RIE2020 Advanced Manufacturing & Engineering (AME) Roadshows

5 and 11 May 2016
Innovis @ Fusionopolis 2
Outline

• RIE2020 AME Strategy

• Overview of AME Competitive Grants
  – Individual Research Grants (IRG)
  – Programmatic Funds
  – Industry Alignment Fund

• Q&A
RIE2020 AME Strategy
Research, Innovation & Enterprise (RIE) 2020
PM announced RIE2020 on 8 Jan 2016

Govt commits S$19b to new 5-year plan for R&D initiatives RIE2020

Plan will contribute significantly to the economy and create opportunities and jobs, support national initiatives like Smart Nation and SkillsFuture, and help workers to thrive amidst technological changes and globalisation, says PM Lee.

Govt sets aside record S$19b for science and tech research

Singapore commits S$19b for new research, innovation and enterprise plan

The government is committing S$19 billion for its new Research, Innovation and Enterprise (RIE) 2020 plan, which is 18 per cent higher than the S$16.1 billion set aside for the previous five-year plan.

- Public R&D spending sustained at 1% of GDP
- Priority in four technology domains
Where S$19B funds will go ...

- **Advanced Manufacturing and Engineering**
  - $3.3 billion

- **Health and Biomedical Sciences**
  - $4 billion

- **Services and Digital Economy**
  - $0.4 billion

- **Urban Solutions and Sustainability**
  - $0.9 billion

- **Innovation and Enterprise**
  - $3.3 billion

- **White Space**
  - $2.5 billion

- **Academic Research**
  - $2.8 billion

- **Manpower**
  - $1.9 billion

- **Creating Growth, Enhancing Lives**

- **Agency for Science, Technology and Research**

- **Singapore**
Priority in Four Technology Domains

- **Advanced Manufacturing and Engineering (AME)**
  To develop technological capabilities that support the growth and competitiveness of our manufacturing and engineering sectors

- **Health and Biomedical Sciences (HBMS)**
  To be a leading centre that advances human health and wellness, and creates economic value for Singapore and Singaporeans through the pursuit of excellence in research and its applications

- **Urban Solutions and Sustainability (USS)**
  To develop a sustainable and liveable city through integrated solutions for Singapore and the world

- **Services and Digital Economy (SDE)**
  To develop, integrate and leverage Singapore’s digital innovation capabilities to meet national priorities, raise productivity and support key services, create sustainable economic opportunities and quality jobs

Due to the pervasive and cross-cutting nature of digital technologies, AME, HBMS and USS domains will draw on and fund research in digital technology capabilities that support the research agenda within their domains

- **Academic Research**
  To build up a significant base of capabilities and a pipeline of ideas that can feed into applied and industrial research to drive the next phase of growth

- **Manpower**
  To build a strong research and innovation community

- **Innovation and Enterprise**
  To build up a strong core of innovative enterprises that drive value creation and economic competitiveness
Key RIE2020 Thrusts

**Closer Integration of Research Thrusts**
- Encourage multi-disciplinary & multi-stakeholder collaboration
- Greater coordination of national efforts
- Strategic investments in basic and mission-oriented research

**Sharper Focus on Value Creation**
- Strengthen flow-through from research to societal and economic impact
- More budget allocation towards public-private research collabs
- Build up private sector’s absorptive capacities for new tech

**Stronger Dynamic towards the Best Teams and Ideas**
- Continued shift towards competitive funding
- More White Space funding to ensure flexibility

**Optimise RIE Manpower**
- Sustain a strong research and innovation workforce
- Strong Singaporean core, supplemented with international talent
AME Strategy in RIE2020
AMERICAN RIE2020 Vision

Aims to develop technological capabilities to support continued growth and competitiveness of our manufacturing and engineering sectors, in order to generate GDP growth, Good jobs for Singaporeans & Position the Economy for the Future

CREATING GROWTH, ENHANCING LIVES
2015 GDP: S$402.5 bil (US$292.7 bil)

- Manufacturing: 20%
- Finance & Insurance: 13%
- Business Services: 16%
- Transport & Storage: 7%
- Wholesale & Retail Trade: 16%
- Construction: 5%
- Others: 23%

Value Added:
- Electronics: 27%
- Biomedical Manufacturing: 20%
- Chemicals: 15%
- Transport Engineering: 14%
- Precision Engineering: 13%
- General: 11%

- Employment contribution >500,000
- Manufacturing productivity growth of 6.1% per annum (‘09 to ‘15)

Source: MTI 2016 Growth Forecast
Manufacturing in Singapore has evolved over time

Global trends and local landscape require a new approach

Emerging Technologies
Additive Manufacturing | Robotics | Advanced materials | Manufacturing IT

Business Model Disruptions
Servitisation of Manufacturing | Mass Customisation

Growth of ASEAN
Emerging region for production and consumption

Sustainability
Land | Energy | Labour

Competitive Manufacturing Location
- Fast technology adopter
- Host to server & offshore plants

Globally Leading Manufacturing Hub
- Manufacturing technology developer
- Location of choice for lead plants

Boosting Productivity
Pilot location for cutting-edge technology & systems

Growing New Activities
Thought leader and first mover in growth areas.
AME RIE2020 Strategic Goals

• Strengthen linkages across public research performers and both large & small companies to sharpen value creation from public R&D investments

• Build capabilities where Singapore can offer a differentiated value proposition, incl making strategic bets ahead of industry to position Singapore for emerging opportunities

• Maximise value capture by developing integrated strategies across entire innovation value chain

Key AME Industry Verticals:

- Electronics
- Chemicals & Energy
- Marine & Offshore
- Aerospace
- Biologics & Pharmaceutical Mfg
- MedTech Mfg
- Machinery & Systems
- Precision Engineering

4 Cross-Cutting Technology Areas

- Robotics and Automation
- Digital Manufacturing
- Additive Manufacturing
- Advanced Materials
Establishing an Advanced Packaging Industry in Singapore

1993 – 2011: TSI/TSV and Embedded Chip Packaging

2000 – 2007: Flip Chip
2004 – 2010: Cu / Low-K Packaging, TSV & embedded chip
2001 – 2011: Wafer Level Packaging (WLP)
2007 - : TSV, TSI (2.5D/3D IC) Packaging
2008: WLP technology with robust chip level and package level reliability
Fine pitch WLP for Cu/Low-k device

2004 – 2010: Cu / Low-K Packaging, TSV & embedded chip
2001 – 2011: Wafer Level Packaging (WLP)
2007 - : TSV, TSI (2.5D/3D IC) Packaging
2008: WLP technology with robust chip level and package level reliability
Fine pitch WLP for Cu/Low-k device

EPRC Consortia 1-5
• Wire Bonding Technology
• Flip Chip Technology

Origin of Capability in Chip Packaging

1993

EPRC Consortia 6-10
• Moving toward TSV & Embedded Chip
• Cu / Low-K Packaging Technology
• WLP

2002

2007: IME and UTAC to Develop TSV Packaging Solution

2008: IME develops WLP technology with robust chip level and package level reliability

EPRC Consortia 11
TSI/TSV and Embedded Chip Packaging

2010

2011

EPRC Consortia 12
2.5D TSI Consortium

2012

AMAT –IME Joint Lab

2006: IME and Chartered Collaborate on Advanced Fine-Pitch Packaging Research

2007: IME and UTAC to Develop TSV Packaging Solution

2013

Metrology
Assembly
Lithography
Wafer Level Packaging

4 Joint Labs

• Joint R&D in process, process integration and device technologies for advanced packaging (3D TSV, wafer level packaging, etc)
• Industry value chain development through collaborations with third-party partners, including wafer fabs, assembly & test service providers, complementary equipment makers and components suppliers.
A*STAR Aerospace Consortium

- **Leading OEMs as Members:**
  - Aircraft Manufacturers: Airbus, Boeing, Bombardier & Embraer
  - Aircraft Engine OEMs: P&W & Rolls-Royce
  - For Components and Systems: Hexcel, Honeywell, SAFRAN, Panasonic Avionics

- **Singapore aerospace players present**
  - Ongoing engagement of LLEs
    - SIA EC, ST Aerospace and DSTA
  - SMEs
    - Addvalue Technologies

- **Operates in the pre-competitive space of TRL 4-6**

To date, a total of 106 projects have been launched, including 20 projects which have been launched in AP Cycle 9 on 1 Feb 2016.

**Beyond the consortium**

- Deepening engagements through 1:1 RCAs with RIs (move up to TRL 7-9)
- MRCAs as a tool to develop research outcomes relevant to Industry

**Mechanism to engage aerospace leadership and develop understanding of Industry needs and trends**
Advanced Remanufacturing and Technology Centre
First in Asia. Putting Singapore in the AxRC and ReMan world map

Focus Sectors
- Aerospace
- Machinery
- Oil & Gas
- Marine
- Land Transport
- Clean Technology

Founding Tier 1:
- IHI
- Rolls-Royce
- Siemens
- SKF
- DMG Mori
- EOS
- Saesl

Tier 2:
- 3M
- ABB
- Barnes Aerospace
- Ecoroll
- Jot Automation
- Kennametal
- Hexagon Manufacturing Intelligence

Tier 3:
- Materialise
- Nakanishi
- National Instruments
- Taylor Hobson
- Trumpf
- UL
- Zeiss

38 industry partners as of April 2016

Creating growth, enhancing lives
Pre-positioning to Industry Impact: The Nanoimprint Foundry

Industrial Consortium on Nanoimprint
ICON 2010-13

- Prepositioning nanoimprint
- Building the value-chain, through collaborative pre-competitive R&D.

Seeding a local ‘nanomanufacturing’ sector

Banshing Industrial
“New manufacturing process development”
Manufacturing anti-fog goggles, production of textured petri-dishes for cancer therapies via nanoinjection molding.

Wangi Industrial
“New product development”
Anti-reflective glass display panels

Nanoimprint Foundry
2013 - current

Increasing industry interest to manufacture via nanoimprinting

- Advancing applications and industrial adoption
- Private – public partnerships

Creating Growth, Enhancing Lives
## Value Creation Framework for Economic Outcomes

<table>
<thead>
<tr>
<th>Public Sector R&amp;D</th>
<th>Innovation &amp; Commercialisation</th>
<th>Business Outcomes</th>
<th>Economic Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>Research Collaborations</td>
<td>Anchor MNC Investments</td>
<td>GDP Growth</td>
</tr>
<tr>
<td></td>
<td>R&amp;D Centres &amp; Joint Labs</td>
<td>Enable Growth of LLEs and SMEs</td>
<td>Good Jobs for Singaporeans</td>
</tr>
<tr>
<td></td>
<td>Contract R&amp;D</td>
<td>Foster a Vibrant Start-Up Ecosystem</td>
<td>Positioning Economy for the Future</td>
</tr>
<tr>
<td>Technology</td>
<td>Licensing &amp; Technology Adoption</td>
<td>Spin-offs</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Talent & Infrastructure

Note: MNC – Multinational Corporation; LLE – Large Local Enterprise; SME – Small and Medium Enterprise
## Competitive Funding to Support AME Research

Open to public sector research performers

<table>
<thead>
<tr>
<th>AME Domain</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Research Grants (IRG)</td>
<td>• Develop novel ideas solicited through an investigator-led, ground up mechanism across the research ecosystem</td>
</tr>
<tr>
<td>Programmatic Funds</td>
<td>• Seed long-term capabilities for future industry readiness, typically beyond a 5-year timeframe</td>
</tr>
</tbody>
</table>
| Industry Alignment Fund – Prepositioning Programmes (IAF PP) | • Develop industry-ready capabilities  
• Projects supported by IAF-PP are expected to lead to industry traction in a 3- to 5-year timeframe |
| Industry Alignment Fund – Industry Collaboration Projects (IAF ICP) | • Support projects between industry and public sector R&D performers that involve commitment of tangible industry contributions |

---

**AME Domain**

**Individual Research Grants (IRG)**

- Develop novel ideas solicited through an investigator-led, ground up mechanism across the research ecosystem.

**Programmatic Funds**

- Seed long-term capabilities for future industry readiness, typically beyond a 5-year timeframe.

**Industry Alignment Fund – Prepositioning Programmes (IAF PP)**

- Develop industry-ready capabilities.
- Projects supported by IAF-PP are expected to lead to industry traction in a 3- to 5-year timeframe.

**Industry Alignment Fund – Industry Collaboration Projects (IAF ICP)**

- Support projects between industry and public sector R&D performers that involve commitment of tangible industry contributions.

---

**All Domains**

**Creating Growth, Enhancing Lives**

---

**Agency for Science, Technology and Research**

---
Summary

- Under RIE2020, Singapore government committing S$19billion, 18% more than previous plan and at about 1% of GDP
- Four major shifts to capture more value from our investments and research
- Domain framework allows for a more focused approach to achieve strategic goals
- Manufacturing will continue to be an important pillar of Singapore’s economy
- R&D and technology play key roles in strengthening existing manufacturing sectors, seeding new growth niches and boosting productivity
- More competitive funding will be available to support research aligned with AME strategy
Overview of AME
Competitive Grants
(IRG & Programmatic)
<table>
<thead>
<tr>
<th>Grant</th>
<th>General Description</th>
<th>Next call date</th>
</tr>
</thead>
</table>
| Individual Research Grants (IRG) | Implementing Agency: A*STAR  

Aimed at developing novel R&D ideas solicited through an investigator-led, ground up mechanism across the research ecosystem. Proposals will be solicited through a grant call mechanism. | To be announced |
| Programmatic Funds           | Implementing Agency: A*STAR  

Aimed at seeding long term capabilities for future industry readiness, typically beyond a 5-year timeframe. Programmes funded are expected to advance new capabilities relevant to existing industrial sectors or seed new growth sectors through first building scientific peaks of excellence. | To be announced |
Overview of Open Competitive Grants for AME Researchers (2)

<table>
<thead>
<tr>
<th>Grant</th>
<th>General Description</th>
<th>Next call date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Industry Alignment Fund Pre-Positioning Programmes (IAF PP)</strong></td>
<td>Implementing Agency: A*STAR and EDB</td>
<td>All year round</td>
</tr>
<tr>
<td></td>
<td>Aims to develop industry-ready capabilities towards deepening the alignment of public sector research as well as develop multidisciplinary and integrated programmes with early industry involvement. Projects supported by IAF-PP are expected to lead to industry traction in a 3- to 5-year timeframe.</td>
<td></td>
</tr>
<tr>
<td><strong>Industry Alignment Fund Industry Collaboration Projects (IAF ICP)</strong></td>
<td>Implementing Agency: A*STAR</td>
<td>All year round</td>
</tr>
<tr>
<td>For All Domains</td>
<td>Aims to support strategic R&amp;D projects between industry and public sector R&amp;D performers, which involve commitment of tangible (cash or in-kind) contributions from industry. Such projects include those with local SMEs. To encourage integration of capabilities across institutes and disciplines, IAF ICP is designed as a single pot open to all research performers across all Domains.</td>
<td></td>
</tr>
</tbody>
</table>
Individual Research Grants (IRG) Overview

• To support novel R&D ideas solicited through ground up mechanism, across research ecosystem

• Modeled after Public Sector Funding in RIE2015 tranche
  – Investigator-led projects
  – Open to public sector research performers
    • Local universities, A*STAR research institutes, polytechnics, and non-defence-related public sector agencies (e.g. Ministries, Statutory Boards)
    – Projects are aligned to AME themes

• Grant call frequency once a year

• Typically up to S$750k* per project over 3 years
  *Inclusive of Indirect Costs (IRC) capped at 20% of direct cost
Assessment Criteria

• PI’s track record/competency

• Novelty and scientific merit of proposed idea

• Relevance and overall impact to Singapore’s AME sectors

• Competitive/comparative advantage

• Likelihood of success
Applicants are invited to present to the Local Review Panel before being shortlisted.

Shortlisted applicants are invited to present to the Local Review Panel.

Award

Local Review Panel

Proposal Submission

Local/International Peer Review

Launch of Grant Call
Application Process

• Application via A*STAR’s iGrants

• All submissions must be endorsed by applying Institution(s) prior to submission

Application form and grant call information will be available on the A*STAR website
Programmatic Funds Overview

• To seed long term capabilities for future industry readiness, typically beyond a 5-year timeframe.

• To fund programmes/projects aligned with strategic AME themes
  – May not have immediate industry application nor identifiable receptacles in Singapore
  – Could be driven by one or multiple public sector research performers

• Open to public sector research performers
  – Local universities, A*STAR research institutes, polytechnics, and non-defence-related public sector agencies (e.g. Ministries, Statutory Boards)
Assessment Criteria

• Track record/competency of PM/PIs

• Alignment with strategic AME themes and programmes

• Scientific considerations

• Overall impact to AME sectors in Singapore

• Competitive/comparative advantage

• Likelihood of success
Application Process

• Announcements will be made periodically on key focus areas or potential programmes
  • Includes via public workshops and calls for proposals

• Applications must be endorsed by the applying Institution(s) prior to submission

Application form and grant call information will be available on the A*STAR website
Overview of IAF PP and IAF ICP
IAF-PP Overview

• To support public sector research aligned with industry outcomes for Singapore, through building up integrated capabilities and programmes

• To address major challenges faced by industry, or with the potential to transform or disrupt existing industry sectors

• To catalyse and orchestrate R&D activities across Singapore towards industry development outcomes and to achieve economic impact

• To support new programmes, as well as existing programmes that have demonstrated strong track record of success and industry potential
Governance

- **Strategic Oversight Committee (SOC)**
  - Makes decisions on all IAF-PP policies and programmes
  - Comprises MD EDB, MD A*STAR and CE NRF

- The RIE Strategy Committee has tasked A*STAR as the **Implementing Agency**, reporting to the IAF-PP SOC.

**Role of Implementing Agency includes**
- evaluation and scoping of proposals together with research performers and companies
- management of budget (e.g. fund disbursement, monitoring overall fund commitment and utilisation)
- tracking progress of endorsed proposals
Assessment Criteria

• Minimum leverage ratio
  – 1 : 0.5 (funding : industry R&D spending in SG)

• Technical and commercial considerations
  – Programmes developed with independent technical assessment

• Programmes supported by IAF-PP are expected to lead to industry investments within 3-5 years

• Key Decision Criteria: Potential for economic impact
  – Pre-positioning for eventual value creation and value capture for industries in SG
Application Process

• Announcements will be made periodically to inform or solicit proposals from community on key focus areas and/or potential programme areas
  • Includes via public workshops and calls for proposals

• Applications must be endorsed by the applying Institution(s) prior to submission

• All submitted applications are subject to evaluation by the SOC

Application form and contact information will be available on the A*STAR website from May 2016
IAF-ICP Overview

• To support strategic R&D projects between industry and public R&D performer(s)

• Requires tangible upfront commitments from companies (e.g., industry R&D spending)

• Open to all public R&D performers across all Domains

• National funding mechanism for public R&D performers
  • Should not be used as an active marketing tool when discussing collaborations with companies; focus should be on scoping the project, involving the Implementing Agency and Economic Agency.
Governance

• **Strategic Oversight Committee (SOC)**
  - Decides on all IAF-ICP policies and project approvals
  - Comprises MD EDB, CE SPRING, MD A*STAR, CEO NRF

• The RIE Strategy Committee has tasked A*STAR as the **Implementing Agency** to administer the programme, reporting to the IAF-ICP SOC

**Role of Implementing Agency includes**

- evaluation and scoping of proposals together with research performers and companies
- management of budget (e.g. fund disbursement, monitoring overall fund commitment and utilisation)
- tracking progress of endorsed proposals
Assessment Criteria

• Upfront industry commitment
  – minimum $5M industry R&D spending in SG (cash and in-kind)*

• Minimum leverage ratio
  – 1 : 1.5 (funding : industry R&D spending in SG)

• Technical and commercial considerations

• Key Decision Criteria: Potential for economic impact
  – Value creation and value capture for industries in SG

* The SOC may consider funding smaller projects (e.g., with SMEs) of high potential on a case-by-case basis.
Application Process

• Proposals can be submitted throughout the year

• Preliminary assessment before full proposal
  • In-principle approval by SOC to facilitate negotiations

• Applications must be endorsed by the applying Institution(s) prior to submission

• All submitted applications are subject to evaluation by the SOC

Application form and contact information will be available on the A*STAR website from May 2016
Potential Modes Of Collaboration

- **Many to One**
  - **STRATEGIC PARTNERSHIP**
  - RI1
  - COMPANY
  - RI2
  - RI3

- **Many to Many**
  - **CONSORTIA**
  - MNC
  - SME
  - LE
  - RI1
  - RI2
  - RI3

- **One to One**
  - **PARTNERSHIPS | PROJECTS**
  - RI
  - COMPANY

- **One to Many**
  - **CONSORTIA**
  - MNC
  - LE
  - SME
  - RI
Thank You