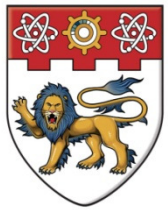


NANYANG TECHNOLOGICAL UNIVERSITY

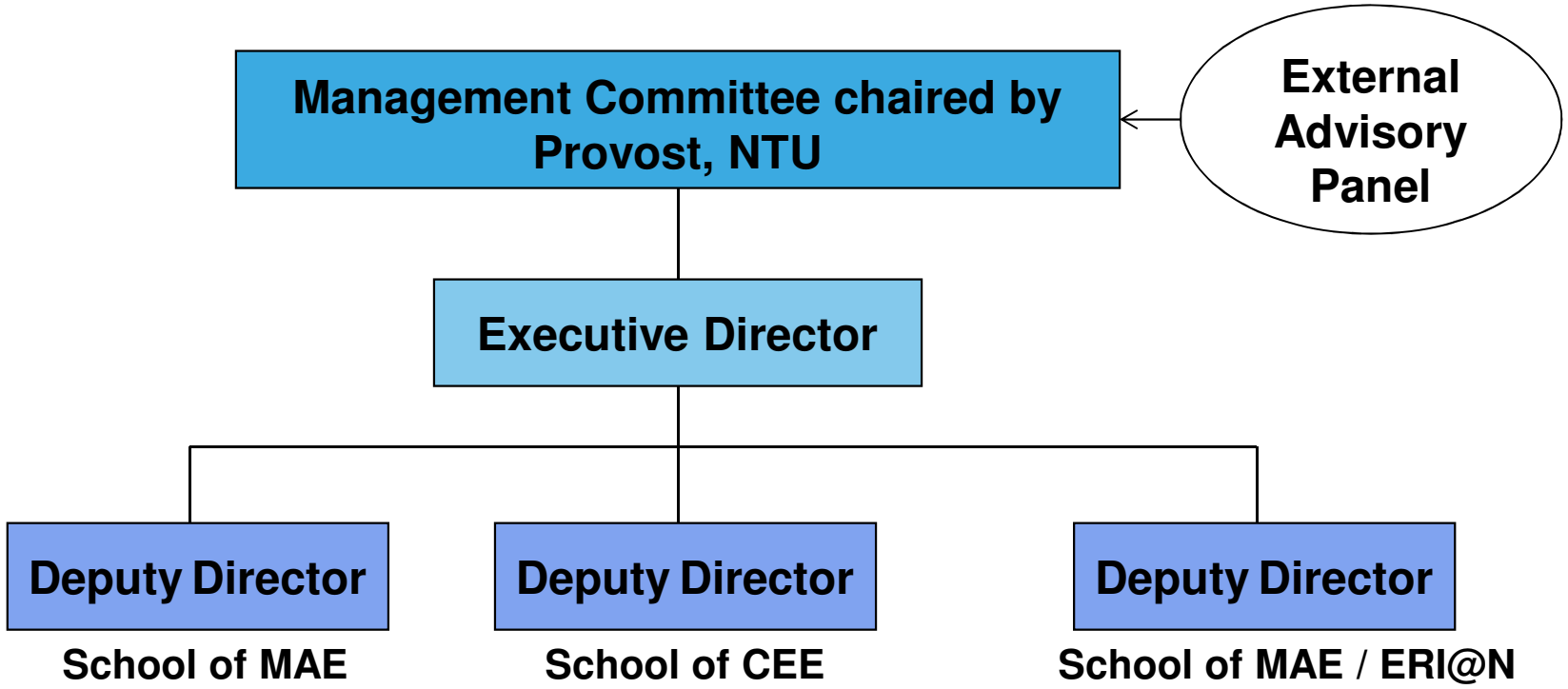
Maritime Institute at NTU (MI@NTU)

presented by

Lam Yen Chin
Executive Director
MI@NTU

29 November 2012

Organisation Structure (MI@NTU)



NANYANG TECHNOLOGICAL UNIVERSITY

Maritime Institute @ NTU

Executive Director
Mr Lam Yen Chin

Deputy Director
Professor Chan Siew Hwa

Deputy Director
Assoc Prof Lo Yat-Man Edmond

Deputy Director
Professor Lua Aik Chong

NANYANG TECHNOLOGICAL UNIVERSITY

Roles of MI@NTU

1. Establish a broad-based maritime education and research platform at NTU, leveraging on NTU's core competencies and partnering the industry.

2. Partner SMI, MPA, EDB and A*Star to champion maritime science and technology development.

3. Attract, retain and support world-class maritime researchers.

4. Foster a culture of innovation in maritime research and technology.

NANYANG TECHNOLOGICAL UNIVERSITY

Research Thrusts

- Naval Architecture and Marine Engineering
- Maritime Clean Energy
- Maritime Technology and Environment
- Maritime Logistics and Operations
- Maritime Policy and Security
- Maritime Business and Economics

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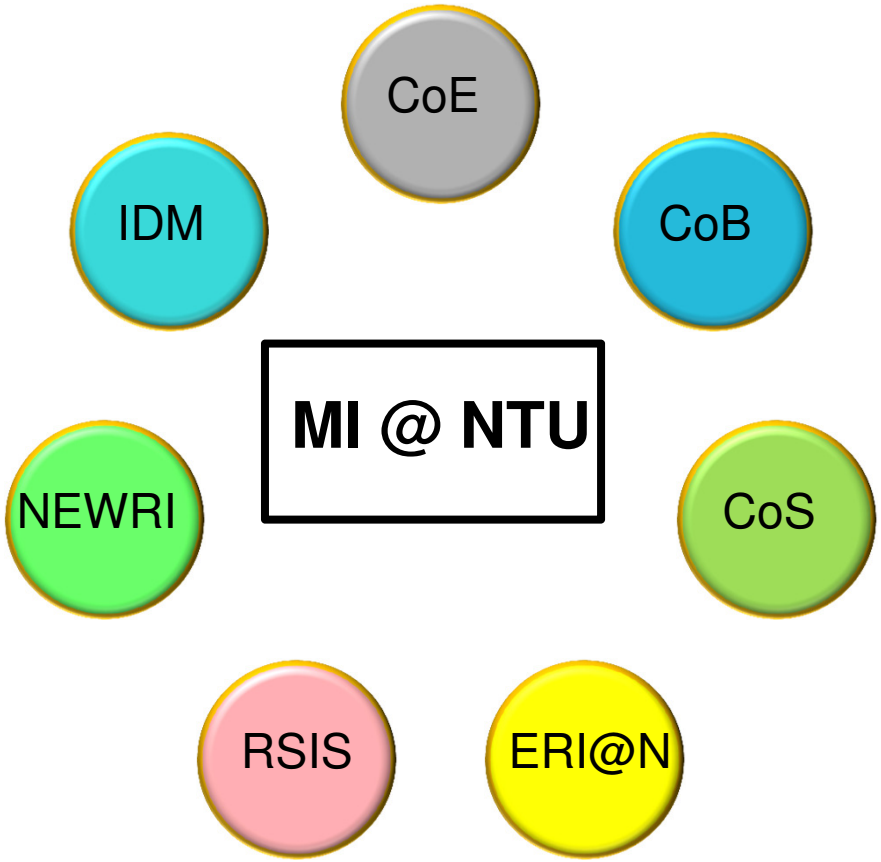
Maritime R&D @ NTU



CoE – College of Engineering
CoB – College of Business
CoS – College of Science
ERI@N – Energy Research Institute @ NTU
IDM – Fraunhofer IDM@NTU
NEWRI – Nanyang Environment and Water Research Institute
RSIS – S.Rajaratnam School of International Studies

NANYANG TECHNOLOGICAL UNIVERSITY

College of Engineering: Maritime Related R&D

CoE - Schools	CBE	CE	CEE	EEE	MSE	MAE
Naval architecture						
Marine engineering						
Ship repair/conversion						
Computational Fluid Dynamics						
Offshore structures						
Robotics						
Sensors & monitoring						
IT & communications						
GIS and image processing						
Maritime environment						
Shipping, port and terminal operations						
Spills and cleanup						

CBE – School of Chemical and Biomedical Engineering
CEE – School of Civil and Environmental Engineering
CE – School of Computer Engineering
EEE – School of Electrical and Electronic Engineering
MAE – School of Mechanical and Aerospace Engineering
MSE – School of Materials Science and Engineering

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Research Thrusts in MI @ NTU

NANYANG TECHNOLOGICAL UNIVERSITY

Naval Architecture & Marine Engineering

- Ship design
- Ship propulsion systems
- Ship construction
- Ship life cycle operations

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Maritime Clean Energy

- Improved ship design for better fuel efficiency
- Propulsion and power generation concepts using alternative energy sources
- Clean technologies for treating emission streams to air and water

NANYANG TECHNOLOGICAL UNIVERSITY

Maritime Technology and Environment

- Deepwater technology and offshore engineering
- Advanced materials to save weight and reduce costs
- Cooperative sensor network clusters for port and maritime security
- Visualisation and inspection of underwater objects using gated imaging
- Management of ship waste and emissions

NANYANG TECHNOLOGICAL UNIVERSITY

Maritime Logistics & Operations

- Decision support systems for port and ship operations
- Capability optimisation in maritime operations
- Visualisation for maritime operations
- Information technology and operations management

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Maritime Policy & Security

- Maritime safety and security
- Maritime management and regime building
- Ocean governance

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Maritime Business & Economics

- Economics and risk management
- Performance of port and shipping companies in the global supply chain
- Strategic port and shipping management in the new era

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Current Maritime Related Research Grants

1. EDB funded NAME Professorships
2. A*Star funded MIMO applications for composite riser
3. NTU funded joint PhD scholarships in naval architecture, marine engineering and offshore engineering with University of Southampton

EDB singapore

Agency for Science, Technology and Research SINGAPORE

UNIVERSITY OF Southampton

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Ongoing Maritime Research Programmes (Examples)

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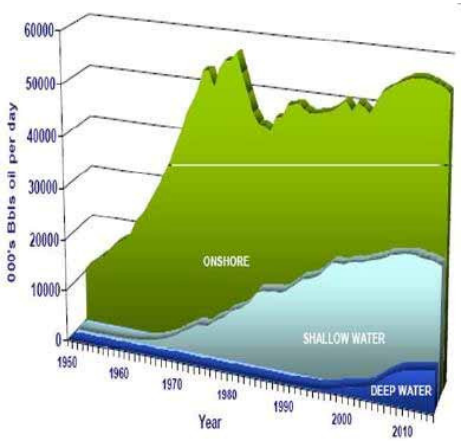
Marine Riser Research Programme

Offshore Production and New Discoveries

- Over 20% of oil/gas production is carried out offshore
- New reserves are sited in deeper waters (> 3,500 ft)

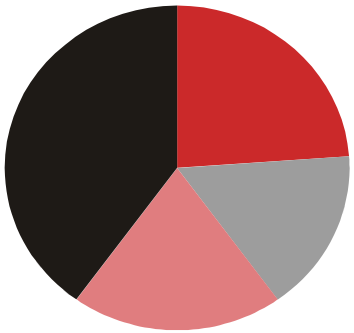


Offshore production
1940s – 1 mmbpd
2010s – 24 mmbpd

New discoveries

Average size of each new reserve
Onshore – 25 mmboe (miilion barrels of oil equivalent)

Offshore – 150 mmboe



Onshore 40%

Ultra Deepwater 24%
> 3.500 ft

Deepwater 16%
1,000 – 3,500 ft

Shallow water 20%
< 1,000 ft

Needs / Challenges

New high strength rigid risers based on composites need to be developed. This is because the existing Steel Catenary Risers (SCRs) have reached their practical design limit at depths of 5000 feet.

Need new tough high-strength flexible risers that allow for ease of installation over many kilometers. The existing flexible risers have limitations on thermal stability and chemical resistance.

Need new liner materials that are durable. Existing liner materials in rigid and flexible risers do not have long-term stability in their gas/chemical barrier properties.

Need to develop reliable techniques to predict and assess the long-term durability of above risers and liners. No reliable technique currently exist.

Additional Considerations:

1. Cost effective to manufacture
2. Can be joined readily and laid over many km
3. Full-scale field testing

Inputs from with DNV and American Bureau of Shipping (ABS)

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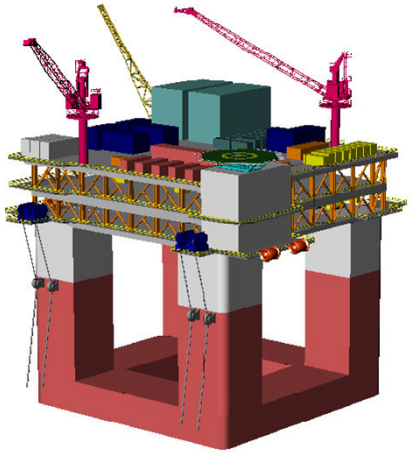
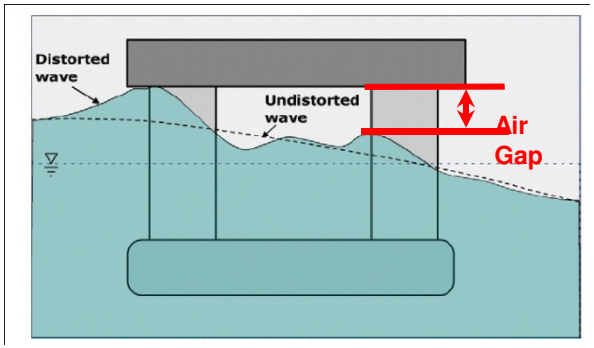
Offshore & Deepwater Work at CEE

- **Topside & Jack-up Structures**
  - Fatigue/fracture of tubular joints
  - Influence of welding residual stress
  - High strength steel
- **Marine Risers**
  - Vortex induced vibrations
  - Fatigue and reliability analysis
- **Fluid-Structure Interaction**
  - Motion of floating bodies
  - Air-gap of semi-submersibles



Keppel's Deep-draft Semi (DDS)

CEE Lab Wave Flume



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Maritime Clean Energy Research Programme

Focus

- Emission control (SOx, NOx, Particulate Matters,etc) for marine vessels
- Intelligent power management and hardware for both hybrid and full electric power generators in both marine vessels and port infrastructures
- Development and integration of environmental friendly technologies to reduce the carbon footprint (smart grid, coal ironing etc.)
- 15 ongoing projects; 16 pending projects

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ZEDSMart – Zero Emission DeSulphurisation Process for Maritime Application

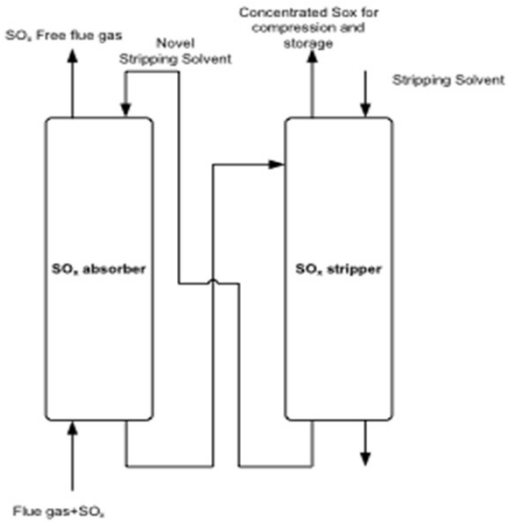
By: Dr Prapisala Thepsithar*, Assoc Arvind Rajendran, Prof Yoel Sasson

Motivation

- Due to more stringent regulations on SO_x emission reduction in years to come, there is a need to develop a reliable and environmentally-friendly system to facilitate ship owners & operators to comply with the regulations in a practical manner.

Objective

- To develop the zero-emission desulphurisation process for maritime applications by which the SOx removed from the flue gas is concentrated and stored onboard for further processing and conversion to other valuable chemicals



Research Approach

- Measurement of process parameters, i.e. thermodynamic and kinetic behavior of the novel solvent
- Development of thermodynamic and process modeling
- Design of the pilot plant and operation to investigate the efficiency of the process
- Optimization, costing and economics of capture and storage of SOx on-board

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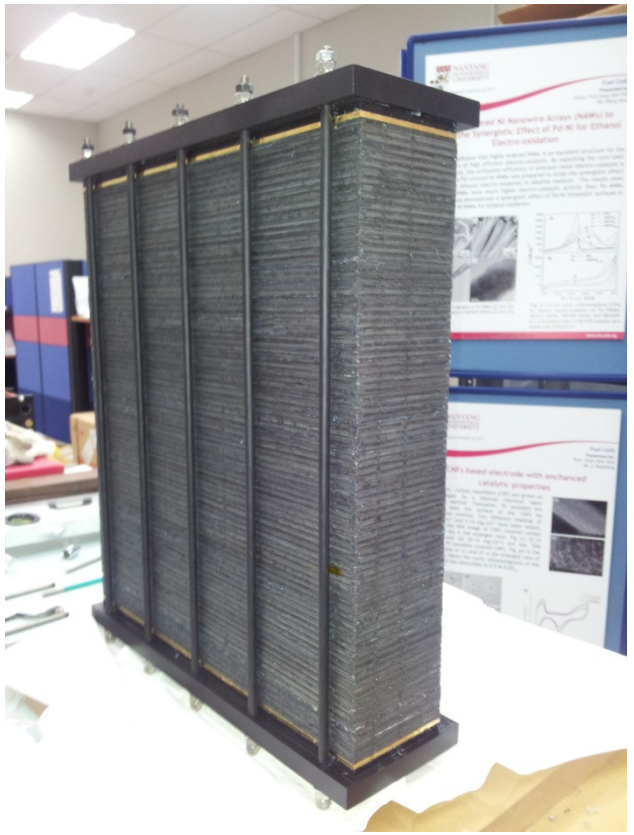
Current Facilities

1. Low Speed Water Tunnel
2. Small Engine Test Room
3. Gas Turbine
4. Wave Flume Facility
5. Offshore Steel Structures Testing Facility
6. Fuel Cells Laboratory



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Proposed Maritime Test Laboratory

1. Dual-Fuel Engine Test Rig
2. Water Channel
3. Structural Test Rig

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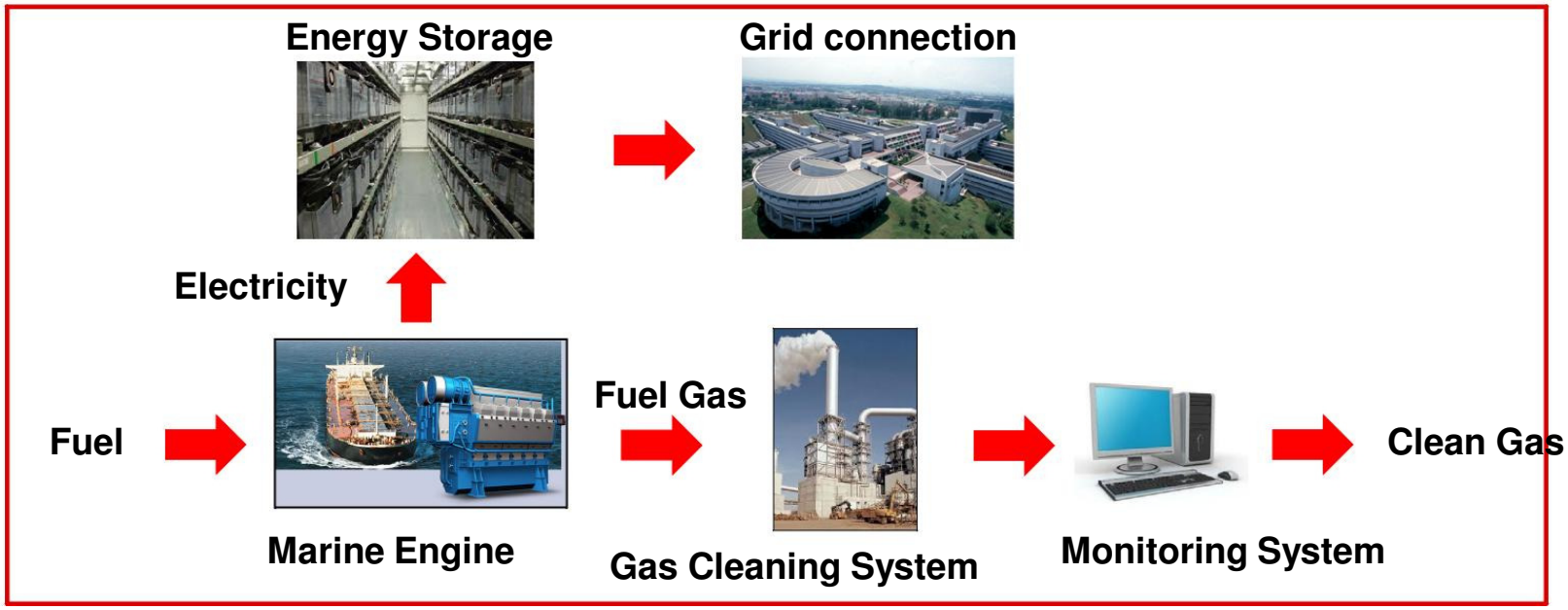
Proposed Clean Energy Test Facility



Alternative or clean fuel: testing of alternative or bio-fuel and testing of fuel additives

Engine: Engine internal modification for low No_x emission and Energy recovery

Energy Storage: Small-scale and grid-scale vanadium redox batteries

Smart Grid: Carbon-neutral electricity and Smart grid

Clean Emission: Exhaust gas cleaning system and Monitoring system for compliance

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Maritime Education @ NTU

1. B.Eng (Mech Eng) with specialisation in Marine and Offshore Engineering

2. M.Sc (Mech Eng) with specialisation in Naval Architecture and Marine Engineering

3. B.Sc and M.Sc in Maritime Studies (in collaboration with BI School of Business, Norway)

4. EMBA in Shipping, Offshore and Finance by NBS (in collaboration with BI School of Business, Norway)

NANYANG TECHNOLOGICAL UNIVERSITY

Final Year MAE Specialisation in Marine and Offshore Engineering

Aim

- To meet the evolving technological and operational needs of the dynamic marine and offshore industry.

Rationale

- Maritime industry contributes 7% to the GDP and offers highly challenging and rewarding careers for engineers.

Desired Outcomes

- Equip MAE graduates with the necessary knowledge and skills to function as a professional in the wide-ranging maritime industry.

NANYANG TECHNOLOGICAL UNIVERSITY

Undergraduate courses in the final year marine and offshore engineering specialisation offered by School of MAE

(Select * and any Three Elective Courses)

MA4810 *	Naval Architecture & Marine Engineering
MA4807	Marine Structural Integrity
MA4808	Marine Control Systems
MA4803	Noise and Vibration Control
MA4814	Computational Fluid Dynamics

NANYANG TECHNOLOGICAL UNIVERSITY

MSc Mechanical Engineering with specialisation in Naval Architecture & Marine Engineering

Aim

•To create knowledge leaders and potential researchers to meet the technological challenges in the maritime industry.

Rationale

•Singapore is the world's premier ship repair and ship conversion centre, a global leader in the building of jack-up rigs, semi-submersible and floating rigs and conversion units. A niche player in customized and specialized vessels.

Desired Outcomes

•Prepare PhD researchers for R & D in Naval Architecture and Marine Engineering.

•Equip engineers in the industry with in-depth and advanced knowledge in areas such as ship design, hydrodynamics and structures.

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Core courses for MSc Mechanical Engineering

M6104 – Advanced Mechanics of Materials
M6801 – Advanced Thermal Engineering
M6802 – Engineering Measurements
M6803 – Computational Methods in Engineering

Five new electives in Naval Architecture & Marine Engineering (NAME) specialisation for MSc Mechanical Engineering.
(Select any Four Elective Courses in NAME and any other 2 elective courses in the other MAE MSc programmes / dissertation)

M6810 – Ship Design and Construction
M6811 – Ship Hydrodynamics
M6812 – Ship Structures
M6813 – Ship Dynamics
M6814 – Marine Engineering

- The number of students enrolled for NAME specialisation :
  AY 2011/12 - 11 students, AY2012/13 – 9 students
- The number of MSc students who have graduated with NAME specialisation : 2

NANYANG TECHNOLOGICAL UNIVERSITY

Visiting Professorships (CEE & MAE)

S/No	Name	Visiting Professorship	Organisation
1	Prof Ajit Shenoi	Michael Fam	University of Southampton, UK
2	Prof Philip Wilson	EDB-NAME	University of Southampton, UK
3	Dr Dominic Hudson	EDB-NAME	University of Southampton, UK
4	Prof Liu Hua	EDB-NAME	Shanghai Jiao Tong University, China
5	Mr Paul Robert Greaves	EDB-NAME	Rolls-Royce, Plc, UK
6	Prof Torger Reve	MPA	BI School of Management, Norway
7	Prof Cameron Williams	MPA	Florida State University, USA (retired)
8	Prof Theo Edmond Notteboom	MPA	University of Antwerp, Belgium

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S/No	Name	Visiting Professorship	Organisation
9	Prof Song Dong-Wook	MPA	Heriot-Watt University, UK
10	Prof Bengt Ramberg	MPA	BI School of Management, Norway
11	Prof Kelvin Cullinane	Visiting Professor, CEE	Napier University, UK
12	Prof Ellen Cathrine Bjune	MPA	BI School of Management, Norway
13	Prof Vaughn Pomeroy	Visiting Professor, CEE	Lloyds Register, UK (retired)
14	Prof Shuo Ma	MPA	World Maritime University, Sweden
15	Prof Han Jong-Khil	MPA	Sungkyul University, South Korea

NANYANG TECHNOLOGICAL UNIVERSITY

Moving Forward

1. Develop R & D Road Map
2. Intensify joint research with maritime stakeholders

2.1 Shipyards

2.2 Shipping companies

2.3 Ports

2.4 Maritime equipment manufacturers and suppliers

3. Build up MI@NTU Test Facilities
4. Strengthen international collaboration
5. Organise industry workshops / forums

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MI@NTU Workshops in Q1 2013

1. Maritime Security
2. Application of Computer Graphics in the Maritime Industry (Visualisation)

NANYANG TECHNOLOGICAL UNIVERSITY

Industry Partners

Thank you for your attention!

Contact us at : +65-6790 4818
Email : ExecDir-MI@ntu.edu.sg
Website : http://mi.ntu.edu.sg

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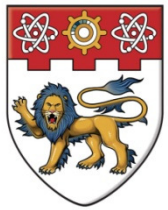

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