

# digest

May - August 2017 Issue



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Smart Nation  
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Going Far In  
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### KNOWLEDGE THAT COMES TO LIFE

Students visit companies as part of their curriculum



### I AM A TUM STUDENT

Our Bachelor and Master students share their unique experiences on their student life



### LESSONS INSPIRED BY THE INDUSTRY

Prof. Horst Baier shares more on how he incorporates his experiences in the Aerospace industry to his teachings

## ON THE COVER

TUMaraderie - Israel Tan Photography (Photo 1)  
Engineering A Smart Nation - Tan Qi Sheng (Photo 2)  
Lessons Inspired By The Industry - Professor Horst Baier (Photo 3)

This newsletter is published by:

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CPE Registration No. 200105229R (13/06/2017 - 12/06/2023)  
German Institute of Science & Technology – TUM Asia Pte Ltd



# director's message



Innovators are taking the world to the next level; they constantly introduce a diverse range of breakthrough technologies that have the power to improve lives, transform industries and protect the planet. These innovations play a role in tackling the challenges faced by the world. Skilled talent is required to work on further developing these technologies, as well as create new products to solve future challenges. With numerous developments in the industry, the education system must ensure that it is relevant with the industry's needs as well. At TUM Asia, the programme structure is constantly being refined to keep up with trends in the industry to ensure that our students gain a holistic learning experience.

In line with this thought, company site visits are common in a TUM Asia student's curriculum. This gives students valuable insight into the industry, along with opportunities to meet experts from renowned companies. In the past quarter, we organized a few visits to our industry partners to allow them to witness technological innovations at work in the companies. To read more, turn to pages 8-9.

New innovations have inspired many of our students to pursue higher education in their respective fields. Thomas Goh and Tan Qi Sheng were inspired by innovations in the fields of Chemistry and Electrical Engineering respectively, leading them to pursue further studies to gain new knowledge and hone their skills. With the education from TUM Asia, they are well-prepared with specialized knowledge to follow the footsteps of the researchers and scientists that they were inspired by. To read about their experiences, turn to pages 6-7, and 10-11.

Behind the successes of innovators are educators, who work behind the scenes and inspire innovators. Professors ensure that the curriculum is industry-relevant by drawing references from their own careers in the industry. This was attested by Professor Horst Baier when the DIGEST team spoke to him to learn more about how he incorporates his own experiences into the classroom. He also shares his own perspective on how students can excel in the Aerospace industry. Turn to pages 16-17 to read his interview.

We hope that you will have an insightful read. We wish you success in the rest of the year.

**Yours Sincerely,**



**Dr. Markus Wächter**  
**Managing Director, TUM Asia**

## TUM Camaraderie



The TUM Asia SMC, also known as the TUM Asia Student Management Committee, aims to facilitate activities that integrate and bond the students from the different programmes and cohorts. Earlier this year, the SMC organized a couple of events to bring together the student body to forge new friendships and to help a good cause.

### Hiking As A Community

On the 4th of March, TUM Asia students woke up early on a Saturday morning to hike, starting from Mount Faber and ending at Hort Park. This route involved passing by the Henderson Waves and the Southern Ridges. It is always enjoyable to take a break from school and enjoy some fresh air and it was a fun mini adventure for everyone who participated.

### Community Involvement Programme - Willing Hearts

The following month, the SMC organised a Community Involvement Programme with the Willing Hearts Soup Kitchen. Willing Hearts is a non-affiliated charity and is mostly run by volunteers, operating a soup kitchen that distributes meals across Singapore every day. The meals prepared would be distributed later in the day to beneficiaries, such as the elderly, the disabled, low-income families, and migrant workers. Students from the Bachelor and Master programmes went to Willing Hearts together to volunteer their time. Tasks involved preparing the ingredients for cooking, such as washing, peeling and cutting an assortment of vegetables before the chefs use them for cooking. The purposeful work ensured meaningful social interactions between the students and other volunteers.

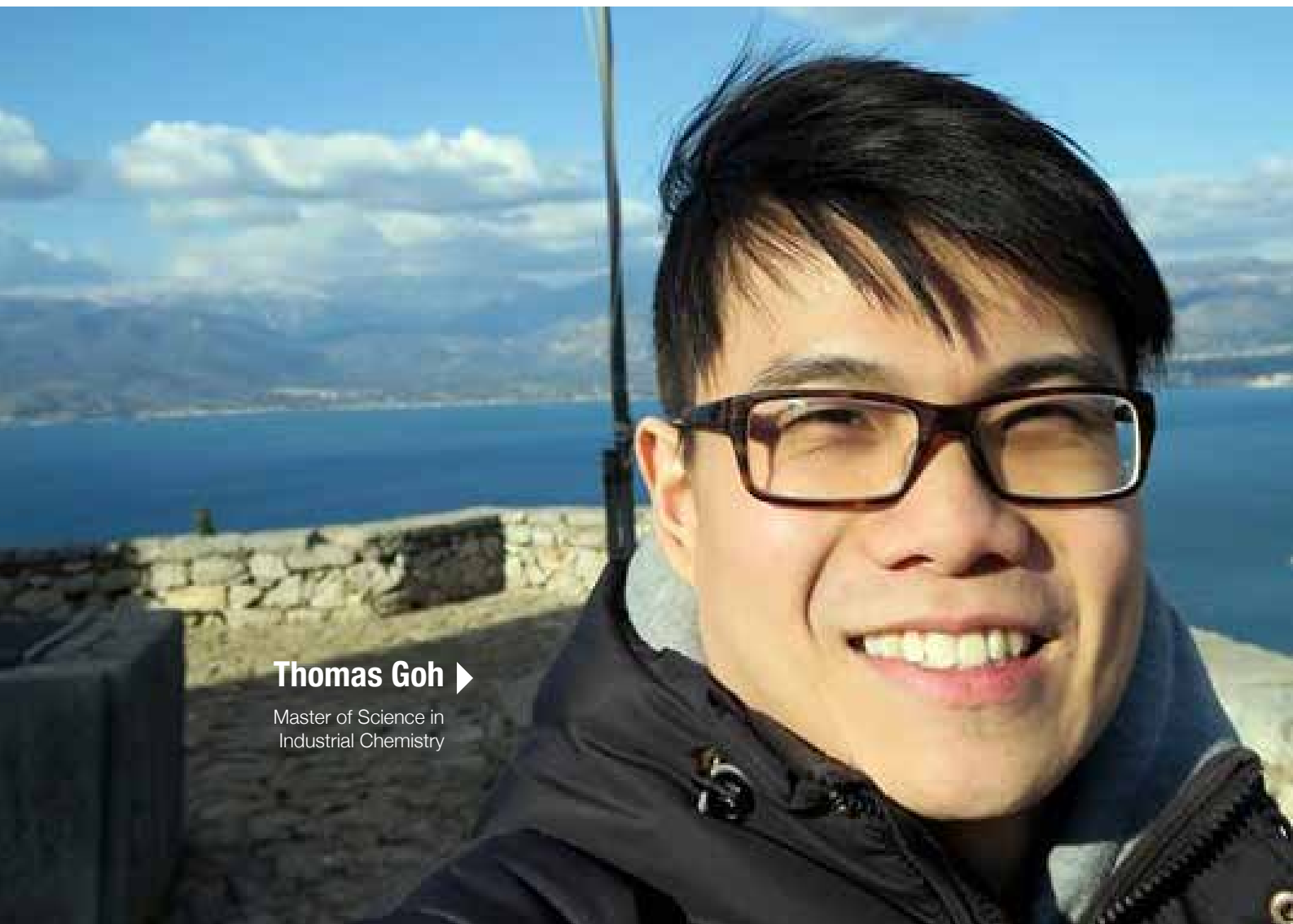






Photos: TUM Asia Student Management Committee

## “Chemistry Is Interesting!”



**Thomas Goh** ►

Master of Science in  
Industrial Chemistry

**Chemistry has always fascinated Thomas from a young age. After completing his undergraduate studies in Chemistry and spending a few years working, he decided to pursue his Masters with TUM Asia to expand his career advancement opportunities. We catch up with him in this issue to hear his thoughts on his education experience.**

**What was your inspiration that led you to pursue an education and career in Chemistry?**

**Thomas:** Ever since my early teens, I have always been fascinated and drawn to science, particularly to Chemistry. My Chemistry teacher was an inspirational figure to me. I recall that she would often dye her hair in all sorts of colours and she would often stroll along the hallway and yell at the class in a high-pitched voice saying “Chemistry is interesting!” Her unique methods to engage the class encouraged my interest in the subject and left a fond impression on me. To this day, I can still remember her words, “Chemistry is Interesting”, to my class like it was yesterday.

**What made you decide to pursue your Master degree?**

**Thomas:** I began working as a researcher after completing my undergraduate studies. As a researcher, the career advancement is limited if one does not have a doctorate. I felt that pursuing a Masters in Industrial Chemistry would help me to achieve my career goals. The programme at TUM Asia was able to provide what I needed to advance my career. It has allowed me to enhance my knowledge and expose myself to modules related to the business aspects of science and engineering. I am also glad that my bosses and colleagues were supportive of my decision to pursue higher education.



## Comparing your Bachelors and Masters, what has changed in your perspective towards studying?

**Thomas:** The teaching systems are very different between my Bachelor and Master programmes. During my Bachelor programme, we have to take approximately five to six modules per semester and sit for the final exams, which span across a period of 3 weeks. The stress level that I experienced was much higher as I had to study these modules within the same period of time. On the other hand, my Master's programme typically follows a block teaching schedule, where we study one module within two to three weeks. It is easier for us to give each module our full attention. However, I suppose this works differently for each individual because everyone retains information in a different manner.

## You will be graduating this year. Looking back, how do you feel about your graduate studies' experience?

**Thomas:** The programme has been reasonably fun and I remember being excited to meet the different German professors in my programme. Each of them bring with them their expertise from different areas of chemistry. I particularly enjoyed Professor Johann Plank's lecture from the module 'Building Chemistry and Construction Chemicals', which allowed us to make cement every day in class. Professor Michael Rossbach was also one of the most friendly, flexible and helpful professors I have met. I am also lucky to have a group of fun and supportive classmates from different parts of the world – China, Germany, India, Saudi Arabia and Singapore. We often exchange cultural and language tips (and laugh at each other).

## Every Master student has to complete an internship. You completed your internship at SGL Carbon. How did it go?

**Thomas:** My internship was conducted in Germany with SGL Carbon and it was an amazing experience. SGL Carbon is a German chemical company and they are known for being one of the world's leading manufacturers for products made of carbon. During my internship, I was required to observe the manufacturing plant, conduct quality control testing, work on research and development, and worked on many innovative ideas that they were exploring to keep up with the industry trends. The German working culture was really nice as well – focused, efficient, and professional. I would love to work in Germany in future should there be an opportunity.



## Now that you have come to the end of your Masters, what's next for you?

**Thomas:** After returning to Singapore from Germany, I started working as a Research Engineer in National University of Singapore (NUS). Till now, I am still intrigued by the spontaneity of research and the opportunity to learn new things. In time to come, I hope to further expand my knowledge in Chemistry and eventually become a lecturer. This would allow me to impart my knowledge and ideas to the next generation.



Photos: Thomas Goh

**"I am also lucky to have a group of fun and supportive classmates from different parts of the world – China, Germany, India, Saudi Arabia and Singapore. We often exchange cultural and language tips (and laugh at each other)."**

Thomas Goh



# Knowledge That Comes To Life



Company visits are significantly important to a student's curriculum, particularly for students studying in engineering. Such visits complement the knowledge taught during lectures, which allow students to witness the practical applications of their studies. It also allows them to view the infrastructure and understand the operational aspects of their industry. These are helpful to prepare students for what to expect at the companies that they will eventually

work for. Company visits are common events taking place during the curriculum at TUM Asia. This past quarter, TUM Asia's Master of Science in Transport & Logistics students were able to visit several places, such as the Marina Bay Cruise Centre, Pepper + Fuchs, and Schaefer Systems International. Students were able to witness how renowned companies facilitate the smooth operations in their facilities and have a glimpse into their future workplaces. It was an insightful session for everyone.







# Engineering A Smart Nation



◀ **Tan Qi Sheng**  
Bachelor of Science in  
Electrical Engineering &  
Information Technology

**With the rapid advancement of technology in the recent years, numerous smart technology ideas and innovations have emerged and will transform the way we live. These breakthroughs have re-shaped the way that Qi Sheng views engineering. In this issue of DIGEST, Qi Sheng shares more on how his time at TUM Asia has contributed to his work in the electrical engineering field.**

**What was your inspiration that led you to pursue an education and career in Electrical Engineering?**

**Qi Sheng:** Curiosity and fascination was what motivated me towards the engineering field. Electricity is the main source of energy which fuels everyone's lifestyle. This is also true across all industries. I was curious about how technological wonders could be accomplished through innovations in Electrical Engineering. It was the driving force behind the desire to gain knowledge and skills through a Bachelor's degree in the same field.

**What made you decide to pursue the Siemen's ASEAN Engineering Graduate Programme?**

**Qi Sheng:** After completing my Bachelor degree, I applied for the Siemen's ASEAN Engineering Graduate Programme (EGP) after completing my Bachelor of Science degree at TUM Asia. It offered a balanced mix of opportunities to build business and management skills beyond engineering. The wide range of skills that I could pick up was intriguing to me and I believe that it is important to ensure career growth in a job. I went



**“I was curious about how technological wonders could be accomplished through innovations in Electrical Engineering. It was the driving force behind the desire to gain knowledge and skills through a Bachelor’s degree in the same field.”**

through several rounds of assessment; a general knowledge test, a group case study, and a panel interview. Even though it seemed like a long process, I was fortunate to be eventually offered a position in Siemens Singapore.

**How did you adjust from being a student to a working adult?**

**Qi Sheng:** Work has definitely had its challenges due to the steep learning curve to perform the tasks delegated to me during the Engineering Graduate Programme. However, during this period, I worked closely with fellow colleagues and that helped to smooth the transition. Finding a good work-life balance is important, which felt similar to my education at TUM Asia when I had to manage my time during my studies. However, when you love what you are doing, the fun comes in naturally.

**How has your education been applied at your workplace?**

**Qi Sheng:** The knowledge that I have learnt through my Electrical Engineering degree has prepared me for what to expect at my job. We were taught with great emphasis on how to approach problems analytically. I feel that it has helped me to break down complex problems to allow them to be manageable and I am then able to achieve concise and feasible solutions.

**How do you see the work you do at Siemens become contributions in the society?**

**Qi Sheng:** The project I am currently working on helps to build the supporting systems for Singapore’s Mass Rapid Transport (MRT) system. In the recent



years, Singapore has embarked on a national effort - the Smart Nation initiative - to improve the society through tech-enabled solutions. In line with Singapore’s push to become a Smart Nation, Siemens is also bringing in new technologies and solutions in the area of digitization. I am glad that my education has prepared me with the skills to support my company and contribute to the development of Singapore’s infrastructure.

**What are your plans for the future and how will you keep upgrading your skills?**

**Qi Sheng:** Currently, I am still exploring the options available. I see myself pursuing a professional certification in project management, and playing a decisive role in supporting the projects for the Smart Nation that Singapore intends to become.

**“I am glad that my education has prepared me with the skills to support my company and contribute to the development of Singapore’s infrastructure.”**



Photos: Playground Pictures, Tan Qi Sheng

# I Am A TUM Student

**Each TUM Asia student has a unique story to share about their education experience. Several TUM Asia students share how their education has prepared them to take on challenges in the working world.**



**“The lectures are highly relevant to current topics as the professors are either connected to or directly from the industry. During our class exercises, we are required to apply combine theoretical knowledge from different modules to adapt to new business situations or to combine knowledge from different modules.”**

Tobias Farwer  
Student, Master of Science in Transport & Logistics

**“I enjoy the small class sizes as it is a good opportunity to interact more with our professors and classmates. We are able to bond with one another not only through our curriculum, but also on life.”**

Lysaris Virginia Bravo Leon  
Student, Master of Science in Industrial Chemistry



**“Friends are my pillar of strength! The bonds that I have forged with my classmates have been positive and we often help one another with our studies. Together, we can soar to greater heights!”**

Khoo Pei Qi  
Student, Bachelor of Science in Chemical Engineering

**“As a student of two reputed universities, TUM and NTU, I am able to experience the education systems of Germany and Singapore. A joint degree programme also allows you to expand your network with professors, students and professionals from both the universities.”**

Karthik Chandran  
Student, Master of Science in Green Electronics







**“Singapore is a very fascinating place as it is very diverse and multicultural and it has contributed to enriching my study and living experiences. Studying abroad with TUM Asia has also helped me to gain self-confidence, international exposure and build up my networking skills.**

Rashmitha Patangi Sudhakar Rao  
Student, Master of Science in Aerospace Engineering

”

**“Many new chemical discoveries are constantly made and that sparked my interest in Chemical Engineering. This interest coupled with knowledgeable and approachable professors made learning in TUM a fun experience!**

Muhammad Noor Eedafi Bin Dahlan  
Student, Bachelor of Science in Chemical Engineering

”



**“Our professors are able to easily engage with each student due to the small class sizes. We are able to receive adequate guidance in our academics and freely ask questions.**

Kenneth Ng  
Student, Bachelor of Science in Electrical Engineering & Information Technology

”

**“When I saw a Personal Computer for the first time, I was awestruck at its high capability of performing tasks of mathematics impossible to humans. Innovators are constantly pushing the boundaries of processor technology year after year. I was inspired by these innovators, which led me to pursue my Bachelors and Masters in the Electrical Engineering field.**

Rupal Jain  
Student, Master of Science in Integrated Circuit Design

”



## “Many People Think Industry 4.0 Is Something You Can Buy Off The Shelf”

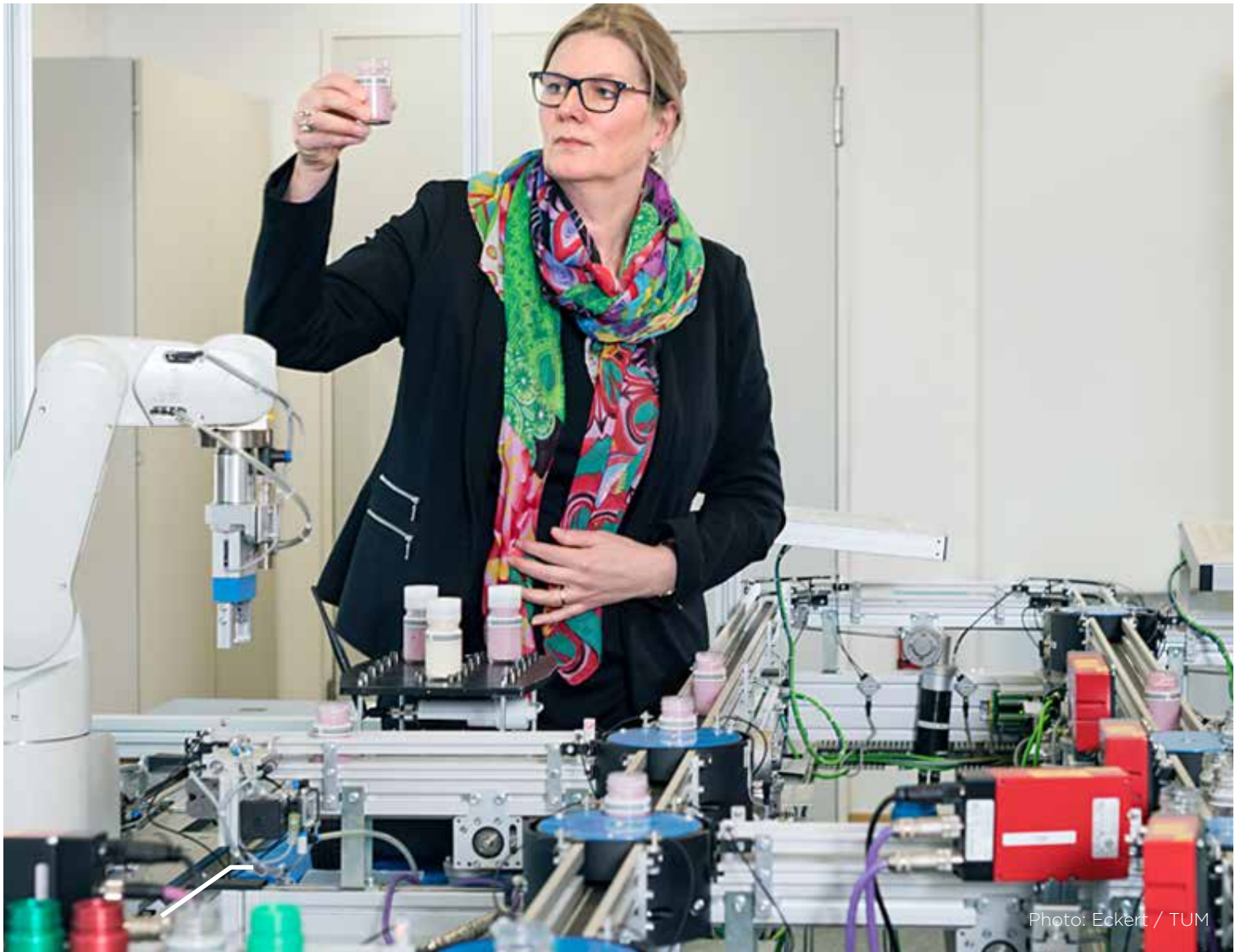


Photo: Eckert / TUM

**The future of manufacturing belongs to Industry 4.0. Anyone not willing to accept it is seen as behind the times. But what exactly is Industry 4.0? Prof. Birgit Vogel-Heuser of the Institute of Automation and Information Systems at the Technical University of Munich (TUM) explains what makes a definition so difficult and how companies can be a part of the new Industrial Revolution.**

**Everyone's talking about Industry 4.0, but many aren't exactly sure what the term means. Is there a definition?**

**Prof Vogel-Heuser:** Yes, there are a number of definitions, but no single one which is generally accepted. Or definitions are kept so general that they really don't mean anything. Industry 4.0 is actually a concept with many different facets. It's just not possible to summarize them all in a single sentence.

**What are the most common misunderstandings when it comes to Industry 4.0?**

**Prof Vogel-Heuser:** Many people think Industry 4.0 is something you can buy off the shelf. But that's impossible. Trade fair booths will often advertise with a banner saying something like "We have an Industry 4.0 PC". Utter nonsense. There's no way a PC as such can be Industry 4.0, it's just a device with software. And at training events I often hear things like, "Tell me





how Industry 4.0 will work at my company.” There’s no such answer in general. Every company has to figure out for itself what parts of this plethora of Industry 4.0 components is interesting for the company, for its business and its customers.

### Can you give us some examples?

**Prof Vogel-Heuser:** A training session brought me into contact with a company where a lot of work is still done manually. There’s also a large core machine which often breaks down. Now the company has joined together with a competitor that also uses this type of machine. They’ve launched an Industry 4.0 project together with the machine manufacturer, with the objective of reducing breakdowns and identifying causes. In another case, a major company with many different departments needed to optimize communication and cooperation between the departments in order to improve engineering and data evaluation. This is why you can’t simply say: Tell me what I should do at my company. Here everyone has to think about their own weaknesses and strengths and what’s most beneficial for them.

### So Industry 4.0 optimizes companies?

**Prof Vogel-Heuser:** Yes, it is an optimization process. Ultimately we want our systems to work better so that we remain competitive or even improve our competitive abilities. This is where the various mechanisms of Industry 4.0 come in. For example, now I can network myself, since a good Internet connection is available almost everywhere. And this networking can take place not only within my own company, but also for example with the competition. Many companies are readily willing to share a certain amount of their data with some of their competitors, since this way they gain additional knowledge for example better results in data analysis to a broader data base. And more knowledge means I can work more productively.

### How does this look in tangible terms?

**Prof Vogel-Heuser:** For example, a manufacturer and a construction contractor can share data about construction machinery, about how often a given piece of equipment is used, which routes it travels or what error messages are generated. When I see the piece of equipment has failed, I can quickly find out

where I can buy or borrow a replacement or a spare part. This may even be from a competitor, if I happen to know he doesn’t need his bulldozer right now. And I give him a little money for it, then we both profit from the situation. This is what’s really new, extending horizons beyond company boundaries.

### You are working together with several other professors in the “MyJoghurt” project?

**Prof Vogel-Heuser:** Professors can also be in a way competitors, when they research and teach at different universities. We want to show that we too can join together to build something and learn together, even without additional funding. Each individual has his or her strengths and runs different lab plants, and when we join together, the result is an Industry 4.0 system. And that’s exactly how it worked, we jointly developed models and wrote software together.

### The MyJoghurt plant demonstrates another aspect of Industry 4.0: The intelligent product. How does that work?

**Prof Vogel-Heuser:** Well, in a manner of speaking we have a yogurt jar that knows how it wants to be filled. Let’s say you want mango and strawberries. First you have to find out if that can be produced, i.e. are all the ingredients available and can these fruits be processed at the plant in the first place. Then the jars start to move and get what they need: In a sense they’re in contact with the machinery. The idea itself is rather old - but now it can be actually put into practice.

### For many people the term Industry 4.0 means completely automated production where no additional human support is needed.

**Prof Vogel-Heuser:** We’re not working towards factories that are entirely devoid of humans. There are certain things machines can do better than humans, for example lifting heavy things and performing monotonous activities such as evaluating data. We want to be rid of these simple but time-consuming tasks, the many little things that keep us from doing what we actually want to do. And Industry 4.0 can make an important contribution. There are still other things humans can do better than machines, such as reacting to critical and unexpected situations. In Industry 4.0 machines are also intended to support humans in doing their work.

### How would that look?

**Prof Vogel-Heuser:** The question is: How can I train less-qualified employees so that they can for example operate a given machine. The important thing is to break complex tasks down into simple steps and to avoid overwhelming the people involved. It’s possible to interpret their reactions, for example with glasses that monitor the line of sight. If someone is looking around without knowing what to do, the fact can be detected and an attempt can be made to find out what the person hasn’t understood. This information can in turn be used to reprogram and improve the interface and the software.

## Prof. Horst Baier



Photo: Prof Baier

**Recently, the DIGEST team had the opportunity to interview Professor Horst Baier, who has been teaching in TUM Asia since the inception of the Aerospace Engineering programme. He shares more on the Aerospace industry and how he brings his experience from the industry into the classroom.**

**Hi Professor Baier, can you share with us about your work in the Aerospace industry before becoming a professor at TUM?**

**Prof. Baier:** I joined the industry after finishing my doctoral studies in 1977. At Dornier – which is now part of Airbus Group – I continued my research work for a couple of years in model based structural and multidisciplinary design optimization methods, with a clear focus on applications. Later, I took over a department with over 50 people, where I worked in the field of structures and structural mechanics. Following that, I was appointed as Chief Engineer for Mechanical Systems, with application mostly in aerospace, but also other areas as well. Through these different roles, I experienced how important it was to lead and manage while possessing a strong knowledge of engineering. I realized that it involved a combination of different aspects which helped to successfully solve challenging engineering tasks, something which became a guideline for my teaching activities.

**How did you come to be associated with TUM and eventually to teach in Singapore?**

**Prof. Baier:** After having stayed for 20 years in the industry, I received an offer in 1997 from TUM to join the Aerospace department and to head the Institute of Lightweight Structures. Such a transition from industry back to university is quite common in engineering at German technical universities, apart from the theoretically based disciplines. This means that professors know both sides of the coin – experience in industry and in academia, with all its pros and cons. It was around 2009 when I was asked to consider teaching some of my lectures also at TUM Asia, where a master programme in Aerospace Engineering was going to be established. I agreed without hesitation and took it as a challenge and also as a chance for a new experience. Till today, I am still happy that I did so.





### **What is your impression of the Aerospace industry in Asia compared to Europe?**

**Prof. Baier:** The Aerospace industry in Europe is 100 years old, with more tradition and has gone through many evolution steps. Because of these deep roots, things in Europe are broader, wider and often deeper in a certain sense than in Asia. However, Asian countries are quickly catching up. This not only holds for the big players like China and India, but also from smaller Asian countries providing special contributions, components and subsystems, being either “mechanical” or “electrical”. I am aware of several German companies which have established good working relationships with Aerospace companies in Singapore and they benefit well from each other. I think that cooperation should be even more enhanced in both in academia and in industry, which also includes small and medium enterprises.

### **Tell us more on the modules that you teach in TUM Asia.**

**Prof. Baier:** Since the establishment of the Aerospace Engineering programme at TUM Asia, I have been teaching two modules; Fiber Composite Materials and Lightweight and Aerospace Structures. The lectures on Fiber Composite Materials are material oriented and due to the material’s special behavior, I place the focus on thinking, designing, analyzing and working with such materials. The lectures on the second module have origins from the other end of the development chain. The discussion of typical and different criteria and loads for Aerospace structures, how are these criteria and loads determined, and what do they mean for design and development steps, also including different tests. These things are substantiated by a set of large-scale practical examples. I hope to make the students aware and to lay the basis to identify and achieve the required syntheses. This then means that they will be able to easily define the criteria, create proper design concepts and materials, simulation and test methods, and also relevant quality assurance aspects.

### **Now that you have been to Singapore for almost a decade, what are your impressions of Singapore?**

**Prof. Baier:** Inside the classroom, the most obvious

difference between TUM Asia and TUM Germany is the size of the classes – in some of my lectures in Munich it is tenfold larger than that at TUM Asia. However, TUM Asia students are equally keen to learn things as the students are in Munich.

Out of the classroom, I enjoy staying in Singapore and visiting the downtown areas and even more so the less populated areas and parks. It is also enjoyable to do my daily rounds at the outdoor pool, where I do not have to worry about the air temperature. On the other side, I see significant changes in the infrastructure as more and more buildings grow over the years. I very much hope that Singapore will be successful in its planned longer term transfer from a “city in a garden” to “a city in nature”.

### **What are some challenges in the workplace that students should be aware of?**

**Prof. Baier:** First of all, the challenge students should be aware of in my eyes is an old one. Since they would very likely start their career not as a boss but as a young engineer in the development, design or production departments, they should focus on gaining knowledge in their field of interest. Soft skills are also relevant, but knowledge is the basic skill that one has to build on. Continuing to learn and growing the theoretical knowledge during their professional life is important in today’s world as changes in the industry occur at a faster pace than before.

### **What are your hopes for the future of the Aerospace industry?**

**Prof. Baier:** The aeronautical industry has defined its long term goals to achieve drastic reductions in the environmental impact of aircraft, which over a longer term could lead to a fundamental redefinition of aircraft concepts. For space, apart from continuing astrophysical investigations, the space community will further promote the application of communication as well as earth and weather observation satellites, and will have to find good ways to significantly reduce launch cost. This again is a matter of defining proper systems combined with good engineering in the different subsystems and disciplines, but also of having good ideas “out of the box”.

# The Chatter

## SingPost And TUM CREATE Launch Trial Of Electric Vehicle For Mail Delivery

Singapore Post Limited (SingPost) and TUMCREATE will on 28 March 2017 commence a road trial of a prototype electric three-wheeler that is environmentally friendly and features innovations to boost mail delivery efficiency.

Developed by researchers with the support of the management team at TUMCREATE, in conjunction with SingPost, the customised vehicle will serve as a test bed for concepts that will guide SingPost's application of electric vehicle technology for postal operations and eCommerce logistics.



The three wheeler has been designed to streamline postal processes, improve rider experience and reduce greenhouse gas emissions. SingPost currently operates a fleet of 674 petrol-driven scooters for last mile postal delivery. Of these, about half are three wheelers, which offer greater ride stability and load capacity than conventional two-wheelers.

Mr Tan Tien Po, SingPost Senior Vice President for Domestic Mail, said, "Innovation and the application of new technologies is how we improve SingPost's services and meet the evolving postal needs of Singapore. We are excited to take this step forward with TUMCREATE, towards realising an urban logistics solution that addresses the future needs of mail and eCommerce logistics, increasing demands for fast and flexible delivery, and the growing need for environmental sustainability."

Prof Ulf Schlichtmann, Professor at Technical University of Munich (TUM) and TUMCREATE Program Director, said: "I am really excited about this innovative vehicle for Singapore which our dedicated TUMCREATE team has developed in cooperation with SingPost. It has been a very rewarding collaboration, and we feel that Singapore will benefit from our research expertise which is backed up by TUM's strong track record in vehicular technology, especially electrically powered vehicles."

The vehicle's all-electric drive produces zero local exhaust emissions and, with relative simplicity and fewer moving parts compared with combustion engines, reduces maintenance costs and downtime. Additionally, it offers near-silent operation, thus curbing noise disturbance, especially during deliveries in residential areas.

Modular batteries, the costliest component of the vehicle, were developed by TUMCREATE so that fleet cost may be optimised by matching battery capacity to the route on which the vehicle is deployed. By changing the battery configuration, the vehicle's range may be configured to 35 kilometres, which is sufficient for an average mail delivery route – or 70 kilometres, which will satisfy almost all postal delivery trips made. Operating costs as well as battery end-of-life management may be further minimised by incorporating regular charging into routine overnight parking of postal vehicles at delivery bases, thus avoiding the battery degradation caused by fast charging, and the cost of fast chargers.

The vehicle features a specially designed storage system that can reduce a postman's daily delivery routine by up to 40 minutes. This is achieved through a detachable, rollable storage box that the postman may pack at his mail sorting station, wheel to the vehicle, and load up on the vehicle with the help of a motorised hoist. Packing and unpacking is cut down as the postman no longer requires a separate trolley to transport mail from sorting station to his delivery vehicle. The box, at 567 litres, offers 23 per cent more carrying capacity than those on existing postal scooters. This enhances delivery efficiency, especially as postal services are used increasingly for eCommerce delivery. For environmental sustainability, the sidewalls of the box are made from an advanced bamboo composite developed by advanced fibre composite material researchers under the Future Cities Laboratory at the Singapore-ETH Centre. Bamboo is durable, grows fast and is recyclable.

Manoeuvrability and stability when cornering is improved by an articulated tilt mechanism that allows the rider cabin to lean into a turn, independent from the rear cargo section. This increases the vehicle's agility and reduces steering effort and counteracts cornering forces. While parked, the tilt mechanism is locked to ensure a stable position on three wheels without a kickstand.

The electric three-wheeler is equipped with a smart instrument cluster that includes dynamic GPS routing for priority deliveries and optimised delivery routing, fleet monitoring for data collection and management, integrated cameras, and on-demand tracking.

The trial will take place along two delivery routes between SingPost's Ayer Rajah Regional Delivery Base and the National University of Singapore and end on 7 April 2017. Three SingPost postmen have been assigned to provide real-world feedback for further development, while a manufacturing partner is being sought to convert the prototype into a market-ready product.





Photo: TUM Asia

## Career Opportunity Day

TUM Asia held its annual Career Opportunity Day, a career networking event aimed to facilitate interactions between students, graduates and the industry, on 22 March 2017. Representatives from the industry were present to promote their companies and employment opportunities. It was a successful turn-out and helpful for students and alumni to find out about the different internships and full-time rolls being offered by the industry.



Photo: TUM Asia

## TUM Asia Partners Nanyang Polytechnic To Raise Engineering Standards

On 4 April 2017, the Singaporean-German Chamber of Industry and Commerce (SGC) hosted a Industrie 4.0 Symposium, which aimed to allow German delegates to exchange information and technology with local experts on the manufacturing environment of Singapore. During the symposium, a Memorandum of Understanding (MOU) was signed between Nanyang Polytechnic (NYP)'s School of Engineering and Technical University of Munich Asia (TUM Asia) with the objective to raise global engineering standards. The joint cooperation would benefit students and staff from both institutes as they will have increased opportunities to go on exchange programmes. The partners are also planning executive training courses, seminars and conferences for the industry, which would greatly benefit the advanced manufacturing sector.

# WE WORK BEHIND THE SCENES TO INNOVATE YOUR DAILY PRODUCTS

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CPE Registration No. 200105229R / Reg. Period: 13/06/2017 - 12/06/2023

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