

# digest

April - June 2015 Issue



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### AN EDUCATION IN ENGINEERING AT TUM ASIA

"Getting priorities right"



### A CAREER IN CONSTRUCTION CHEMICALS

Chemicals are essentials in our lives



### FIRST DAY OF CLASSES AT SIT@SP

Moving into our new location

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# director's message



**T**he first quarter of the year has been an eventful one for TUM Asia. Last month, TUM Asia was involved in several events, the most significant being the third and largest career fair we organized for our students and alumni. At TUM Asia, our mission has always been to give back to society using science and technology through the education we provide. To read up about the career fair and hear what the various companies had to say about a career in engineering, you can turn to pages 4 to 7.

We were pleased to catch up with one of our graduates, whom has achieved much success since pursuing her education at TUM Asia. After winning the Best Student Award (Master of Science in Integrated Circuit Design) in 2014, Shilpa Kumar went on to work as an Analog Design Engineer for Marvell Semiconductor. The DIGEST team was also given the opportunity to speak to Shilpa's supervisor, Mr. Chan Sang Kong, who shared about what graduates should be prepared for and how engineering drives the development of economies. Flip to pages 10 to 11 to read their interview.

By choosing engineering, the opportunities to expand your career and education are limitless. As the need for better engineers continues to increase in the world, a seminar was held in collaboration between DAAD and TUM Asia to address the possibilities of pursuing a doctorate in Germany at TUM. The participants were able to hear about the exciting opportunities of working under TUM professors in Germany. Among the speakers was Amylia Abdul Ghani, graduate, who shared about the benefits and opportunities she had since completing her doctorate in TUM. Read more about what the speakers had to say on pages 14 and 15.

I am also pleased to announce that TUM Asia has officially relocated to our new campus on Singapore Polytechnic, the SIT@SP Building, owned by Singapore Institute of Technology (SIT), our university partner for our Bachelor of Science programmes. A simple welcoming lunch was held for all students, professors and staff. Turn to page 19 to read one of the articles written by one of our student writers.

This issue is packed with career friendly reads, highlighting engineering as a career for tomorrow. We hope that you will have an insightful read.

**Yours Sincerely,**

A handwritten signature in black ink, appearing to read 'M. Wächter', written in a cursive style.

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

**“  
Graduates have  
to be flexible  
and prepared  
to adapt to  
changes rapidly,  
especially in  
times where  
resources are  
tight**

**”**

Logwin Air+Ocean  
Singapore



WACKER

BE PART OF  
ACROSS ALL

CLARIANT

CLARIANT

AMBA





**O**n the 20th of March 2015, TUM Asia organized its annual Career & Internship Fair for its students and alumni, marking it the 3rd and largest career fair organized by TUM Asia. This year's fair was held at Singapore Polytechnic, T1A. Many companies from the different industries were present this year and set up their booths around the room. Many students and alumni came out dressed at their best in professional business attire with their resumes ready at hand.

The function room was thoroughly filled with people shortly after the career fair started. Students crowded around at the different booths, eager to talk to the different companies. Many companies have had TUM Asia students working at their companies and they were excited to network with more students, who would possibly become their colleagues in the near future. "We have had approximately 8 TUM Asia students working at our organization. They have been excellent and valuable assets", commented Advanced Remanufacturing and Technology Centre (ARTC). Advanced Micro Devices (AMD) also mentioned "We have had more than 5 TUM Asia graduates working with us, who are excellent and motivated talents that work well with our organization".

**“We appreciate the openness, flexibility and independence of TUM Asia students.”**

- Wacker Chemicals

As the world continues in its quest for greater excellence, graduates are continuously expected to improve their skills and evolve to keep up with the demands and trends in the industry. "Globalization is still in the trend and most of the industries will favour international graduates with multicultural exposure", said Wacker Chemicals. As expected, graduates have

to be responsible, be prepared to work independently, and take initiative at their jobs. There are many opportunities for talents who want to grow in this dynamic engineering industry.

**“If engineering would not constantly deliver results, the global economy would come to a standstill.”**

- Lantiq Asia Pacific

Engineering has always been in demand despite good or bad economic conditions and has continued to be a constant in rapidly changing landscapes. Innovations that stem from engineering play an important role in ensuring that our global needs are met. "The engineering industry remains as a key economic stronghold in all aspects and has remained a constant over the years. Highly educated engineers are very important to the industry, particularly in the research and development sector", commented HGST Singapore. Solutions that are developed by the engineering industry drive the economy. "Engineers are very important in every business field and industry as they are required to bring businesses forward and drive growth," said Logwin Air+Ocean Singapore.

With that being said, a career in engineering is extremely important and provides many opportunities for advancements in careers. "Engineering is a great launch platform to advance in various career paths, such as technical, general management, or product management", mentioned Lantiq Asia Pacific. "Engineering is necessary for product development as it transfers an academic theory to a real and actual product", noted Acumen Research Laboratories. Making new breakthroughs and developing new technologies allows engineers to make a difference in the world's future.





Photos: TUM Asia







This article was contributed by student writers, Abel Tan and Kelly Han, in collaboration with TUM Asia

In our rapidly changing industry, the young generation of today continues to seek out valuable higher education opportunities that supply them with the capability to remain competitive and industry-relevant. This past quarter, many students have been able to approach TUM Asia at its outreach events to find out more about studying engineering at a German University.

Student involvement by the current undergraduate students helped to play a significant role in TUM Asia's outreach events. Many students, including several from TUM Asia's Student Management Committee (SMC) were present at the Singapore Institute of Technology (SIT) Open House, which was held on the 16th and 17th of January at the Suntec City Convention Center.

**“It was a memorable experience to be part of SIT open house as a student ambassador of TUM Asia.**

Kelly Han  
Student, Bachelor of Science in Electrical Engineering and Information Technology

Throughout the open house, the students shared their perspectives on why they chose TUM Asia, what studying there is like, as well as provide detailed responses on the programme modules. One of the student ambassadors present was thankful for the opportunities she had because of TUM Asia. “I was able to share my experience as a current EEIT student, which reminded me of the journey that led me to study at TUM Asia and I have had no regrets. Although the programme may be tough at times, the rewards that we get at the end of the day make me stay strong and pursue on”, commented Kelly Han.

Abel Tan, the top student in the BSc cohort

and a former JC student, was also present at the open house to interact with interested students and parents to share his experiences. “In the course of 2 days, I shared my experiences and it felt nostalgic as I was once in their shoes scrambling to find a degree in a university that was right for me.”

When asked about what the unique benefits from the programme, Kelly mentioned “Being able to be taught by different German Professors and to be able to exchange cultures is one of the many privileges that you can only get in TUM Asia”. The professors are flown in on an exclusive teaching basis and the small class sizes allow them to be able to devote their full attention to students. Students are also required to travel to Munich during their final semester to complete their Bachelor Thesis. “Although the programme is not easy, it forces us to learn how to manage our time and prioritise between study and play”, said Abel Tan.

Besides sharing about TUM Asia to potential students, this was also a rare opportunity for students and staff to interact and bond with each other. Everyone had a great time! Thank you for all the time from the undergraduate students who came out to lend their support to their university.

**“Studying in TUM has benefitted me greatly as a TUM degree is widely recognised. With the knowledge I have learnt from our German professors, hard work and effort, I can safely say that my future is on the road to success.**

Abel Tan  
Student, Bachelor of Science in Electrical Engineering and Information Technology





Photos: TUM Asia



## Working With A Leader In The Industry

**Do you have what it takes to work in the semiconductor industry? In this issue, the DIGEST team speaks to one recent graduate, who won the Best Student Award in her Master Programme, to find out about working with Marvell Semiconductor.**

**We were also given the opportunity to speak with Mr. Chan Sang Kong, Shilpa's supervisor, who was able to give his comments on why engineering is so important.**

**Shilpa Kumar**

Master of Science in Integrated Circuit Design  
Marvell Semiconductor  
Analog Design Engineer II



Marvell Building was officially opened by

**Mr S. Iswaran**

Senior Minister of State for Trade & Industry

*in the presence of*

**Dr Sehat Sutardja**

Chairman, President and Chief Executive Officer  
Marvell Technology Group, Ltd.

on 20 November 2008.



**Hi Shilpa, how is it like having graduated from TUM Asia and being out in the workforce?**

**Shilpa:** It was a wonderful experience to graduate from TUM Asia. The most interesting part of my program was being taught by top notch professors from both TUM and NTU. The professors were approachable and welcomed doubts always. My classmates took the learning experience to the next level; we were always ready to solve difficult topics and questions together. The coursework coupled with the industrial internship has moulded me to start a perfect career in IC design.

**How have you been able to apply what you learnt at TUM Asia into your job?**

**Shilpa:** I was fascinated by Analog IC design the most during my coursework which eventually led me to pursue my internship and master dissertation in the same domain. The well structured coursework and the hands on experience gained during my internship gives me the confidence to tackle day-to-day challenges in my job.

**What has your job been like working for Marvell Semiconductor? Have you had the opportunity to work on interesting projects?**

**Shilpa:** Being a part of Marvell Technology Group, a leader in the semiconductor industry, has made me realise that learning never stops. It has been an interesting experience to be in one of the most vibrant teams working on cutting edge technologies for storage products. Even though I was a fresh engineer, I had the opportunity to contribute to a few tapeouts which was an enormous learning experience. It is a friendly atmosphere to work in and has been a great place to start my career.

**What made you consider a career in engineering?**

**Shilpa:** Engineering is an ubiquitous part of contemporary life. I feel lucky that I was born in this generation that has seen rapid growth in science and technology. The passion to understand and create new things inspired me to choose a career in engineering. Choosing the right career can mean the difference between being satisfied and being disappointed with one's life.



Photo: Playground Pictures

**Hi Mr. Chan, how has Shilpa been able to contribute to your organization?**

**Mr. Chan:** Shilpa has been a great help to our team. As the top graduate from TUM, she has very strong foundation in her academics. She was able to contribute very quickly after coming on board. She helped to perform numerous simulations on our new analog circuit blocks. She has to think of various test scenarios to verify the correctness of the design. In some cases, her simulations have helped us discover flaws in our designs. This is critical because any hidden issues discovered after chip fabrication would set us back by a couple of months and this could jeopardise our program.

She has also worked on the bench characterization of the new chips, which she has participated in since joining us. She showed great interest in both lab and design work.

**What are some aspects that you have enjoyed about hiring a graduate from TUM Asia?**

**Mr. Chan:** The 18-month Masters program in TUM has a good balance between classroom coursework and the practical 6-month long internship. Graduates from TUM take this internship very seriously. One key difference is that in TUM, the students have to complete a Masters thesis during their internship and through this thesis, the stronger graduates will shine through.

Another aspect is that some of the TUM graduates have some working experience in the field of interest prior to starting their course. I think these graduates in particular, have strong conviction in pursuing a career in their chosen field.

**What are changes in the industry that you would expect future graduates to be well versed in?**

**Mr. Chan:** While the electronics industry has evolved very rapidly and transformed the lives of every human being, all graduates must first have strong foundation in the fundamental theory because many of these advancements are based on a few engineering principles. The field of electronics is so wide, new and major breakthroughs are being discovered every few years; from new algorithms, new materials to new processing technologies, it will be difficult for new graduates to keep up with them. They should however, have a keen interest to follow some of the industry publications about the new trends in the electronic industry and periodically do some readings into the background of the enabling technologies of these new trends.

**Engineering jobs have always been in demand despite good or bad economic conditions, as well as rapidly changing landscapes. Why do you feel that engineering is a constant?**

**Mr. Chan:** Engineers play an important role in the development of a society and a country. A large pool of engineers and researchers are necessary for a country like Singapore because we aspire to succeed in the fore-front of technology, be it in the area of green energy, microelectronics, IC Design, aerospace engineering and many other exciting fields of engineering. As such, engineers are always in demand in Singapore.

# Doing A Doctorate In Germany



To address opportunities for higher education in various specializations, a seminar titled “Doing A Doctorate In Germany” was held in collaboration between German Academic Exchange Service (DAAD) and TUM Asia on the 6th of March. Participants came out to the first seminar held at TUM Asia’s new building to hear about the exciting opportunities for students to work on life changing projects in Germany.

“By doing a PhD in an institute like TUM, you get hired because you can develop solutions to challenging problems”, said Prof. Dr.-Ing. Florian Holzapfel, who gave insight into his visionary aerospace projects, one of them allowing pilots to control a plane’s flight using thought patterns and brain waves. Students were also able to hear from Prof. Dr. Fritz Kühn and Prof. Dr. Gerhard Kramer, whom also shared their projects and opinions

with regards to the chemistry and communications engineering respectively.

Amylia Abdul Ghani, a graduate from the Master of Science in Industrial Chemistry, went on to pursue her PhD under Prof. Dr. Fritz Kühn. She is now working in Singapore and credits her current success because of her PhD. “Having a PhD really helped me out with my job prospects as it opened the door to many opportunities that I would have never had if I did not do my PhD in Germany”.

Such opportunities would not have been made possible without the excellent relations between Germany and Singapore. “Research cooperation between Germany and Singapore can be best described by what TUM Asia has achieved. TUM has set a milestone for German universities abroad”, affirmed Mr Sascha Kienzle, Head of Science Affairs at the Embassy of the Federal Republic of Germany.



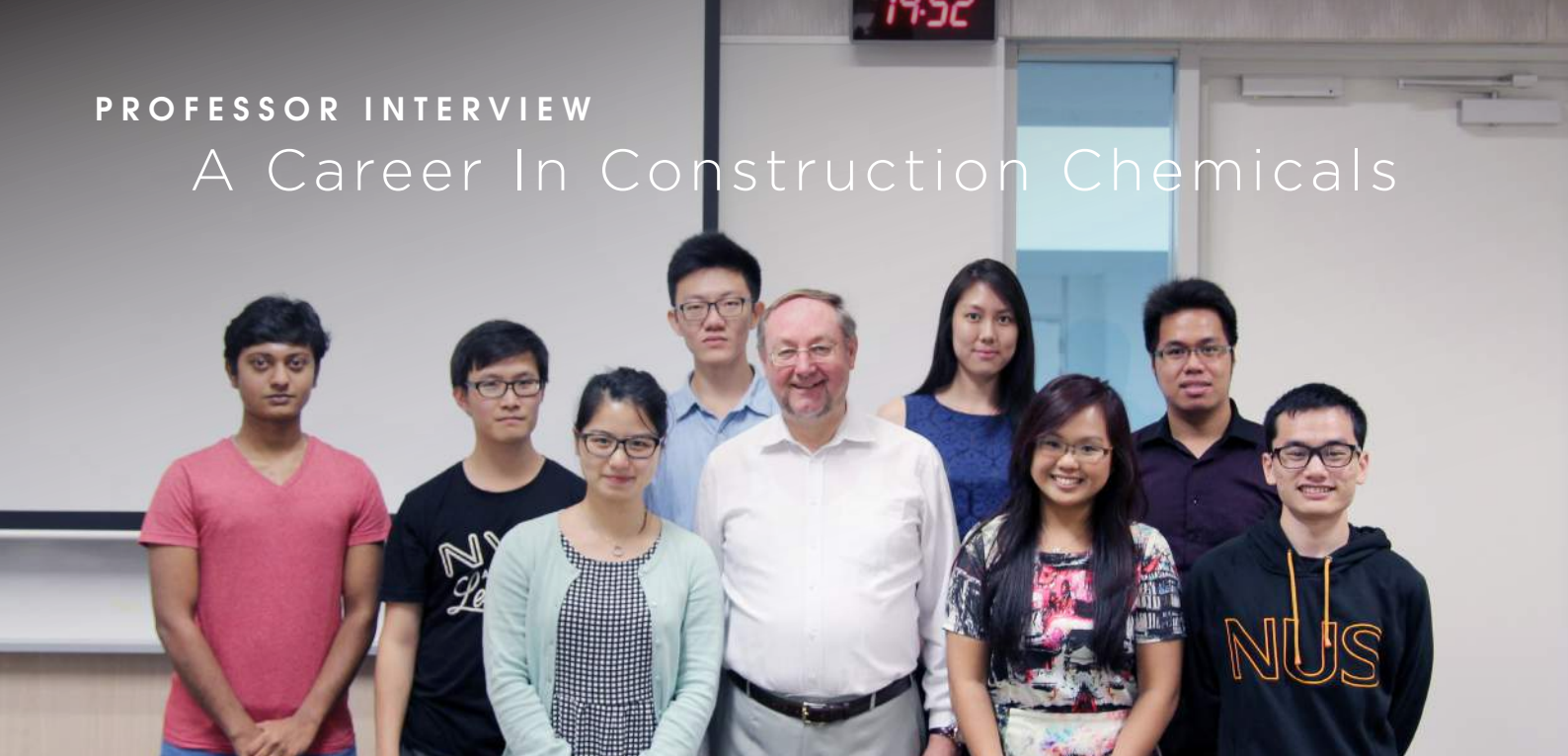


Photos: TUM Asia



## PROFESSOR INTERVIEW

# A Career In Construction Chemicals



From top to bottom clockwise: Prof. Plank with his students, Site visit to Baker Hughes, Prof. Plank teaching at TUM Asia, Site visit to Wacker Chemicals



**Prof. Dr. Johann Plank has taught at TUM Asia for over 10 years, ever since the Master of Science in Industrial Chemistry programme was offered in Singapore. Like many other TUM professors, he has had many years of experience working in the industry and teaches what he knows best, based on real life examples of what he has experienced first hand. Prof. Plank specialises in construction chemicals, such as cement, and whenever he flies to Singapore to teach, he often highlights to his students about the importance of such fields and brings them on site visits to different chemical companies, despite such fields not being the most popular. Prof. Plank, who was recently in Singapore, shares to the DIGEST team on his insights about the importance of chemistry in our daily lives.**

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**Hi Prof Plank, can you tell us more about what your speciality is?**

I teach about cement and construction materials such as concrete and dry mix mortar. My lectures consist of two parts, cement and chemicals used in cement. Students always wonder why a very well-known material like cement is very complex. When cement reacts with water, it becomes complicated to analyse. When cement hydrates it forms certain mineral faces, some with complicated composition and depending on environmental conditions, and how you mix it, you get different products. Cement is a challenging material and though it is cheap, it is wonderful. It is the largest man made product in the world and we use 400 billion tonnes a year worldwide. Cement is largely used in countries that build a lot of infrastructure – such as houses and buildings. This is why cement is important.

**Do your students share the same views as you do with regards to the importance of cement?**

Not always. Students like to pursue fields such as biotech, nanotech, and IT and do not realize the prospects of cement. This is not true as there are few experts in this field. Thus, a student who is interested in cement will easily find a job. Many students give up as cement is as highly complex as it is challenging. Academics do not offer much on it since it is complicated and requires more than 2 to 3 years to understand it. Having had worked for a chemical company for 20 years, which now is part of BASF group, it produces chemical mixtures within cement and mortar. Thus, I am familiar with the market and applications of these products, which is what I teach to my students.

**Do you expose your students to the industrial side of construction chemicals?**

My students and I are visiting Baker & Hughes and Wacker Chemicals this month, where we are hosted by ex-students of mine. As previously mentioned students are not aware about the fields of cement because it is not popular and requires qualified experts. These field trips make the class come alive and show them the importance of construction chemistry.

**What do you think students need to be prepared for in order to stay competitive and relevant?**

We are moving towards a “high tech” society and

students need to be competent or else they cannot continue to succeed in the industry. They need skills and a keen interest in what they do, not be in it just to make money. Students have to think about how they can improve the industry, continuously be open-minded and ready to look at things in different perspectives. For example, today’s buildings involve a lot of IT technology within the construction fields so students must know more than the industry itself. Speaking from experience, students should also do what you are good in and enjoy it to achieve a lifetime of satisfaction in their work.

**Why do you think that the Industrial Chemistry fields are constantly growing despite of economy change?**

That is because products like detergent, food products, home furnishings, entertainment are essential in our daily lives. The standard of living is increasing everywhere and people want better cars, nicer homes, air conditioning, and all these involve chemical products. People do not automatically register that chemistry is involved in all our daily products – such as plastics in our computers and smart phones, the LEDs on our display screens, the beautiful colours on the iphone, the latter of which are from rare natural compounds in natural materials, which is at the same time very sophisticated as these are rare elements. If we talk about electromobility in cars, we need rare materials like lithium. These are scarce and if we apply it for all cars in the world, we will run out of these materials for other uses. We need new solutions and these show the importance of chemistry.

**What advice would you give to students who are thinking of pursuing a Master’s degree, or beyond, after a Bachelor’s degree?**

The difference between a BSc and MSc can be big. In Europe, people expect those studying Chemistry to have a PhD. This is because you always start with research and development and you become a manager of technicians, thus you need to know how to work independently – which is something you learn in a PhD. In Singapore, skills are more looked upon compared to degrees but that is catching up. Of course with a Master degree, you have more opportunities and you rise above the competition. An example would be an ex-student of mine who was a manager of an R&D center in a German company. It was later merged with a larger company, but she got the job as the overall manager because she was the only one that had a PhD.

THE TECHNOLOGIST

# Too Little, Too Much





## **Developing wind and solar won't be enough to wean Europe off fossil fuels. To guarantee an uninterrupted flow of electricity, the continent will have to improve its storage capacity and build a super grid.**

Wind produces 34 per cent of Denmark's energy, and in Italy solar power contributes 6 per cent. But these sources of renewable energy are intermittent and unpredictable.

To ensure that electricity is available 24/7, distributors rely on pumped hydro dams or gas-powered turbines that can quickly compensate for dips in production. Since these operational reserves work only at part of their full-load capacity, they are an expensive way of providing electricity, emphasizes University of Leeds professor Peter Taylor.

Here's a perfect example: On 11 February 2007, wind production in Ireland plummeted from 415 MW to 79 MW in just four hours. Were a dip of proportional magnitude to occur in the UK, four nuclear power plants would have to be brought online to compensate for it.

### **Too much juice**

Even the inverse situation – too much electricity – can be a problem: excess energy is absorbed by a frequency increase in the grid. This fluctuation can damage generators, which are optimised to run at 50 Hz.

“It's crucial to rapidly compensate for these imbalances”, explains Allan Schröder Pedersen of the Technical University of Denmark. “If frequency variations accumulate, they can lead to a complete phase shift between two generators, and that can produce an explosion.”

Excess energy also leads to waste: in March 2014, the operator of the British electricity grid paid wind farm operators £8.7 million to stop generating power.

This is why experts agree that the growth of renewables requires a major increase in storage capacity, so that excess electricity can be saved in times of overproduction and freed during periods of high demand (see the infographic ‘Reinventing Storage’).

### **Continental connection**

At the same time, national electricity grids need to be connected more effectively at the European level.

“Denmark is very well connected with the Scandinavian grid, which has a large hydraulic capacity for absorbing fluctuations in wind energy production,” explains Taylor. “On the other hand, the British Isles are still isolated and need to increase their national storage capacity.”

A renewable Europe must be able to transport solar electricity generated in the summer from south to north, and wind energy generated in winter in the opposite direction.

Building such a continental ‘super grid’ is more of a political challenge than a technological one, explains Falko Ueckerdt, a scientist with the Potsdam Institute for Climate Impact Research. “Because electricity rates can vary from country to country, it's often difficult to figure out how to share the cost and benefits of building a new transnational connection.”

Europe has set global objectives for reducing CO2 emissions, but energy self-sufficiency remains a very sensitive issue at the national level.

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This article was written by Daniel Saraga. The design on the illustration is by Sandro Bacco for Large Network. All information are courtesy of The Technologist O4. To view the infographic “Reinventing Storage” online, please visit: <http://www.technologist.eu/reinventing-storage/>

# The Chatter

## Making Batteries Smarter

With the transition from fossil to regenerative energy sources, as well as emerging Electric Vehicles (EV) and smart grid markets, Electrical Energy Storages (EES) are gaining importance.

Electrical energy is commonly stored in batteries that consist of electrochemical cells. In order to achieve higher pack currents and capacities, cells can be connected in parallel in a module before these modules are wired in series. The energy storage capacity of parallel-connected cells sums up. For instance, for a cell with a nominal voltage of 4V and a capacity of 4Ah, first connecting two of these cells in parallel and then stacking them five times in series would result in a battery with 20V and 8Ah capacity, providing a 160Wh energy storage.

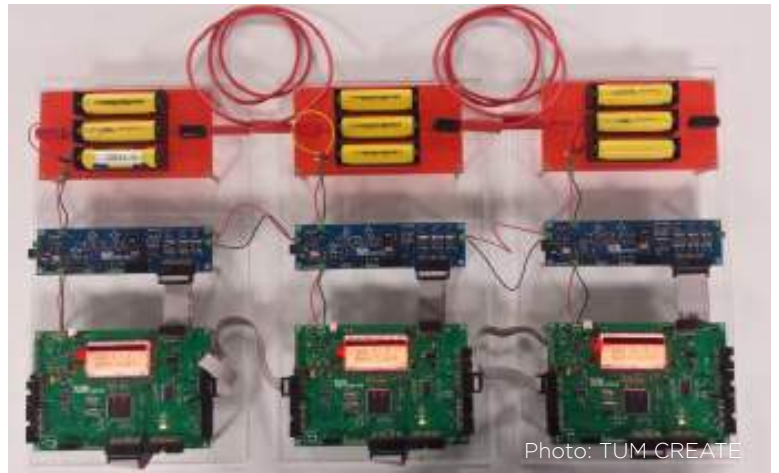


Figure 1: TUM CREATE Smart Cell development platform with battery cells, monitoring and balancing board, and microcontroller board (both in-house developments).

With its high power and energy density, Lithium-Ion (Li-Ion) battery technology is becoming the dominating cell chemistry for most EES applications from wearable electronics to stationary energy storages. Furthermore, in contrast to other battery chemistries such as Lead-Acid or NiCd, Li-Ion offers a higher number of charge-discharge cycles and is not sensitive to memory effects, where the charging cycle history influences the effective cell capacity. As an example, the Tesla Model S has an approximate energy storage capacity of 85kWh and voltage of 350V provided by 7104 Li-Ion cells of type “18650”, with 96 cells in series and 74 in parallel.

Despite their significant advantages, maintaining the individual cells of a battery pack within a defined set of operating parameters is critical for Li-Ion batteries. Operation outside a specified range for temperature, cell voltage or charging/discharging rate can severely damage the cells, definitively reducing their lifetime and possibly causing fire or explosion by thermal run-away. Therefore, sophisticated battery management is required for battery packs, monitoring parameters of individual cells and controlling certain functions such as cell balancing.

Recently, energy-efficiency has become a relevant design objective, as mobile EES are providing a limited amount of energy that translates into runtime of electronic devices or driving range in the case of EVs. Even for applications with periodic access to a power grid, energy-efficiency translates into cost-efficiency and environmental awareness by conserving energy.

Conventional Battery Management Systems (BMSs) are organized in a centralized fashion where a master controller is sensing and controlling all properties of the cells. The master is either directly wired to each individual cell or slave modules form a hierarchy, handling the parameters of a set of cells. Despite the actual architecture, the master controller is the central instance where control decisions are made. This centralized architecture, however, brings several disadvantages that shall be overcome by an approach developed at TUM CREATE.

The concept of Embedded Battery Management (EBM) developed at TUM CREATE proposes, in contrast to the centralized fashion of state-of-the-art approaches, a completely decentralized system. EBM enables system-level functionality without centralized control by coordinating individual actions via communication and distributed algorithms, offering a plug-and-play approach to battery pack integration.

The main components of EBM are smart cells which are developed both on hardware and software levels at TUM CREATE. Smart cells have extensive autonomous capabilities, managing parameters of individual battery cells. Each smart cell consists of a battery cell and a Cell Management Unit that comprises sensing, computation, control and communication capabilities.

For functionality that requires information or control beyond the individual cell level, such as cell balancing or State-of-Charge estimation for the battery pack, the smart cells communicate with each other, forming a distributed self-organizing structure that creates the behaviour on the level of the battery pack.

TUM CREATE has already developed two generations of development platforms for EBM which are used to validate the proposed concepts. Figure 1 shows the newest version.

**Info: TUM CREATE Ltd.**  
**[www.tum-create.edu.sg](http://www.tum-create.edu.sg)**





This article was contributed by student writer, Chia Shao Hua

Photo: TUM Asia

## First Day Of Classes At SIT@SP

On 16th of March, TUM Asia celebrated the official relocation to its new building, welcoming the students as they started their first day of lessons in SIT@SP. To mark this meaningful occasion, a lunch buffet was held for students, professors and staff which allowed for greater integrating among the Bachelor and Master cohorts, whom were previously located at separate locations.

“It was great being able to enjoy the food and desserts with my classmates,” said Angelina Tan, a student from the Masters Programme. She also commented “The classrooms are spacious and conducive for learning compared to the previous building!”

Previously, students who wished to study in school could only stay till 6pm as the staff would have to lock the classrooms. Now students are able to study until 10 pm before the classroom doors locks automatically, which allows students to study together and feel at home. We hope that all TUM Asia students are looking forward to spending time on the new campus!



Photo: TUM Asia

## Bavarian State Parliament Visits TUM Asia and TUM CREATE

On 19th March 2015, members of the Bavarian State Parliament visited Singapore to better understand Singapore’s education landscape. This was to enable them to look for ways to increase or enhance cooperation between the state of Bavaria and the government of Singapore. TUM Asia and TUM CREATE, the latter being the first visit for the day, were two of their stops in Singapore. TUM is the first successful German university that engaged in multiple cooperation projects with Singapore and the delegation found it very fascinating to witness the achievements of a German university, which overcame cultural and geographical differences and internationalised itself.

During the session, the delegation discussed the different teaching methods between Germany and Singapore and how TUM Asia was able to overcome them. Upon learning that a significant number of graduates from TUM Asia work in Germany, the delegation suggested the possibility of attracting good students from Asia to Bavarian companies, ultimately benefiting the Bavarian industry.



A young woman with brown hair tied back, wearing clear safety goggles and a white lab coat, is focused on her work in a laboratory. She is smiling slightly as she looks down at her hands, which are positioned near a piece of laboratory equipment. In the background, another person in a lab coat is visible, working at a different station. The laboratory is well-lit with natural light from a window, and various pieces of scientific equipment are visible on the lab benches.

# PURSUE YOUR RESEARCH INTEREST

Obtain Your Doctorate With TUM

## TUM Asia's Industrial PhD Programme

**Research Topics Are Offered In The Fields Of:**

Integrated Circuit Design, Communication Engineering & Chemistry

**Eligibility:**

- Singapore Citizens or Permanent Residents only
- Must possess a Master Degree in a relevant discipline from a recognised university

For more information or to apply, please log-on to: [www.tum-asia.edu.sg/admissions/scholarships/ipp](http://www.tum-asia.edu.sg/admissions/scholarships/ipp) or write in to [info@tum-asia.edu.sg](mailto:info@tum-asia.edu.sg)