

# MANUFACTURING MATTERS

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## FEATURE

# SIMTech'S 3D ADDITIVE MANUFACTURING R&D COLLABORATIONS

SUCCESS STORIES  
Healthcare Industry  
**OPPORTUNITY FOR SME**

INDUSTRY ALLIANCE  
Roadmapping for Industry Success

PRODUCTIVITY MATTERS  
**THE MAGIC OF LEAN**

RESEARCH SPOTLIGHT  
A New Electrode for **HIGH-PERFORMANCE** Lithium-Ion Batteries





## NOTE FROM EDITOR...

### Dear Friends and Industry Partners,

The market size of 3D Additive Manufacturing (AM) is projected to exceed US\$20 billion by 2020, led by automotive, medical and aerospace applications according to Wohlers Report 2015. This potential focuses significantly in Singapore's future of manufacturing to keep developing new capabilities and stay relevant to create higher-value industries.

Although the business outlook for AM is positive and companies are investing in AM capabilities, the lack of materials, process and design engineering know-how are barriers to industry mass adoption, thus opening windows of opportunities for research and collaboration with the industry.

To address these, a Collaborative Industry Project (CIP) on 3D AM Capabilities in Metal and Polymer is introduced by the Precision Engineering Centre of Innovation (PE COI) at SIMTech to lay the foundation for AM product printing to capture market potential (see Feature in opposite page for details). Response from industry is strong, underlying the need for SIMTech-industry R&D partnership to build 3D AM technology capabilities.

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*Editor, Manufacturing Matters*

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# SIMTech'S 3D ADDITIVE MANUFACTURING R&D COLLABORATIONS

## CIP speeds up adoption of 3D Additive Manufacturing (AM) technologies in metal and polymer for the PE industry

In this new PE COI initiative, participating companies can tap on SIMTech's AM resources to learn the feasibility of AM product printing and better understand the various AM printing technologies, benefits and limitations. SIMTech will demonstrate the AM process capabilities ranging from design and process optimisation, material preparation and handling, product processing to secondary operations. Participants will be exposed to demonstrations and hands-on sessions of virtual design and simulation; two selected AM technologies; post-processing; characterisation studies and product print job. To date, five precision engineering companies have signed up for the programme.

### SUCCESSFUL ADOPTION OF 3D AM TECHNOLOGY

A number of companies have worked with SIMTech to adopt the AM technology in the past.

#### Bio-Scaffold International

In 2000, Bio-Scaffold International (BSI) collaborated with SIMTech to develop technologies to fabricate scaffolds for tissue engineering. Through 3D inkjet printing process combined with conventional processing methods using FDA-approved biocompatible polymers, bone



**“Through this CIP, we are not only able to stay relevant to the industries we serve, we can also enhance our offerings by tapping on SIMTech’s expertise and resources for our research and development work”**

Mr Matthew Waterhouse, CEO  
3D Matters Pte Ltd

tissue scaffolds with engineered porosity and strength were created. Today, Bioscaff Alvelac—a dental product—has been launched in Singapore, UK and Taiwan.

### Tru-Marine

SIMTech also developed a robotised Laser Aided Additive Manufacturing (LAAM) system and process for Tru-



marine, a specialist in maintenance, repair and overhaul of turbochargers for the marine, offshore, power plant and locomotive applications. Suitable for repairing most of the turbocharger components, the system and process improved productivity and property significantly. This technology is commercialised for the repair of turbocharger components.

Applied Materials and SIMTech announced a **joint R&D collaboration in Additive Manufacturing (AM) research**. The partnership aims to address high value problems to enable metal 3D printing of parts which can function in rigorous operating environments, such as semiconductor manufacturing. This collaboration combines Applied Materials’ leading expertise in materials engineering and manufacturing with SIMTech’s AM technology competencies, strong pre- and post-processing capabilities and infrastructure to support AM projects.

### Industrial AM Programme

To grow an internationally competitive AM industry in support of the aerospace, automotive, oil & gas, marine, medtech and precision engineering industries, the Industrial AM Programme was launched in 2013 by the Agency for Science, Technology and Research (A\*STAR), led by SIMTech. As these industries are evolving into more complex and advanced production, requiring new technical skills, high-tech processes enabled by deep R&D capabilities, AM technology can help strengthen Singapore’s manufacturing.

SIMTech works in close partnership with Nanyang Technological University (NTU), A\*STAR Institute of Materials Research and Engineering (IMRE) as well as A\*STAR Institute of High Performance Computing (IHPC) in the identified six

process technologies which form the key thrusts of the programme:

- Laser Aided Additive Manufacturing (LAAM)
- Selective Laser Melting (SLM)
- Electron Beam Melting (EBM)
- Polyjet
- Selective Laser Sintering (SLS)
- Stereolithography (SLA)

Through the integrated development of these technologies, a one-stop platform and eco-system for AM is being established. The developed technologies will be transferred to the Singapore manufacturing industry through collaborative industry projects.



Arising from this programme, SIMTech is currently working with several dental labs on technology optimisation for 3D printing of patient specific wax-ups, dental models and ceramic crowns and bridges. By combining stereolithography with investment casting, customised dental crowns and bridges are produced in a faster and more efficient way.

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**PE COI** Precision Engineering  
Centre Of Innovation  
*Sustaining and Advancing PE Industry*



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Centre of Innovation



## HEALTHCARE INDUSTRY OPPORTUNITY FOR SME

Getech Automation Pte Ltd, an automation system and equipment developer and manufacturer, created an automated bottle dispensing system for Kandang Kerbau Hospital's (KKH) Emergency Pharmacy with the support from SIMTech and Singapore Polytechnic to meet the hospital requirements of high efficiency and improved its patients' experience.

SIMTech developed the software for the Bottle Dispensing System (BDS) including bottle handling and process control as well as graphical user interface. The entire process consists of unloading bottles from carton boxes, configuring storage layouts, picking and placing bottles in the shelves as well as printing, labelling bottles before loading them into RFID-tagged containers, according to prescriptions. The robotic BDS is believed to be the first of its kind in the world

**The Bottle Dispensing System saves up to 8,760 man-hours a year for the hospital**

Two staff members can be re-deployed for high value-added activities such as medication counselling and enhancing inventory tracking. The BDS also enhances the operational efficiency of the hospital and shortens waiting time for the patients. This project allows Getech Automation to venture into the development of automation systems for the healthcare industry.

The BDS has won the HIMSS-Elsevier Healthcare Awards 2015, Outstanding ICT Innovation and SiTF 2015 Awards, Silver Award for Best Innovative Use of Infocomm Technology (Public Sector) for KKH.

For more information, please contact **Mr Tan Chee Tat** at [cttan@SIMTech.a-star.edu.sg](mailto:cttan@SIMTech.a-star.edu.sg)



## FIT FOR FIELD ATTENDANCE RECORDING

Wing Tuck Engineering Pte Ltd, a SME which carries out maintenance works on fuel equipment for Shell and SPC, adopted SIMTech's Field Worker Identification & Tracking (FIT) System. The system uses NFC Android phones to read NFC RFID tags pasted on field workers' work permit cards. Through 3G Telco networks or Wi-Fi, the phone sends the worker's ID, GPS location and time-stamp to a back-end server in Wing Tuck's office. Live visibility of workers at each worksite is possible, generating reports for payroll processing. With this system, data entry effort of HR staff is reduced by 65 per cent from 40 to 14 man-days per month.

Wing Tuck also engaged SIMTech to enhance the back-end Server App to improve payroll processing productivity. This requires differentiating between 5-day and 5.5-day workers, determining workers' punctuality and their overtime duration for week days, Sundays and public holidays, handling of allowances for varied items and other needs. With SIMTech's help, Wing Tuck can now track project activity manpower expenditure closely, and provide useful references when bidding for future projects.

**“ With the customised enhancements, we can now track our project manpower costs better, analyse and improve on our manpower allocation ”**

Mr Sacca Chong, Managing Director  
Wing Tuck Engineering Pte Ltd

For more information, please contact **Mr Wong Ming Mao** at [mmwong@SIMTech.a-star.edu.sg](mailto:mmwong@SIMTech.a-star.edu.sg)



# ROADMAPPING FOR INDUSTRY SUCCESS

The Operation and Technology Roadmapping (OTR) initiative helps local companies improve their technology management

In this initiative, SIMTech assists companies to identify long-term future drivers and develop a plan to introduce relevant technologies that are of strategic importance to the company's business success. Through the OTR's systematic process, companies will be able to recognise their critical system requirements, match technology alternatives to fulfil these requirements and develop corresponding product and process performance targets to achieve business growth and success. To ensure that the technology introduction stays relevant and useful to the companies, the OTR process helps companies establish their own technology roadmaps, providing an overall view of the technology required to meet the company's various business and market needs for the next two to five years.

A beneficiary is Wavelength Opto-Electronic (S) Pte Ltd, a Small and Medium Enterprise (SME) manufacturer of infrared optics components which engaged SIMTech since 2007 through an OTR project. Through OTR, Wavelength Opto-Electronic (WOE)

identified seven key technologies specifically in Lasers and Optics, deemed important to its future growth. Arising from this, WOE collaborated with SIMTech from 2011 to 2013 to develop a product.

The outcome is a first of its kind miniaturised laser calorimeter-based instrument for the characterisation of absorption of optical components used in high power laser applications. The collaboration enhances the technology competency of WOE in developing and manufacturing laser-optics equipment.

WOE is transformed from an equipment trader and component manufacturer to an Original Equipment Manufacturer (OEM). It has successfully created and captured value with the technology and support from SIMTech. Happy with the results, WOE has continued its collaboration with SIMTech.

Following OTR's success, an enhanced version was launched in July 2015. Dedicated Market and Competitive Intelligence modules are included in the Enhanced OTR initiative to ensure industry decision makers are adequately informed of the future trends before venturing into a new market or technology investment.

For more information, please contact

**Mr Jeff Pan** at

[sppan@SIMTech.a-star.edu.sg](mailto:sppan@SIMTech.a-star.edu.sg)

Reduce risk  
Identify opportunity  
Plan for the future



Scan for more information  
on Operation and  
Technology Roadmapping

**The Enhanced OTR is gaining strong acceptance. It will be promoted to the industry through various associations, beginning with the Singapore Precision Engineering and Technology Association**



## LIGHTING UP THE PRINT AND MEDIA INDUSTRY

Collaborative Industry Project (CIP) on Printed Electronics captures new business opportunities for local companies

The CIP on the Application of Printed Electronics for the Print and Media Industry launched in October 2015 was participated by 11 companies from two industries – printing as well as media & advertising. For local printing companies, the CIP's objective is to enhance their capabilities by implementing printed electronics in their product offerings. The CIP aims to encourage the local media & advertising companies to adopt printed electronics as part of their efforts towards innovative advertising solutions. By bringing companies from both industries together, this CIP also seeks to create a sustainable value chain by connecting printing companies that can produce printed electronics with media & advertising companies looking to purchase such products as part of their advertisements.

To establish capabilities in the design, prototyping and manufacturing of

“ OOH Media's participation in the SIMTech CIP gives us the opportunity to work with industry partners to explore more innovative outdoor solutions in Singapore ”

Henry Goh, Head, Mediacorp OOH Media

printed electronics and lighting, the participants were trained in design guidelines; developed printed electronics and printed lighting



“ The CIP introduced a refreshing perspective on creating new vibrant advertising solutions, and providing opportunities for us to explore applications of printed electronics technology ”

Alvin Yapp, Director, BusAds Pte Ltd

products for advertisements, greater interactivity and order processing; optimised integration of printed electronics in Print and Media Industry and provided cost modelling for application of printed electronics to enable industry to tap on business opportunities.

Using printed electronics, printed lighting was already successfully deployed on Singapore Mass Rapid Transit (SMRT) buses. SIMTech and ETPL assisted in the production and installation of eLumniNEX, a large area printed backlit technology. This was launched on Singapore's first illuminated double-decker bus in May 2015. The collaboration won SMRT the SPARKS Award for Media Excellence 2015 in the Most Innovative Technology and Best Media Solution – Out of Home category.

Arising from the successful completion of this CIP, SIMTech is preparing to kick-start the next CIP in printed electronics applications. The Employment and Employability Institute (e2i) will be providing training grants for eligible participating companies in the next CIP batch.

For enquiries, please contact  
**Mr Rick Yeo**, Director, at  
[rickyao@SIMTech.a-star.edu.sg](mailto:rickyao@SIMTech.a-star.edu.sg)

**EAC** Emerging Applications Centre

Seeding and Growing Emerging Industries



# THE MAGIC OF LEAN

The practice of kaizen boosted company productivity

The impact of internet on trade leading to the rise of e-commerce is a significant game-changer for the traditional businesses of MegaChem, a global distributor of chemicals in 11 countries. As part of the ongoing firm-wide productivity drive, Mr Chan Khai Leong, Group General Manager of MegaChem, approached SIMTech to enhance its capabilities and productivity in early 2015.

The Lean Implementation Programme (Lean), based on the philosophy of continuous improvement or kaizen, was rolled out, bringing together 16 cross-functional employees to initiate productivity measures in their respective domains. Apart from reaping substantial cost savings, the bottom-up feedback is effective in improving employees' morale and engagement.

One positive change is the company's improved documentation control. Key changes include restricting access only to authorised personnel, preventing unintended overwriting of data, and issuing auto-alert reports to keep track of new customer specifications. With

“ **The staff is adapting to the Lean approach and they start to analyse problems in a more systematic way** ”

Mr Chan Khai Leong,  
Group General Manager of  
MegaChem

this, MegaChem has strengthened the integrity of its document database. The perennial issue of facing 2 monthly cases of inaccurate documentation that led to wrong product purchase and delivery was completely eliminated.

Another positive change is the company's economical standardisation of its printing process. By using a larger printing sheet to accommodate more chemical labels, Lean has enabled MegaChem to reduce the printing frequency, which offsets the higher label cost. With just a minor tweak, the company saves \$16,700 annually, which is significant to rank-and-file

workers who proposed, and have taken ownership in the company's productivity movement.

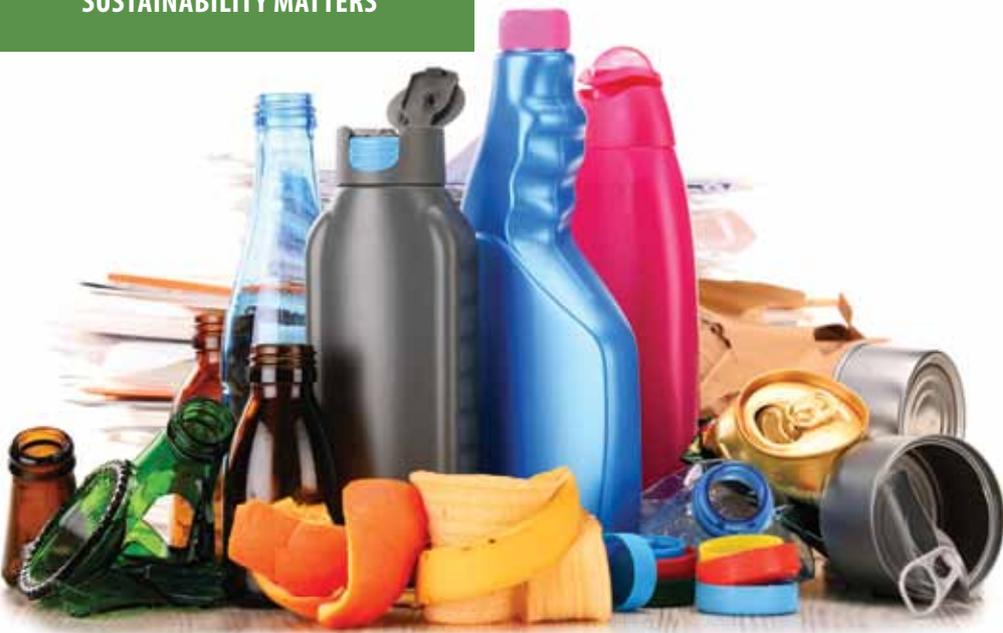
Lean has also triggered MegaChem to cooperate even more closely with its suppliers. The voluminous invoices from third-party warehouses were physically impossible to verify manually or digitally due to system incompatibility. Random sampling verification is the long standing compromised solution. Lean enabled the company to work closely with its external partners to create a new programme that performs 100 per cent validation checks, bringing significant cost recovery from over-invoicing.

For enquiries, please contact  
**Dr Lee Eng Wah**, Director, at  
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Web: [www.SIMTech.a-star.edu.sg/MPTC](http://www.SIMTech.a-star.edu.sg/MPTC)

**MPTC** Manufacturing Productivity  
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*Enhancing Manufacturing Productivity*



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Companies with operations in multiple sites may have different practices with regards to manufacturing waste. The waste audit will help identify best practices that can be shared throughout the company or even to the industry

# WASTE AUDITING

Sustainable Manufacturing Centre (SMC) assists companies to uncover waste opportunities

The National Environment Agency of Singapore has enacted mandatory reporting of waste data and waste reduction plan by large commercial premises such as large hotels and shopping malls.

The mandatory reporting requirement aims to:

- draw and sustain greater management’s attention on the amount of waste produced by the premises

- build greater awareness of the potential for improving their waste management systems.

The SMC Lifecycle Management initiative has started to provide companies with a waste audit service through a formal, structured process to quantify the amount and types of waste generated within the organisation.

The methodology typically consists of:

- Measurement
- Analysis
- Decision Support

### Benefits

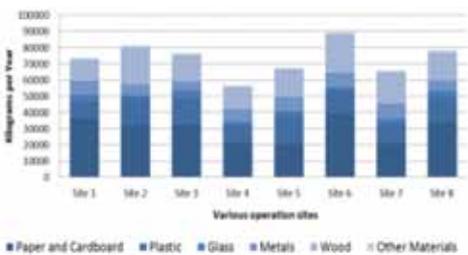
By understanding the relationship between their operations and waste generation, companies can reduce material wastage, improve their resource efficiency and increase cost saving.

Through the facilitated brainstorming session, company staff can propose new ideas for the company to be more eco-friendly by lowering their corporate carbon footprint.

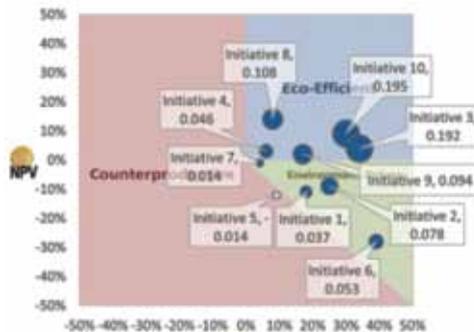
Waste audits also help companies identify opportunities to re-use their waste materials or sell them to companies in other industry sectors.

For enquiries, please contact **Dr Chen Wei Long**, Director, at [wlchen@SIMTech.a-star.edu.sg](mailto:wlchen@SIMTech.a-star.edu.sg)  
Web: [www.SIMTech.a-star.edu.sg/SMC](http://www.SIMTech.a-star.edu.sg/SMC)

Breakdown of total wastes generated by major waste types per site



Eco-efficiency Improvement



**SMC** Sustainable Manufacturing Centre  
Embracing Sustainable Manufacturing



Scan for more information on Sustainable Manufacturing Centre

## Measurement

Quantify waste streams from source to sink

- Data Collection through survey of site operations and interviews
- Quantification of waste streams through manual sorting and weighing
- Waste Value Stream Mapping

## Analysis

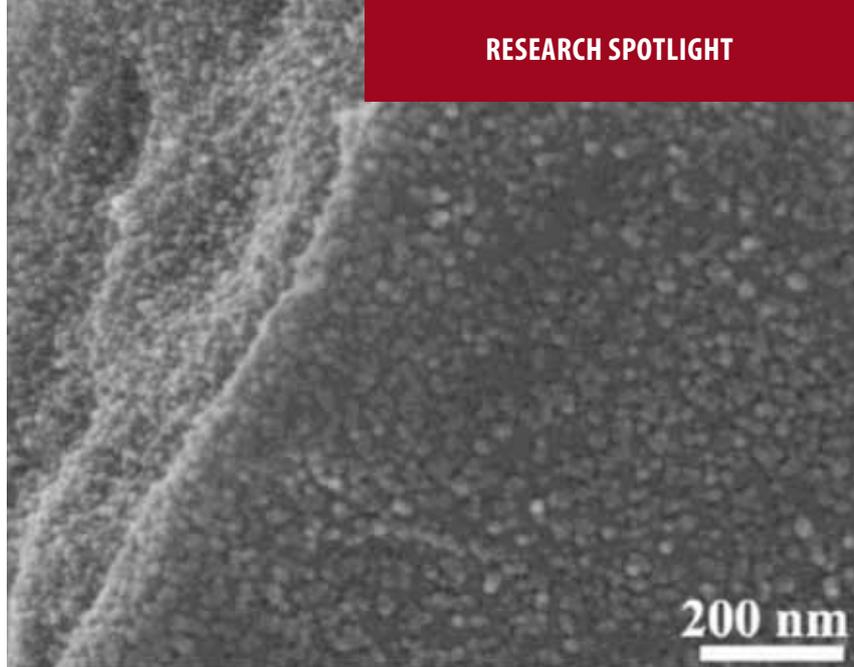
Understand problems and identify improvement opportunities

- Hotspot Analysis to zoom in on problematic areas
- Root Cause Analysis to identify root causes and opportunities for improvement

## Decision Support

Identify, evaluate & prioritise potential improvement initiatives

- Facilitated Brainstorming to identify improvement initiatives
- Selection of Initiatives to be developed into action plan in alignment with the company’s goals



## A NEW ELECTRODE FOR HIGH-PERFORMANCE LITHIUM-ION BATTERIES

To meet the increasing demand on the next-generation lithium-ion batteries for a wide range of applications, considerable efforts have been devoted to develop the advanced electrode materials

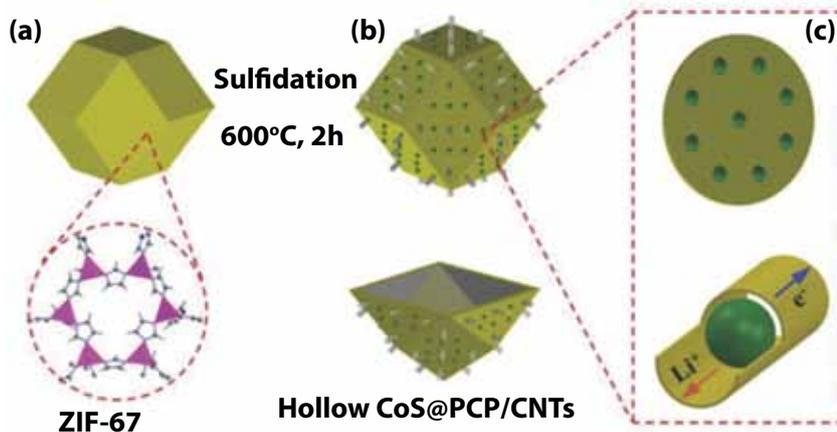
Metal sulfides are the promising electrode candidates due to their higher capacity and intrinsic enhanced safety. Metal sulfides usually exhibit high conductivity allowing for faster electron transportation. However, the practical application of metal sulfides as an electrode material is limited by its loose powder form, causing loss in electrical conductivity and a rapid portable energy capacity fading.

Engineering the nanostructure and mixing metal sulfide electrodes with

more conductive materials such as porous carbon, carbon nanotubes, and graphene could be possible approaches to address these problems. However, the available combining procedures for these hybrids usually involve multi-steps and complicated synthetic conditions.

In a novel one-step approach, 3D hollow hybrid electrodes constructed by carbon and metal sulfides have been successfully developed.

**The achieved electrodes have new advantages including a porous hollow interior ultra small building blocks, conductive carbon matrix, and strong sulfides/carbon adhesion**



Schematic illustration for the formation of 3D hollow CoS@PCP/CNTs: a) ZIF-67 template; b) hollow CoS@PCP/CNTs; and c) magnified representation of an electron/lithium transportation channel of CoS@PCP/CNTs.

Superior and exceptional electrochemical performance are achieved. This strategy can be expanded to the preparation of other porous metal compounds/carbon composites with high-power and high-energy densities for next-generation portable energy-storage devices, and materials for environmental technology such as catalysis.

For enquiries, please contact **Dr Wei Jun** at [jwei@SIMTech.a-star.edu.sg](mailto:jwei@SIMTech.a-star.edu.sg)

A number of events were organised in 2016 to engage the industry and forge partnerships

## SMS Networking Night 2016, 18 Feb

Reinforcing the commitment for closer collaboration, industry leaders from Singapore Precision Engineering and Technology Association, Singapore Manufacturing Federation, Singapore Chinese Chamber of Commerce and Industries, Singapore Business Federation, Singapore Industrial Automation Association, Print and Media Association, Waste Management and Recycling Association of Singapore, and Electronic Industry Training Centre and representatives from SIMTech, A\*STAR, Economic Development Board, Employment and Employability Institute, Infocomm Development Authority, Singapore Workforce Development Agency and SPRING Singapore turned up in full force. 190 attendees, from 63 organisations had a fruitful time networking, were treated to a loh-hei dinner, an entertaining lion dance and music performance by SIMTech's Music Interest Group.



At this event which commemorates the 10th anniversary of the SIMTech Membership Initiative for industry, 11 pioneer members were honoured for their longstanding partnership with SIMTech. Dr John Yong, Director of Industry Development Office, shared on the successful partnerships with the industries, associations and government agencies.

## Endless Possibilities for Media Opportunities with Printed Electronics, 18 Mar



The printing and the media industry comprising companies implementing printed electronics in their product offerings as well as the advertising agencies and media owners got together at a networking event to showcase how printed lighting, printed touch and other printed electronics have been used creatively by the various media players to grow their revenue stream. The event, attended by 124 representatives from industry, was literally lighted up by inspiring prototypes designed and created by the participants of the completed Collaborative Industry Project on Printed Electronics for the Print and Media Industry.



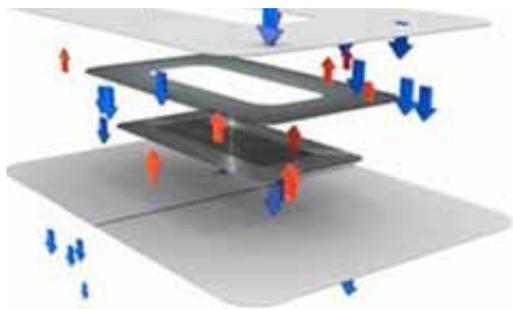
Mr Henry Goh, Head of OOH Media Commercial Group, Mediacorp and Mr Jerry Tan, CEO of Light10 Industries shared on trends, challenges, opportunities and technologies available for outdoor advertisement. The critical insights on upcoming innovation and future opportunities in printed electronics applications in new media platforms were also shared.

## Finance Minister Heng Swee Keat's Visit, 11 Apr

Finance Minister Heng Swee Keat visited SIMTech to know more about how the institute engaged industry. To achieve this, an overview was presented by Executive Director of SIMTech, Dr Lim Ser Yong. Minister Heng toured the four Industry Innovation Centres, namely MPTC, SMC, PE COI and EAC where each Centre Director highlighted the role and activities of their respective Centres. Industry partners from A&One Precision Engineering, Tunity Technologies, LHT Holdings, OE Manufacturing, SIA Engineering Company, LNE Holdings and Inzign briefed the Minister on how the industry collaborations with each of the Centres benefited the companies.



Collaborative Industry Projects (CIPs) are cost-effective R&D platforms, where companies facing similar issues work jointly with SIMTech, to develop manpower and technology



### 3D Additive Manufacturing Capabilities of Metal and Polymer

Call for Participation

This CIP aims to design, develop, and test incremental micro/nano hot embossing system for functional applications on planar parts, micro form rolling surface texturing system for friction reduction on cylindrical parts, and micro rolling system for thermal conductivity enhancement of thin metallic foils.

For enquiries, please contact **Dr Mehrdad Zarinejad** at: [mehrdad@SIMTech.a-star.edu.sg](mailto:mehrdad@SIMTech.a-star.edu.sg)

### Advanced Machining Dynamics Analysis Technology

Call for Participation

This CIP aims to develop laser surface texturing process and transfer the laser produced micro/nano surface textures onto the components and products to generate new and/or improve functional performance.

For enquiries, please contact **Dr Mehrdad Zarinejad** at: [mehrdad@SIMTech.a-star.edu.sg](mailto:mehrdad@SIMTech.a-star.edu.sg)

### Management and Tracking System/ Inventory Tracking System

Call for Participation

This CIP aims to help companies deploy a RFID/barcode-based Inventory Tracking System (ITS) to better manage, track & stock take their inventory. This improves productivity, traceability and minimises errors.

For enquiries, please contact **Mr He Wei** at: [wh@SIMTech.a-star.edu.sg](mailto:wh@SIMTech.a-star.edu.sg)

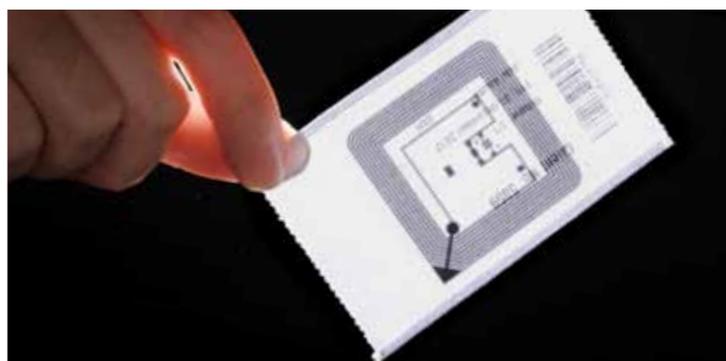


### Manufacturing Operations Management (MOM) Programme

24 May 2016 | SIMTech, Fusionopolis Two

This CIP aims to implement the MOM solution that manages the entire manufacturing operation from production planning, raw material management, mobile shop floor tracking, and delivery order generation. Through this programme, companies can better manage and improve their manufacturing operations

For enquiries, please contact **Mr Chua Tay Jin** at: [tjchua@SIMTech.a-star.edu.sg](mailto:tjchua@SIMTech.a-star.edu.sg)



### RFID-based Field Worker Identification and Tracking System (FIT)

July 2016 | SIMTech, Fusionopolis Two

This CIP helps companies deploy an RFID-based FIT to identify and track attendance of workers using RFID-enabled smart device technology and the Internet. The FIT system provides visibility of field workers' whereabouts anytime, anywhere and is used to improve project productivity.

For enquiries, please contact **Mr Wong Ming Mao** at: [mmwong@SIMTech.a-star.edu.sg](mailto:mmwong@SIMTech.a-star.edu.sg)

## PE COI Annual Conference 2016

12 May 2016 | 8.30am-5.00pm | Employment and Employability Institute (e2i), Halls 1 to 4

SMEs in Singapore will be able to explore business partnerships with industry players in the aerospace, medtech, complex equipment and oil & gas sectors at the PE COI Annual Conference 2016. Industry leaders will be sharing new opportunities in these clusters. Through the industry initiatives offered by PE COI, SMEs can address technology gaps and build capabilities to venture into growing industries. With the theme, **Partnerships in Capabilities Development**, closer collaboration with SPETA and several new initiatives to accelerate the capabilities development of the PE industry will be announced and launched at the conference.

For enquiries, please contact **Dr Alex Thoe** at Tel: 6319 4401 | Email: [tbthoe@SIMTech.a-star.edu.sg](mailto:tbthoe@SIMTech.a-star.edu.sg)

## SIMTech Annual Manufacturing Forum 2016 (AMF'16)

13 July 2016 | 8.30am-5.00pm | Grand Copthorne Waterfront Hotel, Ballroom, Level 4

With the theme, **Lightweight Materials and Technologies: Trends, Applications and Opportunities for Manufacturing**, industry and engineering professionals can look forward to SIMTech AMF'16 as leaders from the aerospace, automotive, construction, medtech and other industries share on the state-of-the-art lightweight technologies in the their respective domains and its impact on industry.

For enquiries, please contact **Mr Steven Tong** at Tel: 6793 8478 | Email: [steven@SIMTech.a-star.edu.sg](mailto:steven@SIMTech.a-star.edu.sg)



Scan for more events

## PE WSQ Graduate Diploma in Advanced Welding Technologies

### Module 1: Design Arc Welding

26 July 2016 | 6.30pm - 9.30pm, SIMTech, Fusionopolis Two

## PE WSQ Graduate Diploma in Manufacturing Operations Management

### Module 3: Manage Manufacturing Execution System (MES)

3 July 2016 | 6.30pm - 9.30pm, SIMTech, Fusionopolis Two

## PE WSQ Graduate Diploma in Precision Mechatronics

### Module 3: Design and Analysis for Machine Vibration

3 July 2016 | 6.30pm - 9.30pm, SIMTech, Fusionopolis Two

## PE WSQ Graduate Diploma in MedTech Manufacturing

### Module 3: MedTech Manufacturing Processes

3 July 2016 | 6.30pm - 9.30pm, SIMTech, Fusionopolis Two

## Operations Management Innovation Lean Improvement Towards Excellence (OMNI-LITE)

6 Jun 2016 | 8.30am - 12.30pm, SIMTech, Fusionopolis Two

5 Jul 2016 | 8.30am - 12.30pm, SIMTech, Fusionopolis Two

## Master Class in Emerging Manufacturing Technologies 3D Additive Manufacturing for Product Innovation

24 - 26 May 2016 | 9am - 5.30pm, SIMTech, Valley Block

For course details and registration, please visit <http://kto.SIMTech.a-star.edu.sg>

For general enquiries, please email [Email: kto-enquiry@SIMTech.a-star.edu.sg](mailto:kto-enquiry@SIMTech.a-star.edu.sg)



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### About SIMTech

The Singapore Institute of Manufacturing Technology (SIMTech) develops high-value manufacturing technology and human capital to enhance the competitiveness of Singapore's manufacturing industry. It collaborates with multinational and local companies in the precision engineering, medtech, aerospace, automotive, marine, oil & gas, electronics, semiconductor, logistics, and other sectors.

SIMTech is a research institute of the Agency for Science, Technology and Research (A\*STAR). With a pool of more than 400 researchers, we are committed to serving the manufacturing industry to develop the human, intellectual, and industrial capital in Singapore.

