Autonomy - The evolution of maritime technology

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Introduction

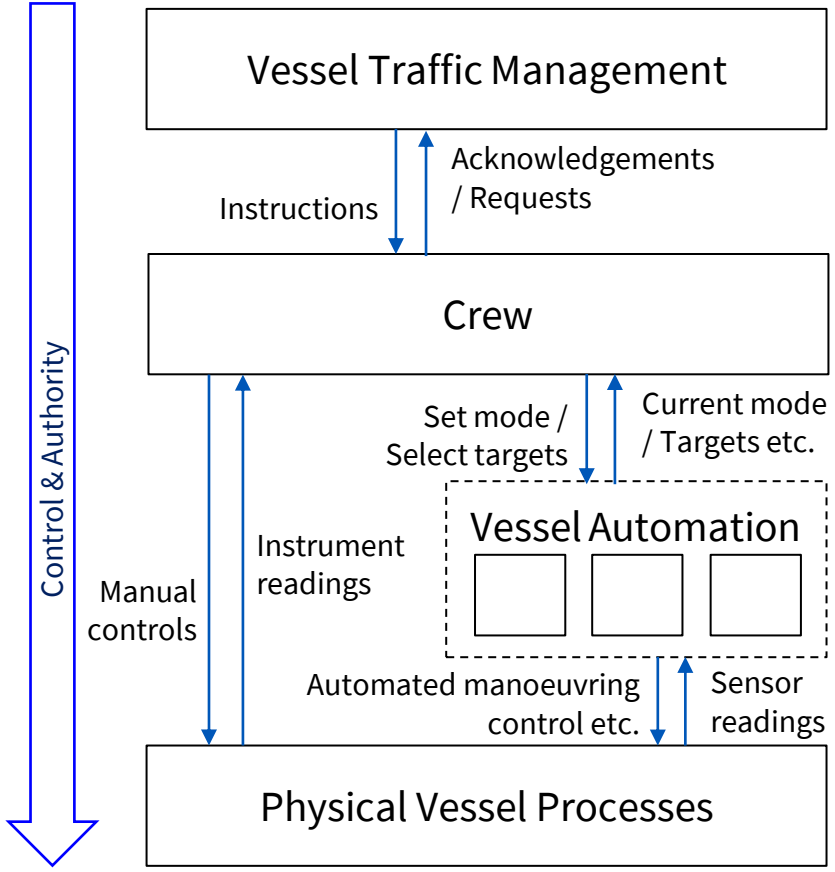
REGULATORY GOALS

- Safe, sustainable and secure shipping systems

ACTIONS

- Managing the risks, when they cannot be eliminated
- Finding equivalence and establishing what is “safe”
- The benefits of collaboration and not competition

New and emerging technology enabling autonomy



Hierarchical control structure for ship systems; adapted from STPA handbook by Nancy G. Leveson and John P. Thomas of MIT *

Example - Regulation of Maritime Autonomous Surface Ship (MASS)

The IMO regulatory scoping exercise defines MASS as a ship which, to a varying degree, can operate independently of human interaction. Autonomy levels were proposed to help assess the applicability of existing regulations. Consideration of amended regulations will follow as a second stage.

Manual operations | Decision support | Remote decision support | Active Human in the loop | Autonomous, rarely supervised | Autonomous, unsupervised

Interim Guidelines for MASS Trials published by the IMO* indicates the goal:

“at least the same degree of safety, security and protection of the environment as provided by the relevant instruments” (EQUIVALENCE).

It adds that: “The risks associated with the trials should be appropriately identified and measures to reduce the risks to as low as reasonably practicable and acceptable should be put in place” (RISK REDUCTION ALARP).

Other requirements are described including the treatment of the human element and manning.

Managing risk – the application of best practice

Depending upon the size and type of autonomous ship, Good Practice may include but is not limited to:

Classification Rules and Procedures

- LR ShipRight Procedure for assignment of digital descriptive notes for autonomous and remote access ships, March 2019
- Unmanned Suface Vehicle (USV) - LR Code for Unmanned Marine Systems, February 2017
- LR Procedure for the Assessment of Cyber Security for New Ships and Ships Systems, October 2020
- LR Best Practice Guide for Equipment Manufacturers; The Human-Centred Approach, April 2014
- LR Guide to resources; Human-Centred approach to ship and equipment design, August 2014
- LR ShipRight Procedure for Human-Centred Design, November 2020

International Standards

- ISO 23860 Ships and marine technology — Terminology related to automation of Maritime Autonomous Surface Ships (*when completed*)

Industry guidance

- Maritime Autonomous Surface Ships (MASS) UK Industry Conduct Principles and Code of Practice, Version 4, November 2020

Remembering seafarers and integrating sustainably

MSC.1/Circ.1604 states that “For the safe, secure and environmentally sound conduct of MASS trials, the human element should be appropriately addressed.”

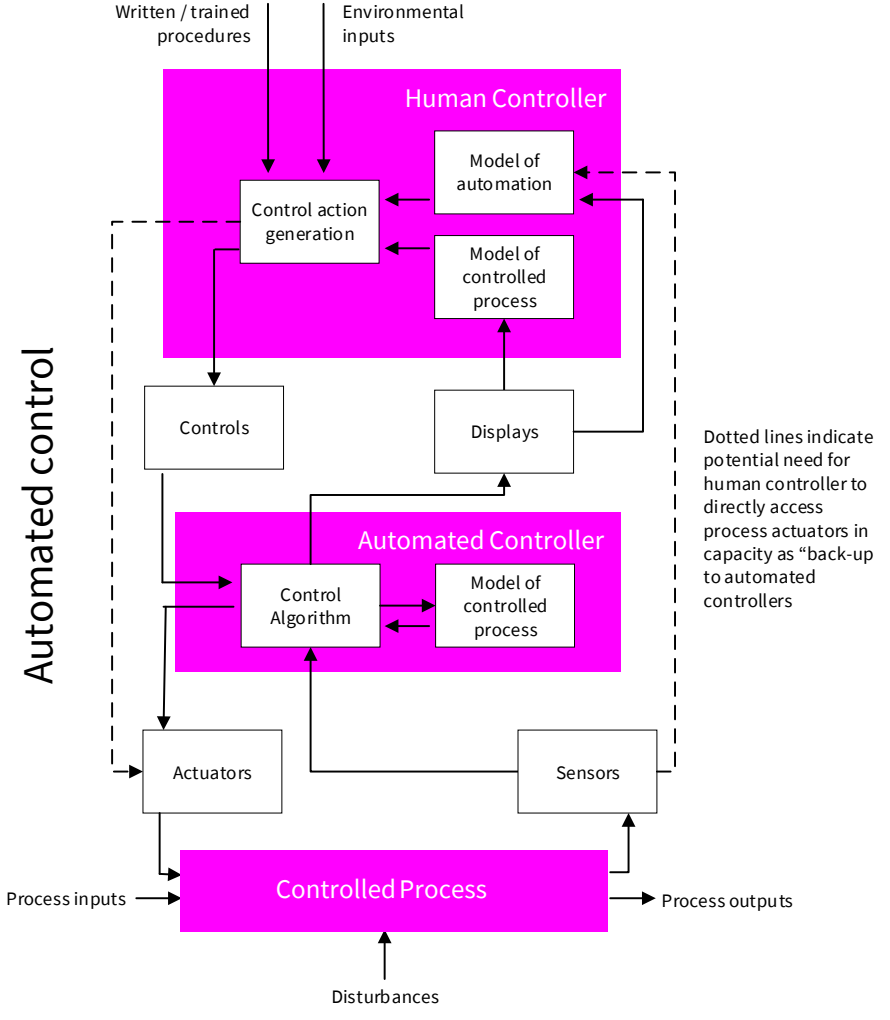
Lifecycle considerations include:

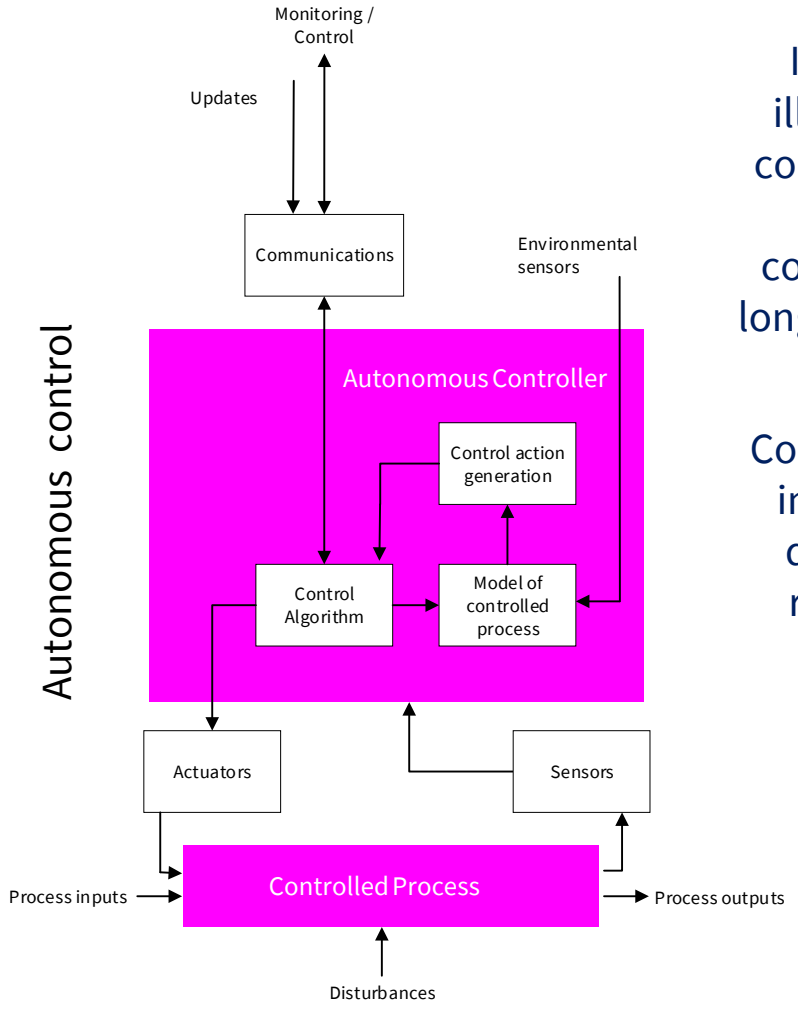
- Is the role of people in the system feasible and safe?
- Are the human-machine interfaces usable?
- Will the required level of human performance be sustainable?
- Can the autonomous system communicate ‘intent’?
- How to adress the management of normal, degraded and emergency situations

What is a “proper look-out”?

Follow that thought to:
MSC/Circular.566

Removing human interventions affects dependability





In the second illustration, the controls, displays and human controller are no longer onboard the ship

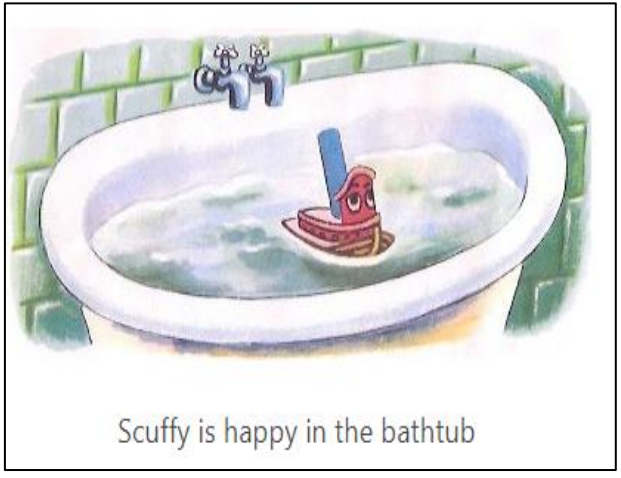
Consider how this impacts on the dependability requirements

Manage the risk, where it cannot be eliminated

Understand the Context of Use to Find Equivalence

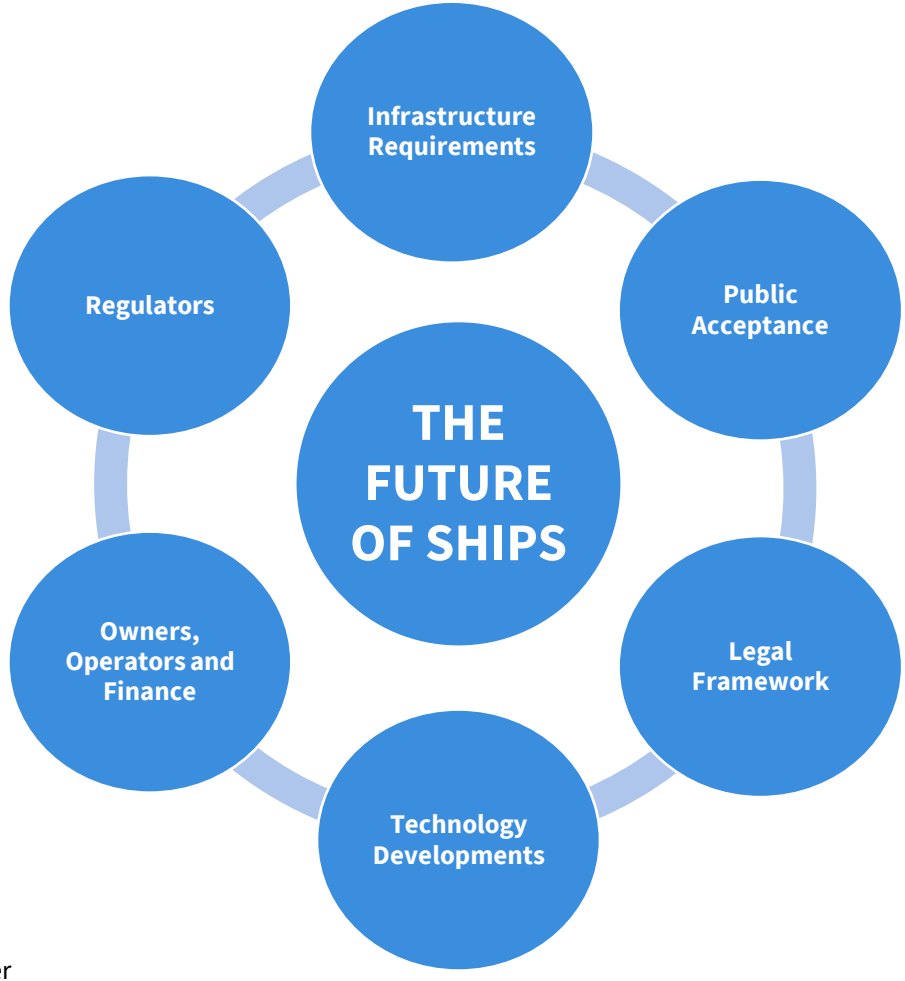
Finding equivalence and establishing what is 'safe' must often be done before standardised solutions exist

iXblue USV


Scuffy is happy in the bathtub

A System Operational Concept document details the design intent and operational modes for complex systems which contain multiple sub-systems and significant items of equipment. It provides context for the design solution

The need for Collaboration and not Competition



In order to develop robust safety assurance regimes, we need to be collaborative, transparent and engaged

Thank you