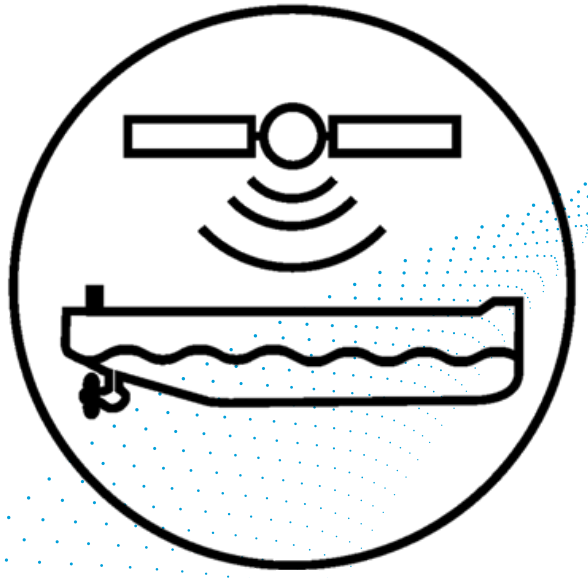
WHEN TRUST MATTERS



Lessons learned regarding
Autonomous & Remotely Operated Ships (AROS)

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Lessons learned

Information needed

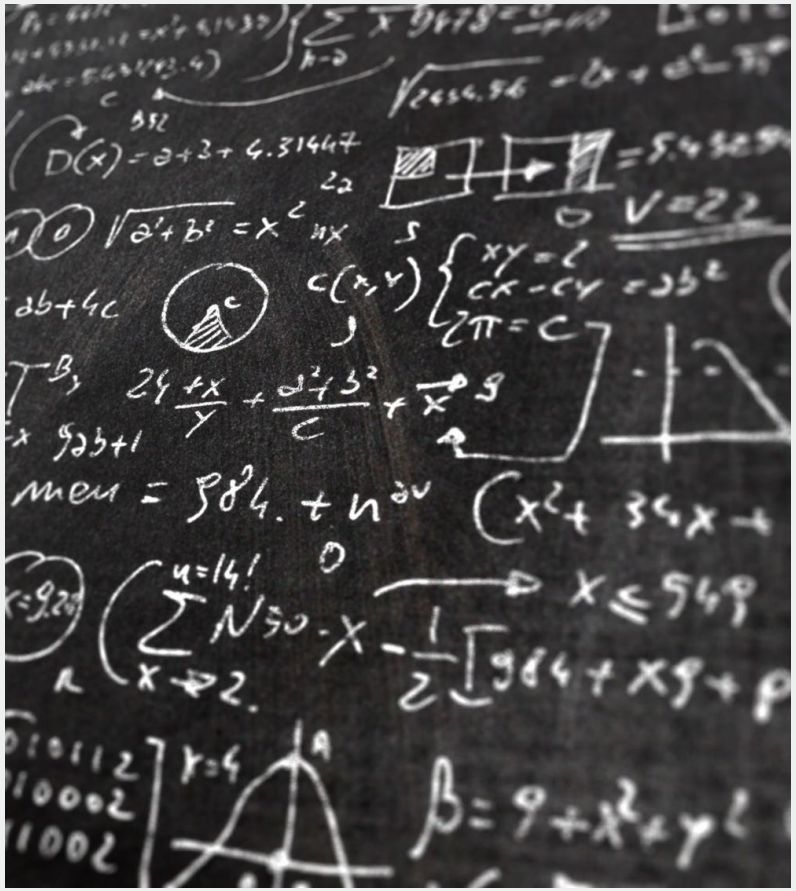
Verification methods

Risk analyses

Functional patterns

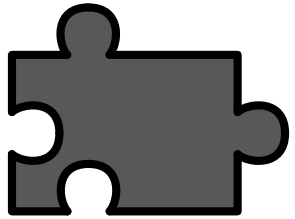
Risk analyses, some lessons learned

1. Only a **few** risk analysis **methods** are well known in the maritime industry
2. Uncertainties around the **scope** of each risk analysis
3. It can be difficult to connect the **detailed** system-analyses to the **overall** risk analysis for the whole concept
4. There is typically more “**brainstorming**” than “structure” during risk workshops
5. Risks that are already sufficiently managed are often **not included** or documented
6. Risks associated with **software** systems and **machine learning** are hard to deal with
7. Mitigation-actions often have an **unstructured follow-up** and **insufficient tracking** to completion



DNV AROS class notations

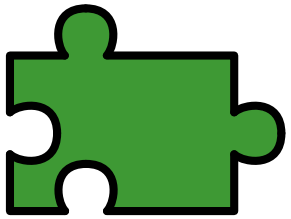
Functional Categories



Four Categories of Functions

- Navigation
- Engineering
- Safety
- Operations

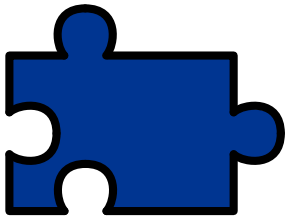
Modes of Operation



Four Modes of Operation

- Remote Control
- Decision Support
- Supervised Autonomy
- Full Autonomy

Location of Control

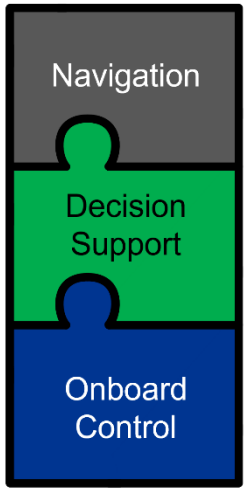


Three Locations of Control

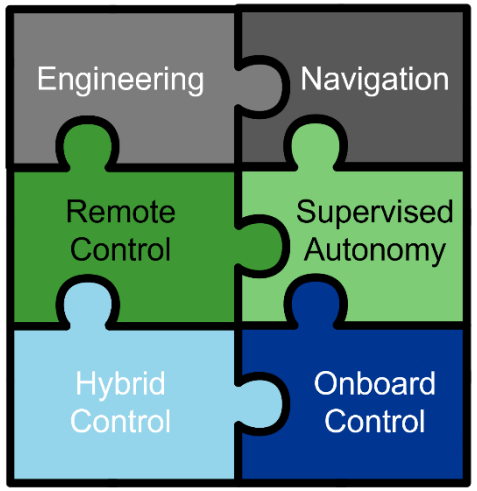
- Onboard Control
- Off-ship Control
- Hybrid Control

AROS Notations: A building block approach

Each AROS Class Notation has multiple possibilities of combination with the two blocks of qualifiers, creating a flexible approach to serve various autoremote vessel concepts.

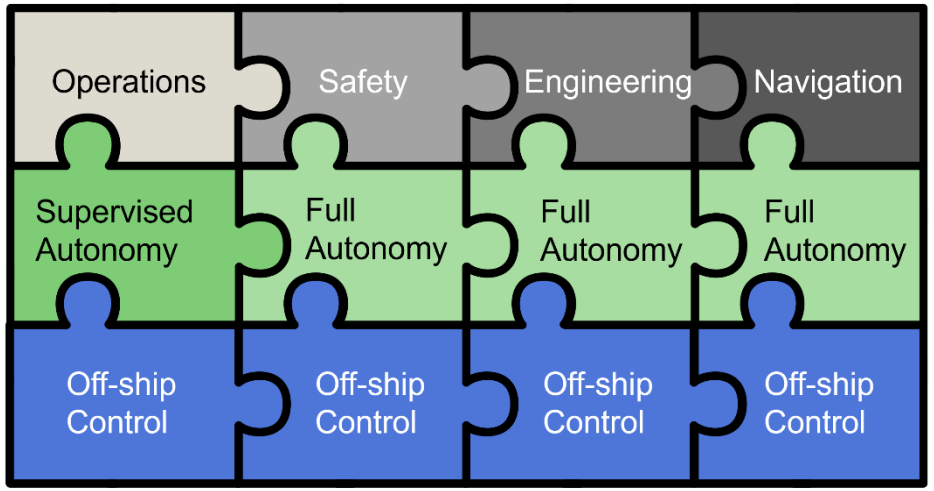


AROS-NAV(DS,OB)



AROS-ENG(RC,HC)

AROS-NAV(SA,OB)



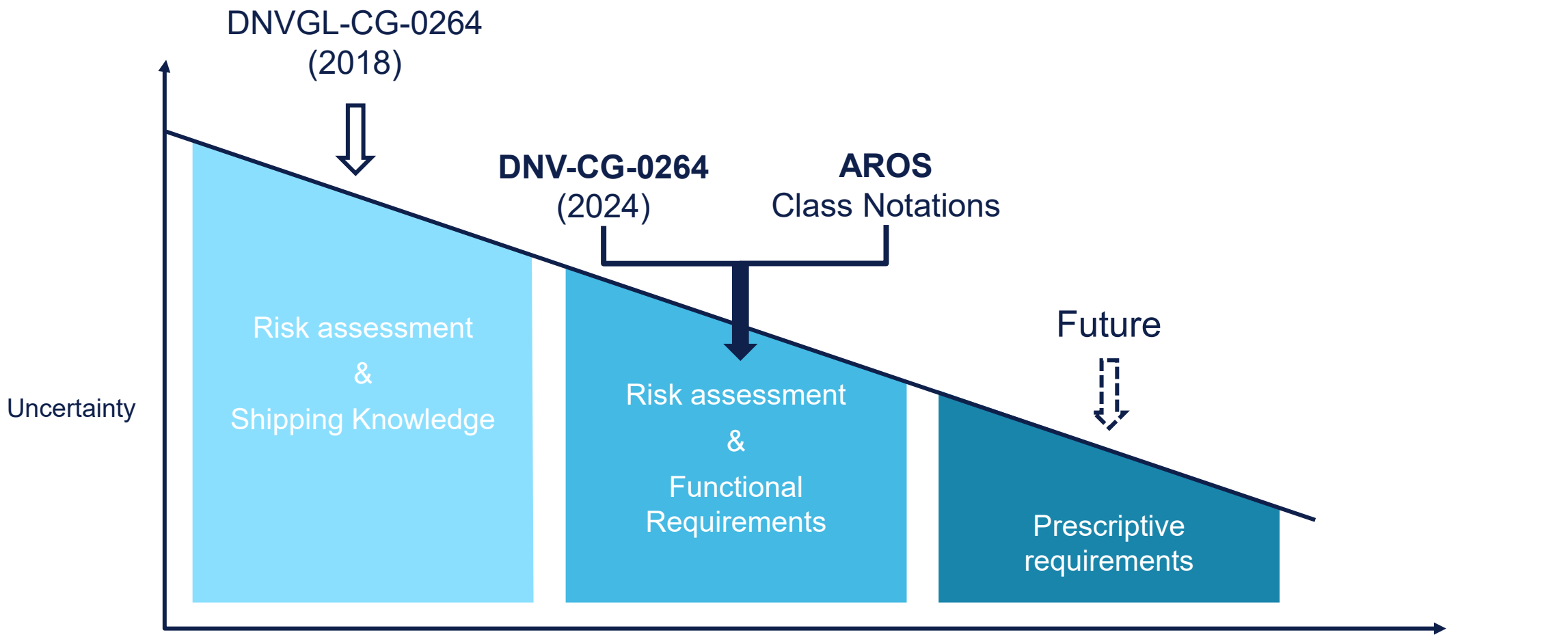
AROS-OPS(SA,OS)

AROS-SAFE(FA,OS)

AROS-ENG(FA,OS)

AROS-NAV(FA,OS)

Evolving with MASS



Thank you for your attention

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