

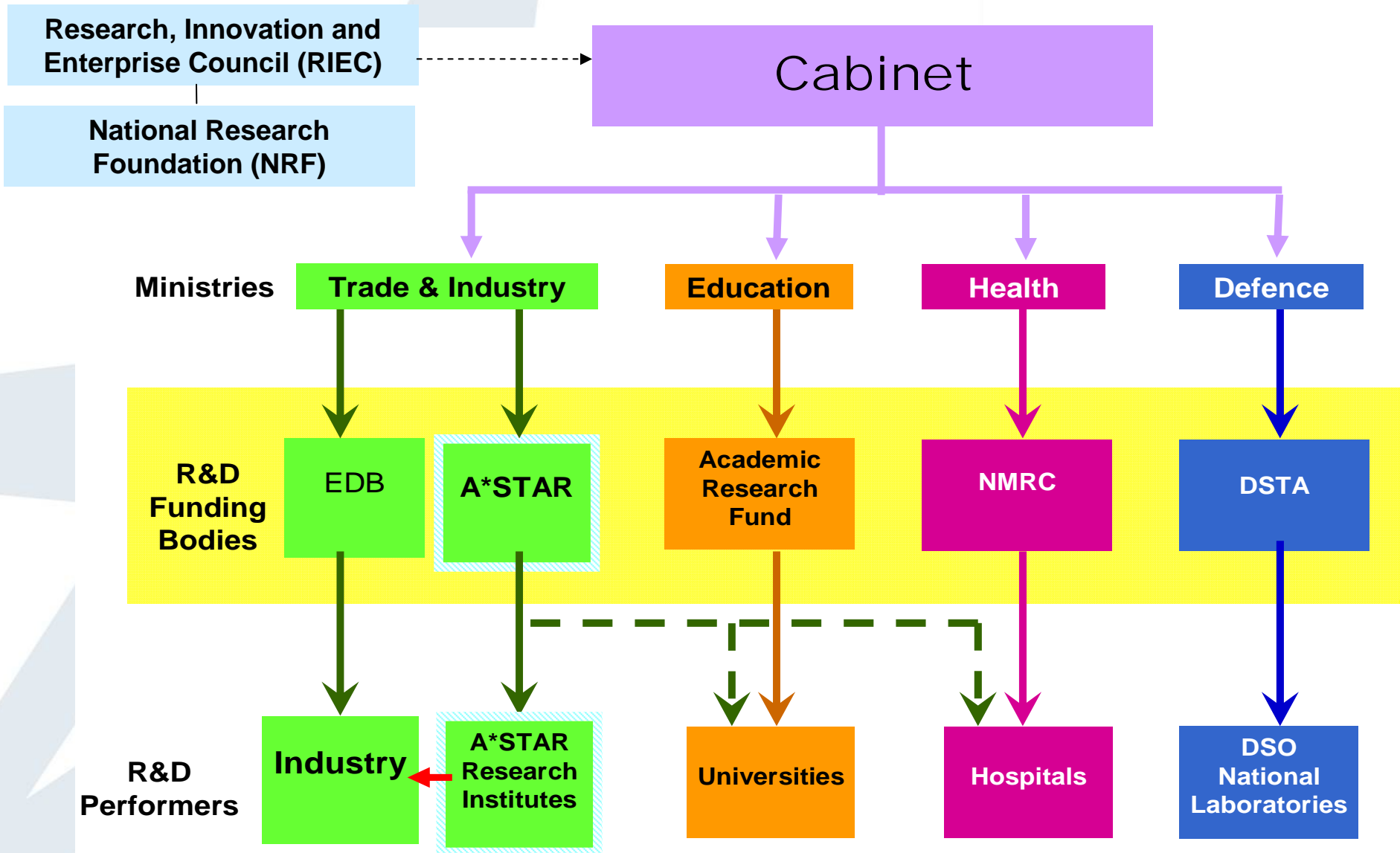
Government-University-Industry Collaborative Models

Singapore Perspective



Prof Dim-Lee Kwong
Institute of Microelectronics

Singapore National R&D Framework

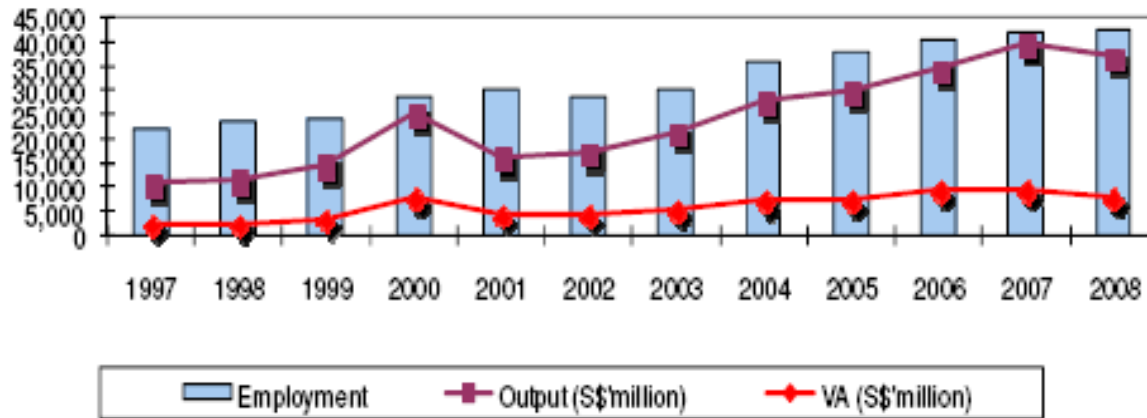


Semiconductors 15% of Total Mfg Output 2008(p)



A Major Area of Focus for Singapore

Manufacturing Output : S\$37.3 bil (US\$26.3 bil)
 Value Added (VA) : S\$7.8 bil (US\$5.5 bil)
 Employment : ~40,000



US\$1.00 = S\$1.418 (2008)

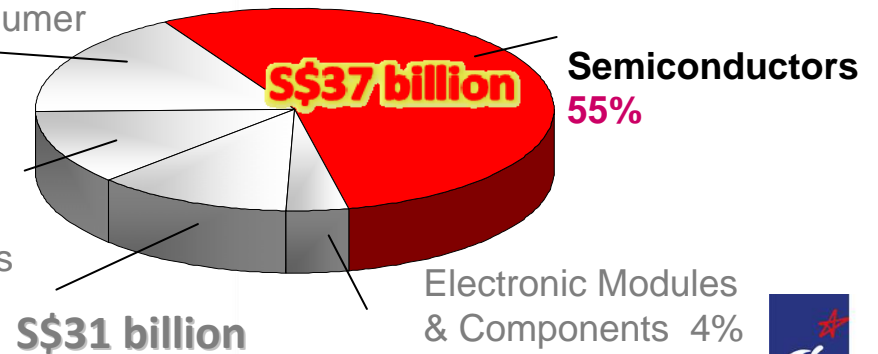
- **Semiconductor Industry**
 - 40 IC design companies
 - 14 wafer fabs (3 12")
 - 20 assembly and test comp
- **World-wide market share**
 - 6% (1998) → 12% (2008)

**2008 Projected
Electronics
Mfg Output
S\$68 billion**

Infocomms and Consumer Electronics 17%

Data Storage 12%

Computer Peripherals & EMS 12%



Source: EDB

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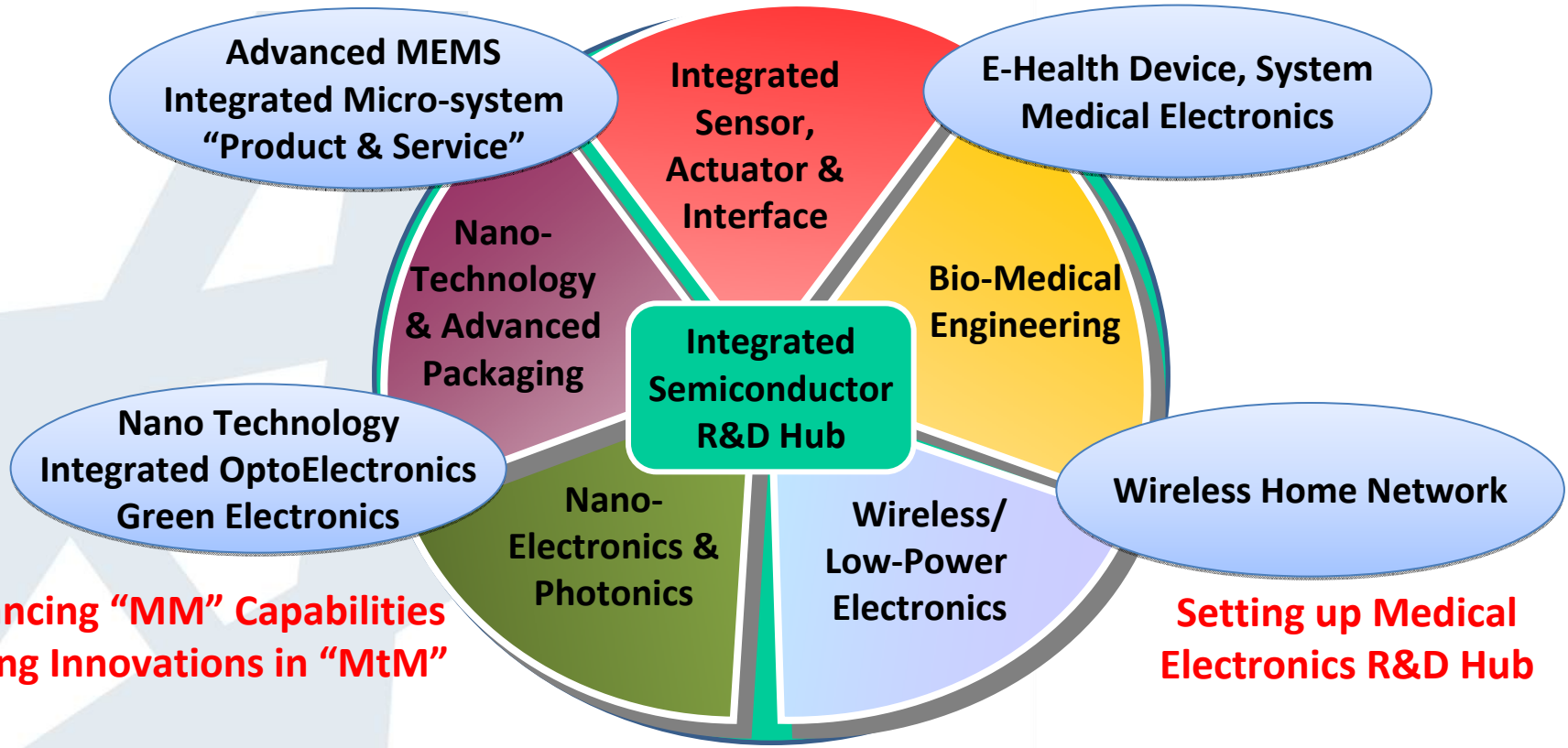
IME Confidential & Proprietary



Miniaturisation and Diversification

Moving up Value Chain via "Product-Service"

Enabling New Growth Areas, e.g., E-Health



Enhancing "MM" Capabilities Driving Innovations in "MtM"

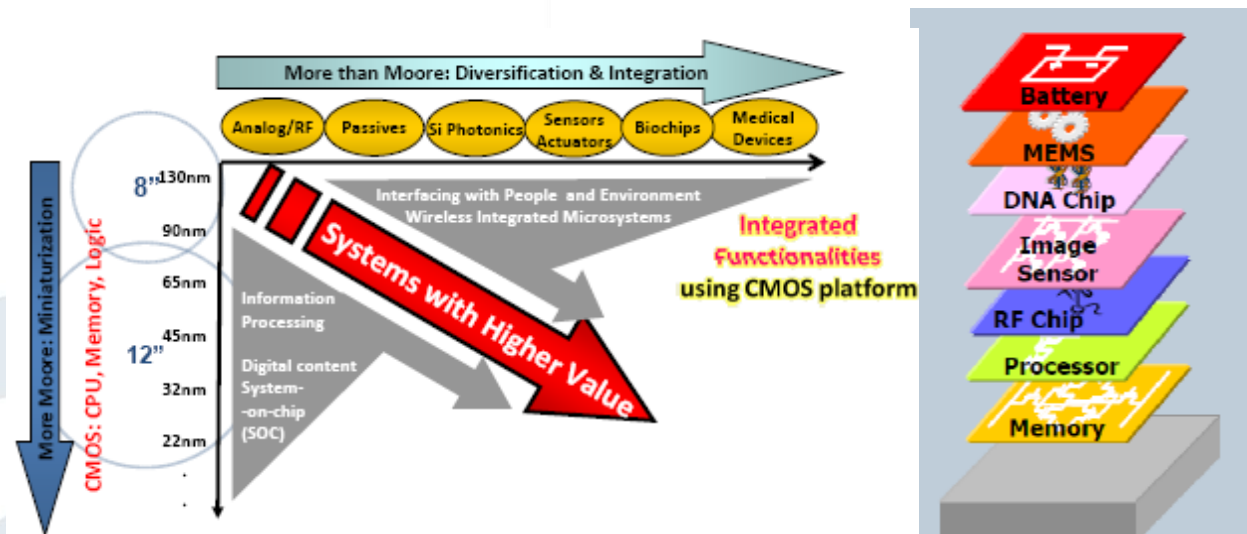
Setting up Medical Electronics R&D Hub

Developing capabilities for the growth of semiconductor industry

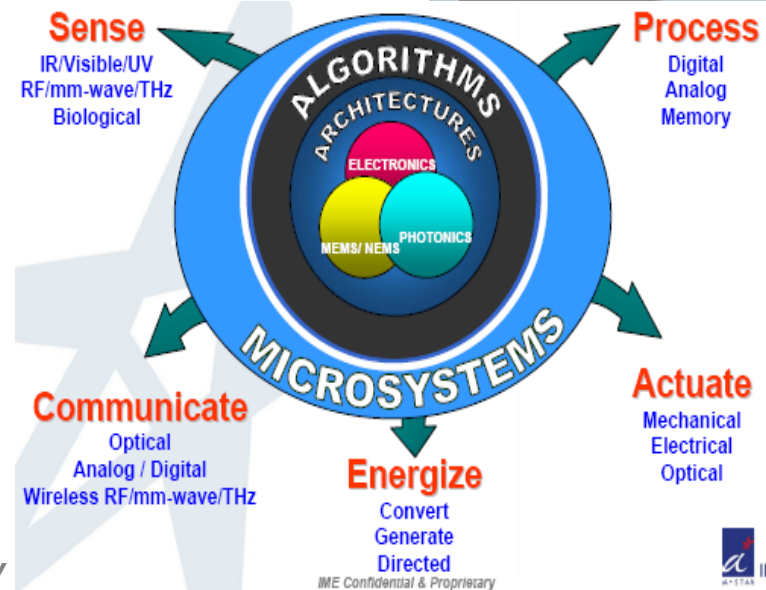
IME's Research Focus

Leading the expansion of Singapore semiconductor ecosystem into "More than Moore" for an industry with strong business growth

- **Nanoelectronics**
 - Vertical NW transistors
 - Novel NW devices
 - Advanced embedded memory
- **Si Photonics**
 - Electronics-photonics IC
- **Bioelectronics**
 - Point-of-care Bio-Analysis
 - Implantable medical devices, circuits, systems
- **Ambient Intelligence**
 - MEMS sensors, actuators and wireless integrated microsystems
- **3-D IC stacking using TSV**



- Establish capabilities in Design/Modeling, Fabrication, Characterization, Packaging, Circuits and Interfaces
- All programs involve strategic partners from industry, medical center, hospital, university



IME's Commitments To "More Than Moore"

- Investing in Innovation

- R&D

- More than 80% of R&D programs in MtM

- Venturing

- Partnering

- University Programs

- Ph.D. students training

- Investing in infrastructures

- 8" CMOS & MEMS

- 12" TSV and selective CMOS

- Si Photonics MPW

- Consortia

- Value Propositions

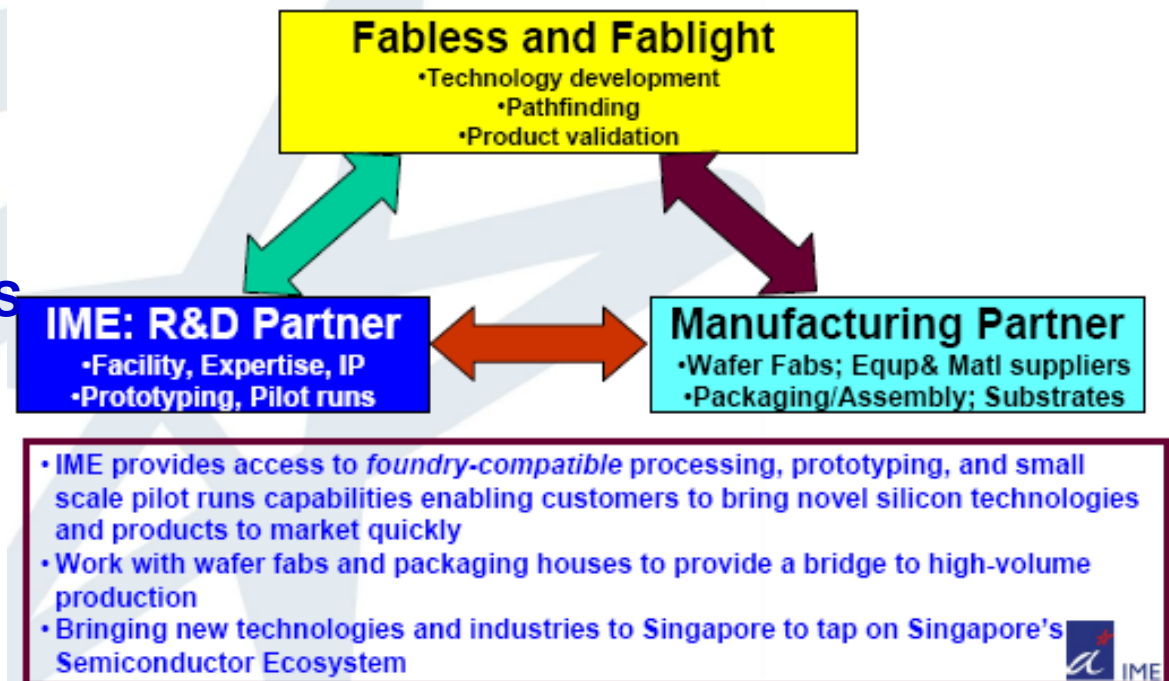
- Responsiveness

- Critical mass

- Flexibility

- Recognized world class capabilities

R&D Foundry Business Model

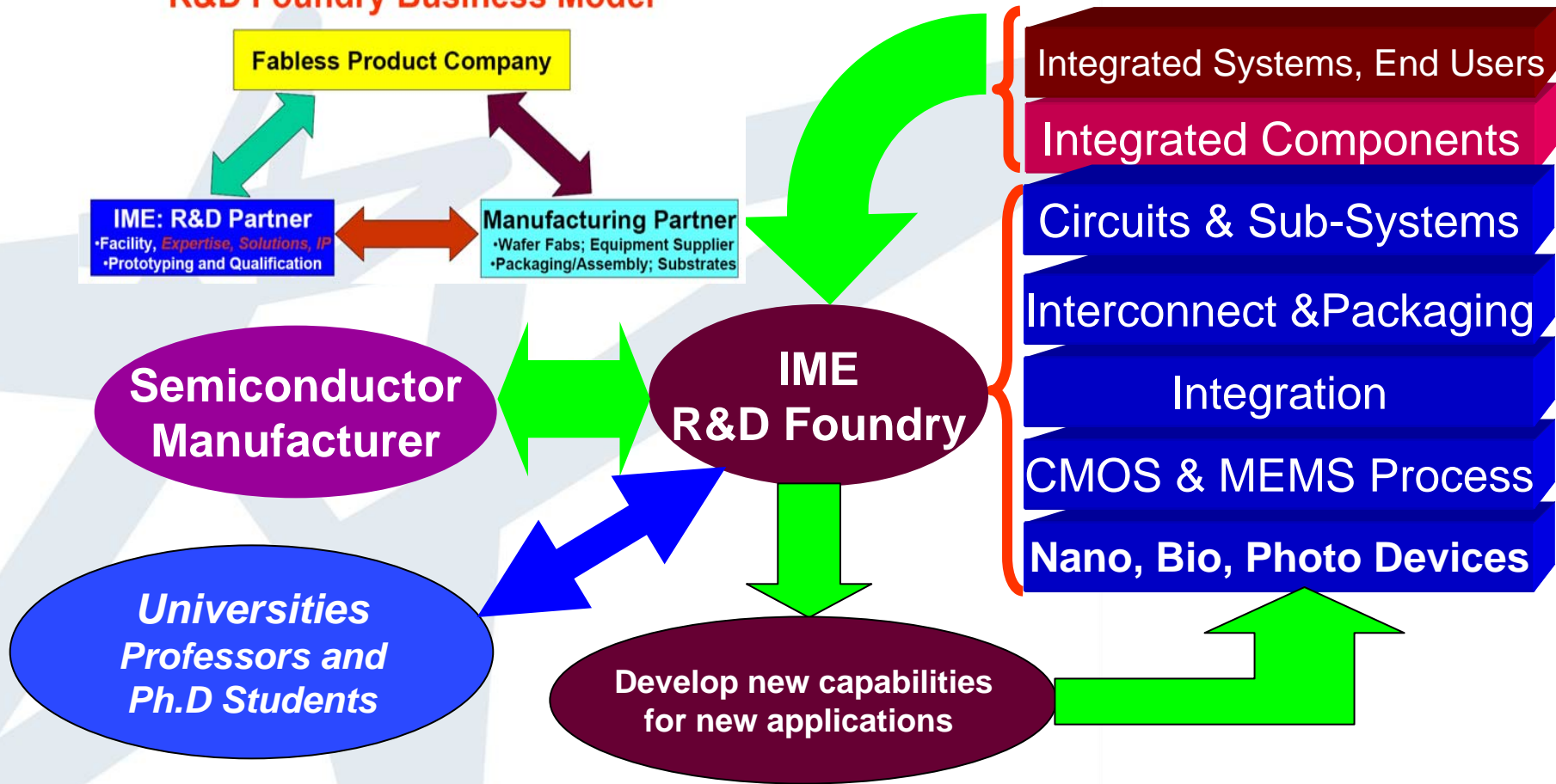


R&D Strategy: Top-Down Approach

- Research driven substantially by commercial applications as the end goal
- Joint development of new capabilities with strategic partners (industry, hospitals, biomedical institutes, universities) by sharing of talents, costs, risks

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R&D Foundry Business Model



Developing Talents for Semiconductor Industry (FY'04 - FY'08)

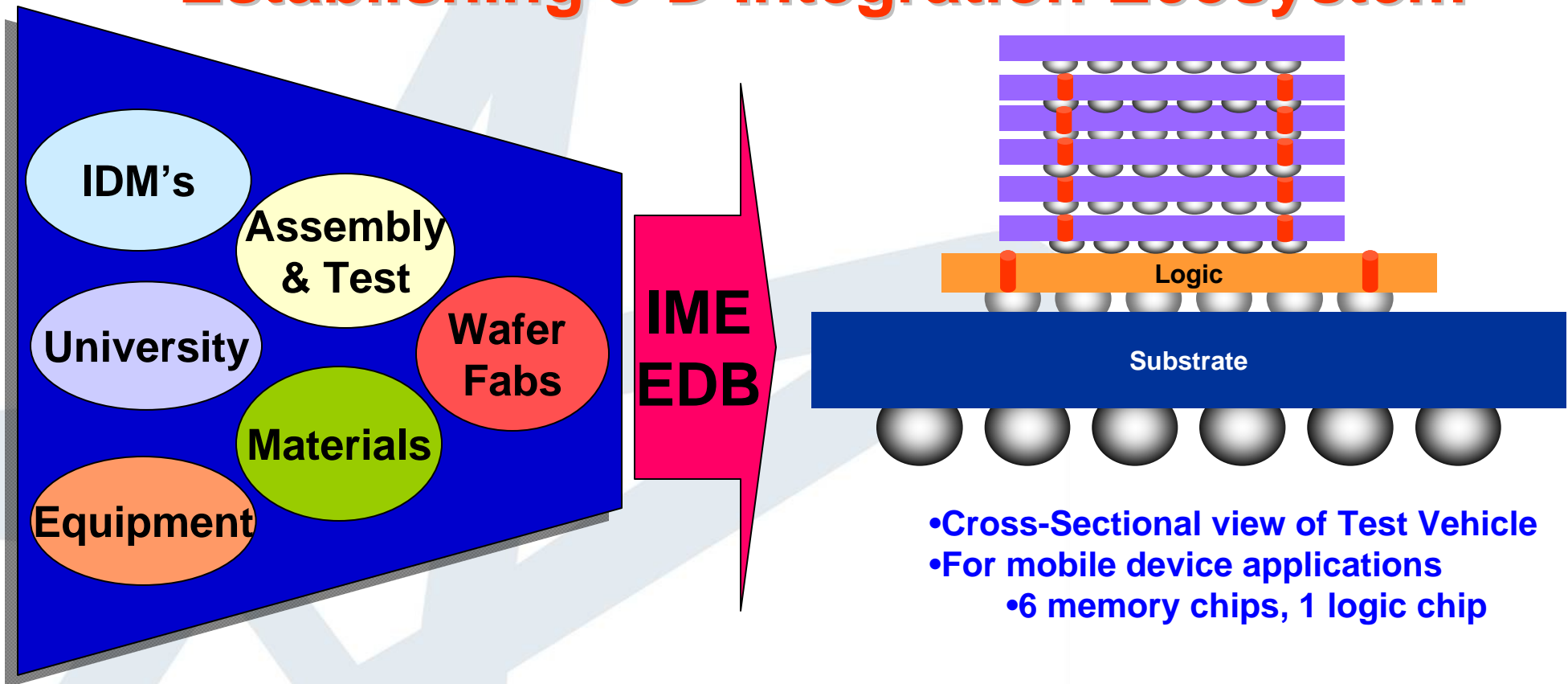
International Electron Device Meeting (IEDM)	18
VLSI Technology Symposium	11
IEEE Electron Device Letters	30
IEEE Trans. Electron Devices	6

- Train and supervise Ph.D. through high-quality & relevant projects
- Students exposed to world-class research community & facility
- Soft skills development

Name of Award	Awarding Body	Year	Remarks
Best Student Paper	IEDM	2008	Title: "Plasmos-PH ₃ -passivated InGaAs MOS"
Best Paper Award	ESSDERC	2007	Title: "Uniaxial strained Si-FETs on SiGeOI substrates with embedded-SiGe stress transfer"
Young Researcher Award	SSDM	2007	Title: "Strained SiGe-on-Insulator N-MOS with Si-S/D for Drive current Enhancement"
Outstanding Student Research Award x2	TSMC	2007	Title: "Strain Engineering with Si:C, Si:Ge S/D Stressor" Title: "Advanced Silicide for Nano-Structure"
Graduate Student Fellowship x 3	IEEE EDS	2005-07	
Travel Grant x 7	SSDM	2004-07	
2008 Paul Rappaport Award	IEEE EDS	2008	Title: "Strained n-MOSFET with Embedded Source/Drain Stressors and Strain- Transfer Structure (STS) for Enhanced Transistor Performance"

Singapore 3D-TSV Consortium

Establishing 3-D Integration Ecosystem



- Cross-Sectional view of Test Vehicle
- For mobile device applications
 - 6 memory chips, 1 logic chip

Vision

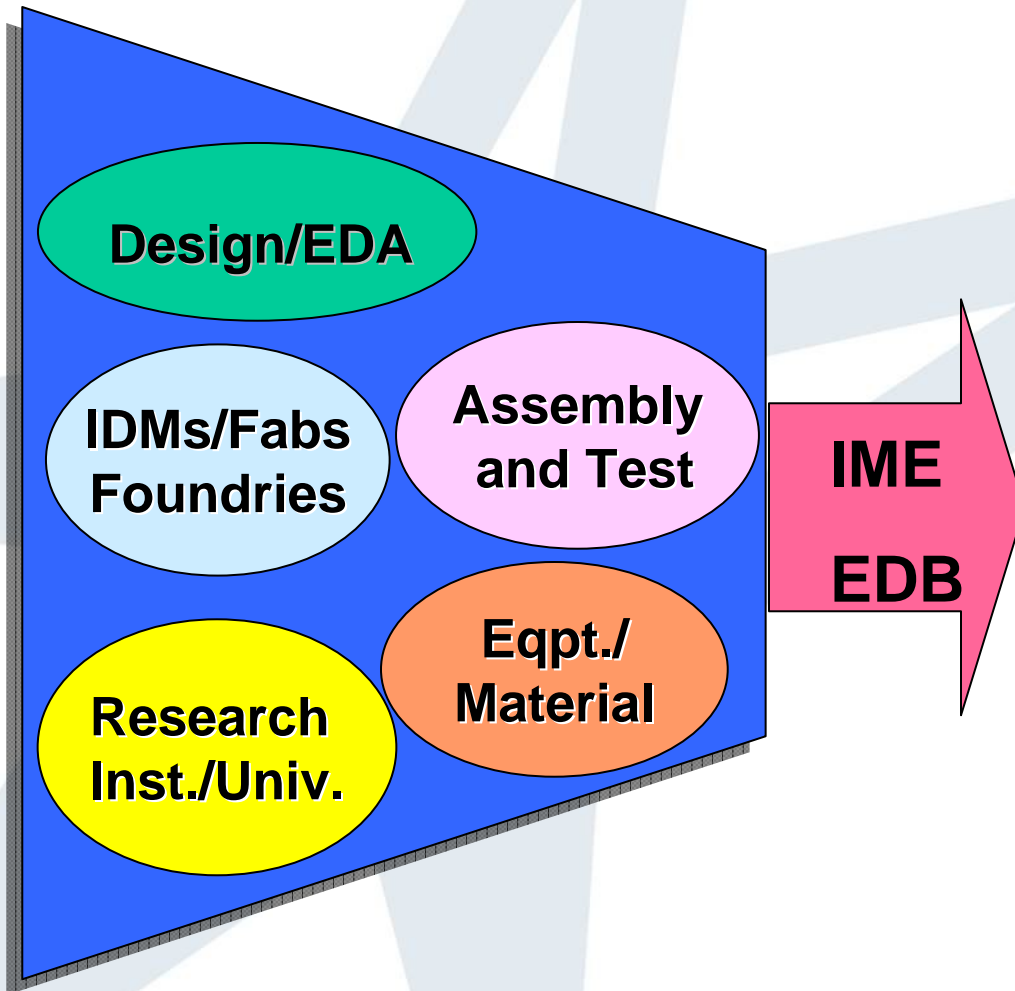
- Enable 3D-Integrated Circuits & Systems through Singapore's Semiconductor industry value chain

Mission

- Promote precompetitive collaborations among the semiconductor companies, Universities and RIs
- Establish cost-effective platform technologies
- Train manpower for the industry

Singapore MEMS Consortium

Establishing MEMS Supply Chain



- **Vision**

- Growing MEMS Industry in Singapore

- **Mission**

- Promoting collaboration among companies for an integrated solution for MEMS manufacturing
- Developing standardization in MEMS design, process and packaging for multiple applications
- Developing technical expertise and know-how to facilitate MEMS development, prototyping and manufacturing in Singapore
- Training manpower

Analog IC Design Centre of Excellence in Singapore



NTU

A*STAR

Industry

ICD COE
-To be led by an Internationally Renowned Professor
Supported by a Advisory Board

- 100 PhDs & MEng over 5 years
- Leading edge technologies
- Industry spin-offs

An **Icon** for ICD in S'pore

Supply top **quality** engineers in analog/mixed signal IC design

Develop **key technologies** and **pre-position** S'pore for advanced analog/mixed signal IC design

- **Energy harvesting**
- **Low power mgt**