MAAT
Maritime Autonomy Assurance Testbed

IMO-ROK MASS Symposium Programme

Developing a simple, usable and reliable assurance framework to enable wide scale MASS operations internationally

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NPL National Physical Laboratory
UK Hydrographic Office
Met Office
WMG THE UNIVERSITY OF WARWICK
UNIVERSITY OF PLYMOUTH
PML Plymouth Marine Laboratory
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About NPL

- UK's National Metrology Institute founded in 1900
- A Government Laboratory owned by the Department for Science, Innovation and Technology (DSIT)
- Based in Teddington (London) with locations across UK
- 1200 staff plus 200 PGRs across multiple sectors and technologies.
- Enabling confidence in adoption of emerging technologies

Maritime Autonomy: Opportunity and Challenge

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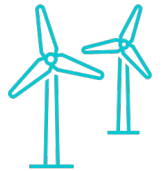
- **The Opportunity: Projected demand for Maritime Autonomy is predicted to grow to become a $10bn market by 2030. ***
- Maritime Autonomy will over time fundamentally change the operating and business models of many maritime sectors, making their operations safer, more sustainable, and efficient. E.g.
    - Lean Crewing / Port Operations
    - Fleet Decarbonisation: energy management of hybrid & full electric propulsion
    - Offshore energy / renewables, fisheries & aquaculture, environmental survey
    - Maritime security and naval logistics
- **The Challenge: A paradigm shift in how these unmanned / uncrewed technologies are tested and certified is required.**
    - Without the capacity to **assure maritime autonomous systems (MAS)**, exploitation and benefits shall be significantly inhibited, slowing/limiting innovation & ecosystem growth potential.



*Fortune insights

Assurance: Challenge and Approach

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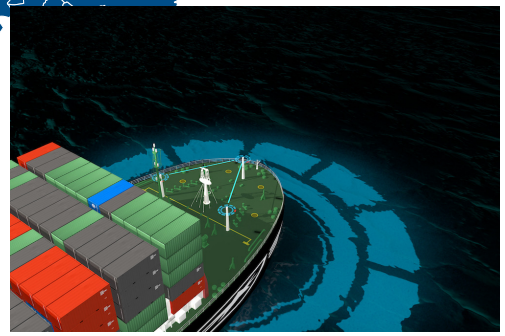

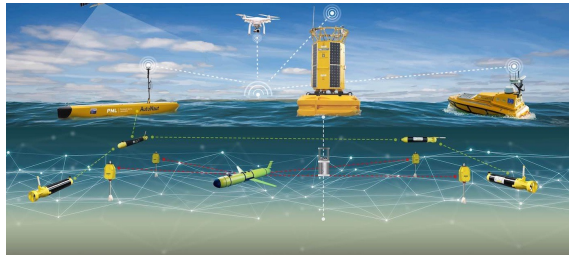

- Proportional
- Standards
- Defining Safe
- Responsibility

Maritime Autonomous Operations Spectrum

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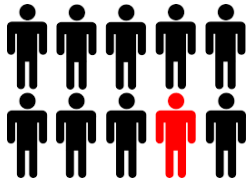
Port | **Inland** | **Coastal** | **Open Seas**

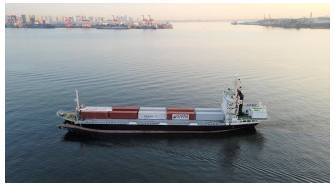



Different levels of interaction, complexity, infrastructure and risk

Requirement for common terminologies, specifications and standards

Bridge Assist / Nav Aids | **Lean crewing** | **Remote Operations** | **Autonomous Operations**

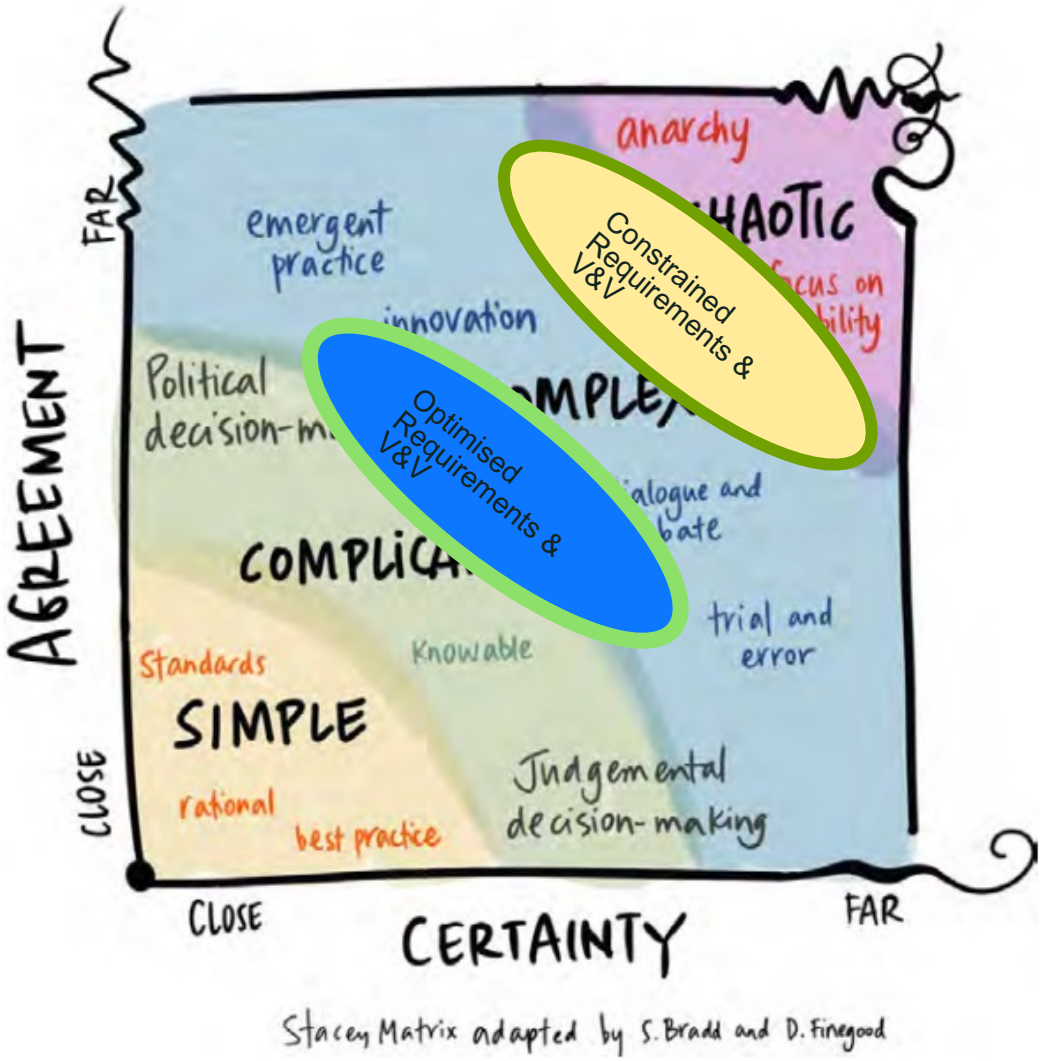


Above Surface

On Surface

Sub Surface

Standardising Complex Systems?



Engineering X, an international collaboration founded by the Royal Academy of Engineering and Lloyd's Register Foundation.
Case Studies available at: Safer Complex Systems (raeng.org.uk)

Proposed Solution:
Maritime Autonomy Assurance Testbed (MAAT)

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- Objective: To enable the **fastest adoption** of MASS technology, making autonomy **affordable & business viable.** Results in accelerated and increased realisation of benefits of earlier adoption of the technologies.
- Programme being developed in the UK, following a data-driven and evidence based approach to:
  - Deliver an internationally relevant assurance capability supported by pro-innovation standards, and not constrained by existing human centric regulatory frameworks..
  - Test, certify and operationally assure maritime autonomous technologies globally, from component through to System of Systems.
- Enabled through the development of validated and integrated test environments for Maritime Autonomous Systems combined with a detailed, common requirements methodology and an operational certification framework.
- Developed in partnership between National Physical Laboratory, Lloyd's Register, UKHO, Met Office, WMG (University of Warwick), PSD Freeport, University of Plymouth and Plymouth Marine Lab (…and growing).
  - Draws on experience across autonomous mobility
  - Designed to be a networked capability, across the UK
  - **Establishing International collaborations**

Traceability back to well-structured requirements

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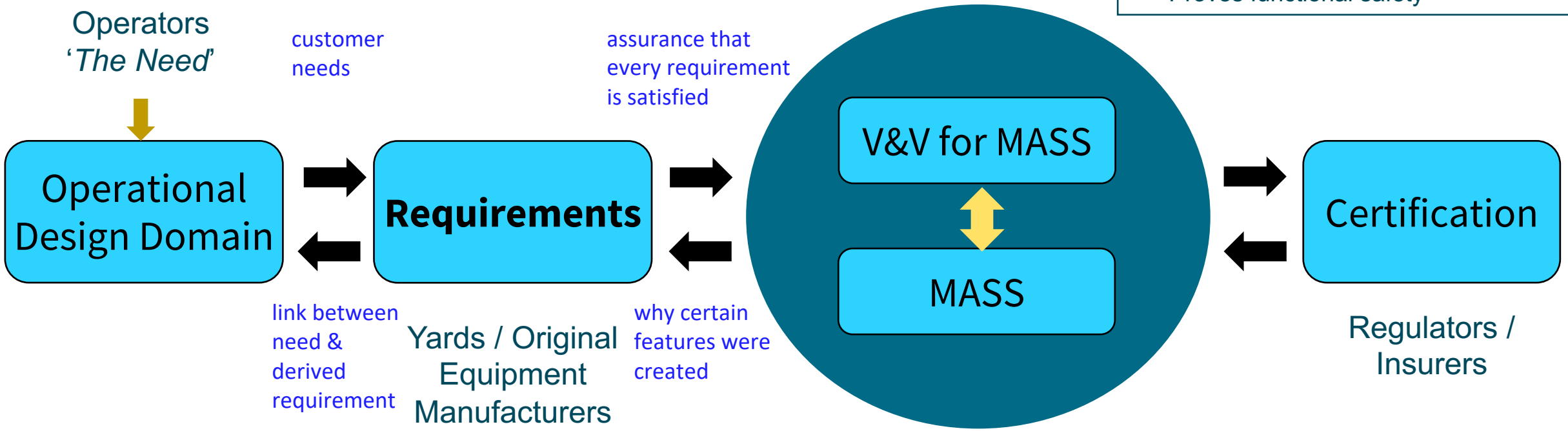
Assurance through the lifecycle? i.e. Ubiquitous, efficient and assured **Operations**

Benefits:
- Clarity of project relationships
- Enhances process visibility
- Increases efficiency & quality
- Improves impact / change analysis
- Demonstrates Verification & Validation
- Clarifies Contractual task ownership
- Proves functional safety



Source: Lloyd's Register

Hypothetical: Assurance as a Service Model

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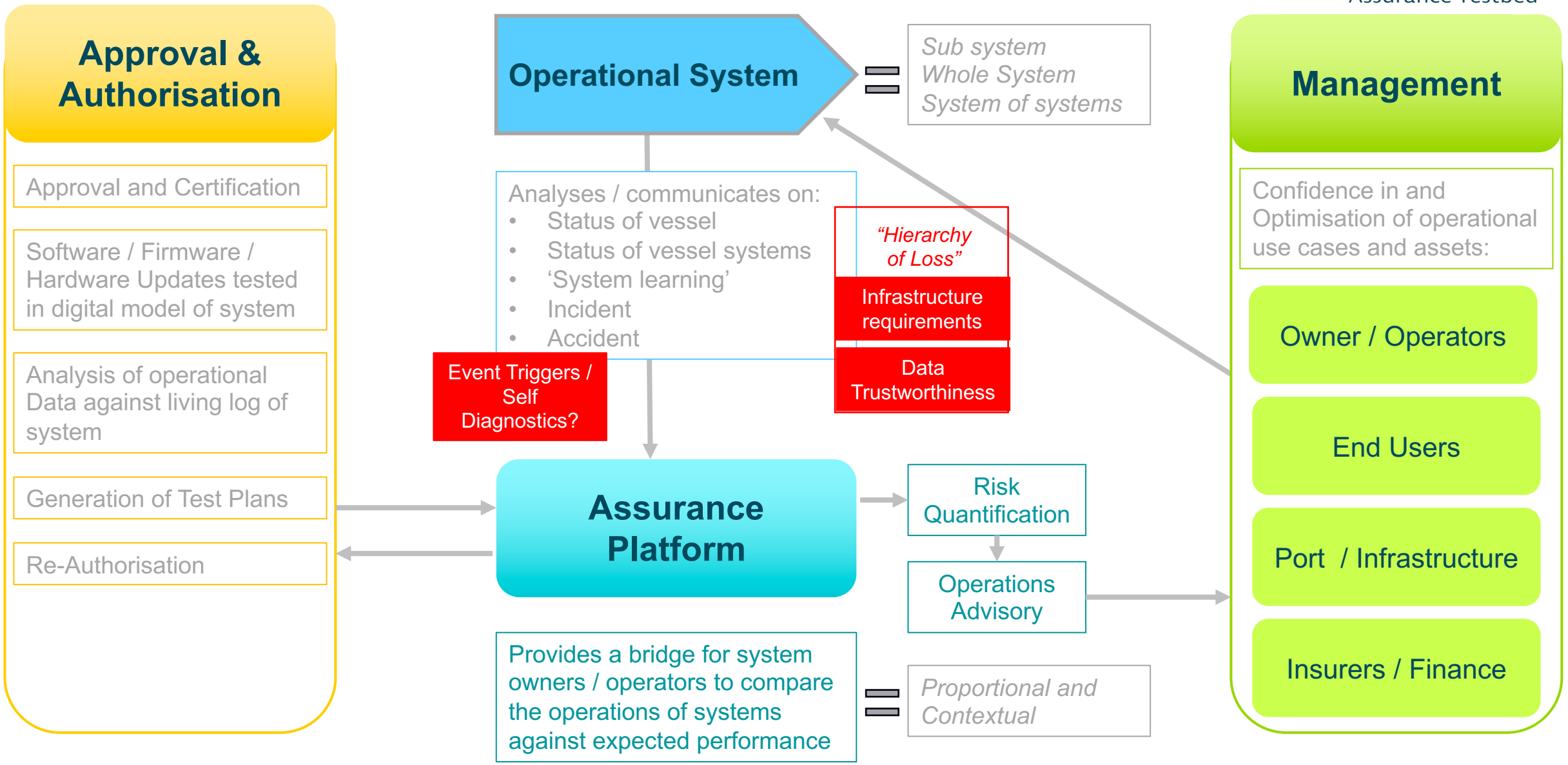

MAAT: A Data-Driven Approach to Assurance

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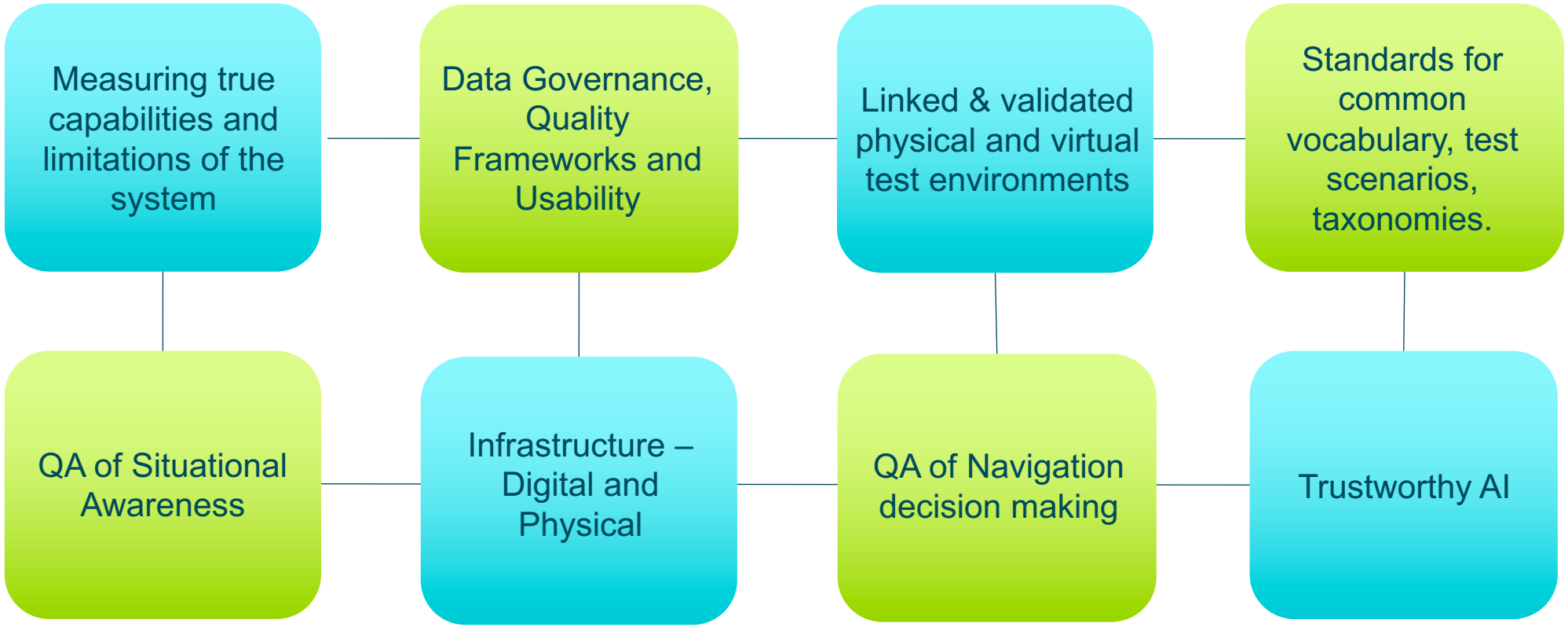

Establishing and measuring true capabilities and limitations of the system

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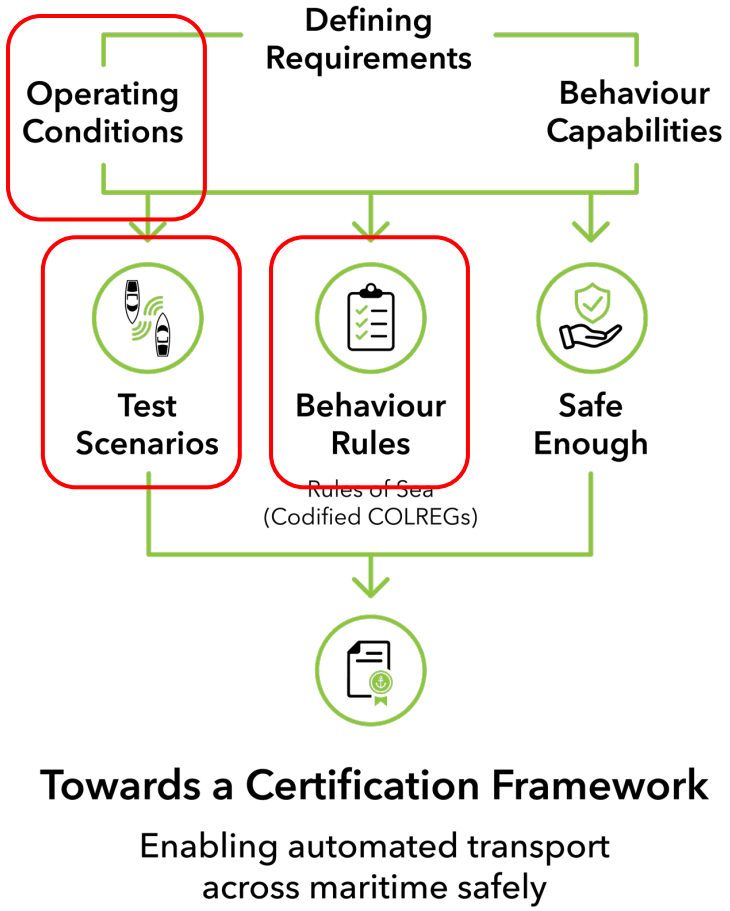
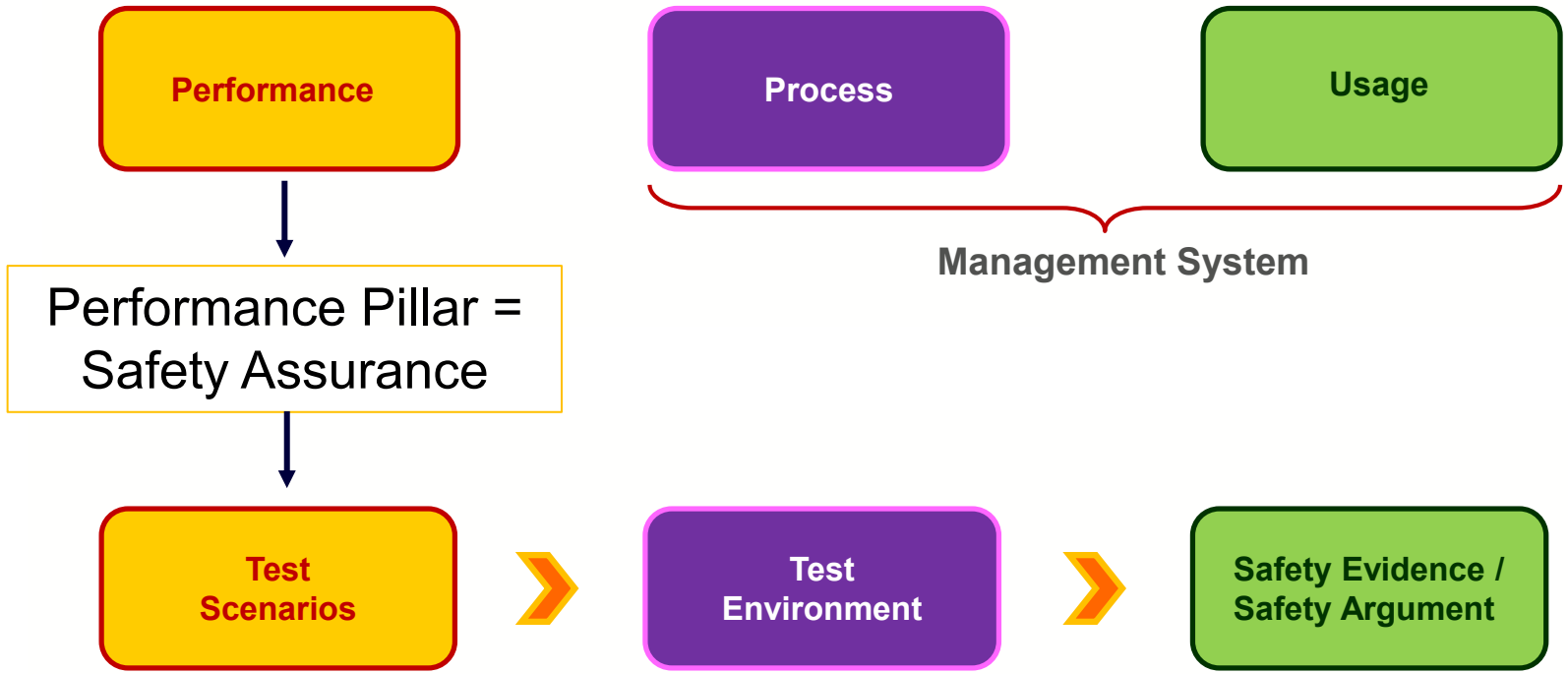
Common taxonomies required





Source: Warwick Manufacturing Group

Developing the evidence base

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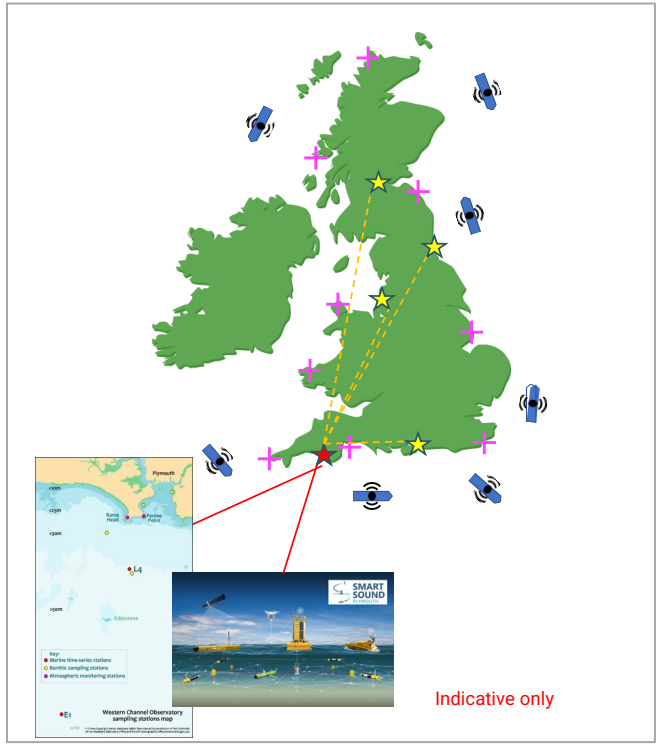
- Day 1- Smart Sound Digital: 1000km^2 of deconflicted Test Infrastructure
- Supports development of assurance tools, data and test standards:
  - Data for Libraries for Operating Conditions and Behaviours and the development of Digital COLREGS
  - Test Scenario development
  - Reference Data for Sensor Assurance Framework and provides reliable environmental and sensor models for Virtual Testing
  - Training Data Library in accordance good practice guides for ML compliance assurance
  - RT Situational awareness of test areas & sound for remote operations – provides blue-print for wider deployment
  - Human Factors Analysis
- Networked structure shared and integrated **across the UK and internationally**, to support ‘distributed assurance capability’ and provide a scalable innovation platform.



Test Environments: Synthetic and Virtual Testing

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To enable the **fastest adoption** of technology, making autonomy **affordable & business viable.**

Requirement for adoption of autonomous technology:
Develop and prove technology is safe, effective and dependable in real-world scenarios through testing and validation.

Challenge:
Real-world testing is expensive, time intensive and unpractical, as testing must be safely carried out in millions of operational scenarios / environments that might not occur in the real world for years.

Synthetic Test Bed as a solution:
An STB would create a fast, affordable and more effective alternative to real-world testing, by creating synthetic environments* and scenarios in which to perform testing and validation of technology for autonomy.

*Essential to provide a quantified and traceable approach to ensuring that the models used in the virtual testing scenarios are a sufficiently accurate reflection of conditions and performance in the real world.

- Main question: **how can we be confident that performance in the virtual environment reflects performance in reality?**
- Related question: **how can we make the process cost-effective?**

Virtual Test Environments: requirements

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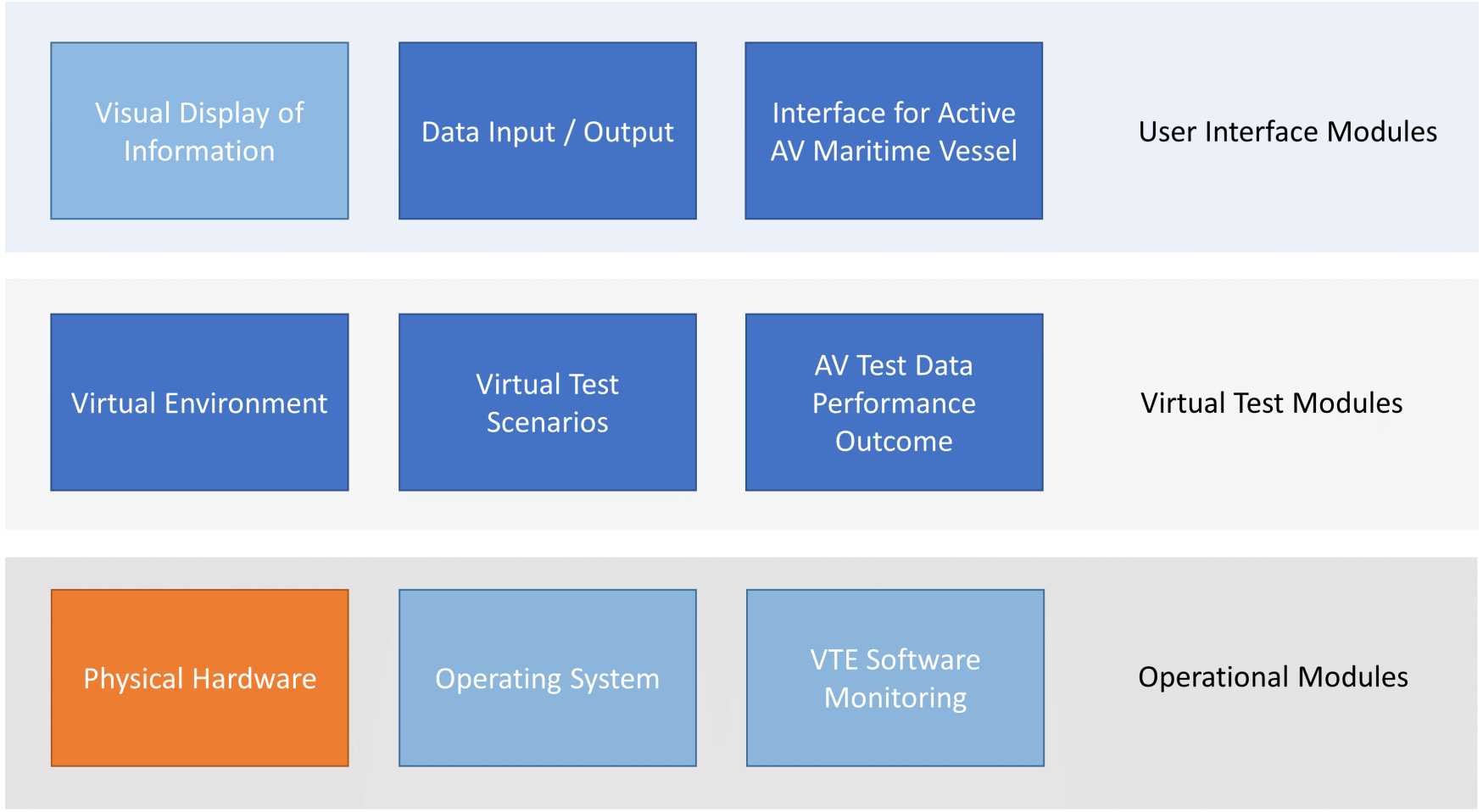

Common definitions and understanding

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- Test scenarios and outputs
- Operating Domain taxonomies
- Autonomy levels
- Machine readable charts
- Maritime definitions for MASS - ‘vessel’; ‘responsible person’

An ambition to ‘make waves’

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“To enable the **fastest adoption** of MASS technology, making autonomy **affordable & business viable.**”

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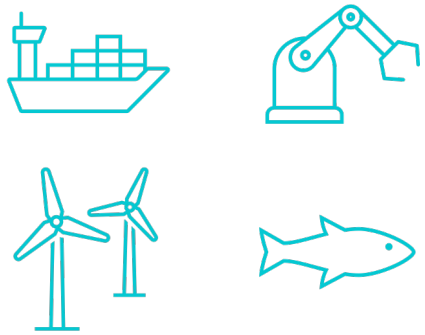
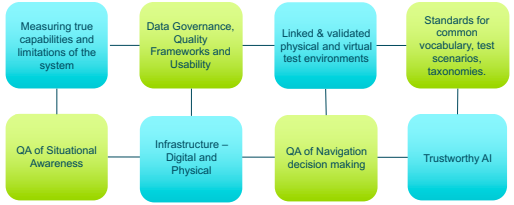
“An international challenge requiring **international collaboration.**”

Driven by clear economic and social imperatives.



Underpinned by science, following an evidence based approach



Developed by a growing roster of leading research & innovation organisations in the UK

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LR
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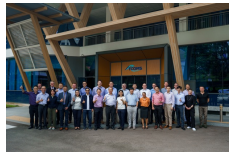
International collaboration is core to the programme







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Thank you!

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