Advanced Remanufacturing & Technology Centre (ARTC)

Technology Revolutionizing MRO

By: Nicholas Yeo
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Agenda

• Introduction
• Collaboration through Private Public Partnership (PPP)
• Examples of emerging technologies
• Impact, benefits and challenges
About the ARTC

- **An initiative by A*STAR in partnership with NTU**
- **Model** – 1st Centre in Asia adopting the AxRC model of Industry-Led Public-Private Partnership across Supply Chains
- **Mission** – To Bridge the Gap from Research to Industry Applications for Remanufacturing & Manufacturing for Cross-Sectorial Industries
- **Vision** – World Renowned Industry-Led Centre of Excellence for Remanufacturing & Manufacturing Technologies, Processes and Systems
- **Currently 42 Industry Members**
Research Partners & Environment

- Lead Government Agency for fostering World-class Scientific Research and Talent
- 21 Research Institutes specialising in Science & Engineering and Biomedical with over 5400 Staff
- Strategic Thrusts in developing Industrial, Human and Intellectual Capital
- Underpinned by strong coordination and support with sister agencies

- Ranked among Top 50 Universities worldwide
- One of the World’s Largest Engineering Colleges
- 10,000 Engineering Undergraduates
- 4,000 Engineering Postgraduates
Historic Constraint to Technology Development

Product and Business Challenges Demand the Development of **New Capability** to Remain Competitive

**Technology Readiness Level (TRL)**

- Basic: 1, 2, 3
- Pre-Production: 4, 5
- Production: 6, 7, 8, 9

**Institutes**

- NTU
- ARTC (Addressing the Valley of Death)
- A*STAR Research Institutes

**Additional Features**

- Competitive Capabilities
- Enhanced Product Quality
- Product Differentiation
- Faster Time to Market
- Reduced Lifecycle Costs
Public-Private Partnership Model

- Leveraging on pooled resources & R&D funding
- Achieving technology capabilities cheaper & faster

Industry-Led Public-Private Partnership Model

- Cross-Sectorial Collaboration across Supply Chain
- Creating & sharing best-in-class knowledge across sectors
- Early co-development with equipment providers to accelerate time-to-market

Public R&D Centre

- Purpose-built facility & industrial-scale equipment
- ‘Extended lab’ with research manpower leveraging
- Industrial skillsets

Private Companies

- Synergy Getting Ahead of Competition
- Safe environment for OEMs to conduct product-sensitive R&D
- Equipment providers supporting projects & getting first-hand feedback & commercial consideration

Resources
Currently 42 Industry Members

Focus sectors

Aerospace  Machinery  Oil & Gas  Marine  Land Transport  Clean Technology

Anchor / Tier 1

IHI  Rolls-Royce  Siemens  SKF  DMG MORI  EOS  SAEESL  McKinsey&Company

Tier 2

3M  ABB  Barnes Aerospace  Ecoroll  Hexagon  Jot  Kennametal  Zeiss  Materialise  Nakaiishi  National Instruments  Plasma  Taylor Hobson  Trumpf  UL

Tier 3

Accumet  Advantest  ABB  Alpha-Com  AmpTec  Creatz3  CT Industrial Pte Ltd  Eye2Eye  Electronic  Laser Cladding Singapore Pte Ltd  Nakom-Link  Sankei Eagle  Spire  Systematic Global  TruMarine  VBC  Whit's Technologies

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ReManufacturing and Manufacturing

Remanufacturing is the process of recapturing value added when the component was first Manufactured.
Key Technology Interests

**Regenerative Repair**
- Blown powder
- Cold spray

**Subtractive Technologies**
- Adaptive Machining with integrated scanning

**Verification Techniques**
- Automated defect detection
- Automated inspection

**Surface Enhancement**
- Fatigue life extension
- Surface finishing

**Industry Internet of Things (IIoT)**
- Wearables
- IoT Device

**Data Analytics**
- Predictive Maintenance
- Asset Optimization

**Advanced Robotics**
- Collaborative Assembly
- Flexible automation

**Remanufacturing**
- Life Cycle management
- Design for Remanufacturing expert system
Laser Metal Deposition

- Multifunctional 3D machine
- Cutting, Welding and Metal Deposition
- Ability to process a variety of metal powders
- Additive Manufacturing for high value component repair

Powered by: TRUMPF

Speed up 20x
Collaborative Robotics Development

- Collaborative workspace is becoming an important subject where human and machines work together in production.
- Collaborative Robotics are seen as a key enabler in this field.
- Support from Industry members for real problems and opportunities for cobot solution.
- Driving towards industrial adoption of robotic automation.
- Develop local SME supply chain for supporting cobot activities.

**Area of Interest**
- HS&E
- Simplified programming methodologies
- Human Assisted operations
- Limitation and explore new dimension of manufacturing capabilities

**Initial Phase**
- ABB YuMi Dual Arm Collaborative Robot
- Siemens Tecnomatix Robotic Assembly Simulation
- Universal Robot (UR10)
Augmented Reality for Manufacturing

- With advancement in technologies (miniature electronics, computational power, imaging process etc), augmented reality for industrial application become a feasible concept to improve manufacturing and repair processes.

**Area of Interest**
- Potential applications: assembly/disassembly inspection, defect detection, instruction and alerting, etc
- Skill Training needs
- Determine safety and limitations of AR in manufacturing capabilities (Eye fatigue, psychological risk)

![Image of Hololens, Epson Moverio, and Augmented Reality Interface]
The ASTAR Factory of the Future Testbed (2017…)

A*STAR Factory of the Future @ ARTC is a public-private partnership programme to setup a model manufacturing line as a platform to collaborate and develop technologies in a testbed, based on real applications in the manufacturing and remanufacturing areas.

Accelerate adoption of Digital Technologies across key industries in Singapore and create a marketplace for digital technology and applications, with unique reach in Asia and beyond.

To jointly develop a test bed model on smart factory where heavy equipment industry players (aerospace, marine, machinery) can validate and test new concepts for the next innovation of manufacturing.

Foster industry alignment by identifying list of immediate outcomes from the FoF development.

Provide a training ground for future engineers and create a digital culture for knowledge management.

Generate potential intellectual property portfolio in Industry 4.0 technologies.
Advanced Robotics
Robotic and automation technologies help boost productivity as part of the government’s efforts to shift towards higher value manufacturing. A*STAR has a number of teams dedicated to robotics. In Singapore, robotics is tapped on to complement the workforce, not to replace.

Drone Surveillance
For everything from remote factory supervision (when attached with cameras), to carrying lightweight items quickly across the factory floor.

Industrial Internet of Things
Objects such as manufacturing machines and environmental sensors are interconnected through a wireless network to provide data, which is then analysed in a variety of ways to improve productivity. Examples include better product design and machine diagnostics to predict when machines need maintenance, thus reducing their downtime.

Factory of the Future
The latest disruptive technologies – such as 3D printing, robotics and simulation – will be better integrated through the Internet of Things and Data Analytics to boost manufacturing productivity. The factory will be made even more efficient with green manufacturing solutions, drone surveillance, as well as smart control rooms and storage management systems.

Industrial 3D Printing
Known in industry-speak as Additive Manufacturing, this technology creates intricate parts more efficiently. Three-dimensional (3D) printing technology – which generates 3D objects from computational data by building them up in layers from materials such as plastic or metal – allows rapid production of complex, customised and previously inaccessible designs. The precise addition of material also minimises waste for a reduced environmental footprint.

Autonomous Vehicle Technology
To move heavy equipment and goods around a cluttered indoor environment safely, and efficiently.

Green Manufacturing
Efficient use of renewable resources such as solar panels to generate electricity; savvy building designs that promote passive cooling to maintain comfortable room temperatures without air-conditioning; better waste water treatment to reduce pollution, etc.

Smart Control Room
A fully integrated control system that does away with the countless monitors, knobs and buttons that could lead to human error. Tapping on the Internet of Things, the connected and smart control room is an organised way for managers to monitor the processing line.

Smart Storage System
For fast and accurate inventory management, companies could tap on technologies such as A*STAR’s Item Management and Tracking System. The data collected from this system can also be analysed to manage production capacity and predict the demand of the goods, to improve efficiency in production and ensure that customers receive their orders in a timely fashion.
Impact, benefits and challenges

What we are trying to solve
• Shortage of skill labors
• Higher productivity
• Increase value adds
• Transformation to knowledge based tasks

Benefit to achieve
• Consistent quality and repeatability
• Faster Turnaround (Increase yields and output
• Increase manufacturing capabilities
  ➢ Improve profitability and quality

Focus Area
• Advancing existing manufacturing techniques (NDT, flexible automation etc)
• Introduction new technologies (cobots / 3D printing, Data analytics etc)

Challenges
• Variability of repair works
• High cost of capital equipment
• Safety and Regulatory requirements
• OEM approving cycle
Thank You

Advanced Remanufacturing & Technology Centre of Singapore (ARTC)
3 CleanTech Loop #01-01, CleanTech Park (S) 637143
Website: www.artc.a-star.edu.sg

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