030. But with Singapore's limited land resources to afford for other renewable energy options, how is Singapore improving its energy efficiency in various sectors of the economy? In TUM Create's new research project in collaboration with Nanyang Technological University Singapore, it is set to evaluate and rank alternative pathways to ultimately reach the goal of climate neutrality in Singapore in the next 30 to 50 years. Here are some of its findings.



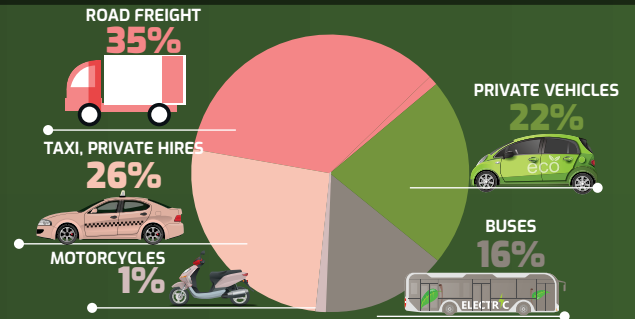
01 REDUCE DEMAND INCREASE EFFICIENCY IN TRANSPORT

Singapore aims to decrease its energy consumption in road transport by reducing demand through the electrification of vehicles, creation of green spaces to encourage the populace to go car-lite and opt for "Walk-Cycle-Ride" modes of transport; and improvements to its rail and bus connectivity.

Breakdown of Energy Consumption on Singapore's Roads in 2019 (Calculated by TUM Create)



Energy Consumption Goal for Singapore's Roads in 2040



01 USE OF CLEANER TRANSPORT



02 INCREASE PEAK PUBLIC TRANSPORT RIDERSHIP



03 SOLAR PANELS

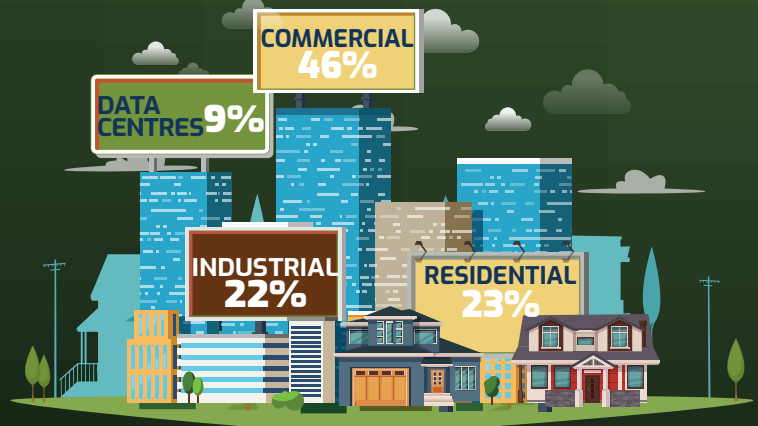
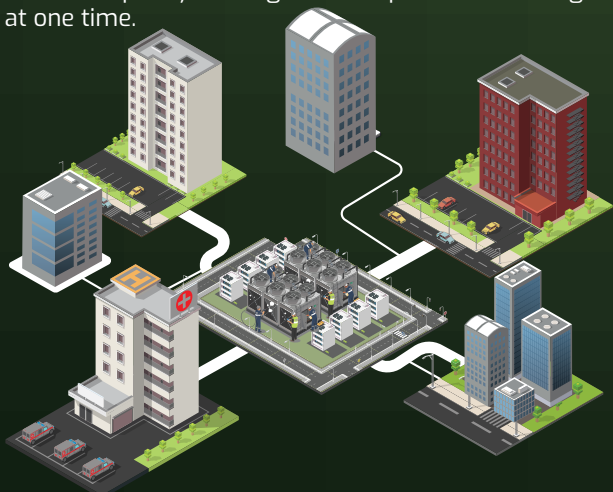


02 REDUCE DEMAND USE OF CENTRAL COOLING SYSTEM

By circulating cool air through a system of supply and return ducts, central cooling systems are more energy efficient by achieving economies of scale through sharing the centralised chiller's capacity, cooling several spaces with a single system at one time.



The total cooling demand in Singapore in 2019 was 15 TWhel, or 30% of Singapore's electricity demand. This is equivalent to 75 terawatt hours. (TUM Create's estimate)



01

INCREASE SUPPLY GEOTHERMAL POTENTIAL IN SINGAPORE

An Intra-CREATE project by NTU and TUM Create(2020 – 2024), the research project aims to provide insights on how to best extract and deploy infrastructure and expertise to harness Singapore's geothermal potential for urban applications.



SLIMHOLE DRILLING

Drilling campaign for physical validation of Singapore's geothermal gradient



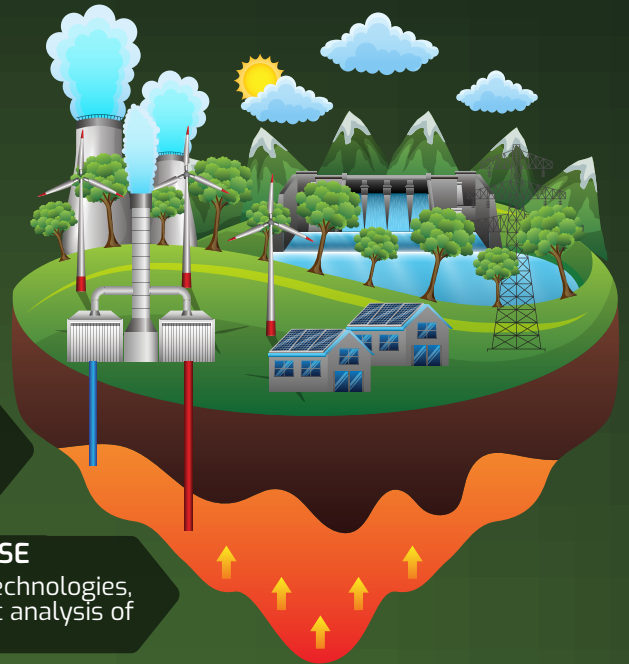
COMPUTATIONAL MODELLING

Development of numerical models for validation of Singapore's geothermal gradient



ANALYSIS OF GEOTHERMAL ENERGY USE

Heat extraction and utilisation: Extraction technologies, life cycle assessment and techno-economic analysis of geothermal energy use



02

INCREASE SUPPLY SOLAR PHOTOVOLTAICS

Solar energy remains Singapore's most viable renewable energy source and the Singapore government recently announced that the City State is committed to deploying at least 2 GWp of solar energy by 2030 – enough to meet the annual power needs of around 350,000 households.

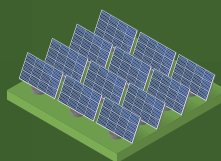
01 FLOATING ISLAND



02 ROOFTOPS

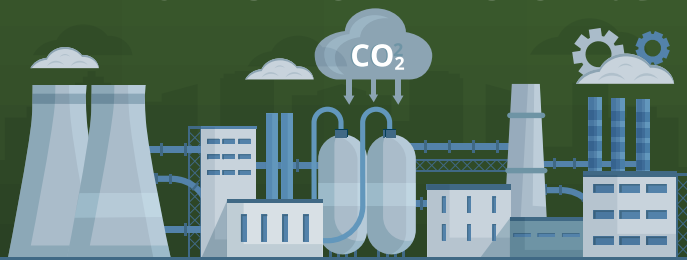


03 FACADES



04

INCREASE SUPPLY CARBON CAPTURE UTILISATION AND STORAGE



CAPTURE



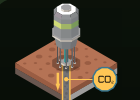
CO₂ is separated from other gases produced in industrial processes, such as power generation plants or factories.

TRANSPORT



CO₂ is compressed and transported via pipelines, road transport or is shipped to a site for storage.

STORAGE

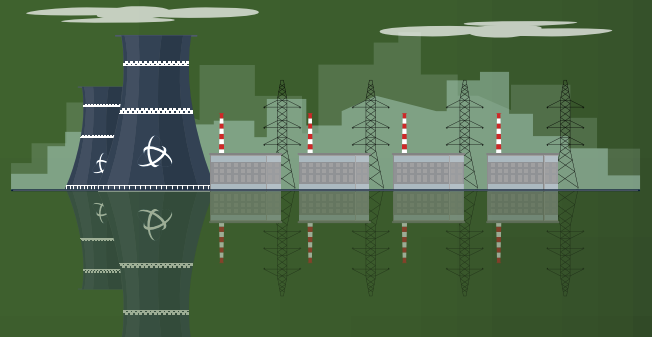


CO₂ is injected into rock formations deep underground for permanent storage.

03

INCREASE SUPPLY NUCLEAR ENERGY

Over the past 50 years, the use of nuclear power has reduced CO₂ emissions by over 60 gigatonnes – nearly two years' worth of global energy-related emissions.

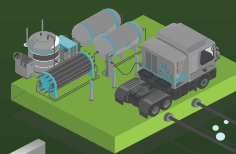


05

INCREASE SUPPLY ALTERNATIVE FUELS

Singapore is also exploring the use of alternative fuels (i.e. hydrogen fuel, synthetic and biofuels) potentially for road freight, aviation and maritime sectors.

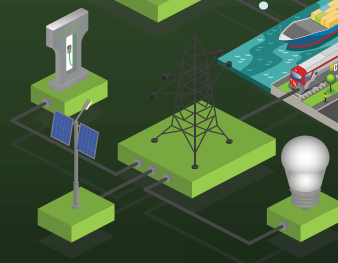
01 HYDROGEN FUEL



02 BIOFUEL



03 SYNTHETIC FUEL



BAVARIAN STATE MINISTER FOR DIGITAL AFFAIRS VISIT



The Bavarian State Minister for Digital Affairs, Judith Gerlach, and her delegation visited TUM Asia to learn more about our digital innovation for the future of mobility. During the visit, the delegation met our research team as they shared the recommendations for the future infrastructure design of Singapore's Pick-Up-and-Drop-Off (PUDO) points that will ease the passenger/pedestrian and traffic flow with the introduction of Autonomous Vehicles (AVs) to our roads. The delegation was also able to learn more about City Mobility Simulator developed at TUM Create, or CityMoS in short, a high-performance, multi-core, agent-based, microscopic mobility simulator capable of simulating city-scale transport systems at high resolution, including private, public and commercial transport.

ACCENTURE UNIVERSITY INNOVATION CHALLENGE 2022



Students from our joint Bachelor of Engineering in Electronics and Data Engineering represented Singapore Institute Technology in the University Innovation Challenge 2022 organised by Accenture and emerged top 12 (semifinals) and top six out of 91 teams. Members from both teams were awarded a certificate of participation and personalised token of appreciation for their strong efforts and outstanding achievements.

Congratulations to teams EV4every1 and Potato Battery!

GRADUATION CEREMONY 2022



The Graduation Ceremony for Class of 2022 successfully closed on the 20 July, which saw more than 200 students taking the proverbial walk to the next phase of their journey. The Class of 2022 experienced an unconventional learning experience where the world was facing one of the greatest health crises in history. Despite the global pandemic casting a dark shadow over all aspects of our lives, and despite it taking a firm hold on every facet of their lives, the graduates remain undaunted in the face of the global pandemic and manage to make the best out of their school years, arriving at the pinnacle of their academic journey at TUM Asia.

We are confident that the courage, resilience, and determination that the graduates displayed so far will be the beacon of hope for the next generations to come!

WELCOMING THE NEW MASTER OF SCIENCE STUDENTS AY2223

Welcoming our new Master of Science students for the academic year 2223! It was a good two years since the campus had this many students on campus. As Dr. Markus Wächter, Managing Director of TUM Asia, cautioned that we might not be in the best of times but it was undoubtedly a time of great need where the world called upon students as next generation of leaders to lead the world to overcoming challenges. Dr. Wächter also encouraged students to open up and work with their fellow classmates, TUM Professors and TUM Asia faculty.

“We have a small cohort with our TUM Professors spending most of their time with you for two weeks each time they are here. So make the best of the time by talking to each other, working with each other and don't hesitate to ask questions. You will have a great time here,” Dr. Wächter said.



A RARE GATHERING FOR OUR MASTER OF SCIENCE STUDENTS

TUM Asia organised a barbeque gathering for the year one students. With most of the social distancing measures lifted, they were able to enjoy to their heart's content a rare barbeque party as an opportunity to get to know and make friends with each other over good food, weather and scenery.



DIES ACADEMICUS DAY

On TUM's Dies Academicus Day, students and staff of TUM Asia delivered a dance performance - a reflection of the cultural diversity that characterises the learning experience at the Asian campus of TUM.

In addition, students were also treated to a classic German film: "Honig im Kopf", which tells the story of the very special love between eleven-year-old Tilda and her grandfather Amandus.

The TUM Dies Academicus Day is an annual academic celebration for employees, students, alumni, friends and partners to exchange ideas, look back together on the past year and honour special achievements at TUM.



GERMAN FEDERAL MINISTRY FOR DIGITAL AND TRANSPORT (BMDV) VISIT



TUM Create had the honour of receiving Mr Oliver Luksic, the Parliamentary State Secretary to the Federal Minister for Digital and Transport of the German Federal Ministry for Digital and Transport (BMDV) and his delegation at TUM Create. During the visit, the delegation met the CityMoS research team and learned more about the recommendations for the future infrastructure design of Singapore's PUDO points. It was a fruitful discussion between the delegation and our lead principal investigators exchanging views on the mobility trends and developments in Germany and Singapore.

BILD DER WISSENSCHAFT READERS' TRIP TO TUM ASIA AND TUM CREATE



TUM Asia and TUM Create welcomed readers of the Bild der Wissenschaft, a popular scientific journal founded in 1964 in Germany, where they were introduced to our campus, students and TUM Create's researchers. The researchers had a field day discussing various scientific approaches to urban challenges with the readers. Amongst the topics discussed were alternative protein food production, evaluating Singapore's options for a future power mix, and using digital tools for optimising urban mobility. The readers too had the opportunity to speak with students who enjoyed the many inspiring anecdotes they shared.

OVERSEAS IMMERSION PROGRAMME 2023



Willkommen in Deutschland! As part of the Overseas Immersion Programme (OIP), students of our joint Bachelor of Engineering spent two weeks in Munich where they visited various TUM campuses and global companies such as Infineon, and Fraunhofer. The OIP was intended to provide students with the opportunity to gain global perspectives and establish their professional network with industry experts. During the trip, students were able to get acquainted with members of the TUM community and witnessed the scale of operations at the research institutions and global companies headquartered there. From the various sharing of experiences, they were able to appreciate the complexity of such multinationals and how they have placed a broad strategic plan in place for any number of scenarios, which would prepare them for their Integrated Work-Study Programme (IWSP).

#WOMENINSTEM: SUDEEKSHNA VIJAYARAGHAVAN



▲ Sudeekshna Vijayaraghavan (extreme right), Master of Science in Rail, Transport and Logistics student together with her mother, Sita, and her sister, Smruthi.

Stories of heroism are often told about winning against all odds, but stories of altruism are equally heroic as well. We tell the story of Sudeekshna and her stalwart sister, Smruthi, who gave up her dream in the hopes of fulfilling her sister's dream of becoming an extraordinary transport planner.

Born in one of the most industrialised cities in Tamil Nadu, Coimbatore, Sudeekshna Vijayaraghavan was raised in a typical family of two children, yet it was anything but common. Sudeekshna's calm and mature disposition bears the distinction of someone who has gone through a lot in a very

short time. Behind her calm and quiet demeanour dwells a kind of determination to excel.

"We grew up hearing my grandfather recounting his experiences working at the Tamil Nadu Electricity Board, where he spent his lifetime surveying and

Despite the financial situation they were mired in, Sita understands how important it is to ensure both children attain the necessary education. And if there was only one who could study overseas, Sita and Smruthi both felt it should be Sudeekshna.



constructing dams. He would share his latest work experiences and explain to us how things work. For us, it was always interesting to hear his stories. For Sudeekshna, it strikes differently,” recounted Smruthi.

Finding the calling in engineering

These stories became her calling. Seeing how these engineering anecdotes sparked a massive interest in the young Sudeekshna, her grandfather would often bring her around India and show her the latest developments in rail and transportation technologies. These trips naturally grew her passion for transportation engineering. Her intense curiosity about the principles behind transportation planning spurred her to work ceaselessly towards deepening her knowledge in this field. After graduating high school, she pursued a bachelor’s degree in civil engineering at the Kumaraguru College of Technology as her first step into the world of transportation.

It all seemed smooth sailing for the Vijayaraghavan family until life dealt a bad hand.

Finding strength from grief

“I had always wanted to study overseas. That has been my dream for as long as I can remember. We lost our father when I was 16 years old. It was also during the same time I graduated high school. My mother became the sole breadwinner of the family. It was hard for me to pursue that dream when our financial situation was not ideal,” Smruthi shared.

**SUDEEKSHNA VIJAYARAGHAVAN,
STUDENT OF MASTER OF SCIENCE IN
RAIL, TRANSPORT AND LOGISTICS**

“While looking through the course descriptions, I came across TUM Asia and was instantly drawn to the programme and modules they offer, which would help pave the path to my dream career. The German academic standards with an Asian relevance taught in the beautiful and high-tech city of Singapore was a winning factor for me.”

For Sudeekshna's mother, Sita, under the weight of fending for the family financially with two children in tow, she had to step up not only to play the mother's role but the father's role as well. Sita toiled tirelessly to raise her children, sticking to her core principle: that she would do anything for her children.



Their father's passing not only left the children a void that was impossible to fill, it also came to redefine all their lives. For Sudeekshna's mother, Sita, under the weight of fending for the family financially with two children in tow, she had to step up not only to play the mother's role but the father's role as well. Turning her grief to strength, Sita toiled tirelessly to raise her children, sticking to her core principle: that she would do anything for her children.

Perhaps the only certainty amid the uncertainties at that time was how determined Sudeekshna was in fulfilling her dream. Despite the financial situation they were mired in, Sita understands how important it is to ensure both children attain the necessary education. And if there was only one who could study overseas, both Smruthi and Sita felt it should be Sudeekshna.

"Sudeekshna has always been certain of what she wants, and she would pursue to the ends of the earth to achieve her goals. We have seen enough proof to believe in her and her decisions. So, my mother and I decided to push her to study overseas. Look at the world outside. See what it has to offer you," shared Smruthi.

Sudeekshna came across TUM Asia and was instantly captivated by the quality of education at the Technical University of Munich, Germany, and was especially drawn to the programme and modules in the Master of Science in Rail, Transport and Logistics programme.

Life - we win some, we lose some

For Smruthi, even as life has dealt a bad hand, she managed to win with the cards she was handed.

After graduating with a bachelor's degree in engineering and information technology, Smruthi moved on to pursue a master's degree in business administration. She is currently working as a business analyst at Renault, where she gets to travel overseas often for work-related matters.

Often, the one who receives the act of selflessness bears a moral burden that few would understand. Her sister's sacrifice seared deeply into Sudeekshna. Knowing that her sister gave up her dreams for hers, Sudeekshna carries the aspirations of not just her own but her sister's as well. Her determination to make an impact in the transportation industry would see her well on her way to realising her dream and even her sister's.

#WOMENINSTEM: GUNJOT KAUR



Gunjot Kaur ◀
Director Product Marketing
Infineon Technologies
Alumna of MSc in
Integrated Circuit Design,
2007

Modern history is replete with examples of men who made a name for themselves in science, technology, engineering and mathematics or STEM in short. And few have been such an inspiration as Gunjot Kaur, who has carved a name for herself in the field. Today, Gunjot Kaur helms the Director of Product Marketing at Infineon Technologies in Germany. As a technical expert in semiconductors and marketing, Gunjot is responsible for product marketing for automotive high voltage power modules for electric mobility working with car original equipment manufacturers (OEMs) and Automotive Tier 1. Gunjot's success today - as a woman who not only found her voice but harnessed it to inspire other fellow women and men - was a culmination of a long personal journey.

For cultures like India and in a field of study that is traditionally leaden with males, Gunjot's family eschewed the traditional notions of patriarchy. Her mother's tenacity in pushing her to pursue the

love of her life - physics - neatly symbolised her family's ethos: nothing could stop her or any other women from pursuing their passion.

“India has a very diverse culture, and I was very fortunate that growing up, I was never aware I was any different being a woman. The very thing my parents gave me was the freedom to choose and the ability to think for myself. The one teaching that carried throughout my professional life to date was whatever decisions I make, I must be accountable for the consequences that happen,” said Gunjot.

“Physics is my big love in life. I have always been very passionate about studying physics since I was in grade nine. I was also very intrigued about life and why things are the way they were. So, when I was introduced to a subject that answers a lot of such questions, my passion for physics simply went through the roof;” she recalled fondly.

Having completed her bachelor’s degree in physics at Miranda House College, a college affiliated with Delhi University, she had steered a different course in her choice of her master’s degree.

Against the odds: overcoming challenges

“Although I always wanted to study astrophysics, I was also into microphysics. When my mother came across an advertisement about this joint master’s degree in integrated circuit design conferred by the Technical University of Munich and the Nanyang Technological University Singapore, she got me to apply for the course,” Gunjot said.

However, she was rejected for the course. Yet that did not stop her from trying further.

“My mother was the one who encouraged me to try again. She urged me to request for an interview, to ask for a chance to study in this course. So, I wrote to Markus (Managing Director, TUM Asia) and asked if I could meet with some Professors. I read a book on analog design and Markus arranged for me to meet with the Professor-in-charge of analog design. Thankfully, I was accepted into the course! Fast forward 15 years later, I am still in the STEM field doing what I enjoy most,” she recounted cheerfully.

For a physics graduate – with close to zero knowledge in engineering – to be suddenly thrust into the nerve centre of semiconductors, to be in daily interactions with engineering would be a tumultuous experience, but not for Gunjot, as she took everything in her stride.

“Looking back, pursuing integrated circuit design was quite a plunge into a land of the unknown. I was even graded a C in the first exam I sat for the course!” quipped Gunjot.



GUNJOT KAUR. MSC ALUMNA IN INTEGRATED CIRCUIT DESIGN

“I was very fortunate to be studying in a close-knit community of Professors and classmates where studying was more like a team effort than a solitary undertaking. I had a lot of support from my classmates and Professors, which pushed me to study doubly hard and confront my weakest topic.”

“I was very fortunate to be studying in a close-knit community of Professors and classmates where studying was more like a team effort than a solitary undertaking. I had a lot of support from my classmates and Professors, which pushed me to study doubly hard and confront my weakest topic. In the end, under the supervision of Professor Siek Liter, I got a 1.0 for my master’s thesis, which I am still very proud of!” laughed Gunjot.

Confronting the hierarchy

In the science and technology space filled with strong personalities with huge ambitions to make a mark for themselves, Gunjot cuts through the crowd with her warm and magnetic personality. But it was not always a bed of roses, as Gunjot’s life walked the same sweep of history as many women of her generation do – gender equality.

“Over the years, there are more women joining the STEM field and there is greater openness to



► **Currently at the top of her game in the industry, Gunjot bears the mantle of inspiring other women to do the same.**

embrace gender diversity in workplaces. I am also given an opportunity to undergo a leadership course at Infineon Technologies. Back then, the gender equality when I first started my career was quite real. I always feel that there was a glass ceiling I had to break. As a woman in this male-dominated space, I often had a lot of self-doubts. I tend to see things and ask myself how a man would do it. Over the years, I have learnt to be honest about myself and realise that I don't always have to do things the way men do. I would do it my way. It may take longer to reach my goal, but at least when I look back, I would be proud of myself that I accomplished things my way," said Gunjot.

Being fresh out of school, Gunjot was not quite prepared to navigate the intricacies in the corporate world, let alone a testosterone-laden one. The economic downturn happened in 2008 when many of her colleagues had to leave, pretty much left Gunjot in professional limbo.

"I don't think I truly recovered from the loss of outstanding mentors who are extremely experienced in their field of study as the company was trying to reduce headcount. I did not know how to deal with the emotional loss of people I

GUNJOT KAUR

Always take the road that is less travelled. It has benefited me and my life, and I always pride myself on taking the unconventional path. So, it seems that the path that very few women have taken might seem difficult, but I think once you have done it, you would feel proud, for you have also paved the way for others.

respect and work with daily," recounted Gunjot. But it was also a defining moment for Gunjot to change her approach in life.

"This was a turning point for me as I decided how I want to conduct myself at work. Since then, I have embraced honesty at work. Whenever I face challenges, I would call them out and find support to navigate them together." said Gunjot.

Paving the way for others

"I recall a conversation I have had with my husband's cousin years ago when she confided in me that she doubted that she is cut out to study math or physics. I told her that was the wrong mentality and that she should never question her interest. She has since pursued medicine and is now a very well-established dentist! I am happy for her to have made the decision not to settle and to pursue her dreams. I would always tell my team to take the road that is less travelled. It has benefited me and my life, and I always pride myself on taking the unconventional path. So, it seems that the path that very few women have taken might seem difficult, but I think once you have done it, you would feel proud, for you have also paved the way for others," said Gunjot.

Having welcomed a new life in October 2021, Gunjot now has different sights in mind.

"Right now, I'm also trying my best to raise my son never to question a woman's ambitions and always to be encouraging and open to women's aspirations," said Gunjot.



TAKING HEALTH TO THE SKY : DELIVERING MEDICINES WITH DRONES

In a life marked by incredible highs and lows, none were quite as dramatic as those experienced by Dinesh Baluraj. Here is his story behind his ambitious goal in transforming India's healthcare with his aerospace engineering knowledge in drones.

Dinesh was born and raised in Thanjavur, the agricultural epicentre of Tamil Nadu in India or famously known as the "Rice Bowl of Tamil Nadu". At the tender age of 10, he experienced a life-changing moment when he attended his uncle's housewarming party in a remote village. Not only did it sear an indelible impression on Dinesh in his formative years, but it also changed his entire outlook and goal in life.

"It came all of a sudden when I heard a cry. It was not the usual sound of quiet sobs but anguish and devastation," Dinesh recounted.

He discovered that his uncle's neighbour had lost not one but two children in a single night.

"I could still remember; she was carrying her child's dead body home as the doctors at the primary healthcare centre could not save her child in time from a snake bite. And when she returned from the hospital, carrying the body of her dead child in her arms, only to realise that her other surviving child had also died from a similar bite from the same snake. In a single day, she lost her only two children," Dinesh recalled painfully.

To this day, the memory of the mother crying over her lost children and the helplessness he felt when he could not do anything continued to reverberate profoundly in Dinesh.

“I started applying for master’s programmes in Singapore, the United Kingdom, and Canada. Eventually, I chose to study at TUM Asia because of how well-structured the course curriculum is. It covers 15 subjects in three semesters; I could learn not one but three aspects of aerospace engineering – flight control systems, propulsion and structures and materials.”

- Dinesh Balaruj, MSc Alumnus in Aerospace Engineering



“The tragedy would not have happened if he had been treated with antivenom in time. The problem is not the lack of doctors or medical supplies but the lack of means to obtain such life-saving medicines fast enough,” said Dinesh.

Growing up, Dinesh has never forgotten this painful episode and has been working towards improving healthcare accessibility in India. After attaining his bachelor’s degree in aerospace engineering at Anna University, he began to search for various learning opportunities and where they could take him.

“I started applying for master’s programmes in Singapore, the United Kingdom, and Canada. Eventually, I chose to study at TUM Asia because of how well-structured the course curriculum is. It covers 15 subjects in three semesters; I could learn not one but three aspects of aerospace engineering – flight control systems, propulsion and structures and materials,” Dinesh shared.

The effect of his choice could hardly have been more profound. The fruit of his years of labour, Yali Aerospace, is set to transform how healthcare can be accessed, especially in rural countries.

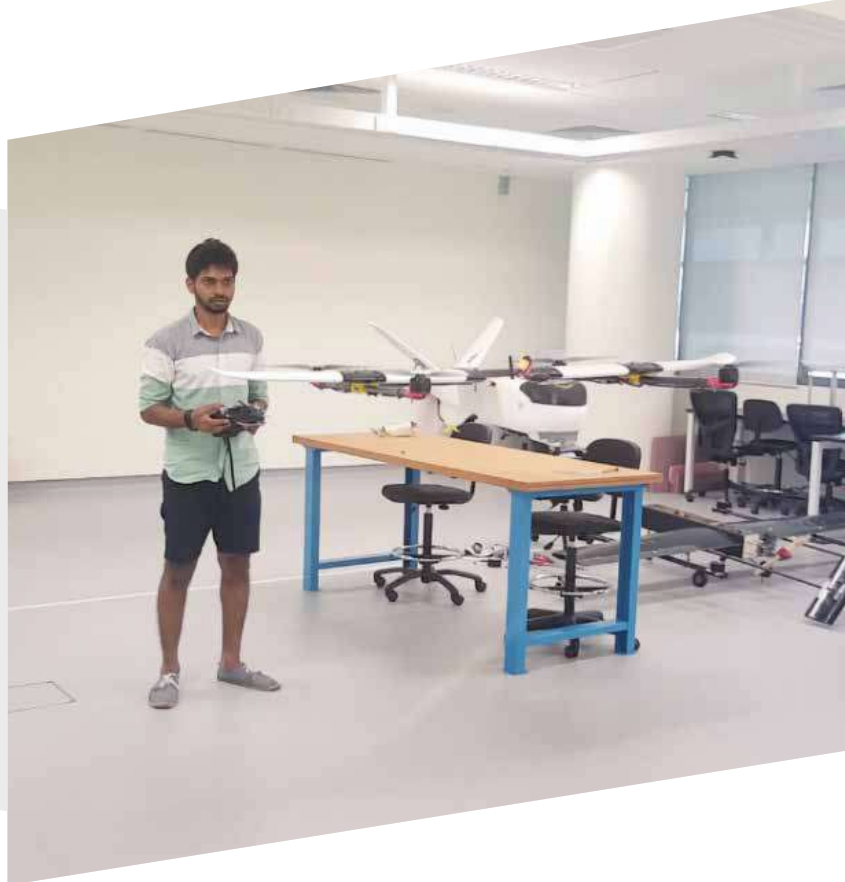
Crucial to keep in touch with the rhythms of

the latest technologies and innovations, Dinesh searched for aerospace-related careers that could take him just about anywhere. Since graduating from TUM Asia, he has interned at Rolls-Royce. His career has since taken flight where his continuous dive into the aerospace arena soared him squarely to where his dreams are – Gilmour Space Technologies.

Naturally, the research of the new and unheard of has always been one solitary journey and is almost always fraught with uncertainties and fear. The risk of failure is very real. For Dinesh, he was unfazed by what laid ahead, as it was simply a checklist of things that needed to be overcome to reach his goal. True enough, he quickly found his bearing even in unknown terrains.

“I was grateful towards TUM Asia as I had the opportunity to dabble in the full scope of scientific research and appreciate the magnitude of what is to come my way. After my internship at Rolls-Royce, I came across a career opportunity at Gilmour Space Technologies developing prototypes on aerial exfiltration aircraft to carry a wounded soldier from one place to another. At this point, vertical take-off and landing (VTOL) fixed-wing, which was still in its nascent phase, where the technology was very new. We were

“I was grateful towards TUM Asia as I had the opportunity to dabble in the full scope of scientific research and appreciate the magnitude of what is to come my way.”



among the first to establish a system that operates two flight control systems in one aircraft. It was not easy, but my time at TUM Asia has prepared me for precisely such a path,” said Dinesh.

Dinesh had tried everything from designing, manufacturing drones to flight operations, working in various capacities in different parts of the world. Despite enjoying an illustrious career journey with his diverse skill set, Dinesh decided it was time to return to India, where his dream began.

“My parents would have preferred me to continue my career abroad, but they could see how important it is for me to do what I was meant to do. So, we relocated and settled back in my hometown, Thanjavur,” explained Dinesh.

Yali Aerospace

Few dared to pull the curtain to uncover and tackle the contrasting healthcare landscape in India. With a population of more than 1.4 billion people¹, the healthcare system in India is surprisingly disparate. There is a government-funded, three-tiered public health system – Sub Health Centre (Urban and Rural), Primary Health Centre (Urban and Rural) and Community Health Centre (Urban and Rural) that provides preventive and curative health service².

According to a Lancet study in 2018, India ranked 145th among 195 countries in terms of quality and accessibility of healthcare³. Under the National Health Mission (NHM), Primary Health Centres (PHC) are established to cover a population of 30,000 in rural areas and 20,000 in hilly, tribal and desert areas. In 2019, there were a total of 24,885 rural PHCs and 5,190 urban PHCs in the country⁴.

Over the years, India has seen improvements in its accessibility and quality of healthcare, but the modern overlay is still anchored by old-fashioned ways of working. Delivering affordable and accessible healthcare services, medicines, and diagnostics has been challenging.

“For one PHC to cover a population of 30,000 in rural areas is a mammoth task. Further impeding the situation is how inaccessible these rural areas are without access to public commutes. Most residents resort to walking for hours just to see a doctor,” shared Dinesh.

“Healthcare should not be a luxury. Nothing should stand in the way of saving a person’s life,” Dinesh continued.

Dinesh endeavours to change that.

¹ <https://www.worldometers.info/world-population/india-population/>

² <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1848808>

³ <https://timesofindia.indiatimes.com/india/india-145th-among-195-countries-in-healthcare-access-quality-lancet/articleshow/64283179.cms>

⁴ <https://pib.gov.in/PressReleasePage.aspx?PRID=1656190#:~:text=Under%20the%20National%20Health%20Mission,hilly%2C%20tribal%20and%20desert%20areas.>



▲ Despite enjoying an illustrious career journey with his diverse skill set, Dinesh decided it was time to return to India, where he founded Yali Aerospace.

Dinesh said, “in many rural areas in India, where citizens rely on primary health centres for primary care, healthcare provision is hampered by frequent stockouts of essential medicines and critical medical supplies. Also in many villages, the provision of medical care is often reliant on poor road conditions and unreliable road networks. These challenges contribute to high rates of snake bite mortality, maternal deaths, and lack of blood transfusions, reduce patients’ ability to adhere to treatment, and slow improvements to the health system. I therefore came up with the concept of “Yali Network Bridge”. Yali Network Bridge is a drone delivery platform and it works by implementing our drone (named Yali) and the drone landing station (named SkyBase) at all of

the main government hospitals in India where our Yali could store, take off, land, change batteries, and switch payload easily. Our plan is to situate our SkyBase at every 100 km radius, connecting all the primary health, community health and sub centres together with the main government hospitals in India. With our technology, we can even transport the emergency medical supplies including organs to longer distances like Chennai to Kanyakumari (750km) within four hours.”

“To me, every delivery matters, and even a single drop of blood could potentially save a person’s life. This is my motivation in establishing the Yali Aerospace and the Yali Network Bridge,” said Dinesh.



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EDB-IPP Scholarship

for MSc. Integrated Circuit Design



Monthly Allowance

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100% Tuition Fees

100% of MSc in ICD tuition fees¹



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50% capped at S\$25,000 for the MSc in ICD²



No Bond Requirement

Can be either a new hire or existing employee of the company

Technical University of Munich (TUM) Asia is working closely with the Economic Development Board (EDB) and Singapore Semiconductor Industry Association (SSIA) to provide postgraduate students with industry relevant training in the area of Integrated Circuit Design. With the EDB-IPP Grant, students have the opportunity to take on Research & Development (R&D) roles in the industry while companies are able to attract talent to fulfil their R&D roles. TUM Asia is committed to support training positions which provide postgraduate training to eligible candidates, and to prepare students for research-intensive roles with strong industry relevance and focus.

Trainee Eligibility

- ◆ The trainee must be a Singapore Citizen or Permanent Resident.
- ◆ The trainee must not be receiving concurrent funding under any EDB grant schemes, or, regardless of the awarding body, any bursaries or scholarships.
- ◆ The trainee must meet the prevailing admission criteria for the MSc in Integrated Circuit Design (MSc in ICD).
- ◆ There is no bond requirement. The trainee can be either a new hire or existing employee of the company.
- ◆ Each trainee will be placed under an ICD training position, in which he/she will be enrolled for the MSc in ICD, while undertaking a research project under their company's supervision for the purposes of completion of the Master's thesis.



Interested applicants please write in to admission@tum-asia.edu.sg

¹ Items which may be claimed under this grant component include: tuition fees, examination registration fees, and fees for other mandatory academic activities. All taxes, including but not limited to GST, are not claimable.

² Items which may be claimed under this grant component must be related to the Project, and include: (i) funds paid to University for usage of lab equipment/consumables at the University R&D laboratory, or software procured for the completion of the academic degree; (ii) funds paid to University to cover overhead charges incurred at the University R&D laboratory; and (iii) funds paid to University and Trainee for publication of research work and participation in research conferences (including the overseas travel expense incurred for such conferences, such as travel insurance, accommodation, meals, local transportation). All taxes, including but not limited to GST, are not claimable.

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