Educating Subsea Workforce of Tomorrow: Global Subsea University Alliance

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The Global Subsea University Alliance

Partners in Advancing Subsea Engineering Through Research and Education

Director: Prof. Ekaterina Pavlovskyaia
Important partner similarities

Initiation of Global Subsea Engineering Curricula
- Our Universities have Solid Industrial Partners
- Our Universities are Good Listeners
- Our Universities are Entrepreneurial and Agile

Preexisting Individual Subsea Programs

Global Subsea University Alliance
Genesis of the Partnership

- Energy is the 21st Century Engineering Grand Challenge
- Energy solutions exist in ultra deepwater locations
- Our cities serve as home to the same O&G Companies
- O&G Engineering has no borders
- Governmental regulations require continued education
- Universities are trying to reach beyond our silos and utilize complementary key competence and infrastructure
Voice of the O&G Companies

**Top Rated Subsea Specific Items**
- Flow Assurance
- Low External Temperatures
- HPHT O&G Production
- Ultra-Long Distance Tiebacks in Severe Environments
- Corrosive Environment
- Reliability and Integrity of Complex Systems

**Top Rated Engineering Specific Items**
- Engineering Efficiency
- Systems Engineering and Integration
- Fault Tolerant Design
- 30 Year Operational Life
- Autonomous and Intelligent Operation
Defining a Core Subsea Engineering Education

Core Curriculum Definition Process

- Voice of the Customer (O&G Companies)
- Benchmark partners’ individual curriculum
- Synthesize findings into a common core subsea engineering curriculum
- Final review among partners and our advisory boards
- Implement the Global Subsea Curriculum
Core Subsea Curriculum

Core Courses
- Flow Assurance
- Materials & Corrosion
- Subsea Systems

Associated Courses
- Pipeline Design
- Riser Design
- Computational Subsea Engr

Selected Supporting Courses
- Multiphase Flow
- Heat Transfer
- Fluid Dynamics
- Mechanics
- Reliability
- Safety
## Course Inventory Among Partners

<table>
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<tr>
<th>Course Name</th>
<th>UH</th>
<th>NUS</th>
<th>Curtin</th>
<th>Aberdeen</th>
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Education Goals

- Implement the Core Subsea Engineering Curriculum
- Enable International Course and Curriculum Sharing among the Alliance Partners
  - On-line streaming, MOOCs
  - Student exchange
- Host Workshops and Software Training
- Recruit other universities to provide a subsea engineering education.
Research Goals

- Establish international subsea research facilities available to the Alliance Partners
- Perform pre-competitive research among the Alliance partners.
- Build qualification and testing facilities coupled to workforce development.
- Faculty mobility
Bergen University College

Expert competence areas:
- Materials and Structural Integrity
- Condition Monitoring
- Multiphase Flow Measurement and Assurance

Key infrastructure and laboratories:
- Ship model tank
- Multiphase Flow Loops (CMR and Univ. Bergen)
- Structural Integrity Test Laboratories (incl. DNV)

Important local partners in addition to industry:
- GCE Subsea, University of Bergen, NTNU, CMR, Subsea Valley, TeknoVest, CCB and other OG supply bases
Expert competence areas:
- Multiphase Flow Measurement and Assurance
- Subsea infrastructure (particularly ROV/AUV)
- Corrosion
- 3-Phase core flooding
- IFT and injectivity analysis
- Drilling engineering
- Subsea vibration and temperature sensors
- Composite pipes.

Key infrastructure and laboratories:
- Corrosion Centre
- National Geosequestration Centre
- 2-phase Flow Loops (liquid and gas)
- 3-Phase core flooding lab
- IFT analysis lab
- Materials testing/Marine Sciences Labs
- 2- CO2 injection test sites and experimental 3D seismic operations
- Pawsey supercomputer centre

Important local partners in addition to industry:
- DnV, FMC, Shell, Woodside, BHPB, Intecsea, GE O&G, Baker Hughes, SUT, SEA, Technip, Chevron, Fugro, Henderson fabrication facility
Expert competence areas:

- Heavy Oil Multiphase Flow Research and Modelling.

Some Key infrastructure and laboratories:

- Three-Phase Oil-Water-Air Flow Loop
- Three-phase process separator and oil & water storage
- Heavy Oil Multiphase Flow Loop
Expert competence areas:

- **Modeling:** Linear and Nonlinear System Identification; Physics Based Modeling, Online Adaptive Modeling, Automated Data-Driven Modeling, Dynamic Systems Analysis.

- **Automatic Control:** Linear and Nonlinear Feedback Control, Data-Driven Controller Identification, Feedforward Control, Multivariable Control Systems, and Adaptive Control.

Subsea Engineering Experience:

- **Model Based Methods in**
  - Subsea Machine Diagnostics, Prognostics and Performance Monitoring; Multi-Phase Flow and Heat Transfer Modeling in Pipelines / Multi-Phase Fluid Pumps; Optimization and Analysis Led Design of Subsea Architectures; Fluid Power (Hydraulic) and Hydraulic Fracturing Modeling; Subsea Systems Integration

- **Automatic Control of**
  - Subsea Blowout Preventers; Multi-Phase Fluid Pumps and Electric Motors; Well and Manifold Multivariable Pressure and Flow Control; Dual Gradient Drilling; Autonomous ROV Tasks
Expert competence areas:
- Static and dynamic analysis of submarine risers and subsea pipes
- Experimental analysis of structures
- Integrity of intact and damaged onshore and offshore structures
- Inspection and monitoring of offshore structures; Risk based inspection of structures and equipment
- Maintenance and repair of offshore structures and equipment
- Reliability of, floating and submarine structures and systems
- Flow assurance
- Alternative materials (composites, intelligent materials, materials for high temperature high resistance steels, etc.)
- Artificial reefs
- Wave energy technologies

Key infrastructure and laboratories:
- Subsea Technology Laboratory
  - Horizontal and vertical hyperbaric chambers, and thermal-hyperbaric chamber
  - Fatigue testing apparatus for rigid pipe welding joints
  - Flow loops for sensor calibration and simulation of different gas-liquid flow patterns
- Well Technology and Engineering Laboratory
  - True Triaxial cell
  - HP/HT Multiphase Flow Loop Test Facility
  - Drilling mud flow loop test bed
  - Virtual Drilling Rig Facility
Subsea Technology Research Directions:

- Decommissioning (underwater laser cutting)
- Subsea Sensors and wireless networks
- High Voltage DC Networks
- Resonance Enhanced Drilling
- Composite Materials Modelling
- Fluid Structure Interaction Modelling
- Iceberg – soil - pipeline interaction studies

Key infrastructure and laboratories:

- Fluid Open Channel and Oscillatory Flow Tunnel Facilities
- High Pressure-High Temperature (HPHT) Facility
- Resonance Enhanced Drilling and Drill String Dynamics Laboratories
- Optical Engineering and Power Electronics Laboratories
- Oceanlab
Thank you

www.subsea-alliance.org