Maritime Autonomous Surface Ships
Development Challenges on Domestic and International Fronts, informal presentation

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Purpose of Presentation

- Impacts of disruptive technology
- Disruptive technology in the marine transportation sector
- Overview of the political developments on maritime autonomous surface ships (MASS)
- Transport Canada's role regarding MASS
- Policy questions surrounding future control centres
- Moving forward with MASS

Disruptive Technology

- Defined as a process by which a product or service takes root initially in simple applications at the bottom of a market and then relentlessly moves up the market, eventually displacing established competitors
- Recent trends have shown that the introduction of disruptive technologies raise questions regarding existing legislation and regulatory guidelines
  - New business models tend to challenge the status quo

Examples

Disruptive Technology in Marine Transportation

- A MASS is defined as a ship which, to a varying degree, can operate independent of human interaction
- The degrees of autonomy are as follows (still under development):
  1. Ship with automated processes and decision support
  2. Remotely controlled ship with seafarers on board
  3. Remotely controlled ship without seafarers on board
  4. Fully autonomous ship
- MASS technological advancements are rapidly progressing
  - In November 2018 and within days of each other, Rolls-Royces & Wärtsiä undertook successful dock-to-dock navigation tests aboard ropax ferries
- Some solutions are being driven by industries that are not traditional shipping companies
  - Yara Project - Norwegian fertilizer company - The world's first autonomous, zero emission container ship

Political Developments

- MASS gaining political traction in North America
  - October 2017: Conference of the Great Lakes and St. Lawrence Governors and Premiers adopted a resolution to aim at developing the region into global centres of excellence for MASS
  - August 2018: Conference launched a Smart Ships Action Plan
    - A Smart Ships Coalition of the Great Lakes and St. Lawrence was formed
    - Michigan Tech University unveiled its Marine Autonomy Research Site and the first freshwater testbed
- International Maritime Organization initiated a regulatory scoping exercise
  - Interim guidelines for autonomous vessel trials are to be developed
  - Member states and organizations were requested to submit proposals for consideration by December 2018
- In addition, countries in the Baltic States, Finland, Japan, Norway, United Kingdom and South Korea, to name a few, are working on MASS concepts, in some cases developing domestic guidelines for operations (i.e., U. K.)
- Singapore has vested interests in shore-based control centres

Transport Canada and MASS

- Undertaking fact-finding missions to fully grasp the developments of MASS and its associated technologies (i.e., Norway, Finland)
- Participated in workshop on '*Transport maritime durable et intelligent*' with the Réseau Québec Maritime May 31, 2018
- Took part in the International Maritime Organization Correspondence Group on the MASS Regulatory Scoping Exercise
- Engaged internationally to position Canada in appropriate organizations
- Founding member of the Smart Ships Coalition of Great Lakes and St. Lawrence (USA)
- Proactively engaging stakeholders through workshops:
  - Enables stakeholders to share their understanding of related commercial, legal, and operational issues associated with MASS
  - A first workshop, limited to the Canadian federal government, was held in April 2018 (29 individuals were present)
  - A second workshop was recently held on September 12–13, 2018. 100 participates from diverse private and public sectors
  - Feedback and information gathered will serve to develop legislative and regulatory frameworks for MASS on the domestic, transborder and transoceanic fronts

Control Centres

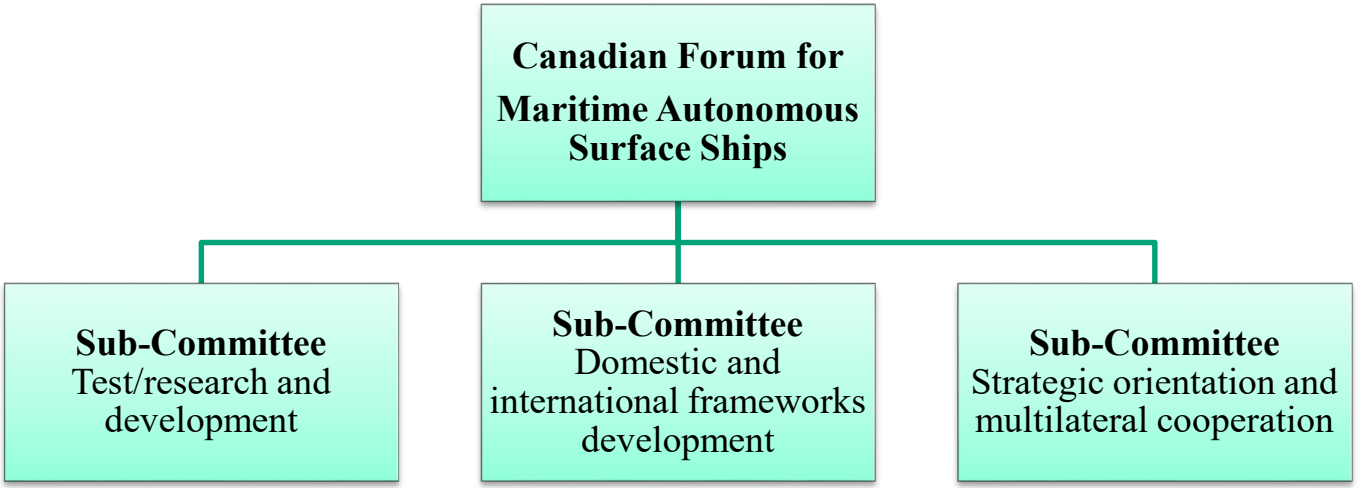
- Highly unlikely that MASS will be fully autonomous with no human interaction in the near future
- It is foreseeable that control centres will remotely operate shipping fleets in the medium to long term
- This brings to light a series of questions:
  - Where would they be located?
  - How would they be regulated?
  - What economic model would govern its operations?
  - How would they be certified and who would be responsible for certification?
  - What type of competencies would be required to remotely operate ships?
  - Would ship owners adhere to external control centres remotely operating their ships from a foreign jurisdiction?
  - How would countries react to a foreign control centre operating flag ships from other countries in its territorial waters or exclusive economic zone?
  - Should a tragic event occur, who would be legally held responsible? The flag state? The country in which is located the control centre ? The country that accepts that a ship is remotely operated in its waters?
  - From an insurance perspective, how would this work?
  - What would be the recourses for affected parties in case of disputes?

Moving Forward

- MASS developments and in particular control centres are projected to create economic opportunities and potentially generate high-quality jobs
- The Government and interested parties' role is to prepare the ground for the development, testing and full-scale deployment of MASS
- TC's MASS policy developments and future regulatory and legislative frameworks require that we
  - Continues to take into consideration private and government stakeholders needs
  - Take into consideration international developments by foreign governments and regulatory bodies
  - Ensure that all appropriate parties are working in a common fashion (see next slide)
- TC is working with both the Ocean and the Artificial Intelligence Superclusters to ensure that MASS supports, and is integrated in, future Smart Supply Chain logistics developments
- TC is working on establishing a Mirror Committee of ISO'S Technical Committee 08
- TC is supporting IMO's work related to MASS interim guidelines, which will be presented at MSC 101, and hopefully be in place for Fall 2019

Canadian Forum for Maritime Autonomous Surface Ships

- Through our engagement efforts, Canadian public and private stakeholders expressed the need for a Forum to:
  1. Foster a Canadian approach to support the MASS development and implementation
  2. Strengthen co-operation among Canadian public and private stakeholders
  3. Be a Canadian consolidated voice
  4. Collaborate and exchange with national/international counterparts fora
- Forum launched on April 11, 2019
- To support the above four pillars, the Forum is composed of three Sub-Committees that have distinct functional areas



Next Steps for Subcommittees

Test/Research and Development:

- Proceed with the selection of an interoperability framework that answers subcommittees needs
- Workshop in Quebec City in September on MASS

Domestic and International Frameworks Development:

- Analysis of MASS at the international level
- Review of scientific litterature on MASS

Strategic Orientation and Multilateral Cooperation:

- Identification of best links with Artificial Intelligence in th epurpose of developing digital chain logistics

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INTER-AGENCY COOPERATION
TO SUPPORT THE RECOMMENDED APPROACH FOR CANADA AND MASS

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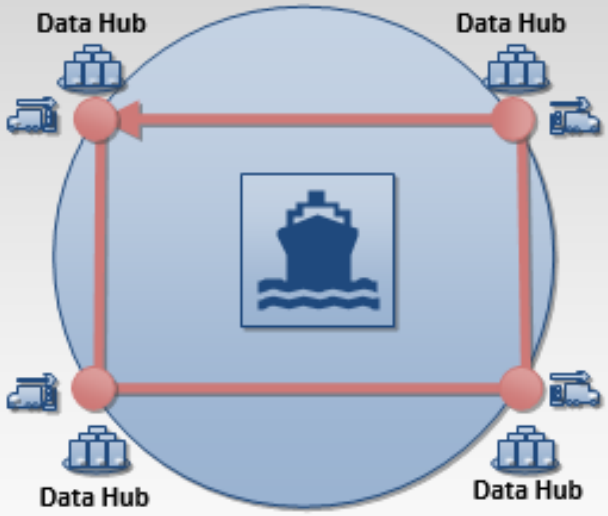
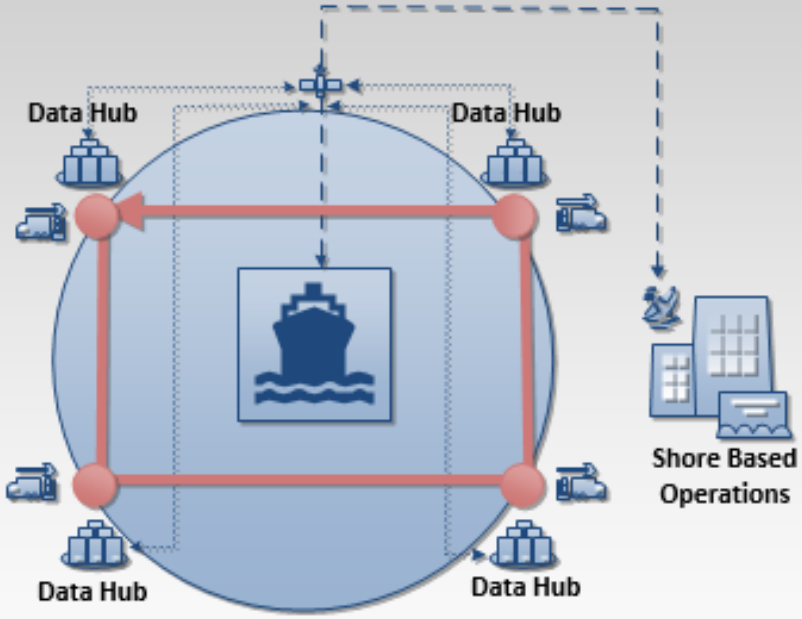
MASS & GLOBAL SUPPLY CHAIN: DATA CONVERGENCE

Traditional Approach



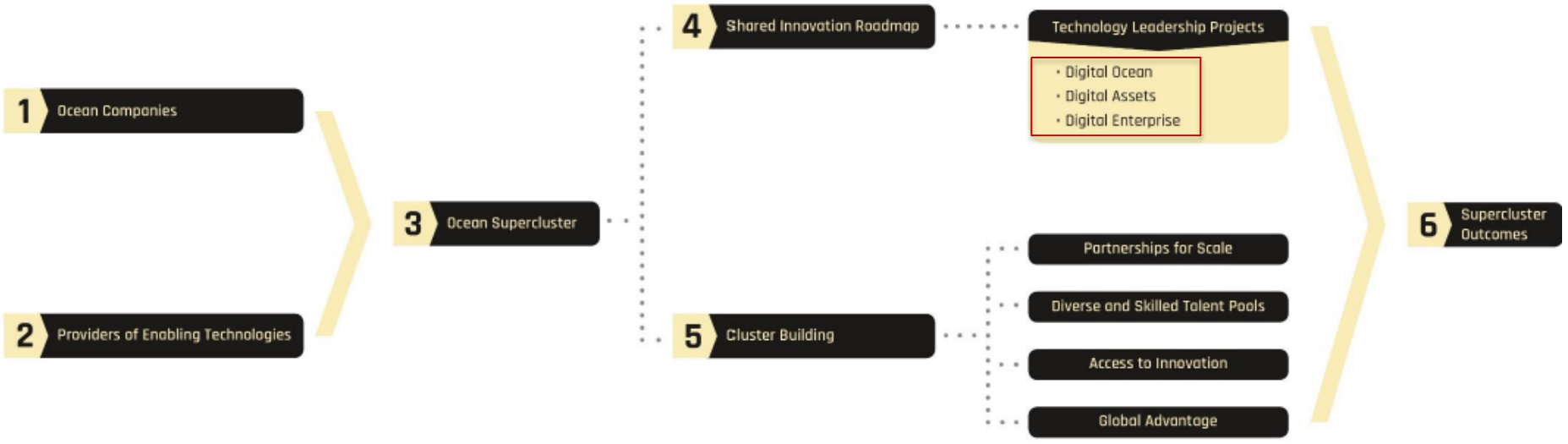
- Raw materials/physical products are modally transferred at ports towards final destination
- Ports act as data hubs containing a wealth of information that is currently underutilized

Shore Based Control Centers Supported by AI



- Enhances traditional approach by enabling the convergence of all supply chain data hubs in a single window, thus providing AI with minable information for logistics optimization

Leveraging SCALE AI &Ocean Super Cluster for MASS



1. Ocean Companies*

- Sea farming
- Wild fishery
- Offshore oil and gas
- Marine renewables
- Defence
- Shipping
- Marine bioproducts

2. Providers of Enabling Technologies*

Suppliers, SMEs, researchers, and others who develop/provide:

- Sensors and imaging
- Subsea communications
- Big data and analytics
- Biotechnology and genomics
- Autonomous systems
- Robotics
- Remote systems
- Satellite technology
- Ocean science

3. Ocean Supercluster

Vision: Build Canada's ocean economy into one of the most significant, sustainable, and value-creating segments of the national economy.

Mission: Build an innovation-driven ecosystem in which companies are well-connected across different ocean related value chains, and to suppliers of enabling technologies.

4. Shared Innovation Roadmap

Objectives for innovation include but are not limited to:

- Ocean resource protection and monitoring
- Safe and cost-effective remote operations
- Enhanced operational performance
- Advanced digital operations
- Efficient data transmission

5. Cluster Building

- Open call innovation projects
- Talent attraction and development
- International networks and cluster linkages
- Branding and promotion
- Cluster events and technology forums
- Supplier development
- Technology brokerage
- Incubation, acceleration, and mentorship

6. Supercluster Outcomes

- Deploy innovative technology platforms across ocean sectors
- Strengthen links between ocean value chains and technology providers
- Fill capability gaps in the innovations ecosystem
- Extend global reach and market opportunities
- Address global challenges related to sustainability, reducing carbon footprint, and improving energy efficiency