SSIA
Singapore Semiconductor Industry Association

SINGAPORE SEMICONDUCTOR VOICE

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SSIA
Singapore Semiconductor Industry Association

INTO A Resilient AND Endemic Future

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Calendar of SSIA Events

Here's a sneak peak of our key line-up next year – follow us for full details!

**Event dates TBC/subject to change*

JAN

▸ Electronics Industry Day

EID 2022 is back for a third edition, to engage young talents by showcasing the vibrancy, resilience as well as career opportunities of our industry.

MAR

▸ Semiconductor Women's Forum

SWF 2022 is back in its second run, to continue inspiring more women to join our semiconductor sector and, at the same time, promote a diverse workforce and inclusive culture in our sector.

• Leadership in Engineering Programme

This programme is designed for engineers and managers, identified as top talent by their organisations, to empower delegates with the mindset and soft skills of leadership, as well as to learn from industry leaders and network with peers.

MAY

▸ Semiconductor Business Connect

The scaled-up SBC brings together MNCs, SMEs, academic and government entities for thought leadership and insight sharing, as well as business matching and networking opportunities.

• Singapore Semiconductor Leadership Accelerator (SSLA) Programme

SSLA returns for its seventh run, a customised programme designed to inspire emerging technical and business leaders to continue creating revolutionary possibilities with semiconductors.

JUL

▸ SSIA Supply Chain Conference

The semiconductor and electronics industry continues to face challenges amid new opportunities, and this event aims to be a platform to initiate discussions, by our sector, for our sector.

SEP

▸ SSIA Summit & Semiconductor Dinner

Industry and government leaders convene to discuss industry and mega trends, and outlook for the sector.

If you would like to support and sponsor our events, contact us at: **secretariat@ssia.org.sg**

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FOREWORD BY

Executive Director

SSIA wraps up 2021 with our AGM this month. It is an understatement that the past year has been challenging, but our Secretariat team acknowledges one thing – that our mission and vision have not deviated from our original plan. We continue to be steadfast in upholding our corporate priorities.

Our industry continues to be in the spotlight, with the world continuing to see a surge in chip demand; as well as investments across the globe, including Singapore. Siltronic recently announced their $3billion investment into a new facility here in Singapore and is expected to create 600 jobs. I'm certain there will be more news to come, and this is a fantastic path forward for our industry.

With the continual expansion of our industry, the need to grow and develop our talent pool is more critical today then ever before. We need more talents to join our industry, not only to address current needs, but also for a sustainable future. We have a number of contributions from industry partners in this edition of VOICE, sharing how they saw opportunities amid difficulties, and overcoming challenges.

It is not by coincidence that like-minded partners have decided to take the opportunity to put more focus on talent development, training and re-skilling. To complete the formula, we cannot dismiss the importance of our academic and educational partners, who are helping current staff future-proof themselves, as well as grooming new talents for our sector.

Besides talent development, we need to also continue focusing on strengthening and growing our local eco-system. This is necessary to support the industry and give assurance to investors that Singapore as a semiconductor hub is ready to support exponential expansion. We see a huge increase in local companies joining our SSIA network this year. We will continue to engage our local companies and expand tour common network. Our MNC partners are not to be forgotten here, as your continued support for and working closely with SSIA allow us to move forward confidently.

For those of you who managed to join us at SSIA Summit in September, you may already have had a glimpse of our upcoming focus. If you had been unable to join us, onsite or virtually, check out our post-event coverage in this edition.

If you have not already been approached by my team to onboard the new Semiconductor and Electronics Job Portal, we have introduced this new experience aimed at being the go-to site for opportunities and insights exclusive to our sector. This is in partnership with e2i and WSG, and will continue to scale up progressively for its intended purpose.

I also take pride in acknowledging the collective efforts of our industry partners in the past year, as we move into a new endemic business norm – our resilience has been put to the test, but we did not falter. Let's continue to beef up our capabilities as we look forward to 2022, expected to be another good year for our semiconductor industry - with demand continuing to beat supply. I have faith that our resilience, flexibility and cohesiveness will bring us through any new challenges, together.

Lastly, continue to stay safe and healthy!

Best regards
Wee Seng

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SSIA SUMMIT 2021

Reiterating Smart Nation with Innovation and Technology

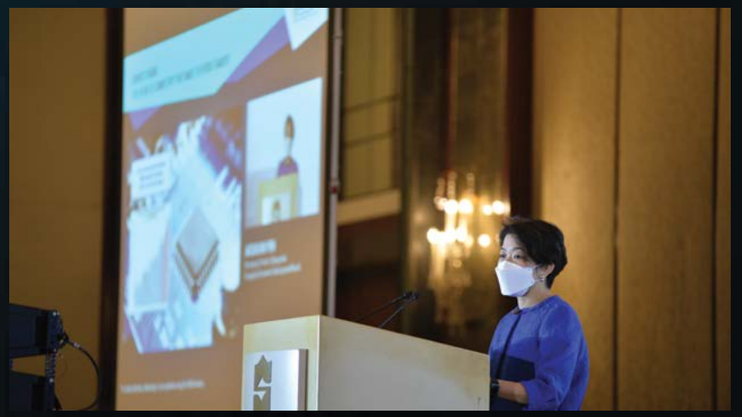
On 30 September, more than 150 multi-national, SME, academic and government leaders and partners convened at our annual SSIA Summit flagship event.

The hybrid event had in place safe management measures, as a demonstration of how our semiconductor industry was coming together to co-exist with new business and social norms.

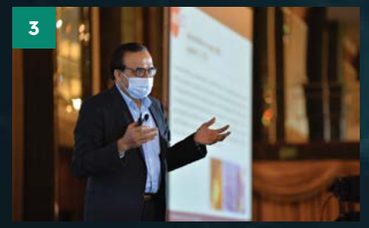
Gracing the event as Guest-of-Honour was Dr Janil Puthucheary, Senior Minister of State, Ministry of Communications and Information & Ministry of Health.

The SSIA Summit – positioned as one that was not only for the leaders, and aspired to attract everyone in and out of the industry – comprised an enduring theme *Building a Smart Nation with Innovation and Technology*, presenting a relevant agenda by strong thought leaders, led by Keynote Speaker Ms Jacqueline Poh, Managing Director of EDB.

Having the respective representatives of Health and Economy onsite helped convey a strong message that Singapore and businesses do need to find a balance and move towards the new norm; at the same time reaffirming that our semiconductor industry has the support of and will continue to work closely with our government partners.



The day's programme also put a spotlight on the most current and relevant industry trends, pivotal to driving the nation's smart initiatives. Of which, photonics is poised to be the nucleus of the next phase for the Singapore semiconductor industry; at the same time, priming ourselves to set our notion of sustainability in motion.



1. Opening Address by Andrew Chong, Chairman of SSIA
2. *Panel Discussion on Looking Into Future Trends for Smart Cities, moderated by Alpesh Patel, Partner, McKinsey & Co, with insights from panellists:*
   - *Jagadish CV | CEO, Advanced Micro Foundry*
   - *Jen Tan | Head of Integrated Solutions (Singapore & Southeast Asia), Sembcorp Industries*
   - *Laurence Liew | Director, AI Innovation, AI Singapore*
3. *Jagadish CV, CEO of Advanced Micro Foundry shared on Photonics Lights the Way To A Smart Nation*
4. *Jen Tan, Head of Integrated Solutions (Singapore & Southeast Asia) from Sembcorp Industries had the audience's attention with Developing Smart Solutions For Environmental Sustainability*
5. *Dennis Wong, Vice President, Enterprise 5G & Cloud from Singtel gave his perspective on 5G and cloud: Unifying divergent industries, technologies and data for smart nation initiatives*
6. *Chung Wei Hoe, Director, Head of IoT Systems AP from Infineon dived into another hot topic - Artificial Intelligence of Things (AIoT) - Enabling IoT Applications To A Smarter Nation*
7. *Sascha Maennl, Senior Director, Factory Automation Sales Asia-Pacific from Siemens flexed his technical knowledge on Industrial Edge For Next Level Production Machines And Factories*
8. *Dr Wu Jie, Head of Technical Customer Service, South East Asia from Henkel Singapore shed light on Innovative Adhesive Technology*
9. In addition to onsite attendees - who each took home a mini terrarium to symbolise the industry's commitment to a greener smart nation - over 500 delegates were part of the event virtually.

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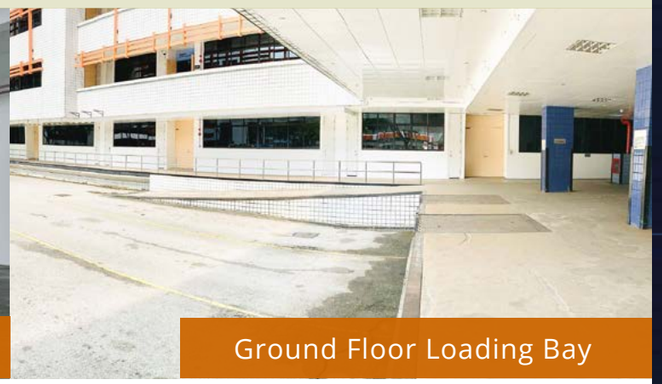
Corporate Identity at Industrial Property

Featuring Kallang Avenue Next to Bendemeer MRT (Downtown Line)

Ground Floor 3,500sf



Ground Floor Loading Bay

Ground floor unit with direct access to loading bay and canteen available

***Upper floor units available**

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CALL FOR PARTICIPATION FROM COMPANIES

ELECTRONICS INDUSTRY DAY

Thursday, 20 January 2022

EID 2022 is back for a third edition, to engage young talents by showcasing the vibrancy, resilience as well as career opportunities of our industry.

Register your interest to be part of this event with Daphne at **daphne@ssia.org.sg**

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e2i Better Jobs For Life Employment and Employability Institute

EDB SINGAPORE

jtc BUILDING INDUSTRIES

Wsg Workforce Singapore

**Event details TBC/subject to change*

Sixth edition | Aug/Sep 2021

Singapore Semiconductor Leadership Accelerator (SSLA) Programme

A strategic collaboration between SSIA and Human Capital Leadership Institute (HCLI) since 2017, the SSLA programme has contributed to the development and growth of more than 100 leaders from over 30 organisations in Singapore's semiconductor industry. Here are some snapshots from the sixth edition.

A custom programme designed to inspire emerging technical and business leaders to continue creating revolutionary possibilities with semiconductors, SSLA was conceived with three priorities - strengthen global competitiveness through innovation, enhance public-private R&D partnerships, and nurture leadership development. The programme is delivered as two modules, including an immersive hands-on learning experience.

The sixth run over 12 days in August and September covered timely and relevant topics such as the macro environmental trends, leadership agility, Industrial 4.0, and more, attracting 30 participants from 15 companies.

Some of the topics and speakers from the robust agenda included:

- The Impact of Geo-Politics, Trade Wars and Supply Chains Challenges on the Semiconductor Industry | by Alex Capri, Visiting Faculty, National University of Singapore
- Enhancing Leadership Effectiveness through the FIRO-B insights | by Irene Chia, Executive Director & OD Coach, Whitespace Management Consulting
- Leadership Agility | by Bill Cornwell, Managing Director, Cascade Consulting
- The Global Leadership Mindset | by Ric Roi, Affiliate Professor of Leadership & Organisation with IMD
- Managing and Facilitating Organisational Transformation | by Patricia Chew, Head, OD/Talent/Learning, FairPrice Group; SVP, NTUC Enterprise
- Communication and Engaging with Impact | by Stephen Krempl, CEO, Krempl Communications International

Here are some of the post-session feedback from delegates.

"It is the most holistic and comprehensive training I have attended in my career. Topics and modules are carefully designed to suit the semiconductor industry. A lot of very useful and practical framework and tips are presented in-depth and practised in class on management and leadership skills.

Ben Zongbin Wang Manager, Process Engineer | Applied Materials

"It has been a very insightful and eye-opening journey for me. Among other things, it has provided a vision of what the next level of leadership looks like, and what it takes to get there. It has equipped me well with lots of concepts, frameworks, and other useful resources to prepare myself for the transition from a manager to a world class leader.

Koh Chin Hwee Senior Manager, Manufacturing System Engineering | KLA

"This course is well-rounded and has a good coverage. I gained more awareness of myself and learned strategies and methods to interact with my team. The sessions on techno-nationalism, business models, etc. inspired me to read more on them. It was truly time well-spent!

Tan Ling Tze Deputy Director, Module Engineering | GlobalFoundries

"Beyond the faculty members and industry experts, I benefited so much from all the participants who have more than 600 years of collective experience and wealth of knowledge to offer. I came in as one man, and now we are going out as a ship full of knowledge, experience, resources and tools.

Ong Eng Hui Human Resources Director | Skyworks Global

"After graduating from SSLA, we are all Singapore Semiconductor Leadership Ambassadors, and we need to create and augment the impact within and beyond the semiconductor industry. Now that we have the benefit of a strong network and sharing, we can collectively bring the industry to the next level!

Samuel Goh Senior Director, Advanced Packaging Business Unit | Kulicke & Soffa

Follow SSIA for information on the next run, slated for May 2022!

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TRAIN, UPGRADE & RESKILL with SSIA

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As the semiconductor and electronics sector strengthen our local ecosystem and relook at ways to attract and retain talents, training, up or re-skilling and upgrading remain critical in staying relevant and future-proofing ourselves. Check out programmes in the pipeline, brought to you by SSIA and our learning partners.

INTRODUCTION TO VACUUM AND PLASMA TECHNOLOGY (1 DAY)

Ever wondered how vacuum and plasma systems work? Find out for yourself through this introductory course where you will learn about vacuum and plasma technology commonly applied in the semiconductor, electronic, and manufacturing industries. The knowledge and skills gained through this course can be applied to optical coating, IC chip fabrication, 5G, Internet of Things, and more!

By the end of the course, participants will be able to:
- provide explanation on vacuum and plasma, their benefits, and applications in the manufacturing industry
- understand the working principles of vacuum and plasma technology
- operate and calibrate vacuum systems, both hardware and software
- deposit copper thin film using MKS sputtering training system

REPUBLIC POLYTECHNIC

Who is this suitable for?
Engineering and technical personnel interested in understanding the vacuum and plasma systems.

MICROSCOPY AND THIN FILM CHARACTERIZATION FOR FAILURE ANALYSIS (1 DAY)

Ever wondered how imaging and characterisation tools work to provide insights on device failure? Participants of this introductory course will be equipped with fundamental knowledge on microscopy and thin film characterisation for failure analysis. There will also be hands-on opportunities and demonstrations during lesson to facilitate learning.

By the end of the course, participants will be able to:
- explain how microscopy and thin film characterisation are commonly used in the semiconductor, manufacturing, and coating industries
- understand the working principles and differences of various microscopes and thin film characterisation tools for an effective failure analysis
- demonstrate an understanding for
- a) various types of microscopes (such as optical and electron microscopes) and recognise the relationship among magnification, resolution, and depth of field for an effective imaging;
  b) various thin film characterisation tools (such as ellipsometer and four-point probe) to obtain important properties of thin film or coating

REPUBLIC POLYTECHNIC

Who is this suitable for?
Engineering or technical personnel who are interested to learn about microscopy and thin film characterisation tools for failure analysis.

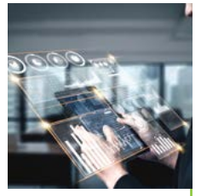
IOT FOR ELECTRONICS INDUSTRY (1 DAY)

This course introduces the fundamentals of Internet of Things (IoT), how data could be transferred from sensors (IoT) to the cloud or network and data management to drive efficiency, enhance and improve operational tasks and work processes for the semicon and electronics manufacturing industry. There would be hands-on session with setting up an IoT system and participants can apply the knowledge and skills to help improve their operational tasks and increase work productivity.

MODULE 1: Overview of a typical IoT application, and sensor data upload to IoT Cloud
MODULE 2: Graphical Data Management Tools and Applications in semicon and electronics manufacturing industries

SP Singapore Polytechnic

Who is this suitable for?
All engineering or technical personnel.



DATA ANALYTICS FOR ELECTRONICS INDUSTRY (1 DAY)

This course introduces the fundamentals of data analytics and various tools such as data wrangling, data visualisation and data analytics which is one of the enablers of industry 4.0 to improve operational efficiency and business processes. Participants will be equipped with knowledge of fundamentals of data analytics. Participants will also be able to apply these analysis tools to their data when designing and developing their future intelligent systems for the electronics & semiconductor industries. There would be hands-on session with the data analysis tools such as data wrangling, visualisations, regression models and prediction. Participants can apply the knowledge and skills to help improve their operational tasks and increase work productivity.

MODULE 1: Introduction to data analytics and data wrangling
MODULE 2: Data Visualization and Unsupervised Data Analytic Techniques
MODULE 3: Supervised Data Analytic Techniques

SP Singapore Polytechnic

Who is this suitable for?
All engineering or technical personnel.

INTRODUCTION TO INDUSTRIAL FAILURE MODE AND EFFECTS ANALYSIS (FMEA) (1 DAY)

This course equips participants with the knowledge of Failure Mode and Effects Analysis (FMEA), a step-by-step approach for identifying all possible failures in a design, a manufacturing process, an equipment, or even a service. Participants will also have the opportunity to work on real-life case studies where they will learn how to create a proper risk assessment, prioritise the different critical levels of risk, and trigger necessary mitigation actions.

By the end of the course, participants will be able to:
- Apply FMEA methodology for identifying risks in their business environment
- Systematically prioritise the risks by understanding their potential effects and assigned team for actions to mitigate them
- Properly document and constantly review them due to situation changes and new learning
- Demonstrate on how to do things right the first time to prevent impact on businesses and customers

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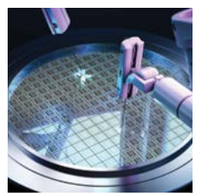
Who is this suitable for?
Technician, Associate Engineer/Assistant Engineer, Equipment Engineer, Maintenance Engineer.



WAFER FABRICATION IN SEMICONDUCTOR INDUSTRY (3 DAYS)

This course provides participants with the relevant knowledge and skills of the Wafer Fabrication process in the Semiconductor Manufacturing Industry. Participants will be introduced to facilities in the manufacturing process such as cleanrooms and handling of hazardous chemicals, various stages in Semiconductor Manufacturing from front end to back end; fabless, manufacturing flow and understanding of the fabrication processes for integrated circuits (IC) and statistical process control. There will be hands-on sessions working with process equipment and metrology tools in the cleanroom. The Industry 4.0 technologies and its benefits to the Semicon Industry will also be taught in the course.

By the end of the course, participants will be able to:
- Identify the various sectors of the Semiconductor Industry ecosystem
- Describe the facilities support needed for Wafer Fabrication
- Describe the procedures for operating in cleanroom and handling hazardous chemicals
- Describe the process flow for integrated circuit (IC) manufacturing
- Describe the various processes for Wafer Fabrication
- Operate the Wafer Fabrication processes
- Apply the principles of the use of statistical process control charts for process control
- Identify key Industry 4.0 technologies that accelerate digital transformation of Manufacturing/ Operations within the Semiconductor & Electronics Industry
- Determine the benefits brought about by Industry 4.0 technologies to address the challenges in the Semiconductor & Electronics industry.

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Who is this suitable for?
All engineering or technical personnel under the Electronics Skills framework; associate engineer for process, quality, product, integration, equipment and facility for the Semiconductor & Electronics Industry.

MACHINE VISION AND PATTERN RECOGNITION IN ADVANCED MANUFACTURING (4 DAYS)

This course will cover the application of machine vision and pattern recognition technologies in Advanced Manufacturing. Participants would be instilled with the essential knowledge of machine vision systems including their key components, functionality and the image processing technologies. On top of that, the course will also provide an overview of the techniques in image analysis and the derivation of useful hidden patterns in the images. These would include the selection, development and application of suitable pattern recognition techniques in solving a given problem.

Who is this suitable for?
Engineers, Technology Specialist.

ROBOTICS OPERATION AND ADAPTATION (3 DAYS)

This subject provides the participants with the knowledge and practical skills for them to plan and integrate robotics and automation systems for robot assisted production in advanced manufacturing. Concurrently, techniques for adaptation of industrial robots to meet the requirements of various industrial process control and automation in advanced manufacturing will also be demonstrated.

Who is this suitable for?
Associate Engineer / Technical Support / Machinist / Operator.

QUALITY MANAGEMENT SYSTEMS FOR SEMICONDUCTORS (2 DAYS)

The semiconductor industry has seen radical changes over the last few years with the advent of more advanced cars requiring new innovations (e.g. autonomous cars). Hence, there Is a need to build up the symbiotic relationships with the automotive industry, particularly in the areas of quality systems.
Is 99.99% quality sufficient? Let this course put things into context.

Automotive Core Tools are the building blocks of an effective quality management system, including:

- Advanced Product Quality Planning & Control Plan (APQP),
- Production Part Approval Process (PPAP),
- Failure Mode and Effects Analysis (FMEA),
- Statistical Process Control (SPC),
- Measurement System Analysis (MSA)

The course provides an overview of these Core Tools, particularly the latter 3 components, and introduce other quality tools that are utilized in the semiconductor industry like 8D, PSDM and PCDA.

Who is this suitable for?
This curriculum is geared towards a non-technical audience and gives a high-level overview of the quality systems being utilized in the industry providing a run through of various components that make up the QMS.

SEMICONDUCTOR PROCESSES (2 DAYS)

In today's day and age, semiconductors are found in all aspects of our lives. They control the computers we use to conduct business, the phones and mobile devices we use to communicate, the cars and planes that get us from place to place, the very machines that diagnose and treat illnesses, electronic gadgets we use to listen to music, watch movies, and play games, just to name a few. This course enables learners to gain knowledge of the journey of semiconductor manufacturing from sand to a finished chip. You will also gain an understanding of the local semiconductor ecosystem and how all of us come together to support the sector.

WHY: we need IC chips (more than just computers)
HOW: chips are made (From Sand to a functional chip)
WHAT: are possible areas of involvement (overall eco system)

Who is this suitable for?
Non-technical audience who wants to know a high-level overview of semiconductor devices and how they are fabricated.

STORY TELLING SKILLS TO CAPTURE HEARTS AND MINDS (1 DAY)

Imagine our world without smartphones today. Steve Jobs was technically brilliant and yet, his real genius and what made him such a game changer was his ability to articulate his ideas in a way that captivated the hearts and minds of his audience. Similarly, have you ever sat in on graphs and data-heavy technical presentations that felt like "Death by PowerPoint?" How inspired did you feel? Imagine being able to capture the attention of your audience and deliver messages that not only inform, but empower and inspire them to action and in the process, elevate your profile as a Leader and Influencer. This session will give you insights into why story-telling is such a powerful tool for conveying ideas and suggestions that stick, and how you can incorporate it into your business and technical presentations to make them memorable.

Who is this suitable for?
Everyone looking at improving persuasion and presentation skills.

Check out SSIA website or scan the QR code for full list of events, training and courses. Or contact Cindy Chong at *cindy@ssia.org.sg.*

SSIA Welcomes New Members

Delighteck

Hewlett Packard Enterprise

Royale International
MAKING IT HAPPEN SINCE 1993

SpareParts 3D

ULTRA WIRELESS Omniconnections

Taking Care of the Bottomline

Rising costs, material waste, human resource underutilization, workforce shortage and labor dislocation. Words that constantly challenging business decision making since time immemorial. On top of that, one word continues to plague – no pun intended – our collective experience: COVID, putting an ever-tangible strain on organizational morale and individual psyche.

It is easy to be bogged down by daily crisis management and lose sight of what is important over the horizon. Yet, there is a silver lining. As we near the end of the second year the pandemic turned our world upside down, and as businesses grow increasingly determined to move forward, there are many areas that can yield significant improvements, with very little disruption to daily production. Strong demand from the semiconductor industry accounts for over half the requests for transformative solutions embedded with AI.

AUGMENTED WORKFORCE

As we increasingly find ourselves working with or alongside machines that use smart and cognitive functionality to boost our own capabilities and skills, the automating of repetitive human activity using robots becomes a clear aspiration. One good example is in patrolling. Be it for security, site safety, or systems health inspection, scheduled patrolling of a large area is a common requirement and critical to many organizational operations.

By mounting various sensor arrays on autonomous vehicles – be it AGV, AMR, or drone – combined with state-of-the-art smart detection algorithm, we can detect any type of scenarios: smoke, fire, or flooding, systems health, changes in ambient or equipment temperatures, oil leak or chemical spills. Detrimental human behavior like falling or fighting can also be detected and alert the relevant authorities in real time.

***Figure 1** - AGV mounted with optical and thermal cameras to detect water leakage*

Another persistently strong demand is the application of AR glasses with clear ROI. Technology has greatly advanced in recent years, creating a growing list of AR use-cases, such as remote collaboration with interactive UI, SOP, AI smart judgement and

***Figure 2** - Improve efficiency by displaying tool SOP information using AR glasses*

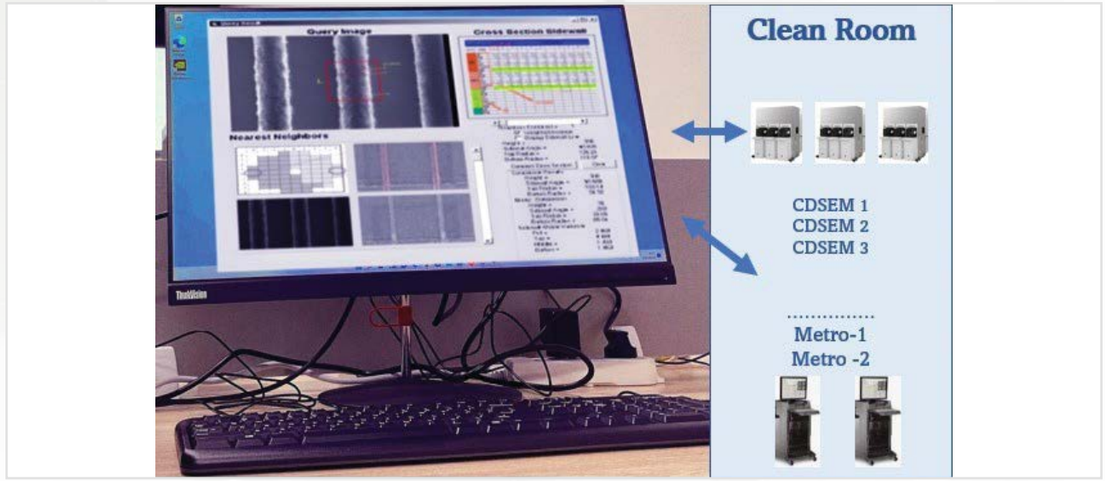

***Figure 3** - Manual operation of tool like CDSEM can be automated easily*

detection of defects, and 3D model display. By utilizing smart glasses, companies have increased the capabilities and competencies of their workforce, while significantly reduced manhours required for each job.

AI EQUIPMENT ASSIST

Many equipment requires constant human intervention to operate smoothly, a process commonly known as manual assist. Such interventions are always scenario-based with a fixed set of responses.

An exciting way to automate such operations is through intelligent remote tool control without the need to install anything on the tool. Combining highly advanced AI that emulates human response and decision making, tool-specific SOP, and our proprietary method that makes the system completely non-intrusive, we have removed the need for manual assistance for many labor-intensive and repetitive tool operations.

AUTONOMOUS MATERIAL TRANSFER

Everyday production requires operators to be constantly moving materials and parts from one location to another – between tools, racks, stockers, even between fabs. This can be extremely inefficient and time consuming, especially when operators must constantly search for their locations first.

Add to that the hazards of having to move wafers manually – damage caused by shaking or dropping, misplacement and loss – it is no wonder the demand for autonomous material transfer is so strong today.

Robots not only eliminate the possibility of human errors, they can also be modified to include enhancements such as air quality and temperature control, even microbes eradication. By integrating the use of smart racks, smart stockers, with AGVs, we can dramatically reduce time, error, and manpower by introducing real-time material tracing and scheduled parts delivery, creating a well-organized production line with efficient use of floor space.

FOCUSING ON WHAT MATTERS

As the country begins to live with COVID as endemic to the population, businesses have also begun to operate with this different set of realities. As such, businesses must go back to first principles – reducing costs and wastes. The good news is, with the right use of artificial intelligence and a focus on low non-disruptive applications, there are still many "low hanging fruits" to be explored.

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FOR CUSTOMERS, EMPLOYEES, INVESTORS,
PARTNERS AND SOCIETY.

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VLSIresearch 10 BEST SUPPLIERS Customer Satisfaction 2021

VLSIresearch THE BEST SUPPLIERS Customer Satisfaction 2021

VLSIresearch RANKED 1ST SUPPLIERS Customer Satisfaction 2021

2018 THOMSON REUTERS TOP 100 GLOBAL TECH LEADER

GRAND AWARD

SINGAPORE QUALITY AWARD 2019 WINNER

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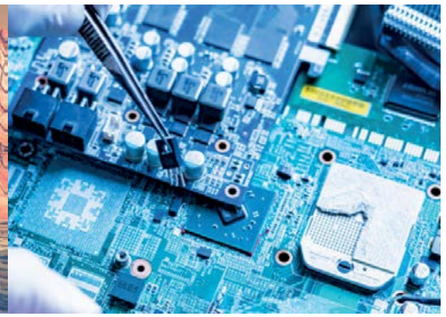
Royale International
MAKING IT HAPPEN SINCE 1993

Enhancing the global semiconductor supply chain

Royale International has been supporting the global semiconductor industry by providing tailored, time critical solutions, to ensure that products reach customers on-time, anywhere in the world.

Since COVID-19 appeared, there has been a huge upsurge in demand for semiconductors from various industries. The automotive industry has bounced back from an initial downturn in production and is now faced with having to ensure the prompt deliveries of semiconductors to keep production lines operating.

Located in Tampines, Royale International is a reputed, high-quality driven global logistics provider to many Fortune 500 corporations. With over 28 years of experience, we offer the fastest and safest Time Critical services. Whether you send your shipments by Handcarry, Next Flight Out or Chartered Aircraft, we make it happen, 24 hours a day, everyday of the year.



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24hr Email : NFO@royaleinternational.com

Please have a look at our Time Critical Service :
https://www.royaleinternational.com/services/time-critical-services/

How Industry 4.0 is Changing our Way of Developing Machines

CHALLENGES

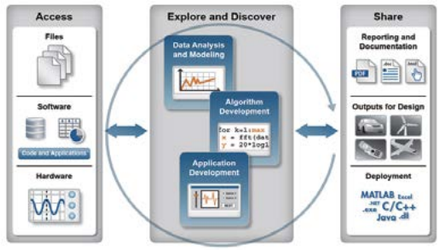
A major driver of Industry 4.0 is the growing amount of data due to

- **More sensors** on modern production machines collecting measured data during operation
- **Higher storage capacities** for storing data (e.g. from sensors or cameras)
- **Increased computational power** available for applying statistical methods (e.g. machine learning, deep learning) on big data

Machine builders are developing methods for gaining insights from measured data for instance for **predictive maintenance** applications.

SOLUTIONS

PREDICTIVE MAINTENANCE BASED ON DATA ANALYTICS



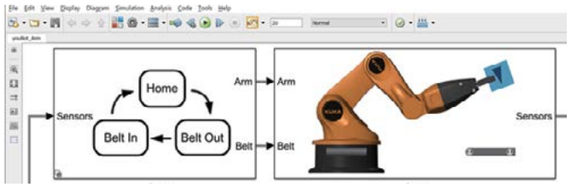
- **Import data** (e.g. via OPC UA, from databases or cloud storage)
- **Design algorithm** (e.g. signal processing, machine learning)
- **Deploy algorithm** (in real-time or non-real-time systems)

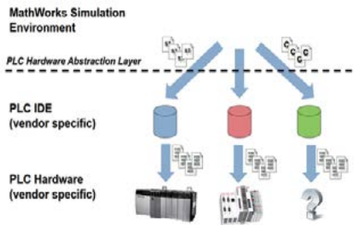
Machine learning algorithms designed for big data (out of memory data) and ***parallel computing*** are used to design Predictive Maintenance functionality for production machines.

VIRTUAL COMMISSIONING BASED ON MODEL-BASED DESIGN

- **Modeling** (functionality, plant, and environment)
- **Simulation & test** (comprehensive test scenarios and parameter optimization)
- **Code generation** (for various hardware platforms)
- **Verification** (throughout the entire design process)

Automatic code generation for different platforms and languages (C/C++, IEC 61131-3 and HDL) as hardware abstraction layer and for reduction of coding errors.





CONCLUSIONS

Growing software complexity and increasing amounts of data encourage machine builders to adopt new ways of developing and to explore new business models

Predictive Maintenance based on Data Analytics allows engineers to make use of their production and machine data and to offer **service-based business models**

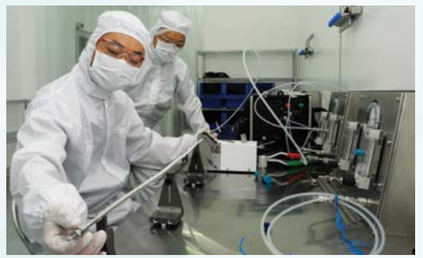
Virtual Commissioning based on Model-Based Design helps engineers to embrace the growing complexity of their mechatronic systems and to **reduce time and efforts for commissioning** their machines in the field

Talent Development as a Significant Enabler During the Pandemic

Swagelok Singapore, an authorized sales and service center for Swagelok Company, focuses on the competence development of our employees to provide fluid system products, assemblies and services to the oil and gas, chemical and petrochemical, transportation and semiconductor industries. In this time of pandemic, we are heavily relying on training to help associates adapt to a changing business environment, build resilience and drive value.

Swagelok's founder, Fred Lennon, used to say that we were in the business of people. We pride ourselves as a global private enterprise with valued associates with long tenures and stay with us through crisis and prosperity. Lifelong learning and development are ingredients of career longevity.

During the pandemic, we doubled up in investing in learning and development of our colleagues. We work with industry groups such as Singapore Semiconductor Industry Association (SSIA) to help develop our people to be abreast with the industry. We attended numerous courses facilitated by SSIA; Two highlights are Singapore Semiconductor Leadership Accelerator (SSLA) to local leaders to bring Singapore's semiconductor industry forward. The other is Introduction to Semiconductor Wafer Fabrication course, conducted by Singapore Polytechnic (SP) where we get to experience their nanotechnology laboratory. We appreciate getting this level of hands-on experience in an introductory course.



Every associate has a personal development plan that is very much a work in progress. We have identified competencies for each role, including leadership competencies for uncertain times such as managing complexity or ambiguity, influencing others, enabling change. These are examples of the competencies we believe will help close talent gaps while keeping employees connected to jobs. To develop competence, we identify training experiences outside the company, or on-the-job, that are fit-for-purpose.

Our training center remained safely open to our customers. We have continued to train people of skilled labor to safely build and support fluid systems for Singapore's process and manufacturing industries including semiconductor. We do our part to support the training of labor when there is a crunch.

Learning and development is a cornerstone of Swagelok Singapore's culture. For local SMEs to thrive in an uncertain and dynamic business environment, we need to ensure that every associate is being developed so we have a strong core.

CONTRIBUTED BY

ZHUOHAN CAI
CEO
Swagelok Singapore

In these past 18 months the semiconductor sector has been put to the test by unprecedented supply constraints and logistical disruption. This has been across the supply chain spectrum from material shortage to material cost increase to significant increase in new equipment cycle time, resulting in historic component shortage. Some industries such as automotive have suffered and continues to suffer the worst. The COVID-19 pandemic has meant that long established methods of working are no longer applicable and need to be adapted accordingly. We are constantly looking at new and innovative ways to navigate through this crisis and ensuring that we can service all our customers' demands.

The semiconductor industry has been under extreme pressure since the onset of COVID-19, due to the higher demands that we continue to see for semiconductor products. UTAC has been running at full capacity and managed to achieve an impressive 22% growth during 2020. In addition, for the first time in its history, it became a one-billion-dollar revenue company - reaching that milestone in Q3 this year.

In the Eye of the COVID-19 Storm

By observing strict guidelines for how our staff interact safely with one another, we have been able to work in a protected environment. The implementation of a safe management system through the assignment of safety officers has proven itself to be highly effective. It has provided the necessary structure for continued safe operation across the entire business - taking care of the workplace, employees located there and attending to the needs of those who become unwell. To enhance safety, new technology and processes have been installed at all UTAC facilities. These include thermal temperature scanning terminals (TTSTs), along with a regular antigen rapid test (ART) program. Safe distancing measures are implemented throughout each site, with check-in and check-out systems installed at all access points.

Some measures have included, where possible, letting a sizeable proportion of employees conduct their work from home. We have supplied them with the necessary IT support to enable this to be done, so that there has been no unwanted impact on the smooth running of the business. In most cases, meetings have been carried out via online conference platforms.

Something that the recent pandemic has reinforced is the importance of how the wellbeing of our employees contributes to the success of our company. At UTAC we are taking this responsibility very seriously - making certain that our staff are safe and healthy. UTAC continues to invest in its employees, by creating a business conducive and safe environment that is very appealing to work in. We also continue to draw on the local Singapore talent pool and nurture our staff to fulfil their potential.

We have implemented a complete range of measures that rigorously follow official Covid-19 guidelines. By doing so, we have been able to maintain continued operations at our sites across Asia - in Singapore, Malaysia, Indonesia, Thailand and China. While some of our facilities had to overcome challenges from the pandemic, our stringent mitigation plan has allowed us to recover within a short period of time. This has meant that ongoing business continuity has been upheld, and we are now reaping the rewards of this.

Although it may be too early to see the full impact of the COVID-19 crisis on long-term trends, projections from leading market analysts, such as Gartner, WSTS and IC Insights, all anticipate double digit year-on-year (YoY) growth to be experienced in both 2021 and 2022. The momentum surge in 5G mobile connectivity, AI, virtual reality (VR), data and cloud computing servers, plus advances in industrial and automotive technologies all seem certain to continue.

To take advantage of these trends, there will be a need to continue increasing the degrees of automation incorporated into our test and assembly operations. This will have to be combined with a highly trained and upskilled local workforce, plus continued access to a robust supply chain. UTAC has invested in state-of-the-art Industry 4.0 IoT devices and robotic systems, as well as leveraging the latest artificial intelligence (AI) technology, in order to increase the levels of automation at our facilities. This has resulted in heightened workflow efficiencies and greater throughput.

Though things are starting to improve, it would be unwise for our industry to assume that we are now fully through the storm. There may yet be further problems ahead. All the indicators suggest

that 2022 should be a good year for the semiconductor industry, with demand driving strong revenue growth. It is therefore of paramount importance that we remain vigilant, and mitigate any remaining threat posed by Covid-19.

Despite all the challenges that the Covid-19 pandemic has presented, and the repercussions that we are facing in its aftermath, UTAC is in a very strong position moving forward. Thanks to the timely and effective decision making and well-judged investments, we have shown our resilience to difficult situations. At the same time, we are vigilant and looking at all options to ensure our future success as a company.

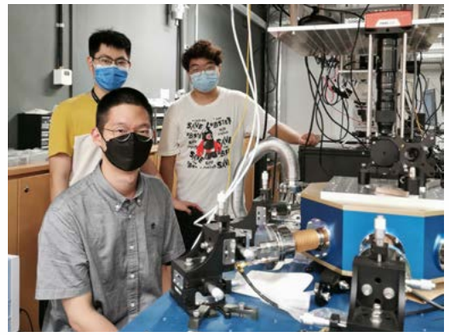
CONTRIBUTED BY

ASIF CHOWDHURY
Senior Vice President, Japan Business, Marketing & Corporate Business Development, **UTAC**

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

NTU prepares talents for industry

The School of Physical and Mathematical Sciences (SPMS) at Nanyang Technological University, Singapore (NTU Singapore) offers undergraduate and graduate degree programmes in the disciplines of physics, chemistry, and mathematics. Originally established in 2005, it now produces around 400 graduates with Bachelor of Science degrees, and around 80 PhD holders, every year.



Its undergraduate degree programmes in Physics and Applied Physics, which have about 80 graduates each year, are structured to provide a broad knowledge of physics and its modern applications. Subjects offered to students include the Physics of Semiconductor and Spintronics Devices, Quantum Electronics, Photonics, and Fabrication of Micro- and Nanoelectronic Devices.

"We make great efforts to train our students not only in the content of physical laws, but also how those laws are applied in the real world," says Associate Professor Elbert Chia, head of the Division of Physics and Applied Physics at SPMS. "For example, we have a rigorous three-year physics laboratory sequence, where the third year labs involve semester-long stints in our professors' physics research laboratories. There, our students are exposed to the actual practice of nanofabrication, device characterisation, and other procedures."

He adds that all Physics and Applied Physics undergraduates are required to undertake either a two semester final year research project under the supervision of a faculty member, or a 5½ month internship in an established company or organisation. Semiconductor companies that have hosted SPMS interns include Micron, GlobalFoundries, Siltronic, and Applied Materials.

Many faculty members in the Division of Physics and Applied Physics are renowned experts in research areas relevant to the semiconductor and advanced manufacturing industry. For example, Professor Lew Wen Siang and Associate Professor S.N. Piramanayagam are leading experts on emerging non-volatile memory materials and spintronics devices, and their research teams often work closely with local industry partners; Professor Fan Hongjin is a leading scientist in battery and supercapacitor technologies; and Professor Christos Panagopoulos, Assistant Professors Bent Weber and Wang Xiao perform cutting-edge research on semiconductor materials for microelectronics; Professors Sum Tze Chien and Sun Handong, Associate Professors Elbert Chia, Gao Weibo, Cesare Soci and Ranjan Singh develop novel semiconductor nanostructures and characterisation technology for advanced optoelectronic devices and photonic chips.

"All these professors do a great job of mentoring undergraduate and PhD students, many of whom go on to fulfilling careers in Singapore's semiconductor industry," says Professor Chia.

The vibrant research and education environment at SPMS is increasingly recognised internationally. In the most recent QS World University Rankings 2021 for Physics, NTU placed at number 20 globally, ahead of many more established institutions.

Launching New Programmes

To further strengthen the connection between its physics curriculum and industry, SPMS is launching two new programmes. The new Bachelor of Science (BSc) in Applied Physics with Second Major in Microelectronics Engineering, which is run in partnership with NTU's School of Electrical and Electronic Engineering, aims to produce students who are trained not only in existing microelectronics techniques, but have the flexibility and creativity to take on the industrial challenges of the future. The new Master of Science (MSc) in Precision Scientific Instrumentation programme is a coursework-based postgraduate programme covering the principles and operation of advanced technical instrumentation used in the physical sciences and high-tech manufacturing.

For more information, visit the SPMS website at www.ntu.edu.sg/spms

Transcending the Pandemic and Endemic Through Digital Transformation

While the semiconductor industry has encountered numerous challenges in the past, there is now an emphasis on a resilient, adaptive and diversified supply chain.

How did Microsoft's customers ride through the pandemic and now endemic period? Here are a few stories.

TSMC & SAMSUNG FOUNDRY ACCELERATE SILICON DESIGN ON THE CLOUD

TSMC and Samsung Foundry are world leading semiconductor foundry companies. Together, they make up ~70% of the global semiconductor foundry market.[1]

About 2 years ago, TSMC collaborated with Microsoft to create a joint innovation lab to accelerate silicon design. [2, 3]

Microsoft worked with many industry partners to optimize EDA workloads and performance on Microsoft Azure. Our industry partners include Synopsys, Cadence, Mentor Graphics, Ansys, Siemens. NetApp is native on Microsoft Azure, enabling optimized file services on the Cloud and on hybrid infrastructure with low latency. [4]

The benefits of working on Microsoft Azure compared to on-prem infrastructure is that it provides flexibility to scale high performance compute resources with phases of projects and production deadlines, together with remote collaboration. Microsoft Azure's elasticity supported TSMC in adapting through the peaks and troughs in the past years. [5]

TSMC manufactured over 11,000 different products using 281 distinct technologies for 510 different customers last year despite the pandemic. Its market share expanded from ~48% in 2019 Q1 to ~53% in 2021 Q2.[6]

Samsung Foundry also runs its chip physical verification on Microsoft Azure.[7]

The digital foundation set up by these two companies through collaborating with Microsoft and adoption of Cloud technologies enable them to respond agilely and securely during the pandemic and pivot with speed to market now.

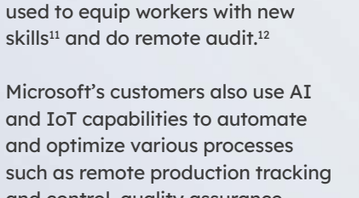
INTEL AND GLOBALFOUNDRIES USE AI AND AUGMENTED REALITY FOR AGILE MANUFACTURING

Social distancing and travel restrictions present a challenge to manufacturers.

During the COVID period, some of Intel's equipment required maintenance and this was of high impact to production. However, the engineer for the job was not available on-site. The problem was resolved with the use of augmented reality glasses, which allow off-site experts to guide on-site technicians step by step to service the equipment.[8]

Technicians heading into semiconductor fab

Here's a Youtube video shared by Intel, where a user uses Microsoft Hololens for routine maintenance at the Intel manufacturing fab.



shorturl.at/czW27

GlobalFoundries also uses Microsoft HoloLens to do equipment maintenance. Together with Microsoft Teams, GlobalFoundries is able to collaborate and exchange data securely across geographies and teams. [9]

ASML developed an augmented reality solution using Microsoft 3D HoloLens headsets that allowed subject matter experts to enter customers' cleanroom virtually to complete service actions. ASML stated that "its new ability using augmented reality to provide remote support became a game changer" in its 2020 annual report.[10]

Microsoft HoloLens can also be used to equip workers with new skills[11] and do remote audit.[12]

Microsoft's customers also use AI and IoT capabilities to automate and optimize various processes such as remote production tracking and control, quality assurance, predictive maintenance.

Training with Microsoft HoloLens

Predictive maintenance

OPTIMIZING THE SUPPLY CHAIN

Demand changes, supplier predictability, border controls and transport availability, have plagued many companies.

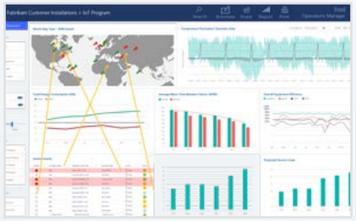
Microsoft partnered with leading supply chain solution providers such as BlueYonder and o9 to help customers to have end-to-end visibility, predict, track, respond agilely to changes in the supply chain. We also build solutions for customers using AI/ML, IoT, Blockchain and other services.

In 2021, Gartner awarded Microsoft with Supply Chain Breakthrough of the Year Award.[13]

DIGITAL TRANSFORMATION WITH MICROSOFT

As a manufacturer that ships from 33 manufacturing facilities and data centres to over 30,000 locations in 107 countries, Microsoft wants to work together with you to deliver impact on our future together.
In a digitally-inclusive Singapore that continues to be a global trading hub, manufacturers can lead with impact by delivering on resilience and diversification in their supply chains building more agile factories to bring new innovation to the world.

To be a manufacturing leader in a resilient, digitally inclusive global economy, companies will need a shift in mindset, partner for success and build digital transformation capabilities.



Factory dashboard

Microsoft is not only a technology partner, but a digital transformation leader in manufacturing. We help customers with agile manufacturing, resilient supply chain, product innovation, workforce enablement, sustainability.

Come speak to us about your priorities. We can be reached via SSIA.

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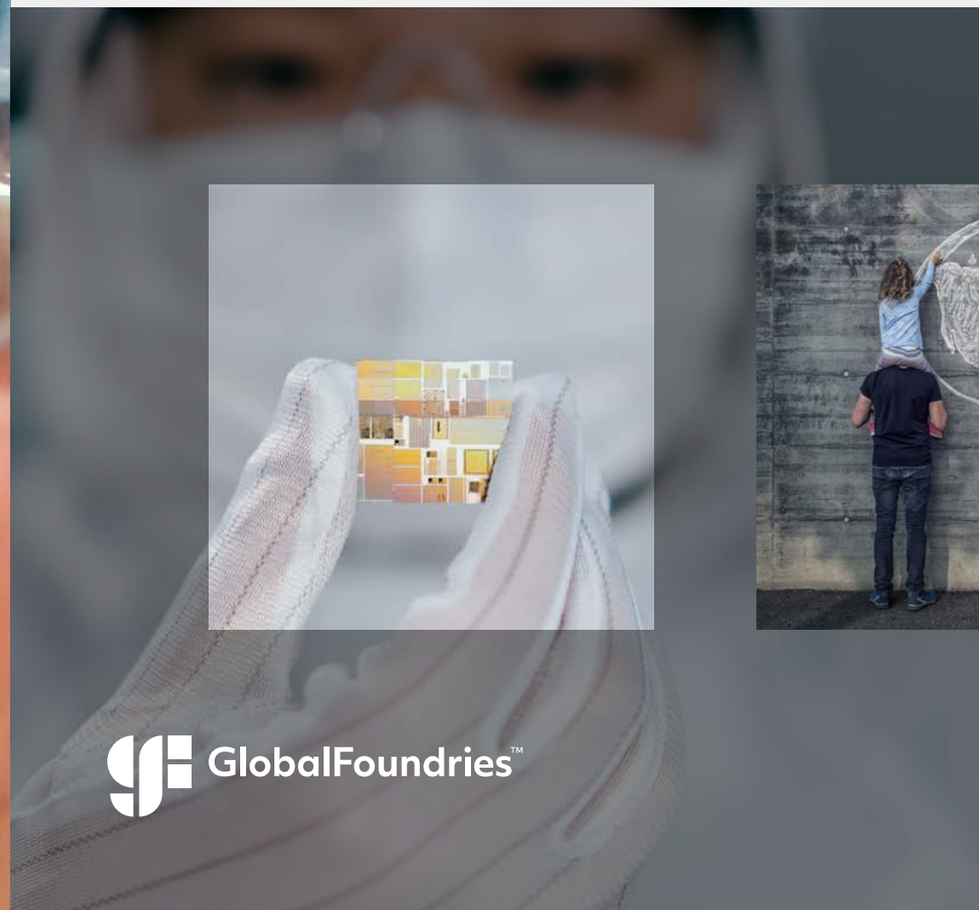

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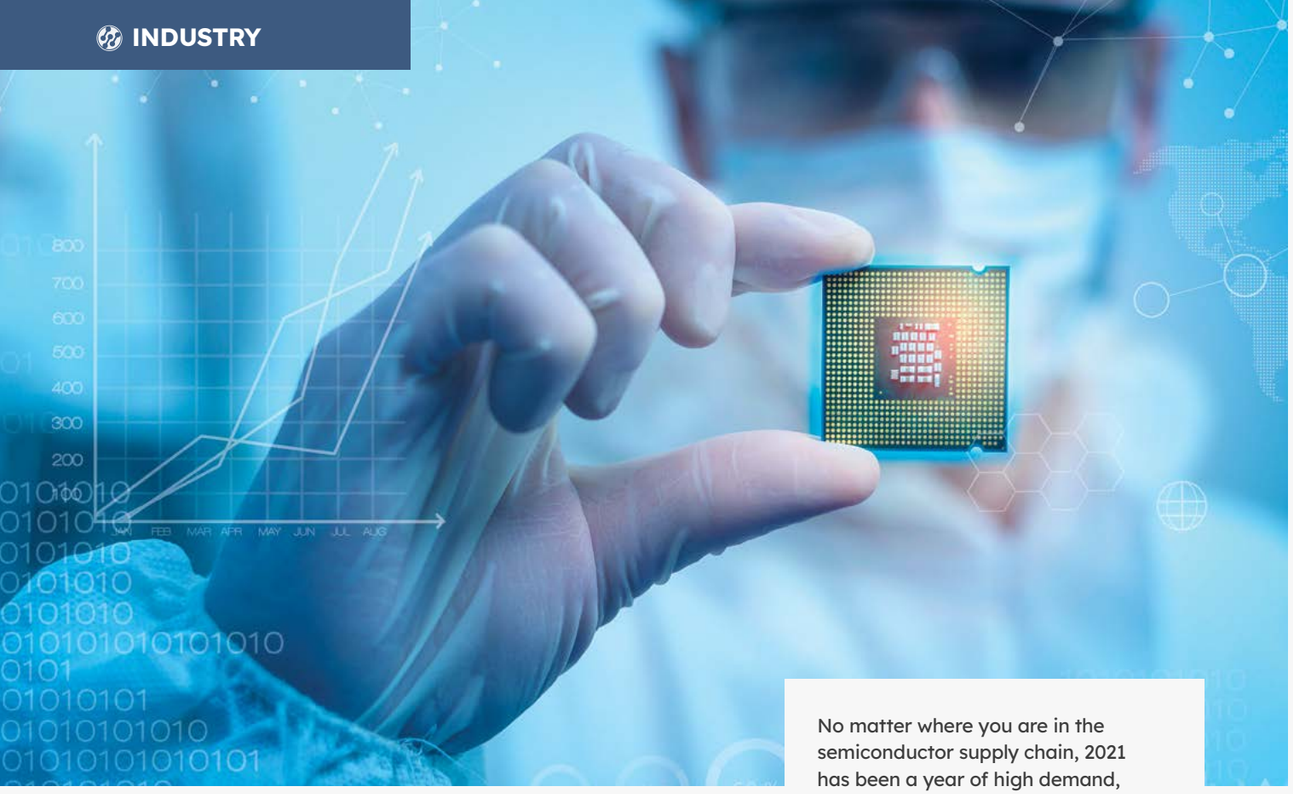

SEMICONDUCTOR TRADEWINDS

September / October 2021

As we head towards the end of 2021, COVID-19 is still with us and the number of cases around the world is still increasing. With vaccination rates ramping up, many countries around the world are updating their policies to co-exist with the virus, and are accepting that the only way forward is to treat the virus as an endemic and put in place measures to live with it. With this mindset update, countries are starting to open up both internally and starting international travel again.

In the semiconductor industry, COVID-19 triggered a boom in demand for the sector which started last year and has continued into 2021. This has led to global chip shortages throughout all semiconductor segments from automotive to consumer and industrial electronics.

No matter where you are in the semiconductor supply chain, 2021 has been a year of high demand, causing backlogs as companies have had a challenging year to make sure they have the materials and enough capacity and manpower to build their products. Throughout the semiconductor supply chain, be it for raw materials like leadframes, resist or other materials or foundry and assembly/test capacity, companies have been under constant pressure to find ways of ensuring supply. This has led to changes in supply chain strategies like 'take or pay' deals, signing long term supply deals or investing in capacity, which in the past were more the exception, but are now becoming the norm to ensure supply. Supply chain operation groups have to be flexible, agile and proactive to operate successfully in the current market.

As raw materials, manpower and logistics costs have risen, this has caused prices to increase. These price increases have flowed down the supply chain from material suppliers to foundries and OSATs. Now chip companies are passing these price increases onto their end customers and certainly we will end up seeing consumer electronic goods prices increasing next year.

RECORD EARNINGS

With booming demand in 2021 driven by 5G, mobile phones, notebooks, servers, automotive, smart home, gaming, wearables, and wifi access points, the semiconductor industry has been setting new records each quarter. Foundry leader TSMC's revenue for the first three quarters was US$40.9billion - 17.5% above the same period in 2020. Whilst backend OSAT market leader ASE reported year-to-date revenue of US$8.7billion for its ATM group, up 25% compared to the same period a year ago. The equipment market is similarly doing well with Q2 billings up 48% year-on-year to US$24.9billion according to SEMI.

FAB EXPANSION

To cope with the record demand and high utilisation rates, foundries and OSATs have been adding capacity but this has in turn led to long lead times for new equipment as equipment manufacturers struggle to keep up with the demand and also acquire necessary parts.

In addition, 2021 has seen a large number of new Fabs being announced, the highest-profile ones being the new TSMC 5nm Fab and also Intel's two new Fabs, all being built in Arizona, USA. In the last two months, two additional new Fabs have been confirmed - Chinese foundry SMIC has announced it will build a new 28nm Fab costing US$8.9billion in Lin-Gang Pilot Free Trade Zone, near Shanghai; whilst TSMC has formally announced it will build a new speciality Fab in Japan with operations starting 2024.

Samsung is still making its final decision for the location of its new US$17billion Fab in the US, and both Intel and TSMC are evaluating whether to build new Fabs in Europe.

Micron has announced it will invest more than US$150billion over the next decade in leading edge memory manufacturing and research and development.

It's not all good news though, as Compound semiconductor wafer manufacturer IQE has announced it will close its Singapore facility by mid-2022, and transfer processes and assets to its Taiwan and North Carolina sites as part of company strategy to consolidate operations.

MERGERS AND ACQUISITIONS

2021 started off with a flurry of merger and acquisitions with a total of US$15.8billion spent in the first quarter, but since then the market has cooled off and only another US$6.2billion in additional merger deals has been announced in the following five months to take the August year-to-date total at US$22billion, according to IC Insights. This slowdown is partly due to issues of getting acquisitions approved in the current political climate. Three of the four mega deals (Nvidia/ARM, AMD/Xilinx and SK Hynix/Intel's NAND business) - announced in the last four months of 2020 and worth US$84billion - are still pending regulatory approval, with the Nvidia acquisition of ARM especially facing increasing scrutiny, not just from China but also from regulators in the UK and Europe. All are reviewing if the deal damages competition and weakens rivals.

It is 13 years since foundry GlobalFoundries was established as a private company, when the investment arm of Abu Dhabi, Mubadala, acquired AMD's Dresden Fab and subsequently acquired Chartered Semiconductor Fabs. In October, Mubadala filed to IPO GlobalFoundries on the Nasdaq, with a valuation of around US$25billion. Mubadala will still hold a 89.4% stake in GlobalFoundries after the sale.

It looks like 2021 will be a very good year for the semiconductor industry with demand outstripping supply and the indications are that this will continue well into 2022. Companies will have to be resourceful, flexible and proactive to do well in such a climate, but it's a nice problem to have.

ABOUT THE AUTHOR

MARK DYSON
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OktoberTech Asia Pacific 2021

Removing boundaries, Building new connections

In partnership with CapitaLand Investment and Hyundai Motor Group, Infineon Technologies has launched their initiative to empower start-ups in Asia to develop innovations in sustainability, future mobility, smart cities and factory.

On 27 October 2021, Infineon Technologies successfully held its flagship innovation event, OktoberTech Asia Pacific 2021.

The theme "Innovating for sustainability" was chosen as a call to action for businesses to collaborate and combine expertise to create new synergies in addressing the challenges of sustainability.

True to the theme, this year's event saw an impressive line-up of distinguished panellists who shared their thoughts on sustainable mobility for the future, innovation eco-systems that solve problems by climate change and the crucial role business play in saving the planet.

For the first time, a virtual platform was also created where online attendees can explore the virtual world and take part in 8 live Q&A sessions. They could also experience 22 live virtual demonstrations, showcasing Infineon innovations in the theme of future energy system, sustainable cities and sustainable mobility.

Speaking at the event, Dr Helmut Gassel, CMO of Infineon Technologies highlighted how climate change, aging world population and scarcity of resources are the reason we need to drive innovation for sustainability so that we can make more from less and work on better solutions for the future.

He pointed out how co-innovation is important for all contributors to gain early exposure and to increase the success rate of new and potentially disruptive applications.

"Beyond being innovative within a company, co-innovation with the right partners is becoming more critical for success." said Dr Gassel in his opening address.

During the event, Infineon also announced two separate collaborations with Asian industry leaders, CapitaLand Investment and Hyundai Motor Group. With these collaborations, Infineon hopes to empower start-ups in Asia to develop innovations in sustainability, future mobility, smart cities and factory.

Mr Chua Chee Seong, Managing Director of Infineon Technologies Asia Pacific, gave an example of how this new collaboration will work, citing Bitsensing Inc, a Korean startup using Infineon sensors to make workplace management more intelligent and energy efficient. "Because only in a vibrant ecosystem can we nurture innovations together" said Mr Chua in his welcoming speech.

Bitsensing demo showcase

Now in its third edition, this year's hybrid OktoberTech welcomed over 900 virtual attendees from across 32 countries and 50 distinguished on-site attendees at its regional headquarter.

CONTRIBUTED BY

Infineon

TWINSCAN: 20 years of lithography innovation

In mid-2020, at the height of the COVID-19 pandemic, ASML shipped its first-ever dry NXT system. It was the first lithography system of any kind capable of processing more than 300 wafers per hour. But it's the history of TWINSCAN – the platform on which these systems were built – that is most fascinating.

ASML came of age as a lithography supplier with the PAS 5500 platform in the early 1990s. Around the same time, precision mechanics and interferometer expert Bert van der Pasch was working on the interferometer systems and wafer handler of the PAS platform. He had started his career at Philips, where his technological knowledge had been fostered.

Bert and the team's continual innovation kept the PAS 5500 ahead of the game, delivering what was at that time industry-leading productivity and resolution. But with the new millennium approaching, ASML realized it needed a revolutionary innovative approach to give its customers the next leap forward in productivity.

Like many breakthroughs, the solution seems simple in hindsight. Wafers must be precisely scanned before the pattern is exposed onto them. Both the scanning and the exposure take time, and previous gains had come from reducing the time for each process. To save even more time, why not scan one wafer while the one before it was still being exposed?

A new stage for lithography

"It was limited new technology, but what was a revolution about the TWINSCAN was the swapping of the stages," says Bert. "Lots of things were normal developments, but that chuck swap was different. We just had to make it work."

And thus, the TWINSCAN platform was born. TWINSCAN was the first – and is still the only – lithography system platform with two complete wafer table modules (or wafer stages). Wafers are loaded onto the wafer table modules alternately. When the wafer on table one is being exposed, another wafer is loaded on table two and then aligned and mapped. The tables then swap position so that the wafer on table two is exposed while the wafer on table one is unloaded. A new wafer is then loaded, aligned and mapped.

Bert van der Pasch, ASML Fellow and expert in position measurement systems for lithography scanners.

The first TWINSCAN system with this revolutionary dual-stage technology was shipped in 2001. The TWINSCAN AT:750T was a KrF lithography system, using light with a wavelength of 248 nm and targeted production at the 130 nm node. It was soon joined by an i-line system, the TWINSCAN AT:400T, and an ArF system, the TWINSCAN AT:1100, to span the range of lithography technologies then in use and enable all chip layers to be exposed on the new platform.

A rendering from the early 2000s of one of the first TWINSCAN systems, the AT:400.

Just add water

Later that same year, ASML introduced its first immersion lithography system: the TWINSCAN AT:1150i. Immersion lithography uses a pool of ultra-pure water between the lens and the wafer to increase the lens's numerical aperture (NA) – a measure of its ability to collect and focus light. With conventional 'dry' lithography, NA can only reach about 0.93. Immersion made it possible to create systems with an NA up to 1.35.

"Immersion was a revolution," says Bert. "This was a thing that you can say in the beginning – will this work?"

Higher NA allowed systems to deliver better resolution and depth of focus with the same wavelength of light and resolution, making it easier to manufacture layers with smaller features. This, in turn, paved the way for modern technologies such as touchscreen and Bluetooth, as well as enabled the rise of mobile laptops over PCs.

Seeing double with NXT

Over the course of the 2000s, chipmakers started to reach the resolution limit of traditional lithography using immersion ArF systems. Yet the constant drive for new, more advanced chips meant they needed to be able to print even smaller features. ASML had started to explore a new extreme ultraviolet (EUV) light source – one that would enable patterning at unimaginably tiny scales. But progress was slow and challenging, and the demand from chipmakers to shrink was not going away.

So, in the meantime, the industry began exploring an approach known as 'double patterning' (also called 'multiple patterning'), which involves splitting one complex layer pattern into two (or more) simpler patterns that can be exposed separately to print the original pattern.

As its name suggests, double patterning requires twice as many exposure steps and the ability to align two patterns extremely closely. To make it feasible and cost-effective, lithography systems had to become significantly faster and more precise. The result was the next major TWINSCAN evolution: the NXT platform, which featured completely reengineered and significantly lighter wafer stages.

The first NXT system, the TWINSCAN NXT:1950i, was launched in 2008 and delivered a 30% increase in productivity to over 200 wafers per hour, while also improving overlay to 2.5 nanometers (nm). Today's leading NXT immersion systems can process 295 wafers per hour with overlay down to 1 nm.

A team of ASML engineers celebrate the release of the TWINSCAN XT:1700i – the first volume production system for immersion.

Becoming extreme

Historically, the big leaps forward in the resolution of lithography systems have come from changing the wavelength of light used. Immersion and multiple patterning bucked this trend for a while, allowing chipmakers to maintain their roadmaps for creating ever more advanced chips with smaller features and while transitioning to many new technology nodes using familiar ArF lithography.

After 20 years of intense research and development, ASML succeeded in developing a new light source for a lithography system using EUV light with a wavelength of 13.5 nm. Light at this wavelength is absorbed by almost all materials, so these systems would need to maintain a high vacuum for the entire light path. This requirement led to the next generation of TWINSCAN: the NXE platform. The first prototypes of NXE systems were shipped in 2006 to help chipmakers start to learn learning about the brand-new technology. By 2016, chipmakers began ordering our first production-ready EUV system: the TWINSCAN NXE:3400.

As the TWINSCAN dual-stage platform gets ready to celebrate its 20th birthday as a commercial technology, it has already evolved significantly to meet the varied challenges the semiconductor industry has faced. In 2021, we celebrated the 100th refurbished TWINSCAN, demonstrating our commitment to the circular economy. As the industry's leading lithography platform, TWINSCAN's ongoing evolution will continue to help chipmakers improve performance and reduce the overall cost of chip production.

"The market will continue to want us to perform better and better and produce better and better products," says Bert. "Thankfully, our employees have the same mentality that I recall from the 1990s and up until now: energy and commitment to finish something, to optimize it, to make it work. It's the culture of ASML, but also it comes with the pride of work for this company."

Scan QR code to read full article

Contributed by

ASML

September 2021

Republic Polytechnic–GlobalFoundries Industry Holiday Programme

From the eyes of our future talent

It's school vacation and I'm glad that I have signed up, along with 17 fellow classmates from the Diploma in Electrical & Electronic Engineering for the Industry Holiday Programme at GlobalFoundries (GF), a leading semiconductor manufacturer.

The five-day immersion programme with GF aims to raise awareness and inspire us as engineering students about the semiconductor industry and career opportunities. The eye-opening experience provided us with valuable insights and exposure to GF's facilities.

A series of events were lined up, which included the sharing of work experience at GF by the engineers and managers, career development opportunities, technical knowledge on wafer processing via interactive gamification approach, and a facilities tour of the various state-of-the-art laboratories and cleanroom. There were also other interests such as the art of storytelling, essential skills needed for interviews and the Waferthon competition where we collaborate in teams to solve a problem, design a prototype and present our solutions. Let me take you through this wonderful programme as I recount my experience.

INTERESTING SHARING AND FUN LAB VISIT SESSIONS AT GLOBALFOUNDRIES

We kick-started the programme with an introduction and some Ice Breakers followed by an overview about GF as a company and the possible career pathways.

The most awaited segment took place after lunch, visiting the various laboratories of the company! We went to the Reliability Lab, Failure Analysis Lab and Cleanroom where we learnt about the various functions, and job scopes of the labs. It was a memorable experience wearing the lab suit and the session benefitted us greatly as we got to learn the purposes of the labs and what happens in each of them.

As we walked along the corridor, we chanced upon a Zero Excursion Zero Defect (ZEZD) mural wall. The ZEZD mindset was testament to the values that the company continuously strive towards, and helped improve product quality and reduce the wafer failure rates delivered to their customers.

Towards the end of the day, we logged on to Padlet to pen down our reflections for the day which brought back memories from school as we use to do Reflection Journals every day.

BUILDING MY FIRST LEGO

Clean Technology! Diffusion! Photolithography! Etching! These are some of the processes involved during wafer fabrication. Ms Rosaline Tan, Senior Section Manager Technical Training, started the day by sharing videos of wafer fabrication and the processes wafers go through to become an integrated chip. The content was interesting and very much informative as it gives us a heads-up on what we will be learning in the upcoming semester when school starts. We paid attention as it's a really great learning opportunity as we were required to understand the basics so know how to build our wafers later. The Overhead Hoist Transport (OHT) system caught all our attention as we heard the 'zoommm' noise from one of the videos. We were all impressed knowing on the extent of automation happening in the Cleanroom with minimal human intervention.

Ms Rosaline Tan distributed Lego blocks to every team and the inner child in us came out. She guided us through and asked us questions to help facilitate an interactive session. As a team, we worked together to build a wafer using the Lego blocks. Following a long process filled with hurdles, we finally completed our wafer model. We were proud that given a few hours of learning and basic understanding, we were able to build it according to the instructions given.

All the teams had a chance to present our wafers and the processes involved to everyone. We started to jot down our learning experiences and reflections into the Padlet. A common challenge everyone faced was knowing when to use the different wafer cleaning methods and we overcame it with their guidance and deeper understanding on our part.

LEARNING TO BE A STORYTELLING PRESENTER AND FUTURE READY

As we entered the training room, we were amazed by the colourful flipcharts done by Mr Alvis Chew, Principal Specialist Learning & Development. We were looking forward to the art of making a good presentation and the hacks to impress our audience, like the way the colourful flipcharts caught our eyes from far!

We started the session by learning how to do up a good presentation, from planning the storyline and making it flow. It was a timely learning opportunity for us as we have to do daily presentations in RP. We started to brainstorm our ideas and followed the guiding questions to craft our story. When we had questions or stuck at certain parts, Mr Alvis Chew and the facilitators inspired us by sharing their experience and asking leading questions that got our brains thinking.

We were all looking forward to the panel discussion after lunch to ask all our burning questions. The panel included engineers, manager and even a RP alumnus currently working at GF. The panellists shared with us their job scope, as well as their education and career pathways. It was encouraging to hear all their experiences. Loud cheers and claps could be heard when we saw our Year Leader, Dr Koh Kah How, who was previously a Principal Quality Engineer at GF. Dr Koh shared with us, as well, his education pathway after his National Service journey and how GF has given him the opportunities to learn and grow.

After a fruitful panel discussion, we got the answers to most of our questions and were keen to secure an internship position with GF. Ms Sylvia Chan, Deputy Director of Manufacturing Technical Training, shared with us some tips which can help us to write a good resume, ace our interview and garner a good impression from the interviewer.

SHOWCASING OUR STORYTELLING PRESENTATION SKILLS AND START OF WAFERTHON

The Waferthon started with Ms Sylvia Chan, talking to us about the STEM (Science, Technology, Engineering, Mathematics) field and our teams will be required to work on either the following two case studies.

CASE STUDY 1: Not enough students are pursuing STEM (Science, Technology, Engineering and Mathematics) field

CASE STUDY 2: Graduates are attracted to “other” industries than semiconductor industries

We commenced by brainstorming our ideas with the help of the Affinity Diagram as it aided us in gathering the thoughts that were running on everyone’s mind, and we can then group similar inputs accordingly. After this, all the teams started searching online for statistics and news that would help to strengthen our case studies. We drew a mind map and elevated all the possible root causes that resulted in lesser students pursuing in STEM field.

The various team facilitators chipped in their comments to better help us to understand and ideate the problems. All of us were immersed in the Waferthon that we forgot it was already 4 pm and decided to continue working on our progress once we reached home through the various online platforms available.

WAFERTHON AND FINALE

Finally, the day most of us were waiting for came, the WAFERTHON finals!

All of us got on our feet, split our workload, and started to work actively on our flipcharts.

After a quick lunch, we finally started our presentations. The content of our presentations was all different from one another which made it even more interesting. We learnt a lot more about STEM from the various presentations, with some of the key takeaways include the benefits of pursuing a career in the STEM field, various career opportunities and the work involved. As we were presenting, the judges asked us challenging questions which got our heads thinking for viable solutions.

The scores for the Waferthon were soon tabulated and the winner was announced! We drum rolled and cheered loudly as they announced the winning team. The winning team received the most amazing gift, a waterproof JBL speaker and a certificate. Despite having only one team as the winner, we were proud that we did a good job and acquired new knowledge.

Finally, it was time to say goodbye, we took group pictures along with all the facilitators and judges as it marks the end of the Industry Holiday Program. We were sad that all the fun was ending yet we were silently grateful for having signed up for this event.

We are very thankful to be given the opportunity to be part of this wonderful programme where we got to meet amazing people from GF and learnt more about the semiconductor industry. Thanks to our Republic Polytechnic lecturers, Dr Eric Teo, Dr Koh Kah How and Dr Yang Hong as well as GF facilitators, Alvina, Cecelia, Cheng Bee, Cindy, Sylvia and Zhi Heng.

> **“We were very impressed with the Republic Polytechnic DEEE students of their high energy, strong desire to learn, and great maturity. One of the highlights during the Industry Holiday Program was Waferthon (similar to Hackathon). The students had no prior experience but they did well overall by collaborating in teams and presented some new and innovative ideas to the table, which GF could possibly be implementing some of them.**
>
> **We hope the short program has given the students a glimpse of what this exciting semiconductor industry can offer and sparked the interest in them to join the GF Internship Program in 2022."**
>
> **Sylvia Chan,** Deputy Director of Operations Training & Development, GlobalFoundries

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RAVI HARIPRIYA
Year 2 student
Diploma in Electrical and Electronic Engineering (DEEE)
REPUBLIC POLYTECHNIC

Addressing Killer Hydrogen Peroxide Related Defects in your UPW Stream

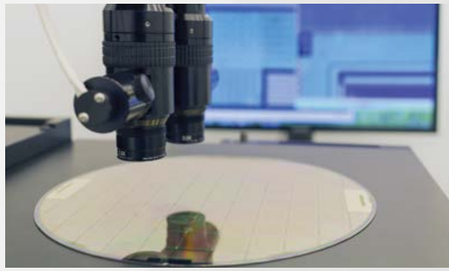
With the introduction of 7-nm, 5-nm, and even 3-nm node sizes in chip manufacturing technologies, the requirements for both the quality and quantity of ultrapure water (UPW) used in chip surface cleaning has increased significantly. The transition to FinFet transistors has further intensified water consumption as more rinsing is necessary, and the quality of UPW is increasingly pivotal in the industry's efforts to decrease contamination, minimize wafer defects, and increase wafer yield.

One particular challenge in the industry's bid to increase wafer yield is the presence of hydrogen peroxide originating from enhanced UV treatment during UPW production. This chemical produces a thin layer of oxide on the silicon wafer surface which, in turn, could become a key contaminant and culprit for wafer defects. Such contamination often results in difficulties in controlling the formation of very thin thermal oxide thicknesses and makes it challenging to increase the electrical resistance of a contact pad.

To address the issue of undesired oxide contamination and prevent wafer defects, there is a need for the industry to perform control experimentation and analysis by isolating non-variables in order to determine the correlations of certain impurities on a wafer surface. This will require close collaboration between the UPW engineers and semiconductor process engineers.

It is also important to control the critical parameters in real-time so as to bring greater clarity to the correlation between impurities and wafer defects, and this is particularly crucial in the manufacturing of FinFet devices and, going forward, nanowire-based devices. By addressing these technological gaps, the industry will be better poised to move from managing product quality to controlling it.

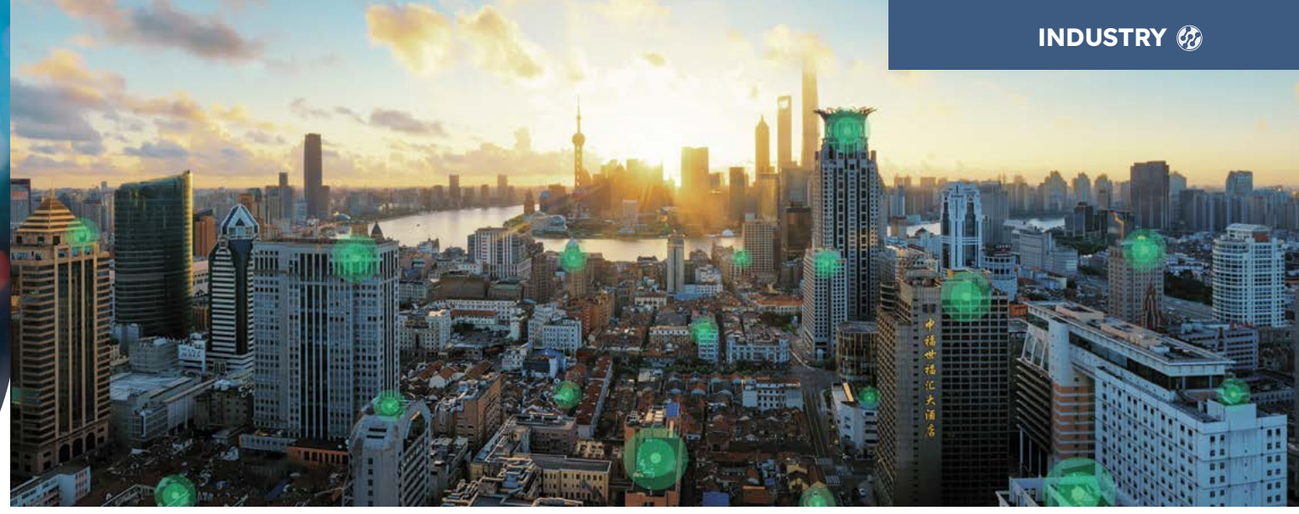
Having studied hydrogen peroxide removal in the UPW stream of a leading manufacturer in Korea, Veolia Water Technologies is ready to offer a workable solution or a pilot. Visit **our website** or contact me at *mehbub.khan@veolia.com* to learn how you can devise a wafer defect reduction strategy with high-quality ultrapure water.



CONTRIBUTED BY

MEHBUB KHAN
Asia Pacific
Market Manager,
Microelectronics
Veolia Water Technologies

6G: The Next Generation of Wireless Communication



Promising Technologies for Exploration

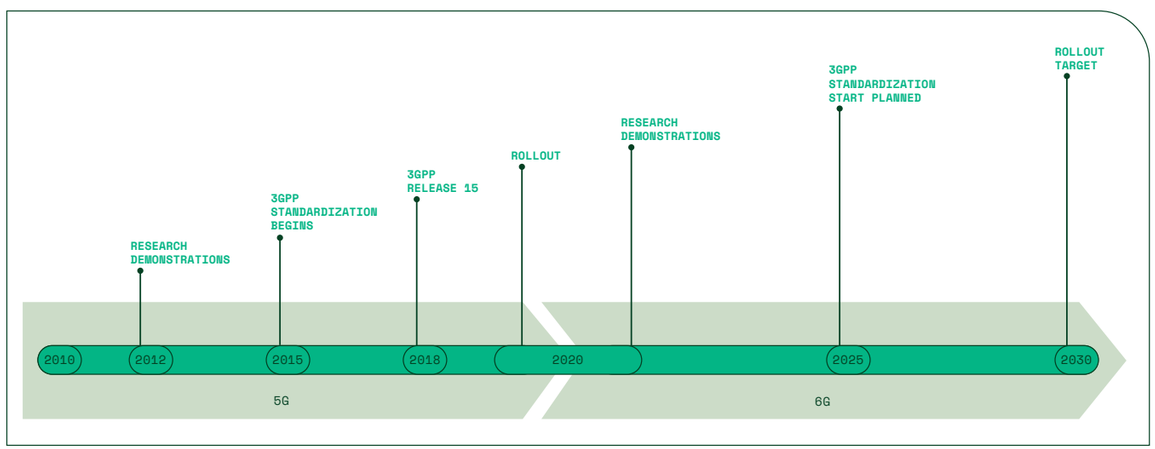
As we look at 6G's possibilities and promise, four candidate technologies stand out in terms of business opportunity and viability.

Joint Communication and Sensing

The 6G experience requires more data as well as more environmental sensing and awareness—and joint communications and sensing explores combining them. Those working on sensing are looking to communications technologies such as orthogonal frequency-division multiplexing (OFDM) waveforms or multiple-input, multiple-output (MIMO) phased-arrays to help improve their outcomes, while those working on communications see opportunity for more data bandwidth in the vast swaths of radar-allocated spectrum. The extent to which these two traditionally separate functions merge will depend on regulatory and technical factors, but the combination could potentially define 6G.

Sub-THz

The perpetual demand for more data bandwidth is pushing researchers to explore underutilized spectrum in the sub-THz frequency bands. Pathloss at higher frequencies—one of the biggest hurdles in moving to sub-THz bands—is potentially mitigated by matching a frequency band's attenuation properties with appropriate applications. While expanding to sub-THz bands may seem premature, leading industry and academic researchers are closely exploring it to significantly increase network capacity.



CELLULAR TECHNOLOGY EVOLUTION

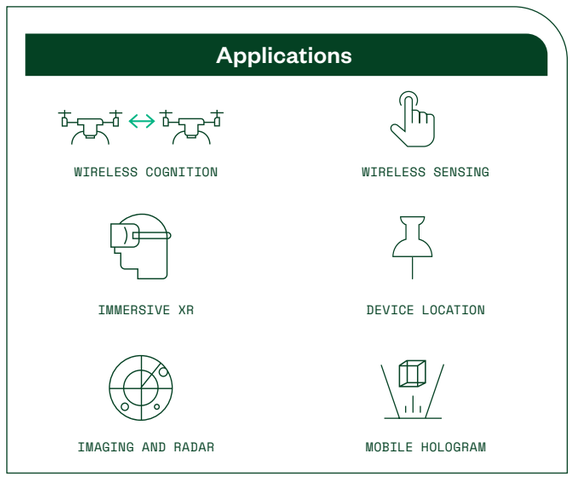
Evolution of MIMO

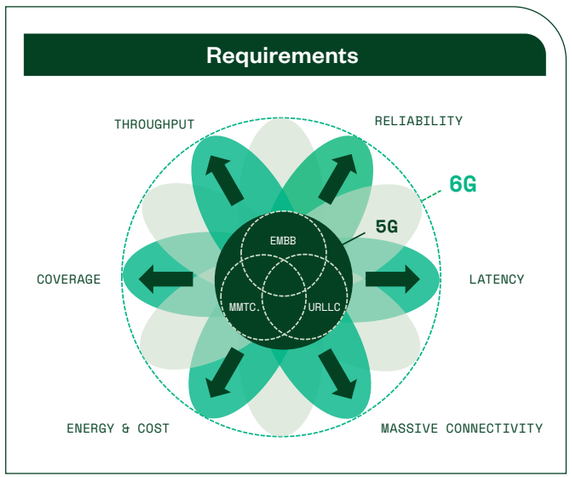
With potential across many different use cases as well as frequency bands, MIMO continues to build on popular multiantenna techniques. Distributed MIMO, which disaggregates large antenna arrays into multiple smaller, geographically separated radio heads, is especially interesting for sub-8 GHz frequencies, where antenna size becomes prohibitively large. MIMO's expansion to include higher system antenna counts for more users, and more precisely directed beam steering, aims to increase cell capacity and provide enhanced location services.

Artificial Intelligence and Machine Learning

As complexity increases and we seek to squeeze every bit of bandwidth out of the available spectrum, it becomes increasingly difficult to optimize the communications system with traditional signal-processing methods. AI/ML-driven design or adaptation seeking to dynamically optimize link performance could offer improvements through capabilities such as automatic spectrum allocation, beam management, and RF nonideality cancellation. The availability of big, open datasets for AI/ML wireless communication research and training will play a significant part in 6G development.

While these 6G candidate technologies all offer an array of possibilities, they will inevitably live or die by the business case.





EXECUTIVE SPOTLIGHT

In this edition, we put the spotlight on **Mr Terence Gan**, Executive Director (Designate), Institute of Microelectronics (IME), Agency for Science, Technology and Research (A*STAR) and Member of SSIA Board.

I also want to bring about deeper and wider involvement by our youths in R&D conversations, to help them to appreciate the tech that we are developing, and the positive impact our creations can have on society.

Q **It has been a few months since you took on this role as ED (Designate), IME in July 2021. How has it been different from your portfolio at EDB?**

A The work at EDB and IME, I would say, is "same same, but different". The similarities are that the outcomes from both agencies contribute to the development of the industry in Singapore. This is not surprising as EDB and A*STAR are both statutory boards under the Ministry of Trade and Industry. In fact, EDB's mission is "to create sustainable economic growth, with vibrant business and good job opportunities for Singapore", while A*STAR's mission is "to advance science and develop innovative technology to further economic growth and improve lives".

Before joining IME, I was fortunate to be part of the A*STAR-EDB-NRF team that developed Singapore's "Future of Microelectronics (FME)" strategy for RIE2025. We identified five pillars for Singapore to invest in:

a. wide bandgap semiconductors,
b. millimetre wave and beyond for future communications,
c. sensors and actuators,
d. edge AI hardware, and
e. heterogeneous integration

I am now part of the research community that has to deliver these technologies and talent.

To put this in another way, my role has changed from being an industry developer in EDB, to being the developer of technologies and talent that enable Singapore to secure good projects, towards being an innovation-led economy.

Q **How do you see your background in EDB bringing merit to your new role?**

A I feel what I bring to IME is a deep understanding of companies and the industry, as well as my business network. What I have gained from my few months in IME is a better understanding of our R&D ambition and capabilities. I enjoy and appreciate the opportunity to be the bridge between business and tech. This has allowed me to renew relationships with some companies and initiate new conversations with others.

Q **Could you share more about your vision and plans for IME, particularly top priorities that you wish to see IME continue to do (well in) as well as new areas to explore?**

A My personal goal is to leverage IME to build a stronger R&D community in Singapore, comprising companies, academia, public research institutes and our youths. For example, through the process of identifying the FME R&D pillars, I've seen researchers discover other researchers who are working on complementary areas. We live on a small island, but we still need platforms and catalysts to bring us together to spark new ideas.

Besides bringing researchers together, I also want to bring about deeper and wider involvement by our youths in R&D conversations, to help them to appreciate the tech that we are developing, and the positive impact our creations can have on society.

Q **How do you envision even better synergy between IME and related industries and partners? How can the government and semiconductor industry work even more closely?**

A I believe we can work better together if we have a common goal (purpose), good relationships (people), and good processes.

For a start, IME needs to better communicate our capabilities and research direction to our potential customers. We already do this well through our publications, but we need a complementary and stronger marketing engine to increase awareness and help make the connections. I believe SSIA is a good platform for IME to leverage.

On relationships (people), I believe strongly in networking, through online platforms like LinkedIn, attending conferences and events like SSIA Summit, and the power of referrals. I look forward to being able to have more in-person events again because it is harder to make new personal connections via virtual events. At the right time, I plan to revive IME's series of regular technical seminars, for relevant parties to come together to learn about the latest achievements in the community and network.

Processes are often the bane of all discussions because if they don't work, the failure happens towards the end of a courtship. I am still figuring how to better prevent processes from hindering us from crossing the finishing line. From what I can see, there is no systematic failure, but when it happens, it can be painful and disappointing. I choose to put my trust in that all parties are working together to resolve any issues to the best of our ability.

Q **How do you see SSIA's role to better gel the industry and government? Any notable initiatives or upcoming plans to highlight?**

A SSIA plays an important role to not just build the community, but to be the voice of the industry. This was an important role that SSIA played during last year's Circuit Breaker, and SSIA continues to serve the community through its talent outreach, continuing education and volunteer career advisor programmes.

One of the FME initiatives is to improve our outreach to youths, to win their heads and hearts, so that many more aspire to join the semiconductor industry. I am happy that Wee Seng and his team are taking an active role to lead and shape this initiative.

Q **Aside from your strong academic and career background in engineering and technology, what are your hobbies/what do you do in your free time – there must be area you personally like that are not engineering/ tech-related?**

A The things that I like to do in my free time – swim, cycle, table tennis. But notice they are all still based on physics principles? Guess I do build my work and personal life around these constant elements.

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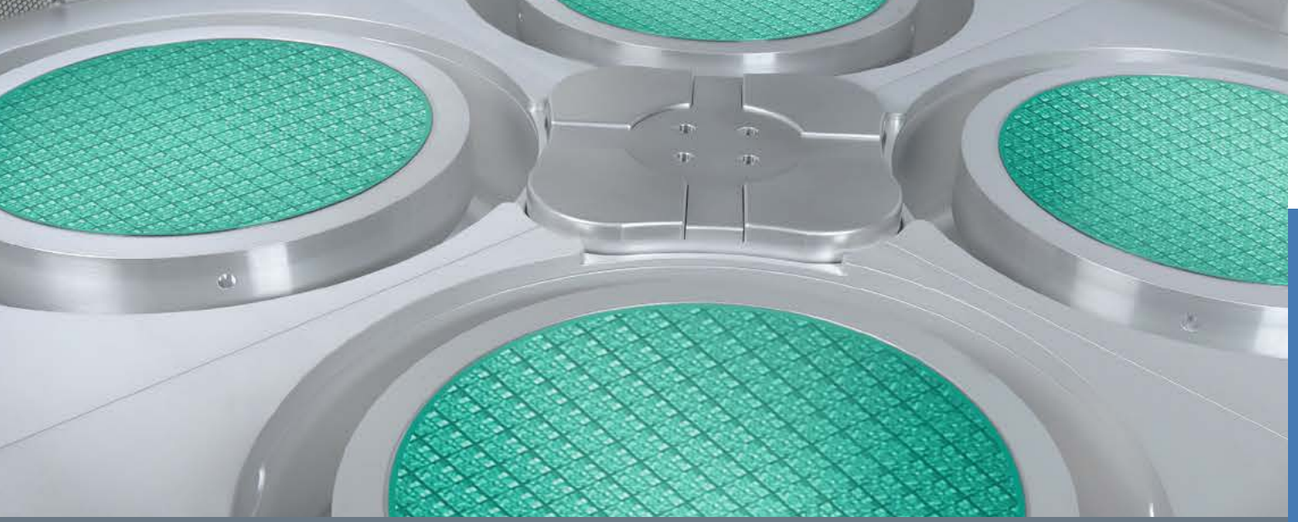
INSTITUTE OF MICROELECTRONICS (IME)



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23 OCT 2021

Xilinx All Women Hackathon

BRINGING FEMALE TECH ENTHUSIASTS TOGETHER

PYNQ was all the rage at Xilinx Singapore (XAP) where the local Women of Xilinx (WOX) committee hosted the second all-women hackathon. Several elements contributed to making this year's event an extraordinary one. First, this event was fueled by the passion of the organizing committee and students from local Institutions of Higher Learning (IHLs). Due to the unpredictability of the Covid-19 situation, the event had to make several last-minute changes including a postponement. Everyone took the changes in stride and focused on getting the event in place. Second, this was the first time Xilinx Singapore hosted a hybrid hardware hackathon.

This year, the hackathon participants had the opportunity to solve a problem on a new Xilinx platform and demonstrate the output to the Xilinx team of experts and get real time feedback. Mr David Ferguson - VP, Production Operations & Site Director, APAC HQ in Singapore – graced the finals, held 'live' on Xilinx premises.

This year's hackathon focused on building a toy car with intelligence. Basic features of the car included the ability to follow a predefined route, avoid obstacles along the route and navigation without a guided route. Participating teams were given an added challenge to think about what other applications these can be expanded into. For example, self-navigating an IOT car to track ambience temperature, and transferring collected data to a cloud database, essentially expanding the scope to add-on a real-time temperature monitoring system. On top of temperature, lighting conditions, detecting unexpected foreign objects are amongst other features that can be added. The possibilities are endless!

Despite challenges brought about by Covid-19, this year's hackathon has been a success by merit of the participants' participation, no less enthusiastic than the inaugural edition. The Xilinx team is hugely encouraged by the participation of more than a hundred female students on this journey. The excitement surrounding the finals was contagious and we hope to make this an annual event to attract and encourage more women in STEM. Here are some words from the organizing committee and the winning team.

"It was inspiring to see the enthusiasm and talent with which some of Singapore's brightest university students attacked problems and then engineered solutions often in real-time. Different approaches from different teams to quickly find and then refine ways to overcome the unexpected obstacles that surfaced during testing and even in the competition itself. It made me want to be a student again and I am sure it inspired others who saw the excitement, the joy and the temporary agony, that engineering can spark. My heartiest congratulations to all the participants and especially to the 7 teams that made it to the finals! Congrats!"

Mr David Ferguson, VP, Production Operations & Site Director, APAC HQ in Singapore

"The teams demonstrated resilience and the determination to want to complete the challenge. We definitely need more of such ladies in STEM."

Pei Fern Ng, Women of Xilinx regional lead for Singapore

"The hackathon has been a wonderful exposure to hardware for us. We thoroughly enjoyed the experience and are grateful for the guidance received throughout the event. The organizing team and fellow participants have been nothing but friendly and helpful. Through this experience, we have gained much and will continue to explore our interests in the world of hardware."

Disney+, winning team

Women of Xilinx Singapore would also like to express our heartfelt thanks to our partners and supporters to make this event a success.

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XILINX.

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IHCI
Industry 4.0 Human Capital Initiative

Are you ready for new opportunities through Industry 4.0?

The Industry 4.0 Human Capital Initiative (IHCI) Programme is designed to help manufacturing companies in Singapore to understand, implement and scale Industry 4.0 successfully through an experiential triple-pronged approach which includes Business, Technology and Organisation!

An Initiative by

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Anchor Partners

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IHCI Programme Structure

Phases: Awareness > Pilot > Plan > Scale > Sustain

Elements:
- 1. Self-help portal
- 2. Enabler Programme
- 3. Community of practice

Expected Outcome

Awareness

Building IOT Solutions

C "See" It Yourself

Do it Yourself roadmap

Ecosystem to meet Industry 4.0 transformation needs in business priority mapping, technology solutions and job redesign.

Toolkits

SMART INDUSTRY READINESS INDEX

Hear from our minister:

Minister Tan interacting with Souperfood's Managing Director, Mr Andrew Chan, to learn how technology adoption has improved work processes

"By adopting Industry 4.0 solutions, the company (Souperfoods) was able to scale up its operations and improve productivity."

Minister for Manpower & Second Minister for Trade and Industry,
Dr Tan See Leng

Source: https://www.facebook.com/DrTanSeeLeng

Our Alumni:

"Once we had data (from IOT solution), we started to recognise lost time. We were able to track the standard vs actual (process duration) and from that data analysis, it prompted us to think about the improvement projects we want to do and that is exactly where we are focused right now."

Manufacturing Director, Ms. Hsieh Min Zong

ASM has participated in IHCI Cohort 3 where they piloted an IoT solution that provides visibility on process duration across various job steps, which then allowed management to drive improvement in performance and optimise production lead time.

Pricing Fee and Available Subsidies for the IHCI Enabler Programme

Over $60,000 government subsidy to help you in your business transformation

Subsidy 1
WSG absorbs 90% (SME) or 70% (non-SME) of the original programme fee $63,250

Subsidy 2
SSG SkillsFuture Enterprise Credit (SFEC) - S$10,000 credit to cover up to 90% out-of-pocket expenses

SMEs are defined as:
- Registered and operating in Singapore;
- Have minimum 30% local shareholding; AND
- Company's Group annual sales turnover not more than S$100 million; OR
- Company's Group employment size not more than 200 workers

Pay $6,325 upon commencement

Is my company eligible for Subsidy 2?
- Claim up to $5,692.50 from SFEC: Check Business Grants Portal (BGP)

Potential final cost of programme after claiming Subsidy 2

→ $632.50

Go through the 6-8 week Enabler Programme

Pay $18,975 upon commencement

Is my company eligible for Subsidy 2?
- Claim up to $10,000 from SFEC: Check Business Grants Portal (BGP)

Potential final cost of programme after claiming Subsidy 2

$8,975 ←

Disclaimer: Final costs may differ depending on remaining value of subsidy credits.

Scan the QR code to register your interest for our next cohort!
Cohort 6 (Nov 2021)
Cohort 7 (Feb 2022)

Explore our self-help portal to discover Industry 4.0 application guides:

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Other Alumni

DenseLight · UAC

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