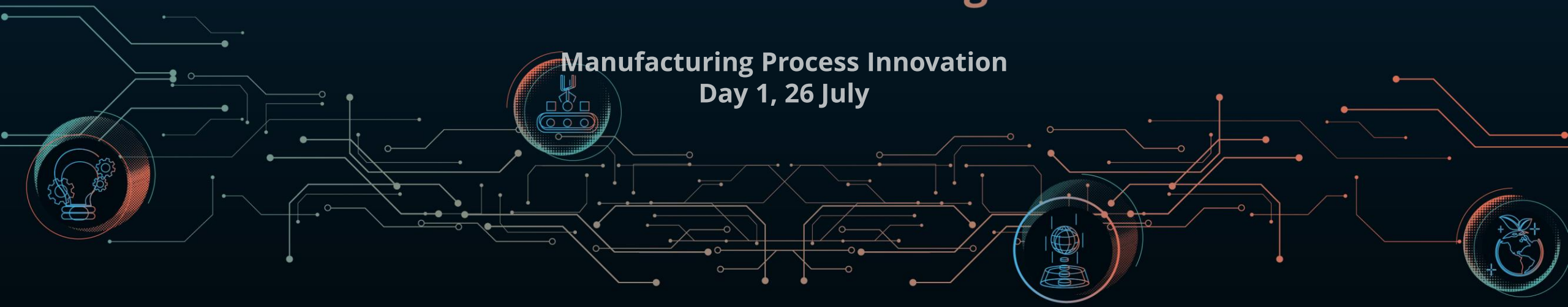
Singapore Institute of Manufacturing Technology

SIMTech

INNOVATION & TECHNOLOGY CONFERENCE 2023

Innovation Through Advanced Manufacturing Research & Technologies

Manufacturing Process Innovation
Day 1, 26 July



Manufacturing Innovation

Dr Chua Beng Wah
Acting Director
Precision Engineering Centre of Innovation (PE COI), SIMTech

Singapore Institute of Manufacturing Technology
SIMTech

30 Years of Driving Manufacturing Innovations with Local Enterprises
1993 - 2023

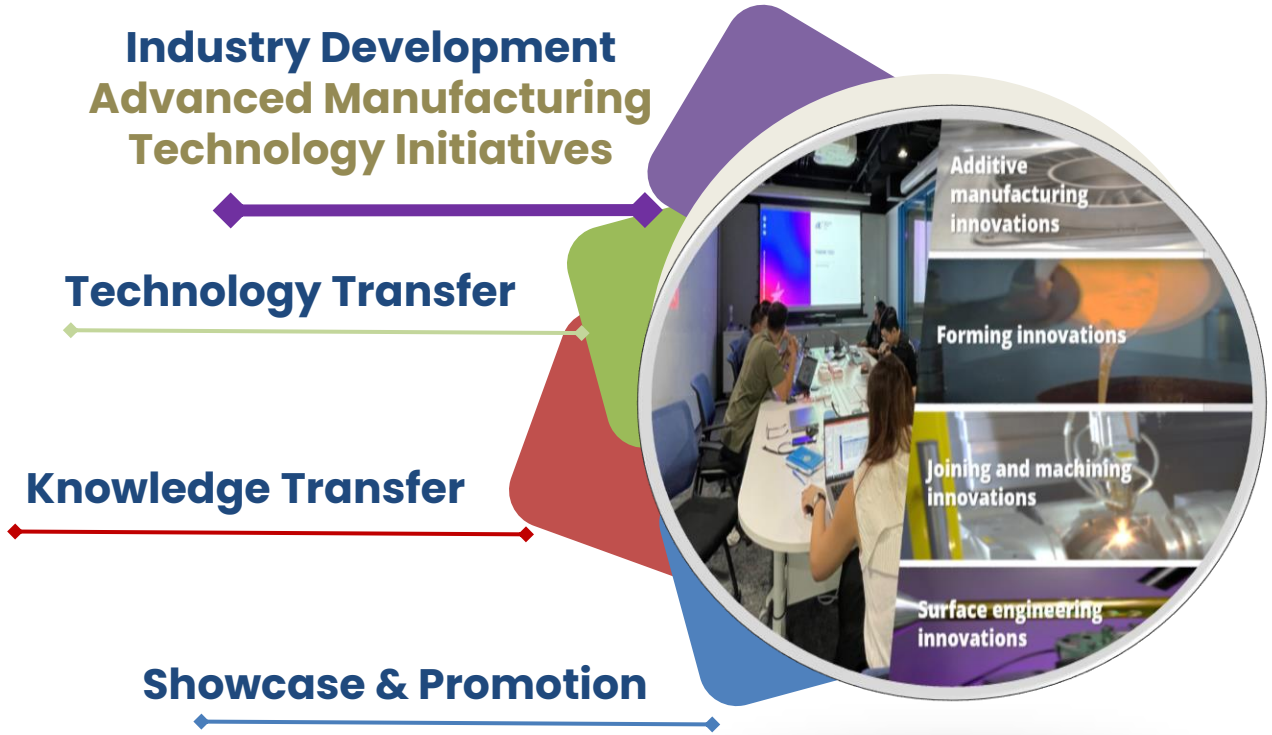
MANUFACTURING INNOVATION – PE COI (PRECISION ENGINEERING CENTRE OF INNOVATION)

Chua Beng Wah
Ag Director , PE COI & Advanced Forming and Surface Technology Division

A*STAR SIMTech

About PE COI

- To support our precision engineering manufacturing companies in leveraging SIMTech's innovative manufacturing technologies to sustain, transform and advance their businesses locally and internationally.



* Data since 1 June 2007

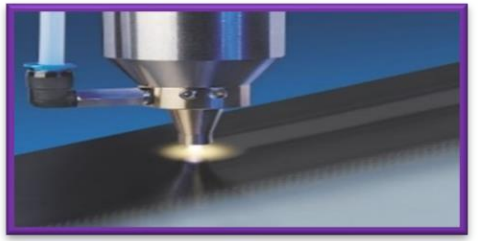
Industry Development – Technology Initiatives

Over 2,700 Precision Engineering (PE) firms needed to supply critical products and manufacture complex components and equipment to support these industries.

3D Additive Manufacturing

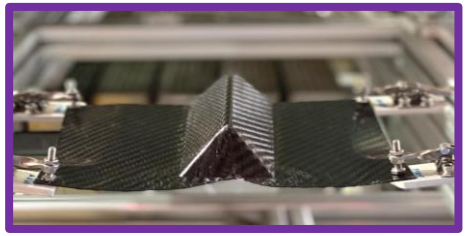
Laser aided Additive Manufacturing & welding

Surface & Circular Engineering



Functional & structural Material Manufacturing

Polymer & Composite Manufacturing



Manufacturing Innovation Initiatives – T Model

Companies

Trade Associations

Public Agencies

Joint Labs

Broad engagement through Technology Initiatives for SMEs

Deep engagement through Joint-Labs

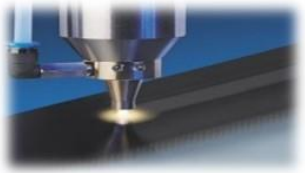
Broad Based Initiatives

3D Additive Manufacturing

Parts with complex design and geometries

Functional & Structural Material Manufacturing

Hybrid metal composite components with high strength-to-weight ratio and enhanced thermal performance

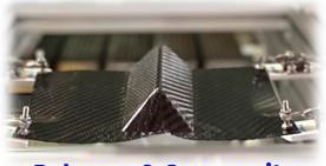


Surface Engineering

Advanced surface treatment and sustainable coatings

Laser aided Additive Manufacturing & welding

Large format high temperature alloy components

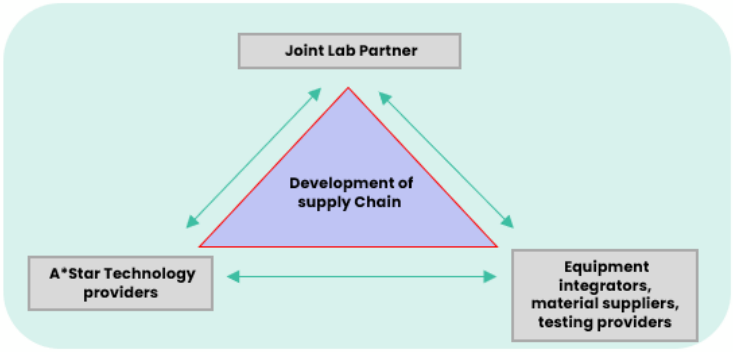


Polymer & Composite Manufacturing

Lightweight structural thermoplastic and hybrid composites

Deep Engagement

End to end solution



Supplier capability development

Broad Based Engagement

I.D.E.A workflow to bring together companies with similar manufacturing needs and provide opportunities for cost-sharing.

Identify

ALIGNMENT AND ORGANIZATION

- Grouping of common problem statements from various industries
- Process benchmarking and estimate process cost analysis.

Develop

CONCEPTUALIZATION

- Design for Manufacturing, Technology Demonstrator design
- Process knowledge and concept through classroom training (SSG courses)

Engineer

PROCESS TRAINING

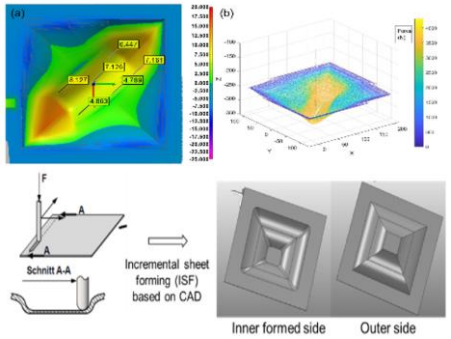
- Understand on the tooling/fixture design, system setup, simulation and modelling
- Process demonstration and optimization technology demonstrator

Apply

IMPLEMENTATION

- Specific part design & Specification.
- Process Development for the specific part
- Identify strategic suppliers and system integrators for potential implementation.

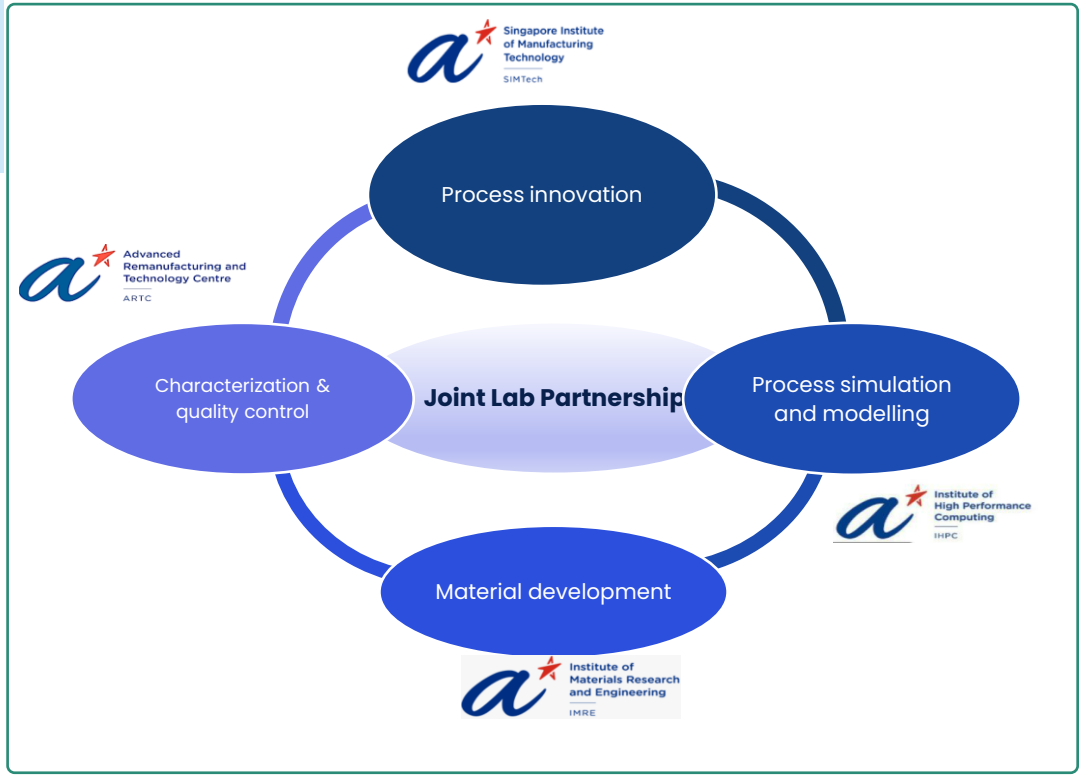
Example on Technology Demonstrator



- **1 to 1 Project Collaboration**
- **Joint Lab partnership**

Deep Engagement – Joint Lab Partnership

- To develop local manufacturing capabilities for components with improved product performance, reduced cost and component lead time together with research performers



Building up local competencies in aircraft interior to support SIA & SIAEC

SINGAPORE AIRLINES

SIA ENGINEERING COMPANY

Applied Total Control Treatment Pte Ltd

ATC

- ATC obtained service provider approval for copper trim repair from SIA and SIAEC and entered the Approved Vendor List.
- Coy secured new business from SIAEC.

Copper trim for Business class seat

Damaged trim

Repaired trim

Dynamold Precision Pte Ltd

DYNAMOLD PRECISION

- CAAS qualified Injection moulding process
- Established local manufacturing chain for 2 variants of sanitizer holders installed on all SIA & SCOOT aircraft.

Sanitizer Holder

LNE Holdings Pte Ltd

LNE HOLDINGS PTE LTD

- CAAS qualified Injection Moulding process and mould making.
- Improved part performance by ~40%.

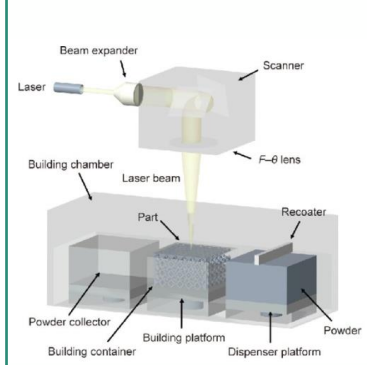
Armcap

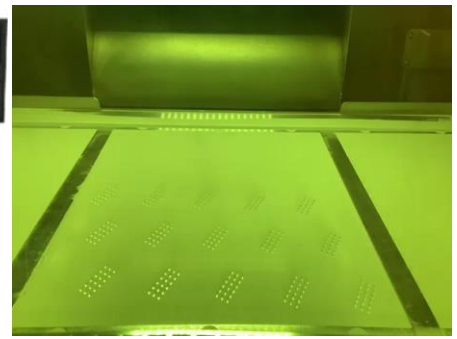
- To enhance the local manufacturing ecosystem for components manufacturing by uplifting SMEs capabilities and helping them to move up the value chain.

Technology Initiative – 3D Additive Manufacturing

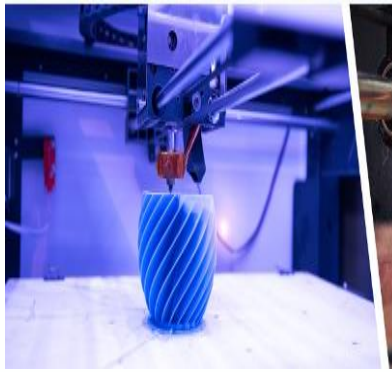
Motivation

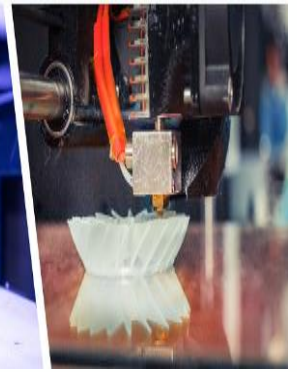
- To demonstrate end-to-end AM solutions from design & process optimisation, powder preparation & handling and product printing to secondary operations for manufacturing **parts with complex design and geometries.**



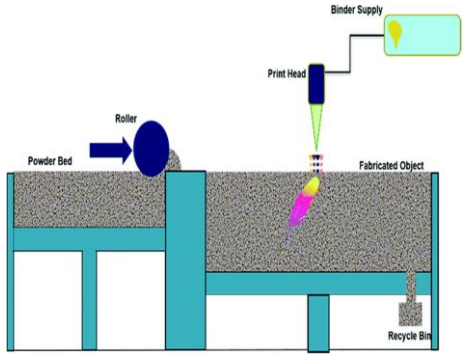


Micro Selective Laser Melting process





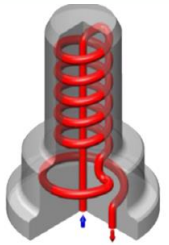
Fused Deposition Modelling (FDM)/Fused Filament Fabrication (FFF) process

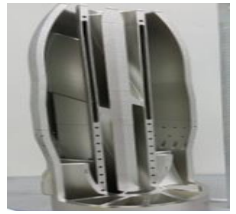


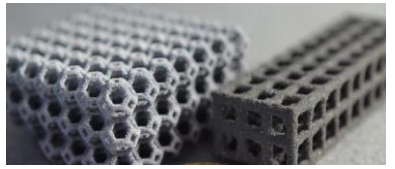
Ceramic Binderjet process

Potential Applications

- Complex design heat sinks
- Porous filters
- Conformal cooling tooling
- Medical devices







Keynote Speaker

Prof David Rosen – Design and Functionality of products taking advantage of the unique capabilities of AM, including geometric complexity, multiple materials, and multi-functionality.

Contact Person:
Tan Lye King – tanlk@SIMTech.a-star.edu.sg

Technology Initiative – 3D Additive Manufacturing

Value Capture

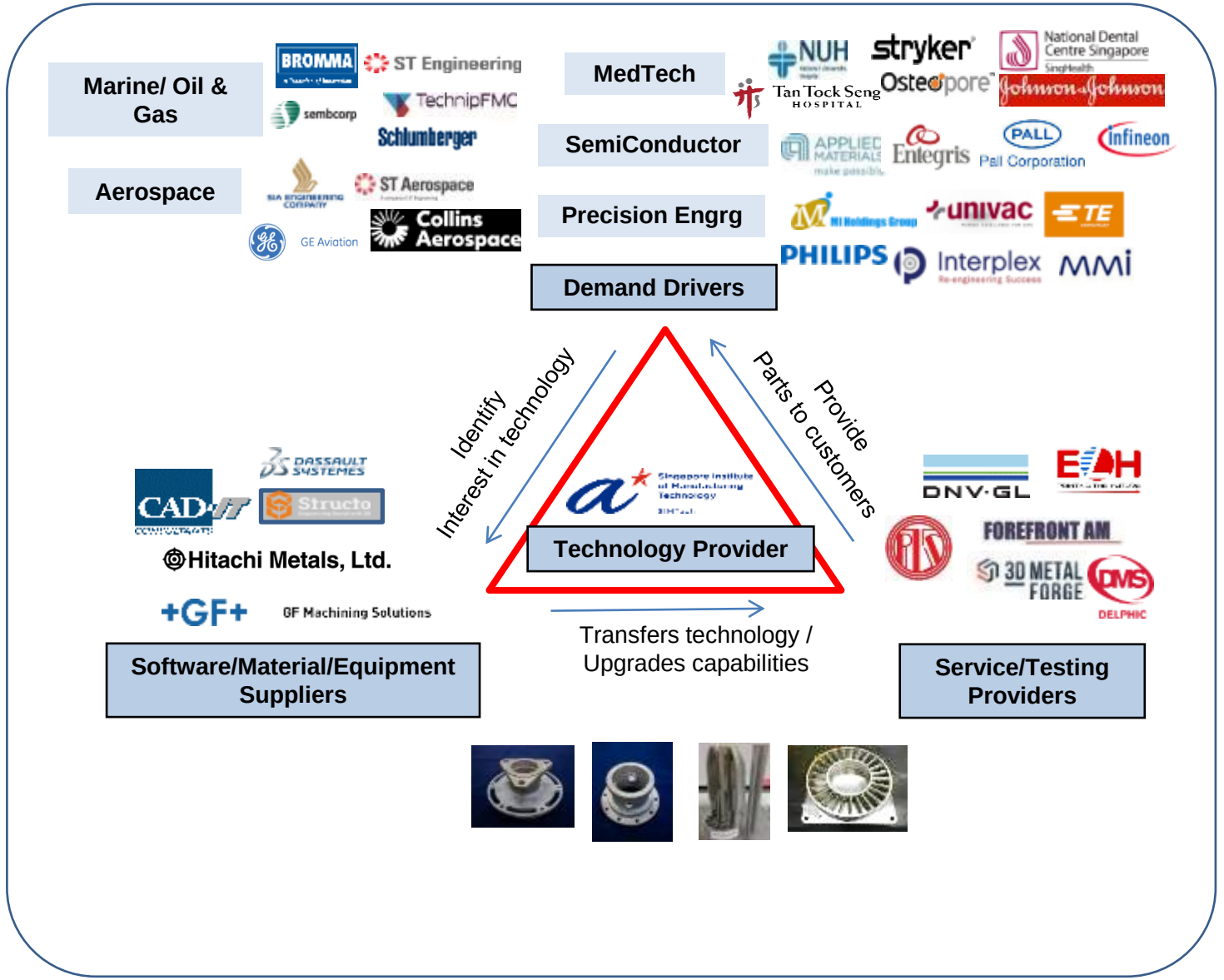
- Companies gain process knowledge on 3D powder based and extrusion based AM processes to assess the feasibility of 3D product printing for the various industries.

Companies visit/Seminar/Webinars

↓

I.D.E.A

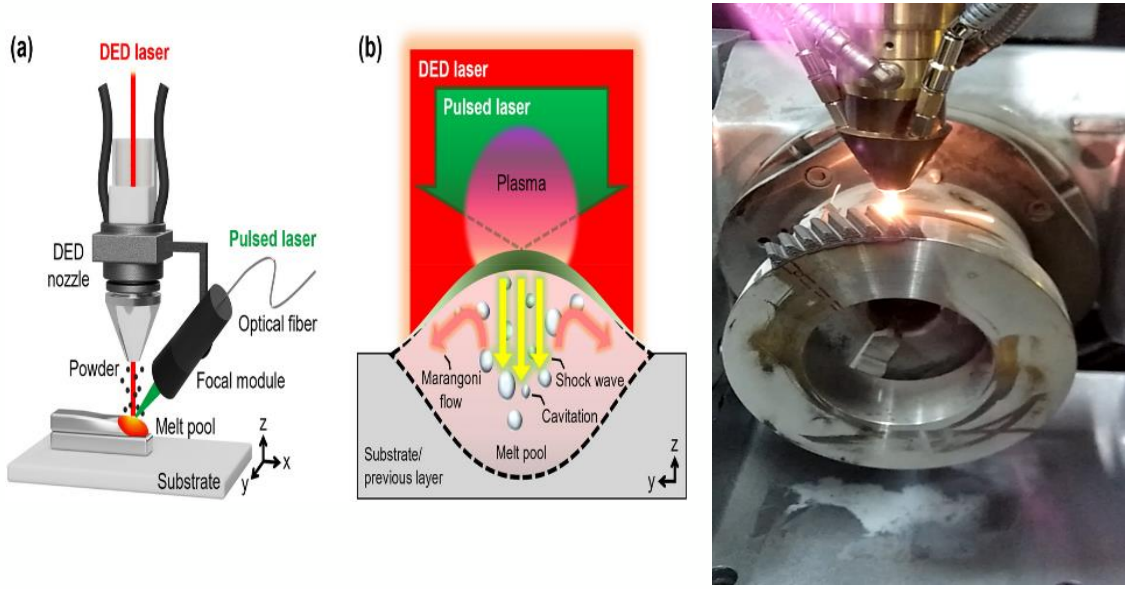
Supported through SSG courses	
1 to 1 project collaboration Joint Lab Partnership	



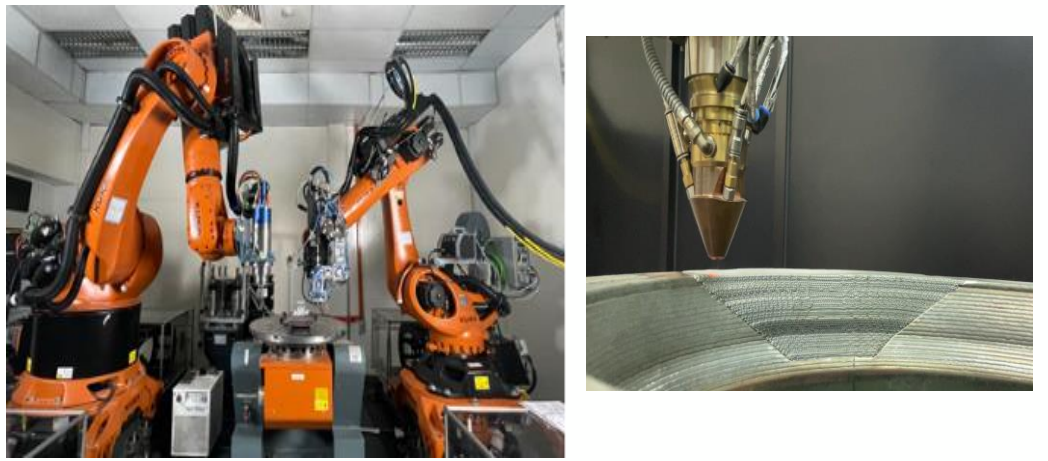
Technology Initiative – Laser Aided Additive Manufacturing

Motivation

- To demonstrate both robotic and CNC based hybrid LAAM/WAAM with machining and welding technologies for manufacture **large format high temperature alloy components** in marine oil and gas, transport, construction and automotive industries.



Hybrid CNC based 5 axis LAAM



Hybrid robotic 5 Axis LAAM and Machining

Potential Applications

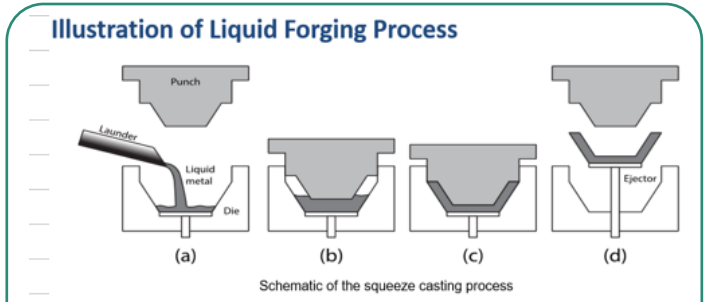
- Large format structural components
- Multi material metal parts

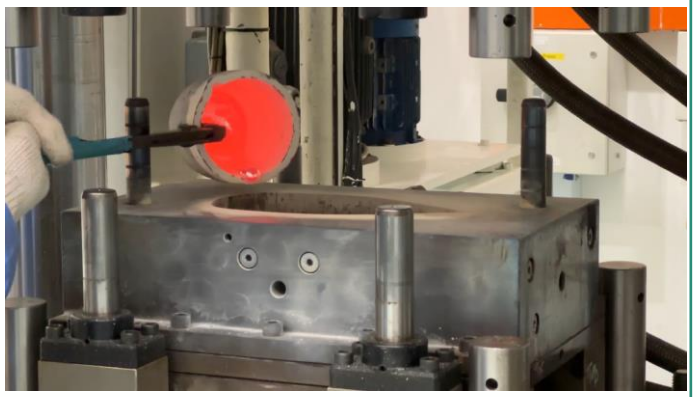
Contact Person:
Tan Lye King – tanlk@SIMTech.a-star.edu.sg

Technology Initiative – Structural & Functional Material Manufacturing

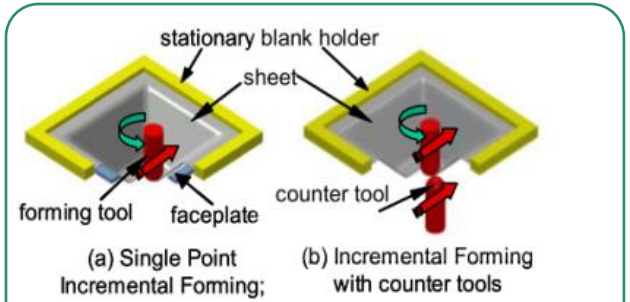
Motivation

- To demonstrate integrated liquid forging and powder forming processes for near net shape **hybrid metal composite components with high strength-to-weight ratio and enhanced functional properties**

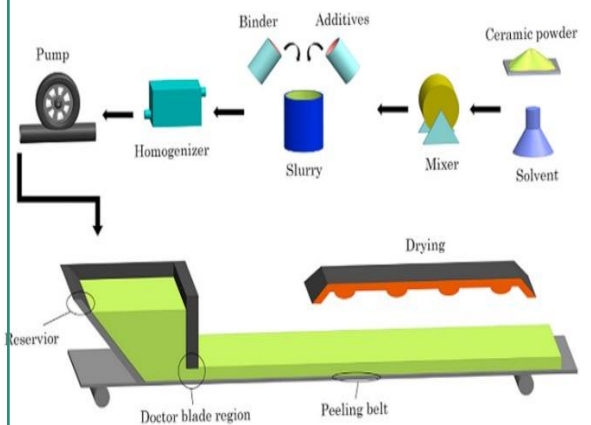


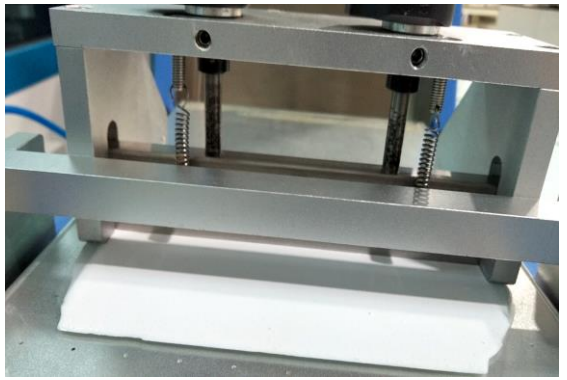


Liquid Forging



Dieless Forming

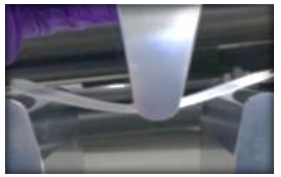


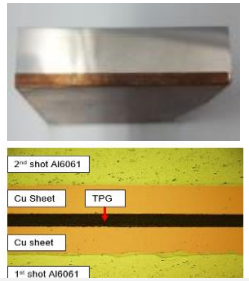


Gel Tape Casting process

Potential Applications

- Conformable structural metal sheet parts
- Thin and flexible functional ceramic sheets
- Multi material for high thermal components



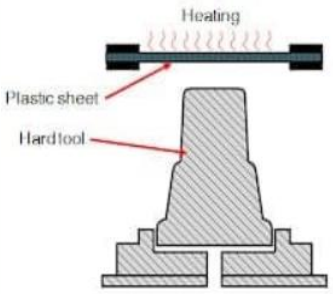


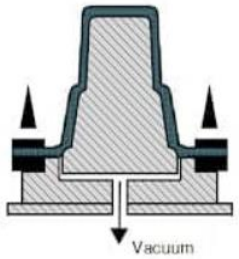
Contact Person:
Alex Thoe – tbthoe@SIMTech.a-star.edu.sg

Technology Initiative – Polymer & Composite Manufacturing

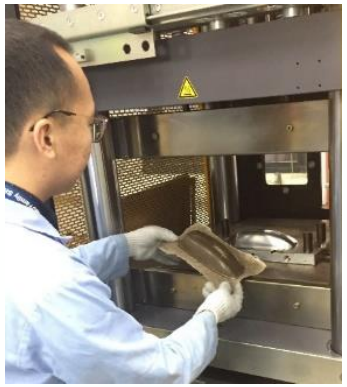
Motivation

- To demonstrate technologies in **lightweight structural thermoplastic and hybrid component** manufacturing for engineering and transport applications to enhance local companies' capabilities for new business opportunities.

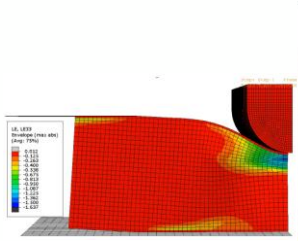


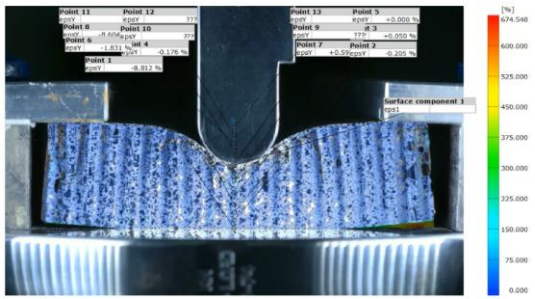


Polymeric Sheet Thermoforming process



Compression Moulding



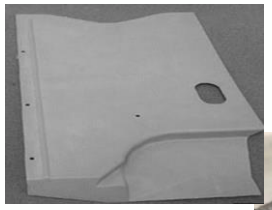


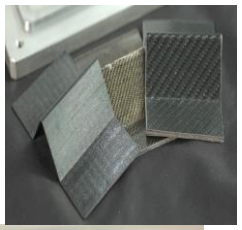
Advanced Composite Testing

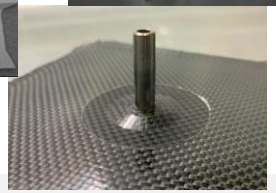
Fiber Reinforced THERMOPLASTIC Composites Thermoforming

Potential Applications

- Thermoplastic polymeric and composite aviation parts
- Insert moulding of composite parts







Contact Person:
Sun Zheng – zsun@SIMTech.a-star.edu.sg

Training Course – Polymer & Composite Manufacturing

Singapore Institute of Manufacturing Technology
SIMTech

Supercharge Your Career With Our Upcoming Courses on Advanced Manufacturing Processes for Sustainable Polymer-based Materials and Composites

1 August 2023, Tuesday | 11:00am – 12:00pm

LIVE WEBINAR

To register the webinar

Scan QR code to learn more about our courses

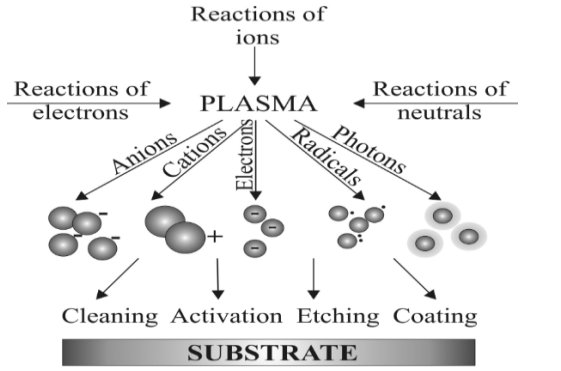
Program of the webinar

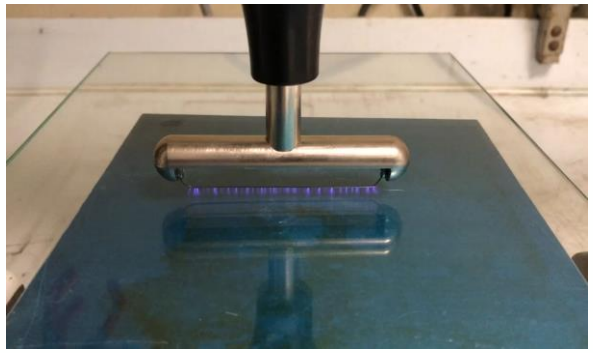
11:00 am	Introduction of Advanced Composite Testing Course by Dr Wang Chen, Senior Scientist, Polymer & Composite Processing, SIMTech
11:20 am	Introduction of Advanced Manufacturing Processes for Sustainable Polymer-based Materials by Dr Lau Soo Khim, Principal Scientist, Polymer & Composite Processing, SIMTech
11:40am – 12:00 pm	Q&A

Technology Initiative – Surface and Circular Engineering

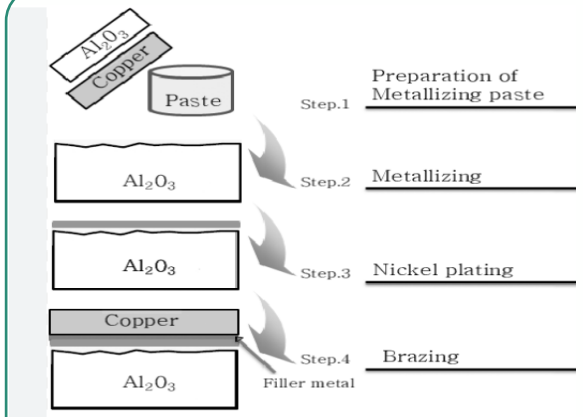
Motivation

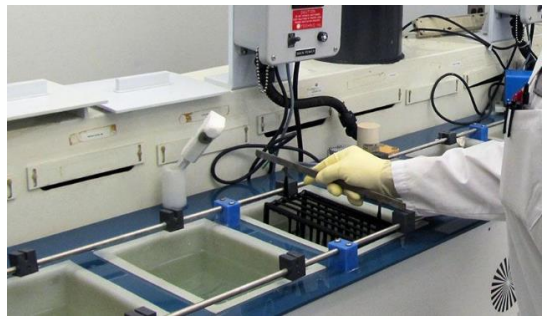
- To demonstrate **advanced surface treatment and sustainable coatings** for various applications in Aerospace, Electronics and Automotive industries.



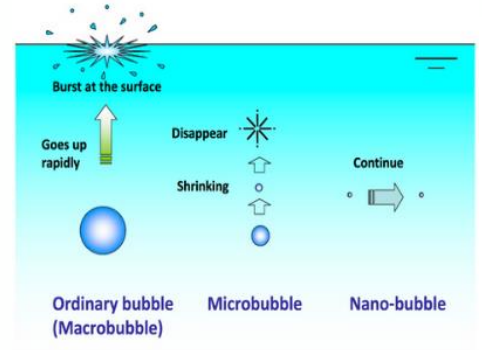


Atmospheric pressure plasma surface modification process





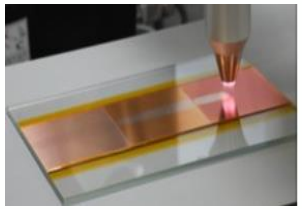
Lab Scale Electroplating line

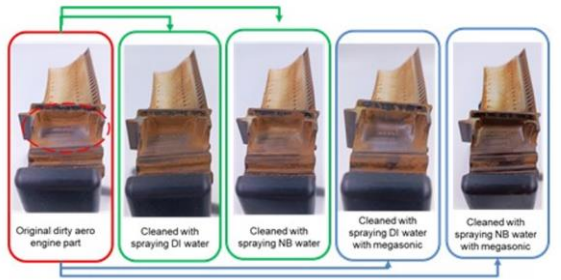


Nanobubble cleaning process

Potential Applications

- Rapid electrolytic deposition of NiP coating for mould inserts, diamond turning
- Atmospheric Pressure Plasma cleaning
- Nanobubble cleaning for oil contaminated parts





Contact Person:
Goh Chee Chien – gohcc@SIMTech.a-star.edu.sg

Project Collaboration Highlights

Capability Development from process, system integration to building manufacturing ecosystem

On Demand Moulding of aviation components

SIA*SIAEC*SIMTECH JOINT LAB

15 Apr 2021

ACCELERATED COLLABORATION IN RESPONSE TO COVID-19

In July 2019, a joint laboratory was set up between Singapore Airlines (SIA), SIA Engineering Compa
SIMTech. This tripartite collaboration aimed to accomplish the following goals: (1) to develop local
capabilities for aircraft cabin interior components with improved product performance, redu
component lead time; (2) to enhance the local manufacturing ecosystem for aircraft cabin interior c
uplifting SMEs capabilities and helping them to move up the value chain and (3) to provide manpo
support the local aerospace cabin interior manufacturing workforce. The established local sup
ecosystem will help Singapore become the R&D Centre of Excellence for cabin interior componer
manufacturing.

Surface Coating of copper trims for cabin seats

A*STAR AND LOCAL SME ATC COLLABORATE ON SUSTAINABLE MRO REPAIR WORK FOR SINGAPORE AIRLINES

21 Jun 2023

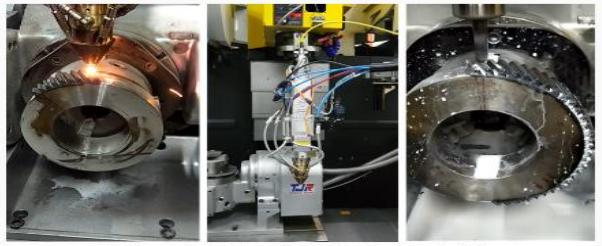
*A*STAR and local SME ATC collaborate to refurbish Singapore Airlines' cabin components*

SINGAPORE, 21 June 2023 – The Agency for Science, Technology and Research (A*STAR) and local SME, Applied Total Control Treatment Pte Ltd (ATC) have completed a technology transfer, enabling ATC to take over the repair line for the refurbishment of Singapore Airlines' (SIA) cabin components. The repair line allows SIA to integrate

Advanced Powder Metallurgy for net shape components

Laser aided AM system

LASER-AIDED ADDITIVE MANUFACTURING (LAAM) TECHNOLOGY SUPPORTS PRODUCTION AND REPAIR OF COMPLEX, FUNCTIONAL METAL PARTS.



Hybrid Computer Numerical Control (CNC)-based 5-axis 3D printing and machining system

Hybrid robotic 5-axis LAAM and machining system *Printed Turbocharger casing*

ISDN Holdings Limited ("ISDN") is partnering with SIMTech to commercialise the Laser-Aided Additive Manufacturing (LAAM) technology platform for 3D printing and deposition of corrosion-resistant metal structures and components for heavy industries such as aerospace, oil and gas, and offshore and marine.

Large format AM

A big thank you to our industry keynote speakers

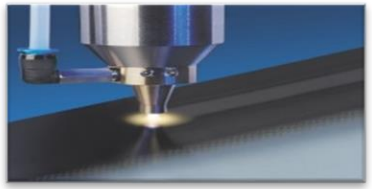
Mr Sito Waiseng, Mr Glenndle Sim, Mr Chen Li, Mr Tay Geok Kee, Mr Jacky Chan

Showcase and Promotion

Technology Initiatives

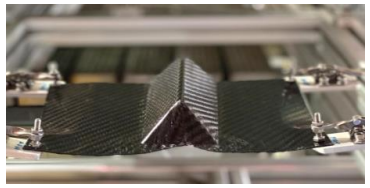
3D Additive Manufacturing

Laser aided Additive Manufacturing & welding



Surface & Circular Engineering

Functional & structural Material Manufacturing



Polymer & Composite Manufacturing

- Series of webinars/workshops to promote new manufacturing Technologies and lab tours
- Strategic discussion with TACs and Agencies
- Research collaboration with IHLs (Institute of higher learning)
- Roundtables & networking

PE COI is one of the appointed partner institutions to validate innovation projects.

Enterprise Innovation Scheme (EIS)

Share:

As announced in Budget 2023, to encourage businesses to engage in research and development ("R&D"), innovation and capability development activities, DPM and Minister for Finance has decided to introduce the Enterprise Innovation Scheme ("EIS"). Under the EIS, existing tax measures will be enhanced and a new tax measure will be introduced. In addition, eligible businesses may opt to convert up to $100,000 of the total qualifying expenditure for each Year of Assessment ("YA") into cash at a conversion rate of 20%. Learn more about the EIS (PDF, 588KB).

https://www.iras.gov.sg/schemes/disbursement-schemes/enterprise-innovation-scheme-(eis)

Upcoming Technology Initiatives

Decarbonization

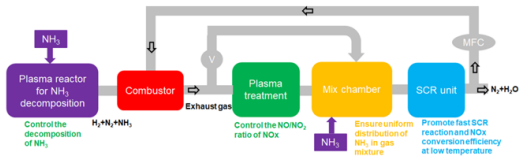
- Closed Loop Manufacturing
- Manufacturing processes for new energy storage (Ammonia , H2) and conversion

Q4 2024/2025

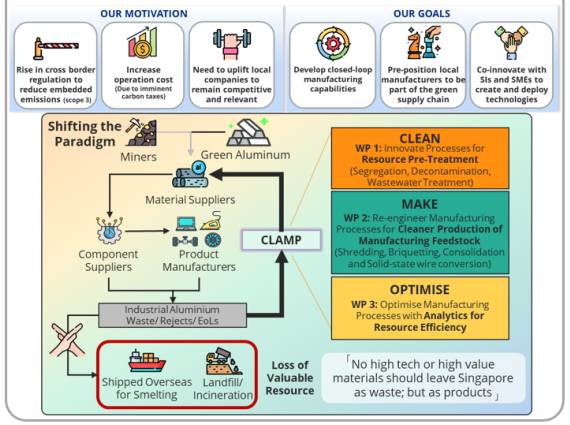
- Clean Energy via Ammonia Utilization for Hydrogen Economy: **Plasma enhanced processing systems for low temperature NH_3 cracking and NOx reduction**

Using plasma to improve the flame stability and NOx reduction

- ✓ Plasma reactor for NH_3 treatment for H_2 content control and system energy efficiency improvement
- ✓ Plasma assisted low temperature SCR (175- 260°C) for enhanced conversion efficiency at low temperatures and overall system efficiency improvement



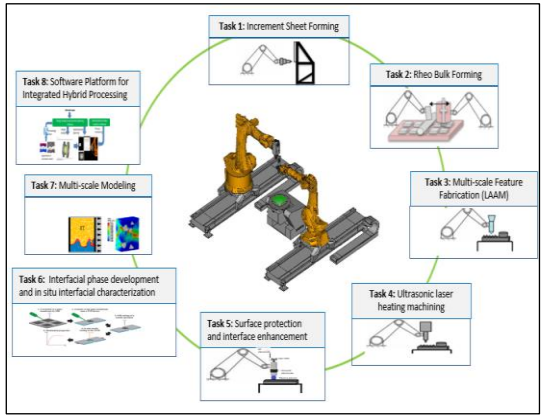
- Reducing Scope 3 embedded Emissions: **Closed-Loop Advanced Manufacturing Processes (CLAMP)**



Q3 2024

Digitalization in Manufacturing

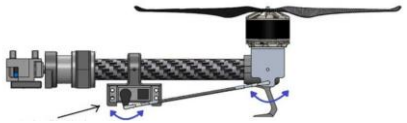
- Adaptive and flexible manufacturing



Q1 2024

Electrification

- Manufacturing for thermal and lightweight components



Manufacturing Innovation is the key to enhance our competitiveness

CREATING GROWTH, ENHANCING LIVES

Singapore Institute of Manufacturing Technology
SIMTech

30 Years of Driving Manufacturing Innovations with Local Enterprises
1993 - 2023

THANK YOU

www.a-star.edu.sg/SIMTech

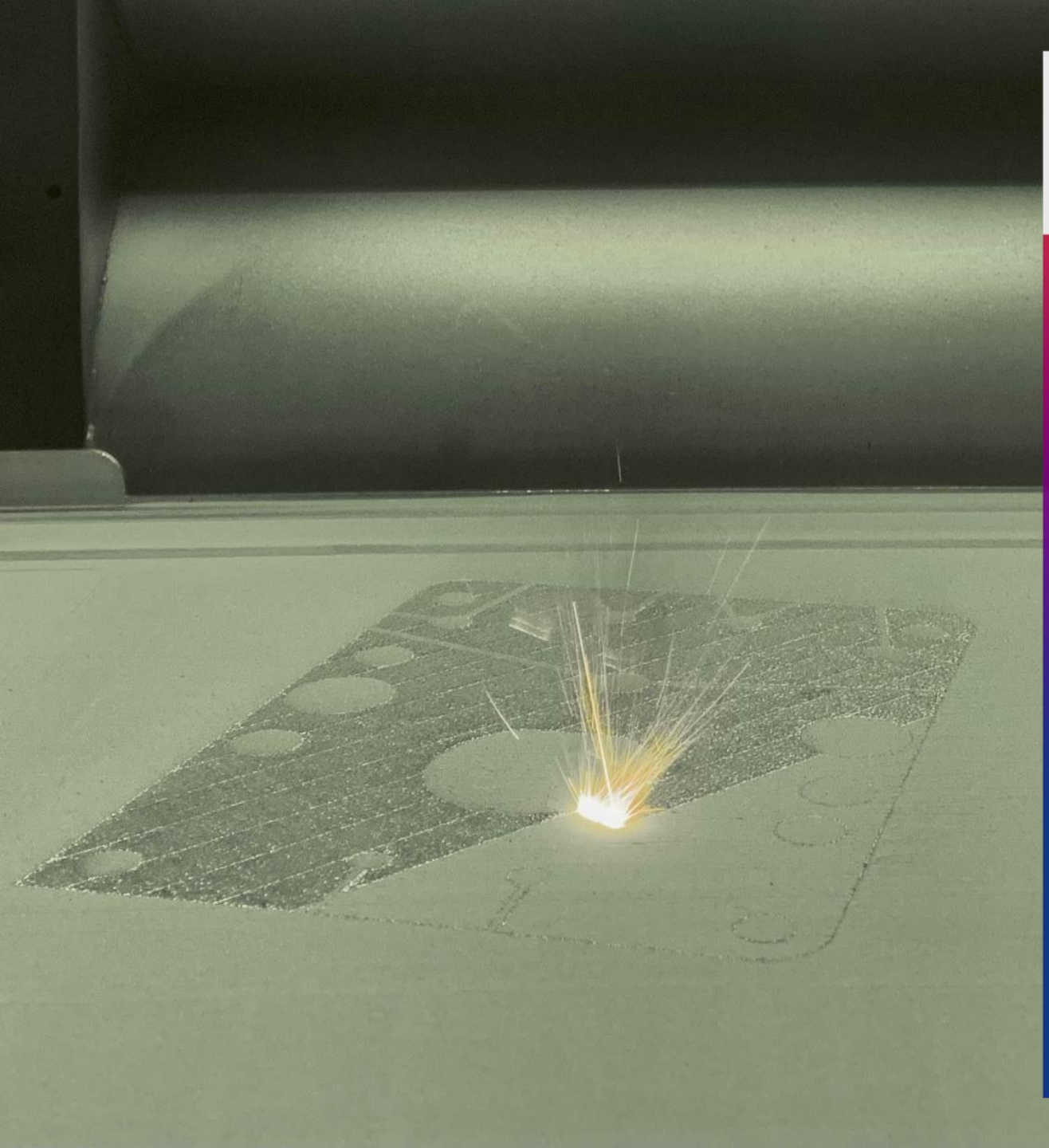
Chua Beng Wah
bwchua@SIMTech.a-star.edu.sg
Contact number: 97975305

@SIMTechSG

INNOVATION & TECHNOLOGY
CONFERENCE 2023
Innovation Through Advanced Manufacturing
Research & Technologies

Developing Additive Manufacturing Solutions – From Research to Development and Towards Integrated End-to-End Platform Solutions

Prof David Rosen
Principal Research Scientist
Institute for High Performance Computing
and SIMTech, A*STAR



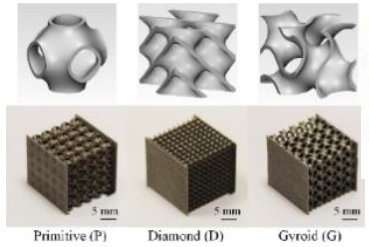
Singapore Institute of Manufacturing Technology
SIMTech

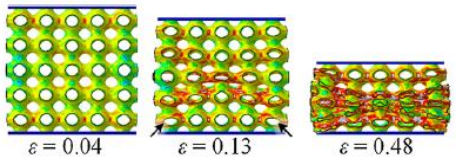
Institute of High Performance Computing
IHPC

Developing Additive Manufacturing Solutions – From Research To Development And Towards Integrated End-to-end Platform Solutions

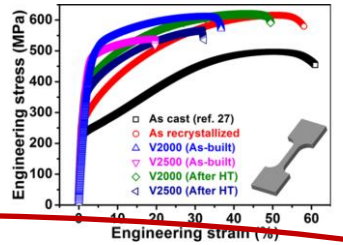
Prof. David Rosen, SIMTech & IHPC

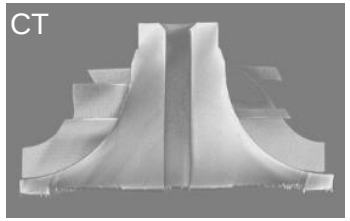
Additive Mfg End to End Technology Solutions





Lattice & cellular structures exhibit excellent energy absorption





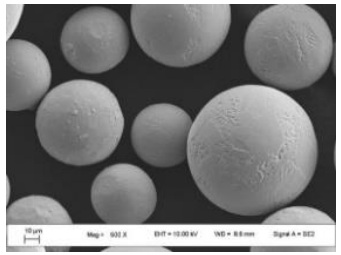
X-Ray CT scan of a highly dense E-PBF Ti impeller after process development

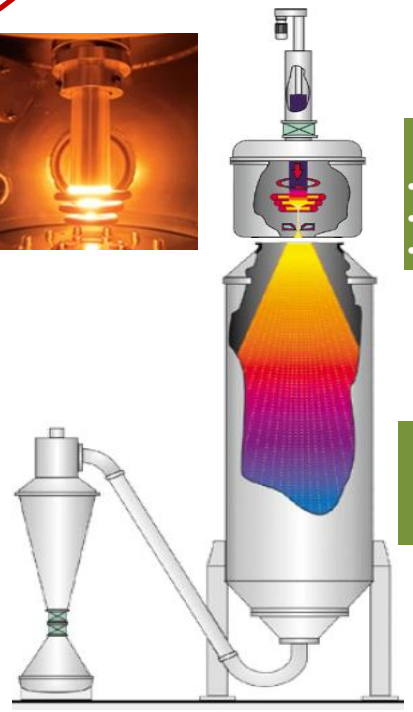
Digital system workflow: design through the integrated AM process chain

Design for AM → **Composition** → **Feedstock Processing** → **AM Process** → **Post-Process** → **Quality Assurance (Performance)** → **Applications**

Process Dev. **System Dev.**

Development of gas atomized metallic powders





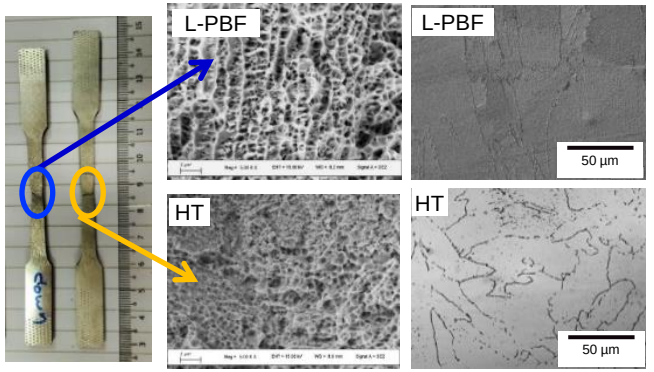
Powder-bed Fusion
- Laser Powder-bed Fusion (L-PBF)
- Electron Powder-bed Fusion (E-PBF)
- Selective Laser Sintering (SLS)

Direct Energy Deposition
- Powder-blown Laser AM
- Wire-fed Laser & Wire Arc AM

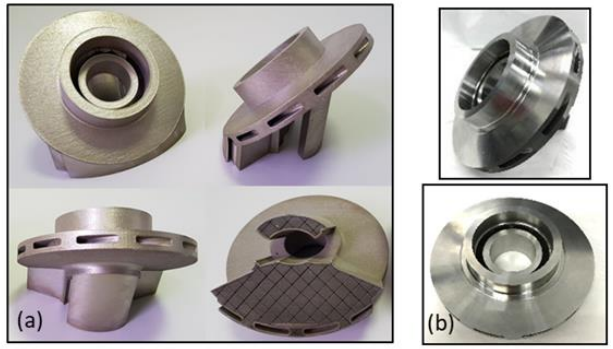
Jetting Technologies
- Powder-bed 3D printing / binder jet printing (BJP)
- Multi-material polymer jetting

Material Extrusion
- Fused Filament Fabrication (FFF)
- Pellet Extrusion

Vat Photo-polymerization
Stereolithography (SLA)



Design of heat treatment profiles to transform anisotropic microstructures into isotropic ones



Impellers (a) printed using L-PBF & (b) post-machined externally & internally

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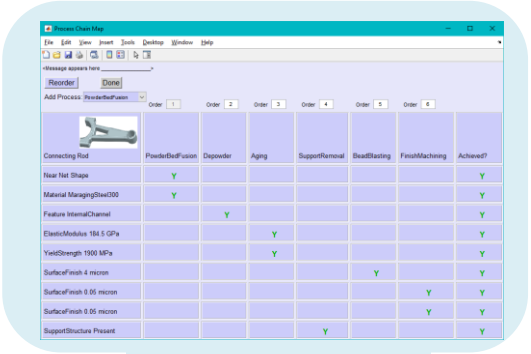
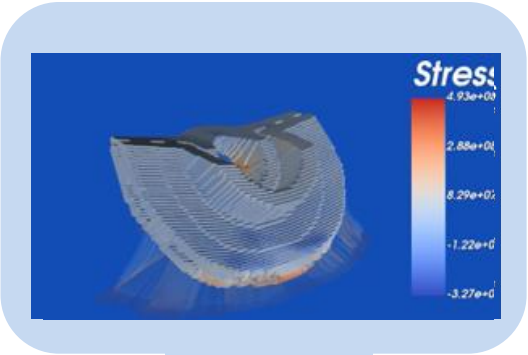
ADDITIVE MANUFACTURING

DESIGN & SIMULATION

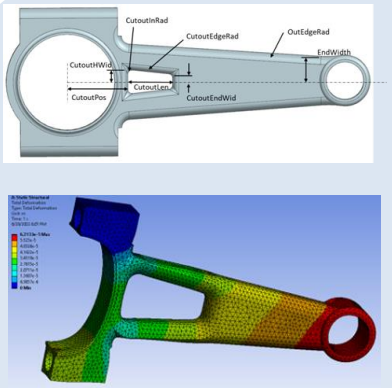
Proposed Digital Workflow

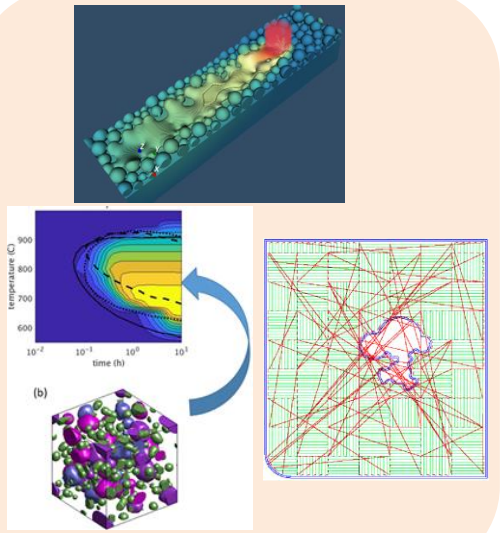
Digital system workflow: design through the integrated AM process chain





Generative Design → Process Chain Design → Optimization → Simulation → Process Planning → AM Process → Post-Process





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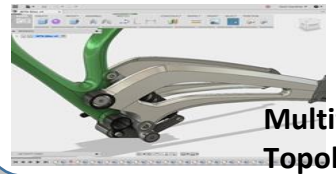
Unified Design & Digital Manufacturing System

CREATING GROWTH, ENHANCING LIVES

AM Process Chain CAD System: Integrated design of parts, products, processes

Product Design



Multifunctional CAD & Topology Optimization

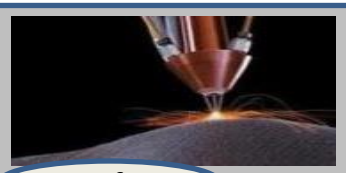
...

Process Chain Considerations

AM Process Design | **Machining Process Design** | **xxx Process Design**

Uncertainty Quantification & Propagation

Interface

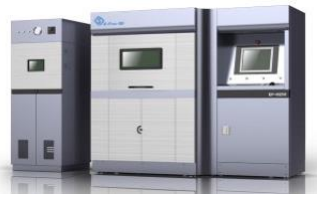


Digital Twin: Simulation of powder bed AM (SLM), and post-processes (heat treatment, finishing)

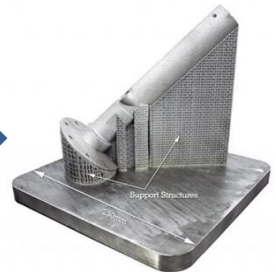
Interface

AM Process Sensing & Analytics

AM Post-Processes Workflow



SLM Metal Printer



Heat treatment

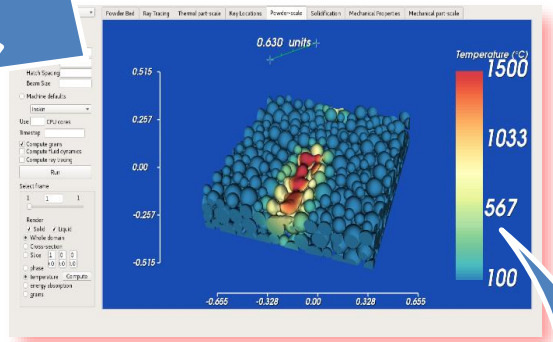
Milling

3D scanning

Powder Bed Fusion Simulation

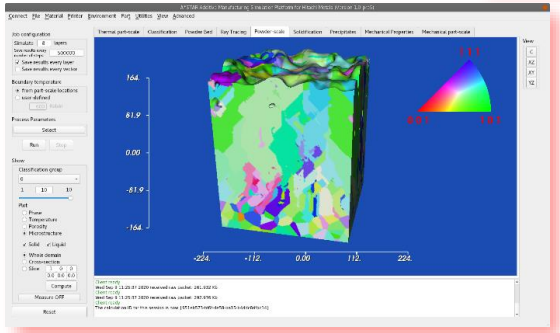
IHPC's 'Digital Twin' is a high-fidelity, physics-based software which simulates, models and predicts the industrial additive manufacturing process

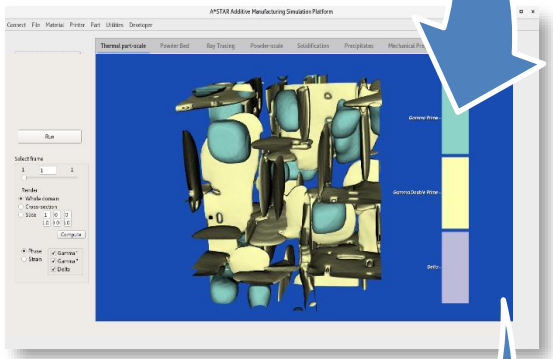
Capabilities

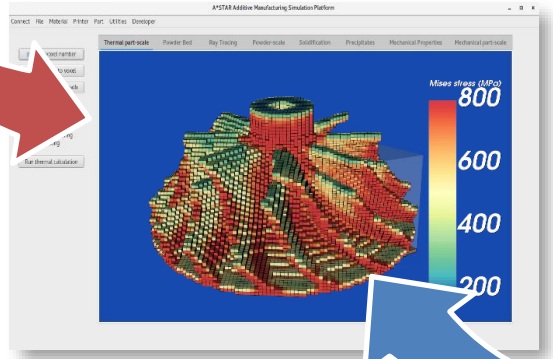


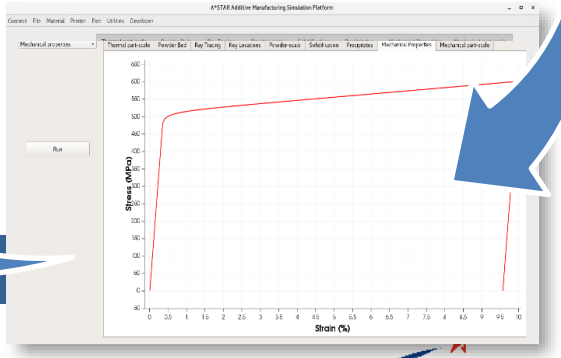
FORWARD

A.I









Value capture

- In-house code gives **freedom to customize** to specific needs and maintains **confidentiality**
- **Truly integrated multiscale platform** gives information at the part scale as well as at the powder scale **at the same time**
- Advanced model of powder gives information on **porosity, microstructure, and mechanical properties**
- Available for **powder-bed fusion, powder-blown (LAAM), and wire-feed processes**

Scientific standing

- L. Lu, N. Sridhar, Y.-W. Zhang, Acta Mat. **144** (2017)
- G. Vastola and Y.-W. Zhang, Additive Manuf. **22** (2018)
- Jakub Mikula et.al., Smart Materials and Structures **27** (2018)

Institute of High Performance Computing
IHPC

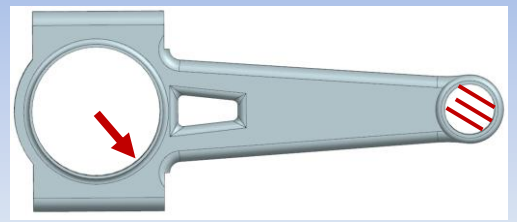
for Industry

CREATING GROWTH, ENHANCING LIVES

Design Optimization with as-Manufactured Properties

CREATING GROWTH, ENHANCING LIVES

Size optimization in bending



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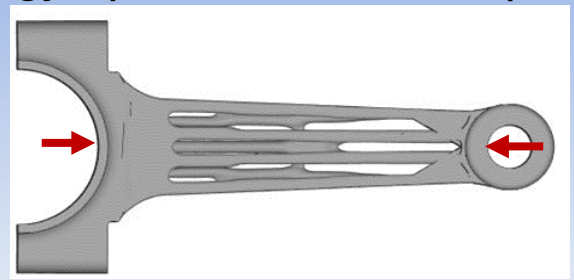
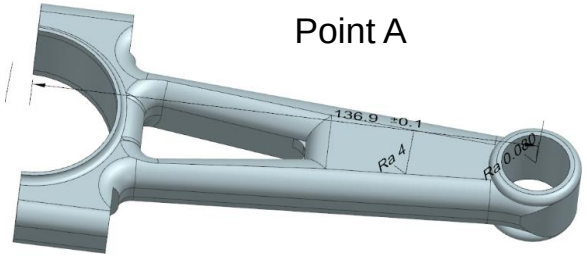
Advanced Remanufacturing and Technology Centre
ARTC

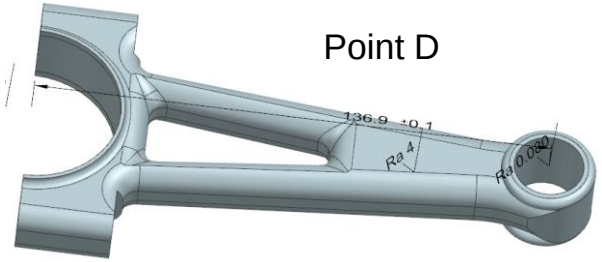
Topology optimization in compression

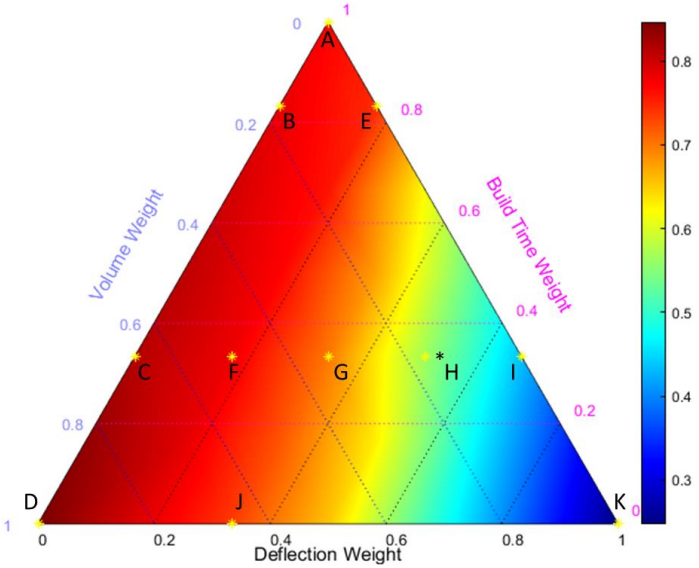


Point A

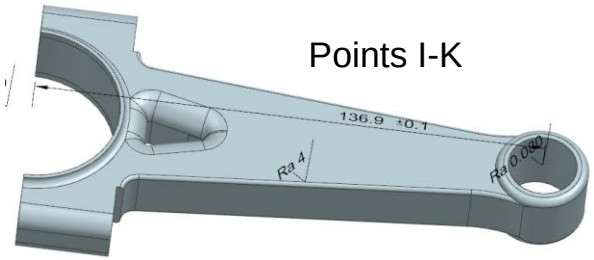


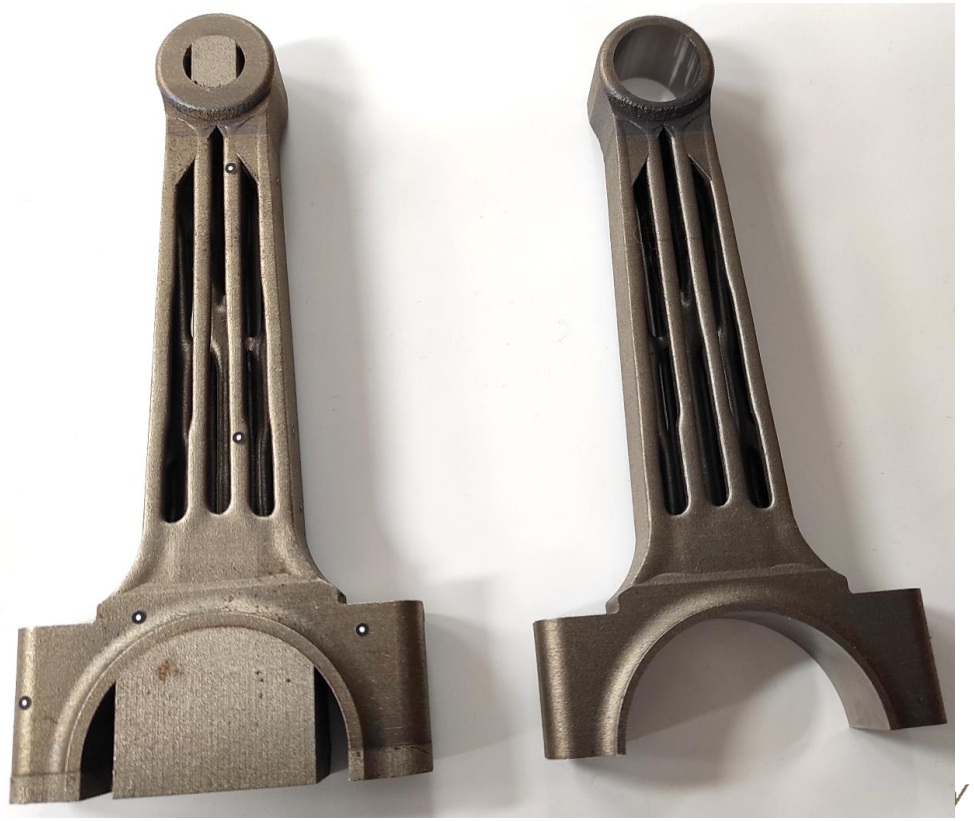
Point D



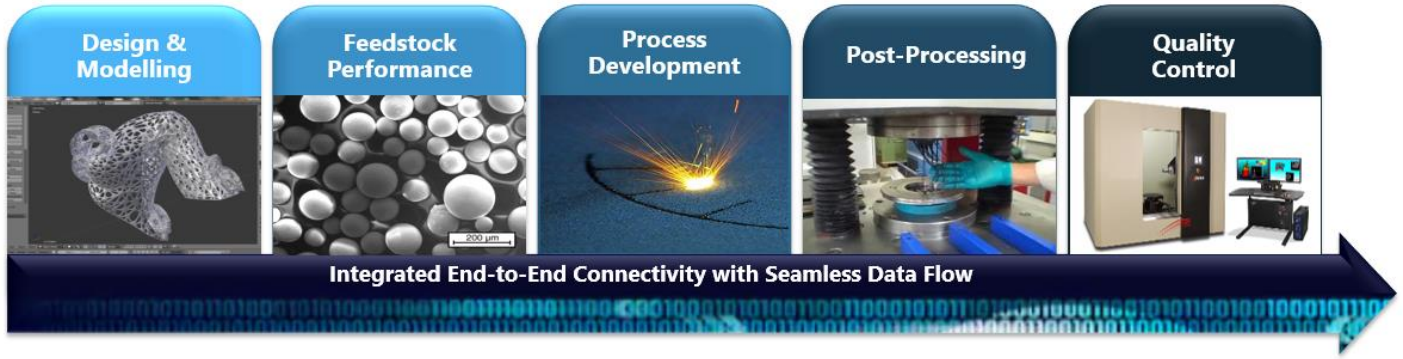


Points I-K





On-Demand Manufacturing of Spare Parts



3D printed manifold
Source: Mercedes Benz

Problem Statement:

- Premature failure of critical components or obsolete parts can result in unplanned down times.
- Spare parts replacements can be difficult to source or are only available with long lead times at high cost due to lean inventory for end-of-life products.
- 3D printing enables opportunities to fabricate spare parts on-demand, without requiring physical warehousing of these replacement parts.
- However, 3D printed spare-part may not be a direct drop-in replacement & will require further refinement to match performance of original part.

Value:

- **Translation of functional performance requirements for replacement part into quantifiable technical specifications** in 3D printing domain.
- **Rectified 3D printing challenges** that cause distorted geometry in critical features through in-house expertise in design for Additive Manufacturing with CFD verification, laser process parameter and print strategy optimization, and thermal distortion modelling and compensation tools.
- An actual functional part was fabricated, and further verified to meet all dimensional and surface quality requirements using an **in-house developed inspection regime** for 3D printed components.

Industry Impact:

- Increased confidence in using 3D printing for **producing performance-conforming spare parts** in critical applications.
- Successful **deployment of end-to-end workflows** enable industry to adopt on-demand manufacturing of spare parts using 3D printing as a practical solution.
- **Digital warehousing** through 3D printing can be used to shorten the supply chain and reduce overhead storage costs.

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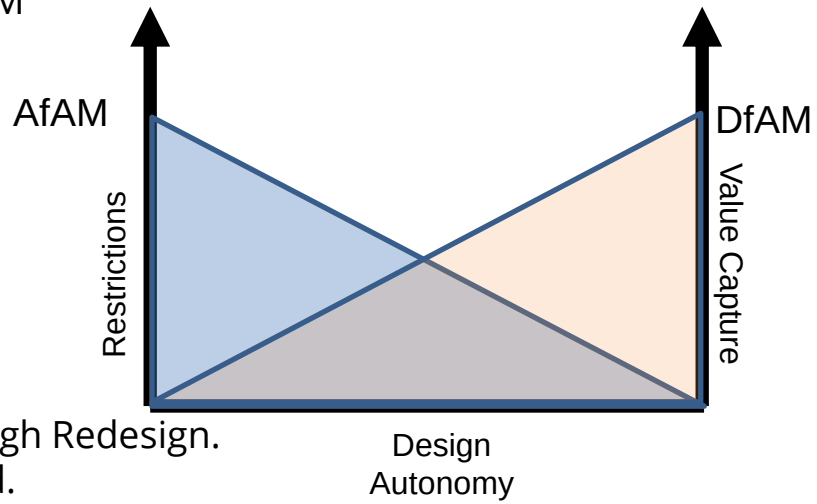
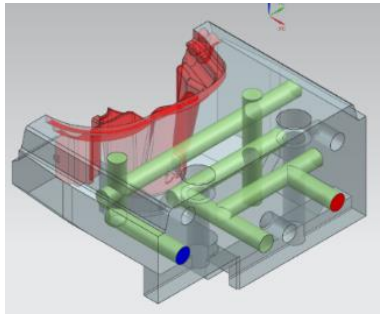
Adaptation for Additive Manufacturing vs Design for Additive Manufacturing (AfAM vs DfAM)

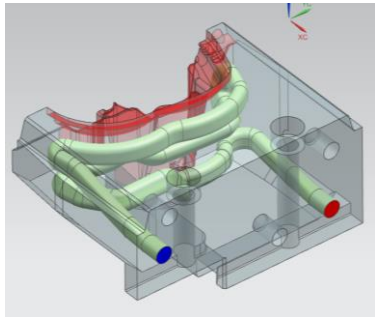
AfAM (Restrictive DFM)

- Adaptation for AM would typically start with a design where the part has been defined adhering to the form/fit/function.
- Rules of Additive Manufacturing will only be applied for manufacturability.
- Limited benefits derived from using AM





Traditional Design (AfAM)

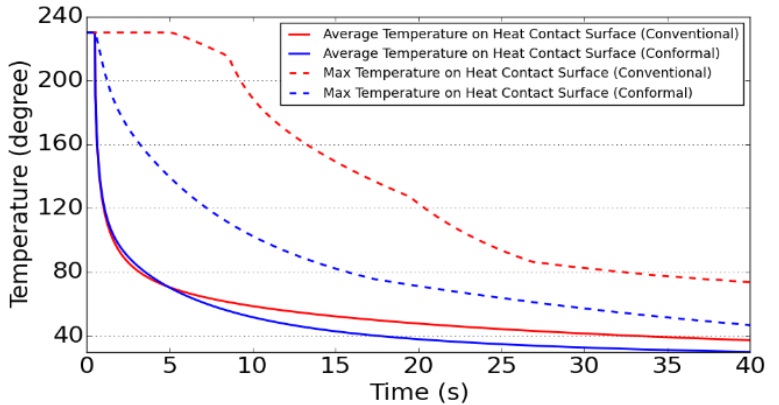


Design Autonomy (DfAM)

DfAM (Opportunistic DFM)

- Total freedom of Redesign for AM.
- Design for part consolidation.
- Harness the full benefits of AM. Through Redesign.
- Topology and topographical optimized.
- Breaking the traditional DFM and at the same time complimenting traditional manufacturing.
- Designing for functional, process and purpose specific.
- Taking into consideration for AM's post process requirements
- Value engineering- cost, performance benefits, etc

AM printed insert



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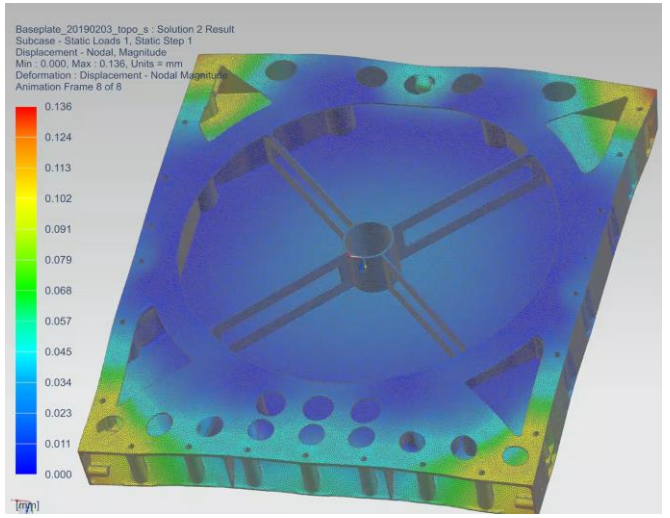
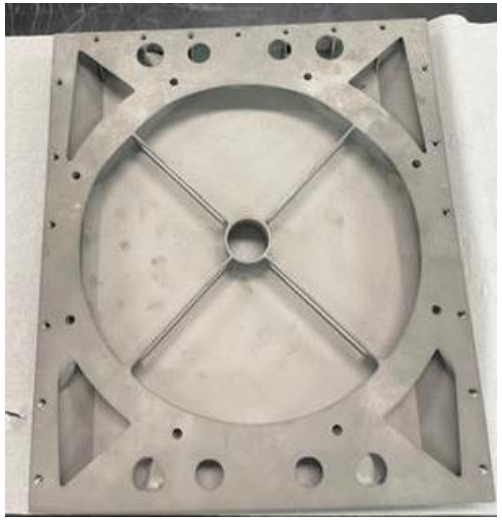
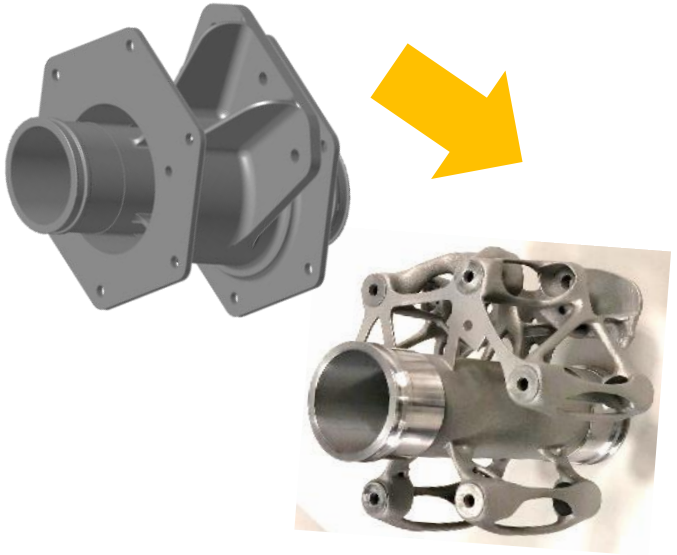
DfAM-AM Simulation (CFD/FEM/Topo)

With DfAM & using tools like CFD/FEM/Topo, design freedom allows engineers to harness AM / Non-AM manufacturing technique to the fullest.

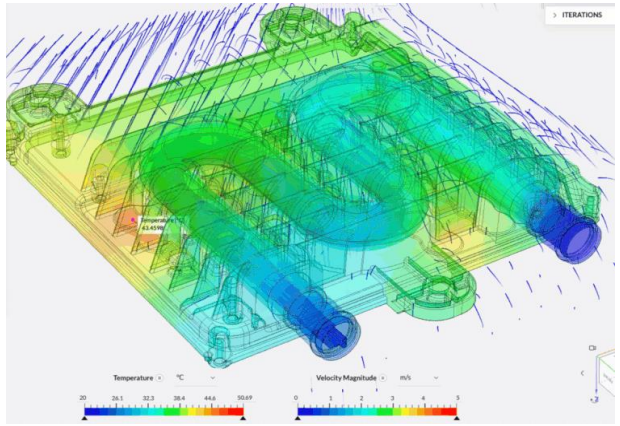




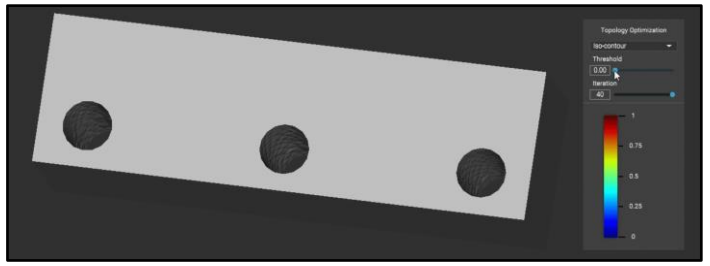
FEM of a satellite base (30+ parts into 1) – launching in 2nd half 2023



Lightweight metallic component designed for AM and fabricated using LPBF.



CFD of cooling plate



Light weighting (Topo-optimization)

CREATING GROWTH, ENHANCING LIVES

ADDITIVE MANUFACTURING

PROCESS DEVELOPMENT

Feedstock Development – Powder

CREATING GROWTH, ENHANCING LIVES

OBJECTIVE

To develop **new class of alloys & composite materials**, specifically for AM, take advantage of faster cooling rates & unique processing conditions used during AM.

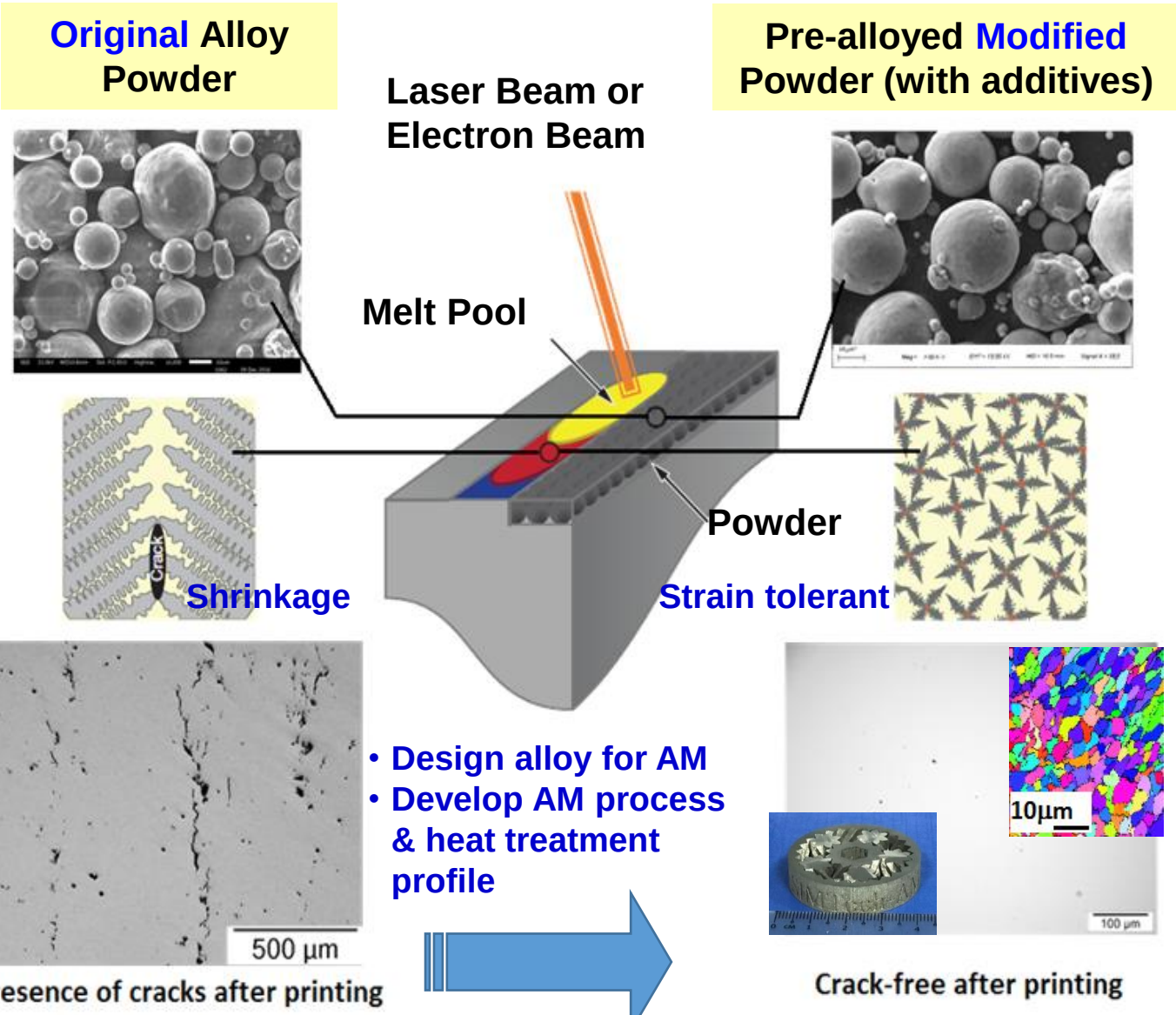
R&D CONTRIBUTION

Design alloy for AM: select suitable additives to modify chemical composition of base alloy

- Introduce lattice-matched elements to act as nucleation sites to control solidification microstructure
- Small batch production of powder feedstock using A*STAR gas atomizer

OUTCOME

Highly dense, crack-free printed parts with superior properties.



for Industry

AM Process Development – Powder Bed Fusion

CREATING GROWTH, ENHANCING LIVES

OBJECTIVE

To **tailor performance of printed parts** as desired to meet application's requirements.

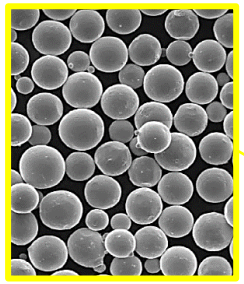
R&D CONTRIBUTION

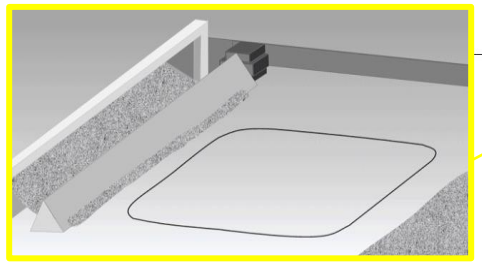
- **Laser & electron beam based AM process development**
- **AM process mapping**: detailed understanding of interaction of AM process parameters, microstructures & properties

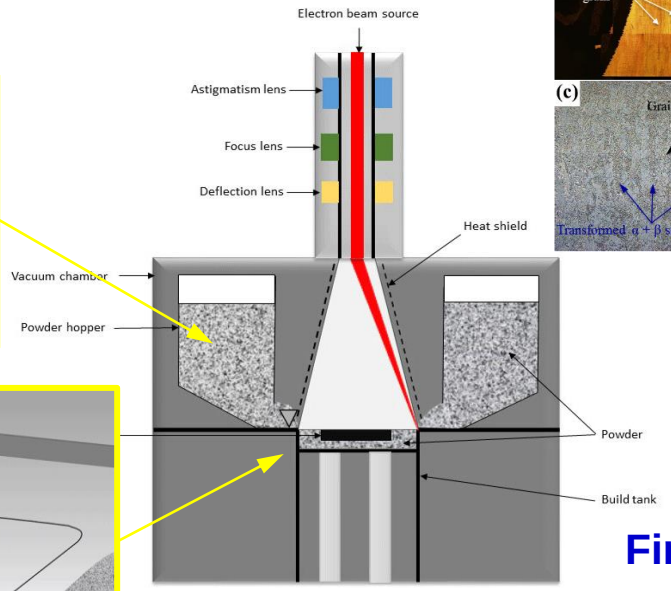
OUTCOME

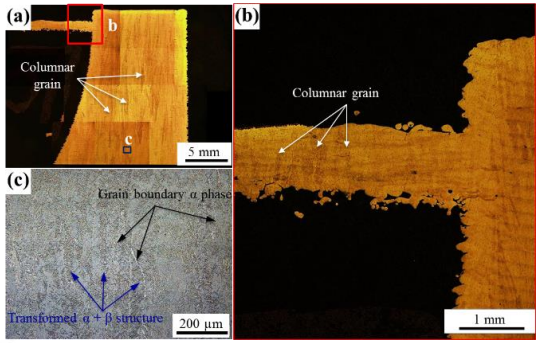
Localised tunable microstructure according to printed part's geometry

- Functionally graded structures & properties
- Uniform microstructures & properties



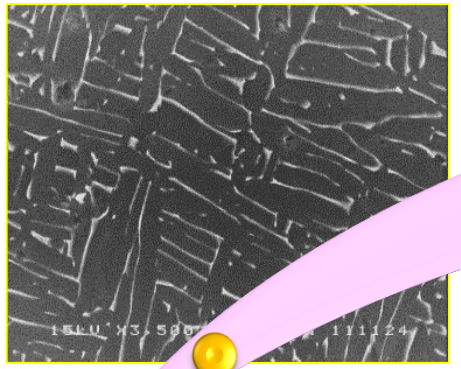






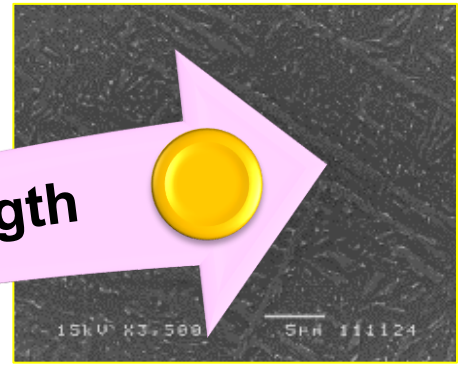
Fine microstructure

Coarse microstructure



Default
Process Parameters

New$_1$
Process Parameters



New$_2$
Process Parameters

Strength

for Industry

AM Process Development – Binder Jetting

CREATING GROWTH, ENHANCING LIVES

OBJECTIVE

To achieve porous metallic & ceramic printed parts with tunable porosity levels through feedstock & AM process development.

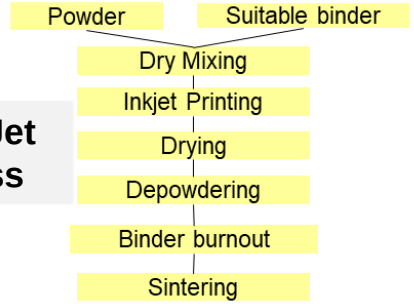
R&D CONTRIBUTION

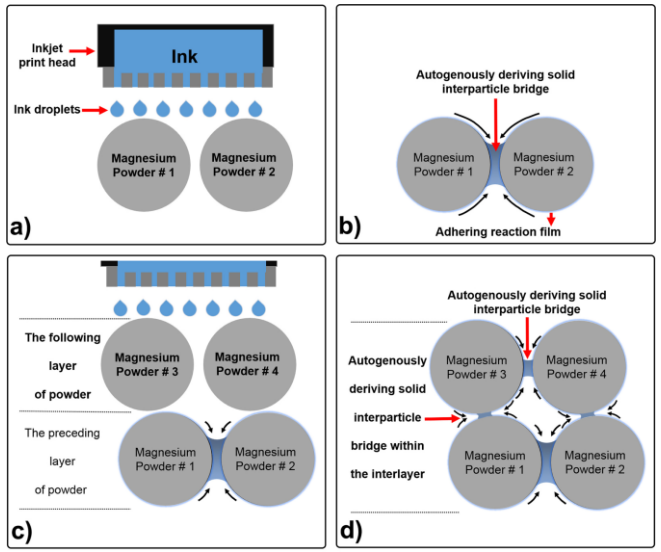
- Developed **new ink material & process methodology** to enable 3D printing.

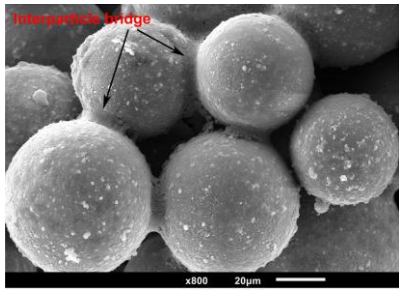
OUTCOME

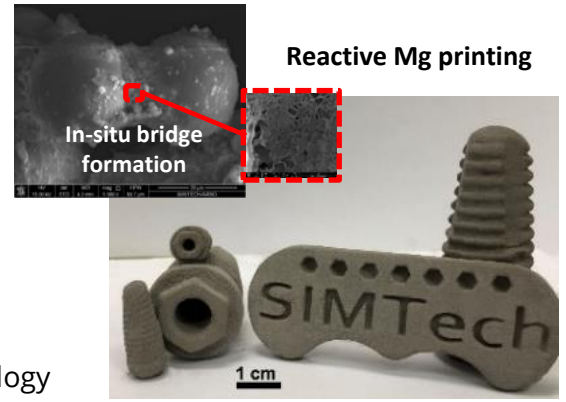
- 3D print Mg with **no binder** (proprietary solvent).
- A **scalable approach** to fabricate **strong green parts** with no ex-situ binder materials and **no lengthy debinding**
- **Ceramics & Cermets printing**

Typical Binder-Jet Printing Process

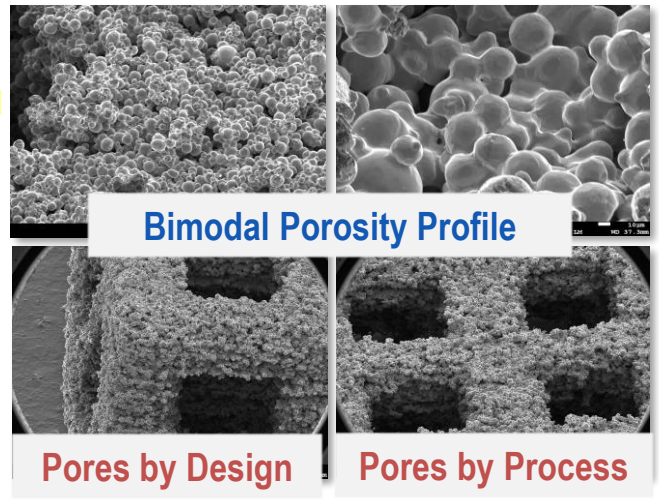


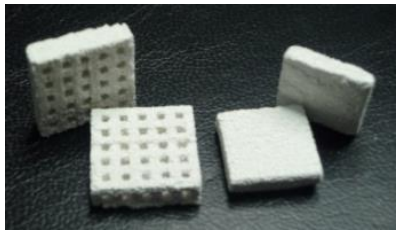






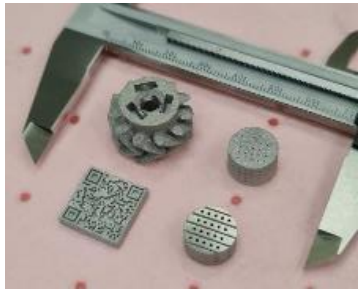
Reactive Mg printing





Printed porous ceramics

Ti spine bone replica

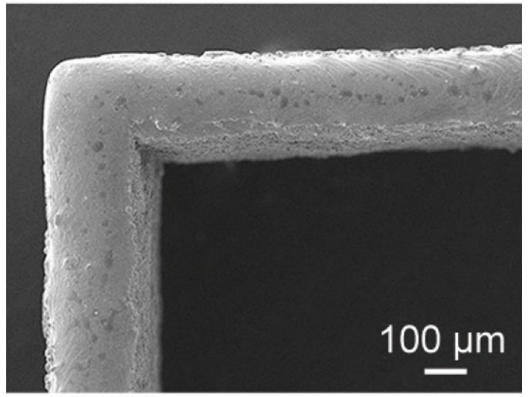


WC-Cr-Ni cemented hard metal

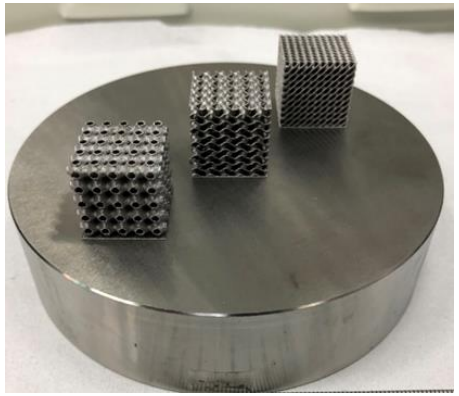
for Industry

Powder-bed Micro Selective Laser Melting System

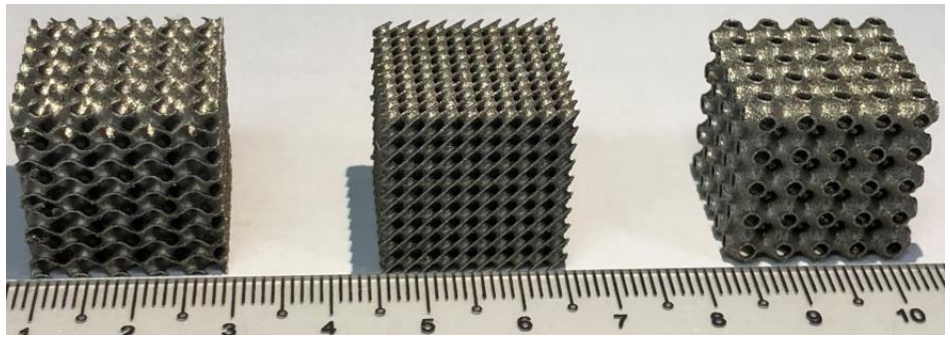
- Fine features printing
- Material development & research



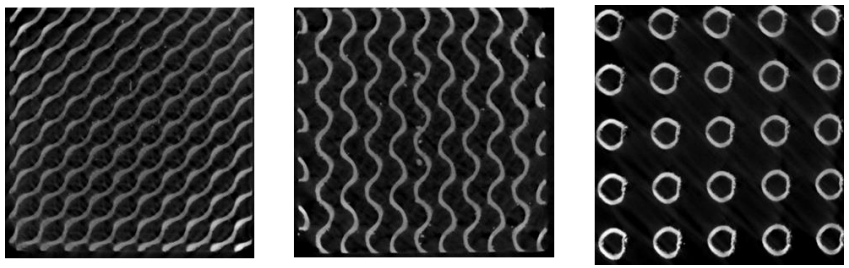
Thin walls



Lattice Structures



As-Printed Lattices



X-ray Computed Tomography

Technical Specifications

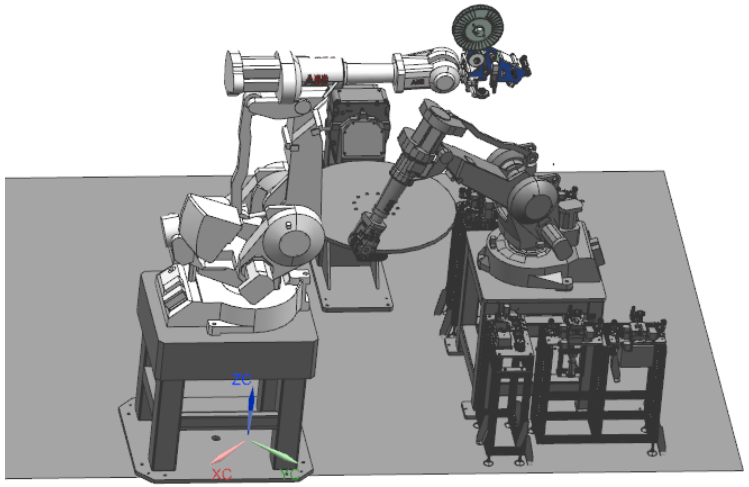
Country	Singapore
Building Volume	Ø120 x 100mm
Recoater Type	Silicone
Recoating Direction	One-way
Chamber gas	Argon / Nitrogen
Laser type / spot size	100W, 15µm
As-Print surface roughness	5 ~ 25µm Ra

CREATING GROWTH, ENHANCING LIVES

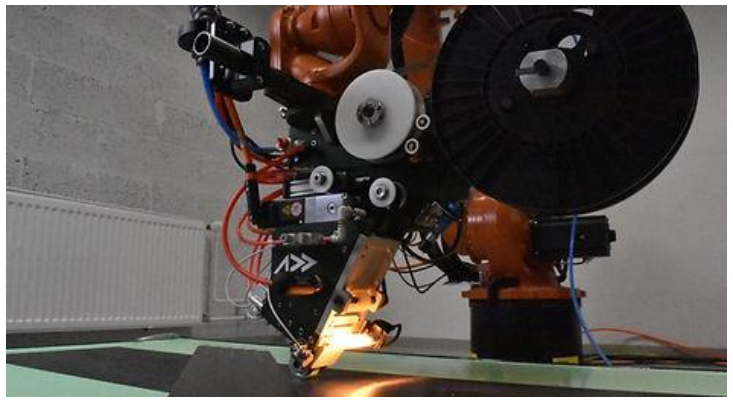
for Industry

Large Format Polymer Composites Printing

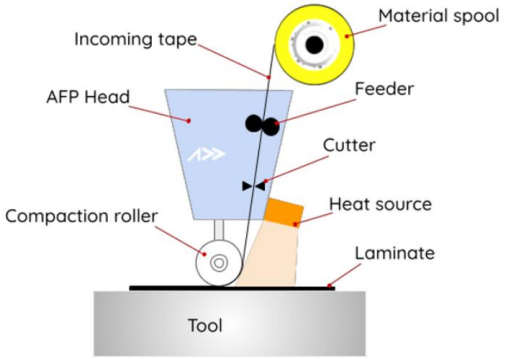
- Develop a large-format material extruder polymer with dynamic mixing and continuous Carbon-Fiber Reinforced ThermoPlastics (CFRTP) via Automated Fiber Placement (AFP) printing capabilities
- **Build envelop:**
  - 2000 x 1000 x 1000mm; expandable in the future
- **Materials:**
  - Thermoplastic: ABS, Nylon, PLA, PA6 (AFP), PEEK (AFP)
  - Thermosets



Large Format Composites Robotic Cell



Automated Fiber Placement (AFP)



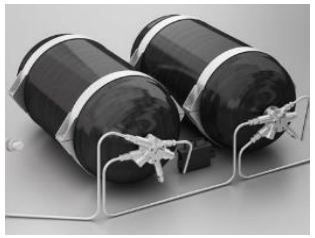
Working Principles of AFP

Applications

Marine

Propeller Blade

Energy



Hydrogen Storage Tank

CREATING GROWTH, ENHANCING LIVES

CREATING GROWTH, ENHANCING LIVES

Integrated End-to-End Additive Mfg (AM) Solutions

Wide Suite of End-to-End AM Facilities

A*STAR AM Technical Capabilities

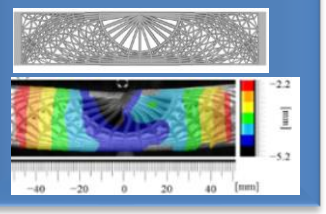
Outreach

ADDITIVE INNOVATION CENTRE
Supported by NAMIC

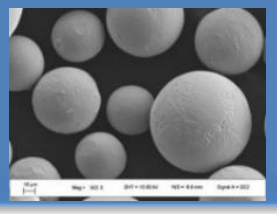
Singapore Institute of Manufacturing Technology
SIMTech

A*STAR AIC

Design & Modelling



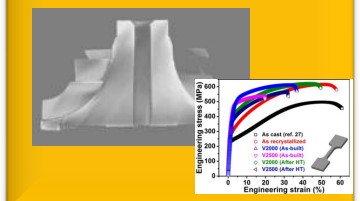
Material Performance



AM Process Development

Post-Process Development

Validation & Qualification



Pilot Batch Production

Accelerating Industry Additive Manufacturing E2E Deployment

VISION

A leading platform to accelerate the transition and deployment of additive manufacturing (AM) solutions

MISSION

To facilitate and foster strong collaborations between A*STAR RIs & IHLs for AM solutions

To partner SMEs, LLEs & MNCs and accelerate sustainable AM deployment

To build an inclusive ecosystem, high manufacturing & testing standards and upskilled workforce towards AM adoption

Additive Manufacturing for Industry through Strategic Partnerships

CREATING GROWTH, ENHANCING LIVES

Novel product design / new process & material

CAAS
Civil Aviation Authority of Singapore

DSO NATIONAL LABORATORIES

IHI

Shell

voestalpine
ONE STEP AHEAD.

HALLIBURTON

Schlumberger

SAESL

TE connectivity

Mitsui Chemicals Group

SINGAPORE AIRLINES

APPLIED MATERIALS

PALL
PALL CORPORATION

Entegris

PROTERIAL

Osteopore

ROLLS ROYCE

ST Engineering

Technology enablers

DMG MORI

EOS

materialise

MOLYWORKS
MATERIALS CORPORATION

SIEMENS

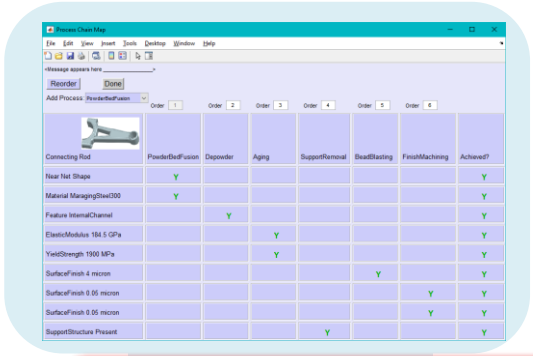
for Industry

ADDITIVE MANUFACTURING

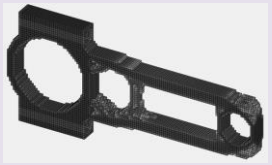
FUTURE DIRECTIONS

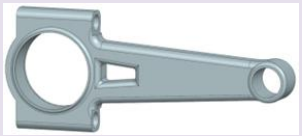
Proposed Digital Workflow

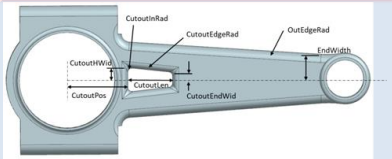
Digital system workflow: design through the integrated AM process chain

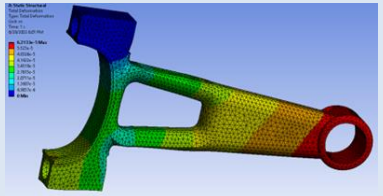


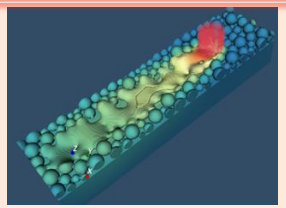
Generative Design → **Process Chain Design** → **Optimization** → **Simulation** → **Process Planning** → **AM Process** → **Post-Process**

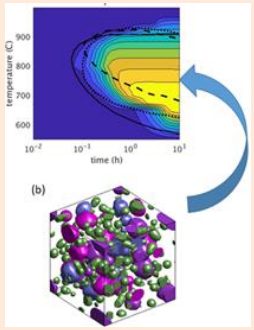


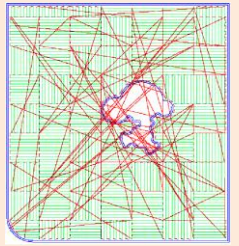












CREATING GROWTH, ENHANCING LIVES

Future Directions

- 4D printing
- Generative design of complex devices and metamaterials
- Cybermanufacturing

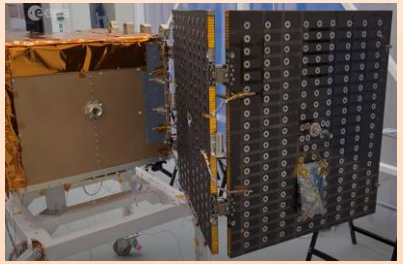
CREATING GROWTH, ENHANCING LIVES

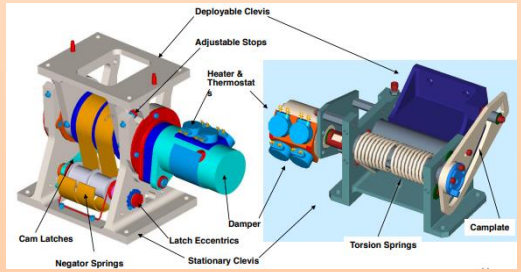
4D Printing

CREATING GROWTH, ENHANCING LIVES

Current

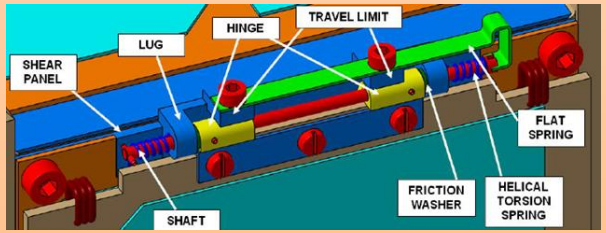
Current object shape change capabilities through **complex mechatronics systems** with conventional kinematic joints and **sophisticated control systems.**





Complex motions performed by a **system of components.**

No systematic design methods and libraries leading to **complex systems with high part counts.**



Component & Device Design

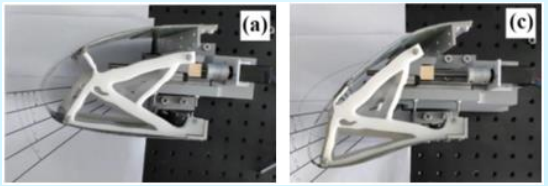
Behavior Model & Simulation

4DAM of Smart Structures

Shape Memory Polymer

Shape Memory Alloy

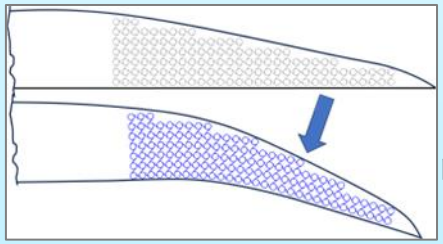
Future



Systems will perform **complex motions** with **minimal part count** driven by **shape memory actuators**

4DAM processes enable alternative system designs with **flexibility of material configuration**

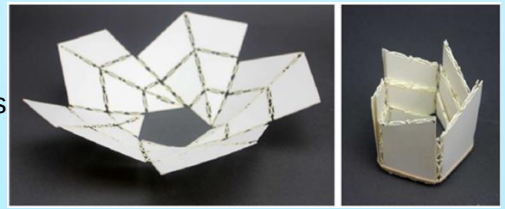
New **shape memory polymer** and **metal materials**



New **generative design** methods for integrated shape memory actuators, compliance, origami / kirigami devices, lattices and metamaterials.

Novel **design library**

Localized activation

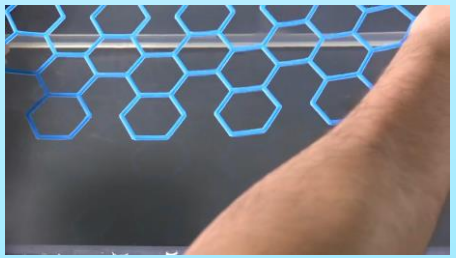


Outcomes

> **New conceptual-to-detailed computational design methods**

> **Local device controls** through **direct-write electronics** on shape memory actuators

> New materials with **improved toughness and fatigue resistance**

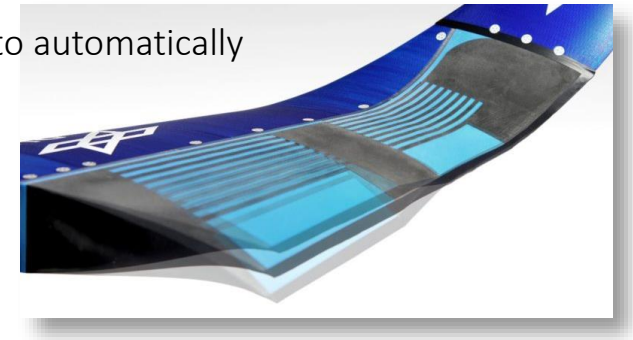


Generative Design

"The flying car has a body that is similar in shape to pterodactyls, with a body designed to control drag, lift, and thrust. It is lightweight and has a propeller to generate thrust. The vehicle's hull is constructed of high-performance carbon fiber, inspired by the lightweight skeletons of pterosaurs.

Generated designs

Morphing wings, via 4DP, to automatically optimize lift and drag

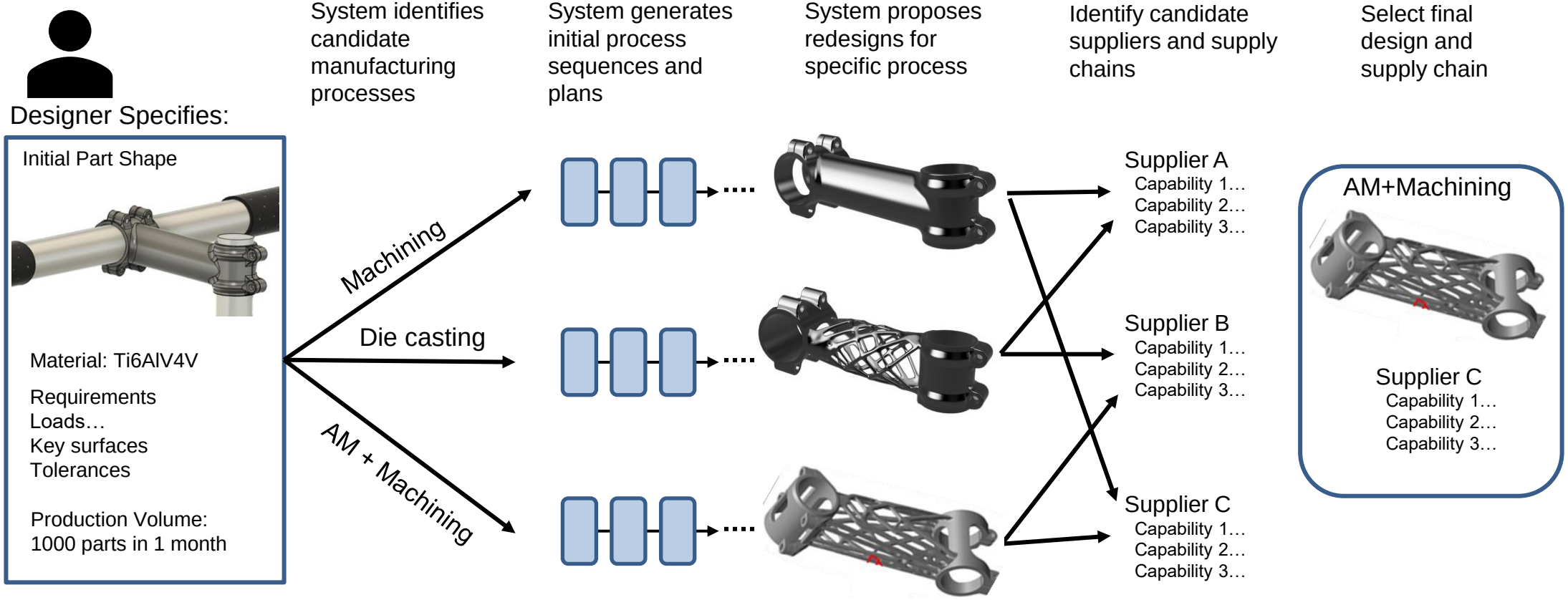


CREATING GROWTH, ENHANCING LIVES

for Industry

Cybermanufacturing

CREATING GROWTH, ENHANCING LIVES



for Industry

Closure

- Integrated additive manufacturing at SIMTech, ARTC, and IHPC
  - Overview and capabilities
  - Industry collaboration examples
- Design for AM and simulation of AM
  - Design across the AM process chain
  - AM process simulation
  - Design with as-manufactured properties
- Future directions
  - Generative design
  - Cybermanufacturing
  - 4D printing

CREATING GROWTH, ENHANCING LIVES

for Industry

CREATING GROWTH, ENHANCING LIVES

Singapore Institute of Manufacturing Technology
SIMTech

THANK YOU

www.a-star.edu.sg

Dr David Rosen
rosendw@ihpc.a-star.edu.sg

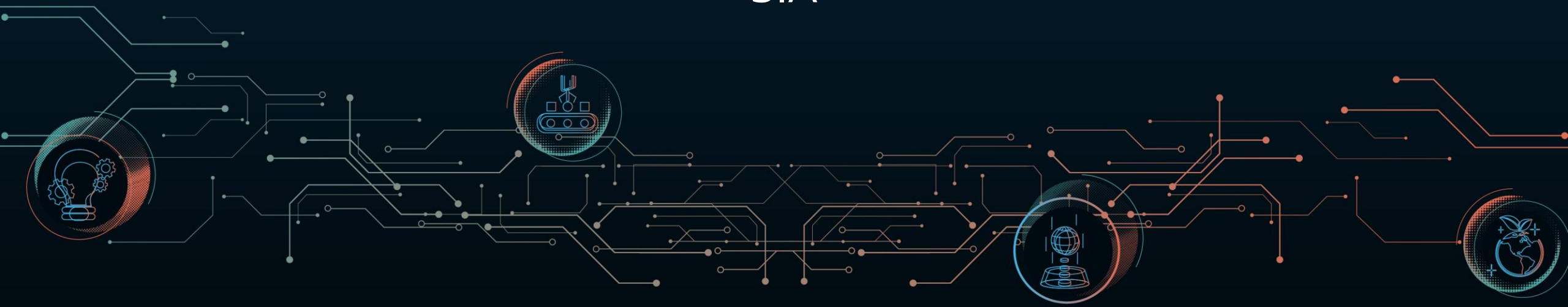
Dr Sharon Nai
mlnai@simtech.a-star.edu.sg

for Industry

INNOVATION & TECHNOLOGY
CONFERENCE 2023
Innovation Through Advanced Manufacturing
Research & Technologies

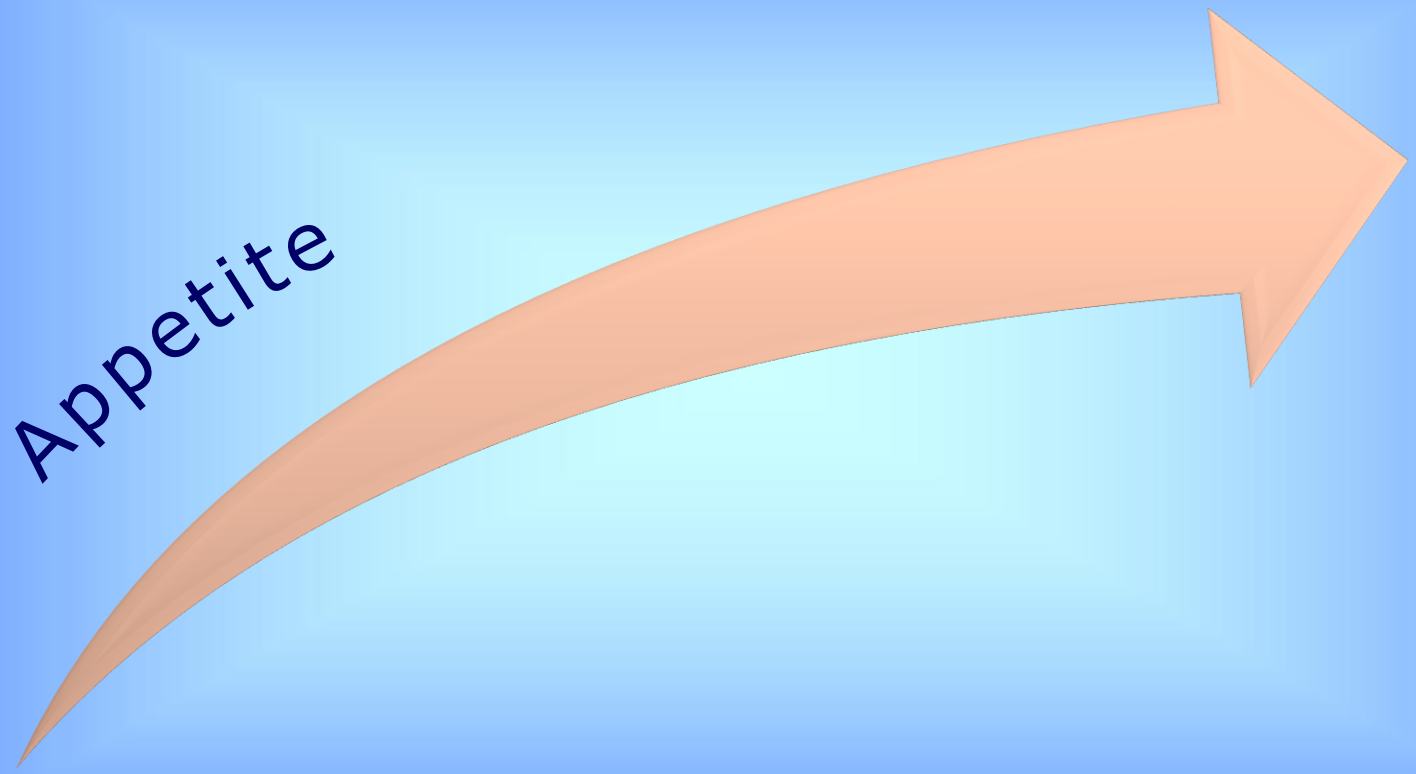
Supplier Capability Development for Localisation of Aircraft Interior Parts

Mr Sito Wai Seng
Senior Manager, Technical Services
SIA



Innovation & Technology Conference 2023

Innovation Through
Advanced Manufacturing Research & Technologies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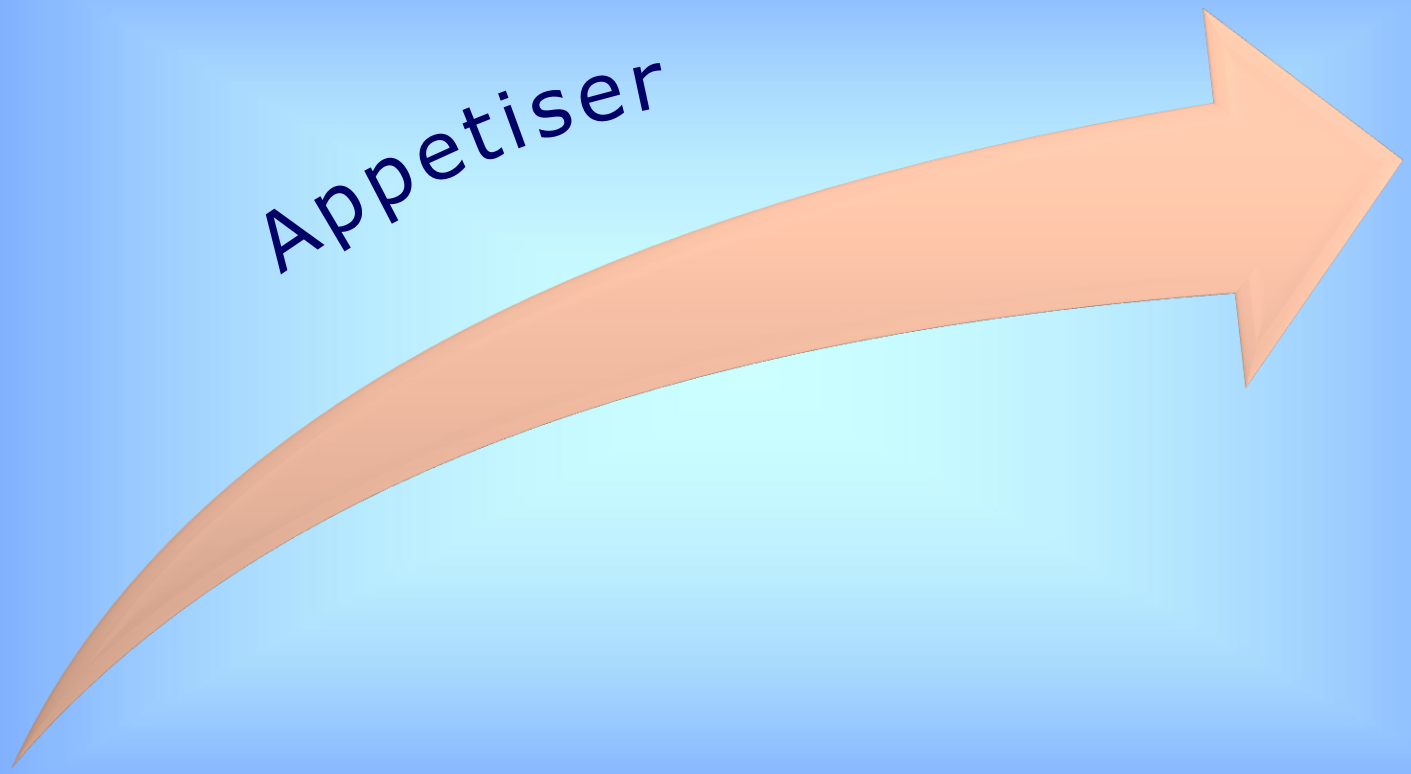
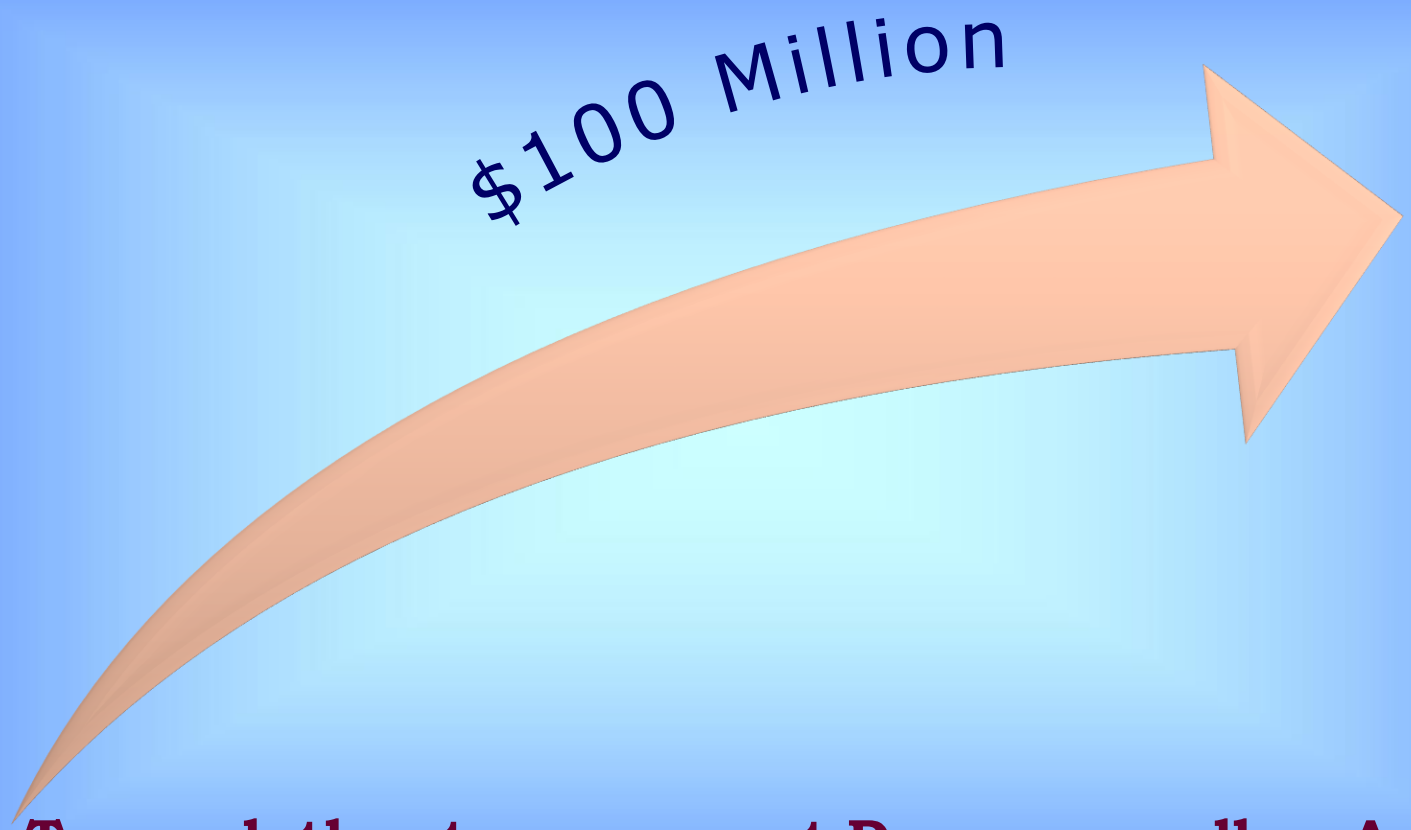
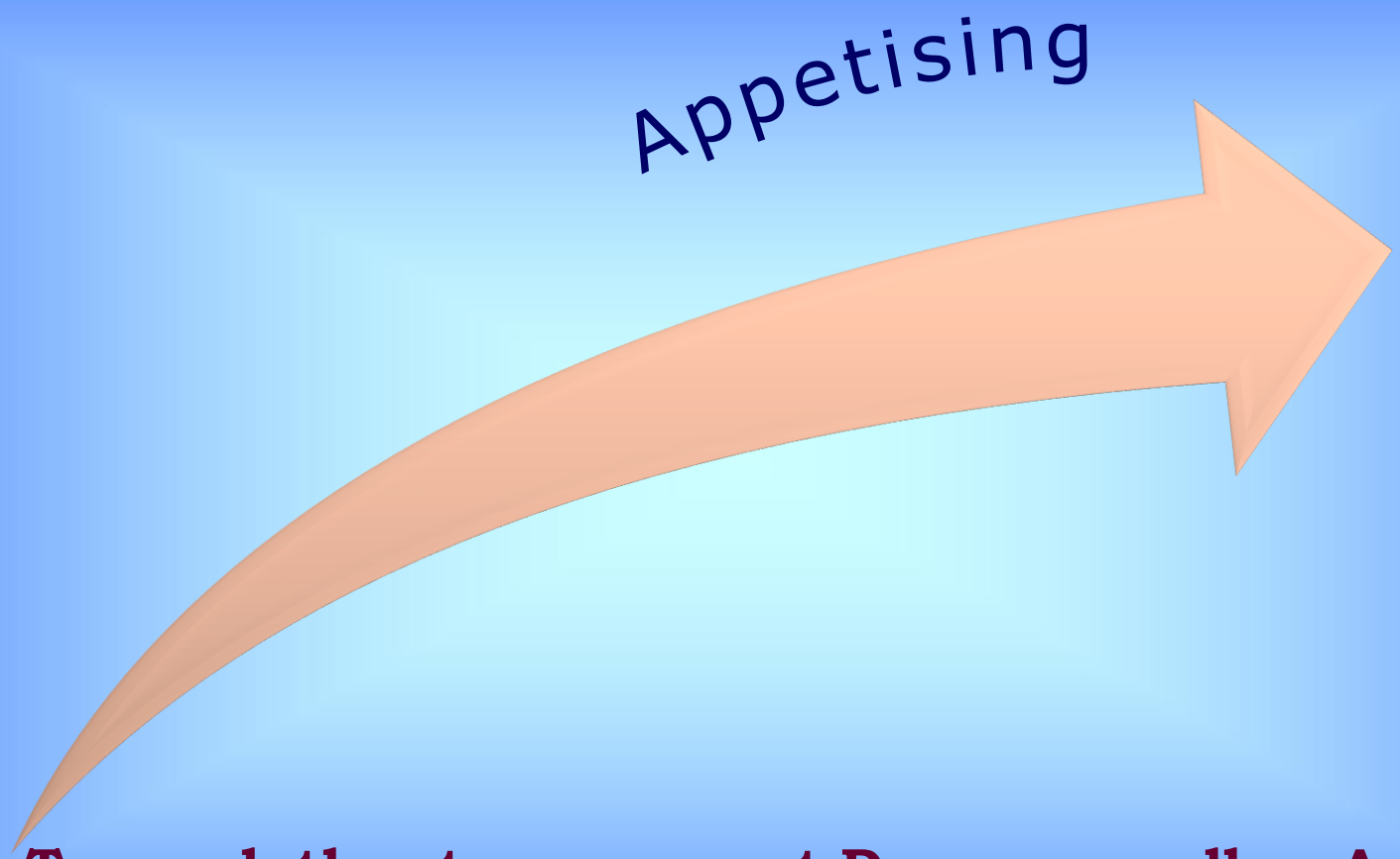

Appetiser

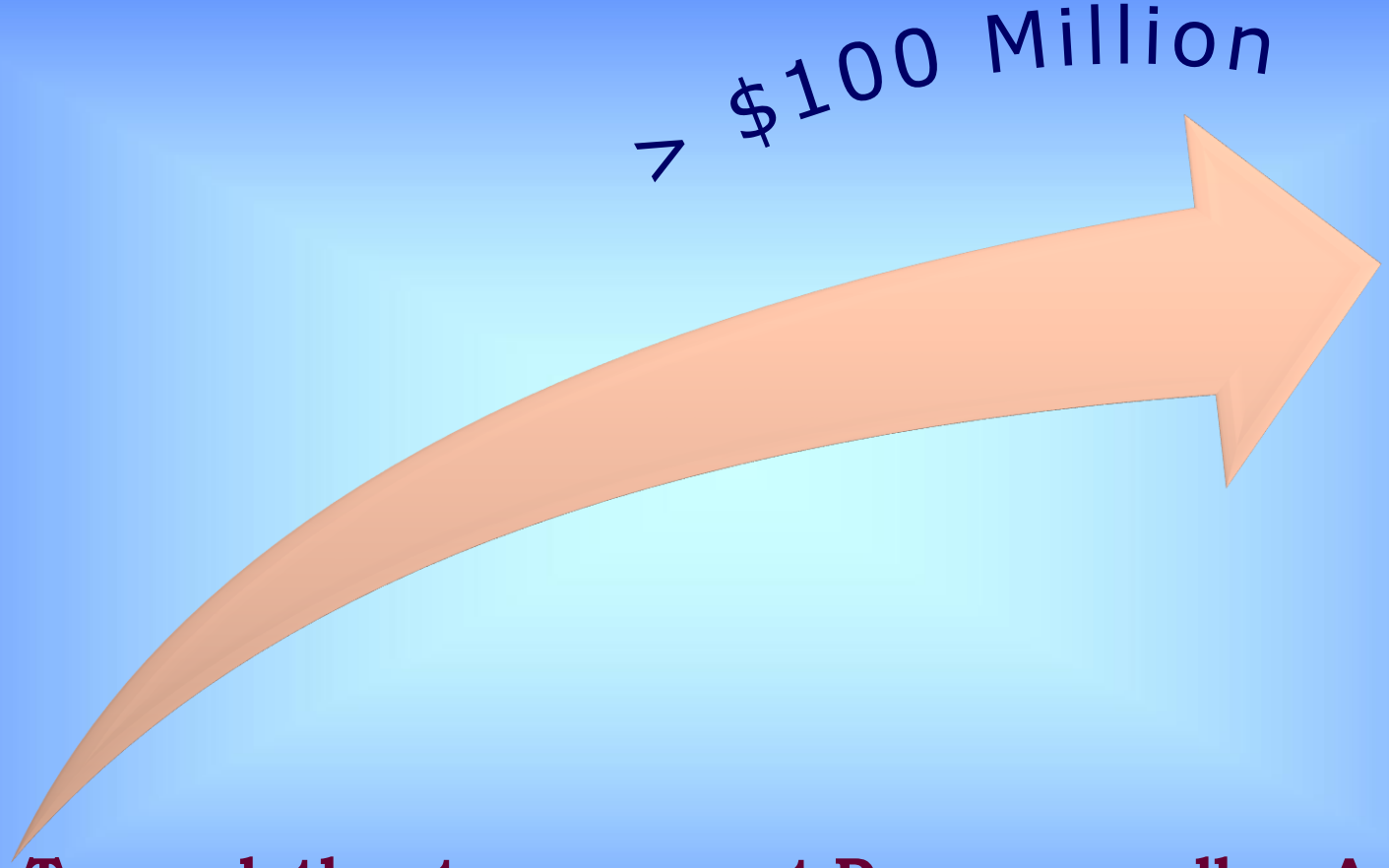


To reach the stars, we must Dream as well as Act



To reach the stars, we must Dream as well as Act

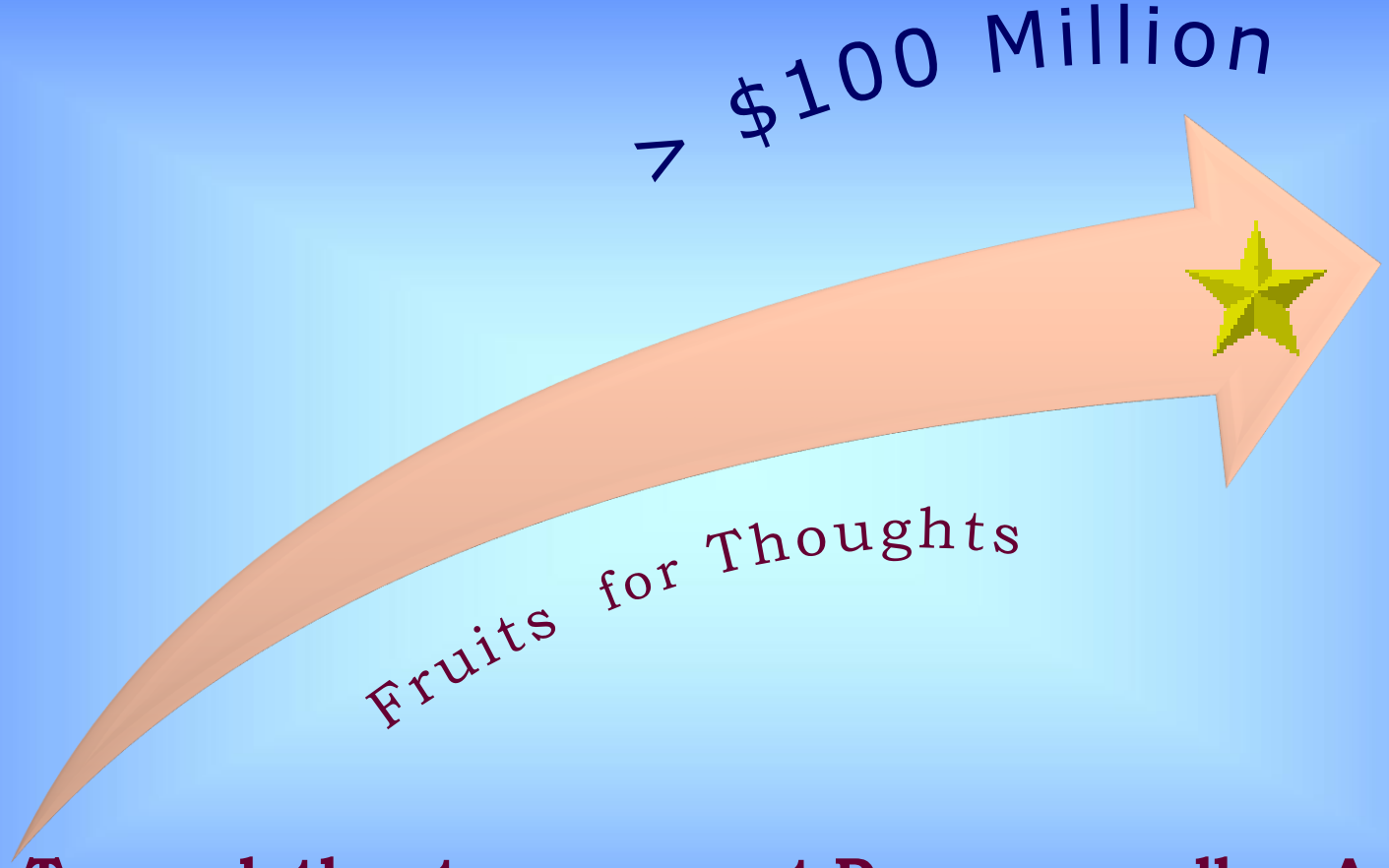
The best way to predict our future is to create it ourselves



To reach the stars, we must Dream as well as Act

The best way to predict our future is to create it ourselves

Think about the Stars & we will land at least among the clouds



To reach the stars, we must Dream as well as Act

The best way to predict our future is to create it ourselves

Think about the Stars & we will land at least among the clouds

Innovation & Technology Conference 2023

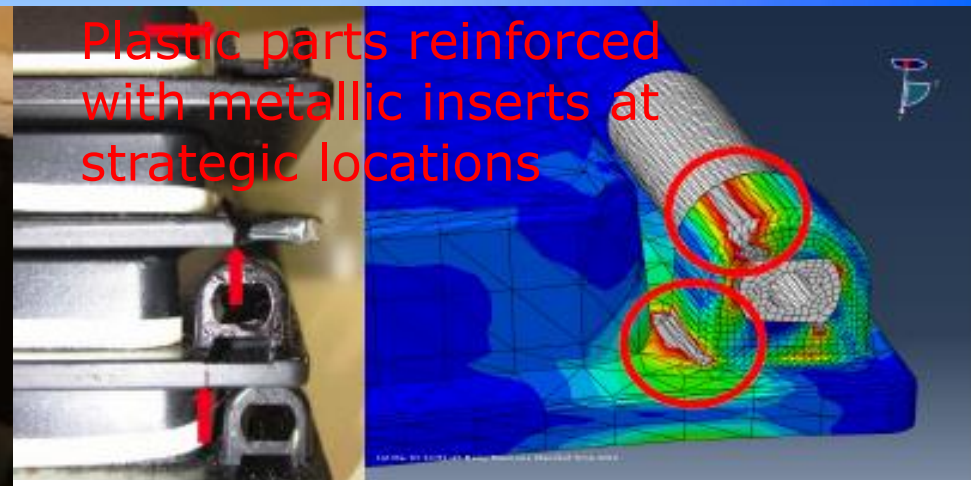
To reach the stars, we must Dream as well as Act

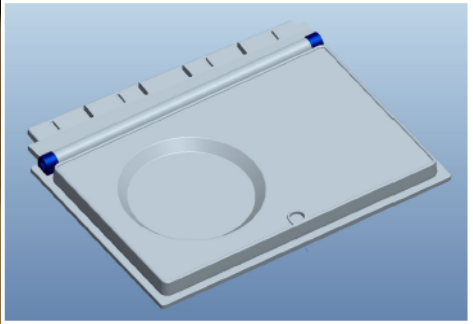
The best way to predict our future is to create it ourselves

Think about the Stars & we will land at least among the clouds

SIA started working with SIMTech on small cabin projects about 10 years ago

Plastic parts reinforced with metallic inserts at strategic locations





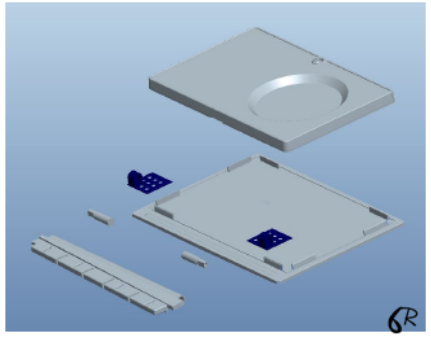
Cocktail tray assembly

Hinge join insert: stainless steel SUS304

Tensile strength at yield
ABS: 41 Mpa
Stainless steel (SUS304): 215 MPa

Plastic part: 3
- Cocktail tray door
- Cocktail tray
- Hinge

Metal part: 4
- Hinge pin (2 pcs)
- Metal insert (2 pcs)

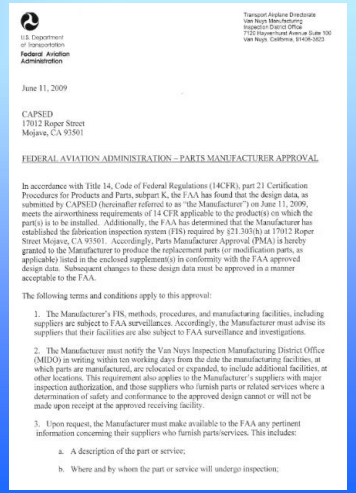


Challenges Faced Initially

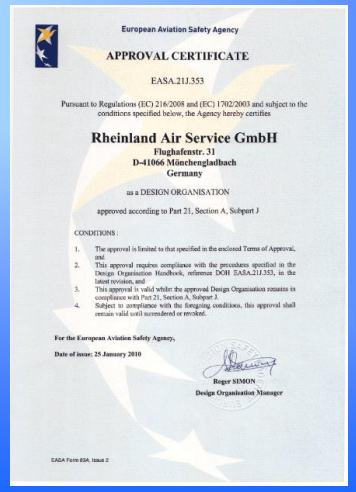
- Local engineering & manufacturing industry highly capable
- Able to design & manufacture complex parts
- Lack of knowledge on aviation regulations & requirements
- No aviation DOA & POA approval

DOA = Design Organisation Approval
POA = Production Organisation Approval

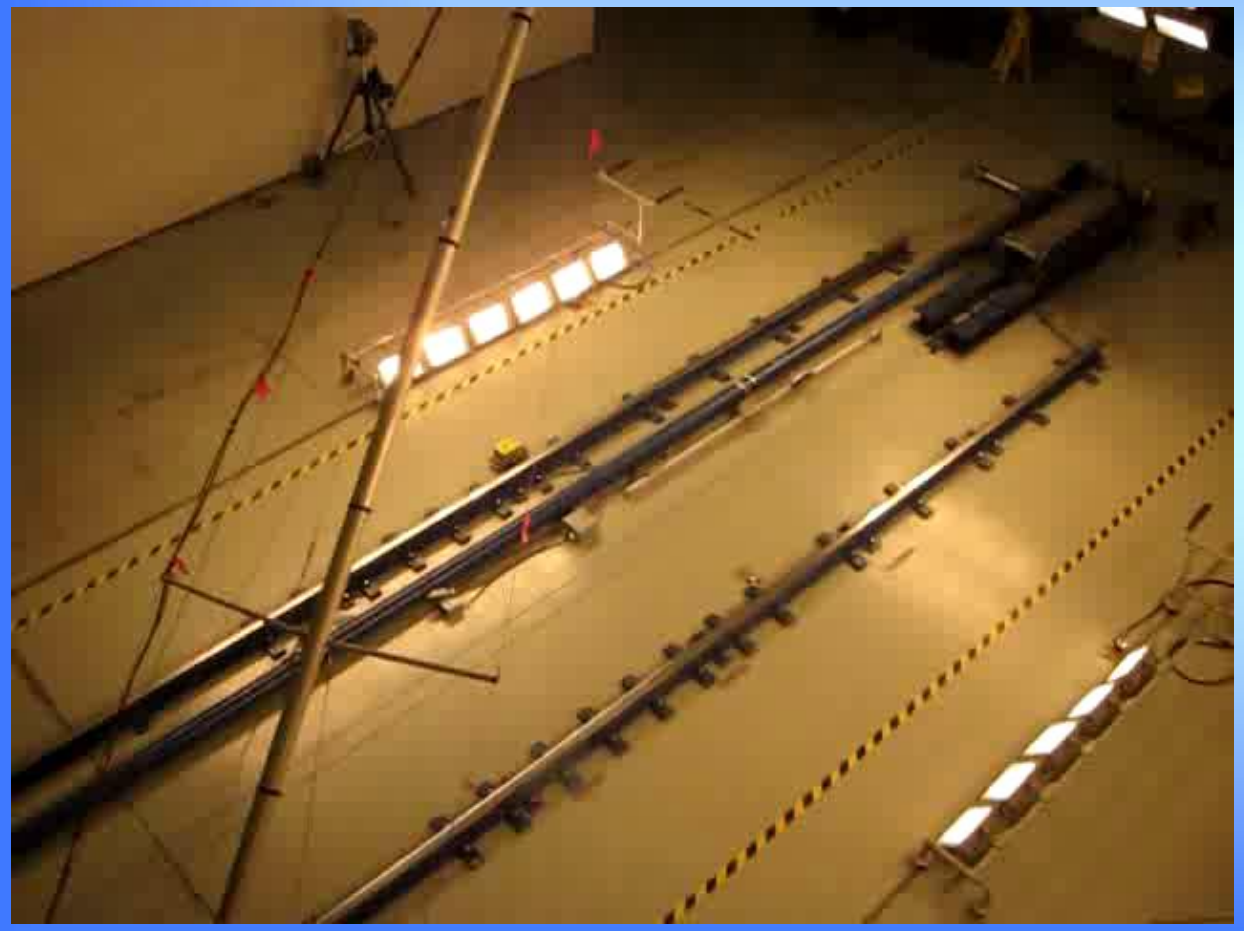

CAAS
Design Organisation Approval
NO. AWI/DOA/005
Singapore Airlines Ltd.
(Technical Services Department)
09-B AIRLINE HOUSE
25 AIRLINE ROAD
SINGAPORE 819829
Period of Validity: 01 June 2016 to 31 May 2017
for Director-General
Civil Aviation Authority of Singapore


June 11, 2009
CAPSED
17012 Roper Street
Mojave, CA 93501
FEDERAL AVIATION ADMINISTRATION – PARTS MANUFACTURER APPROVAL


CAAS
Production Organisation Approval
NO. AWI/POA/007
SIA Engineering Company
31 AIRLINE ROAD
SINGAPORE 819831
Period of Validity: 01 May 2016 to 30 April 2017
for Director-General
Civil Aviation Authority of Singapore


European Aviation Safety Agency
APPROVAL CERTIFICATE
EASA.21J.353
Rheinland Air Service GmbH
Flughafenstr. 31
D-41066 Mönchengladbach
Germany
as a DESIGN ORGANISATION
approved according to Part 21, Section A, Subpart J
Date of issue: 25 January 2010
Roger SIMON
Design Organisation Manager

Seat Certification Requirements

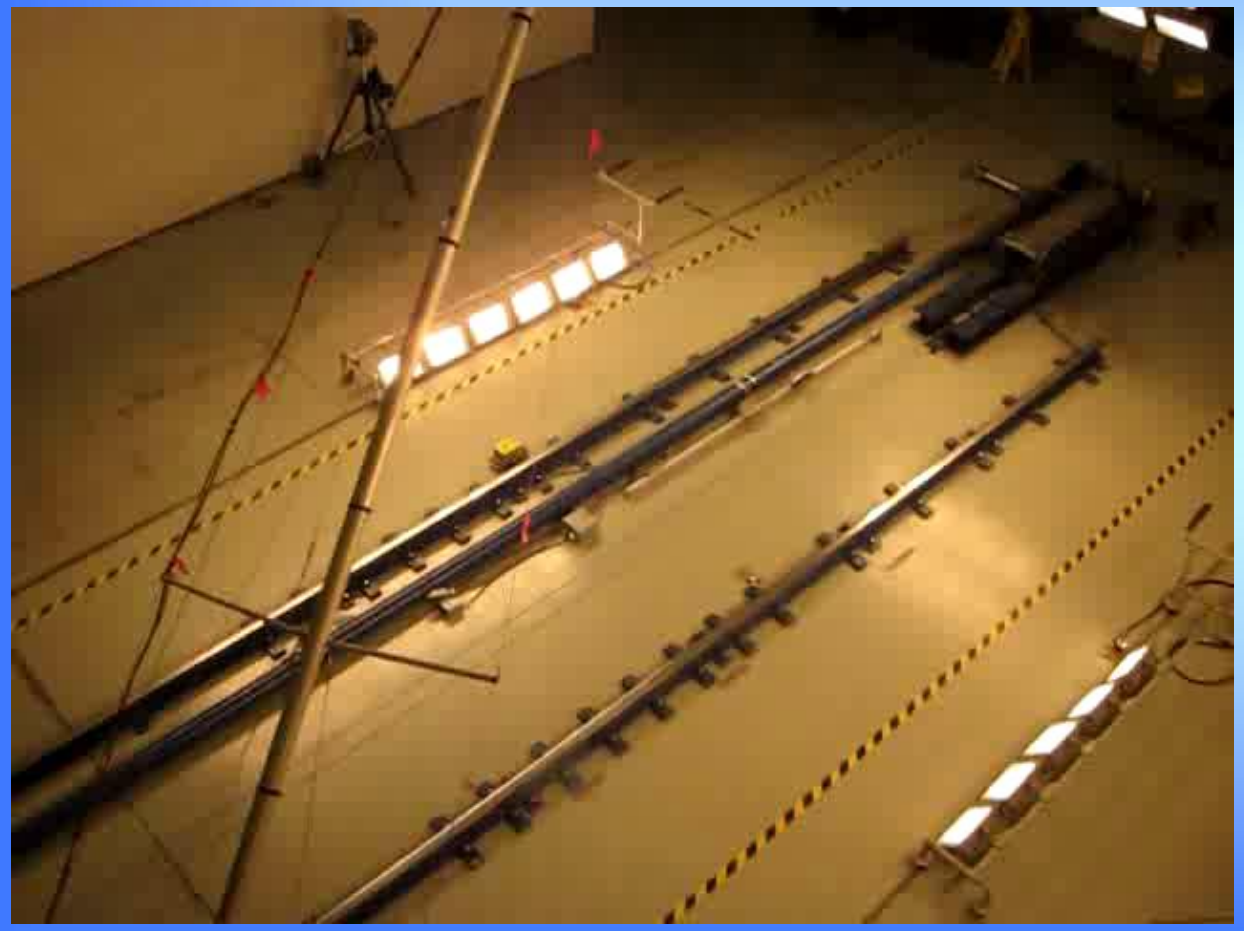


14 CFR 25.562*

- Emergency landing 16g Dynamic Load Conditions
- Head Impact Criteria

*CFR = Code of Federal Regulations

Seat Certification Requirements



14 CFR 25.562*

- Emergency landing 16g Dynamic Load Conditions
- Head Impact Criteria

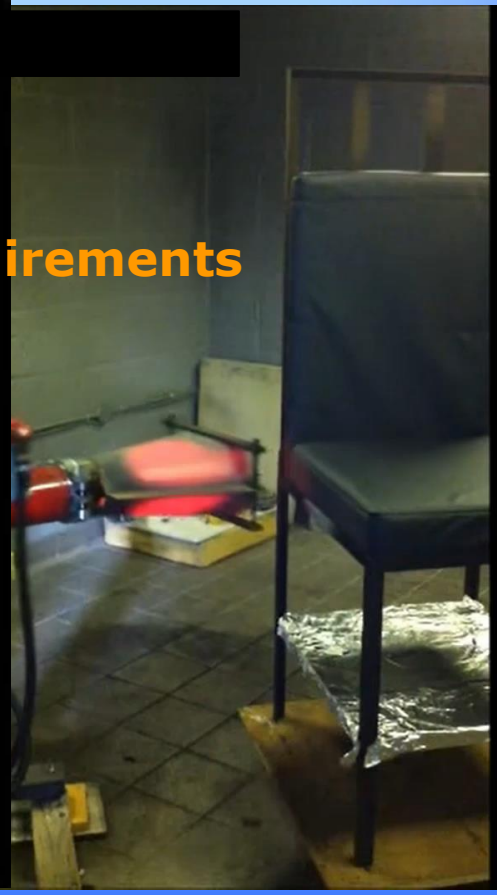
*CFR = Code of Federal Regulations

Seat Certification Requirements

14 CFR 25.853

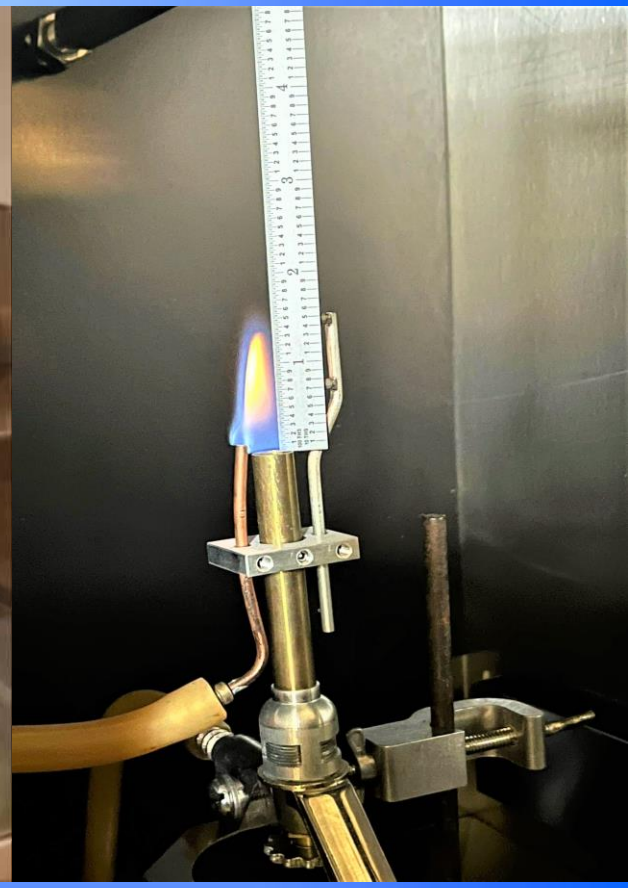
Fire Properties Requirements

- Oil Burner
- Flammability
- Smoke Release
- Heat Release
- Heat Release Rate
- Toxicity
- Gas Release



Cabin Materials F2 Flammability Test

- Comply with FAA & EASA Requirements
- Burn it for 12 secs
- Burn length < 8”
- Extinguishes itself within 15 secs
- Must not drip > 5 secs



Vision

- Upscale Local Design & Manufacturing Cap
- Rescale Singapore's landscape & Aerospace Map
- Scale up Local Fab
- Timescale our Joint Lab


Welcome Aboard
Integrate to Collaborate


SINGAPORE AIRLINES
Singapore Institute of Manufacturing Technology
SIMTech
SIA ENGINEERING COMPANY
SIA-SIMTech-SIAEC Joint Lab


SINGAPORE AIRLINES
Singapore Institute of Manufacturing Technology
SIMTech
SIA ENGINEERING COMPANY
SIA-SIMTech-SIAEC Joint Lab


SINGAPORE AIRLINES
Singapore Institute of Manufacturing Technology
SIMTech
SIA ENGINEERING COMPANY
SIA-SIMTech-SIAEC Joint Lab
SWL 2 10851 TONS
INTERLIFT


SINGAPORE AIRLINES
Singapore Institute of Manufacturing Technology
SIMTech
SIA ENGINEERING COMPANY
SIA-SIMTech-SIAEC Joint Lab
SWL 2 TONS

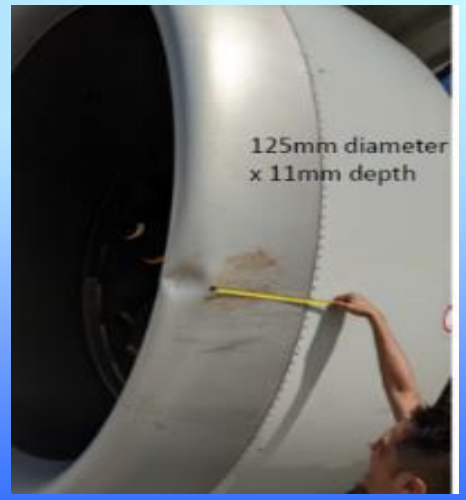

Collaborate to Accelerate

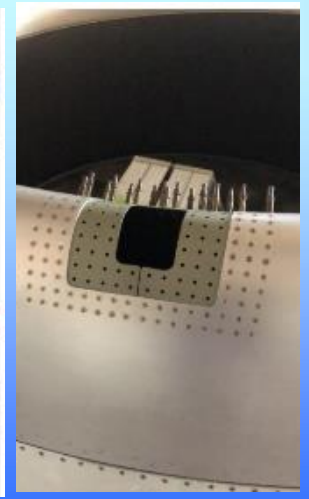
SIA*SIMTech*SIAEC Joint Lab

Collaborate to Accelerate

- Launched end July 2019
- Expertise expanded beyond manufacturing to design of new seats
- Workscope elevated from cabin to aircraft parts
- Achieved Production Organisation Approval
- Horizon broadened from design & manufacturing to new technology applications
- Collaboration extended to other A*Star Research Institutes (IMRE, IBB, I^2R & IHPC)

Thrust Reverser Fire Seal





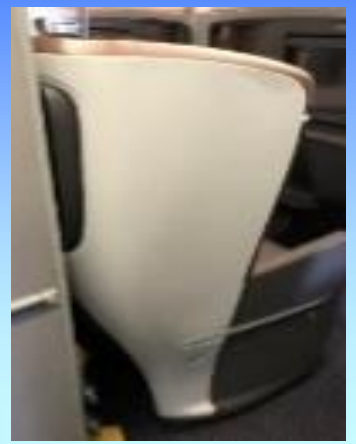
Engine Inlet Cowl Lip Repair

Anti-microbial Coating

JL Re-engineered Components

12 Jul 19
SIA SIMTech SIAEC Joint Lab

DNG Tambour Door



DNG Seat Back Shell

Sanitiser Holder (3DP & Injection Moulded)

2019 | 2020 | 2021

DNG Meal Table Top

ZIM PEY Literature Cover

Z200 Armcap

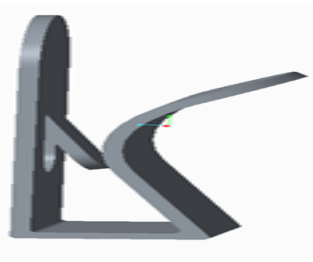
B737 Inner Armcap

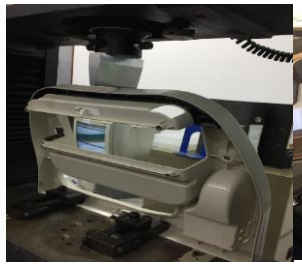
B737 Outer Armcap

SIA*SIMTech*SIAEC Joint Lab


Drain Strainer


EY Escutcheon


Galley Wall Clip


EY Shroud Support


JCL Arm Pad




Sanitiser Holders (3D Printed and Injection Moulded)


JCL Cocktail Tray


EY Cup Holder


FR Table Support


EY Armcap


EY Cup Holder


JCL Tambour Door


EY Safety Shield


JCL Meal Table Top


PEY Lit Cover


EY Armcap


EY Inner Armcap

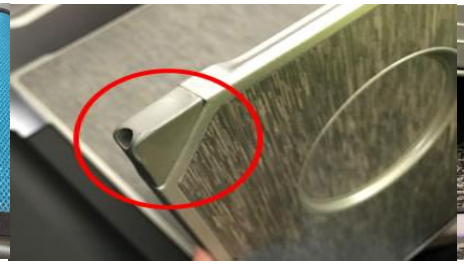

B737 Outer Armcap


JCL Back Shell


JCL Life Vest Cover


A350 EY Armcap


B787 EY Armcap


Meal Table Bumper



Galley Fitting Cover


JCL Lateral Panel


EY Spreader Shroud


Accelerate to Innovate

Accelerate to Innovate

- Able to accelerate innovation at short notice
- Create with close integration & strong collaboration
- In tandem with SIMTech's innovation
- Build a solid foundation

Accelerate to Innovate

- Restaurant A380@ Changi
- Runaway success near Changi runway
- Automated sanitiser dispenser holders
- Designed, analysed, tested, validated, manufactured & installed in 3 weeks

Accelerate to Innovate

- Design optimised with modelling CREO
- Analysed with FE Analysis & Simulation
- Validated to withstand > 20Kg abuse load
- 3DPrinted with SIMTech's Advanced Technologies

Accelerate to Innovate

- Success catapulted to all SIA fleets
- Used Injection Moulding instead of 3DP
- Certified with SIMTech's POA

SIA*SIMTech*SIAEC Joint Lab

Accelerate to Innovate

- All completed within 2 months
- SIMTech’ s POA help develop SMEs
- Strengthens local cabin design & manufacturing value chain


Innovate to Create

Innovate to Create

- Local talents in design & manufacturing of aircraft cabin components
- Opportunities for SMEs to upskill, reskill & scale up the value chain
- A R&D Centre of Excellence for cabin design & manufacturing
- Develop & implement new technology & applications in aircraft
- An effective & efficient manufacturing ecosystem in Singapore, by Singapore, for Singapore & beyond

Create to Differentiate

SIA * SIAEC * SIMTech Joint Lab

Develop Local Ecosystem for Manufacturing of Aircraft Cabin Components

SIA ENGINEERING COMPANY

SIMTech

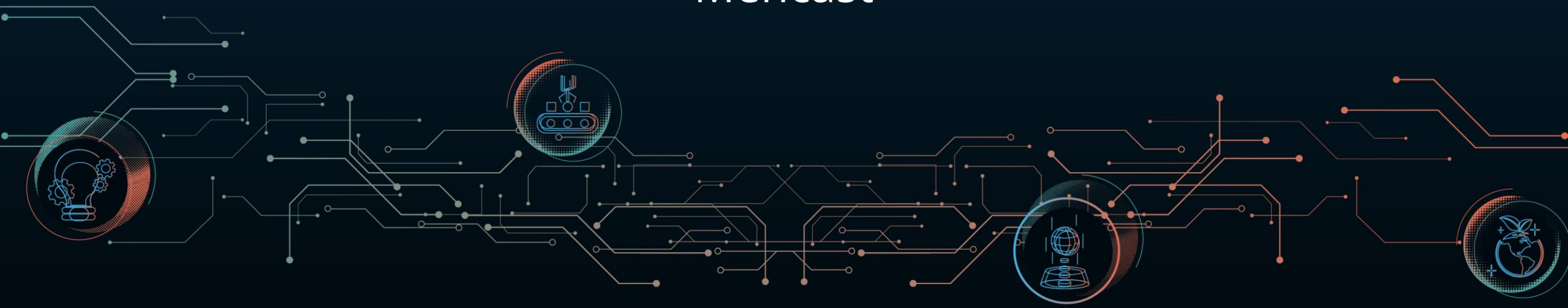
The Stars are our Limits

7he Beginnings

INNOVATION & TECHNOLOGY
CONFERENCE 2023
Innovation Through Advanced Manufacturing
Research & Technologies

Transforming from MRO Provider to a Global Leader in Marine Propellers

Mr Glenndle Sim
Executive Chairman and Chief Executive Officer
Mencast



Mencast
PARTNER PERFECT

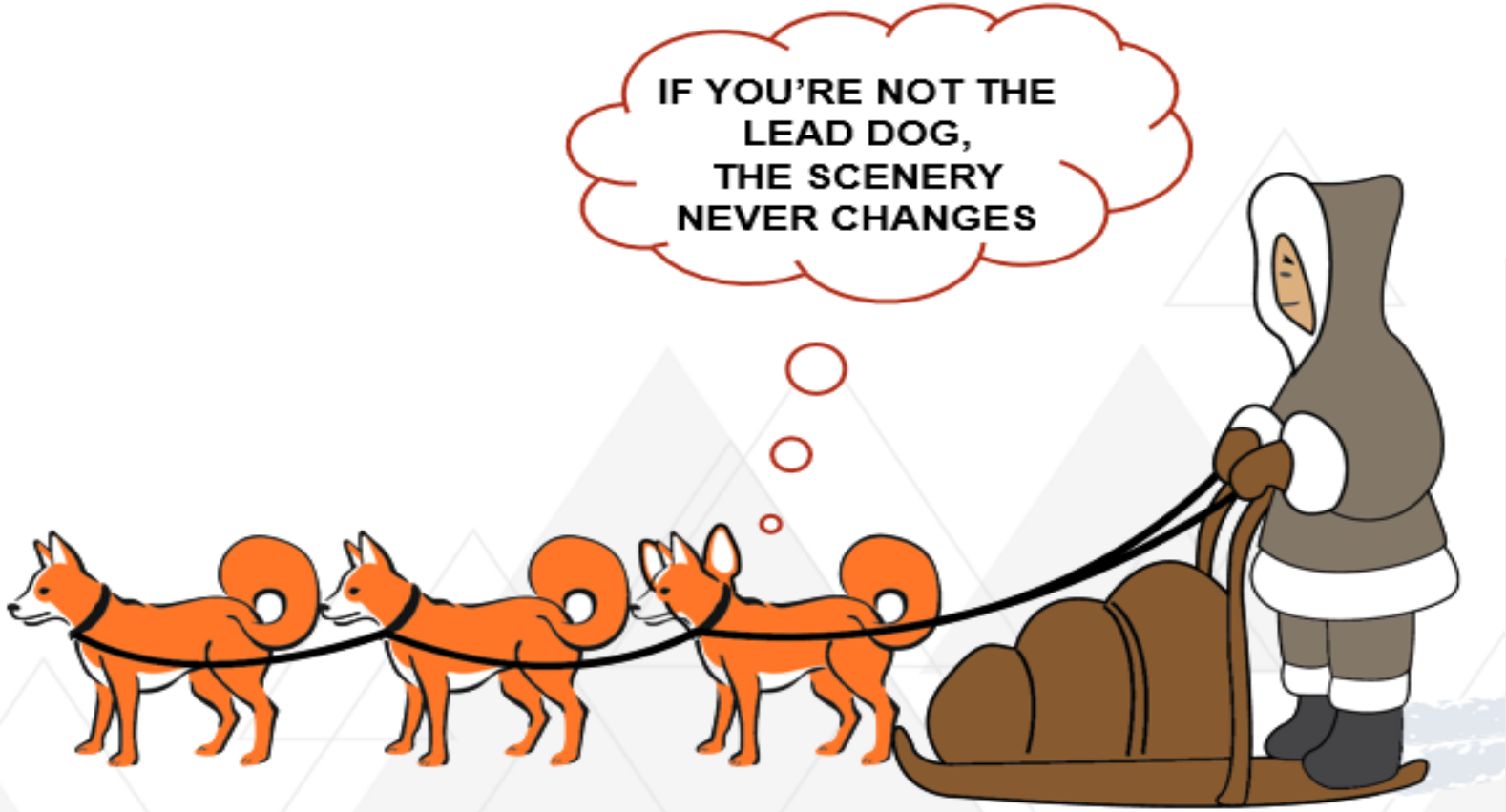
SIMTech Innovation & Tech Conference 2023

26TH JULY 2023

GLENNDLE SIM
EXECUTIVE CHAIRMAN AND CHIEF EXECUTIVE OFFICER
MENCAST HOLDINGS LTD

Building Businesses in Turbulent Times

A Journey-Not a Destination



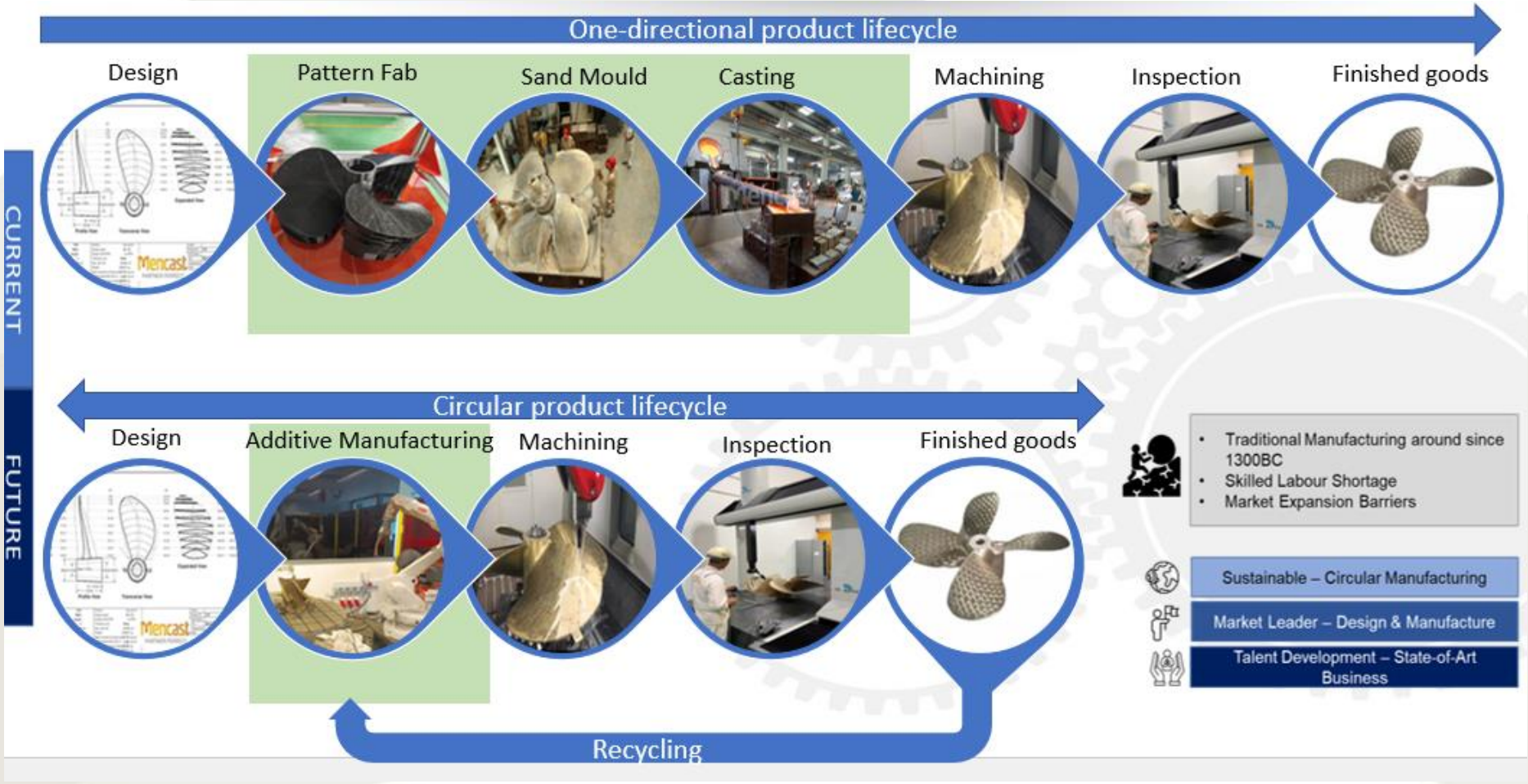
Are you leading into familiar or unfamiliar territory?

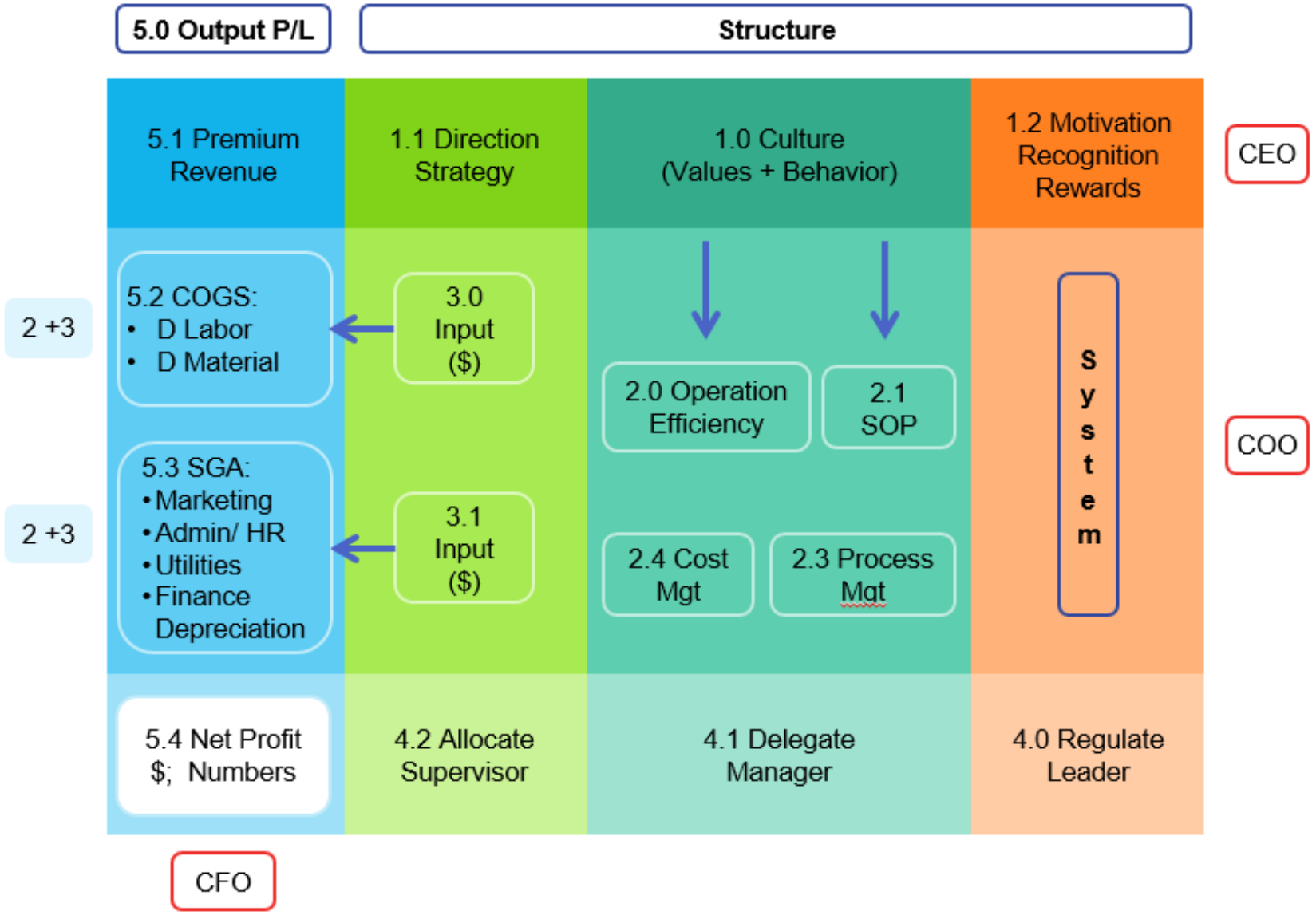
Mencast

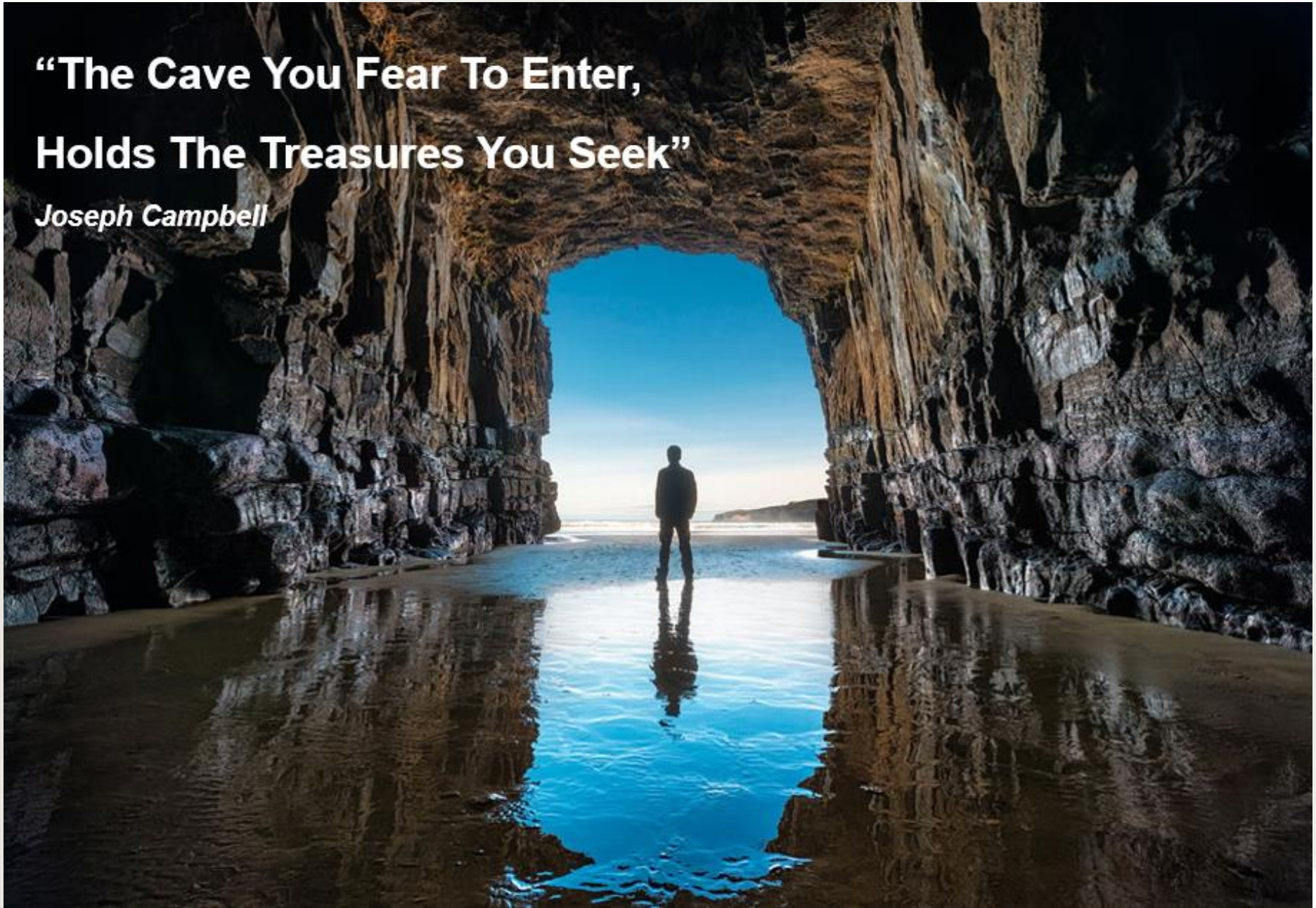
Rear-View Syndrome


Our Minds Must Be Like Parachute,
It Can Only Function When It's Open.

Transformation: Mencast's Journey towards Propeller Market Leader equipped with Advanced, Innovative, and Greener State-of-Art Manufacturing




5.0 Output P/L
Structure
5.1 Premium Revenue
1.1 Direction Strategy
1.0 Culture (Values + Behavior)
1.2 Motivation Recognition Rewards
CEO
2 +3
5.2 COGS:
• D Labor
• D Material
3.0 Input ($)
2.0 Operation Efficiency
2.1 SOP
System
COO
2 +3
5.3 SGA:
• Marketing
• Admin/ HR
• Utilities
• Finance
Depreciation
3.1 Input ($)
2.4 Cost Mgt
2.3 Process Mgt
5.4 Net Profit $; Numbers
4.2 Allocate Supervisor
4.1 Delegate Manager
4.0 Regulate Leader
CFO


“The Cave You Fear To Enter,
Holds The Treasures You Seek”
Joseph Campbell

INNOVATION & TECHNOLOGY
CONFERENCE 2023
Innovation Through Advanced Manufacturing
Research & Technologies

Enabling Precision Engineering from Development of Advanced Powder Metallurgy Manufacturing

Mr Chen Li
Engineering Director
Dou Yee Technologies

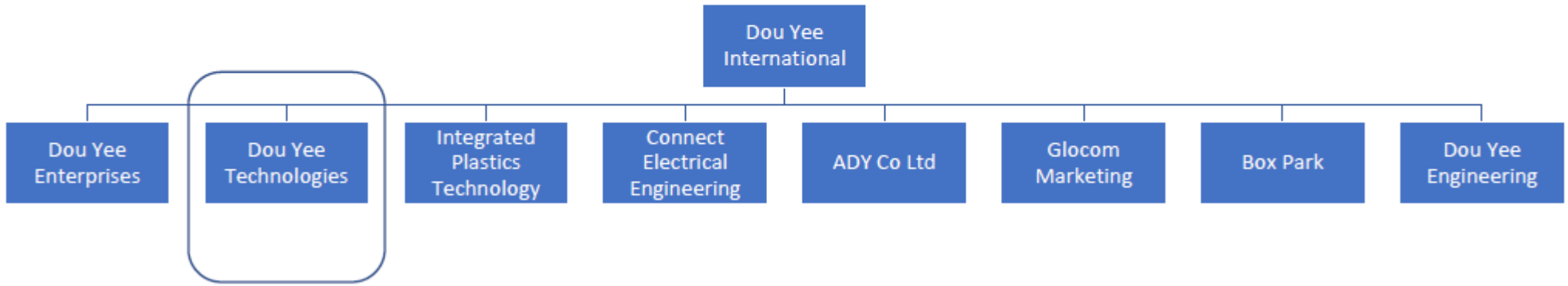
DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Enabling Precision Engineering from Development of Advanced Powder Metallurgy Manufacturing

Chen Li

Director Engineering
Dou Yee Technologies

DYI Group Corporate Structure



- *Vision : '**Global** Industrial Solutions Provider'*
  - ✓ From electronic, electrical industries to home appliance, personal & industrial space solutions
  - ✓ From manufacturing, trading to engineering solutions for direct materials

- **DY Group** is the world's market leader :
  - ✓ Leading supplier of ESD and related materials for the Electronics (DYES Group).
  - ✓ Leading manufacturer of carrier tapes (C-Pak Group).
  - ✓ One of the largest independent Metal Injection Molding Company (DYT).
  - ✓ One of the few manufacturers of capillaries (DYT).

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

About Us

• **Incorporated**	**April 1996**
• Core Business	Delivering Complex Components & Sub-Assemblies thru Metal Injection Molding, Ceramic Injection Molding, Engineering plastic injection molding & Assembly services
• Capital investment at Cost	S$ 67 Mil
• Awards	Development Expansion Incentive by Economic Development Board of Singapore
• QMS Certification	ISO 9001 : 2015 ISO 13485 : 2016 IATF 16949 : 2016

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Our Plants

Dou Yee Tech. - Singapore

- Defu Lane Building (DYT)
- Headquarters
- 74,000 sq ft Manufacturing Area

Dou Yee Precision Technologies (Anhui) Co. Ltd

- Suzhou-Chuzhou Industrial Park, Anhui, China (DYA)
- 323,000 sq feet Manufacturing Area
  - Phase 1 – 172,000 sq ft
  - Phase 2 – 151,000 sq ft

Kako Suntax - Malaysia

- Kluang Building (KSM)
- Secondary Operations
- 20,000 sq ft Manufacturing Area

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

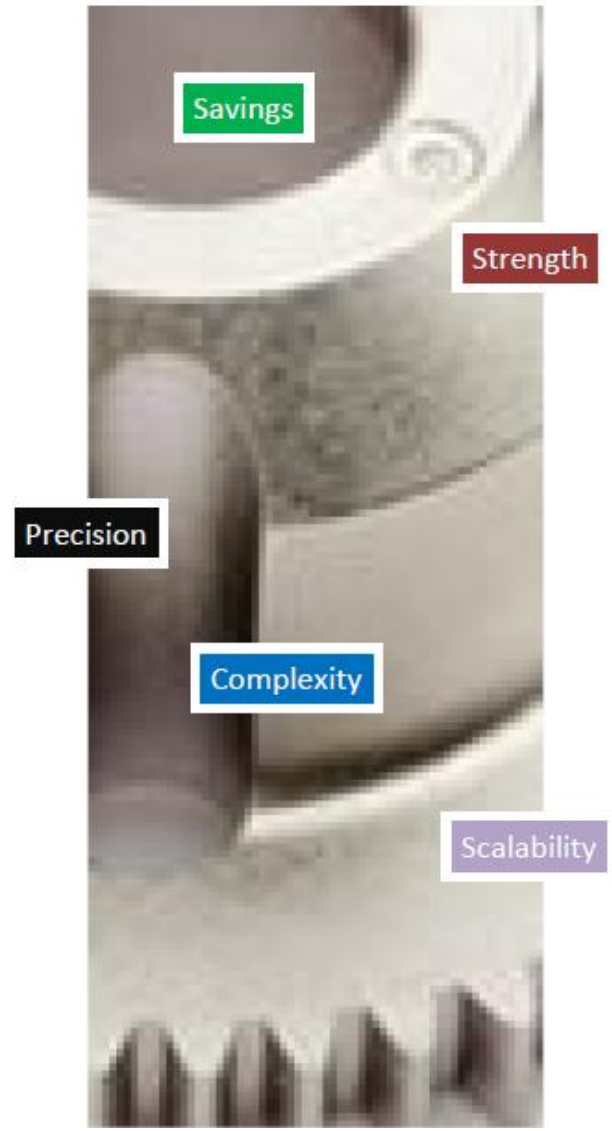
MIM Process - Overview

Mixing → Injection → Debinding → Sintering

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

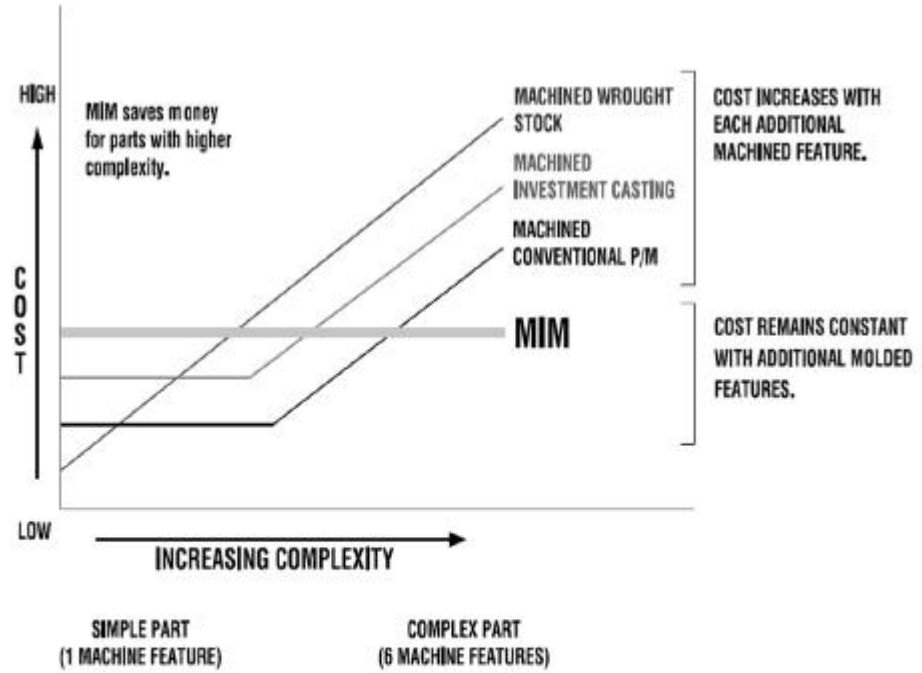
Why MIM?

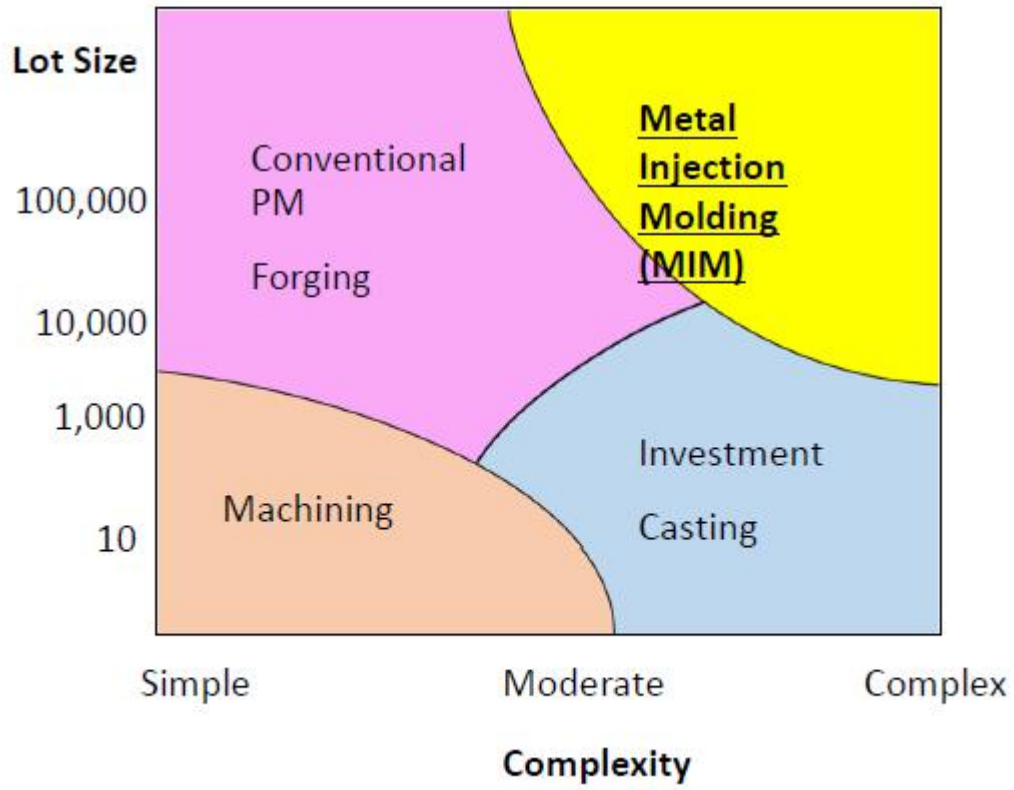
- Net-shape approach to component fabrication
- Cost-effective for moderate to high volumes
- Excels at applications that require complexity and material properties
- Ability to produce metal geometries **without** machining
- Ability to combine multiple parts into one single part.



DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Selection of Suitable Mfg Process





DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

MIM Materials Portfolio

Typical Mechanical Properties of MIM Alloys

Materials	Grades	Density (g/cm³)	Hardness
Stainless Steels	17-4 PH	7.60	35 – 40 HRC
	304L	7.80	120 HV
	High C-314	7.65	180 HV
	316L	7.85	120 HV
	317L	7.85	120 HV
	420	7.40	45 – 50 HRC
	440C	7.50	55 – 58 HRC
	HK-30	7.55	200 HV
	1.4957	7.65	140 HV
	Panacea	7.60	290 HV
Case Hardened Steels	2200	7.50	500 – 600 HV
	2700	7.60	500 – 600 HV
	8620	7.40	800 HV
Hardened & Tempered Steels	FeNi8	7.50	400 HV
	4140	7.50	42 – 48 HRC
Controlled Expansion Alloys	Alloy 42	7.55	110 HV
	F-15 (Kovar)	7.70	65 HRB
Soft Magnetic Alloy	FeSi3	7.50	75 HRB
Cobalt-Chromium Alloys	F75	8.00	225 HV
Ni-Fe-Mo Alloy	Fe80Ni4Mo	8.40	290 HV
Ni-Cr Superalloy	Inconel 713C	7.80	290 HV
Tungsten Alloy	W95NiFe	17.5	25 HRC

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

CIM Materials Portfolio

Typical Properties of CIM Materials

Materials		Grain Size (μm)	Density (g/cm³)	Hardness (Hv 300)	Electrical R (Ω-m)	Rupture Strength (MPa)
Pure Alumina	Al_2O_3	<3	3.95	2000	$>10^{13}$	400
98% Alumina	Al_2O_3	<5	3.88	1900	$>10^{13}$	275
Zirconia	ZrO_2	<0.6	6.05	1200	$>10^{12}$	700
Toughened Alumina	Al_2O_3+ZrO_2	<1	4.15	1850	$>10^{13}$	550
Stabilized Zirconia	ZrO_2+Y_2O_3	<0.8	5.55	1350	$>10^{13}$	900
Tungsten Carbide	WC-10Co	<5	14.2	1900	-	2200
Improved Toughened Alumina	KCR+	<1	4.15	1960	-	600
RUBY	Al_2O_3 + Cr_2O_3	<1	4.2	2000	-	650
Translucent Alumina	DYTT-1000	<25	3.95	1880	-	400
Aluminum Nitride	AlN	<5	3.3	1460	-	250

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Sector Products Showcase

Medical Sector

Automotive + eV

Consumer Electronics Sector

Industrial –
housing, enclosure

5G

SMCs

Heatsinks

Ceramics –
seals, heat & electrical insulators, e-filters,
porous filters

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Equipment Capacity

Description	DYT	DYA
Molding	52	35
Solvent DB	8 tanks	1 tank
Catalytic DB	4	10
LÖMI Solvent	2	nil
Thermal Furnaces	19	2
Batch Furnaces	20	3
Heat Treatment	1	nil
TAV Furnace	1	nil
2-in-1 Combo Furnace	5	12
Continuous Furnaces	nil	2
Curtis Twin Vector Grinders	Nil	6

Batch Furnaces

Continuous Furnace

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Areas of Strengths

- **Medical MIM**
  - Established customer base
    - EES, Medtronics, CMR, BD, Aesculap, Neotract, Cooper S
  - Experience including Robotic surgicals > Complex shapes, miniature, precision
- **Automotive MIM**
  - Expertise in Vanes
  - High temperature materials – HK30, Inconel, 1.4957
  - Growing customer base – Cooper Std, BMTS, Sensata, Garett > Fonatec, Cummins
- **CIM – Alumina & Zirconia**
  - Wax formulation > capillaries, insulators, heat shields, washers, seals, pistons
- **Multi-site**
  - Singapore, Malaysia & China > risk mitigation
- **Research links**
  - Joint Lab with SIMTech > new materials, new processes, innovation
  - NUS collaboration > 3D printing, binder jet AM
- **Assembly with automation, in-house machining, HT & finishing capabilities**
- **Medical device CM**

Development of Advanced Powder Metallurgy (PM) Manufacturing to Enhance Technical Capabilities and Operational Efficiency

Key Performer

- Singapore Institute of Manufacturing Technology (SIMTech)
- Institute of Materials Research and Engineering (IMRE)
- Institute of High Performance Computing (IHPC)

Industry Partner

- DOU YEE TECHNOLOGIES – ENGINEERED CONSISTENCY

Objectives:

1. To develop **advanced Powder Metallurgy (PM)** manufacturing to **enhance technical capabilities and operational efficiency**
2. To enhance **supply chain development** for advanced Powder Metallurgy manufacturing

WP1 – End-to-end PM manufacturing solutions for new applications *(Tech 1 & Tech 2)*

WP2 – PM process yield and productivity improvement *(Tech 3 & Tech 4)*

WP3 – Advanced PM processes and materials for emerging applications *(Tech 5, Tech 6 & Tech 7)*

Deliverables:

1. Established **end-to-end PM solutions** and **supply chain** for high value-added products
2. Implemented **X-ray imaging** for quick screening and **in-process quality prediction**
3. Developed **advanced PM processes** and **functional materials** for communication and electrification applications

Development of Local PM Supply Chain Ecosystem

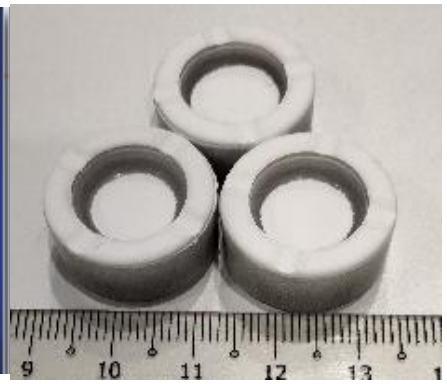
- Component Technology Pte Ltd
- GVT Manufacturing Solutions
- FOREFRONT AM
- PRECISION HYDRAULIC TECHNOLOGY
- Harrier Technology pte ltd

Singapore Institute of Manufacturing

End-to-end PM manufacturing solutions for new applications

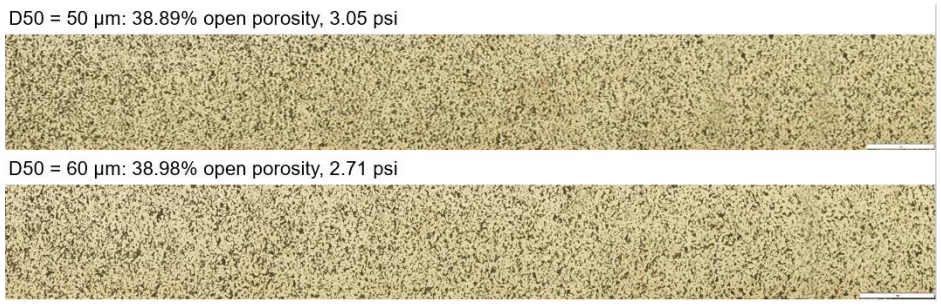
- To provide end-to-end advanced powder compaction manufacturing solution for ceramic ring, metallic gear and metallic porous filter.
- To develop a novel computer simulation approach that provides a faster alternative to the conventional trial-and-error method for the powder compaction process

Ceramic ring

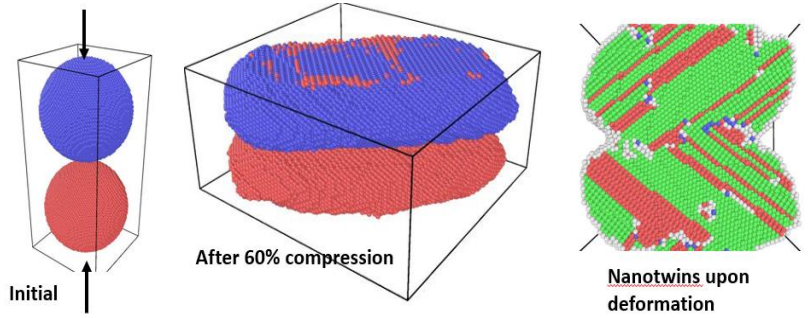


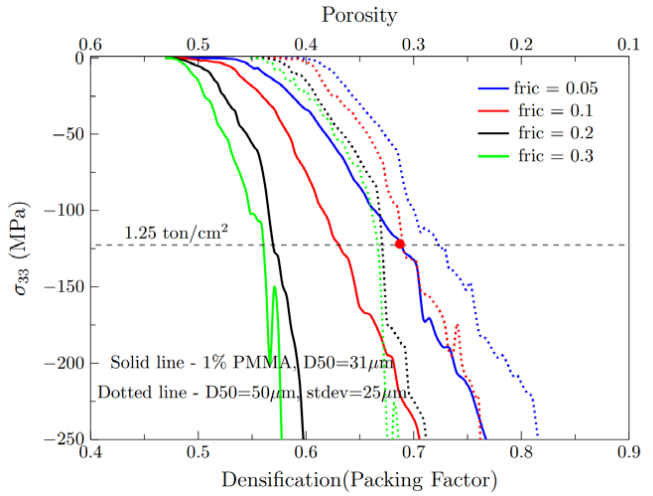
Ceramic piston

Steel gear



Porous steel with controlled pore size and porosity level

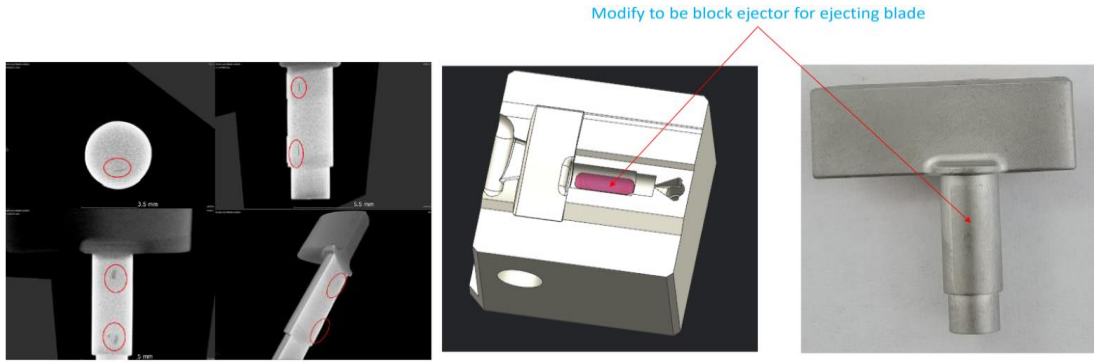




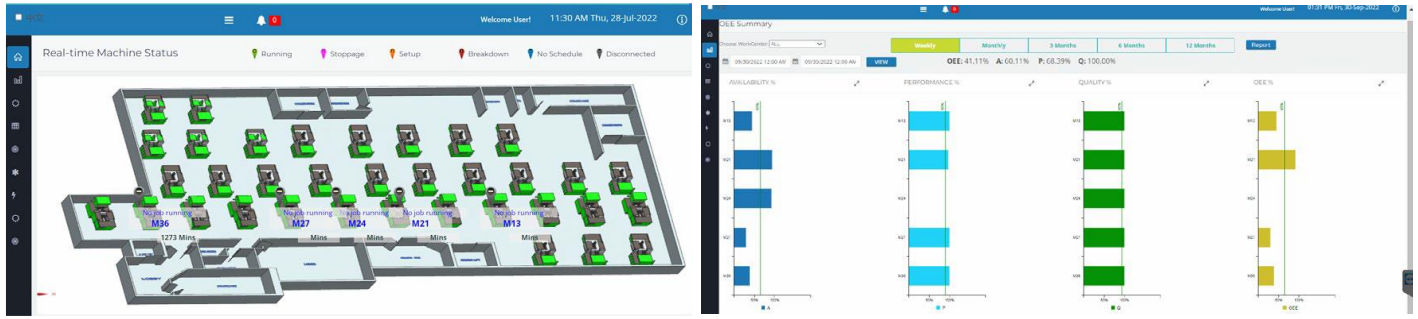
Modelling of powder compaction and effect of different parameters on porous control

PM process yield and productivity improvement

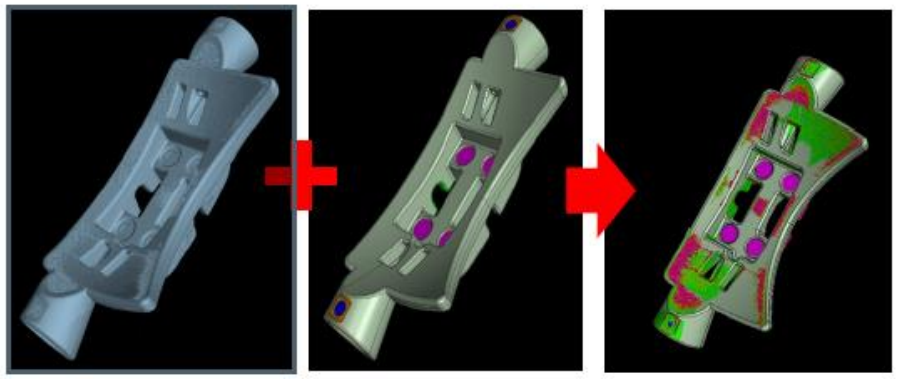
- To establish non-destructive inspection and defect root cause analysis for complex parts by X-ray technique
- To develop neural network based in-process quality monitoring and machine performance analysis for MIM process



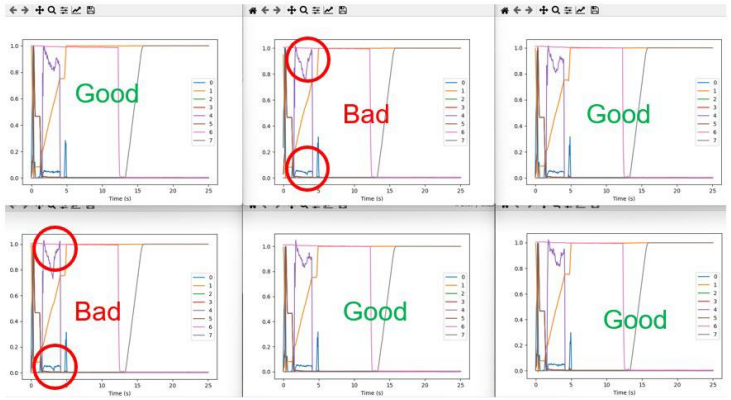
Defect root cause analysis and yield improvement



OEE software used at Dou Yee



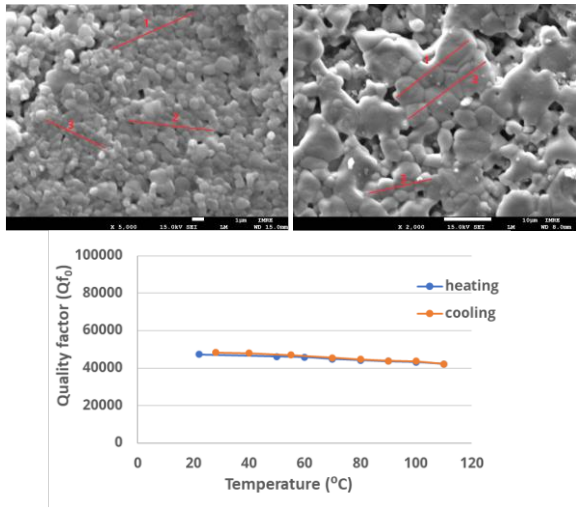
New product 3D profile analysis



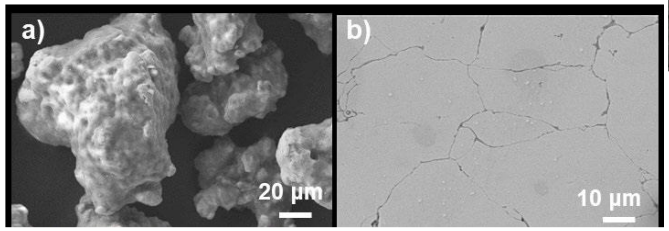
Good and bad quality samples for DB part

Advanced PM processes and materials for emerging applications

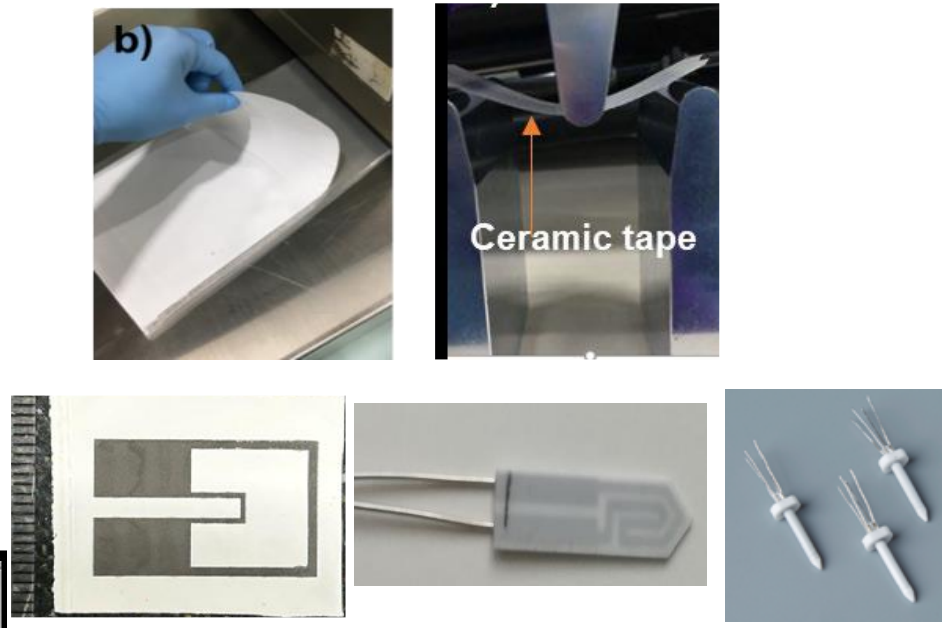
- To develop material and processing technologies for high performance ceramic RF filter and soft magnetic composite.
- To develop a new gel-tape casting to produce high value-added thin sheet and multi-layered ceramics for different applications
- To develop material system and processes for reliable mass production of micro-parts/features



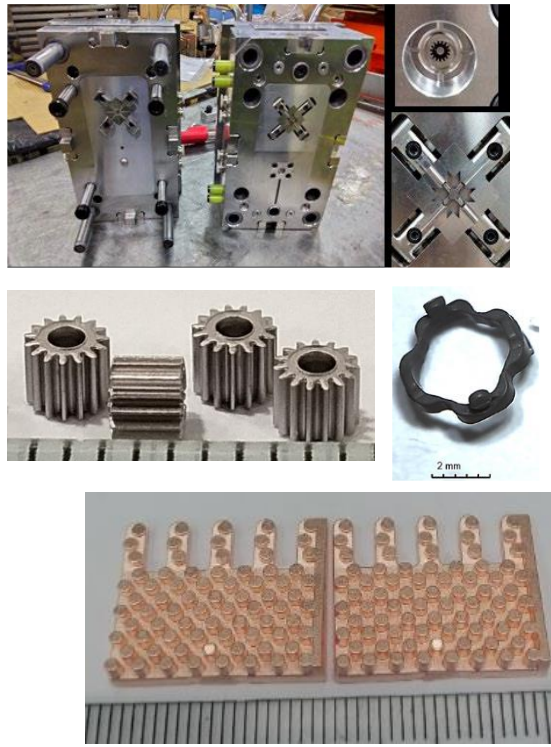
Dielectric ceramics and properties



Soft magnetic composite



New gel-tape casting and application in ceramic heater



Micro-MIM for small parts and features

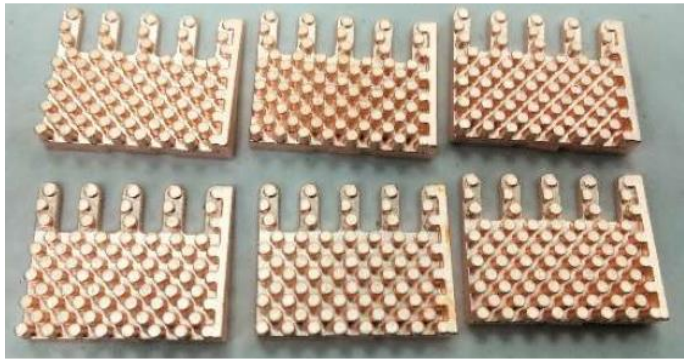
DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Pure Copper – Cu

Advantages:

- High electrical conductivity
- Excellent Thermal conductivity
- Good ductility
- Good machinability and corrosion resistance

Applications:



Heat Sink

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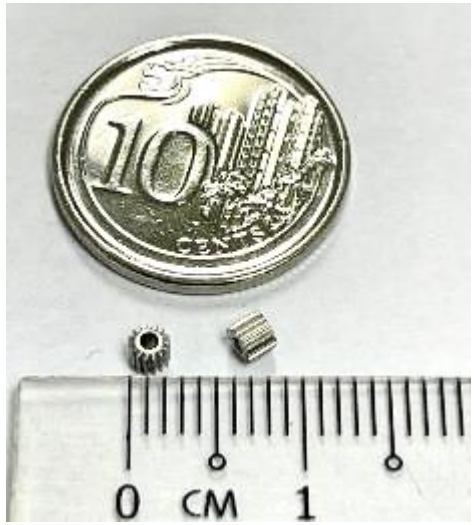
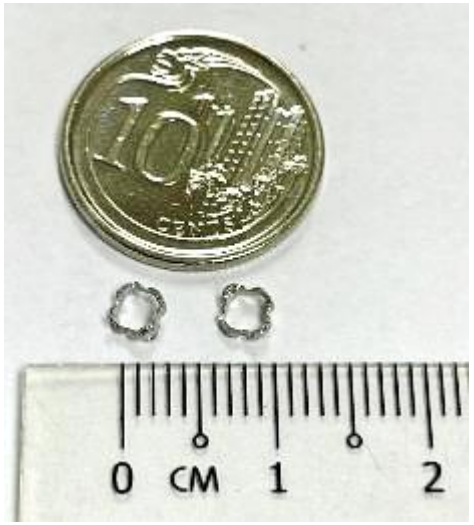
DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Micro-MIM Process



- **Part Name :** **Planet Gear**
- Material Type : 17-4PH
- Color : As MIM
- Part Volume : 6.56 mm^3
- Part Weight : 0.05 grams
- Application: Micro Motors



- **Part Name :** **Hinge Capture**
- Material Type : 17-4PH
- Color : As MIM
- Part Volume : 3.85 mm^3
- Part Weight : 0.03 grams
- Application: Hypotubes for Key-hole Surgery

Return to Index

DOU YEE TECHNOLOGIES
ENGINEERED CONSISTENCY

Contact us

Contact Us

+(65) 6444 0218

+(65) 6444 8273

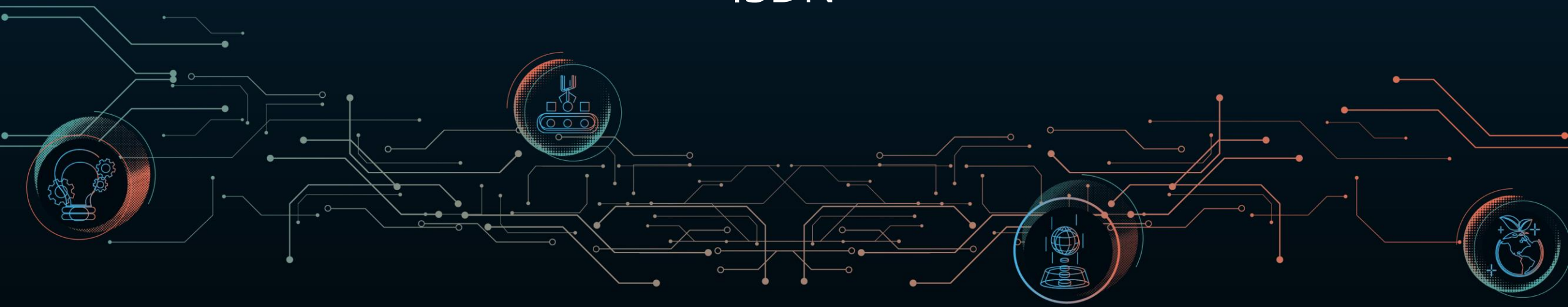
Email: marketing@douyeetech.com

Website: http://www.douyeetech.com/

INNOVATION & TECHNOLOGY
CONFERENCE 2023
Innovation Through Advanced Manufacturing
Research & Technologies

Integration of Precision Engineering and Digitised Manufacturing Solutions

Mr Tay Geok Kee
Chief Technology Officer
ISDN



ISDNHoldings

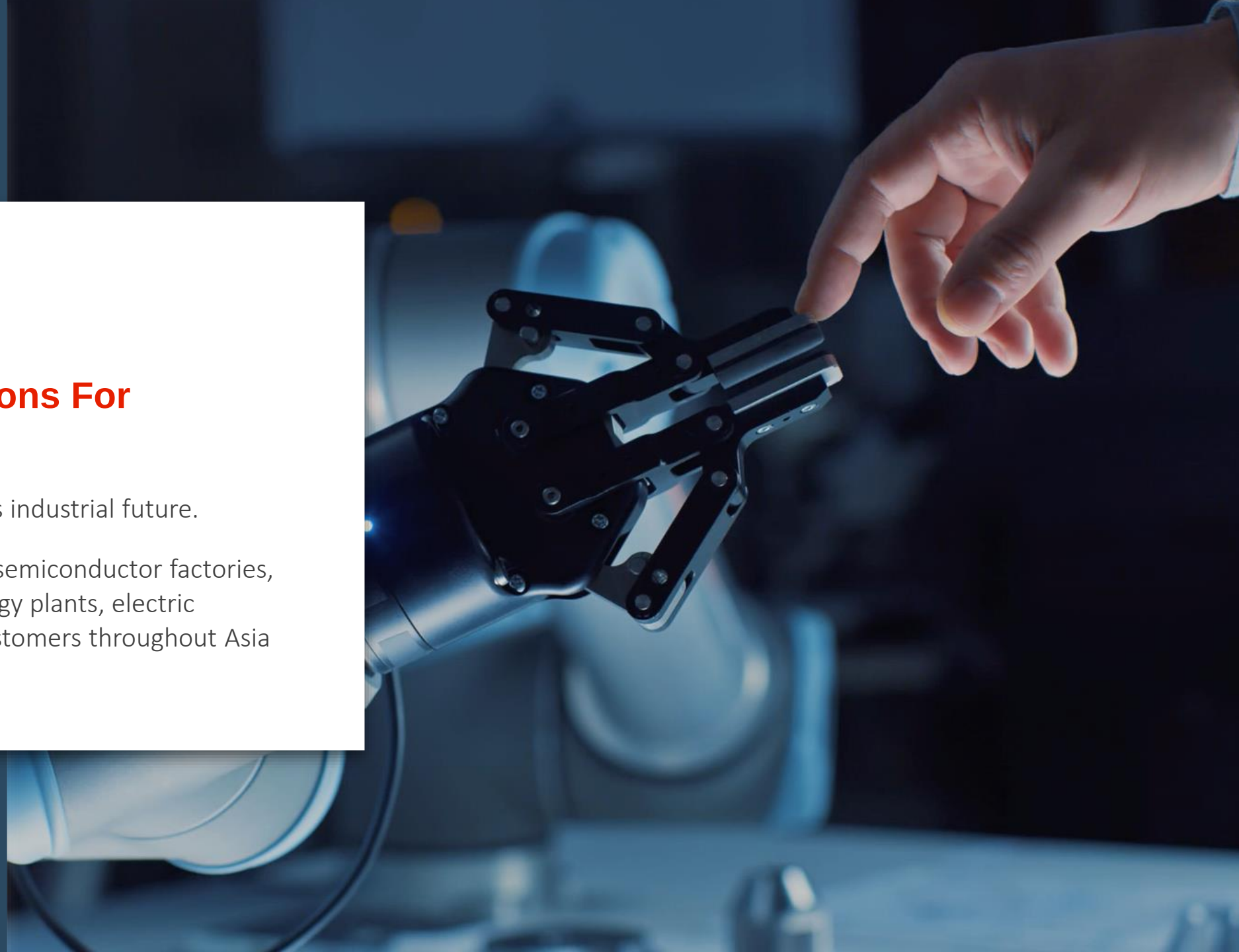
ISDN collaboration with A*STAR entities

ISDNHoldings

Powering Smart Operations For Sustainable Growth

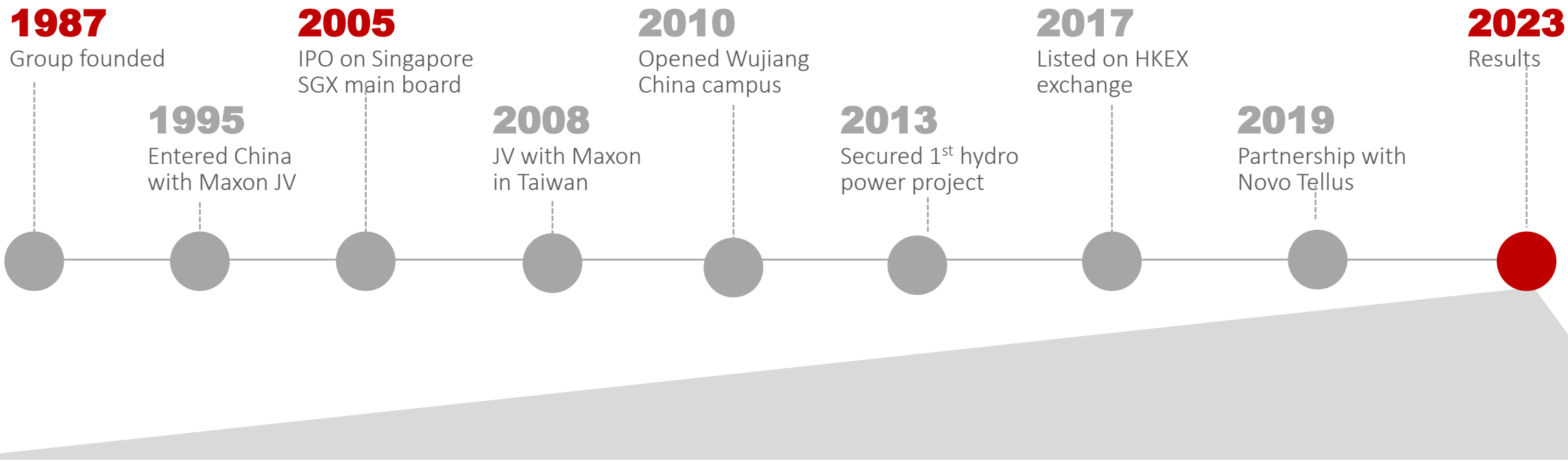
We deliver solutions that power Asia's industrial future.

Our components and systems power semiconductor factories, advanced medical devices, clean energy plants, electric vehicles and more for over 10,000 customers throughout Asia



Solid platform in a growth market

We have grown profitably for over 35 years



Growing scale		Growing reach			Growing shareholder return		
$62bn+	**$440m**	**10,000+**	**900+**	**70+**	**$25.5m**	**+68%**	**>490%**
Asia market for Industrial Automation	revenue all-time record	enterprise customers throughout Asia	employees across Asia	locations throughout Asia	profit to shareholders all-time record	profit growth from 2020	5-year growth in profit to shareholders

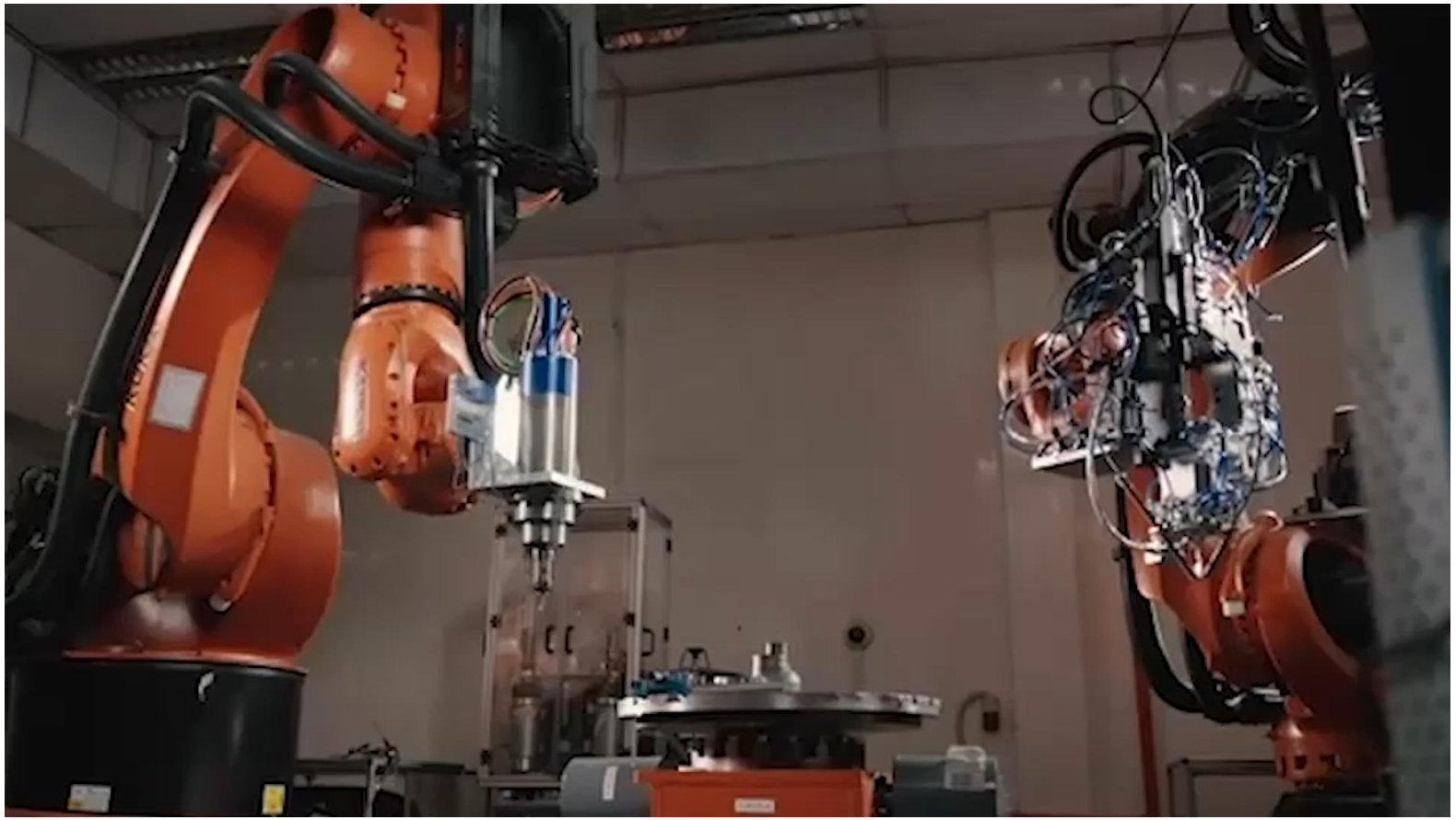
Source: ReportOcean amd Fortune Business Insights (2021)

COLLABORATIONS

- SIMTech-ISDN joint laboratory
- Rapid Vibrio Detector
- TruMarine

SIMTECH-ISDN JOINT LABORATORY

Working with SIMTech to jointly manage SIMTech-ISDN joint laboratory for large format hybrid laser aided additive manufacturing (LAAM) system and CAM for 5-axis CNC and 8-axis robot for combined LAAM and subtractive machining.



- **High power laser system for welding and additive manufacturing;**
- **Full 5-axis hybrid system with additive manufacturing & milling functions for fabrication of 3D components, capable for additive manufacturing and machining of freeform 3D parts in one machine for components over a large footprint (>1m)**

How LAAM will propel ISDN forward?

	Manufacturing Capabilities	Enhanced Efficiency and Cost Reduction	Customization and Personalization	Diversification and Expansion
 LAAM	Explore the possibility of incorporating large format hybrid LAAM systems within its manufacturing processes. This could enable ISDN to produce custom parts, components, or prototypes in-house, reducing reliance on external suppliers and enhancing production efficiency.	Streamline the manufacturing process by reducing material waste, minimizing the need for multiple manufacturing steps, and enabling faster production cycles. This can lead to increased operational efficiency and cost savings for ISDN	LAAM technology allows for the production of highly customized and personalized products. ISDN Holdings Ltd can leverage this capability to offer tailored solutions and services to its clients, providing unique and value-added offerings in the market.	LAAM technology opens up new possibilities for ISDN Holdings Ltd to enter or expand into industries that require large-scale manufacturing capabilities. This could involve venturing into sectors such as aerospace, automotive, energy, or medical, where LAAM systems find significant applications.
 Vibrio Detector				

RAPID VIBRIO DETECTOR

Working with IMRE to transform Aquaculture Bacteria Detection

- Advanced onsite bacteria detection tool
- Transform Aquaculture and improve production outcome with timely bacteria detection
- Reduce time taken from 2 days to 30min
- Cost reduction by 50%

How Vibrio Detector will propel ISDN forward?

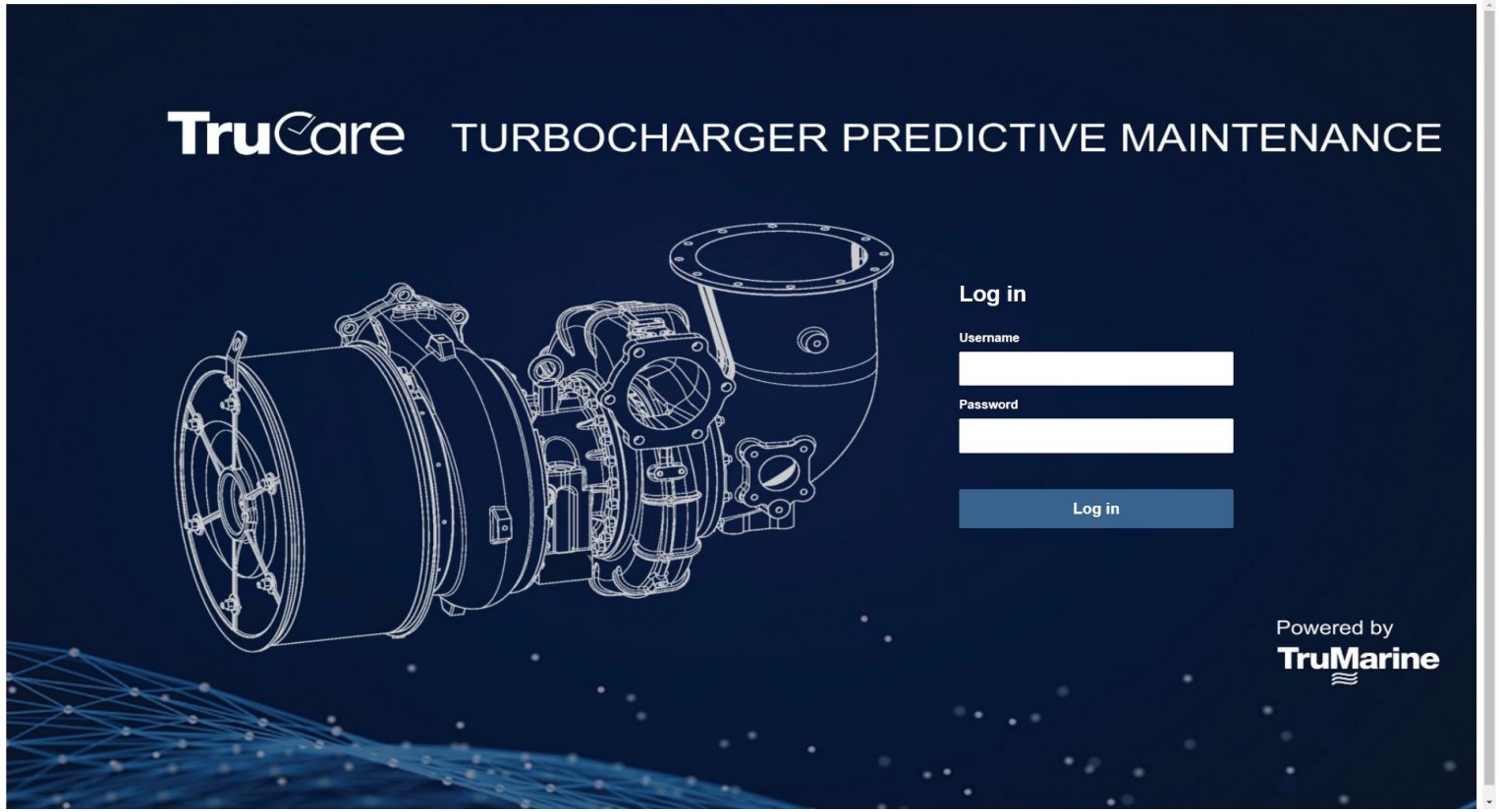
LAAM

Vibrio Detector

Enhanced Environmental Monitoring	Data Analytics and IoT Integration	Customized Solutions
The Rapid Vibrio Detector can help ISDN Holdings Ltd expand its offerings in environmental monitoring. The device's ability to quickly detect Vibrio bacteria in water samples can support ecological studies, pollution control, and water resource management initiatives.	ISDN can develop data analytics capabilities and integrate the Rapid Vibrio Detector with its ISDN platform. This would enable real-time monitoring, data collection, and analysis, providing actionable insights to clients and enabling proactive decision-making in response to water quality issues.	By combining the Rapid Vibrio Detector with ISDN expertise, we can develop customized solutions tailored to specific industries or client needs. This could involve integrating the detector into existing systems, developing user-friendly interfaces, or providing remote monitoring and control functionalities.

TRUMARINE, in collaboration with ARTC

Collect the data from vessels all around the world, and present the data and results from predictive analytics on a dashboard



- Filter different companies and the corresponding health score easily and locate the vessel
- Details like the individual health score and the details of fault can be viewed. Both generated using predictive analytics and transmitted back to the dashboard

ISDN is develop its platform suite of applications and turnkey solutions to address clients' varied automation needs

ISDN Platform Suite

Applications + **Solutions**

L3/4

*Digital Twins**

Edge computing

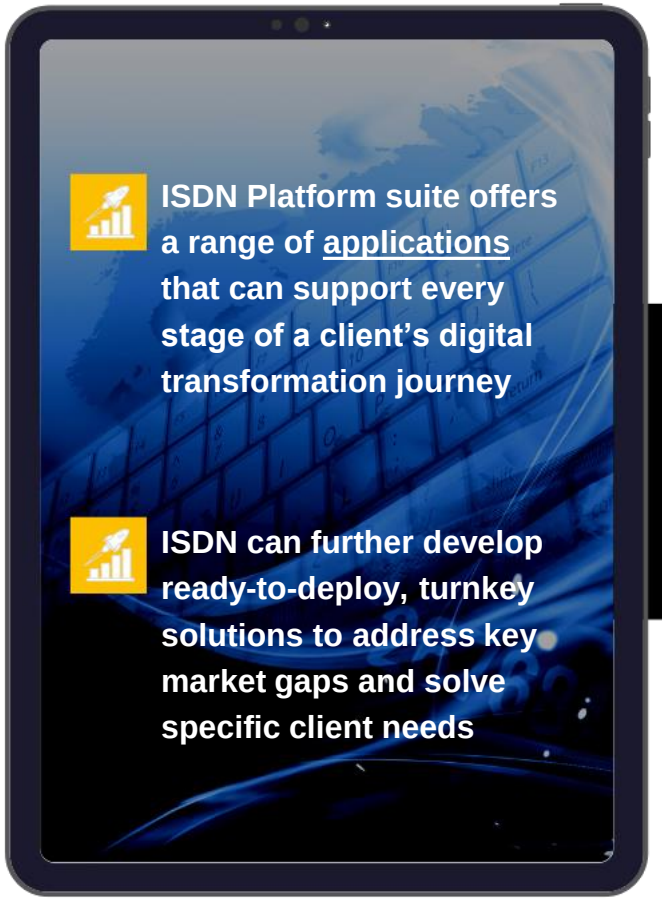
Storage & Retrieval System

Metal 3D Printing

Data Center Software

L1/2

*Machine Vision**



Note: (*) Applications considered for future development

Our growth engine: accelerating our proven growth engine

Growing technology capabilities

- **5 pillars of growth**
  Motion control, precision manufacturing, software, systems, renewable energy
- **Growing Industry 4.0 technology**
  Proven ability to deliver from components to full systems. Growing market need for increasing automation.

Sustainable industry

- **Early visionary and leading among peers**
  Early investment in sustainable industry with strong commercial outlook anchored by hydrop investments.
- **Comprehensive commercial portfolio**
  including solutions for solar, clean agriculture, disinfectants

Diversified growth drivers

- **Growth industries**
  including advanced medical, semiconductors, precision manufacturing, digital infrastructure, shifting to Industry 4.0
- **Growth technologies**
  from components to modules, systems, software and cloud
- **Growth geographies**
  China, Singapore, Vietnam

Operational cost discipline

- **Sales efficiency**
  Ready access to 10,000+ customers with growing needs
- **Strong economies of scale**
  Many brands with common infrastructure
- **IT-driven productivity**
  Consolidation & automation of corporate infrastructure

ISDNHoldings

Thank you

INNOVATION & TECHNOLOGY
CONFERENCE 2023
Innovation Through Advanced Manufacturing
Research & Technologies

Partnership for Innovation and Business Success

Mr Jacky Chan
Chief Financial Officer
ATC

ATC

Your surface finishing partner

INNOVATION AND BUSINESS SUCCESS

INTRODUCTION

WHO WE ARE

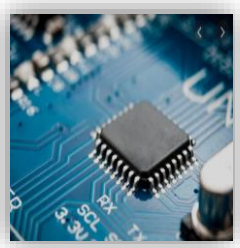
ATC GROUP

APPLIED TOTAL CONTROL TREATMENT PTE LTD (HQ)

2022 (NEW) - LIVE

350 Headcounts | 200,000 sqft | 2 shifts

Aerospace



Semicon

Oil & Gas

Medical & Optical

Industries We serve

2004

Applied Total Control Treatment
INITIAL SETUP
Marsiling, Singapore

2010

ATC Coating
LIVE
Woodlands, Singapore

2012

ATC Surface Finishing
LIVE
Penang, Malaysia

2018

ATC Cleantec
LIVE
KL, Malaysia

BUSINESS SEGMENT

ELECTROPLATING

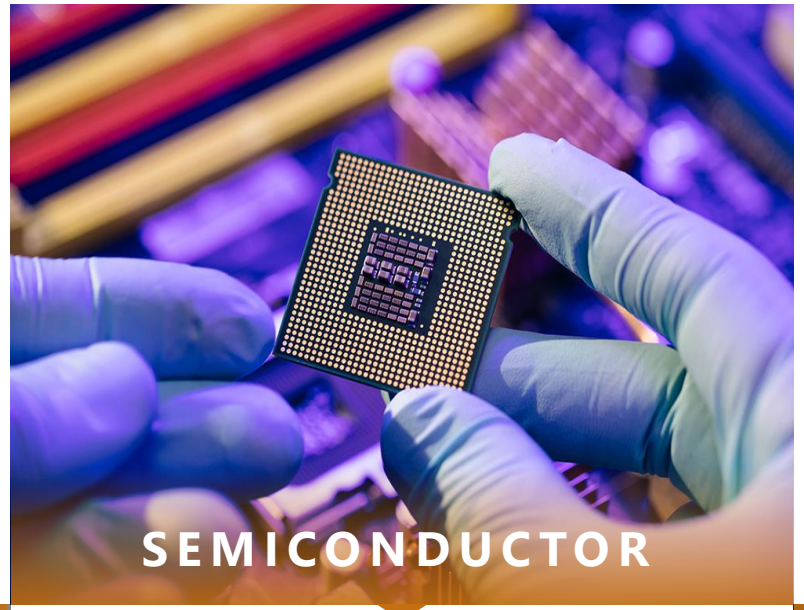
COATING

CLEAN & PACK

(CLEANROOM CLASS 100)

PRODUCTS - SURFACE TREATMENT

- Colour Anodizing
- Chromate Conversion Coating
- Electroless Nickel
- Passivation
- Electropolish
- Cadmium
- Chrome
- Dry/Solid Film Lubricant
- Silver
- Tin Plating
- Spray Painting



- Colour Anodizing
- Chromate Conversion Coating
- Electroless Nickel
- Passivation
- Electropolish
- Blueing
- Powder Coating
- Spray Painting
- Clean & Pack
- Zinc Plating

- Colour Anodizing
- Chromate Conversion Coating
- Electroless Nickel
- Passivation
- Electropolish
- Gold
- Silver
- Powder Coating
- Spray Painting
- Clean & Pack
- Zinc Plating

AEROSPACE Qualification & Award

01 Quality Management System
AS 9100 REVD & ISO 9001:2015

02 Nadcap Accredited in Chemical Processing
Anodizing, Passivation, Conversion Coating, Electroless Nickel, Tin, Silver, Chrome, Cadmium, Electropolishing, Dry/Solid Film Lubricants

03 Singapore Aerospace Awards
2009 Silver Supplier Excellent Awards
2011 Gold Supplier Excellent Awards
2014 Silver Industry Excellent Awards

SINGAPORE AEROSPACE AWARDS
2014 Silver Standard
Aerospace Industry Excellence

SINGAPORE AEROSPACE AWARDS
2011
GOLD
Supplier Excellence

SINGAPORE AEROSPACE AWARDS
2009 Silver Standard
Aerospace Supplier Excellence

BUREAU VERITAS 1828
BUREAU VERITAS

Nadcap
Administered by PRI
ACCREDITED
Chemical Processing

PARTNERSHIP FOR INNOVATION AND BUSINESS SUCCESS

PARTNERSHIP WITH SIMTech

ATC
Your surface finishing partner

Centre of Excellence For Advanced Surface Treatment and Coatings
(Proposal in Progress)

Enhanced the Technology and Commercialize

To enhance local supply chain resilience and partnerships through developing technology demonstrators for advanced manufacturing value add applications.

R&D (Research & Development)

To develop advanced and sustainable surface treatment and coating processes to enhance technical capabilities and process efficiency.

SUSTAINABILITY ACHIEVEMENT

SIA ENGINEERING COMPANY

Sustainable practices by reusing repair copper trim for business class seats.

Development of metallization and electrolytic coating for ABS polymer.

Singapore Institute of Manufacturing Technology
SIMTech

TECHNOLOGY TRANSFER VIA LICENSING

Localization and project transfer to local SME and expand local aerospace MRO ecosystem.

ATC
Your surface finishing partner

COMMERCIALIZATION
COPPER TRIM REPAIR FOR SIAEC

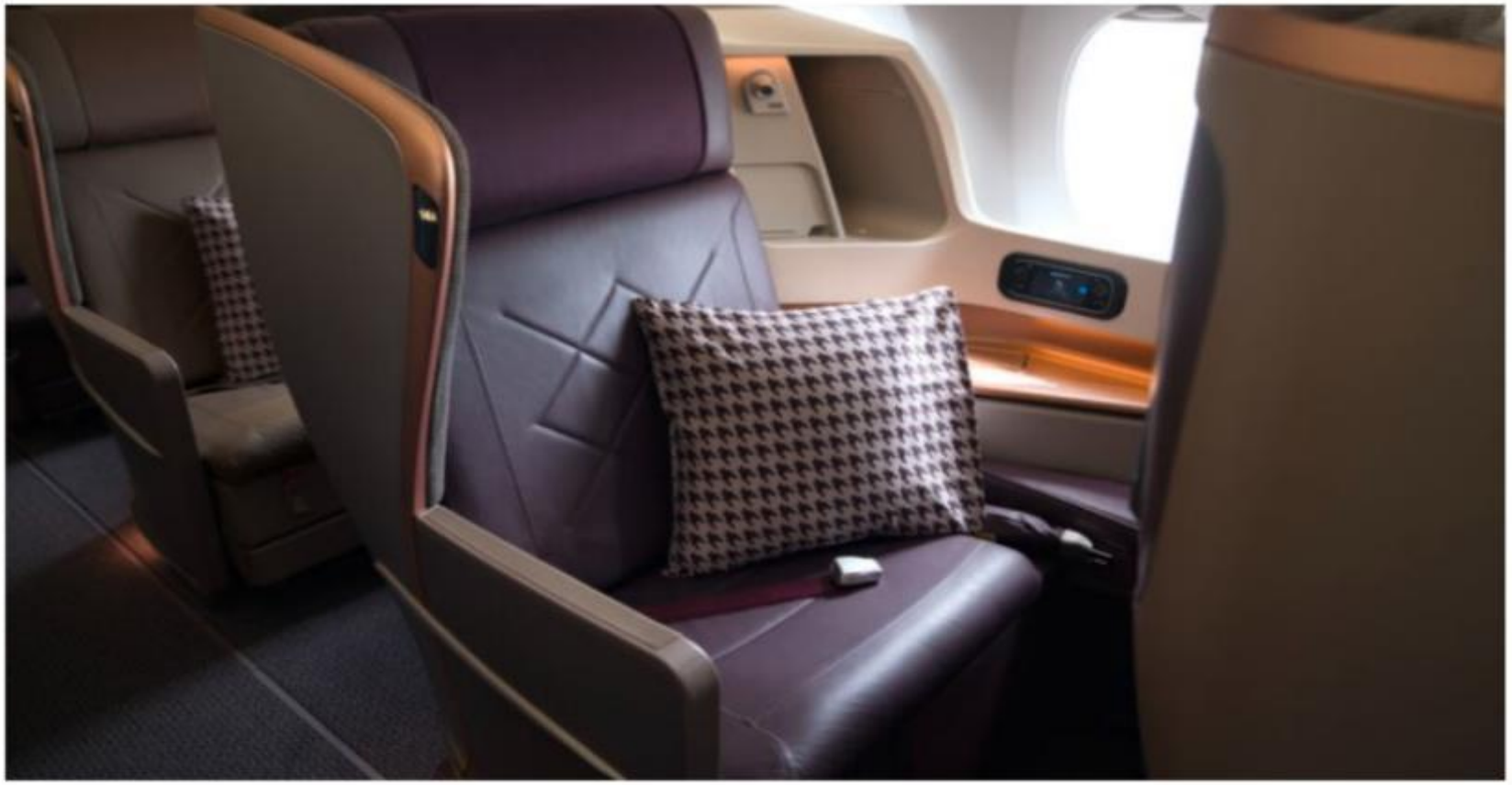
MRO BUSINESS CLASS SEAT

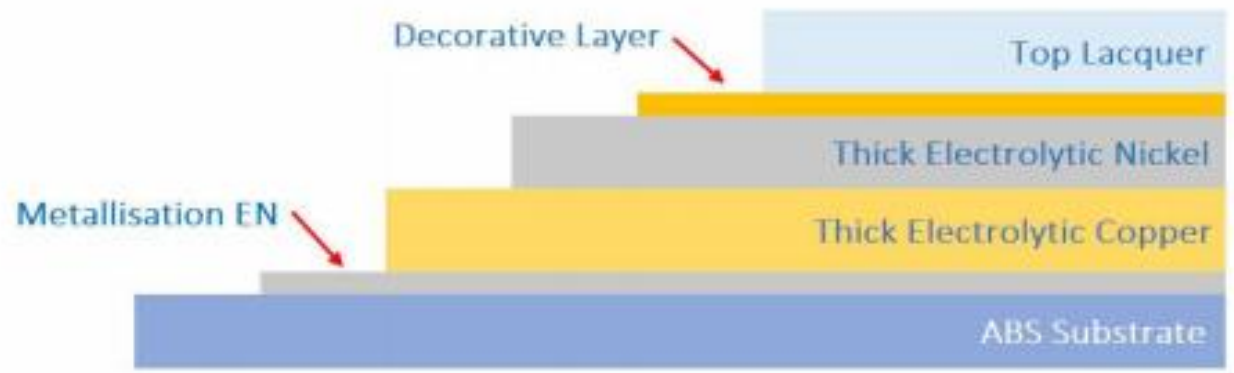
Our Workmanship

AIRCRAFT | COMPONENTS | MRO MANAGEMENT | MRO NEWS

ATC to take over repair line for refurbishment of Singapore Airlines' cabin components

Craig Waters
June 21, 2023





Trim Coating Layer Structure (ABS Base + Multi Layer Coatings)

FUTURE DEVELOPMENT

FUTURE DEVELOPMENT

PRODUCT FROM OEM TO ODM

Research & Development
Partnership and cooperation to developing new technology

Partnership with
Singapore Institute of Manufacturing Technology
SIMTech

Centre of Excellence
Advanced surfaced treatment and coatings

Start
Build From Print

2004
Chemical Line

2013
Manufacturing

2020
Design & Build Swab Booth

2023
Clean room MRO - NDT

2024
Joint Lab

2030
Build Own Product

CLEANROOM

ATC Singapore: 6,000 sq. ft.
ATC Penang: 6,000 sq. ft.
CLASS 1000
CLASS 100

MRO NDT

Non-Destructive Test

Testing Methods

- Fluorescent Penetrant Inspection
- Magnetic Particle Inspection
- Eddy Current
- Ultrasonic

CENTRE OF EXCELLENCE

Centre of Excellence
Advanced Surface Treatment and Coatings

A
Phase 1

Sustainable Surface treatment and coating processes

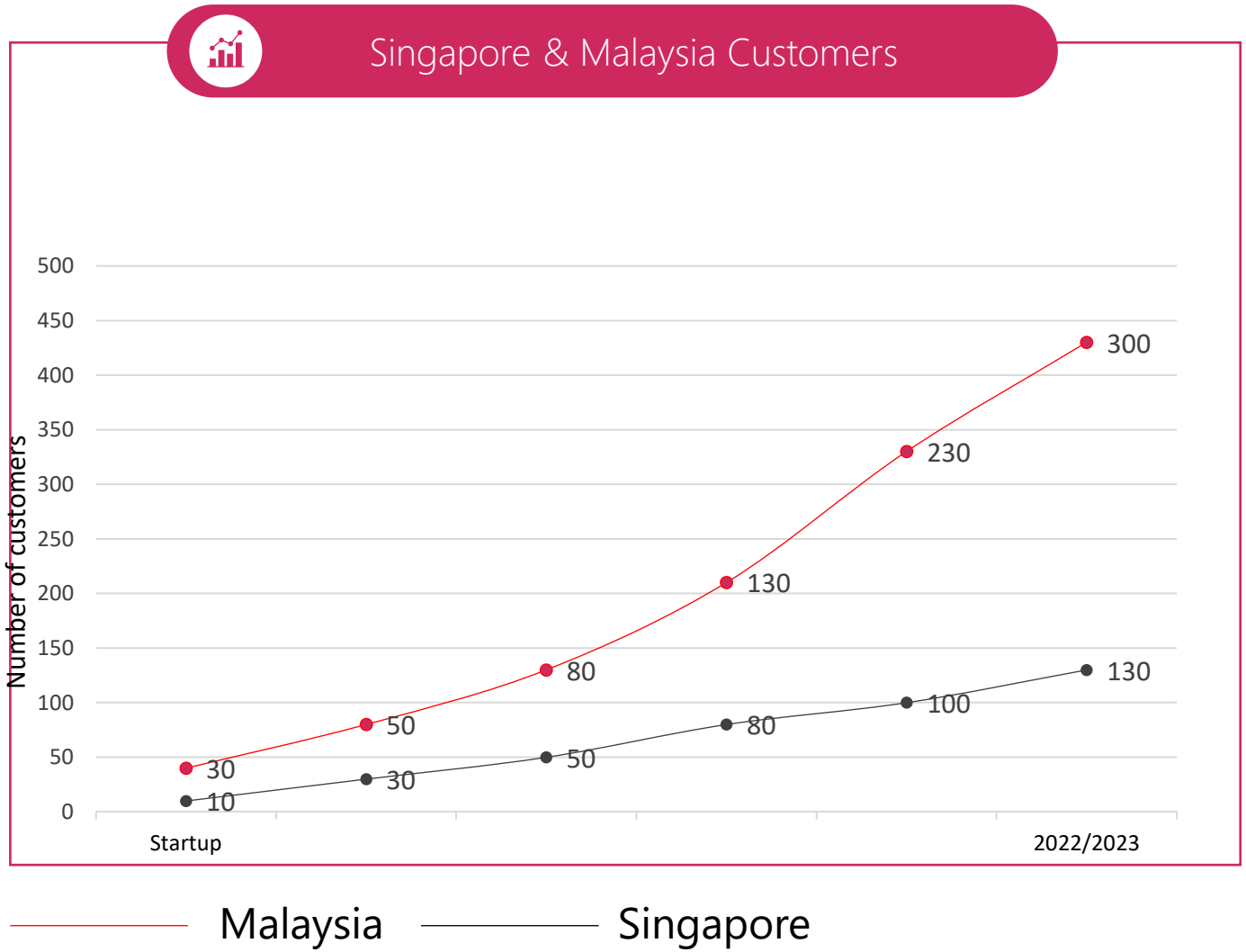
B
Phase 2

Surface contact and interfacial enhancement

C
Phase 3

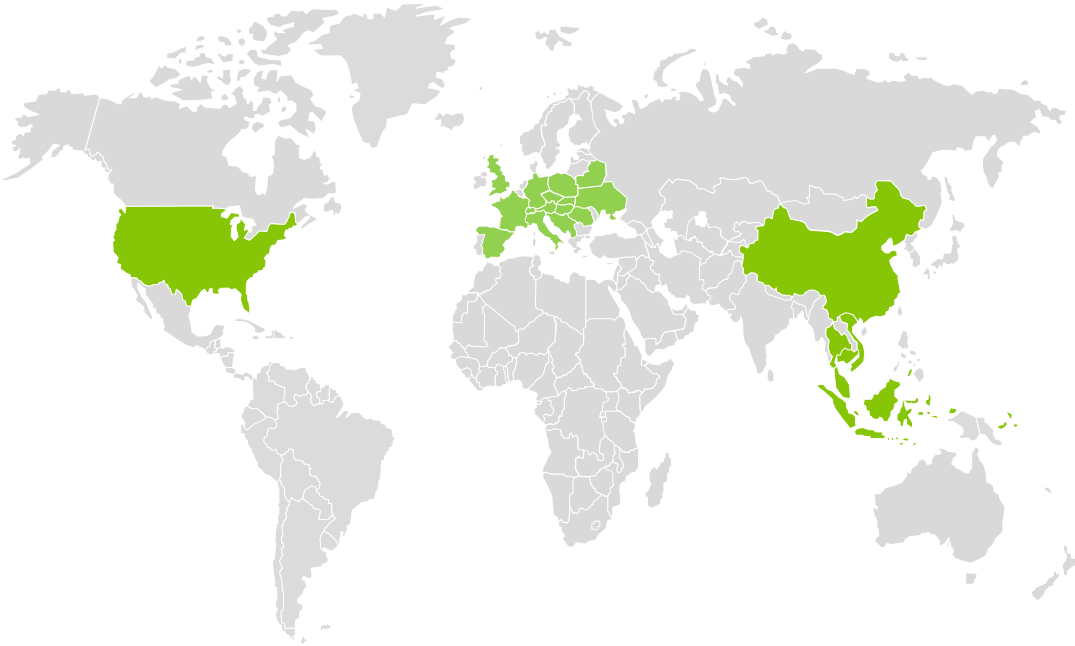
Surface treatment productivity improvement

ESSENTIAL MANUFACTURING SUPPLY CHAIN

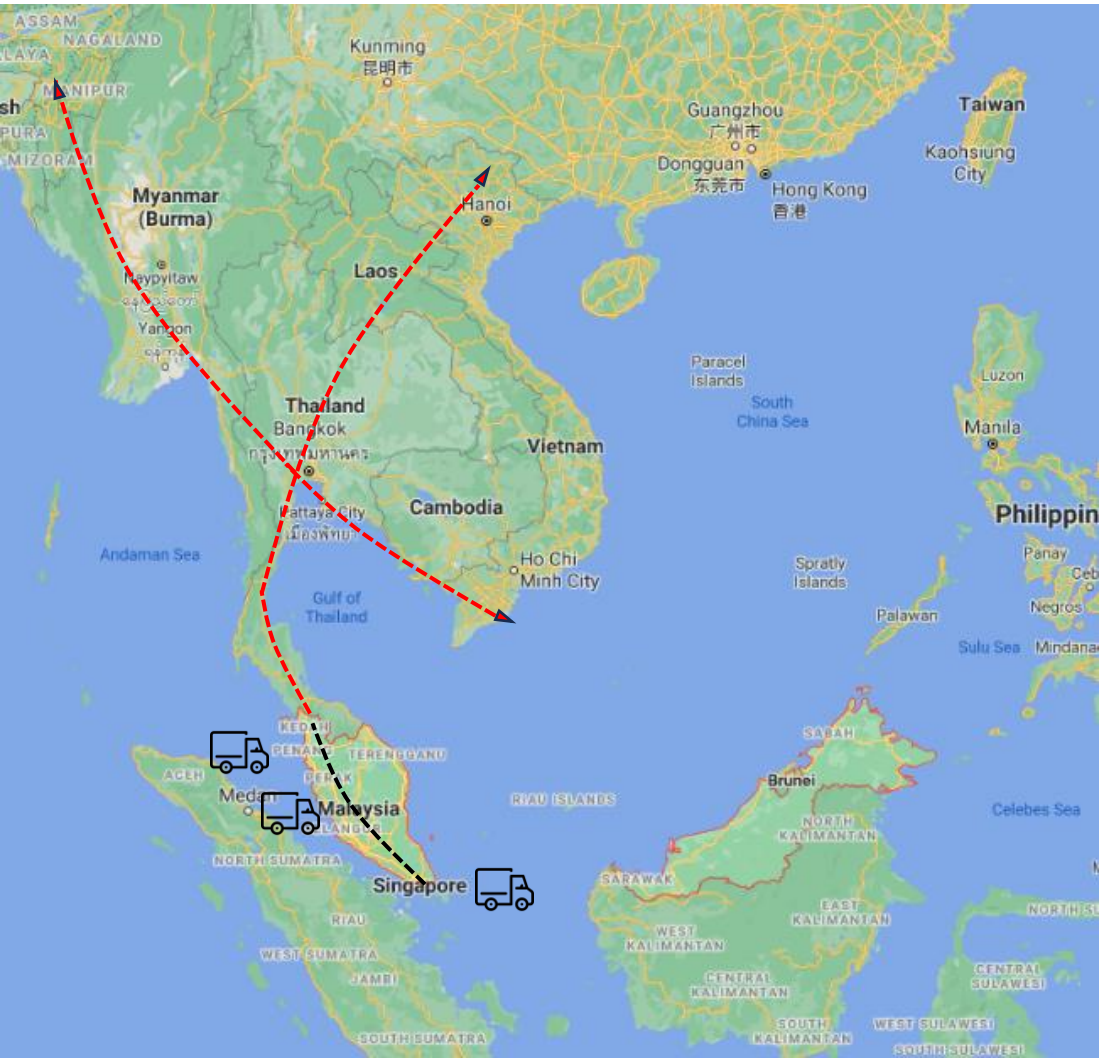


ATC group of companies, Singapore and Malaysia factories have been provided solutions to more than 130 customers across various industries. Many of these customers have been with us for more than 10 years.

ATC remains an essential supplier in their supply chain nodes, enhancing their resources and collaboration ecosystems.



REGIONAL PRESENCE AND EXPANSION



-------🚚 Existing plants along the coastal line of Singapore and Malaysia

---------- Future regional expansion

ATC's vision is to scale up operations in Malaysia and expand regionally in the future, drawing inspiration from Singapore's best-in-class factory setup as their role model. ATC partnership with A*Star's SIMTech for the establishment of a Centre of Excellence dedicated to surface treatment and coatings will significantly enhance ATC's capabilities in the region, ultimately leading to improved customer service and satisfaction.

THANK YOU

Applied Total Control Treatment Pte Ltd
24A Woodlands Loop
737891 Singapore
EMAIL : sales@atc-treatment.com
PHONE : +65 6362 1200
WEBSITE : www.atc-treatment.com

ATC Coating Pte Ltd
BLK 205 Woodlands Avenue 9
Woodlands Spectrum II #04-54 738957 Singapore
EMAIL : sales@atc-treatment.com
PHONE : +65 6362 1200
WEBSITE : www.atc-treatment.com

ATC Surface Finishing Sdn Bhd
No 1 & 3, Lorong IKS Juru 6,
Taman Perindustrial Ringan Juru,
14100 Simpang Ampat, Seberang Perai
Tengah, Pulau Pinang, Malaysia
EMAIL : sales.pg@atc-treatment.com
PHONE : +604 508 2166
WEBSITE www.atc-treatment.com

ATC Cleantec Sdn Bhd
Lot 3, Jalan P/2A, Seksyen 13,
Bangi Industrial Estate,
Bandar Baru Bangi,
43650 Selangor, Malaysia
EMAIL : sales.kl@atc-treatment.com
PHONE : +603 8928 0823
WEBSITE : www.atc-treatment.com