Approaching Autonomous Shipping: Cyber Security Considerations in Maritime Operations

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Research Question

- What, if any, are the critical issues that would prevent the integration of autonomous shipping in Atlantic Canada seaports?

  - Critical issues being defined in terms of acts, decisions, or conditions that would prevent the adoption of autonomous shipping.
  - Autonomous shipping is looked at in terms of all four degrees of autonomous shipping currently considered by the International Maritime Organization (IMO).
  - Atlantic Canada seaports as identified through the delegation mechanisms associated with the “Canada Marine Act.”

This presentation…

- Broken into three sections:
  - The context.
  - The findings.
  - The recommendations.
- Each section has a small breakout after for discussion purposes.
- This presentation is intended to promote discussion. The topic here is broad enough that one work will not cover it all.

The Context

Section 1

Our Desired Outcome

- Understanding that the purpose of transportation is the movement of persons or goods from their point of departure to their intended destination so that they arrive on time, in acceptable condition, and for a reasonable cost.

- *Spoiler alert: the above turns out to be one of the key aspects missing in this exercise.*

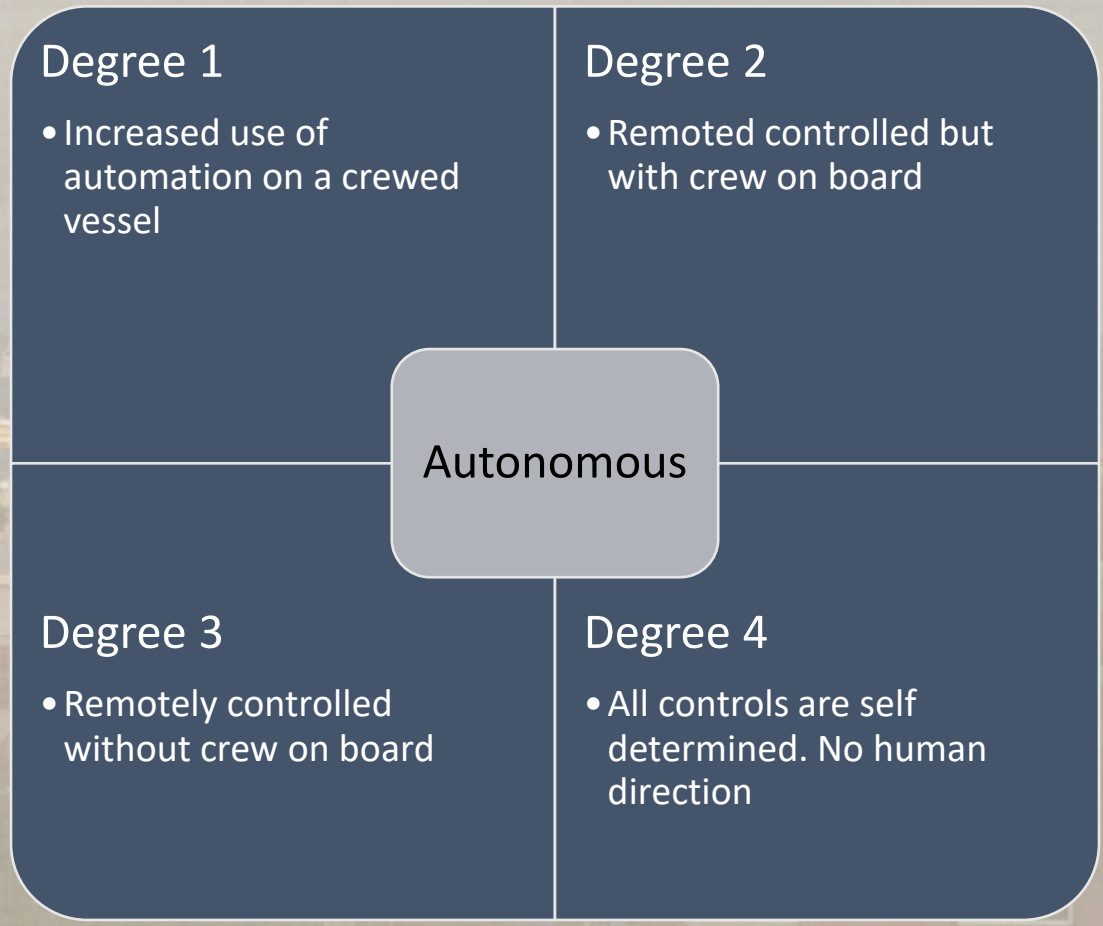
- Safety is tied to the statement “acceptable condition” and can be further divided into the safety of the activity and public safety.

Readiness Defined

- Three major areas need to be satisfied in order to declare “ready”:
  - Technological – can the systems used on shore and at sea communicate and achieve a trusted state?
  - Organizational – can the entities attempting to use this technology integrate its use into their business activities?
  - Environmental – can this technology meet the requirements and constraints associated with current operations in the broader shipping and maritime operations context?

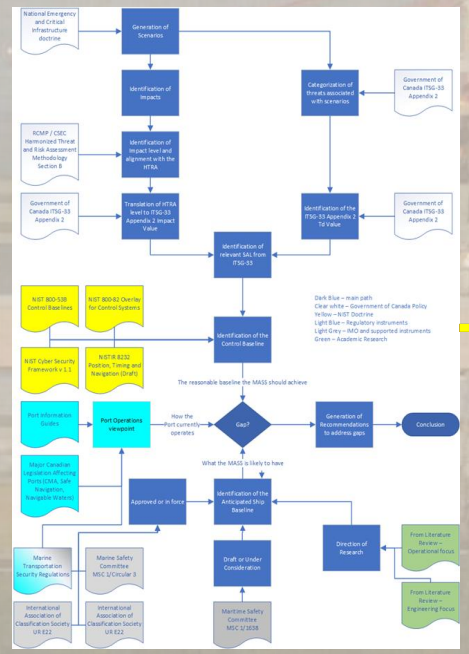
Autonomous Shipping Defined

- Based on IMO MSC.1 / Circular 1638 “Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships.”
- Four distinct categories of “autonomous.”



An Overview of the Effort

Analysis → Outcomes → Readiness → Recommendations



Environment (How ports / ships interact)
- Significant operational gaps
- Significant technical gaps
- Marginal attention or communications
- Effort to resolve limited

Organizational (Focus of Effort)
- Some challenges in terms of training
- Technical gaps being addressed
- Good attention in some areas, others lack
- Efforts are sporadic and inconsistent

Technology (Comparison of Regimes)
- Common approaches to the technology
- Gaps being addressed
- Significant attention on technical issues
- Efforts are focused and supported

Technological
- Cyber security focus

Organizational
- Procedures
- Training

Environmental
- How these will interact with traditional ships and ports.

Readiness

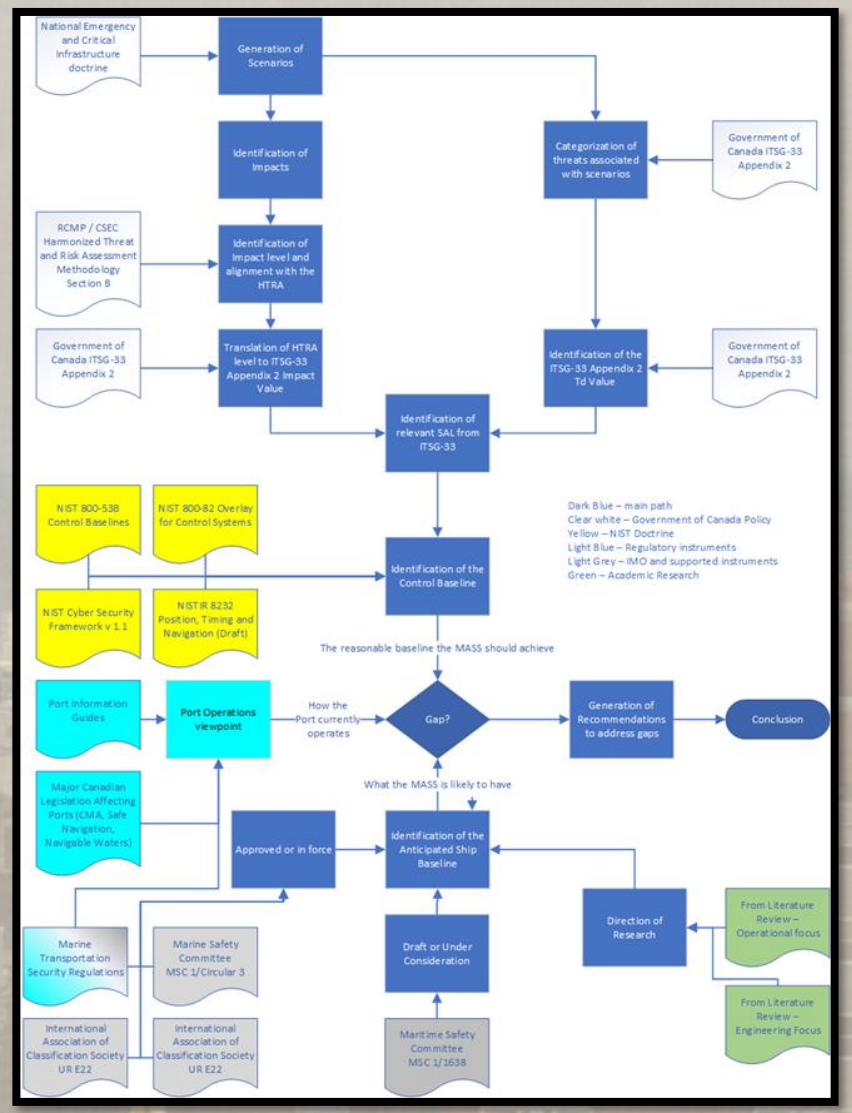
1 Think System
- Ship-to-ship and port-to-ship interaction need to be factored in

2 Phased Approach
- Gradual change to allow for due diligence on all fronts

3 Adjustments
- Across legislation, regulations, conventions, and training

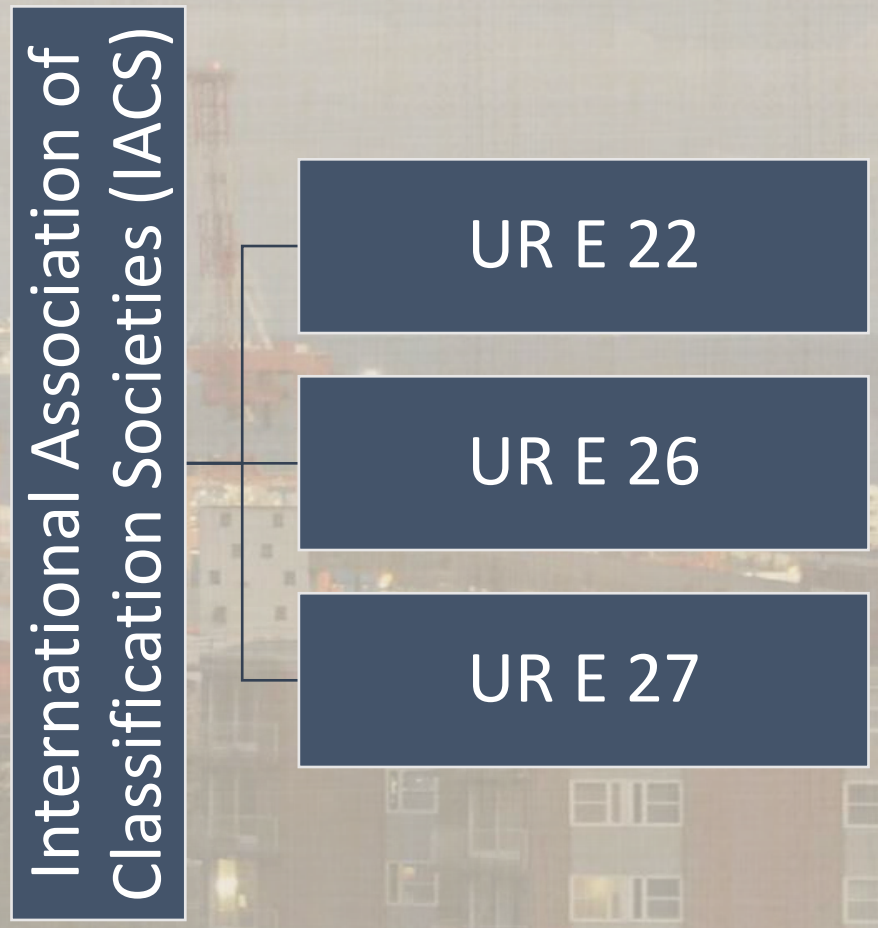
Overview of the Analysis

- Are the technologies being used currently relatable to those proposed and is the effort being made to close the gaps?
- Given the adoption of the technology, what are the organizational impacts in terms of support, training, etc.?
- Given organizations adopting this technology, can it be integrated into current maritime operations? If not, what is the magnitude of the change?



The current context for ships…

- A significant change coming through the classification societies for new build contracts beginning 01 January 2024.
  - Unified requirements (UR) span all classification societies with respect to a certain class of ships (cargo, passenger, etc.).
  - Currently ships only need to adhere to IACS UR E 22 “On Board Use and Application of Computer Based Systems.”
  - IACS UR E 26 Unified Requirements on the Cyber Resilience of Ships.
  - IACS UR E 27 Cyber Resilience of On Board Systems and Equipment

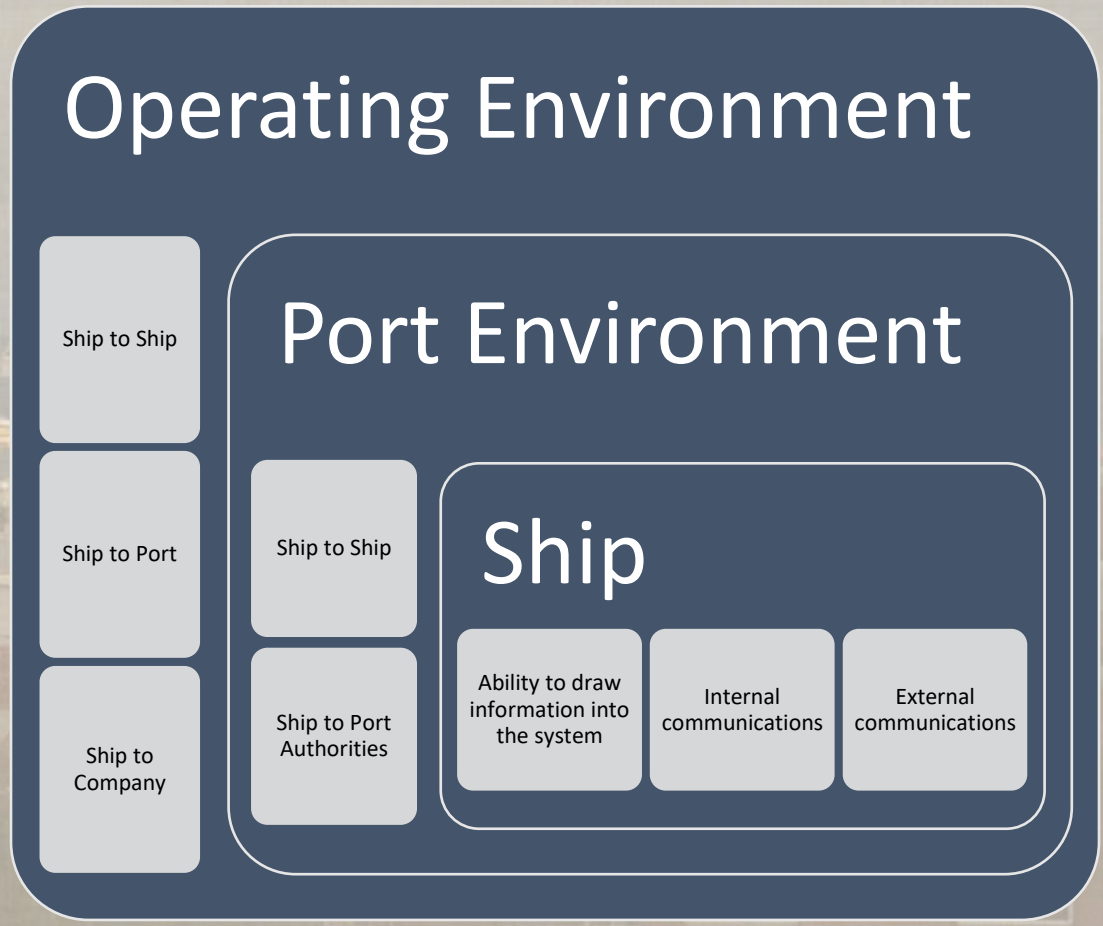


The Findings

Section 2

Finding 1A: Technological

- The approaches used by IACS and other bodies relate directly to the NIST Cyber Security Framework.
- There is a challenge, however, in that ships will have formally accredited regimes that are only allowed to connect with trusted systems, whereas ports and other external systems are declared “untrusted” by default.



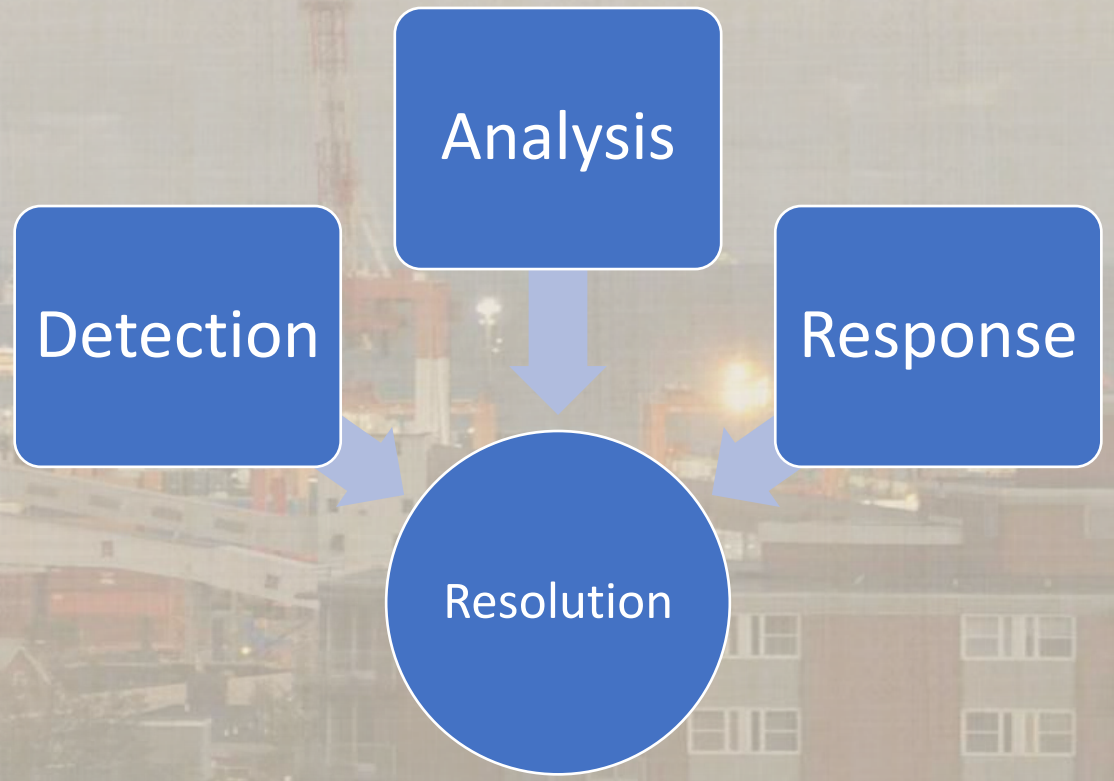
Finding 2A: Tailoring

- While the Cyber Security Framework (CSF) targets (all 108) can be met, challenges arise when moving from the NST CSF to the Control Baselines (NIST SP 800-53B).
- Certain systems must remain accessible to all.
- Certain systems cannot simply be shut down. If this is needed, a redundancy constraint is created.

Finding 3A: Organizational Challenges

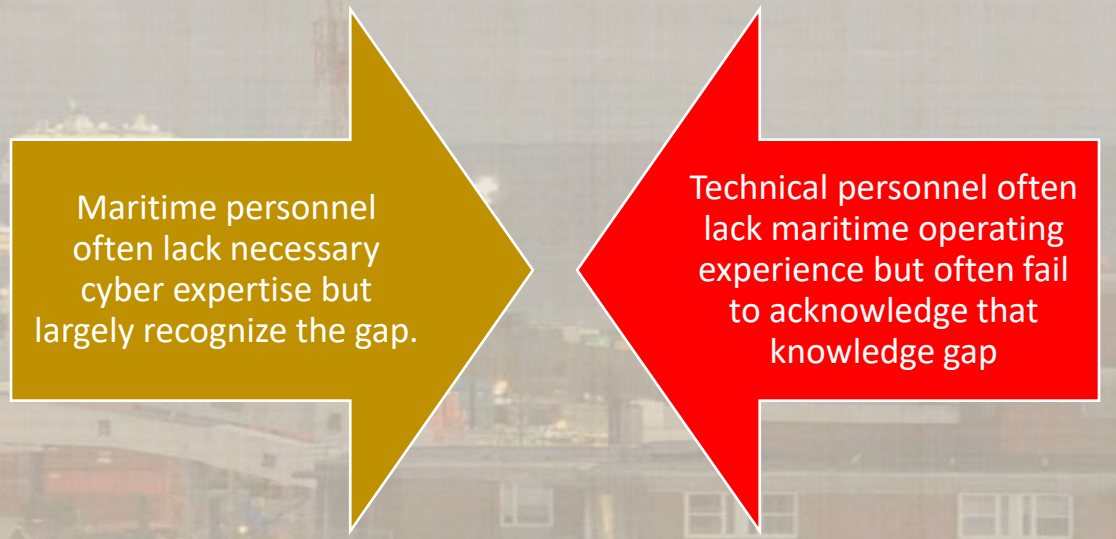
- Degrees 1, 2, and 3 ships will force changes to Standards for Training, Certification, and Watchkeeping (STCW) that map both to maritime safety protocols at the AT-family of controls.

- Applies across all degrees of automation.



Finding 3B: Certification Criteria

- Applies at three levels:
  - The criteria to be met by ships.
  - Is there a need for a port certification to handle these kinds of ships?
  - Personnel requirements for training, working on systems, and responding to events.



Finding 4A: Environmental Gap

- While the research has looked at ships, some port technology, and companies, it has very limited depth when considering the current traffic normally found in ports.
- These include how would automation interact with fishing, pleasure, recreational and other craft found in the port environment.

Finding 5: Governance

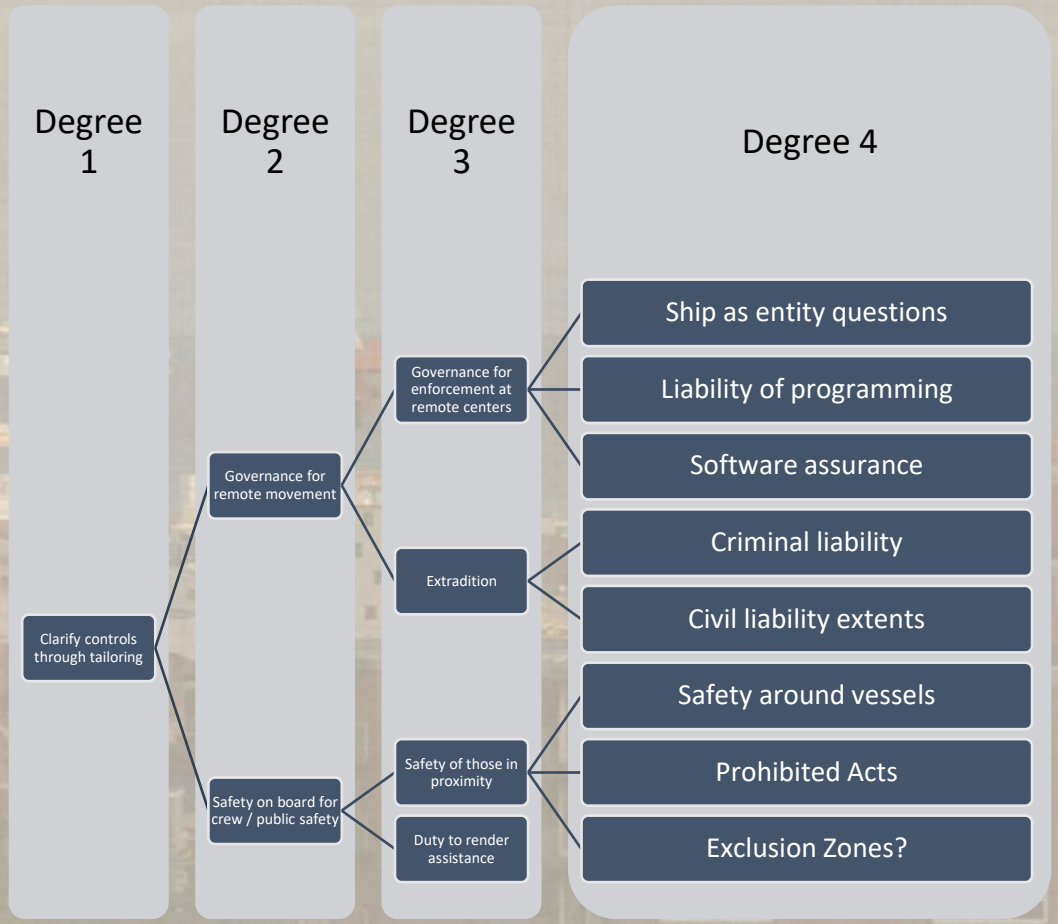
- Several legislative changes are needed to adapt to this kind of technology.
- Current debates need to be realigned with the United Nations Convention on the Law of the Sea.
- Adjustments are needed to public safety and enforcement frameworks, particularly where unlawful decisions are made extraterritorially.

Recommendations

Section 3

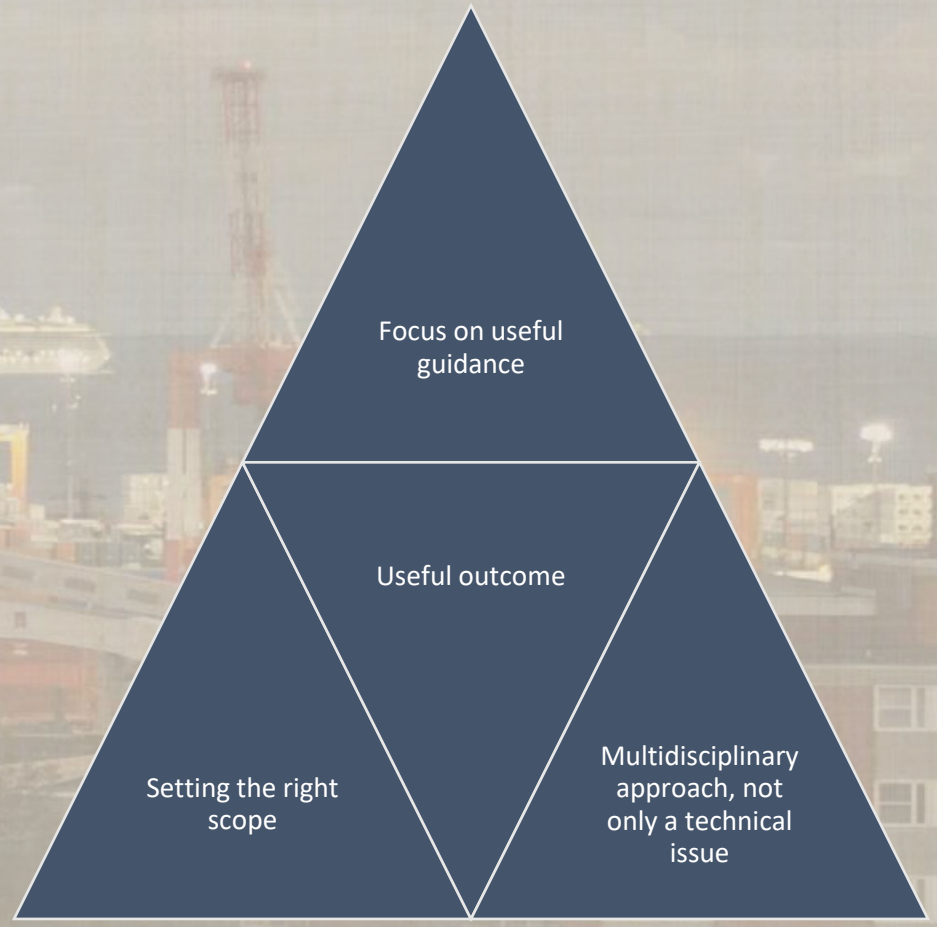
R1: Phased Approach

- Based on the degrees of shipping:
  - Degree 1: no significant issues.
  - Degree 2: governance and remote pilotage standards.
  - Degree 3: more significant work to be done across all domains.
  - Degree 4: critical work prior to entry of the first ship.
- Allows for the adoption of the technology but in a controlled manner.



Activities

- Some of the proposed activities:
  - Adoption of a minimum baseline level as per the guidance in NIST SP 800-53B.
  - Adoption of minimum assurance levels tied to public safety considerations.
  - Tailoring of certain controls to maintain safety concerns. This might include requirements for redundancy where shutting down is recommended in one regime but forbidden in another.
- These are working group level activities, likely at the Canadian Marine Advisory Council (CMAC) level coordinated by Transport Canada.



R2: The Program or Context Layer

- When considering the phased approach, include the full suite of levels of the system:
  - System level: tied to the multimodal supply chain.
  - Local Environment level: tied to all known activities in the space.
  - Then move into the interaction between the port, ship, and company in isolation after appropriate constraints are identified.
- Intended to preserve public and local safety conditions.
- Aligns with NIST guidance in NISTIR 8179 for Criticality Analysis.

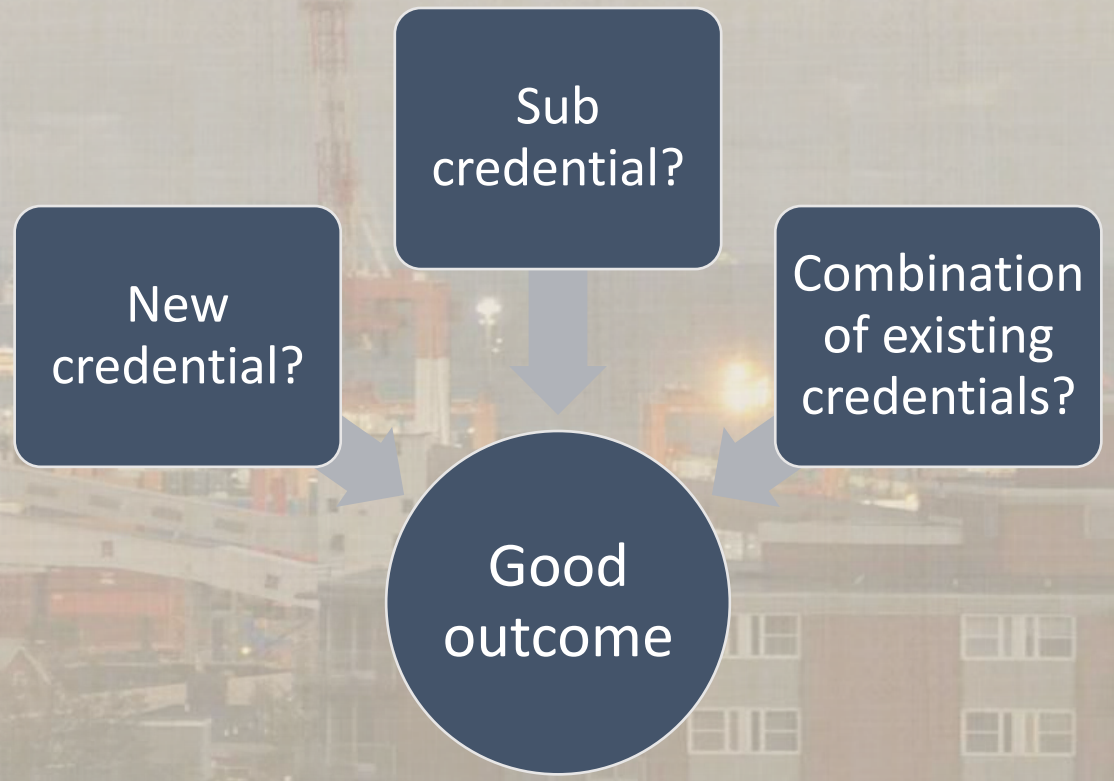
Proposed Activity

- Establishment of a technically led (system engineering) and focused group to bring together regulators, public safety, business, and technical groups to do a comprehensive development of stakeholder needs and requirements.

- The Key System is the supply chain infrastructure supported by Port / Ship operations.

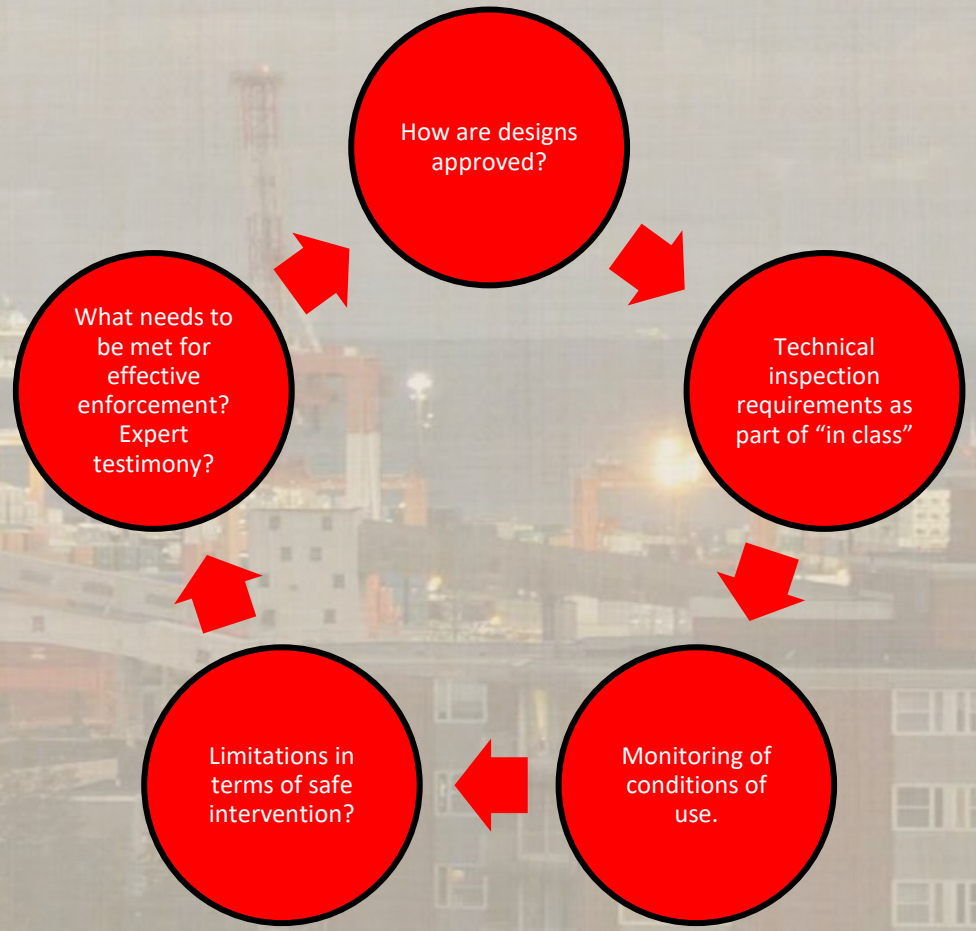
R3: Tailoring and Credentialling

- Need to ensure that the guidance associated with Maritime Safety (under the IMO Maritime Safety Committee regimes) and the NIST regimes are aligned or at least don't conflict.
- Need to ensure that those practicing within the field are capable and competent in both domains.



Activities

- This will largely be driven by the government and supported by operators.
  - Symbols for AIS and LRIT that clearly identify remote or autonomous (D2-D4) shipping.
  - Representation should review the Duties of the Flag State and Coastal State to ensure consistency or at least equivalency.
- Technical guidance will be needed in terms of how to verify and validate the systems in design, implementation, and operation.



Final or Open Discussion