Maritime Institute @ NUS (MI@NUS)

Chow Yean Khow
Executive Director, MI@NUS
The Maritime Institute @ NUS (MI@NUS) functions as a Maritime and Offshore Cluster Office to drive and coordinate the maritime and offshore education, training and R&D activities within NUS in partnership with the following NUS research institutes/centres:

- Centre for Offshore Research and Engineering (CORE)
- Centre for Maritime Studies (CMS)
- Tropical Marine Science Institute (TMSI)
- Centre for International Law (CIL)
- The Logistics Institute - Asia Pacific (TLIAP)
Structure of MI @ NUS

Management Committee:
Deputy President (Research & Technology) (Chair)
Executive Director of MI@NUS
Directors of Research Institutes/Centres
Senior Faculty Members

Advisory Panel

Maritime Institute @ NUS

CORE  CMS  TMSI  CIL  TLIAP
MI @ NUS Management Committee

Chairman
• Prof Barry Halliwell, Deputy President (Research & Technology)

Members
• Prof Chan Eng Soon, Dean, Faculty of Engineering
• Prof Chow Yean Khow, Executive Director, MI@NUS and CORE
• Prof Bernard Tan, Director, CMS
• Prof Peter Ng, Director, TMSI
• Assoc Prof Robert Beckman, Director, CIL
• Dr Robert de Souza, Executive Director, TLIAP
• Prof Lim Hock, Director, RGE, ODPRT
• Dr Wang Hui, Director, Research Administration, ODPRT

In attendance
• Prof Choo Yoo Sang, Director (Research), CORE
• Dr Andre Wan, Research Director, ODPRT
Roles of MI@NUS

- Drive and coordinate the maritime and offshore education, training and R&D programmes and initiatives within NUS by working closely with NUS Research Institutes/Centres
- Promote R&D collaboration with industry, research institutes and tertiary institutions
- Organise conferences, symposia, workshops, seminars and other events for knowledge-sharing and interaction with industry
- Provide oversight and administrative support to the programmes/projects funded by SMI
Professorships

**Keppel Professorship**
- Prof Torgeir Moan, NTNU (Dec 2002 - Dec 2006)
- Prof Andrew Palmer (Apr 2007 – Oct 2012)

**Lloyd’s Register Educational Trust Professorship**
- Prof Peter Marshall, formerly Shell (Mar 2007 - Mar 2009)
- Prof Choo Yoo Sang

**MPA Maritime Technology Professorship**
- Prof Rodney Eatock Taylor, Oxford University
- Prof Paul Taylor, Oxford University
- Prof John Dempsey, Clarkson University
- Dr John Halkyard, formerly Technip

**EDB Subsea Engineering Professorships Programme**
- Dr Bil Loth, WD Loth and Company
- Alistair Birnie, Denmore Tech Ltd, formerly CEO Subsea UK and Global Head of Technology, Aker Subsea
Professorships

**MPA Professorship in Maritime Law**
- Professor Steven Hazelwood, Sem 1, 2012/2013
- Assoc Prof Paul Andrew Myburg, Sem 2, 2012/2013

**MPA Professorship in Shipping Economics**
- Selection of appointee for 2012/2013 in progress
Education Programmes & Manpower Development

**Offshore Technology**

- B.Eng. (Civil) with Specialization in Offshore Engineering (2004)
- B.Eng. (Mech) with Specialization in Offshore Oil & Gas Technology (2005)
  *(with a Track in Subsea Engineering: August 2012)*
- M.Sc. (Civil) with Specialization in Offshore Engineering (2006)
- M.Sc. (Mech) with Specialization in Offshore Oil & Gas Technology (2007)
- M.Sc. in Offshore Technology (Aug 2011) integrating the above 2 M.Sc.
  *(with a Specialization in Subsea Engineering: August 2012)*
- M.Eng. and Ph.D. Research in Offshore Technology
- Joint Ph.D. Programme with University of São Paulo, Brazil in the field of Marine, Ocean and Offshore Engineering (in discussion)
Education Programmes & Manpower Development

Maritime & Shipping

• Graduate Diploma in Maritime Law and Arbitration
• Master of Laws (Maritime Law)
• Maritime & Shipping Economics Module
• Port Economics Module
• Dual Master Degree in Logistics and Supply Chain Management - TLIAP
  - Master of Science (Logistics & SCM) from NUS
  - Master of Science (Supply Chain Engineering) from Georgia Tech
• Master of Science in Supply Chain Management - TLIAP
Continuing Education Programmes

- Keppel Offshore & Marine Annual Lecture
- Lloyd’s Register Educational Trust (LRET) Annual Lecture
- CORE Seminar Series; CMS Seminar Series
- Joint CORE, SNAMES, Joint Branch of RINA and IMarEST Technical Talks
- Conferences, Symposia and Workshops (e.g. MTEC (2007, 2011); OSV (2007, 2009); MOSS (2008, 2012); Deepwater Development Workshop (2008); LRET Marine Research Workshop (2010); NSRI-CORE Subsea Symposium (2010); ABS-CORE Offshore Geotechnics Workshop (2012); DNV-NUS Pipelines Open Day (2012))
- Regional conferences/workshops on issues of concern to Asia with the CIL-sponsored participation of government officials/leading researchers from ASEAN countries (e.g. joint development in the South China Sea)
Offshore Technology Research Programme (A*STAR, MPA)
15 projects covering smart sensing, re-assessment and retrofitting, and fracture resistance and repair of offshore structures; intelligent deepwater mooring systems; LNG sloshing; subsea processing; AUV; methane hydrates; pipeline-soil interaction; offshore foundation systems (jack-up spudcan foundations; plate anchors, torpedo anchors)

Multiphase Flow Analysis for Downhole Oil & Gas Equipment (A*STAR)
7 projects addressing constitutive and numerical modeling of multiphase flow, and multiphase flow processes and issues concerning flow assurance; heavy oil production and downhole equipment design

Materials Innovation for Marine & Offshore Industry (A*STAR)
6 projects covering mainly design and analysis of composite risers and joints; fatigue, durability and impact survivability of composite risers; study on novel composite materials for risers
CORE: Joint Industry Projects (JIPs)

1. **JIP on Static and Fatigue Strength of Grout-Reinforced Tubular Joints**
   **Sponsors:** ABS, ClassNK, Densit, Lloyd’s Register, MODERMONT, PETRONAS, TATA STEEL

2. **JIP on Improved Partial Joint Penetration (PJP-plus) Welded Tubular Joints**
   **Sponsors:** ABS, HGG, MODERMONT ENGINEERING, NIPPON STEEL

3. **JIP on Spudcan-Pile Interaction**
   **Sponsors:** ABS, ExxonMobil, Shell, Total, Keppel Offshore & Marine

4. **JIP on Spudcan-Footprint Remediation**
   **Sponsors:** ABS, ConocoPhillips, ExxonMobil, Keppel Offshore & Marine, FUGRO, GL Noble Denton, MAERSK DRILLING, MPA SINGAPORE

5. **InSafe JIP (Jack-up Foundation Assessment Study)**
   **Project Team:** RPS Energy; NUS; University of Oxford; University of Western Australia
   **Sponsors:** ABS; ConocoPhillips; ExxonMobil; Shell UK; Braemar Falconer; Fugro; Geo-Danish Geotechnical Institute, Global Maritime; Noble Drilling; GL Noble Denton; Premier Oil & Gas Services; Premium Drilling/COSL; DONG Energy; HSE UK; ENSCO International; Keppel Offshore & Marine; Maersk Drilling; Matthews Daniel; Transocean (Global Santa Fe)
InSafe Joint Industry Project

**IMPROVED GUIDELINES FOR THE PREDICTION OF GEOTECHNICAL PERFORMANCE OF SPUDCAN FOUNDATIONS DURING INSTALLATION AND REMOVAL OF JACK-UP UNITS**

**Work Scope**
- Site investigation & lab testing
- Spudcan bearing capacity predictions; punch-through
- Spudcan operation related issues

**Project Team**

**Project Sponsors**

- American Bureau of Shipping
- GEO-Danish Geotechnical Institute
- Noble Drilling
- Braemar Falconer
- GL Noble Denton
- Premier Oil & Gas Services
- ConocoPhillips
- Global Maritime
- Premium Drilling/COSL
- DONG Energy
- HSE UK
- Shell UK Limited
- ENSCO International
- Keppel Offshore & Marine
- Transocean (Global Santa Fe)
- ExxonMobil
- Maersk Drilling
- Fugro Singapore
- Matthews Daniel
CORE: Trends in Offshore Oil & Gas Exploration and Production

Deepwater Development Systems

Subsea systems
CORE R&D: Major Focus on Deepwater Technology

Deepwater Structural Systems
- Floating Structures
- Hydrodynamics & Wave-Structure Interaction
- Innovative Structural Systems
- Structural Integrity Management
- Moorings & Risers
- Marine Operations

Subsea Systems
- Subsea Processing
- Subsea Compression
- Multiphase Flow
- Multiphase Pumping
- Multiphase Metering
- Produced Water Separation

Seafloor & Subsurface Engineering
- Foundation Systems
- Pipelines
- Geohazards
- Methane Hydrates
- AUVs/Underwater Robotics

Courtesy of Emerson Process Management.
## CORE: M.Sc. In Offshore Technology

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Title</th>
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</thead>
<tbody>
<tr>
<td>OT5001</td>
<td>Independent Study Module (8 MCs)</td>
</tr>
<tr>
<td>OT5101</td>
<td>Exploration and Production of Petroleum</td>
</tr>
<tr>
<td>OT5102</td>
<td>Oil &amp; Gas Technology</td>
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<tr>
<td>OT5201</td>
<td>Marine Statics &amp; Dynamics</td>
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<tr>
<td>OT5202</td>
<td>Analysis &amp; Design of Offshore Structures</td>
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<tr>
<td>OT5203</td>
<td>Design of Floating Structures</td>
</tr>
<tr>
<td>OT5204</td>
<td>Moorings &amp; Risers</td>
</tr>
<tr>
<td>OT5205</td>
<td>Offshore Pipelines</td>
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<tr>
<td>OT5206</td>
<td>Offshore Foundations</td>
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<tr>
<td>OT5207</td>
<td>Arctic Engineering</td>
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<tr>
<td>OT5208</td>
<td>Fatigue and Fracture for Offshore Structures</td>
</tr>
<tr>
<td>OT5301</td>
<td>Subsea Systems Engineering</td>
</tr>
<tr>
<td>OT5302</td>
<td>Flow Assurance</td>
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<tr>
<td>OT5303</td>
<td>Subsea Control</td>
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<tr>
<td>OT5304</td>
<td>Subsea Construction &amp; Operational Support</td>
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<tr>
<td>OT5881</td>
<td>Topics in Offshore Engineering</td>
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<tr>
<td>OT5882</td>
<td>Topics in Subsea Engineering</td>
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<tr>
<td>CE5307</td>
<td>Wave Hydrodynamics and Physical Oceanography</td>
</tr>
<tr>
<td>ME5301</td>
<td>Flow Systems Analysis</td>
</tr>
<tr>
<td>ME5506</td>
<td>Corrosion of Materials</td>
</tr>
</tbody>
</table>
The global leader in offshore rig design, construction and repair, ship repair and conversion, and specialized shipbuilding

Spearheads the R&D of new technologies, processes and competencies, across the spectrum of KOM’s businesses

The joint venture between McDermott and KFELS to design, build and deliver deepwater floating production systems

A leading research-intensive university at the cutting edge of knowledge creation. The Centre for Offshore Research and Engineering (CORE) and the Maritime Institute @ NUS represents NUS in this Consortium.
Programmes and Scope of Activities

- Promote relevant workshops and seminars among the universities, research institutes and industry players in Brazil
- Invite outstanding academics for visiting professorships and research fellowships
- Promote engineering postgraduate programmes at NUS and Brazilian Universities to look into the challenges facing the deepwater industry
- Facilitate technology exchange between Brazil’s ocean basin, tow tank and numerical laboratories and Singapore’s research institutes
- Promote engineering undergraduate exchange programmes between NUS and the Brazilian universities
CMS: Research Focus Areas

- Shipping, freight transport & logistics modeling
- Port planning and management
- Maritime strategies and management
- Multimodal freight transportation
- Maritime information technology
- Maritime environmental management
CMS: Research Focus Areas

Maritime Policy & Management Cluster
- Maritime policy & planning
- Maritime economics & finance
- Maritime strategies & management

Maritime Operations & Modeling Cluster
- Shipping & logistics transportation
- Multimodal freight infrastructure planning & management
- Port operations modeling & analysis
- Port planning & development
- Marine cluster planning & operations management
- General cargo logistics
- Maritime information technology
- Maritime communications technology
- Maritime vessel and navigation simulation
- Maritime environmental management
CMS: Joint Industry Projects

1. **Global Liner Shipping Network Analysis**  
   *Sponsors: NOL Fellowship, APL Co Pte Ltd*

2. **Port Carbon Footprint Study**  
   *Sponsors: Jurong Port Pte Ltd*

3. **Development of Ship Sale Form**  
   *Sponsors: Singapore Maritime Foundation*

4. **East and Southeast Asia Port Database Development**  
   *Sponsors: National Land Planning Association, Japan*

5. **Quantitative Risk Assessment for Shipping Operations**  
   *Sponsors: MPA MINT Fund, Dalian Maritime University*

6. **Port and Shipping Hinterland Developments in Asia**  
   *Sponsors: NOL Fellowship, Kainan University, Inha University*

7. **MicroPort and MicroCity Simulation Model**  
   *Sponsors: Global Centre of Excellence, Kyoto University*
TMSI: Marine Science Research

Sensing & Monitoring
- Real time water monitoring
- Current measurements
- Side scan seabed mapping
- Vertical land movement
- Coastal line retreat/erosion
- Underwater Acoustic Communications
- Ambient Noise Studies
- Cooperative Autonomous Underwater Vehicles

Modelling
- Coastal Hydrodynamics
- Tsunami and Wave Dynamics
- Ocean currents and ship movement patterns
- Sediment Transport
- Hydrology, Hydro-informatics
- Water Quality
- Oil/pollutant Spills
- GIS, Informatics

Climate Change Research
- Rainfall Temperature, Wind, Sea Level Changes, Storm Surges, Ocean current changes and anomalies
- Effects on Environment, Coastal Erosion, Infectious Disease. Impacts on Energy Demand and Emissions

Ecology
- Biodiversity, Invasive Species
- Marine Biosecurity: Antifouling, Ballast Water Management, Harmful Algal Blooms
- Environmental Monitoring, Pollution, Impact Assessment
- Ecological Modelling and Engineering
- Bio-energy, Sustainability
- Shipping impacts on marine mammals
- Underwater Vision

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TMSI Research: Ocean Modelling for Maritime Operations

**Maritime Operations & Modeling**
- Harbor modeling & design
  - Ship Wakes
  - Wave-Structure Interaction
  - Wave-Current Interaction
- Ocean forecasting
  - Typhoons
  - Currents
  - Wind-Waves
  - Storm Surges
  - Search & Rescue

**Maritime Environmental Modeling**
- Oil Spills
- Ballast Water Discharges
TMSI Research : Marine Biofouling & Antifouling R&D

Marine Biofouling Research
• Biofouling surveys, hull inspection
• Fouling management
• Alien invasive species

Antifouling Testing & Performance
• ASTM Static Field Immersion Tests
• Rapid field tests to screen for novel antifouling coatings
• Laboratory bioassays for antifouling activity against microalgae, barnacle, calcareous tubeworms

Antifouling Technology Development
• Novel biocides (NUS-A*ICES-MPA)
CIL: Research Focus Areas

Law and policy issues relating to:

**Offshore Platforms**

• Risks and opportunities arising from abandoned and disused offshore platforms in Southeast Asia, including the feasibility of converting offshore platforms to artificial reefs
• Research on feasibility of global and/or regional regulations and best practices for the prevention of pollution from offshore platforms and installations
• Research on liability and compensation schemes applicable to major oil spills from offshore platforms and installations
• Note: 2012 MOU with Institute of Technology Petronas for collaboration and joint research on offshore activities (including decommissioning) and other ocean policy issues

**Submarine Cables and Pipelines**

• *Handbook on Submarine Cables and Law of Sea*, in partnership with the International Cable Protection Committee (industry organization of cable owners and operators) [Co-Editors, publication in process]
**CIL: Research Focus Areas**

**South China Sea Disputes**
Study of the international legal issues relating to the South China Sea disputes, including the prospects for joint development arrangements.

**South China Sea Marine Biodiversity**
Study of the features in the South China Sea and their surrounding marine habitats for the monitoring of marine biodiversity and its protection from shipping and other offshore activities.

**Piracy & International Maritime Crimes**
Examination of the capability of international law to combat piracy, ship-hijacking, hostage-taking and maritime terrorism, as well as problems faced by States in implementing global and regional conventions on international maritime crimes. [Book published in 2012]

**Industry Collaboration**
On-going dialogue with industry through seminars and workshops.
Supply Chain Intelligence:
This area seeks to focus on providing an overarching analysis of the logistics market, the trade flows, and economic barometers of the various countries in Asia as far as it pertains to effective supply chain management for various industries.

Supply Chain Optimization:
This, being the traditional and existing strength of the Institute, seeks to deepen expertise in supply chain global network design and optimisation, involving the respective modes of transportation.

Supply Chain Technology:
This is an emerging area and intends to look at the test bedding of RFID and data capture related technologies, within the context of an independent environment. Policy and implementation issues pertaining to new supply chain technology and the end-to-end supply chain network are undertaken on a contract research basis.

Network Sustainability Modelling
To provide a ‘technical reference’ for a sustainable supply chain network modelling reference, using commercial optimisation and simulation tools as a basis

Sustainability Opportunity Assessment
To provide a comprehensive framework of supply chain sustainability best practice, with causal modelling to identify carbon and cost opportunities
TLIAP: New Areas of Research

Master facilitative control tower for risk management of complex supply chains
• Develop advanced Control Tower capabilities for companies to manage their supply chains
• Develop an infrastructure to enable dynamic exchanges between Control Towers to better manage risks from disruptions

Humanitarian Supply Chain Programme
Serve as a neutral knowledge broker to the sector at large, capturing and disseminating Supply Chain Management (SCM) knowledge and best practices.

City Logistics
Multi party coordination for last mile logistics in an urban environment
TLIAP: Industry Outreach

The THINK Portfolio

- THINK Executive
- THINK IT
- THINK Sustainability
- THINK Humanitarian
- THINK Logistics

One Concept – Different Target Groups
Research Facilities

1000 Tonne Actuator

200 Tonne Actuator for Cyclic Testing

Geotechnical Centrifuge

Methane Hydrate Test Facility
Research Facilities

Wave Basin (Shallow Water)

Wave Flume

Three-Phase Oil-Water-Air Flow Loop
TMSI Research Laboratories

St. John’s Island Marine Laboratory

Acoustic Research Laboratory

Physical Oceanography Research Laboratory
# Upcoming Plans

<table>
<thead>
<tr>
<th>Goals</th>
<th>Key Action Steps</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Education Programmes:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benchmarking of education programmes with key universities in the field</td>
<td>Identify key universities in the field</td>
<td>Key universities identified and internet</td>
</tr>
<tr>
<td><strong>Education and Training:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment of maritime and offshore education and training to needs of industry</td>
<td>Consult external stakeholders; conduct needs assessment</td>
<td>SMI, EDB, MPA, A*STAR, maritime and offshore companies</td>
</tr>
<tr>
<td><strong>Research &amp; Development:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road mapping exercise on R&amp;D focus areas and needs of industry</td>
<td>Consult internal and external stakeholders</td>
<td>Internal: CORE, CMS, TMSI, CIL, TLIAP External: SMI, A*STAR, MPA, EDB, maritime and offshore companies</td>
</tr>
<tr>
<td><strong>R&amp;D Collaboration with Industry:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promote R&amp;D collaboration and partnership with industry as well as research institutes and tertiary institutions</td>
<td>Engage in external and outreach activities</td>
<td>Maritime and offshore companies, research institutes and tertiary institutions</td>
</tr>
</tbody>
</table>