Volume 9

SINGAPORE SEMICONDUCTOR VOICE

T05SS0291A

How Automation can Facilitate FASTER ECONOMIC RECOVERY in Singapore

Transformation

Next-Generation Employee Transport Solution

Developing Industry-Level ReRAM Technologies

SSIA
Singapore Semiconductor Industry Association

Foreword by Executive Director

Despite COVID-19, companies in our industry are still reporting strong business demands throughout the year. That said, issues like travel restrictions are having an impact on factories' operations. The situation is made worst when foreign workers dormitories are locked down.
The absence of these workers in semiconductor plants has left a devastating impact on daily operations as they are essential to the business.

There is an urgency to fix issues caused by COVID-19 quickly because of the fear that the second wave might happen, or worse, a second pandemic might hit any time. Many of these issues can be addressed with the framework under the Electronics Industry Transformation Map (ITM), which focuses on 3 major categories of transformation – improving productivity, innovation and developing the talent pool.

Over the past months, SSIA Secretariat team has been busy working to woo retrenched workers from other industries to join ours. Our goal is to preserve this technical talent pool and help grow our industry's talent pool, too. It also aligns with the need to fill up the workforce gap caused by travel restrictions on foreign workers. I am heartened to see our companies' willingness to hire these retrenched workers. SSIA is the program manager for WSG's Professional Conversion Programme (PCP), which can help companies train these retrenched workers in their new roles. Together with our partners, SSIA is also providing more industry-relevant courses to upgrade and upskill our workforce.

There is a strong need from the industry to expedite plans to automate and digitalize their businesses. Companies see this strategy as a way to minimize the pandemic impact on their business operations, and a way to come out of this pandemic stronger and better. In the coming months, SSIA will organize a regional webinar specific to industry 4.0, and a Summit on digitalization. We will continue driving these topics to help companies, especially SMEs, to start digitalizing their businesses and be future-proof. Do keep a lookout on our website for details.

Another challenge faced by companies is the supply chain disruption caused by both the pandemic and US-China trade tension. SSIA is going to organize the Supply Chain Conference to discuss this issue in late August. We will listen to both local and regional industry leaders on their views and how their companies are addressing the issue. Please contact us if your company is interested in supporting us in organizing this event or details of sponsorship.

I am happy to see this magazine serving its purpose to be a platform by the industry and for the industry. The readership has grown and we have been getting great support and content from the industry over the past year. We look forward to your continue support in the form of sponsorship or content for the publication.

Please enjoy this edition and stay safe and healthy!

EDITORIAL TEAM

EXECUTIVE DIRECTOR
Ang Wee Seng
weeseng@ssia.org.sg

PROJECT MANAGER
Daphne Leong
daphne@ssia.org.sg

MARKETING & COMMUNICATION MANAGER
Gillian Cheng
gillian@ssia.org.sg

HR MANAGER
Patsy Tan
patsy@ssia.org.sg

SENIOR PROJECT EXECUTIVE
Rebecca Foo
rebecca@ssia.org.sg

EXECUTIVE ASSISTANT
Cindy Chong
cindy@ssia.org.sg

SSIA BOARD

Andrew Chong	(Chairman)
KC Ang	(Vice-Chairman)
Jerome Tjia	(Secretary)
Brian Tan	(Treasurer)
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Chok Yean Hung	(Board Member)

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Transformation

For SSIA and the Semiconductor Industry

Transformation is, by definition, a process of changing completely the character or appearance of something in order to improve it. It is a journey that SSIA has embarked on over the past two years, and will continue into the future. The most recent transformation is also the most important one - not only for the trade association and the semiconductor industry but also for people who are driving this transformation.

The semiconductor industry is an industry with over 52 years of history in Singapore. The industry has transformed over the decade, riding up the value chain to a point where we have almost the entire eco-system of the industry present here in Singapore. We have the top foundries, the best R&D teams and the biggest names in the industry here.

Unfortunately, the industry is also facing a misconception that it isn't growing anymore, and the government isn't interested in growing the industry further. Though it is far from the truth, this rumor has spun out of control over the past decade. As many people believe in it, this in turn becomes a self-fulfilling prophecy. The more people believe this rumor, the less future talents will be interested in joining the industry. With an ever-shrinking future talent pool, the less likely the industry will move forward.

This problem is what SSIA, together with our partners and industry leaders, has to address. The process is by no mean a small feat, but we are thankful to have a systematic approach to address this by leveraging the framework in the Electronics Industry Transformation Map (ITM). In its most simplistic form, the key areas of the ITM focus on helping companies improve productivity, innovate their products and services and, most importantly, develop and grow the talent pool.

"Transformation is an ongoing process that tends to appear ordinary, when, in fact, something extraordinary is taking place." – Suzy Ross

It all started in early 2018 when the Association's Board of Governance assembled a team of Secretariat staff, which would grow over the next two years to support the daily operations of the organization. We rewrote the constitution to have better governance over the running of the organization. After the 2018 AGM, the real work started along with the ITM framework coupled with the direction from the new Board.

While striving to help companies embrace the ITM and focus on its three pillars, SSIA has identified workforce development as our particular focus. We emphasize on looking at our future, current and past talents. By partnering with different institutes and inviting our past talents on sharing their experience, we have been organizing different industry-relevant and leadership programmes to develop a pool of leaders which is crucial to ensure the long term sustainability of this industry. Moreover, we have planned for campaigns to excite future talents and woo them into the semiconductor industry.

"Transformation doesn't take place within a vacuum; instead, it occurs when we are indirectly and directly connected to all those around us" – Byron Pulsifer

We believe that we can only serve our members and the industry better by understanding them first. We are committed to diversifying our outreach to all sectors within the industry, especially the SMEs. Many companies are planning to push forward aggressively on the digital front and enhance workforce skills to cope with new ways of working. An "ecosystem strategy" could help in this respect as MNCs push forward on the innovation and digitalization fronts, the SMEs that are part of their supply chains will have to keep pace to remain competitive.

The SSIA Secretariat Team has tirelessly helped transform the organization over the past year, and brought us to where we are today

Photo taken at the SSIA Summit 2019

Photo taken at the Singapore Semiconductor 50th Anniversary

SSIA events focus on helping companies improve productivity, innovate products and services, and develop the talent pool

With this in mind, we have been launching more relevant initiatives and events, such as the Automation Supplier Day, to help SMEs network and connect to the big players in the industry. Over the past year, SSIA has been launching more than 50 activities and initiatives, reaching out to more than 4,000 participants from both MNCs and SMEs. We are not slowing down any time soon. With the impact from COVID-19, we will only become more aggressive in driving the ITM across our industry.

"Every success story is a tale of constant adaption, revision and change" – Richard Branson

SSIA will continue to transform with our industry. This year marks the third Annual General Meeting for this newly transformed trade association. This AGM also has an important milestone, where we will be conducting an election of Board members for the next term of office. Board members are leaders across all sectors who would step up to lead SSIA in the transformation of our industry. Continuing to transform for the better is the key now. SSIA Secretariat will further expand to support the needs, and keep rolling out initiatives to help the industry transform. Having members and leaders of the industry's workforce actively engaging SSIA will also be key to ensuring the success of all these initiatives. There is no doubt that as soon as the majority of our workforce is behind SSIA, the goal to transform the semiconductor industry can be achieved faster.

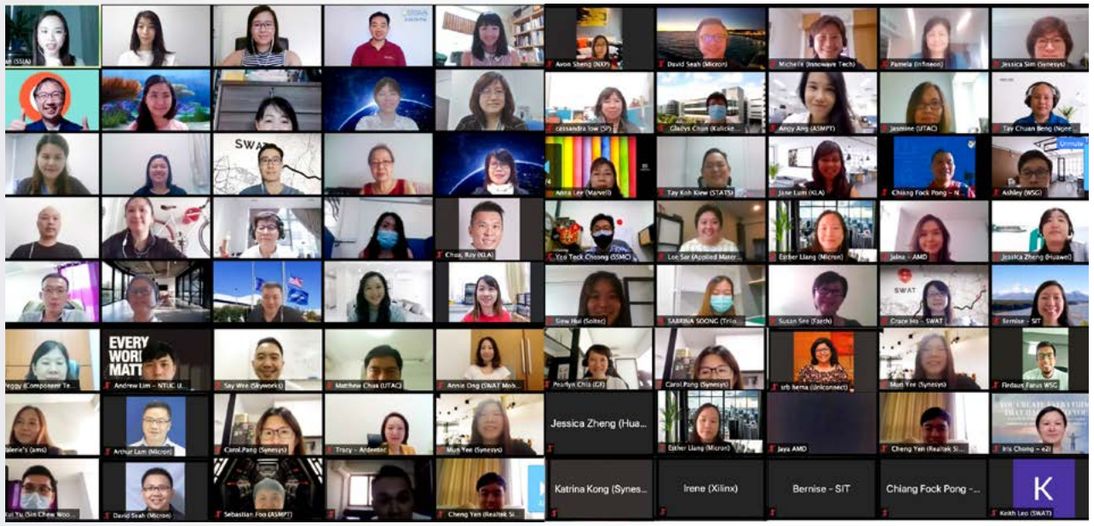
The semiconductor industry plays a vital role in the world. This industry remains one of the bright spots in all nations' economies amid the ongoing pandemic. Economists around the world have always been looking at the performance of this industry as one of the leading economic indicators. Though Singapore's semiconductor industry remains strong and resilient, we need to ensure it continues to transform to be bigger and better in order to stay competitive and relevant in the future. It is SSIA's mission to help companies transform in a more concerted and coordinated way so that we can emerge stronger together.

Photos taken at the Singapore Semiconductor Lo Hei Dinner 2020

SSIA events provide a platform for leaders to network and foster collaborations in the industry

ABOUT THE AUTHOR

ANG WEE SENG
Executive Director of Singapore Semiconductor Industry Association



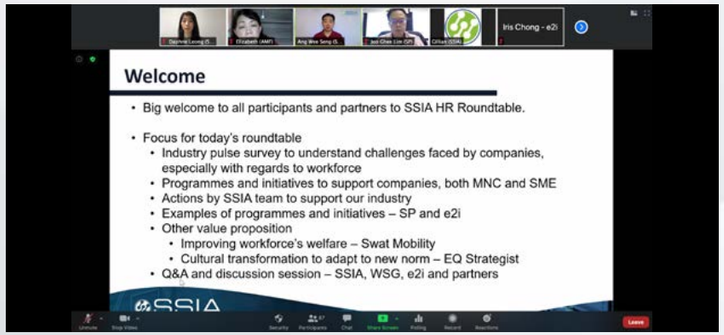
SSIA Virtual HR Roundtable

An Important Platform to Update the Available HR Initiatives

Singapore Semiconductor Industry Association (SSIA) held a virtual HR Roundtable on 25 June 2020 with over 80 HR leaders and SSIA working partners. Topics presented and discussed included programmes and initiatives to support the workforce in companies launched by SSIA, Singapore Polytechnic and e2i, solutions in optimising employee transport by SWAT Mobility as well as tips on creating a resilient and growth-oriented culture introduced by EQ Strategist.

SSIA HR Roundtable is an important platform for SSIA to understand the needs of the industry when it comes to human capital. It also helps the Association communicate to the industry all initiatives and support that are relevant to our HR peers.

Ang Wee Seng, Executive Director of SSIA shared with the participants that the semiconductor industry continues to hire despite this unprecedented pandemic. He said, "We encourage companies to utilize different programmes and schemes from our government to support them to hire good talents, especially the fresh graduates and mid-career job seekers from other industries. Meanwhile, companies need to help our current workforce upgrade and upskill to adapt to the new business norm. We will be introducing various courses and programs to develop your workforce."



Programmes to Support Hiring

In the coming months, SSIA will be organizing virtual career fairs and continuously working with our partners to fill up the roles that are needed by the companies. Companies that are currently hiring or will be hiring in the future can participate in the programs below.

1. RECRUITMENT FOR RETRENCHED WORKERS FROM OTHER INDUSTRIES

SSIA and several partners will introduce the semiconductor industry to job seekers from other technical industries, and woo their interest to consider joining our industry. Job seekers who are interested will submit their resumes to SSIA and it will be shared with companies who are hiring.

Companies may also be invited to interview these job seekers on site (should the situation allow it). SSIA has also put in place programmes such as Professional Conversion Programme (PCP) that can support companies' effort in recruiting these talents.

2. VIRTUAL CAREER FAIR IN AUGUST (CO-ORGANISED WITH E2I)

SSIA will partner e2i in this virtual career fair for the whole month of August. Companies will be able to participate and hire the necessary talents for their businesses. It will also to the masses that semiconductor industry is a vibrant industry who is still hiring.

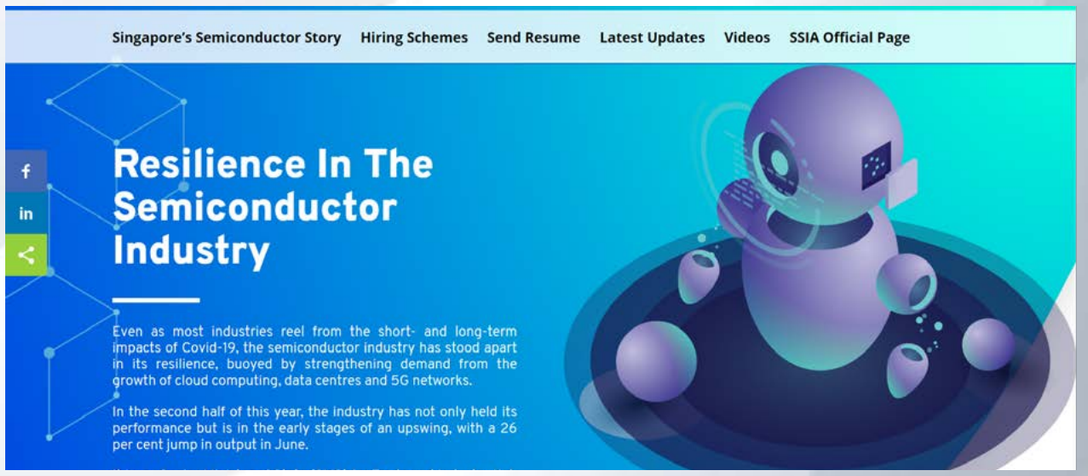
3. SGUNITED JOBS INITIATIVE

As part of the SGUnited Jobs initiative collaboration model, SSIA will work closely with Workforce Singapore who will be playing a leading role in SGUnited Job. The initiative creates employment opportunities for locals through matching workers to employers with current available jobs which include short-term jobs to handle COVID-19 related operations as well as longer-term jobs. It also helps employers recruit for the eventual recovery.

Through this collaboration model, Singapore Business Federation (SBF) will work closely with SSIA on job-matching efforts between companies with manpower demand and companies with excess manpower. The job-matching will be done primarily through vacancies posted on MyCareersFuture.sg and company-to-company brokering, either within the same sectors or across different sectors. Factors to be considered include, but not limited to, type of job roles, length of employment, job description, work location, expected working hours, etc.

4. NEW SSIA JOB PORTAL

SSIA will post companies' job vacancies and collect resumes from job seekers on this portal **(www.ssia.org.sg/jobs)**, which also provides information on the development and latest updates about the semiconductor industry in Singapore.



New SSIA Job Portal - www.ssia.org.sg/jobs

Dialogue with Minister for Semiconductor Industry

Dr Koh Poh Koon, Senior Minister of State for Trade and Industry

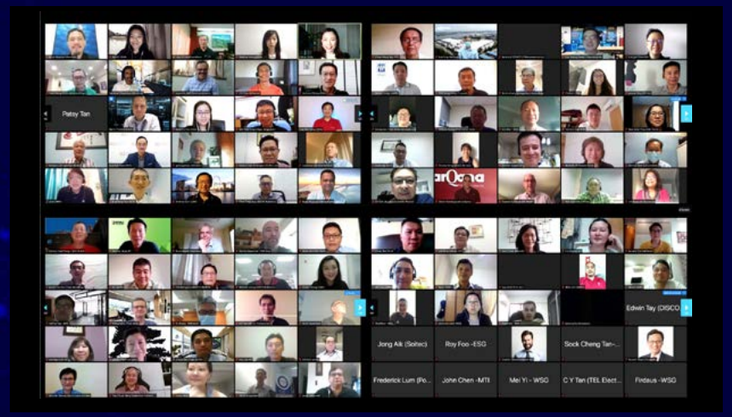
Singapore Semiconductor Industry Association (SSIA) organized a dialogue session with Dr Koh Poh Koon, Senior Minister of State for Trade and Industry, on 4 June 2020. Over 100 senior leaders participated in the dialogue session discussing the pressing issues facing the semiconductor industry in Singapore, such as supply chain disruption, freight challenges travel restrictions.

The dialogue session was a good platform to understand the feedback from the industry leaders and the views of our government on these matters.

SSIA Chairman Andrew Chong said in his opening speech, "Some feedback from our members shows that the global semiconductor business has remained stable in the first half of the year, indeed in some areas like the communications market demand has increased. Besides managing the risks, I hope each of you is also thinking about the opportunities that can arise as we recover from the health crisis, and the support you need to succeed."

As mentioned by SMS Koh in the Dialogue Session, the Industry Transformation Map (ITM) is crucial in helping businesses transform better and faster, especially during this unprecedented COVID-19 situation. SSIA is committed to driving innovation, productivity and talent under the Electronics ITM – in a new way through online platforms.

He also mentioned on his Facebook page, "The semiconductor industry is important to Singapore and provides good jobs for our workers. We remain committed to partnering our companies to improve the economic competitiveness of the industry as well as the broader manufacturing sector. Likewise, workers must also do their part to upskill and support their employers in this journey. With our collective efforts, I have no doubt that we are in a good position to weather the challenges and emerge stronger."



Over 100 senior leaders from the semiconductor industry participated in the dialogue session

Automation Supplier Day 2020

SSIA hosted the Automation Supplier Day 2020 on 16-17 July 2020. This year's event was held on a virtual platform with record-breaking participation. It has brought together over 250 participants from over 100 MNCs, SMEs and other organizations. Many of the participants said that it was an experience to see both suppliers and clients share openly on this platform, and they were keen to explore collaboration opportunities after the event.

Automation Supplier Day is also a platform for business networking and establishing relationships. SSIA has set up a Linkedin Group for participants to share, network and collaborate with other end-users and suppliers. Meanwhile, the Association will help arrange virtual meet-ups if there is a need.

Said Ang Wee Seng, Executive Director of SSIA, during the event, "SSIA is transforming to better represent the semiconductor industry in the fight against the COVID-19. We will continue to launch a series of initiatives to help companies focus on productivity improvement and, most importantly, to stay competitive by innovating their product and services. Do keep a lookout to our two major events coming up - the Semiconductor Supply Chain Conference in August and SSIA Summit 2020 in October. We hope to seek your continuous support for these events."

Highlights of the Event

- **K&S Operation's Journey in Digital Transformation and Smart Manufacturing**
  Mr TK Loh, Senior Director of Equipment Operations Engineering, Kulicke & Soffa

- **No Shortcuts: Evolutionary Steps to Smarter Manufacturing**
  Mr Ricco Walter, Managing Director, SYSTEMA Automation Singapore Pte Ltd

- **Holding out for a HERO – Closing Automation Gaps with Mobile Robots from Germany**
  Mr Burkhard Stegemann, Department Manager Sales & Marketing, Fabmatics GmbH

- **Practical guide of AI Inspection and AI Preventive Maintenance**
  Mr Jiro Chiba, Consultant, NEC Asia Pacific Pte. Ltd

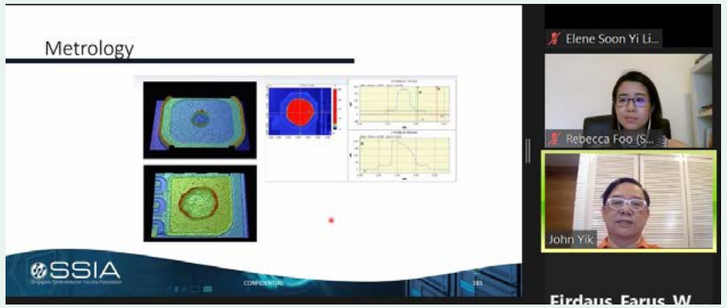
- **Business Continuity and Competitiveness during The New Normal**
  Ms Michelle Phua, Co-Founder & Director of Operations & Mr Mike Feng, Head of Solutions, Innowave Tech Pte Ltd

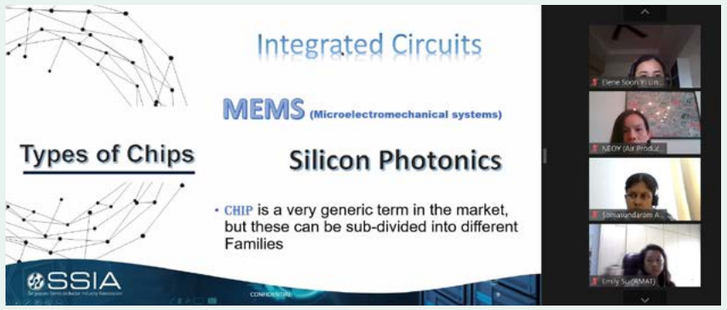
- **Transforming Business with AI**
  Mr Kevin Lee, Head, AI Advisory and Adoption, AI Singapore

Event Highlights

Join the LinkedIn Group and view the presentations

Develop a Foundation of Knowledge in Semiconductors





Questions Raised During the Course:

- **What is the number of wafers in one pot?** (The average pot has 25 wafers)
- **Which photolithography process is the most forgiving of error?** (Photolithography is very forgiving process in general but the most important factor to take note of is alignment of patterns on wafer)
- **Why do gasses need a heater jacket?** (To maintain a standard temperature so that gasses do not condense and cause contamination)

The first run of the SSIA Semiconductor 101 course was held on 13 – 14 July 2020 via the Zoom platform. The course was conducted by Mr John Yik, who has 25 years of experience in the semiconductor manufacturing industry.

John introduced the participants from 7 companies across the electronics industry to the fundamentals of semiconductor manufacturing and the makeup of the electronics eco-system over the duration of the course. Participants were introduced to concepts such as integrated circuits, microelectromechanical systems, and silicon photonics.

Many participants found the course to be very enriching and useful in helping them to better understand their work. They were also keen to tap on John's experience in the industry to hear about his opinions on the trends for future of the semiconductor industry, such as whether nano materials are ready for the industry, is in-situ metrology widely employed, and if the photolithography process might be streamlined in the future.

Register for the Next Run of Semiconductor 101 (29-30 September, 9-10 November)

The 5% Zone – Visibility Strategies That Get You Recognized

Today, most of us are privileged to work in companies that are diverse and often global. We want to get ahead and be recognized for all the great work we do or can do. So, how do you achieve that?

Over 100 industry peers joined the two engaging online classes taught by Stephen Krempl, CEO of Krempl Communications International, on 'Visibility Strategies that Get you Recognized and Rewarded in Any Organization' on 28 May and 17 June 2020. Participants were keen to know the tips and techniques on getting visible and noticed by senior leaders as well as their clients.

In the coming Global Executive Mindset (GEM) Online course on 14 and 21 August 2020, Stephen will share with participants how to increase their communication repertoire, and know-how to change their virtual and face to face presence and mindset to standout in these critical "5% situations" with senior leaders.

Participants will learn what they need to do in these situations, to connect personally, communicate confidently and stand out. Also, the course will cover what may be preventing us from participating even though we know we should. It comprises of 10 online modules where participants will practise and show mastery of the skills and techniques taught with worksheets and scenarios provided.

The course is suitable for:

- The hard-working executives who aspire to get ahead
- The Manager who wants to know how best to get into senior management
- The executive who believes he/she has the ability to do better but can't seem to communicate at different levels
- Senior management and Leaders who want to learn how to help encourage and coach your team to express themselves well

Stephen Krempl, Instructor of GEM Online

Scan the QR code for registration and details:

Singapore Semiconductor Industry Association

Upcoming Electronics & Industry Relevant Courses

Global Executive Mindset (GEM) Online Course

14 and 21 August (participants must attend both sessions)

This 2-day online course helps you understand what the expected appropriate behaviour senior management wants from you. It also enable the participants to recognize and know how to appropriately "show up" in the five key work situations. It comprises of 10 online modules where participants are required to practice and show mastery of the skills and techniques taught with worksheets and scenarios provided.

Who should attend?

Executives who aspire to get ahead; Managers who want to know how best to get into senior management; Senior management and Leaders who want to learn how to help encourage and coach your team to express themselves well

Industrial Cost Optimization

17-18 August 2020/ 21-22 October 2020

This online course, held over 2 days, will cover cost saving measures based on technical engineering data analysis as well as statistical evidence

Who should attend?

All personnel in charge of optimising company's materials spending, equipment maintenance spending as well as energy required for production

IoT for Electronics Industry

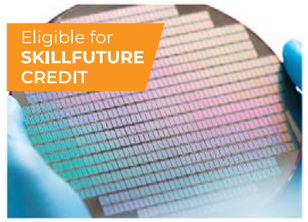
Co-organized by SSIA & SP

20 August 2020

One day classroom/practical session to equip participants with knowledge of the internet of things (IoT), IoT applications and its eco-systems used in the semiconductor/electronics manufacturing industry. There is a hand-on session for particaipants to apply their knowledge

Who should attend?

All engineering or technical personnel



Wafer Fabrication in Semiconductor Industry

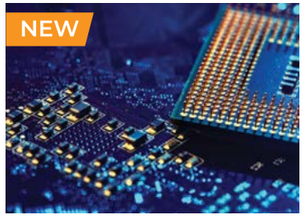
Co-organized by SSIA & SP

26 - 28 August 2020

Interactive 3 day course with classoom sessions and practical laboratory work that provides participants with the relevant knowledge and skills of the Wafer Fabrication process in the Semiconductor manufacturing industry The courses are conducted in person

Who should attend?

Those who recently joined the semiconductor industry or engineering techinical or personnerl under the Eletronics Skills framework



Semiconductor 101

29-30 September 2020/ 9-10 November 2020

This 2-day online course enables the learners to gain knowledge of the journey of semiconductor manufacturing from sand to finished chip. Students will understand the eco-system and how all of them come together to support the semiconductor industry

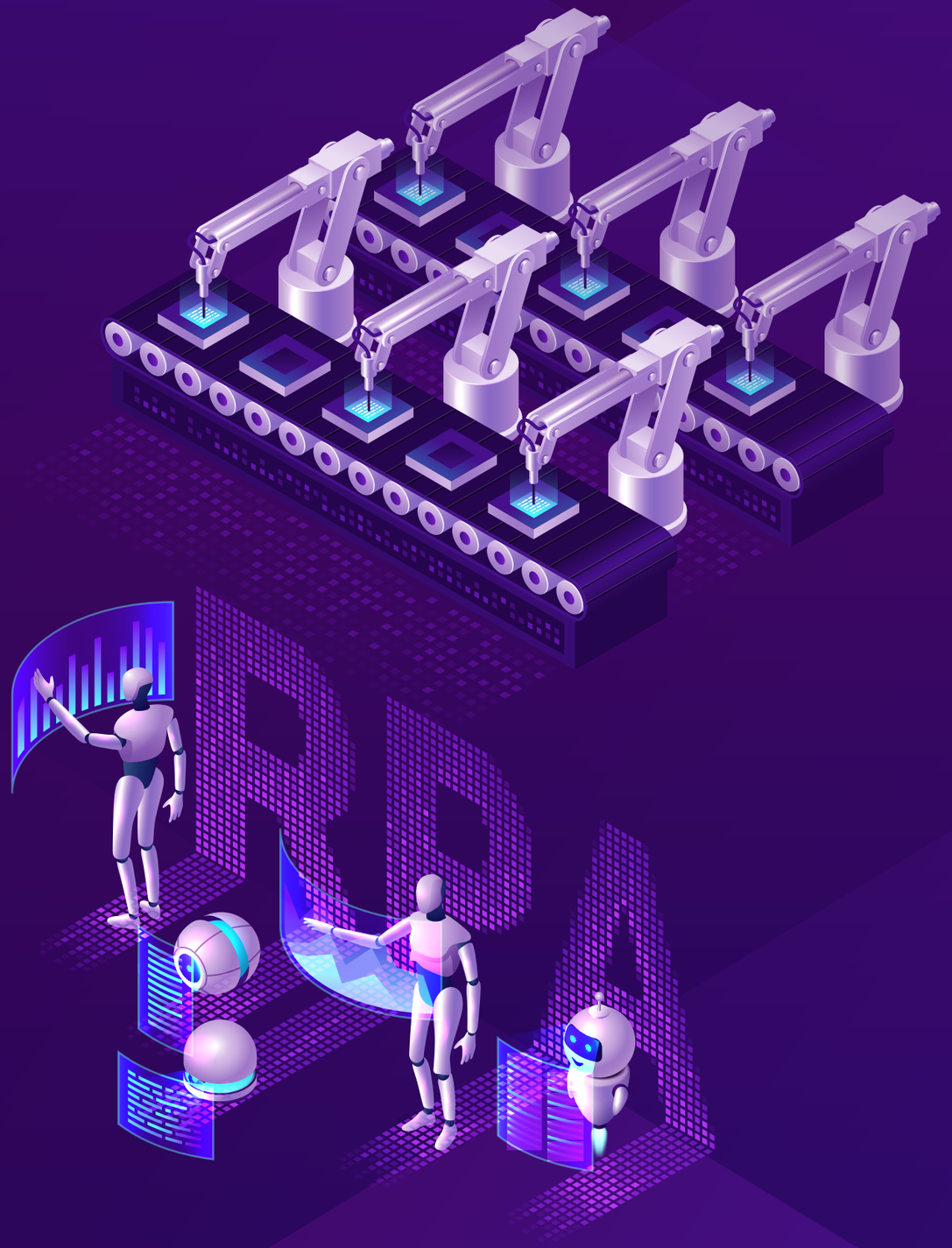
Who should attend?

Non-technical audience who wants to know a high-level overview of semiconductor devices and how they are fabricated

If you are interested to customize an in-house course for your company, or for any other enquiries, please contact daphne@ssia.org.sg

Scan the QR code for more details

HOW AUTOMATION CAN FACILITATE FASTER ECONOMIC RECOVERY IN SINGAPORE?



To tackle the challenges in workforce and embrace the new normal of working from home, many companies in Singapore, especially those in the manufacturing sector, are accelerating their transformation journeys on digitalization. Some companies have even admitted that the digital transformation they have done in the last 2 months is a lot more than what they did in the last few years.

In Singapore, since the launch of the Electronics Industry Transformation Map (ITM) in 2017, companies in the semiconductor industry have embarked on their digitalization journey. As mentioned by Dr Koh Poh Koon, Senior Minister of State for Trade and Industry, in the SSIA Minister Dialogue Session, what is important now is to take it in practice and drive the transformation faster. It will help companies switch to a less manpower-reliant mode, boost productivity, and eventually emerge stronger out of the COVID-19 pandemic.

In this issue, we will look at digitalization solutions newly launched by different companies to drive productivity, enable solutions, and build resilience to cope with other expected or unforeseeable challenges.

Artificial Intelligence and Automation Would Actually Benefit Singapore

Now that the General Election is over, it is time for Singapore to refocus on the big challenge of creating jobs to tide citizens over a pandemic and double down on digitalisation for the long term.

Singapore businesses and workers are no strangers to the need to adapt to new technological changes.

With every change comes hesitance, even resistance. In the push for a Smart Nation, this resistance may come from a fear of the unknown. Reports of artificial Intelligence (AI) and digital technologies cannibalising jobs do not help either.

However, Singapore is in a unique situation. With a small and ageing workforce, Singapore has to tap on AI and automation to preserve its competitive advantage over other economies.

A country increasingly powered by more artificial intelligence

Digital technologies and AI (including machine learning, computer vision and natural language processing) can boost efficiencies, performance and productivity in various ways.

It is these advanced technologies that help e-commerce retailers like Lazada sell more by analysing massive amount of data, learning customer preferences and providing targeted products to be displayed online for the customers.

In engineering and aviation, AI has been used to increase the performance of gas turbine engines, such as finding an optimal way to increase thrust and decrease fuel consumptions.

In the long term, the savings on fuel could be passed to the passengers. Such performance improvements cannot usually be attained using traditional models.

In logistics in Singapore and around the world, AI has also been utilised to predict traffic patterns and route conditions. For companies like Grab, the use of AI has enabled drivers to complete as many jobs as possible in the shortest amount of time.

In healthcare, AI has been employed to optimise hospital management and processes like managing a large number of patient beds in the case of Tan Tock Seng Hospital. Predictive analytics can help optimise hospital bed assignment decisions by predicting when patients will be discharged to make more beds available.

AI will be an integral part of Singapore's healthcare system to help doctors make better decisions and design early intervention programmes and improved care pathways for patients using predictive modelling.

In educational applications and tools, AI has helped the development of skills and testing systems and allows the adjustment of learning based on differentiating students' needs in Institutes of Higher Learning in Singapore. Students can thus enjoy more customised testing and learning tailored to the specific needs and ability level of each student.

HOW AUTOMATION CAN FACILITATE FASTER ECONOMIC RECOVERY IN SINGAPORE

Jobs are changing

In areas where AI and digital technologies improve businesses significantly, the nature of jobs has changed.

Certain jobs like routine clerical work may be reduced while the employment rates for professionals and those in the service sectors have increased. Understanding what tasks AI is suited or not suited for will be a business priority for firms. Singapore's learning, retraining and upskilling efforts must take full advantage of the AI era.

Prior research has shown AI is suited to perform tasks that provide clear feedback with definable goals and metrics. AI is also efficient at recognising associations based on empirical and statistical data.

On the other hand, AI is not so good at unstructured tasks and reasoning, especially based on background information that is previously unknown to the computer.

This is why AI (or machine learning) can be used to spot irregular heartbeat from scans and detect diseases from medical imaging, but it cannot explain as well as doctors how and why one is diagnosed with a certain disease.

In other words, the interpretation of the causes and severity of these diseases and their linkages to other diseases are much more difficult for AI to ascertain. AI also does not perform well when the tasks to be learned change quickly.

Humans do much better at interpreting data and drawing inferences even when the tasks evolve over time.

Retraining and upskilling are essential

In light of the above understanding, how we should we adjust, retrain or upskill the valuable human resource we have in Singapore to prepare for the new paradigm involving AI and digital technologies?

We understand that most jobs have many interrelated tasks. People say the jobs AI could likely replace include telemarketing, receptionists, computer support specialists (think chatbots used by banks like OCBC) and market research analysts. However, it doesn't mean these jobs will disappear entirely. AI is weak on relatively unstructured, creative tasks and those involving emotional intelligence.

The focus of the training or upskilling of such roles should be on these areas. Upskilling courses can cover developing strategies in branding, designing and marketing.

Use AI to gather your data, but use humans to develop business and innovation strategies and design marketing campaigns based on understanding those data.

People and leadership skills will continue to be important, yet another area that AI currently does not fill the void. The expertise in asking interesting questions and looking for new and innovative solutions, which is required in researchers or entrepreneurs, will also be deemed more valuable.

The age of AI and digital technologies is already here. It is clear they can and probably should be applied to different industries and have the potential to significantly improve productivity. In the process, they will transform our work and lives. While some jobs may be replaced, many other job and career opportunities will be created.

Singapore has the infrastructure, talents and resources to take advantage of the benefits brought about by the AI revolution. With national emphasis on innovation and Industry 4.0, as well as additional resources and upskilling opportunities, this could yet be another pivotal point for Singapore to create and deliver value in a competitive global arena.

ABOUT THE AUTHOR

DR KENNETH G. HUANG
Associate Professor at Department of Strategy & Policy at National University of Singapore (NUS) Business School & Department of Industrial Systems Engineering & Management at NUS

FUTURE IS NOW

Smart Manufacturing at GlobalFoundries Singapore with SixSense

Today Artificial Intelligence (AI) in Manufacturing is inspiring a revolution! It is no longer a distant vision but a miraculous reality that is being promoted by many innovation leaders at GlobalFoundries Singapore (GFS). Here is a story of how SixSense embarked on this journey of AI when GFS connected with SixSense at the SSIA Automation Supplier Day 2019 and initiated a paradigm shift in digitisation.

Collaboration with SixSense for Enabling AI-based Industrial Visual Inspection

GFS is adopting a new technology called classifAI, an AI-based Auto-Defect Classification software, that is transforming the way industrial visual inspection is performed today. It has been developed by SixSense, a Singapore-based startup promoting smarter manufacturing in the semiconductor industry.

HOW AUTOMATION CAN FACILITATE FASTER ECONOMIC RECOVERY IN SINGAPORE

SixSense has combined their expertise in deep learning with the insights of the inspection specialists to build a product that takes factory automation to the next level. With deployments planned to span across fabs, and globally, this could change the way we review and classify defects.

Manual Image Classification at Wafer Inspection Stations

Currently, visual defect review and classification are conducted 24x7 by highly trained human operators who closely examine images through the naked eye," said Mr Kian Huat Ang, Manager of Yield Defect Density at GFS. As chip sizes continue to shrink, manufacturing complexity is sharply increasing, making identification of defects extremely challenging. The repetitive and cognitively demanding nature of manual classification has to change and there is an imminent need for an alternative solution.

An AI-powered Future for Wafer Inspection

ClassifAI is addressing such challenges by reducing dependency on human judgements, preserving valuable domain knowledge and adding consistency to processes," said Ms Avni Agrawal, Co-founder and CTO at SixSense.

The technology is designed to handle high volume and broad variety of complex manufacturing defects at GFS. The software learnt visual patterns of defects from images of various inspection layers, devices and technology nodes. It now classifies defects in new images from production at high speed and accuracy. With its auto-learning capability, it constantly adapts to changes in defects, making the engine more dynamic and robust.

Ms Akanksha Jagwani, Co-founder and CEO at SixSense, shared: "We are committed to making the journey of AI for manufacturers smooth and sustainable using a UI-assisted continuous performance improvement framework."

"Our team has made many efforts to set up a dedicated technology infrastructure for AI applications and is actively working to make this initiative an enormous success," Mr Kah Hing Ting, Integrated Manufacturing IT Manager at GFS, highlighted.

Harnessing Untapped Opportunities by Reducing Time to Market

A wide-scale deployment of AI can make remote inspections a reality and will be a great accomplishment. "The success of this solution will establish high confidence in reliability and consistency of AI-based solutions, and will drive many more smart manufacturing initiatives across the company," Mr Zhimin Gu, VP & GM at GFS 200mm Operations, expressed.

The bar on quality standards is rising and innovators are taking strides forward in their Industry 4.0 goals. It is going to be an even more exciting journey ahead and we cannot wait to see where the AI technology will take us next!

ABOUT THE AUTHOR

AH CHOI YAP is the Smart Manufacturing Solution Manager at GFS. He is overseeing the automation as well as the innovative solutions and adaptations at the 200mm Fab of GFS.

Xilinx Digitizes Inventory Count

Every company has an inventory control process requiring physical inventory count to be conducted on a periodic schedule. In Xilinx, this responsibility falls on our Inventory Control team.

In this role, Inventory Control provides confidence to the organization in making sure physical inventory exists where it is reported. It requires personnel to travel to business sites to confirm the physical existence of these inventory. The physical count is conducted in a traditional manner using human eyes to observe the physical existence of the inventory and using pen and paper to record. Finally, a reconciliation is conducted against the system of record. Such efforts take days to complete, often with challenges since Xilinx inventory is fast moving, synonymous to a "motion picture". Constant dreads include factors like inventory size, transaction volume, number of business locations, budget, cost, time and preparation.

Figure 1: Traditional inventory count using pen and paper

Leveraging Emerging Technology

The advent of emerging technology played a huge role in "recasting" the manual process we just described. The goal is to efficiently extract label information necessary for the inventory counting process from the images. The new process involves getting business partners to take photo images of the inventory. Once uploaded to Cloud, automation takes over.

The automation consists of a pipeline comprising computer vision and text mining operations. The first step involves the usage of a deep learning model to identify, extract and segregate label images from the photos.

The extracted images containing individual labels are then processed with OCR (Optical Character Recognition) technology. An algorithm developed to mine the raw text produced from the OCR process finally extracts the label attributes of interest.

Figure 2: Pre-trained CNN and OCR to automate extraction of label information

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Applying CNN

A key aspect of the solution, using an object detection model to identify the labels from the photos taken, is described in more detail here. A CNN (Convolutional Neural Network) was trained to predict bounding boxes of the labels. Photos of probable Xilinx or partner labels are taken and used for the training process. Thousands of images are then generated synthetically from each image to produce a huge dataset.

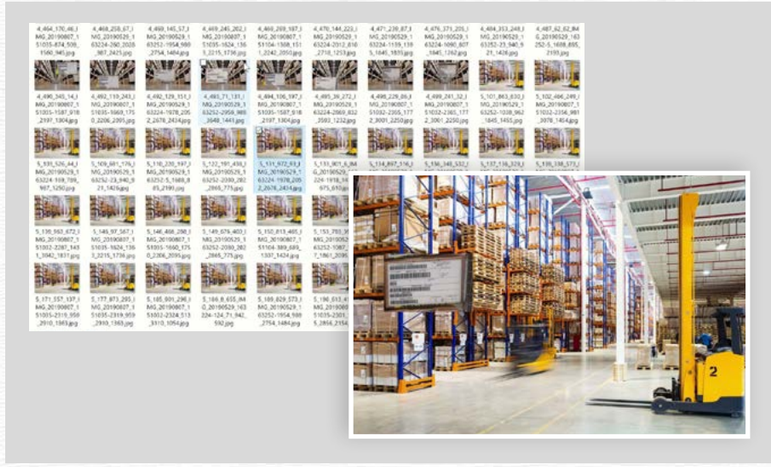

Figure 3: Thousands of synthetically generated label images for training

The TensorFlow framework was then used to train the CNN model on the generated dataset. Once training is completed, the model is used to detect labels from new images containing Xilinx or Partner labels. Using individually extracted label images significantly increases the accuracy of OCR and the extraction of the label attributes.

Input Image | Model Predictions

Figure 4: Trained model detects and separate labels

New ways to do old things

With inventory as a "snapshot", a static moment in time, inventory count accuracy increases since the "motion picture" scenario is eliminated, now becoming more efficient given the short duration of taking snapshots of the entire inventory.

For the Inventory Control team, validating the physical existence of inventory can now be done from the comfort of the office and in a shorter time span. For our business partners, the preparation and disruption brought about by the old way of conducting manual physical count is gone.

With this, we now have new ways to do old things. By eliminating the human aspect of the physical inventory process, the new digitized process allows for sustained social distancing.

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Xilinx Asia Pacific Pte. Ltd.

www.xilinx.com

Remote Digital Assistant: An Essential Tool for SMEs to Adjust to the "New Normal"

COVID-19 Impact to Semiconductor Industry

Cities all over the world are grappling with the impact of the COVID-19 pandemic, addressing long-standing challenges alongside new ones on multiple fronts. The United Nations (UN) estimates that the impact of the crisis on the world economy will hit $1 trillion this year alone. IDC expects the overall semiconductor market to decline 4.2% and non-memory market is expected to decline 7.2% in 2020 as the global economy fights to recover from the global crisis.

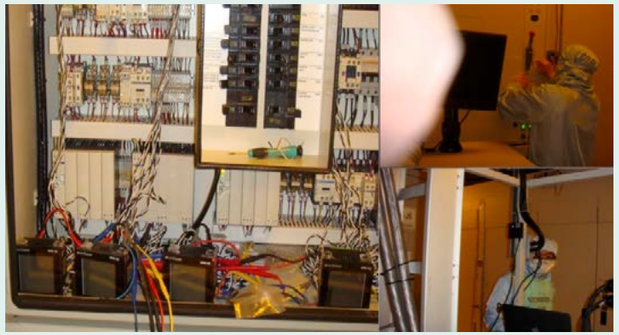
Accelerating Product Improvement (RPI)

To mitigate the huge impact resulted from the unprecedented pandemic, management consultants like McKinsey & Co are suggesting Rapid Product Improvement (RPI) consists of 4 key launch accelerators namely a) Empowered cross functional task force, b) Actionable insights, c) Relentless focus on execution and d) Design-sprint approach. Evercomm Singapore, an energy AI startup incubated and accelerated by NTUitive– Nanyang Technological University, Singapore (NTU Singapore) and accredited by Infocomm Media Development Authority (IMDA) addresses the first three (3) accelerators through their AI driven remote digital assistant tool.

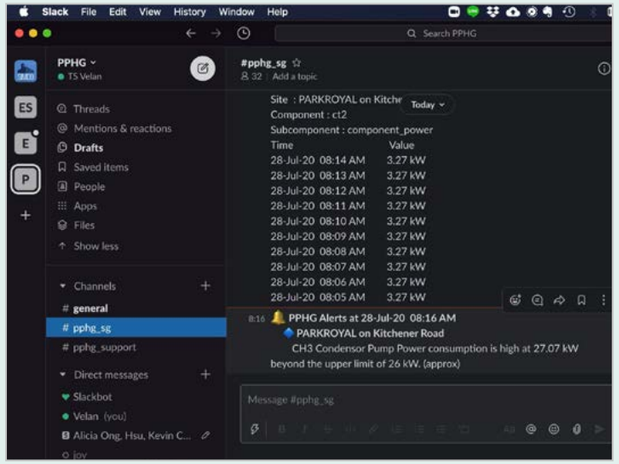
HOW AUTOMATION CAN FACILITATE FASTER ECONOMIC RECOVERY IN SINGAPORE

AI-driven Remote Digital Assistant

This tool comprises of IoT sensor & Operations chatbot which has the capabilities of transmitting data wirelessly to the operational chatbot where the production operators can retrieve/receive the data in real-time remotely and it also keeps track of the performance of these equipment assets proactively through real-time alerts and notifications. This platform also allows the management and operations team to collaborate virtually and thus empowers cross functional team collaborations. It also provides real-times equipment operations insights.



IoT Sensors



Mobile Chatbot

Semiconductor SME Digitization

World-wide experts and consultants recommend accelerating digitization to increase resilience. Digitization is all the more important to SMEs because of productivity losses due to COVID-19 regulations like social distancing, workplace safety, shortage manpower etc. A robust technology infrastructure and end-to-end digital processes are the key elements to safeguard productivity during this pandemic crisis. Digitization helps semicon SMEs in ensuring business continuity which is one of the top priorities of all the SMEs to stay relevant in the Industry.

Problem as an "Opportunity"

In a way, COVID-19 outbreak has boosted the awareness of need for digitalization- Right now, businesses see the value proposition - whether it is working remotely, whether it is transacting with business partners around the world - and also for employees understanding why digital technologies are very relevant and useful. SMEs need to manage their digital transformation journey in taking incremental steps instead of jumping into the deep end in one fell swoop.

Globally, governments are providing relief payouts, grants, incentives to SMEs to recover from the COVID-19 crisis. Singapore Government has announced several financial support mechanisms to SMEs during this challenging period. Government is providing special incentives to the SMEs who embrace digitization through several programs like SME-Go- Digital, Digital Resilience Bonus etc. SMEs take this problem as an opportunity to digitize and improve their productivity.

*For more information, please contact **sales@evercomm.com.sg** to request a free DEMO.*

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EverComm Singapore

How an Integrated Smart Factory Reduces COVID-19's Impact on Manufacturing

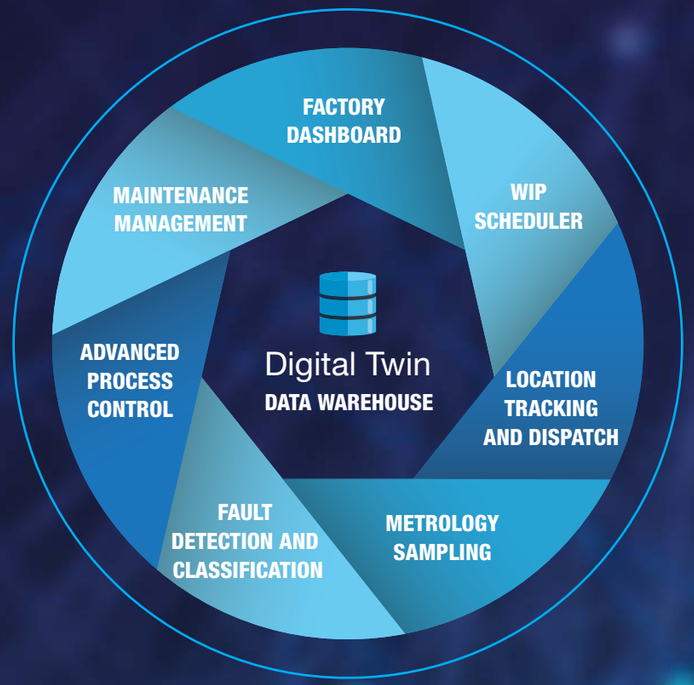
With the recent global COVID-19 pandemic, the world has learnt how to adjust business and manufacturing operations to compensate for the need to isolate and quarantine. This has resulted in companies working remotely to support facilities that are running with minimal staff. To reduce contact and still be able to manufacture products, factories are in a situation where they must accelerate their transformation into Smart Industry 4.0 facilities. This is critical for operations today and in the future.

The adoption of Industry 4.0 methodologies merges well with the need to reduce social contact inside fabs. As more decisions become automated and factory systems become more interconnected, more employees can monitor and control operations from home. This means that factory output can remain high while minimizing the risk of having key employees succumbing to COVID-19.

The first step toward developing highly integrated Smart factories is the deployment of a real time Digital Twin. A Digital Twin is a living data warehouse that is not only a repository of factory state information, but it is also a system that uses the collected data from disparate factory systems to derive new information. This information is used to connect and control systems throughout the factory with the express purpose of making more accurate real time predictions of expected factory outcomes. Using the Digital Twin, WIP Scheduling, Location Tracking and Delivery, Maintenance Management, and Process Control systems can make automatic optimal decisions and reduce the need for humans to intercede.

Digital Twin and Applications

Multiple applications are built upon a Digital Twin, the primary highest ROI application is a Factory Scheduler. This system makes key decisions about what material to move where and when. A well-tuned Factory Scheduler can be adjusted to optimize WIP movement and tool loadings. This minimizes the number of people on the factory



HOW AUTOMATION CAN FACILITATE FASTER ECONOMIC RECOVERY IN SINGAPORE

Metrology Sampling Dashboard

FDC System Example

floor by eliminating inefficiencies in operations and dramatically reduces the need for real time operator-based decision making on the production floor. WIP Location Tracking and a Smart Dispatch are important extensions to the Scheduler. By employing a Smart WIP Tracking and Dispatch system, the physical delivery of material can be managed to minimize contact with other operators. Maximizing the number of lots moved at a time and minimizing the number of stops on a delivery route can reduce social contact. In sites with automated material delivery systems, a Smart Scheduler and Dispatch system work with the delivery system to move the material at just the right time and reduce the need for intervention.

Additionally, using a Smart Digital Twin enabled system, factories can enhance floor staff contact tracing by combining material location tracking and operator transactions.

Another key set of components that benefit from a Smart Digital Twin are the Process Control (FDC and APC), Metrology Sampling, and the Maintenance Systems. By utilizing predictive systems, equipment downtime can be reduced. By understanding the health of the equipment, Smart integrated Process Control systems can maximize uptime by make process adjustments to compensate for changes in equipment performance. Connecting the information from the Fault Detection System with a Metrology Sampling System enables the metrology sampler to minimize the amount of sampled material and focus on at risk lots. This reduces the number of operators and decision makers required to manage the metrology queue. Those systems also provide predictive capabilities for excursions and changes in equipment health. This allows factories to better schedule preventative maintenance and manage changes in tool health that minimize the need for maintenance and equipment engineering personnel to be in the factory.

While independently these systems can provide benefit to semiconductor operations, the combination of WIP and metrology Scheduling, Location Tracking and Dispatch, Process Control and maintenance systems with a comprehensive Digital Twin, multiplies the benefit. This is done by providing interconnection between the systems, allowing them to easily share data, and developing a connected environment that enables automatic predictive systems to make intelligent decisions about factory operations. A Smart Factory environment is critical to minimizing the risks associated with day to day operations on the factory floor, and the good news is it also provides a rapid return on investment from the improvement of multiple KPIs.

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Semiconductor Tradewinds – MAY & JUNE 2020

As we enter the 2nd half of 2020, COVID-19 continues to impact people's lives, jobs and have a severe impact on the economy. The pandemic is still not under control and continues to grow exponentially worldwide with over 11 million confirmed cases and over 525,000 confirmed deaths at the time of writing. The IMF is now projecting global GDP to shrink 4.9% this year, 6.5% lower than it's pre-pandemic forecast.

Many countries are trying to reopen economies but it is a fine line between safely opening and allowing the pandemic to spike again. In the next few months, the true toll of the pandemic will start to become visible globally as many countries start to withdraw stimulus measures that protected jobs. In the U.S. by the end of June, there were still 19.5 million people receiving unemployment benefit and although this number is going down slowly as companies restart and rehire, it remains to be seen how long it will take to get back to pre-COVID19 employment levels. With this as a backdrop, the U.S. announced it will extend its ban on new work visas through to the end of the year and broaden its scope to include H-1B visas for highly skilled workers, as well as L visas used by companies to transfer their own employees in an effort to protect U.S. jobs. This policy will particularly hard hit the U.S. tech and semiconductor sector which depends on employing skilled engineers using H1 and L1 visas to fuel its growth and innovation.

The news is not all gloomy as Taiwan has demonstrated it can buck the trend, with industrial production continuing to improve for the 4th straight month in June. The semiconductor sector has continued to do particularly well with the MOEA saying production by the electronics component industry was up 22% from a year earlier in May, marking the sixth consecutive month of double-digit increase, on the back of strong demand for 5G applications and high-performance computing (HPC) devices. The Taiwan I.C. sector grew 7% in May compared to April and was up 37% compared to a year ago. Taiwan was one of the first countries to impose COVID-19 restrictions and enforced the wearing of masks in public and social distancing and used computer tracing to fight the pandemic. As such, the total cases were only 443, with the majority imported. As of the end of June, the country had only 6 active cases.

Also continuing to do well is the semiconductor foundry segment. In the latest foundry rankings from market analysis company Trendforce, foundry revenue of the top 10 foundries is expected to increase by more than 20% yoy in Q2 2020. Sequentially compared to Q1, revenue is expected to increase ~4.5%. TSMC is expected to retain number one position with 51.5% market share, followed by Samsung (18.8%) and Globalfoundries third with 7.4% market share.

The Trade War Continues

Despite the economic impact of the pandemic the U.S. has continued its trade war with China, with several new measures announced recently. In May, the U.S. President extended for another year the executive order signed in May 2019 declaring a national emergency and barring U.S. companies from using telecommunications equipment made by firms posing a national security risk, which includes Huawei and ZTE. Ever since the order was first announced, the U.S. Commerce Department has issued a general temporary license which has been extended many times, allowing U.S. companies to keep doing business with Huawei. This was further extended again in May for another 90 days, yet it is expected that this will be the final extension.

In addition, the export controls against Huawei were further tightened on 15 May, with the Department of Commerce extending the Huawei ban to include the use of U.S. technology and software to design and manufacture its semiconductors abroad. The original ban prevented companies with greater than 20% American content from selling products to Huawei. Still, up until now Huawei has managed to keep its supply of semiconductor chips going by buying from TSMC and other overseas foundries. These extended restrictions close this loophole as it bans any company using U.S. equipment from manufacturing for Huawei and its affiliates without a license. TSMC immediately stopped accepting new orders from Huawei and HiSilicon (Huawei's chip division). The extension of the restrictions has a far-reaching impact as it effectively stops all foundries around the world from producing for Huawei. According to Credit Suisse, semiconductor equipment from U.S. companies like Applied Materials and Lam Research is used by about 40% of the world's chipmakers, while software from the likes of Cadence, Synopsis and Mentor is used by 85%. It said it would be almost impossible to find a fabrication plant, or fab, that could still work with Huawei, including Chinese foundry SMIC.

The impact on TSMC could be quite significant as HiSilicon accounts for approx. 14% of TSMC's revenue and this is expected to drop to zero by next year if the ban is not lifted. Recently it has been reported that TSMC has already filled the gap in orders, and certainly the decision by Apple to start using its own processors in its laptop and desktop computers will help TSMC. The first Apple models with Apple processors are expected to be shipped by the end of this year

and transitioning fully over the next 2 years. It is expected the first Apple processors will be made on TSMC 7nm technology before switching to 5nm technology next year. In addition, TSMC is hopeful that the current trade issues will be gradually resolved and say they will start to apply for a license to start supplying to Huawei subsidiary HiSilicon by mid-July.

The ban severely impacts HiSilicon which has only recently risen to rank in the top 10 semiconductor companies based on sales. It is unlikely to find any companies that can produce chips for HiSilicon. HiSilicon's Kirin processor is now rated to be equivalent to Apple and Qualcomms processors in performance, but designing next-generation processors will be hard without U.S. design software.

One unintentional consequence of the above restrictions was that it caused U.S. companies to be sidelined and potentially fall behind in setting and developing global standards for the next-generation telecommunications technology. Therefore, on 15 June, the U.S. Commerce Department amended the rules to allow U.S. companies to work with Huawei on these standards committees without requiring a license.

At the same time, as the U.S. has been trying to limit its dependence on Chinese goods, it has also been promoting semiconductor manufacturing in the U.S. and offering aid to set up factories in the U.S. This initiative culminated in the bipartisan American Foundries Act 2020 being introduced in the Senate in late June which will champion the sector and lure high tech supply chains back into the United States. The act will provide up to US$25 billion in federal grants, US$15 billion of which is earmarked for federal grants to states to build, expand or modernize domestic semiconductor manufacturing and R&D facilities.

Capital Expenditure Projects Continuing

Whilst the pandemic is causing short term impact, there has been still lots of good news for the semiconductor segment for the future as companies are continuing to invest in new facilities. In recent months, several companies have announced new facilities around the world. All the big foundries are continuing to invest record amounts in capex and research and development for advance technologies. As a result, the semiconductor equipment industry is one of the areas that is expected to grow significantly next year by up to 24% to a record US$67.7 billion spend globally. Memory fabs will lead spending with leading-edge logic and foundry fabs close behind.

As a result of the U.S. initiative to promote manufacturing in the U.S., TSMC announced it has plans to build a 5nm Fab in Arizona. Construction is planned to start in 2021 with production targeted to begin in 2024. The Fab will eventually produce 20,000 wafer per month, with TSMC investing approx. US$12 billion from 2021 to 2029.

Globalfoundries (G.F.) also announced it had secured a purchase option agreement for approximately 66 acres of undeveloped land adjacent to its current Malta Fab in New York. G.F. said it is looking to expand output by utilising unused space in its existing Malta Fab or build a new Fab next to it.

In South Korea, Samsung announced that it intends to build a new chip plant in Pyeongtaek, some 70 kilometres south of Seoul, S Korea. It is reported that it will invest US$116 billion to build a 5nm plant for foundry business to start operating in the 2nd half of 2021 to challenge TSMC's foundry business.

In the U.K., Huawei has received approval to build a new research and development centre in the U.K. Huawei plans to invest £1 billion (US$1.2 billion) in the first phase of the planned centre which the company will use to build state of the art chips. Huawei has acquired a 50,000 sq m site in South Cambridgeshire and will create 400 jobs according to the company. If you remember last year Huawei laid off 600 people, three quarters of its staff were at its US R&D centre Futurewei.

New Opportunities for LED Manufacturers

For many years, the LED segment has struggled from oversupply but now there is an opportunity as the next-generation display technology is being adopted by the mainstream consumer products. As a result, mini and micro LED are expected to be the big growth area in the coming years as companies like Apple adopt them for the next generation iPad and Mac computers. To take advantage, LED companies in both Taiwan and China are increasing their investments to build new production and research facilities for Micro LED and Mini LED R&D, production and sales.

Apple is reported to be setting up its mini-LED supply chain based around Taiwan suppliers to avoid supply issues due to the US-China trade war, with Epistar and Fittech being 2 companies identified to benefit. Recently, Taiwan-based LED wafer manufacturer Epistar announced it will spend US$200 million on capex to build new facilities.

In addition, Epistar has announced it will partner Lextar and establish a joint holding company through share conversion. Under the agreement, Epistar will focus on LED wafer production and Lextar will focus on LED packaging and modules. The companies will avoid overlapping investments by sharing production capacities. Market Research company TrendForce estimates that after the merger, the joint company will collectively account for 12.43% of global LED chip production capacity.

What Will Happen in 2nd Half 2020

So what does the 2nd half of 2020 hold in store for the semiconductor segment? That is a question everybody is trying to answer, but

until a vaccine is developed, it is hard to predict when economies can get back to normal. Currently, the number of people confirmed with COVID-19 is still increasing exponentially around the world. While some countries have seen success in controlling the pandemic and started to slowly open up their economies again, they are still a long way from pre-pandemic days. Being the largest economy in the world, the U.S. is still struggling to control the pandemic with over 50,000 new cases per day.

The first half of 2020 was good for semiconductor foundries but the demand further down the supply chain is not so good. Therefore, how long the strong demand for chips will last is a big question, especially as automotive and smartphone sales are significantly down this year. There is pent up consumer demand out there but that is not likely to fully recover the lost sales from the 1st half of 2020.

We can only hope that a vaccine is found soon, and until then countries manage to control the pandemic. This will allow economies and borders to be reopened so that international travel for business and leisure can resume again.

ABOUT THE AUTHOR

MARK DYSON is the Head of Global Subcon Manufacturing of Osram Optoelectronics

An Overview Of The Aerospace Sector And Workforce

The Aerospace sector experienced strong growth over the last decade, with Singapore enhancing its capabilities in advanced manufacturing, and maintenance, repair and overhaul (MRO). Singapore is known as the MRO hub of the region, accounting for an estimated 10% of the global market, pre-COVID-19. In 2018, the industry employed a workforce of 22,000 predominantly Singaporeans, two-thirds in the category of PMETs, producing an output of S$11.3 billion.

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Association of Aerospace Industries (Singapore)

This growth momentum continued in 2019 on the back of a higher volume of repair and maintenance jobs from commercial airlines. Guided by the Aerospace Industry Transformation Map, aerospace companies pursued innovation, and many started integrating automation and digital technologies in their processes and shop floors. Workers were upskilled to ensure competence with advanced technologies such as automation equipment, data analytics, IOT, advanced materials, non-destructive testing and process automation, etc.

With the COVID-19 crisis, air travel took a direct hit with consequent impact on airlines, aircraft manufacturers and aerospace companies. The International Air Transport Association has forecast that air travel will only recover to 2019 levels in 2024. While the industry is doing its best to retain its workforce and capabilities in support of Singapore's air hub and the eventual economic recovery, some companies have already had to trim their workforce in the face of the sustained weak market outlook.

The sector employs a diverse range of skills. The four major functional skills tracks are Aircraft Maintenance, Fleet Management, Aircraft Engine Overhaul and Component Repair, and Manufacturing. Aside from technical skills, aerospace employees are generally well-versed in safety assurance, standards compliance, and quality management, given that it is a highly regulated industry.

Sample Job Roles In The Aerospace Sector

The table below gives a description of skills involved in some sample job roles.

Work Function	Aircraft or engine maintenance/ repair technician	Process technician (engine build/ machining/quality control/NDT)
Legislation and regulation	• Basic human factors & error management • Interpret basic regulatory requirements	• Similar
Maintenance	• Specific skills – e.g. painting, cleaning, disassembly/assembly, inspection, maintenance of aircraft equipment or parts, machining, plating, polishing etc	• Specific skills – e.g. engine build processes, handle, inspect and pack, CNC machining, surface coating, surface preparation and finishing, material hot processing, rig and derig engine for tests
Operations/ Production	• Handle measurement instruments, set up and operate coordinate measuring machine • Perform dimensional and geometric measurements	• Similar
People & relationship management	• Teamwork and communications	• Similar
Personal management and development	• Adapting to change, self-management and personal effectiveness, etc	• Similar
Planning and implementation	• Critical thinking and analysis	• Similar
Productivity and innovation	• Basic lean techniques, continuous improvement techniques, lean thinking	• Similar
Quality	• Apply ISO9001 and other QMS, perform inspections, use of measuring equipment, statistical process control	• Similar
Specialised processes	• Non-destructive inspection techniques, welding, heat or surface treatment, etc	• Advanced gas tungsten arc welding, diffusion bonding, NDT
Workplace safety and health	• WSH practices, basic safety practices and documentation	• Similar

Next-Generation Employee Transport Solution

How Demand-Responsive Employee Transport Can Help You Improve Your Service Levels While Maintaining Cost And Ensure Safety In Light Of COVID-19

The Ministry of Manpower has laid down a rule for all employers to reduce the Maximum Passenger Capacity (MPC) allowable on all employee transportation vehicles by 25%. With this new regulation, you can expect to incur more costs. Demand-responsive technology can help you save costs while improving service levels, and even ensure safety in your employee transport.

Typical employer-provided transport is inflexible, with fixed routes, fleets and schedules that do not adjust to fluctuations in demand. This leads to inefficiencies that may cost you more in the long run. Technology solutions can not only optimize resources leading to potentially reduced costs, it can also enhance safety within the workplace.

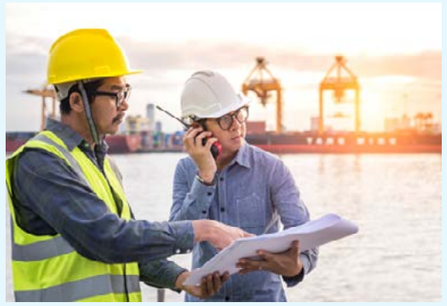
What Is Demand-responsive Employee Transport?

Imagine "ridesharing" on your company buses. Employees book onto the company bus through a mobile app and get picked up from a location close to their homes. They sit with other colleagues while complying with safe distancing measures on board the vehicles.

Behind demand-responsive transport lies a smart algorithm that calculates the optimal fleet combination to deploy based on the allowable MPC, maximising fleet utilization and occupancy rate. The algorithm pools employees living within the same area together and generates the most efficient routes that reduces trip times and detours.

The system plans the transport service, taking into account any change in employee schedules automatically. Such technology does not require large fleets and can work with your existing fleet operators to execute.

See How A Large Corporation Increased Their Bus Utilisation While Maintaining Costs With Technology



A large marine and engineering company headquartered in Tuas has to cater transport for 1500 employees daily. Initially, the company transport picked up employees from 9 MRT stations in the morning and dropped them off at 2 MRT stations in the evening.

The HR department was concerned about attrition rates as the employees faced long and inconvenient commutes (most had to transfer to get to their pick-up points) everyday. The company decided to switch to a technology-based transport solution that not only improved their employees' commutes, but also increased their service levels and gave them insights into ridership and operations, such as the number of employees taking the bus each month.

The large corporation worked with the technology company SWAT Mobility. SWAT Mobility provides demand-responsive transport technology for employee transportation.

Using their app SWATBiz, employees book their rides for an entire month under a "Commute Pass". They can check the bus pick up time, estimated work arrival time, view the buses location, provide daily feedback, and make payment on the app.

With SWAT Mobility, the number of stops served increased from 9 fixed pick-up points to over 200 points islandwide that are all within 10 minutes walking distance of employees' homes. Similarly, the drop-off points expanded to

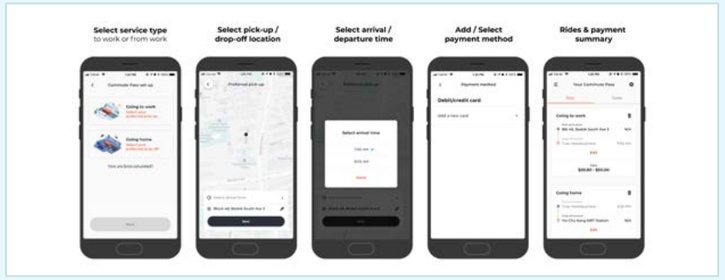
BEFORE: 9 fixed pick-up points (dots represent employees' homes)

AFTER: Employees are pooled together and bus routes are optimised

over 80 points close to various MRT and LRT stations in the evening. Routes are optimised based on employee bookings and other constraints the company works with SWAT Mobility on setting, such as total ride duration and distance to home.

Bus utilisation rate improved from 62% to 80%. The company managed to reap cost savings as they stopped paying for unnecessary empty seats. SWAT Mobility also sends the company status updates and review of key metrics. Regular reporting ensures that the employee transport remains cost-effective and the agreed-upon service levels are delivered.

Through surveys, staff have feedback that they are highly satisfied with SWAT Mobility's services as they no longer need to make multiple transfers on public transport in order to reach their pickup points.



The VP of the HR department at the large corporation vouches for SWAT Mobility, saying "I am confident their routing technology, easy-to-use passenger apps, will continue to help improve work commutes for our employees, making it convenient, affordable and comfortable."

A safer transport for your employees

SWAT Mobility's system enables contact tracing through ride bookings that are automatically tracked and recorded. It also allows for physical distancing on board your vehicles, allocating rides to passengers based on the allowed MPC. In addition, the technology accounts for split shift arrangements. It adjusts the transport schedule based on the employees' rotating rosters, with automated route planning and vehicle assignments.

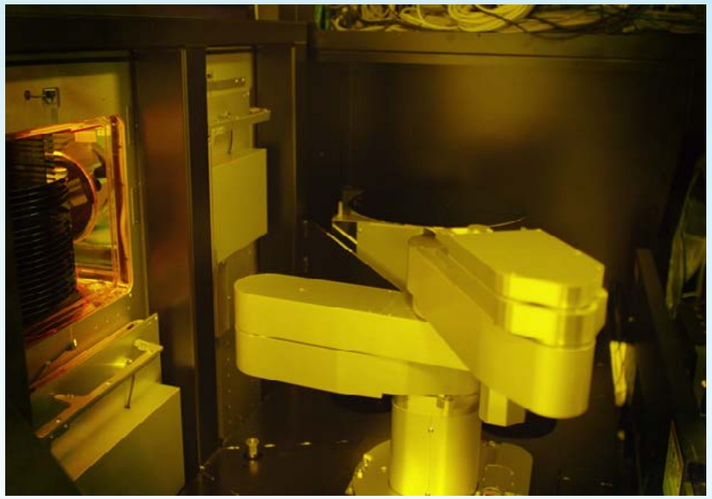
WILL THIS TECHNOLOGY WORK FOR YOUR COMPANY?

If you are interested in finding out more and getting a complimentary transport analysis, contact us at www.swatmobility.com/contact-us.

SOURCE OF CONTENTS

SWAT Mobility

Semiconductor Solutions of Sioux



Accelerate Customers' Product Commercialization to Stay Ahead of Competitors

Sioux has all the expertise inhouse to contribute to the maximum success of high-tech products and production systems. Sioux's strength lies in the unique combination of high-quality competences of software, mechanics, optics, mechatronics, electronics, mathematics, and final assembly & testing. With more than 800 engineers globally, Sioux supports or forms the R&D department of leading high-tech companies.

Multidisciplinary Competencies for the Semiconductor Industry

Sioux offers combination of high-quality competencies like software, mathware, mechatronics, electronics and assembly.

MECHATRONICS SYSTEM

- System architecture
- Machine dynamics
- Model-driven development
- Embedded software

PRECISION & HIGH-SPEED MECHANICS

- nm, µm domain
- High speed (µs, ns)
- Active mounting
- Thermal/vacuum technology

ELECTRONICS DESIGN

- System intelligence
- FPGA, DSP, ARM
- PCB design
- Machine cabling

OPTICS & METROLOGY

- Optics
- Laser technology
- Measurement
- Sensor technology

INDUSTRIAL IOT & CLOUD

- Data control
- Security
- Remote diagnose
- Application software

INDUSTRIAL MATHEMATICS

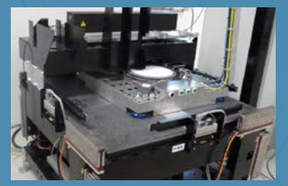
- Simulation
- Process optimization
- Image analysis
- Data analysis

SOURCE OF CONTENTS

SIOUX TECHNOLOGIES

Kelvin Ng
marketing.china@sioux.asia

Customer References



EXTREME POSITIONING

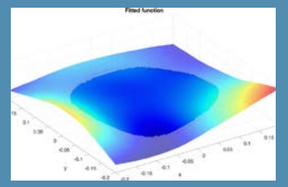
When accuracy requirements go sub-micrometer, Sioux can bring up experts that master the multi-disciplinary approach for development. As an example, the planar motion platform nForcer is a cost-effective solution for sub-micrometer positioning can realize up to 100nm positioning accuracy with 500mm/s moving speed. We have developed this kind of applications for several OEM companies.

FLAT-PANEL AOI

Sioux has developed a modular high-resolution flat-panel scanner for the in-line quality inspection. The scanned image data from the 9 optical units come together in a dedicated PC board which combines the data to a single image. Using an up-sampling resolution of 2.5 µm, the image size of a 24" x 24" PCB substrate is 60 Gb. Data compression and pipe-lined techniques make real-time image processing possible in 20 seconds per scan.

LITHOGRAPHY FOR ADVANCED PACKAGING

Sioux has designed, implemented and tested the complete software stack for lithography machines used for advanced packaging, which including the user interface, the control software for all devices, the business logic for processing on a wafer, exchanging and aligning wafers, handling reticles and executing metrology measurements with the projection lens and the CCD camera and the mathematical algorithms for the metrology.



PHYSICS MODELLING

In machines that produce micro-electronics, internal temperatures increase considerably during the production process, which decrease the product quality. Using knowledge of mathematics and Multiphysics, Sioux has created insight into the dynamic thermal effects. A model was created to calculate how to finetune the machine within 12 milliseconds and continually correct deviations during production.

GaN-On-Silicon Technology for >100 GHz Applications?

The Start of GaN Technology

In this past couple of years, more commercial products using Gallium Nitride (GaN) based High-Electron-Mobility-Transistors (HEMTs) have started to emerge. For example, fast chargers and adapters for smartphones, laptops and game consoles using GaN can offer faster charging speed with smaller size and weight as compared to the current silicon-based technology. However, these applications are just the tip of the iceberg of the wide range of applications which can leverage on GaN. These include dc-dc converters and traction inverters in electric vehicles, data centres, light detection and ranging (lidar) systems for autonomous cars, robots, drones, and security systems which can take full advantage of GaN's high-speed switching and high-power abilities. In short, we are witnessing the start of GaN technology which is ready to transform the entire power electronics industry.

GaN-on-Si HEMT can now be applied to other applications such as >5G wireless broadband communications

Extending Operating Frequency of GaN-on-Si HEMTs

In view of the huge economic potential, increasingly more silicon wafer fabs have also started to invest and build up their capabilities to enable high-volume GaN HEMTs on low-cost silicon substrates leveraging on their existing 8" CMOS lines. By adopting this approach, it will make GaN products more affordable and thus more readily adopted by the mass consumer market. Hence, to be ready for these burgeoning demands, the focus for these wafer fabs will be to develop devices targeting high-power and high-speed switching applications which typically have operating frequency in the KHz to MHz range. At such a lower frequency regime, standard low-resistivity silicon substrates are still able to meet the technical requirements as the substrate loss is still acceptable. However, does that mean GaN-on-Si HEMT will only be limited to low-frequency applications? What about other applications such as >5G wireless broadband communications, or ultra-high frequency test systems, which need to operate at much higher frequency? To enable GaN-on-Si HEMT to extend its operating frequency capability, researchers worldwide have adopted high-resistivity silicon substrates which have lower substrate loss at higher frequency. Using this approach, extremely high frequency HEMTs have been reported. For example, a research team from Cornell University has recently reported a 55 nm HEMT fabricated on 200-mm-diameter 725-µm-thick high-resistivity (3000 Ω·cm) Si substrates with cutoff frequencies >250 GHz [1].

Research in Singapore

In Singapore, the Nanyang Technological University (NTU)'s Electrical and Electronic Engineering (EEE) research team led by Prof. Ng Geok Ing has been working on GaN-on-Si technology since 2005. Recently, his team in collaboration with the researchers at SMART LEES are embarking on an A*STAR AME IRG project to develop a GaN HEMT for E-band (60-90 GHz) applications. Using a more advanced HEMT structure, namely InAlN/GaN, and with deeply-scaled 40 nm gate-length, the team has reported a record-high cutoff frequency of 310 GHz [2]. The team has also reported an 80 nm GaN HEMT with high Johnson's Figure-of-Merit (product of cutoff frequency and breakdown voltage) of 8.8 THz-V using a CMOS-compatible non-gold process [3]. These results also rival those GaN HEMTs fabricated on more expensive silicon carbide substrates using non-CMOS-compatible gold-based processes. Thus in contrast to the early beliefs that GaN-on-Si is limited to low-frequency applications, these promising preliminary results have demonstrated the great potential of GaN HEMTs on high-resistivity silicon substrates using CMOS-compatible processes to extend their operation beyond 100 GHz, which will enable their use in many new application domains in the near future.

Nanyang Technological University

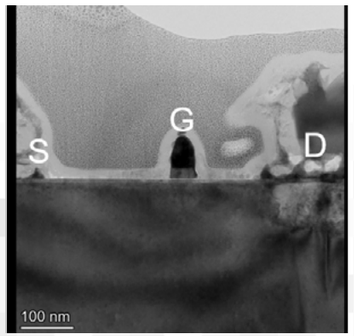


Fig.1: Transmission Electron Microscopy picture of the GaN-on-Si HEMT with gate length of 40 nm and source-drain spacing of 400 nm.

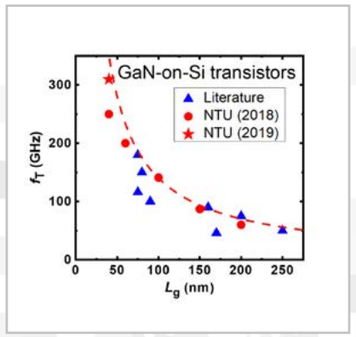


Fig.2: Comparison of the achieved fT versus Lg of NTU's devices with other published state-of-the-art GaN-on-Si HEMTs results.

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1. L. Li, K. Nomoto, M. Pan, et. al, "GaN HEMTs on Si with regrown contacts and cutoff/maximum oscillation frequencies of 250/204 GHz", IEEE Electron Device Letters, vol. 41, no. 5, pp. 689-692, May 2020.
2. H. Xie, Z. Liu, Y. Gao, K. Ranjan, K. E. Lee and G. I. Ng, "Deeply-scaled GaN-on-Si high electron mobility transistors with record cut-off frequency fT of 310 GHz", Applied Physics Express, vol. 12, no. 12, pp. 126506-1-126506-5, Dec. 2019.
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ABOUT THE AUTHORS

GEOK ING NG
School of Electrical and Electronic Engineering, Nanyang Technological University

HANLIN XIE, KENNETH LEE
Low Energy Electronic Systems, Singapore-MIT Alliance for Research and Technology Centre

Developing Industry-Level ReRAM Technologies

Changing Memory Requirements for IoT

Static Random Access Memory (SRAM), Dynamic Random Access Memory (DRAM), and Flash memory were invented in 1964, 1966, 1980, respectively. They have been the primary memory solutions over the last a few decades. Continuous development of higher performance digital systems has demanded faster memory solutions so that the overall system performance, usually limited by memory performance, can be improved to meet the market needs. Among the aforementioned memory solutions, DRAM and SRAM are faster than flash memory, which makes them employed as primary computing memories. Flash memory was invented as a technology for data storage without power supply targeting to replace various hard disks. Even though the progress in the flash memory speed has been demonstrated, it is still slower than DRAM and SRAM, and is mainly used as a non-volatile data storage solution.

However, the introduction of Internet of Things (IoT) has changed the memory requirements. The topmost goal of many IoT devices is to minimize overall power and energy to maximize the system lifetime when powered by batteries or energy harvesting devices. Various emerging non-volatile devices such as Magnetic Random Access Memory (MRAM) and Resistive Random Access Memory (ReRAM) show good potential as a memory solution for IoT devices. MRAM has been commercialized by companies like GlobalFoundries (with Everspin) and Samsung Electronics. While MRAM provides good performance for IoT devices, it is difficult to fabricate because of many thin layers requiring precise fabrication control. This will increase the overall fabrication cost, which limits its proliferation in the IoT era.

Advantages and Limitations of ReRam

ReRAM is another promising candidate for IoT devices because of its simple structure and low-cost fabrication. Like MRAM, ReRAM also shows different resistance levels depending on how it is programmed (Fig. 1). Higher resistance is formed when no conductive filament is formed between two electrodes (Fig. 1 (left)). Lower resistance occurs when the two electrodes are electrically connected through a conductive filament (Fig. 1 (right)). In spite of various advantages of ReRAM, it is not mature yet and still has various challenges like technology compatibility, endurance, and variability to be overcome for commercialization. Currently, most of the demonstrated ReRAM chips use higher voltage for programming, which cannot be accepted in most main-stream semiconductor fabrication technologies. Besides, the ReRAM device characteristics changes significantly over usage time, limiting the device lifetime.

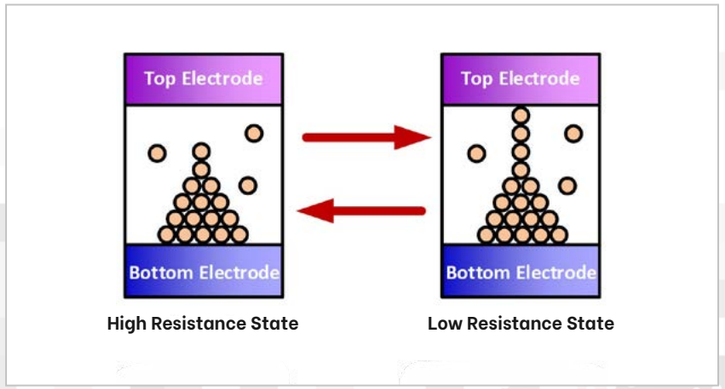


Fig.1: Two resistance states of ReRAM

Research Team to Develop Industry-level ReRAM Technologies

Recently, Nanyang Technological University (NTU) formed a research team (led by Prof. Lew Wen Siang in School of Physical and Mathematical Sciences) with GlobalFoundries to develop industry-level ReRAM technologies. The NTU team consists of professors, researchers, and Ph.D students with various research expertise covering from materials to circuits and architecture. The NTU research team dreams of developing ReRAM technologies ready for mass production after leveraging the manufacturing technologies of GlobalFoundries.

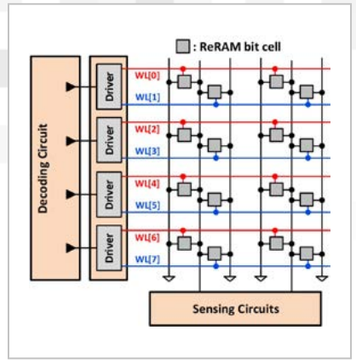
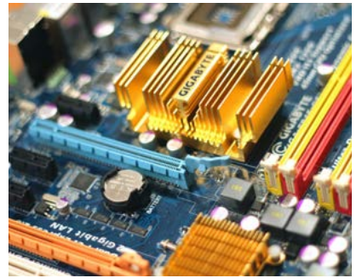


Fig.2: Simplified ReRAM architecture for explaining data sensing



ABOUT THE AUTHOR

PROF. TONY TAE-HYOUNG KIM
Associate Professor of School of Electrical & Electronic Engineering, Deputy Director of Centre for Integrated Circuits and Systems (CICS) & Program Lead of NTU-TUM Integrated Circuits Design (ICD) Programme

A Chat with the SSIA Secretariat Team Member

THE STORY OF PATSY'S CAREER JOURNEY

Patsy has spent more than 25 years in Human Resource Management covering SMEs and MNCs in Singapore and countries in Asia. She is now the HR Manager of SSIA supporting the HR management including compensation and benefits and payroll administration.

Patsy climbing Mt Krisvec in Croatia last year

Can you tell us about your own journey in the semiconductor industry? What first got you into the semiconductor industry?

I do not have a long history in the semiconductor industry as I started my career when I was fresh out of school, "wet behind the ears" not knowing what to do. It was after 20 years working in various companies and in real estate, hotel, trading and metal industries that my first foray into the electronics and semiconductor sector started when I joined Siemens Electromechanical Components in 1997. I worked with a dynamic leader and started up from a team of 6 to 60 staff in the Asia Pacific regional headquarters in Singapore within less than a year.

After this I joined Magnetic Data, owned by venture capitalists in USA. After 3 years the company was sold to Solectron and I moved to the Regional office to support the Regional HR Director in Ethics & Compliance, SOA, Integration of Group HR & union matters in Singapore and managing the Shenzhen plant for a short while before I was offered to return to Siemens to start-up the Electronics Assembly Division factory in 2003.

When the division was started, we had just 27 staff in the Sales, Product Management, R&D and Technical Support teams. As I counted, I sieved through more than 7,500 resumes on Jobstreet and other advertisements and interviewed like more than 1,000 in 18 months! We finally grew close to 300 employees, before the 2008-2009 economic downtown struck and we had to downsize. It was painful and hard to see experienced employees leave. Business picked up again in 2010. The business was eventually acquired by ASM Pacific Technology in 2011. I stayed on until I retired in 2017.

What were your biggest challenges and excitements as an employee in the semiconductor industry?

The biggest challenge was the amount of technical knowledge I had to grasp so that I can understand discussions at meetings and know how to approach business issues. There is so much to learn and very technical and till today I am still learning. I enjoy learning and therefore was very excited whenever I sat in interviews with the managers who were

Patsy visiting children at Nazareth Bush School, Yangon, Myanmar during her church mission trip

recruiting technicians, engineers in R&D, manufacturing and even procurement. At one stage I even learnt how to read technical drawings and refreshed my school geometry and mechanics lessons! It helped me to improve my selection skills and I was able to ascertain the technical skills of candidates sometimes without the managers.

Another challenge was the M&As and integration and I have gained much experience on both the side of the acquirer and the acquired. Each experience was different and the most challenging was not only business functions but cultural integration not only in Singapore but across the regions. With these experiences gained, you can safely say that I have enough experience to bring a company from birth to death.

How do you see the changes in the semiconductor industry in Singapore in the recent 10 years?

There has been and will continue to have a lot of automation and use of AI in the processes. A lot more investment has been and will be put into R&D to ensure the industry keeps up with the technology changes in AI and IoT. Even after this COVID mess, I am sure there will be many more job redesigning and consolidation of functions not just in the semiconductor industry but also everywhere. Everyone needs to embrace changes. Learning is lifelong and if the company or government don't have time to train you, you train yourself. In the impending changes in the new normal, remember to upgrade and invest in yourself through training. Treat the money you spend on training as an investment that you will not lose but only gain.

Let's talk about something personal

I enjoyed my work in HR. As an extrovert personality, I adapt and warm up very quickly with most people and am comfortable with peoples at all levels from the janitor to the CEO of companies and the playful teenager to the serious professional.

I believe Integrity and Honesty with Care together with Trustworthiness, Discretion, Impartiality and Loyalty are essential values in a relationship and especially so in a HR function. Every interaction is a new experience and there must be a general interest and dedication to serve others. I believe everyone has talent and ability and must be given a chance to excel.

I must also appreciate that all my bosses in the companies that I have worked with have been very supportive and if they have not liked me, they tolerated me. My colleagues, lunch mates, people who work closely with me have been nice to me and I always say as a parting shot that when we meet outside "please do not "elak" / "siam" (Malay and Chinese word for avoid) me. Come and say hello to me"

Patsy enjoys going pilgrimages and mission trips and have made trips to Israel, Europe, Mongolia and Myanmar in the last few years

" I believe Integrity and Honesty with Care together with Trustworthiness, Discretion, Impartiality and Loyalty are essential values in a relationship and especially so in a HR function."

Wisdom of the Synchronicity Leader

NEW WISDOM OF ... SERIES — This article is the third in the series, and this one is about the Wisdom of the Synchronicity Leader.

I have known Dr. Philip Merry since the late 90's. He has 40 years of experience delivering learning events in 61 countries to global organizations. He is one of the only Ph.D.'s I know who has developed a grounded theory in Synchronicity and Leadership. He thrives on helping global teams work together by engaging both their head and heart when making critical decisions. Philip is British by birth and has worked globally from Singapore for the last 31 years.

Philip shared three thoughts on the topic of Synchronicity and how leaders can use it to make better decisions. The first idea he shared was to answer the question **what is synchronicity, and how can we use it in business?** He continued on to say, "Synchronicity is a quality known to us – even if you do not recognize the word at first– but it is seldom explored, we either call it luck or coincidence. Synchronicity or "gut" is the ability that we have to attract to us the things that we need or desire.

Leaders should learn to trust and pay more attention to their "gut" together with their logic to make decisions. This ability draws us to answers that we have been seeking.

What Can We Learn From This? - Dig Beneath One's Logic And Be Open To Your Intuition

The question is, how much do you make decisions from your gut and not solely with logic? Which one turned out better for you? In reality, you probably need both; however, many leaders who have developed this skill have been able to trust their "gut" feelings about things. Sometimes as much as the numbers looking right, the ensuing decision may end up being wrong. So how are you doing this?

Here are some questions for you:

- How well are you attuned to Synchronicity or your "Gut Feelings"?
- Do you recognize when veiled messages come to you?
- Should you be using this innate skill more in these times?

In his second idea, Philip shared about how we need to dig beneath one's logic and be open to your intuition.

He explained how he lives his passion for the topic and even did his Ph.D. because synchronous events have happened to him so many times in his life, and he wanted to understand what the topic was and how it could help us as we face all the issues that we face in our lives. Many leaders don't pay enough attention to their 'gut' when they feel something other than the "facts" or "numbers." It is not just theoretical knowledge; it is based on living and understanding and applying this topic to one's own life. Hence, I know of that which I speak. It is best to combine both our head and heart.

What Can We Learn From This? - Be Willing To Search For Your Mission In Life

If the definition of Synchronicity is: "a meaningful coincidence providing guidance and direction to individuals that gives a sense of purpose and reassurance."
How do we combine head and heart (or gut) when the head drives so much of our corporate decisions? Have you seen something on paper that looks really good, but somehow your gut told you it was not going to work out for you at that time, and you were right?

Here are some questions for you:

- Do you give credence to your own decisions of the "heart" vs. just the "head"?
- Have you made decisions only based on logic, and it did not work out?
- Should you be trusting your intuition more?

The third idea on Synchronicity he shared was: be willing to search for your mission in life.

Philip shared that the COVID19 event has provided us with more "thinking time" to reflect on our leadership, our organization, and our team. "I believe all of us have a unique gift to offer to the world, and I am passionate about helping people find meaning in their life. I know for certain that understanding synchronicity can help them do that. Very often the answer to your life's problems is right under your nose, but you don't see them. Leaders need to increase these skills to live a life of Synchronicity."

What can we learn from this? - "Big Picture" Thinking

You have more time to spend on the areas of your organization that you did not have before. How are you balancing you and your teams' focus on work-life balance? Do you need a makeover for your goals, work process, and members to be able to deal with situations in the new normal?

Here are some questions for you:

- Have you spent more time on "big picture" thinking?
- What is the right balance for you and your team going forward?
- How can you build your intuitive skills?

ABOUT THE AUTHOR

STEPHEN KREMPL is an International Speaker, Best Selling Author, Facilitator, and Business Communication Coach. His latest book: The 5% Zone: Visibility Strategies that get you Noticed and Rewarded in Any Organization. He has worked with thousands of leaders and students in over 30+ countries.

He creates organizational and individual impact through his programs offered both virtually and in-person. Visit us at: www.kremplcommunications.com.

Singapore's industry has gone through various transformations – from being labour intensive to skills intensive, then from capital intensive to knowledge intensive. Technology is advancing at a pace of change that is unprecedented. To stay on top of the ever-changing landscape or pioneer new fields and industries, we have to embrace change and continue learning. New knowledge opens the door to new opportunities.

TUM Asia Hosting Webinars to Benefit Jobseekers, Career Switchers and Workers

Working closely with industry leaders to Design Training Programmes

Academic institutions have a huge role to play in bridging the skills and talent gap. Of course, this cannot be done without the support from employers, industry associations, unions, and government.

This is because educators must embrace the real world to truly understand its challenges and potential solutions. Unlike the previous industrial revolutions, the fourth industrial revolution is not characterised by a single technology. There are 9 pillars in Industry 4.0; big data, internet of things, cyber security, cloud computing, augmented reality, autonomous robots, additive manufacturing, system integration, and simulation. The engineering workforce needs to adopt an accelerated digital mindset and leverage on multidisciplinary knowledge and insight to be future proof.

From an academic perspective, a multidisciplinary curriculum would therefore help to build a common language for alignment. This will facilitate more effective communication within the organisation and with external partners and customers. For example, at TUM Asia, we actively engage the various stakeholders to create a common skills language and to support the design of training programmes for skills and career development.

We incorporate Industry 4.0 curricula into our Bachelors and Masters programmes through practical based learning. We moved away from the traditional electrical and electronics engineering programme and offer electronics and data engineering for the engineers of tomorrow. We advocate lifelong learning through our suite of continuing education and training programmes. We recognise the value of academic industry

partnerships and are working closely with industry leaders like Siemens, FESTO, Emerson and Fraunhofer Singapore, on a couple of executive training programmes on advanced manufacturing. Technologies aside, we also focus on unique pedagogy to inspire the next generation of problem solvers and game changers. Complex problem solving, critical thinking, creativity, design thinking, people management, and cognitive flexibility are amongst the top skills in demand across the Skills Framework for the various sectors to make engineers effective catalysts for transformation.

Partnering SkillsFuture Singapore to Provide Skills Training Opportunities

During the Fortitude Budget Speech in May 2020, DPM Heng Swee Keat announced the SGUnited Jobs and Skills Package which aims to support close to 100,000 jobseekers through expanding job, traineeship, and skills training opportunities to aid Singaporeans affected by the economic impact of COVID-19. As part of SGUnited Jobs and Skills, TUM Asia will be partnering SkillsFuture Singapore to organise thematic webinars, online chats and/or online courses. The objective is to signpost individuals and help them make informed decisions to pursue skills upgrading and career development. Individuals that can benefit from this includes jobseekers, career switchers and workers at risk of displacement.

We will be hosting webinars on smart sensors, lean manufacturing, and our executive course offerings from July – August 2020. For more information on our upcoming webinars, please visit our social media page on Facebook and Linkedin.

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TUM Asia

Research Excellence Through Strategic, Sustainable Partnerships

Industry experts and academic thought leaders convened at Singapore University of Technology and Design (SUTD)'s annual FIRST Industry workshop on 22 July 2020, a platform specifically established to foster collaborative research success by developing and deepening industry-academia ties.

It was the first time the event went virtual since its inception in 2016. This was in accordance with safety precautions due to the ongoing coronavirus pandemic.

However, going virtual also meant that visitors from international shores beyond Singapore had the opportunity to participate in the workshop, resulting in a turnout of more than 1,000 participants. Attendees also got the opportunity to reach out to the event sponsors and participate in a networking session through the webinar platform that was dedicated to host this event. Additionally, the virtual nature of the event allowed for the access to post-recordings of all programme items which were accessible via the FIRST Industry website at the end of event.

Themed 'What makes University-Industry collaboration succeed?', Professor Yeo Kiat Seng, Associate Provost, Research and International Relations, SUTD, delivered the welcome address.

The filming behind the scenes of the inaugural virtual version of the annual workshop.

The event was also honoured to have Dr Bicky Bhangu, President, South East Asia, Pacific & South Korea, Rolls-Royce and Mr Nicholas Ma, Chief Executive Officer, Huawei International, deliver their keynote addresses.

Dr Bicky Bhangu shared insights into Rolls-Royce's approach in co-creating a more sustainable future through collaboration while Mr Nicholas Ma explained how collaborations between universities and industry formed a vital component in the development of continuous innovation.

Following that, experts from Kulicke & Soffa, LionsBot International, NTUC LearningHub and Artificial Intelligence Industrial Institute together with Mr Lim King Boon from SUTD's Partnership, Innovation & Enterprise, led a virtual forum panel discussion that delved deep into discussions on advancing translational research based on sustainable frameworks.

The event also featured a research competition and poster showcase which highlighted the design and technological innovations of SUTD's researchers and students. The top five prize winners of the research competition were announced and they were recognised for their efforts towards the advancement of science through industry-academia collaborative research.

The next SUTD FIRST Industry Workshop will be held on Wednesday, 28 July 2021. To find out more on the workshop or to access the post-recordings of the virtual workshop's programme items, please visit www.sutd.edu.sg/FIRST.

Panel discussion in progress at the SUTD FIRST Industry Workshop on 22 July 2020.

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