

MANUFACTURING MATTERS

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RESEARCH SPOTLIGHT

**IMAGING ULTRAFAST
PHENOMENA** at Higher
Resolution and Lower Cost

NOTE FROM EDITOR...

Dear Friends and Industry Partners,

Being energy efficient has many advantages. Cost saving for company operations and buildings is one. Fraunhofer ISI (Fraunhofer-Institut für System- und Innovationsforschung, November 2015) reported that by increasing the energy efficiency (EE) of industry, transport and buildings, USA, Europe, China, India, Mexico and Brazil combined can reduce the cost of decarbonisation by up to a total of US\$250 billion annually. Another benefit for being energy efficient is improved productivity for workers and machines through analysing the energy usage.

With energy analytics, heat management and waste heat recovery, industry can achieve greater energy efficiency (see opposite Feature for details) by working with SIMTech through training courses and consultation. Collaborative industry projects, such as the e2i - supported Energy Efficiency Monitoring, Analysis and Planning for Solutions (E2MAPS), and courses, such as Manufacturing Productivity Improvement through Energy Usage Pattern Monitoring and Analysis which SIMTech has jointly developed with Singapore Workforce Development Agency, are ways to enable 10 to 20 per cent gain in energy efficiency and productivity.

**WISHING OUR FRIENDS
AND INDUSTRY PARTNERS
A HAPPY AND PROSPEROUS
LUNAR NEW YEAR**



Swee Heng

Editor, Manufacturing Matters

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ENERGY EFFICIENCY FOR INDUSTRY

Methodology and technology to identify hot spots and energy saving potentials, benchmark for best practices, manage thermal dissipation and recover waste heat

Energy costs account for approximately 10 per cent of the total production cost. Industry sectors such as petrochemicals, semiconductors and food manufacturing consume even more energy. Hence, there is much potential for energy savings working with SIMTech. Over the past two years, SIMTech has partnered various energy players to tap on this opportunity. SIMTech's EE Initiative consists of four major thrusts.

1. Identify hot spots and energy-saving potentials

SIMTech has developed a four-step approach that helps companies to achieve this (Figure 1). Known as Energy Efficiency Monitoring, Analysis and Planning for Solutions (E²MAPS), this methodology also test-beds prospective energy solutions. In addition to resolving the companies' immediate energy concerns, it also provides hands-on training in energy management for companies' staff to continue EE improvement. E²MAPS is supported by Employment and Employability Institute (e2i).



Figure 1

2. Benchmark for best practices

For companies with multi-lines and multi-sites operations, one approach is to identify the best practices through the EE benchmarking. It helps to establish baseline, and hence highlight the problem areas as well as the potential for improvement by comparing with best practices (Figure 2). This five-step energy benchmarking methodology (Figure 3) enables users to model and visualise the energy and material flows in the operations via multi-linear



FEATURE

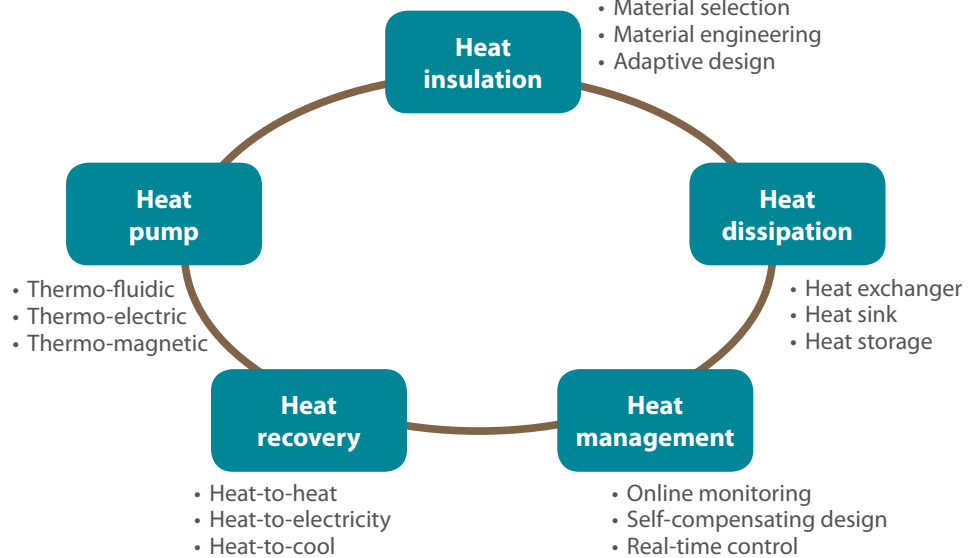


Figure 5

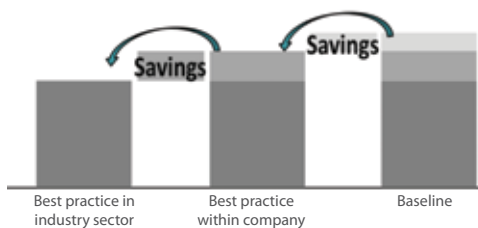


Figure 2

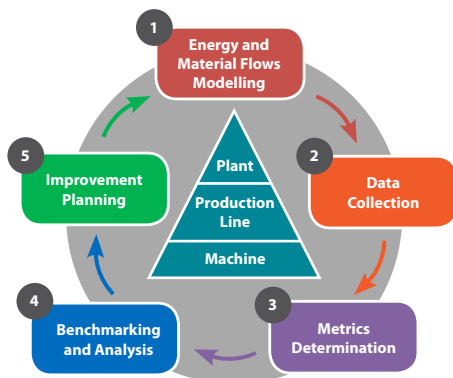


Figure 3

regression modelling, identify best practices data envelopment analysis and improve potential analysis through theoretical model-based analysis.

3. Thermal management for energy savings

In some high temperature processes, much of the electrical energy supplied to the equipment is dissipated as waste heat into the working environment. This requires additional energy, for example air conditioning, to remove it. This thermal comfort is important as it significantly affects shop floor productivity. Energy savings can be achieved by minimising the heat generation and dissipation from the

equipment. The knee-jerk solution to use air-conditioning is energy inefficient and suboptimal because the thermal balance of the process may be affected by the lower ambient temperature. An optimal approach is to create layers of stratified air-flows, which act like a blanket that reduces heat dissipation from the equipment to the room and minimise cool air in the room from getting into the equipment (Figure 4). SIMTech's competencies in thermal modelling and simulation competencies can thus guide the company in designing optimal shop floor ventilation and cooling systems.

4. Recover waste heat to reduce energy usage



Figure 4

Operations with high temperature processes have the opportunity to recover waste energy for other uses. Conducting a systemic analysis of thermal transfers and energy conversion is the first step towards better energy efficiency. (Figure 5). This is followed by on-site measurements and optimal design analysis to efficiently convert the waste heat to various forms such as heat-to-heat, heat-to-electricity, and

With E²MAPS, we can get accurate monitoring and reporting of energy consumption for our five hot-spot machines. Compared to our previous manual tracking and reporting, this is more than 100 per cent productivity improvement in energy efficiency management

heat-to-cold, that commensurate with the operations' characteristics. For example, operations that use hot water can better use waste heat to pre-heat (heat-to-heat conversion) the incoming water. Figure 5 illustrates some of the critical technologies required for the effective implementation of any thermal management solution.

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SMC Sustainable Manufacturing Centre
 Embracing Sustainable Manufacturing





COMPLEXITIES MADE EASY

JN Medsys, founded in 2010 and part of Camtech Management, is a life science company driven by the desire to make complex genomic tools accessible to more people. It aims to grow into a global maker of excellent products. JN Medsys is developing a cutting edge system for detecting DNA at extremely high sensitivity and precision which can be applied for clinical diagnostics of cancer and infectious diseases. The key technology behind this product is an innovative chip which comprises thousands of densely packed nanolitre reactions. It is not easy to develop this innovative chip due to the complexities involved. Working with SIMTech, the company developed a fully functional digital PCR (Polymerase Chain Reaction) technology, an efficient and cost-effective way to copy or amplify small segments of DNA or RNA system. The development project includes image analysis software, a working prototype of dPCR (Digital PCR) system, and design validation study.

“ Working with SIMTech allows us to develop cutting edge technologies in a shorter time as we have access to well-qualified staff and leading edge prototyping facilities ”

Dr Johnson Ng, Founder & CEO, JN Medsys Pte Ltd

JN Medsys is able to leverage SIMTech's resources. For example, the access to the specialised biology laboratory which is equipped with a range of high-end equipment is frequently used for its research.

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LOGISTICS SME'S BUSINESS PROCESS TRANSFORMED

A SIMTech researcher was attached to RichLand Logistics to improve its business operation productivity, flexibility and customer services through supporting the implementation of SAP Transportation Management (TM). The company, founded in 1992, is a Small and Medium Enterprise logistics solution provider of Distribution, Full Container Haulage, Terminal Handling, Warehousing, Project Logistics and Chemical Logistics services to its clients in the Asia-Pacific region. It aspires to be a leader in the areas of quality, health, safety, as well as the environment.

To achieve these, Richland needs efficiency in its operations as its business processes are manual, tedious and prone to errors. There is no real-time visibility of resource load capacity, job status and business performance. Enterprise-wide Resource Planning (ERP) is the answer to these challenges. However, the implementation of ERP requires clear understanding of the business processes and work flows for successful implementation. SIMTech supported by providing a more comprehensive overview of RichLand's business processes and work flows.

On completion, the User Requirements Specification (URS), work process flows and translation of documents into Electronic Data Interchange (EDI) format are in place. With URS, expectations of the users and the tasks of the vendor are clear. The exchange of business documents between business partners is enhanced by the use of EDI, leading to reduced errors and cost, increased processing speed and improved business partnerships.

The streamlined work process provides better visibility for the staff and remove redundant steps in the work flows

For more information, please contact **Mr Cedric Yon** at 6793 8561 or email to xyyon@SIMTech.a-star.edu.sg



VALUE CREATION FOR EMERGING MICROFLUIDICS INDUSTRY

Collaborative Industry Project (CIP) in Design, Prototyping and Characterisation of Polymer Microfluidics Device

Demand for polymer-based disposable microfluidic devices is rising rapidly globally - presenting both opportunities and challenges to the Precision Engineering (PE) industry. Assistance is needed to help PE companies secure orders from microfluidics device owners which are usually multinational life science companies. Specific expertise, skills and technological know-how are also required to cope with the design and manufacturing of the polymer microfluidic products.

In this CIP, SIMTech works with companies to build state-of-the-art capabilities in polymer-based microfluidics device manufacturing. The scope ranges from microfluidics technology overview, microfluidic components analyses, design,

prototyping to polymer microfluidic manufacturing technologies.

Participants can expect to benefit from this upgrading process technology on precision polymer moulding and bonding as they will be better equipped with capabilities to secure business in polymer microfluidics device manufacturing and grow their business with a wider product range. Funding from various sources is available:

SPRING ICV grant for SMEs, e2i (Employment and Employability Institute) grant for MNCs and SMEs, IRAS PIC (Productivity & Innovation Credits) for both SMEs and MNCs.

SIMTech has been developing the design and manufacturing capabilities for polymer microfluidics since 2007. It is the only research organisation in the region that specialises in providing manufacturing solutions for such devices.

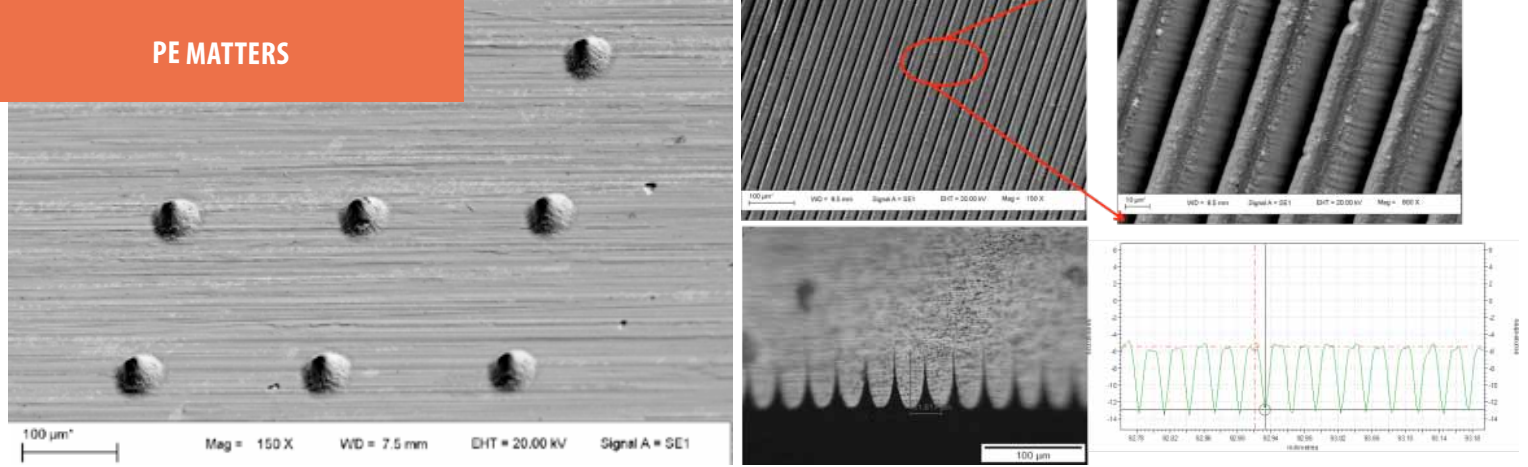
For enquiries, please contact
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EAC Emerging Applications Centre
 Seeding and Growing Emerging Industries



Scan for more information on SIMTech Microfluidics Foundry

To date, 12 companies, big and small, are participating in this CIP to establish the microfluidic value chain and eco-system locally



ACHIEVING SUPERIOR FUNCTIONAL SURFACE PROPERTIES FOR INDUSTRY

CIP builds capabilities in technology for industry participants

Technology using ultra-fast pulsed laser or deformation-based surface texturing opens up vast new applications of engineered surfaces, where the specific surface textures can create or influence functional properties. Surface functional property changes are dependent on morphology and size of the patterns created. Mimicking natural surfaces provides opportunities to offer special properties on the surface of metallic or polymer components. The technology is able to produce consistent large area surface textures such as periodic ripples, micro-bumps array and micro-dimple array pattern on different metallic or polymeric materials.

The technology leads to endless applications on materials ranging from steels, aluminium alloys, nickel-based alloys, tungsten carbide, silicon and many of the polymeric substrates. The laser or microformed surface textures can be transferred onto the components and products to generate

The technology is relevant to Precision Engineering-related industries with potential to spawn innovation of new products, add new or improve functional performances of current products and routine processes

new properties or improve its functional performance. Surface is enhanced for self-cleaning of consumer products; anti-sticking for IC packaging, home appliances; anti-corrosion; anti-fouling; friction reduction for cutting tools, sliding contacts in automotive components; friction drag force reduction to improve the efficiency and, reduce fuel consumption in aerospace and marine applications; wettability control for biomedical and microfluidics devices; thermal conductivity adjustments or improvement; increase light absorption/trapping for solar cell application; create

biocompatible surfaces such as increased cell adhesion for biomedical application, and many more.

To help companies adopt and benefit from surface texturing technologies, a CIP is introduced. Participating companies can benefit from the following:

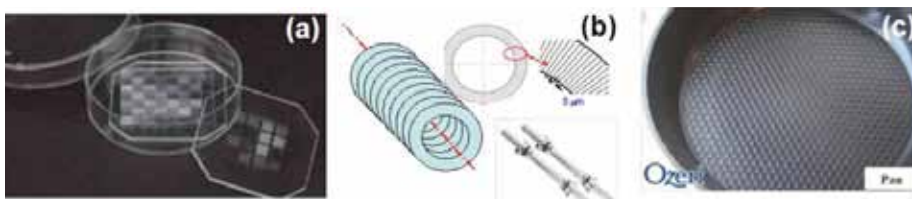
- Development of the surface texture features to generate the desired functional properties
- Simulation of the effect of developed surface texture on the metal and substrate
- Development of the laser or deformation fabrication process to transfer the developed micro/nano surface textures onto metal or polymer substrate
- Technical support on applying the developed surface texturing process onto real products in collaboration with industry partners.

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a) Surface texture on the petri dish for promoting the cell proliferation; (b) Surface texture on the water filter for the Oil & Gas wastewater treatment; (c) Surface texture on the cooking ware for anti-sticking property and thermal enhancement

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



Scan for more information
on Precision Engineering
Centre of Innovation



RAISING PRODUCTIVITY IN CONSTRUCTION SECTOR

RFID technology is used to manage, track, trace and audit natural stones inventory

Since 2011, the Manufacturing Productivity Technology Centre (MPTC) has successfully assisted enterprises, big and small, in various industry sectors to upgrade their productivity through the use of technologies. Thirty of them have received the inaugural Productivity Partnership Recognition for their productivity improvements. This award encourages manufacturing and service companies to create and drive a culture of continuous productivity, inspiring other enterprises to forge partnerships and initiate such journeys for productivity and growth. One of the recipients is highlighted.

Polybuilding (S) Pte Ltd is a leading stone and tile supplier specialising in materials supply and installation projects since 1974. Its local factory was set up in 1983 to meet the growing demand for the supply and installation of Italian marble processed from imported semi-finished products into kitchen and vanity tops including others which require the cutting and profiling of raw size slabs into finished cut sizes.

The company managed, tracked and audited its varied inventory items manually without using a computerised system. As business expanded, the existing system came under more pressure as too much time was spent on doing the same manual processes repeatedly, leading to inefficiency and errors. This slowed down the speed of operation and increased business cost.

To overcome these challenges, Polybuilding collaborated with SIMTech. A RFID/barcode-based IMTS which is affordable, easy to implement and use was developed. It allows Polybuilding to auto capture, track the size of each individual piece of natural stone and do registration, check in/ out, stock taking,

auditing, locating and relocating of items. The system also manages the operation data in a server, providing information on the history of its track flow, audit and stock taking.

With this system, the cycle time for stock taking is reduced by 50 per cent from 2 to 1 hour, saving 2 hours per day. The search time for natural stones is estimated to reduce by 95 per cent, saving a total of 5 hours daily. Polybuilding is planning to implement High-Mix Low-Volume manufacturing and other initiatives to continue its productivity improvement journey.

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“ **This new implementation has helped us to improve productivity which is so important for a SME where resources are limited** ”

Ms Sharon Thng, Financial Controller,
 Polybuilding (S) Pte Ltd

MPTC Manufacturing Productivity
 Technology Centre
 Enhancing Manufacturing Productivity



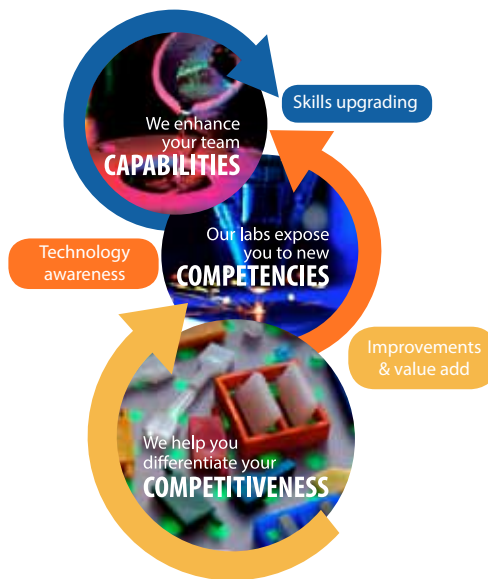
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 Manufacturing Productivity
 Technology Centre



UPGRADING MANUFACTURING WITH SKILLS AND TECHNOLOGIES

SIMTech is geared towards this

Unique technology and case study-based training that provides a mix of learn, practise and implement advantages is available to upgrade companies with industrial workforce skills and transfer cutting-edge knowledge and technologies for industrial application or adoption. In strategic partnership with the Singapore Workforce Development Agency (WDA) and other funding agencies, SIMTech initiated 20 Workforce Skills Qualifications (WSQ) training programmes for various sectors of the manufacturing industry. Through participating in these training programmes, more than 1,000 companies have benefitted, of which



more than 200 companies have reported productivity improvement ranging from 10 to 200 per cent.

With the government's announcement of Singapore SkillsFuture (SSF) Initiative, SIMTech has aligned its training programmes to SSF to create a vibrant learning environment for Singaporean individuals and employers. The effort includes:

- Streamlining or restructuring the training topics and course materials for solution-based or skills utilisation-focused training
- Strengthening Learn-Practise-Implement course delivery model with emphasis on Workplace Learning
- Establishing the e-learning management platform to incorporate e-learning for relevant topics

New WSQ training programmes in 2016 include two WSQ Graduate Diploma programmes in 3D Additive Manufacturing and Sustainable Manufacturing Technologies

SIMTech will continue its effort to be a technology-based knowledge transfer centre of excellence recognised by the manufacturing industry.

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KTO Knowledge Transfer Office
Enriching Industry Training



Scan for more information on SIMTech Knowledge Transfer Office

IMAGING ULTRAFAST PHENOMENA AT HIGHER RESOLUTION AND LOWER COST

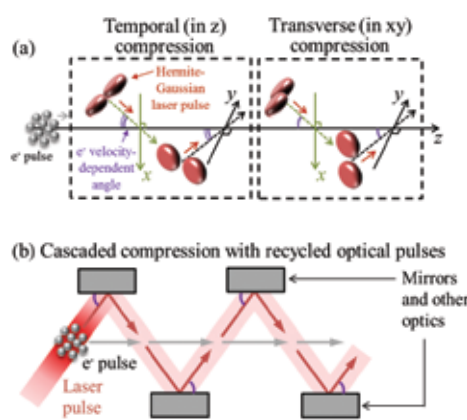
A new, all-optical method for compressing electron pulses to extremely short durations enables higher-quality imaging of ultrafast processes like chemical reactions

Many processes, such as chemical reactions, occur faster than a split second. To study these processes, scientists fire very short pulses of electrons at the sample. The electrons scatter off the sample, and resulting measurements at different times are put together to produce a real-time movie of the process. This technique, known as ultrafast electron imaging, depends on the duration of the electron pulse being much smaller than the duration of the process in question.

Guiding short pulses of electrons from their source to the sample, however, is a challenge since electron pulses tend to expand as they travel. Conventional electron imaging setups rely on static fields to do this. However, static fields can affect the electron source and the sample negatively, leading to deterioration in the image quality.

To avoid the problems associated with static fields, an SIMTech-MIT team has proposed the first all-optical scheme

for compressing electron pulses. In this scheme, a special type of laser pulse is fired towards the electron pulses at a slanting angle. This technique can compress the electron pulses along any one or more dimensions, including all three dimensions, to micrometer widths and ultrashort durations.



(a) An all-optical, 3-D method of compressing electron pulses for ultrafast electron imaging
(b) The cost-effective implementation of an all-optical, 3-D method for electron pulse compression

A major advantage of the proposed scheme is its inherent cost-saving feature, which allows the repeated re-use of a single optical pulse to implement a succession of compression stages. Thus, the use of a single laser pulse can be maximised

This scheme has been presented at the Optical Society of America's (OSA) Conference for Lasers and Electro-Optics (CLEO 2015) and Frontiers in Optics (FiO 2015). The achievement was featured in a press release by the Optical Society of America and the American Institute of Physics. Patents are being filed for this technology.

For more information, please contact Mr Tan Chee Tat at 6793 8576 or email cttan@SIMTech.a-star.edu.sg

A number of events were organised in 2015 to engage the industry and forge partnerships

MPTC Annual Conference 2015, 8 Oct

The Manufacturing Productivity Technology Centre (MPTC) Annual Conference 2015 was a huge success. More than 400 CEOs, CTOs and engineering professionals from the manufacturing and service industry attended the event. With the theme Towards Lean Enterprises, it generated awareness of productivity improvements through the use of technology and innovation by local enterprises. The focus of Lean Enterprises is on value creation for the end-customers and reduction in resource utilisation and waste. Though the journey to Lean Enterprises for the manufacturing and service sectors is critical, the complexity and lack of know-how and capabilities have to be resolved.

The Keynote Lectures on Business Transformation Model by Mr Jimmy Chua, CEO of Huatong Holdings; Business Model Innovation by Professor Serguei Netessine, Professor of Technology and Operations Management at INSEAD and the Lean Enterprise Model by Mr Mark Reich, COO of Lean Enterprise Institute provided insights to these challenges. A

Panel Discussion addressed the queries from the audience. Technical sessions in Business Innovation and Operations Innovation, including success stories of productivity journeys complemented the keynote lectures. Productivity discussion sessions for participating companies were organised for companies to discuss productivity improvement issues with our Manufacturing Productivity Associates. To assist companies to transform into Lean Enterprises with improved productivity, agencies and technology providers in automation, design and manufacturing including metrology, showcased their products and services.

At the event, 29 companies from the manufacturing and service sectors received the inaugural Productivity Partners Recognition from Minister for Manpower, Mr Lim Swee Say, for their productivity journeys which made a difference to their companies. Memoranda of Understanding on OMNI Partnership Agreement, R&D Collaborations and Advanced Manufacturing Masterclasses were also signed. MPTC Annual Conference 2015 is supported by the Singapore Workforce Development Agency (WDA), Infocomm Development Authority, SPRING Singapore and Employment & Employability Institute in collaboration with the Singapore Manufacturing Federation.



SMC Annual Conference and Technology Exhibition 2015, 5 Nov



Circular Economy – Sustainable Business Trends for Tomorrow's Manufacturing is the theme of SMC Annual Conference and Technology Exhibition 2015 (SMC'15). The event comprised the Keynote Session: The Circular Economy and Industry Cases Session covering business models, wastes revival, rethink resources, and re-engineering for sustainability. In this conference, SIMTech's new capability related to water efficiency was introduced. Winners of the 2015 Green Technology and Green Enterprise Award also shared on their green journeys.

SMC'15, which attracted more than 130 company representatives, is co-organised with Singapore Business Federation (SBF), supported by the Waste Management & Recycling Association of Singapore (WMRAS), and Sharing Economy Association (Singapore).

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



Integrated Carbon Footprint Assessment Reporting Essentials (i-CARE) for Building and Construction

Ongoing

Jointly organised by the Singapore Green Building Council and BCA's Centre for Sustainable Buildings and Construction, this provides an in-depth understanding of carbon footprint for the building industry. Participants will be able to undertake a carbon footprint assessment of their products competently.

For enquiries, please contact **Mr Jason Yip** at:
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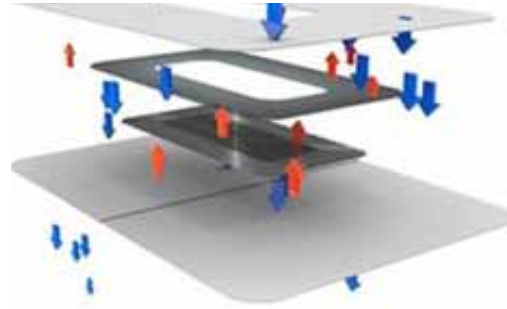


Item Management and Tracking System

Ongoing, 15 February 2016 and 21 March 2016

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:
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Deformation-based Surface Texturing for Functional Applications

Ongoing

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:
Tel: 6793 8513 | Email: mehrdad@SIMTech.a-star.edu.sg

Laser Surface Texturing for Improving Surface Functional Performance

Ongoing

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

For enquiries, please contact **Dr Mehrdad Zarinejad** at:
Tel: 6793 8513 | Email: mehrdad@SIMTech.a-star.edu.sg

High-Mix Low-Volume (HMLV)

12 January 2016 and 8 March 2016

This CIP trains production planners and supervisors in key planning concepts and shop floor tracking concepts respectively.

For enquiries, please contact **Mr Chua Tay Jin** at:
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SMS Networking Night 2016

18 February 2016 | 6.30pm-10.00pm | Grand Corpthorne Waterfront, Ballroom, Level 4

Our valued members and invited industry partners will come together to celebrate SIMTech's 10th SMS Night since the membership launch in 2006. SIMTech warmly welcomes our members to join us in this networking night for engaging interactions during the Lunar New Year. Guests will be updated on SIMTech's upcoming activities and our intention to bring more value to your trusted membership with us.

For enquiries, please contact Mr Cedric Yon at Tel: 6793 8561 | Email: xyyon@SIMTech.a-star.edu.sg



Scan for more events

PE WSQ Graduate Diploma in Advanced Welding Technologies

Module 4: Adopt Friction Stir Welding and Diffusion Bonding

26 January 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

PE WSQ Specialist Diploma in Precision Engineering

Module 6: Advanced Joining Technologies

16 February 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

PE WSQ Graduate Diploma in Metal Manufacturing Processes

Module 5: Perform Advanced Metal Welding

3 March 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

PE WSQ Graduate Diploma in Precision Measurements and Characterisation

Module 5: Materials Characterisation

10 March 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

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

For general enquiries, please contact

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Scan for more courses

PE WSQ Graduate Diploma in Precision Measurements and Characterisation

Module 4: Industrial Vision Inspection and Measurements

10 March 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

PE WSQ Graduate Diploma in Advance Welding Technologies

Module 5: Evaluate Advanced Brazing

22 March 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

PE WSQ Graduate Diploma in Manufacturing Operations Management

Module 2: Operations Analysis

4 April 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

PE WSQ Graduate Diploma in Precision Mechatronics

Module 2: Automatic Control in Precision Machines

4 April 2016 | 6.30pm - 9.30pm, SIMTech, Tower Block

Editorial Committee

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Ms Lee Swee Heng	Editor
Mr Daniel Lin	Member
Dr Goh Kiah Mok	Member
Mr Cedric Yon	Member
Ms Connie Ng	Member
Mr Larry Lim	Member
Mr Kelvin Goh	Designer

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.

