

**CISMaRT**  
CANADIAN NETWORK FOR INNOVATIVE SHIPBUILDING, MARINE RESEARCH AND TRAINING | RÉSEAU CANADIEN POUR L'INNOVATION DANS LA CONSTRUCTION NAVALE, LA RECHERCHE MARINE ET LA FORMATION

## Overview and Challenges: Marine-Related Education and Training in Canada

### Workshop on Education and Training

Ottawa, ON  
11 July 2017

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## Overview

- Brief Survey of Marine Technology Education in Canada
- Challenges
  - General
  - Small
  - Fragmented
  - Increasing demands
- Possible Strategies
  - Alliances
  - Training – commercial opportunities
  - Modern technologies
- Conclusions

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## Undergraduate Programs

- Memorial's undergraduate Ocean and Naval Architectural Engineering Program, the only one in Canada
  - It is also the only co-op program in the world
  - About 24 graduates a year
  
- Marine Institute's diploma programs on marine engineering systems and naval architecture – also unique in Canada.
  - About 21 graduates a year in each of
    - Marine Engineering
    - Naval Architecture, Marine Engineering Systems Design



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## Graduate Programs

- Memorial University
  - Thesis-based Master and PhD programs in Ocean and Naval Architectural Engineering (ONAE)
  - Course-based Masters Program (one-year with internship) in ONAE (to be launched in 2018)
  
- Marine Institute
  - Course-based Master programs in Maritime or Technology Management



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## Graduate Programs

- University of British Columbia
- Master of Engineering in NA & ME
  - One-year multi-disciplinary, industry-focused program with four-month internship)
- *Thesis based program to be re-launched in 2017*



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## Graduate Programs

- Master of Engineering Leadership (MEL) in NA & ME
  - One-year course intended for students with 3 or more years industrial experience
  - Engineering courses + business courses



	WINTER JANUARY—APRIL	SUMMER MAY—AUGUST	FALL SEPTEMBER—DECEMBER
TECHNICAL COURSES (12 CUs)	NAME 522: Ship Production & Industrial Engineering (3 CR)		NAME 578: Marine Engineering (3 CR)
	NAME 566: Ship Dynamics & Control (3 CR)		NAME 591: Computer-Aided Ship Design Project (3 CR)
	APPP 501: Project Management & Leadership (1.5 CR)		MECH 488: Intro to Ship Hydrodynamics (3 CR)
	APPP 503: Organizational Leadership (1.5 CR)		CIVL 437: Intro to Ship Structures (3 CR)
LEADERSHIP COURSES (12 CUs)	APPP 505: Analytics & Interpretation for Applied Sciences (3 CR)	AFSC 412: GRAD. CO-OP for Engineer or Mechanical Industry Project OR UBC LEAN LAUNCHPAD 12 weeks	APPP 502: Leadership & Sustainability (1.5 CR)
		BOOT CAMP* 4 weeks (3 CR)	SAUDER BUSINESS COURSE (1.5 CR)

\*Boot Camp = APPP 504: Business Acumen for Technical Leaders. Offered in May or August with UBC Lean Launchpad & in August only with Grad Storage.

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## Research

- Some institutions, while not having formal naval architecture and marine engineering programs, nevertheless undertake marine-related research
- Examples include
  - Dalhousie University
    - Material and structural engineering, underwater robotics
  - University of New Brunswick
    - High performance computing
  - University of Victoria
    - Marine renewables, underwater vehicles

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## Marine Training Institutes

- Several colleges offer courses targeted primarily at providing engineers and other professionals for supporting ship and offshore installation operations

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## Experienced Engineer Training

- In a typical career, engineers will attend courses on technical and non-technical subjects, often on an ad hoc basis
- Some organizations have structured training programs which may include short courses on technical and non-technical subjects
- Technical subjects
  - Enhance technical skills or keep up to date in specialist areas and regulatory developments
  - Courses provided by engineering software vendors
    - Reflects greater reliance on software tools for most aspects of design, construction and operation
    - Often used by vendors for marketing purposes

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## Experienced Engineer Training

- Typical non-technical subjects
  - Technical writing
  - Management
    - Project management
    - Leadership
  - Presentation skills

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## Challenges

- Canada's general performance in science & technology – mixed picture
- Small size of marine industry
- Fragmented nature of educational infrastructure
- Meeting industry/government demands?
  - Required numbers (NSS etc.)
  - Technology developments
  - New regulations

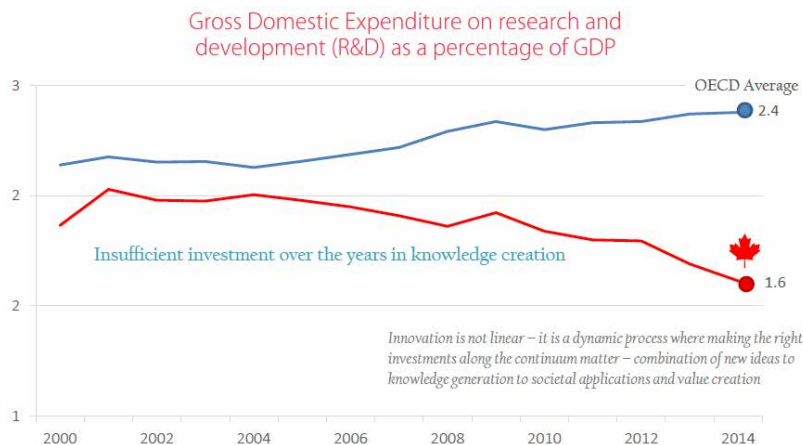
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## Challenges

### - Innovation in Canada

- Some of the challenges reflect those of Canada generally



Source: OECD Main Science and Technology Indicators, quoted in Canada's Inclusive Innovation Agenda, Nov 2016

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## Challenges

### - Educated workforce

- Mixed news:
  - Highest %age (55%) of population with tertiary education ✓
  - Doubled number of science & engineering PhDs from 2006 – 2012; 19<sup>th</sup> to 17<sup>th</sup> (OECD countries) ✓
  - While good at attracting at immigrants with STEM credentials, Canada producing fewer graduates in science, engineering, business & health
    - 14<sup>th</sup> in 2006 to 16<sup>th</sup> in 2012 (OECD Countries) ✗
  - Canadian businesses not sufficiently commercializing S&T and innovation research ✗

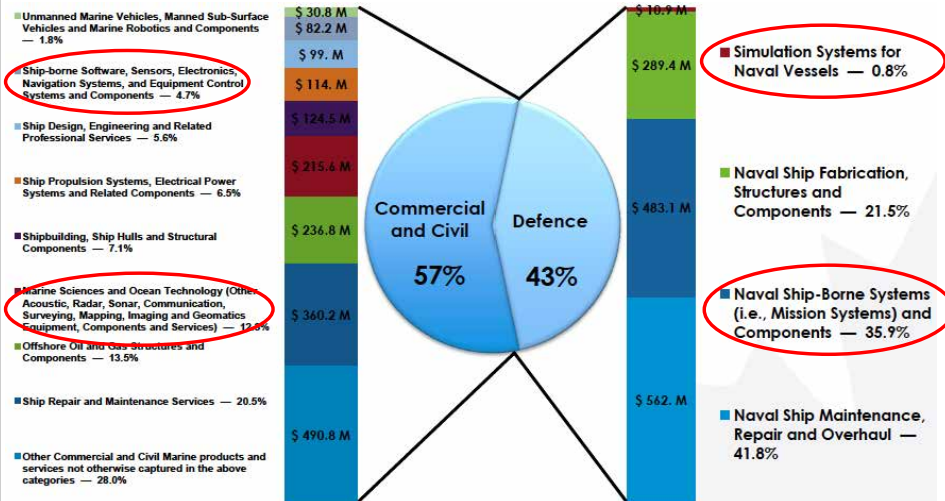
Source: Presentation - Canada's Inclusive Innovation Agenda, Nov 2016

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## Challenges

### - Small Size



Total Sales in Marine Sector (2014) = \$3.1B

Source: Overview of the Canadian Marine Industry (2014), Presentation by ISED, June 2016

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## Challenges

### - *Small Size*

- Total Sales
  - Marine (2014)      \$3.1B
  - Aerospace (2015)    \$29.8B
- Employment
  - Marine (2014)      ~~11.1M~~ 11,100
  - Aerospace (2015)   ~~89.0M~~ 89,000
- R&D
  - Marine (2014)      \$42.4M (~1.4% of Sales)
  - Aerospace (2015)    \$1.9B    (~6.4%)

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## Challenges

### - *Fragmented*

- Just two NA & ME graduate programs – both focus mainly on traditional subjects
- Limited scope to offer courses in technical areas considered important - several such subjects were identified as important at the UBC workshop:
  - Green ship technologies
  - Marine simulation
  - Advanced shipbuilding technologies
  - Ship design issues concerned with systems design and modelling
  - Arctic technology
  - Marine and cyber security
  - Automation and control

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## Challenges

### - *Fragmented*

- Except for a few exceptions expertise in non-traditional areas is lacking
- This also limits research capability:
  - Marine related research occurs in MUN and UBC and also in three or four other schools
  - However very limited collaborative marine technology research – but there are exceptions

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## Challenges

### - *Meeting industry demand*

- Will the Canada's current educational infrastructure be able to meet demand?
  - Numbers
    - Increased demand from NSS etc.
  - Technology
    - The growing importance of newer technologies

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## Possible Strategies

- Education
  - Specialist educational institutions
  - Adding new programs through alliances
- Training
  - Professional societies
    - IMarEST
    - ASME
  - Commercial academies

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## Education

### - *Specialist Educational Institutions*

- Australia will establish the Maritime Technical College
  - Will open its doors in early 2018
  - Initial investment of A\$25
  - Based in Adelaide at the Osborne Naval Shipyard
  - Designed to provide personnel to meet the needs of the Australian naval shipbuilding program
    - Steel fabrication
    - Welding
    - Naval engineering



- /continued ...

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## Education

### - Specialist Educational Institutions

- Australia will establish the Maritime Technical College
  - Part of the \$730M Next Generation Technologies Fund, an Australian government initiative to enhance Australian defence capability and innovation
  - Technology focus areas:
    - Cyber security
    - Space capabilities
    - Quantum technologies
    - Trusted autonomous systems
    - Enhanced human performance
    - Medical countermeasures
    - Multi-disciplinary material sciences
    - Integrated intelligence, surveillance and reconnaissance
    - Advanced sensors, hypersonics and directed energy capabilities

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## Education

### - Forming Alliances

- Examples in research already exist – additive manufacturing for marine applications
- Initiative led by:



- Several partners:



- Can this be a “model” for educational programs?

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## Education

### - Forming Alliances

- Universities and colleges do not typically have all the expertise necessary to provide education in many newer technologies
- Example – marine cybersecurity
- Possible alliance between universities and colleges with
  - “domain” expertise – marine technology in this example
  - Expertise in cybersecurity
    - Canadian Institute for Cybersecurity
    - Institute of Quantum Computing
    - NRC
    - Etc.

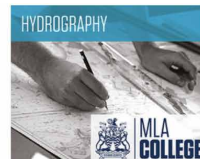


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## Training

- Professional societies offer courses, often in partnership with others
- In the marine field one of the professional societies most active in training is IMarEST
- The courses are mostly taught remotely
- Examples include:



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## Training

- Perhaps the professional society that offers the most comprehensive training programs is the American Society of Mechanical Engineers
- Types of courses:
  - Live short courses in the USA and occasionally elsewhere
  - Programs also target
    - Europe
    - Middle East
    - India
  - E-learning courses
    - Online instructor-supported courses
    - Online self-study courses
    - Online assessment based courses



International Association  
of Continuing Education &  
Training



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## Training

- Several commercial outfits provide training directed primarily at ship operations
- Example:
  - Marine Training Academy
    - Based in UK
    - Provides training in a wide range of marine subjects
    - Short courses delivered online
    - Certificate awarded
- Would there be a demand for similarly delivered technology-oriented short courses?



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## Delivery of Education/Training

- Distance learning started in the late 19<sup>th</sup> century
  - Correspondence courses
- Revolutionized with the advent of IT, the internet in particular – wide range of possibilities
  - Webinars (limited interaction between instructor and students)
  - Near-classroom environments (real-time audiovisual interaction)
  - Virtual reality
  - Etc.
- MOOCs (Massive Open Online Courses)

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## Concluding Remarks

- While Canada's performance in S&T-related activity is good, there are areas for improvement
- Canada's marine industry
  - Small
  - Fragmented
- Strategies for addressing shortcomings

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