Smart Shipping and the Human Machine Interface

3D Interactive, Immersive Environments for Reconfigurable Control Centers

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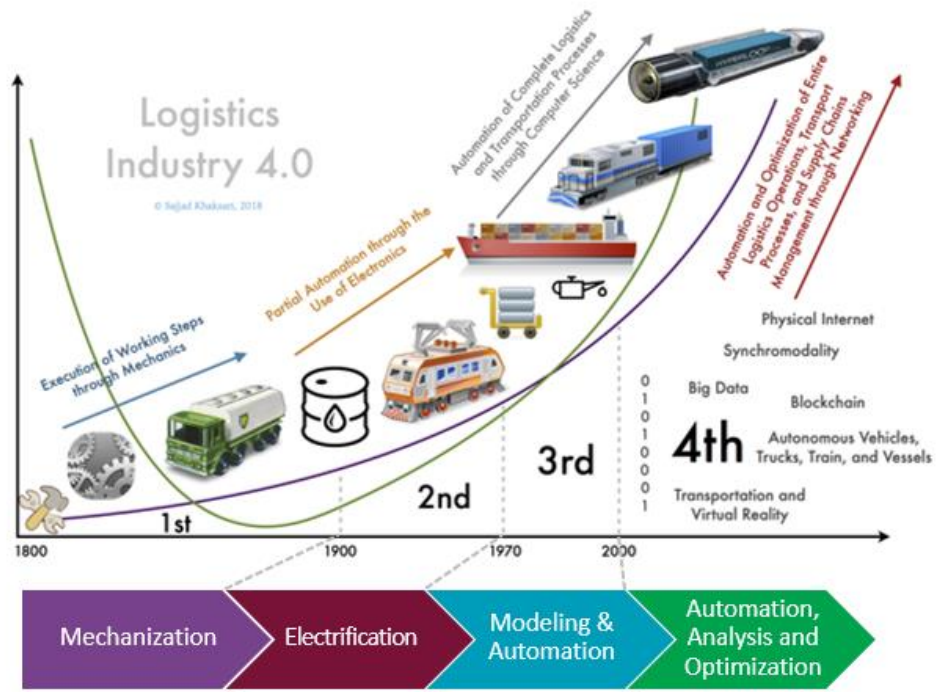
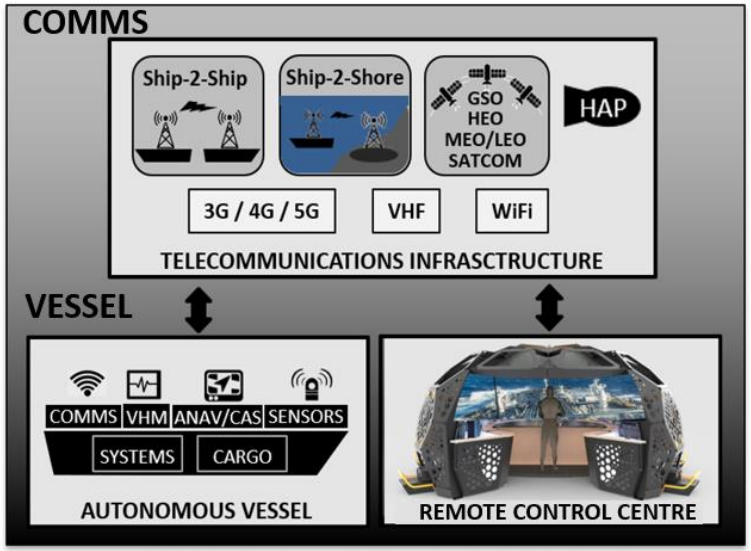
Pegasus
RESEARCH & TECHNOLOGIES

The 4th Industrial Revolution ⇨ Logistics Industry 4.0



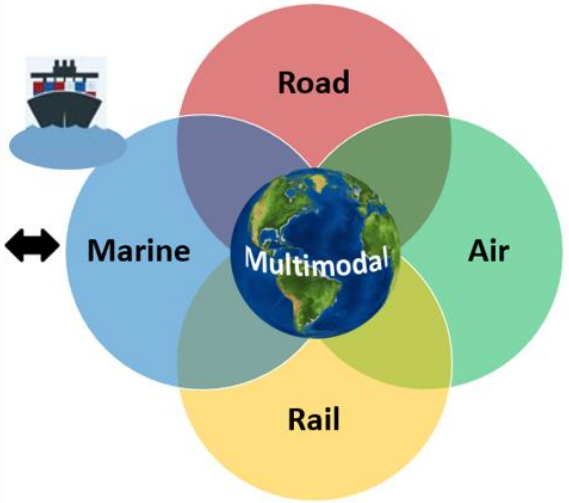
Global Transport & the Smart Shipping Ecosystem



RCC is an extension of Vessel Bridge

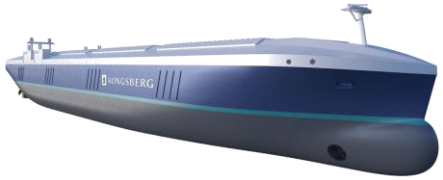
LAND-BASED INFRASTRUCTURE

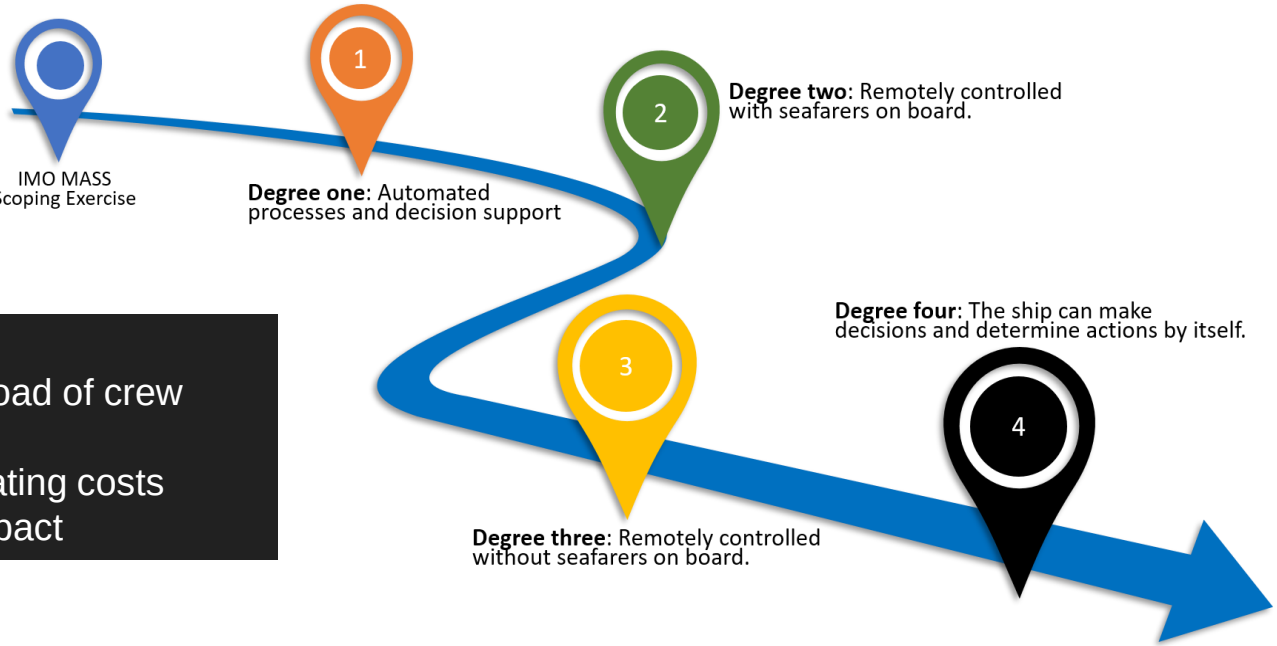
Vessel Traffic Services



The Path Toward Increasing Levels of Autonomy

Maritime Autonomous Surface Ships (MASS)



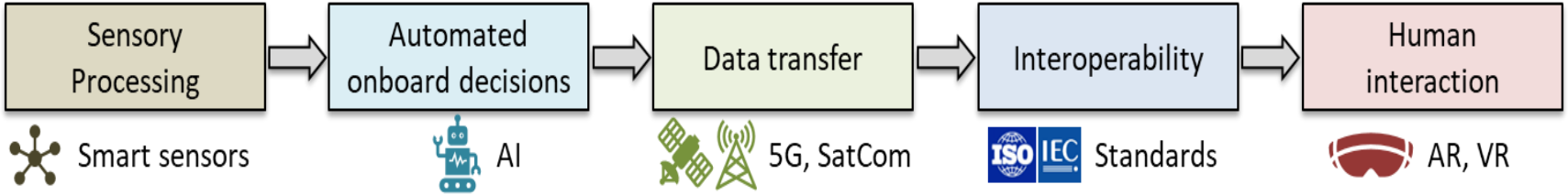


BENEFITS of MASS

- Reduced fatigue and workload of crew
- Improved safety
- Potential for reducing operating costs
- Reduced environmental impact

See, e.g., International Maritime Organisation (IMO) Strategic Plan (2018-2023)
"Integrate new and advancing technologies in the regulatory framework"

Enabling Technologies for Smart Shipping



Smart Sensors

LiDAR, Camera Arrays,
RFID, GPS
Synthetic Aperture Radar

Shared Data Services

Canada Ice Services, CHS, CSA
S-100 Maritime Data
Sea Traffic Management Services

Ai

Decision Aids, Automation
Intelligent Adaptive Interfaces
Object/Pattern Recognition

STD

IALA/IMO E-Navigation
ISO TC8 MASS
Canadian ITS Architecture,
US ARC-IT,

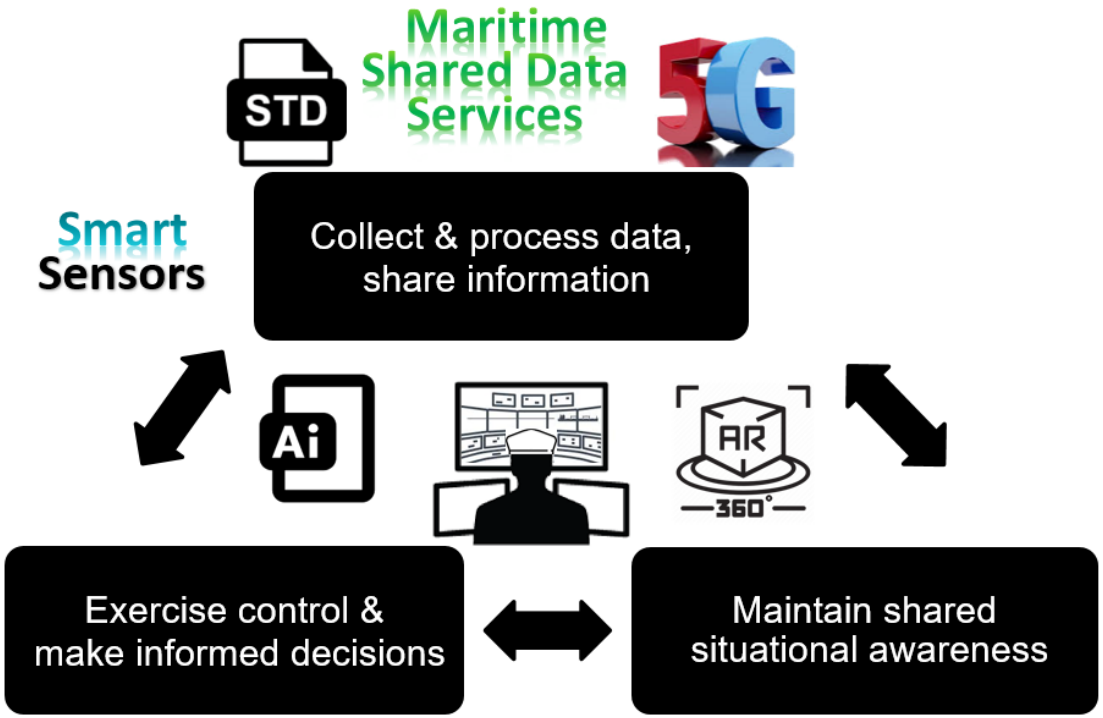
5G

LEO Satellites
Shore Antenna Arrays
Ship-to-Ship
Ship-to-Shore

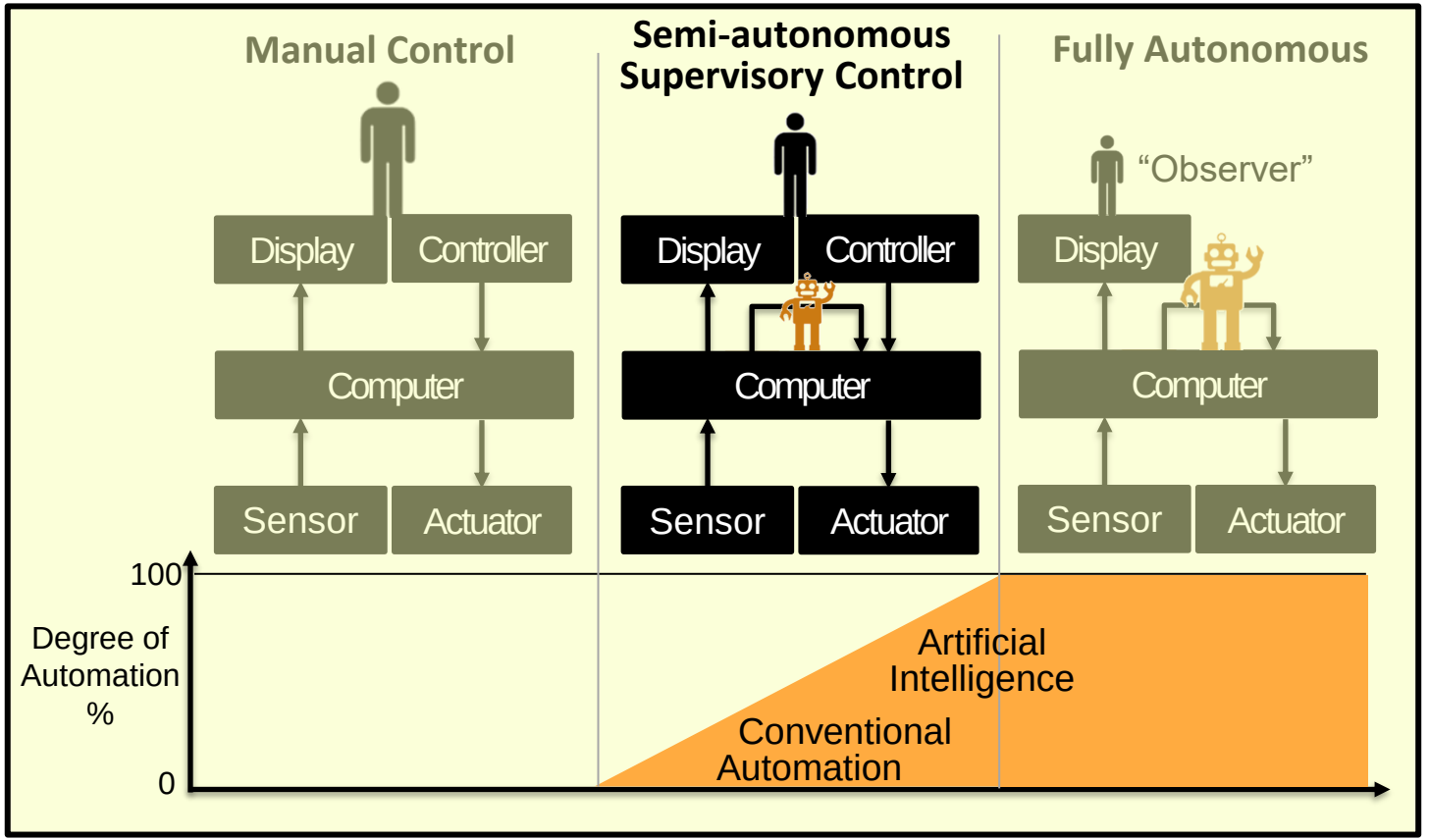
AR
360°

VR Headsets, Walls
Domes, Immersion, 3D
Enhanced User Interactions

Emerging Technologies for Smart Shipping

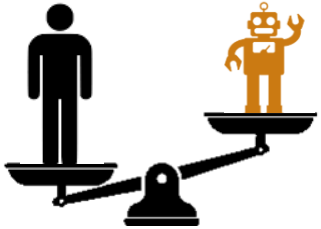


Human-Autonomy Teaming: Semi-Autonomous Operations



Judicious use of AI in Safety-Critical Systems

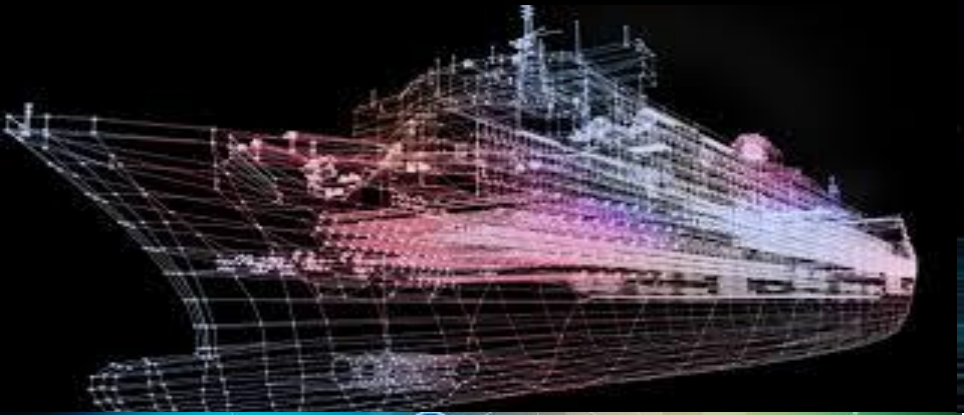
- **Automated information flows**
- **Object detection, classification**
- **Enhanced situational awareness**
- **Automated decision-making**

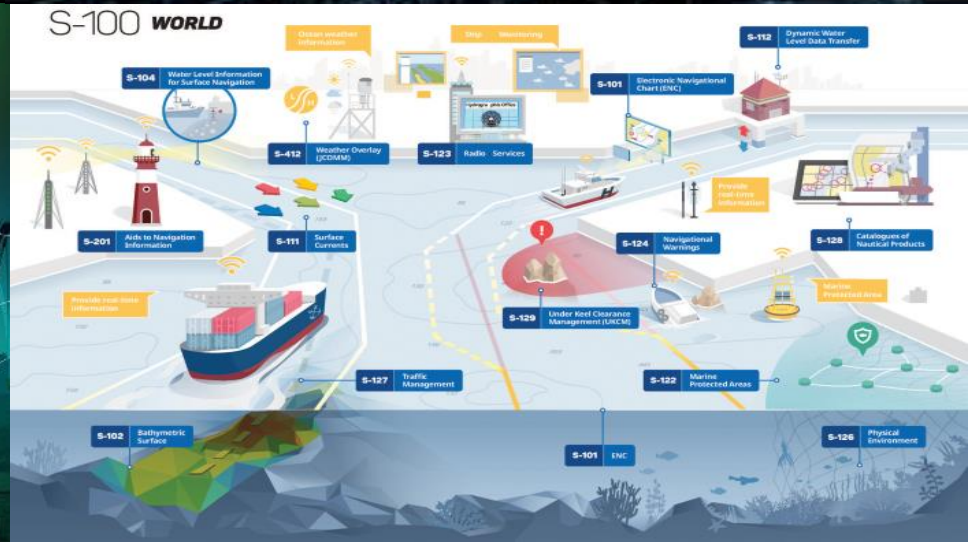


Today: *Humans are better than machines for most complex decision-making tasks.*

Short/Medium term: *Humans will remain primary decision-makers*

Digital Twins of Vessels, Infrastructure and Waterways

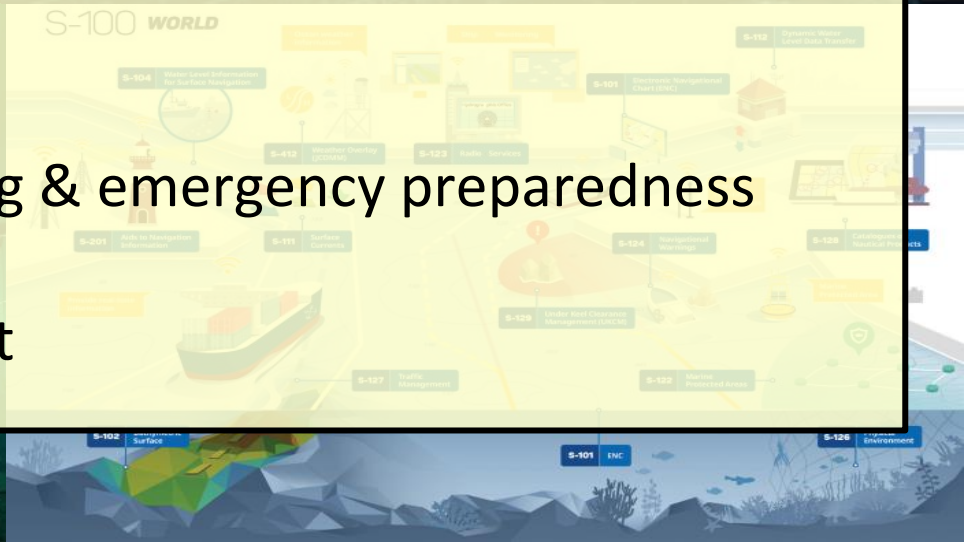




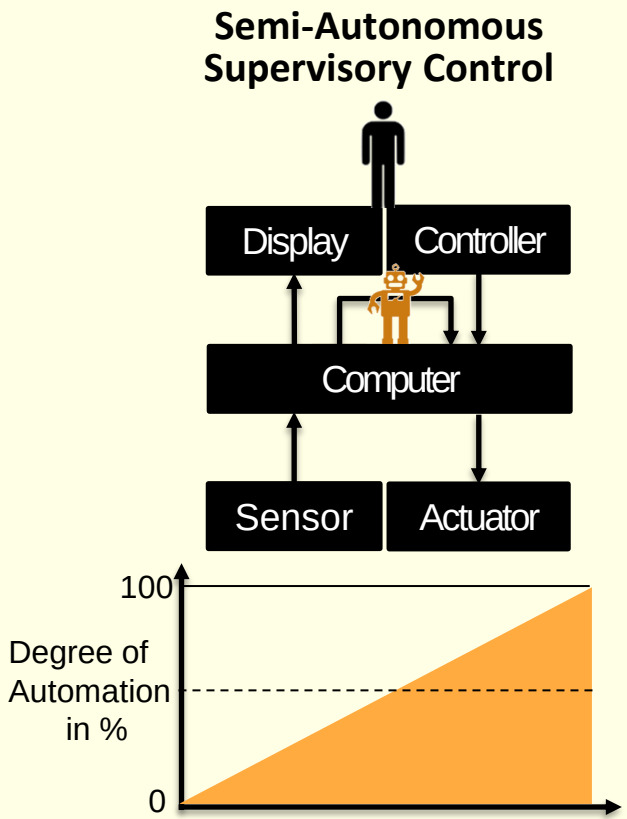
Digital Twins of Vessels, Infrastructure and Waterways

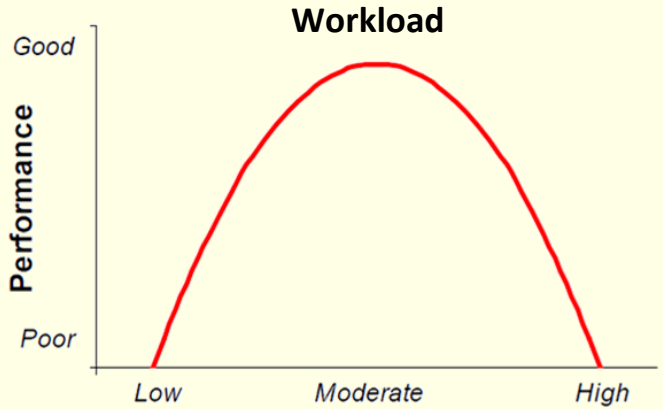
ASSIST OPERATORS AND STAFF TO PERFORM TASKS

- Plan Operations
- Monitor Operations
- Inspection
- Maintenance & Repair
- Evidence-based training & emergency preparedness
- Search and Rescue
- Life-Cycle Management



Optimizing Human Performance for Decision-Making



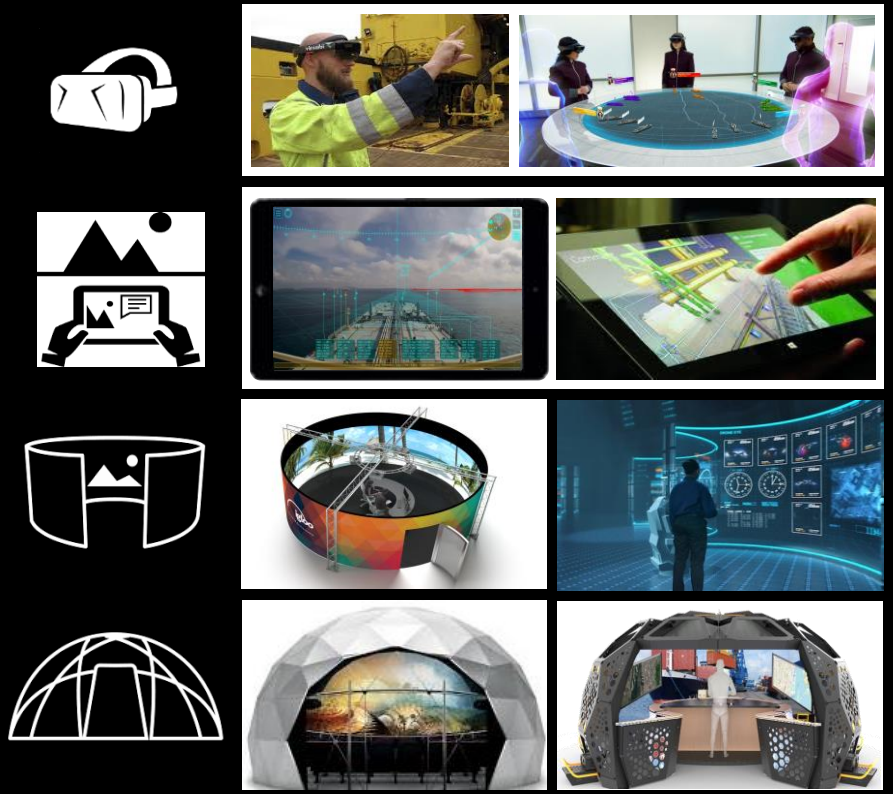


AI can contribute to maintaining optimal performance :

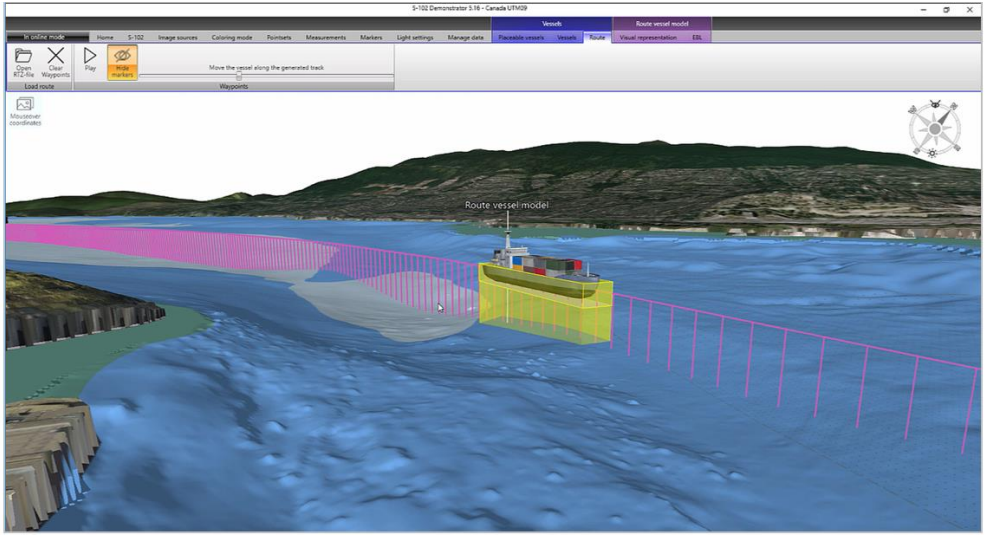
1. **E.g. by dynamically adapting the operators' displays and controls to the operational context while avoiding information overload, and**

2. **E.g. by using digital twins to extract and highlight relevant information in a 3D immersive, interactive environment to better inform decision-making.**

3D Interactive, Immersive Virtual Environments



Digital Twin Example: Under Keel Clearance



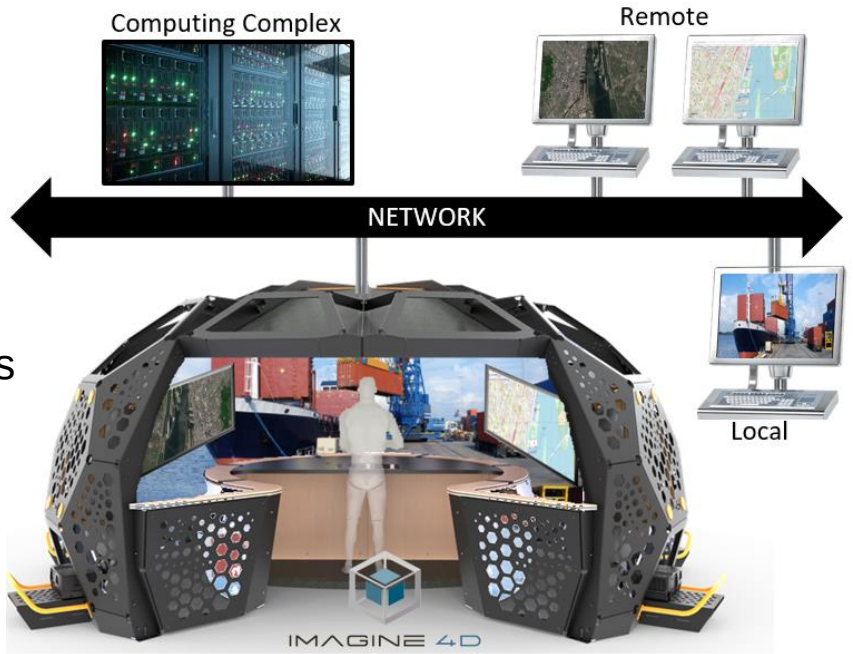
Source: [S-102 Bathymetry Data as a Service Pilot Project]

3D Immersive Environments for Safety-Critical Systems

3D Immersive Accuracy & Realism: Certain tasks (e.g. navigation in confined waters) require accurate depth-perception cues for safe operations.

Interactive Immersion: More than just viewing digital twins, users need to actively seek information (e.g. drill-down), train, and exercise control.

Virtualization: Integration of operational systems that can be displayed using interactive virtual monitors. This can facilitate collaboration across local and remote sites where system displays can be replicated via streaming.

Reconfigurability: Virtualization is an enabler for reconfigurability. Reconfigurable control centers can support activities like concept development and experimentation, equipment repurposing, and training.

Reconfigurable Control Center Example