How Safe Is Safe Enough?

Synthetic environment assurance of mariner-like decision making

SMI Conference Edinburgh | March 2023

Introduction

Thomas Howe

Senior Principal
Navigation and
Seamanship

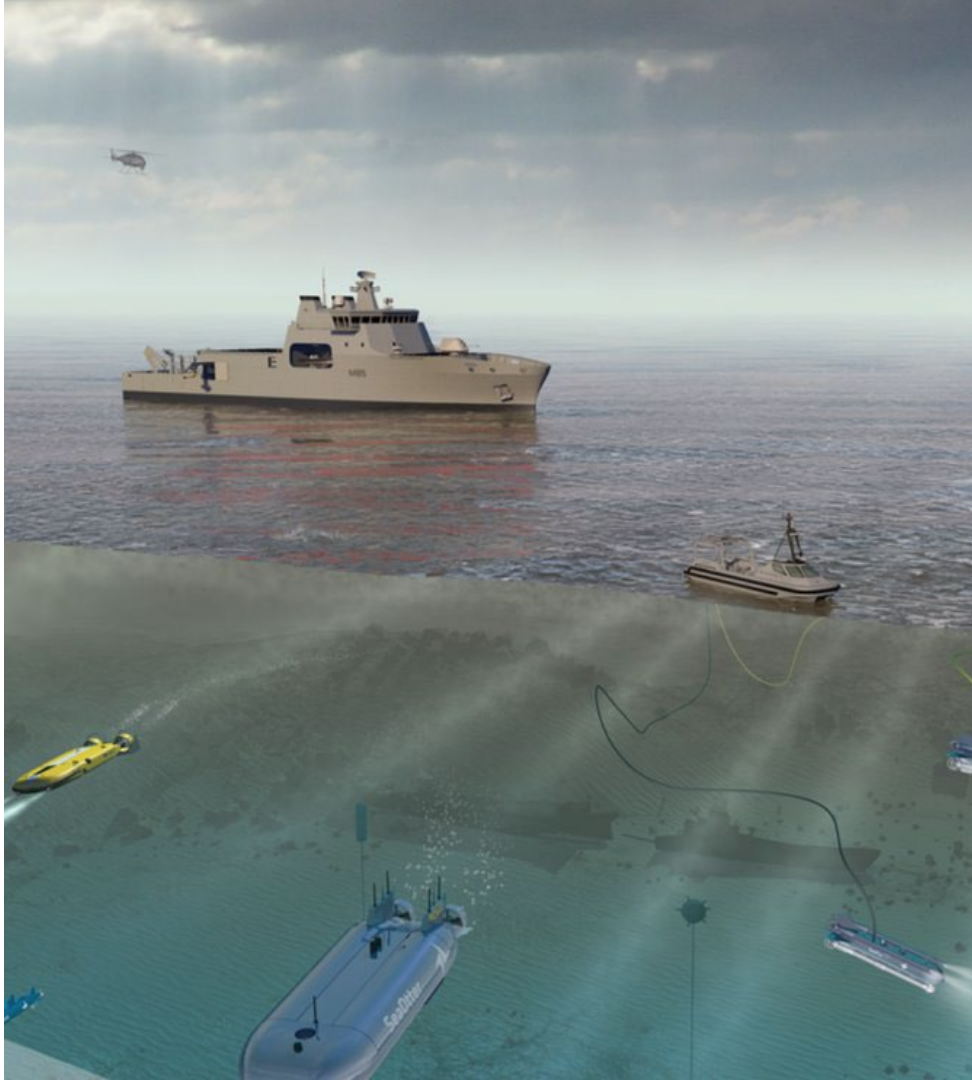
Will Alexander

Maritime
Autonomy Deputy
Team Leader

BMT

Scope

- Safe & effective MASS operations
- Mariner-like decision making
- Autonomous anti-collision under human supervision
- Assurance & MASS SEAS
- Synthetic environment testing
- BMT REMBRANDT simulator



Safe and Effective MASS Operations

Tolerable event – ISO TS 23860:

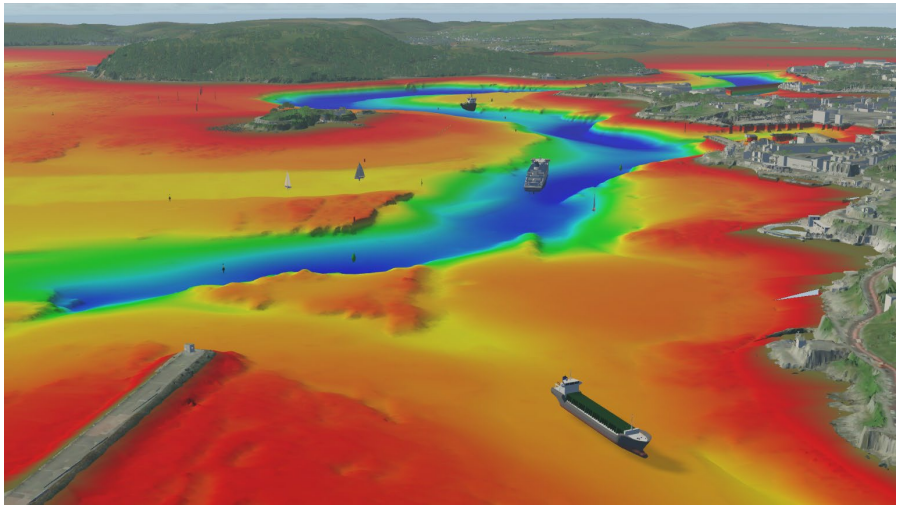
‘technical or operational event for which there is a designed response that keeps the system within its operational envelope’

Therefore, defining the safe operational envelope is key.

ISO TS 23860: Vocabulary related to autonomous ship systems

BMT

MASS SEAS



Marine Autonomous Surface Ship

Synthetic
Environment
Assurance
System

BMT

MASS SEAS - Building the Evidence for Certification

Vessel Master, OOW must be certified by appropriate authority, self-certification not an option

Result enables regulator to certify safe operating envelope

Observance of Good Seamanship → **Certified by Appropriate Authority** → **Assessment of Competence** → **Result Provides Evidence**

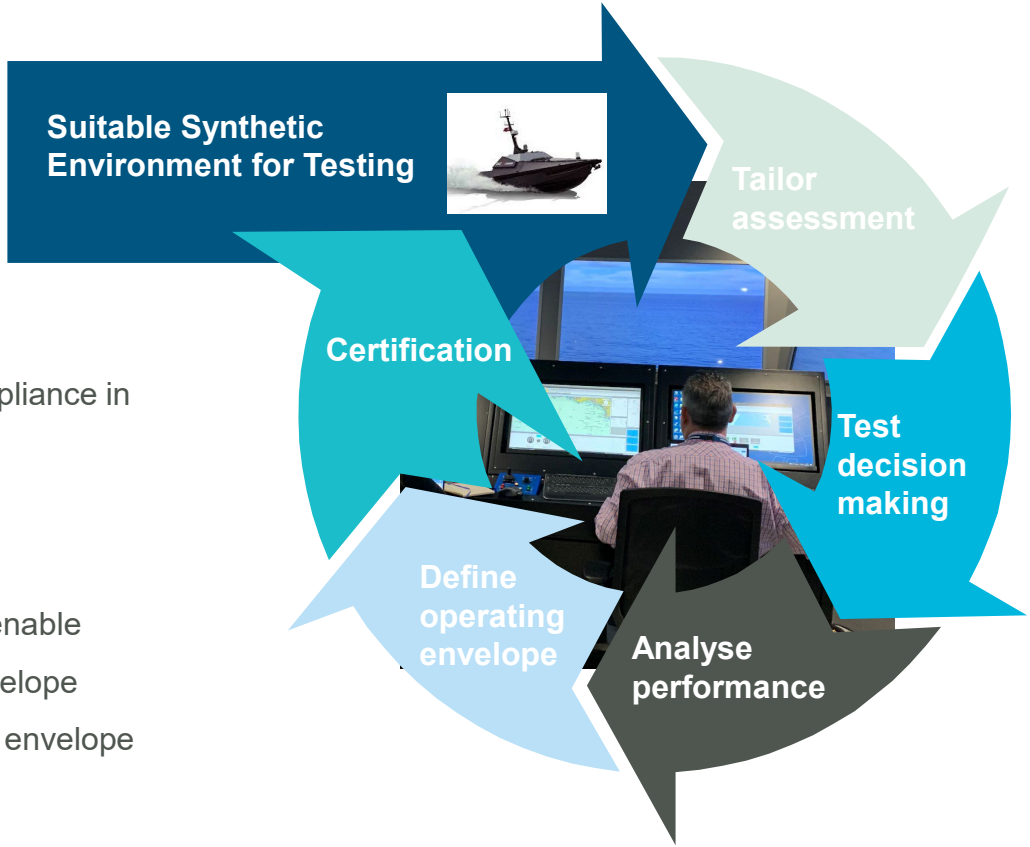
Principle underpining all the individual rules within COLREGs

An assessment of competence to make decisions is required

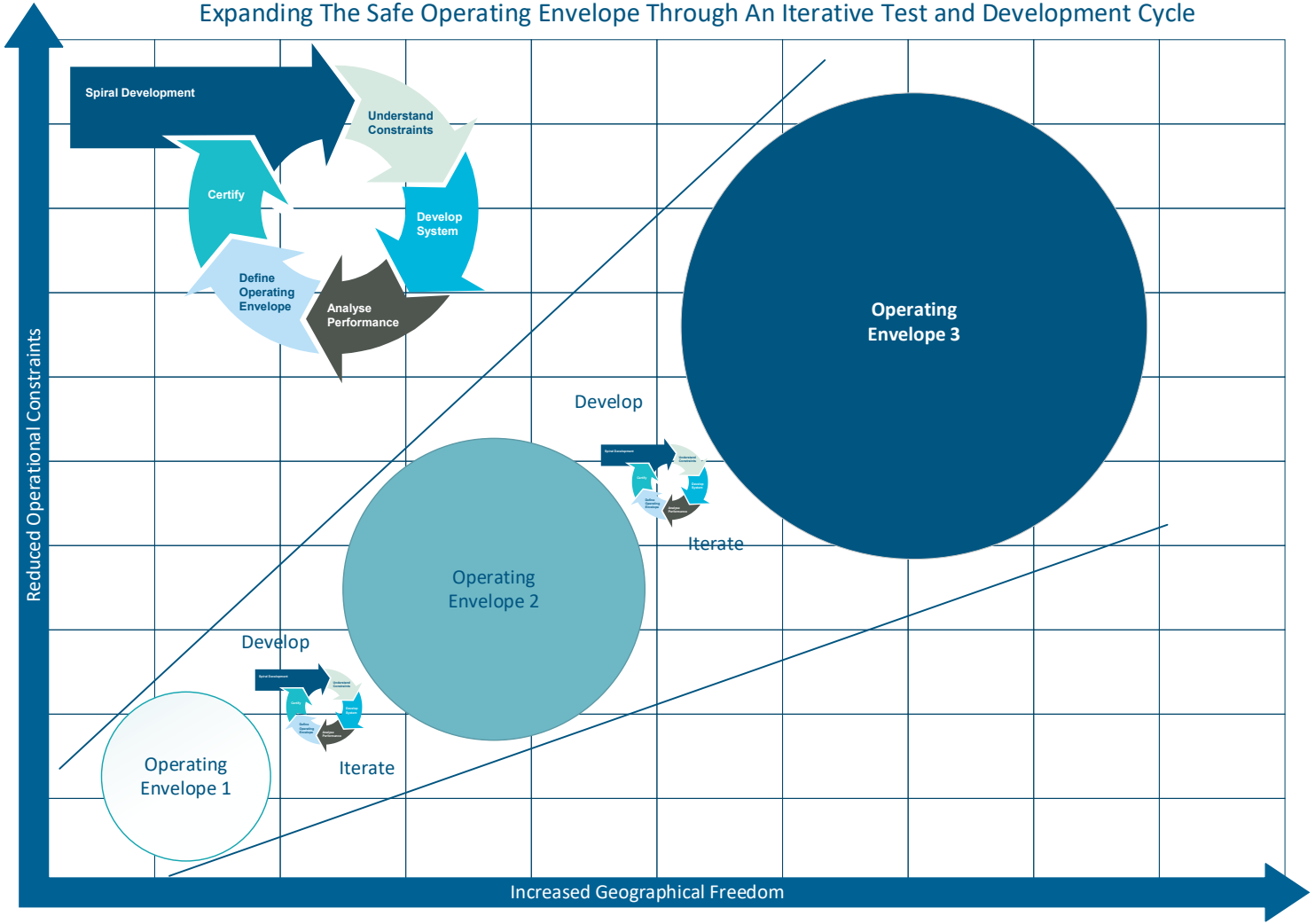
BMT

Test & Certification Iterative Process

1. Tailor assessment for vessel type & task
2. Test machine's decision making & COLREG compliance in synthetic environment
3. Analyse results, highlight areas of strong & weak performance
4. Report provides compelling body of evidence to enable appropriate authority to define safe operating envelope
5. Certification issued based on a defined operating envelope



BMT


Expanding The Safe Operating Envelope Through An Iterative Test and Development Cycle
Spiral Development
Understand Constraints
Develop System
Analyse Performance
Define Operating Envelope
Certify
Operating Envelope 1
Develop
Iterate
Operating Envelope 2
Develop
Iterate
Operating Envelope 3
Reduced Operational Constraints
Increased Geographical Freedom

Benefits of synthetic environments for testing MASS

Regulators

Auditable and objective analysis of system performance provides assurance and route to certification.

Developers

Testing and evaluation in a safe and controlled environment accelerates development of technology in an iterative way. De-risk live trials.

Owners

Accelerates the route to certification enabling capabilities to move from design to productive operations much faster.

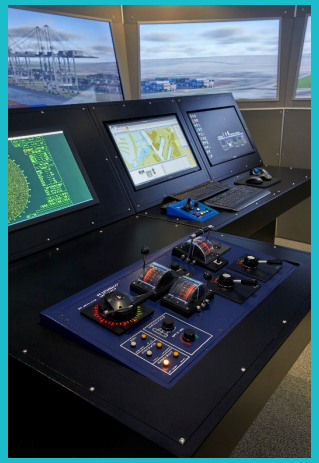
Operators

Provides a safe environment to train and demonstrate performance building confidence and trust, enabling safe marine operations.

BMT

A Safe Test Environment

BMT REMBRANDT



'While virtual test environments offer the advantage of testing a large number of scenarios efficiently, we need to validate the virtual environment itself, i.e., ensure the virtual environment reflects the real world, to be able to trust the results of the tests within a given scenario'.

WMG University of Warwick paper Cross Domain Safety Assurance Framework for Automated Transport Systems

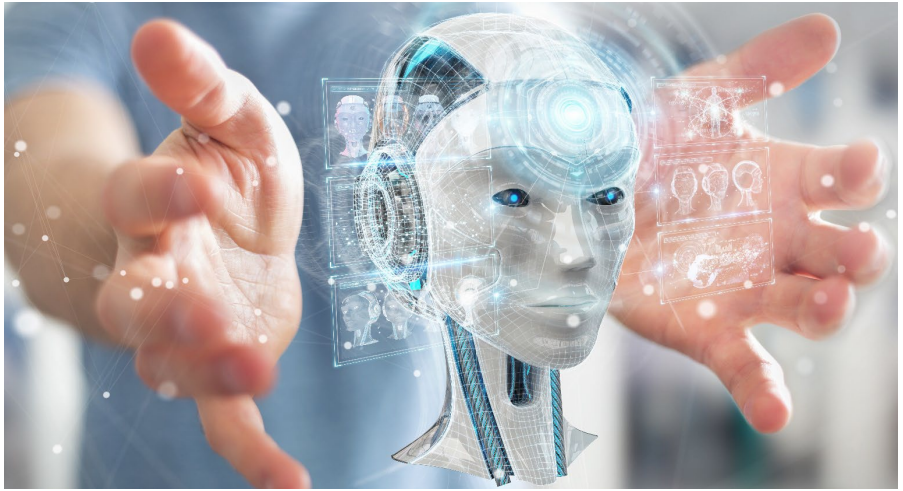
BMT

So, how safe is safe enough?

A system in which a failure to make decisions with due regard to the observance of good seamanship is tolerable if it allows ample time for a competent human operator to intervene.

This requires:

- A clear understanding of system performance
- A defined safe operating envelope which allows system failure to be tolerable



Conclusion

- Synthetic environment assurance allows the COLREG performance of the system to be understood in a way which allows an appropriate operating envelope to be defined.
- This means immature technology can be certified and operated with the minimum of constraint.

“the next goal is that by 2040 we expect about half the ships in Japan will be fully autonomous”

Nippon Foundation 2022, Japan

Thank you