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SINGAPORE SEIZES FUTURE OF MANUFACTURING BY CATALYSING GROWTH OF SUSTAINABLE PRODUCTION TECHNOLOGIES  

The Agency for Science, Technology and Research (A*STAR) launches Asia’s first centre for test bedding and developing remanufacturing technologies  

Singapore—Singapore’s manufacturing sector is taking strides towards a more sustainable future with the launch of a new facility which allows companies to breathe new life into old product components by reusing them in their manufacturing processes.  

Located at Singapore’s first eco-business park JTC CleanTech Two@CleanTech Park, A*STAR’s Advanced Remanufacturing and Technology Centre (ARTC) is the first of its kind in the region dedicated to test-bedding and development of remanufacturing technologies through a public-private partnership approach, together with strategic partner Nanyang Technological University.  

Remanufacturing is a sustainable production process that involves transforming a recovered part or product through disassembly, cleaning, testing and other operations to produce like-new products to be reintroduced to the market. Remanufactured products are tested and certified to meet technical and safety specifications of new products as a mark of quality, and they are often sold with warranties comparable to the original.  

Said Mr Lim Chuan Poh, Chairman of A*STAR: “The ARTC embodies A*STAR’s commitment to driving Singapore’s economic growth, and moving Singapore to a more sustainable future. As the future of manufacturing continues to evolve, we believe the ARTC will strengthen Singapore’s competitiveness and allow us to capture the greatest value from the new growth area of remanufacturing.”
With the growing focus on sustainability and technology innovation, remanufacturing is widely seen as the future for manufacturing. Remanufacturing typically utilises less energy and generates less waste as compared to traditional manufacturing processes and is able to result in substantial environmental benefits. Through R&D, companies can also develop advanced sustainable remanufacturing technologies to strengthen their capabilities and technology know-how as well as increase their global market competitiveness.

**Strong industry support for the ARTC**

The ARTC provides a collaborative platform which brings together public sector research laboratories, academia and industry players from MNCs and SMEs to help bridge technological gaps in the adoption of advanced remanufacturing processes. It also works with NTU to develop a strong talent pipeline to support the shift towards eco-friendly production processes and techniques.

Specifically, ARTC aims to catalyse the adoption of remanufacturing in the aerospace, oil and gas, marine, energy, automotive and engineering industries. This effort towards spurring sustainable production has been met with strong support from the industry. Since the programme was first unveiled in 2012, the ARTC has welcomed 29 members on board including EOS GmbH, IHI Corporation, Rolls-Royce PLC, Singapore Aero Engine Services Private Limited (SAESL), Siemens Industry Software, and SKF. The members also include 12 local SMEs.

Dr David Low, Chief Executive Officer of ARTC, said, “ARTC is the first centre in Asia that adopts the AxRC model of industry-led public-private partnership across sectors and supply chains. Through this unique collaborative model, like-minded companies come together at ARTC to provide the real industry requirements, spark new ideas, catalyse new opportunities, leverage on shared-resources and accelerate the development of remanufacturing capabilities in a faster, better and cheaper way than doing it alone. We are truly grateful for the invaluable confidence and support our industry members have offered to the ARTC.”

To date, the Centre has completed over 50 industry projects. These range from an automated process to protect surfaces during repair processes, to a robotised inspection process to check for defects in components.
ARTC is collaborating with IHI to develop an advanced process for surface finishing of industrial components, to better protect surfaces from damage and contaminants that result in increased energy usage and higher likelihood of component failure in the long run. As an automated process, it reduces labour intensity and the amount of time taken for surface finishing, which will boost productivity for industries such as aerospace, automotive and oil and gas.

ARTC’s partnerships with industry leaders have also created new business opportunities that local enterprises can capitalise on as Singapore gears up for the future of manufacturing.

One SME which has captured business value as a result of ARTC’s efforts is local SME AmpTec Industrial Heating Pte Ltd., a company involved in one of ARTC’s projects with Rolls-Royce. AmpTec was commissioned to develop a dry ice blasting machine as a project. Dry ice blasting is an eco-friendly technique of cleaning aircraft engine components as it does not use polluting industrial chemicals and heavy scrubbing. It also causes less damage to the component surface than current methods of cleaning; thus retaining the quality and performance of the component. Through this collaboration, AmpTec has made headway with other member companies to see how it can support their remanufacturing business requirements.

Worldwide, remanufacturing is already commonly applied in the aerospace, marine, automotive and engineering industries. A report by Global Industry Analysts (GIA) predicts that the global automotive remanufacturing market is expected to reach US$104.8 billion by 2015. In Singapore, sectors such as aerospace, oil and gas, automotive and machinery have remanufacturing activities located here, with aerospace Maintenance, Repair, and Overhaul (MRO) being the biggest contributor.

Quotes from NTU and ARTC Members:

**Professor Bertil Andersson, President, Nanyang Technological University:**

“NTU is a natural partner for ARTC, and we are proud to work with A*STAR in establishing this unique facility. The research and proof-of-concepts will be done at NTU while the development and implementation of such innovative technologies will be undertaken at the ARTC. This completes an innovation value-chain, where ideas and innovations get commercialised and fed back into industry, contributing to the economy.”
Mr Ken Teng, Director, AmpTec Industrial Heating Pte Ltd:
“We have been in partnership with ARTC since 2014. To transform traditional ways of cleaning to the green way in the manufacturing industry is never easy. Cost and human habits are often the obstacles hindering the adoption of green manufacturing methods. After joining the ARTC membership programme, our company has received opportunities for growth and advancement.”

Mr Terrence Oh, Vice President, Asia Pacific, EOS GmbH:
“The primary goal for EOS in this collaboration is to bring about awareness of Additive Manufacturing / Industrial 3D Printing to the various industries in Singapore. The program at ARTC has provided such a platform whereby this goal could be met. In addition, the collaboration between EOS and ARTC has provided synergies in terms of analysis, measurement and post processes for Additive Manufacturing technology.”

Mr Tateno Akira, Executive Officer, General Director, Corporate Research and Development, IHI Corporation:
“IHI has a great interest in Additive Manufacturing and its related technologies, like internal surface finishing. They have a potential to change IHI’s way of production. And also, Automation with Robots for surface finishing and masking is our important theme to improve productivity. Through collaborations with ARTC and other members, we are able to accelerate our research activities on these themes.”

Dr Hamid Mughal, Director of Global Manufacturing, Rolls-Royce PLC:
“Rolls-Royce has played an instrumental role in the development of the ARTC and we are delighted to be celebrating its opening today. Our close involvement in the ARTC is an integral part our strategy to establish a global network of Advanced Manufacturing Research Centres. These centres operate a novel model of academic and industrial collaboration that is designed to accelerate the transfer of innovation from early university research to successful exploitation in industry. I have no doubt therefore that this environment of cross-sector knowhow and team spirit will enable the ARTC to establish itself as a world leading centre of excellence in manufacturing processes, systems and technology.”

Mr Rajiv Ghatikar, Vice President & General Manager, ASEAN/Australasia, Siemens Industry Software:
“Our vision for this collaboration with ARTC is to deliver fully on our commitment as a founding member. Together with ARTC, we aim to establish a center of
excellence in Singapore. Our joint projects in verticals like shipbuilding and aerospace and defence have the potential to revolutionize remanufacturing by replacing tedious and costly manual processes with tools like robotic machining development and hard metal machining. Together, we can build a robust, energy efficient digital enterprise for Singapore to enable local manufacturers to achieve and maintain leadership position in the industry. This partnership has also encouraged us to increase our investment and offerings here so we can contribute more to the economy, create more jobs and do our bit in helping Singapore reach its Smart Nation goal."

Mr Ulf Sjoblom, Vice President, Group Manufacturing Development, SKF:
“The scope and aim of the partnership is to develop technologies related to SKF Manufacturing and Re-manufacturing and its processing of materials to enhance the knowledge within manufacturing. The membership will give SKF access to world class research and a network with other membership companies which will strengthen SKF manufacturing.”

Mr Paul Inman, Chief Executive Officer, Singapore Aero Engine Services Private Limited (SAESL):
“SAESL is delighted to join ARTC. Our business has grown strongly through the support of our major partners SIA Engineering Company and Rolls-Royce. As we look to the future we will continue to expand our repair and overhaul capability in Singapore, specifically in the deployment of new repair technology and automation. Our partnership with ARTC is key to underpinning this growth, enabling us to bridge the gap between technology development and world class production capability.”

Enclosed:

ANNEX A – List of ARTC Research Themes
ANNEX B – List of ARTC members

For media queries and clarifications, please contact:

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About A*STAR’s Advanced Remanufacturing and Technology Centre (ARTC)

The ARTC is a platform built upon strong partnerships across the supply chain, complemented by technical support from research institutes and academia. ARTC combines the challenging industrial requirements of cross sector global OEMs, the state-of-the-art industrial equipment and software makers with the best minds in R&D to accelerate that creation of industrial solutions for manufacturing and remanufacturing.

For more information about ARTC, visit http://www.a-star.edu.sg/artc

About the Agency for Science, Technology and Research (A*STAR)

The Agency for Science, Technology and Research (A*STAR) is Singapore's lead public sector agency that fosters world-class scientific research and talent to drive economic growth and transform Singapore into a vibrant knowledge-based and innovation driven economy.

In line with its mission-oriented mandate, A*STAR spearheads research and development in fields that are essential to growing Singapore’s manufacturing sector and catalysing new growth industries. A*STAR supports these economic clusters by providing intellectual, human and industrial capital to its partners in industry.

A*STAR oversees 18 biomedical sciences and physical sciences and engineering research entities, located in Biopolis and Fusionopolis, as well as their vicinity. These two R&D hubs house a bustling and diverse community of local and international research scientists and engineers from A*STAR’s research entities as well as a growing number of corporate laboratories.
For more information on A*STAR, please visit www.a-star.edu.sg.
LIST OF ARTC RESEARCH THEMES

1. **Repair & Restoration**

Repair and restoration is an essential part of remanufacturing. The theme develops advanced technology for the rejuvenation of high value components with complex geometry, using state-of-the-art technology for cleaning, removing defects and adding material to reconstruct features. Integrated adaptive technology minimises human intervention and at the same time, reduces errors that can potentially lead to rework or scrapping of expensive parts, thereby enhancing productivity.

**Areas of Focus:**

- *Environmentally Friendly Cleaning*
  - Minimises usage chemicals
  - Eliminates the need for pre/post processing

- *Integrated Adaptive Repair Processes*
  - Remove defects accurately from high-value components
  - Compensate for part-to-part variations

- *Additive Techniques for Part Regeneration or Repair*
  - Enable free-form reconstruction of complex features
  - Minimise part distortion and heat damage

2. **Surface Enhancement**

Surface enhancement is an integral part of remanufacturing operations. It is a key process stage in improving the functionality, performance, and longevity of a component. Activities encompass a wide range of treatment technologies to both remove contamination and enhance surface quality through the elimination of surface defects using mass finishing or robotised processes. Further activities focus on fatigue enhancement, where processes are being developed to induce, measure and accurately predict sub-surface compressive stress.
Areas of Focus:

- **Robotised Finishing** (Deburring, Linishing, Polishing, Grinding)
  - Improves surface quality and consistency
  - Provides high accuracy and repeatability
  - Reduces consumable usage by up to 75 per cent

- **Surface Processes** (Cleaning, Mass Finishing, Abrasive Media Finishing)
  - Remove imperfections such as contamination, scratches, burrs etc

- **Sub-Surface Processes** (Shot Peening, Burnishing, X-Ray Diffraction)
  - Ensure fatigue enhancement to measure and predict sub-surface compressive stress

3. **Product Verification**

Product verification encompasses the whole life cycle of a component and/or system. It includes the measurement techniques for geometric, dimensional, and topographic information, as well as non-destructive evaluation methods for defects data. As an important supplement, measurement analysis using data prioritisation and fusion approaches, coupled with automated part sentencing, will aid the user in making decisions and minimise subjective errors.

It also covers component life prediction to provide the manufacturer with the expected product life cycle and economic justification for remanufacturing of a component. Other areas of focus include:

- **Complex Geometric & Surface Measurement**
  - Enables highly accurate non-contact measurement techniques to acquire geometric and surface information

- **Defects Detection & Measurement**
  - Enhances productivity by reducing human error with automation
  - Provides non-destructive evaluation
  - Enables convenience through online machine monitoring

- **Functional Characterisation & Diagnostic Analysis**
- Identifies and classifies defects
- Quantifies abnormalities against mechanical properties

- **Product Assessment & Lifetime Performance Prediction**
  - Estimates component life span through analytical and computational models
  - Assesses material integrity through non-destructive evaluation
  - Enables data fusion for intelligent automated part sentencing

4. **Additive Manufacturing**

The Additive Manufacturing theme develops advanced technology for the manufacturing of high value components. The focus is to identify current limitations on part geometry and performance using traditional manufacturing methods, and explore opportunities for product improvement and functionality using additive technology.

In addition, the technology theme aims to deliver complete solution from pre- to post-additive manufacturing processes, in order to enable test bedding of the manufactured components and translation into production ready solutions.

**Areas of Focus:**

- **Additive Process Development**
  - Develops near net shape manufacturing for metallic and ceramic materials
  - Optimises process for material and part performance
  - Improves material utilisation & cost efficiency

- **Pre-and Post-Processes**
  - Analyse and develop powder materials for performance
  - Enable post-machining of additive parts
  - Develop methodologies for measuring and validating part quality

- **Process Industrialisation**
  - Ensures part consistency through process repeatability
  - Enhances productivity through size scalability
  - Test-beds additive manufacturing components
LIST OF ARTC MEMBERS

1. EOS GmbH
2. IHI Corporation
3. Rolls-Royce PLC
4. Singapore Aero Engine Services Private Limited (SAESL)
5. Siemens Industry Software
6. SKF
7. 3M Singapore
8. ABB Pte Ltd
9. Barnes Aerospace
10. DMG MORI Seiki SEA Pte Ltd
11. Ecoroll AG Werkzeugtechnik
12. JOT Automation Ltd
13. Kennametal Inc
15. Taylor Hobson
16. TRUMPF Pte Ltd
17. Carl Zeiss Pte Ltd
18. Abrasive Engineering Pte Ltd
19. Alphasonics Pte Ltd
20. AmpTec Pte Ltd
21. Creatz3D Pte Ltd
22. GT Industrial Pte Ltd
23. JM Vistec System Pte Ltd
24. JPT Electronics Pte Ltd
25. Laser Cladding Singapore Pte Ltd
26. Spire Pte Ltd
27. Sysmatic Global Pte Ltd
28. Tru-Marine Pte Ltd
29. Whits Technologies Pte Ltd