

# Autonomous Shipping and Inland Navigation

## Safety in the Autonomous Era

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# Topics for the Workshop

- **Smart & Autonomous shipping as part of intelligent transport systems**
- **The Maritime experience**
- **Autonomous vessels in inland navigation – added value, opportunities and challenges**
- **The Regulatory Framework**
- **Autonomous inland vessels – existing vessels, urban lines and projects under development**
- **Data exchange, cyber security and related issues**
- **Social aspects related to autonomous shipping and possible solutions**

# Desired Outcomes of the Workshop

- **Certification for the new members of the crew members**
- **Safety issues and requirements**
- **Acceptance criteria**
- **Terms of data exchange, the standardisation and harmonisation of requirements and documents in terms of interoperability**
- **Relevance to international conventions, existing barriers and challenges**

# The Maritime Environment

- **Life at sea is 3D**
  - **Above, On and Below the waves**
- **Well established order for:**
  - **Navigational safety**
  - **Air safety and airspace management**
  - **Water space management below the waves**
- **Maintaining the status quo wherever possible for all manned and unmanned craft using existing principles, laws, rules and regulations is critical.**
  - **Principle of 'Equivalence'**

# Life at sea is dangerous



HMV BRITANNIA



HERALD OF FREE ENTERPRISE



HMS HURWORTH



HMS CLEOPATRA





# Maritime Accidents



OCEAN BREEZE 2012



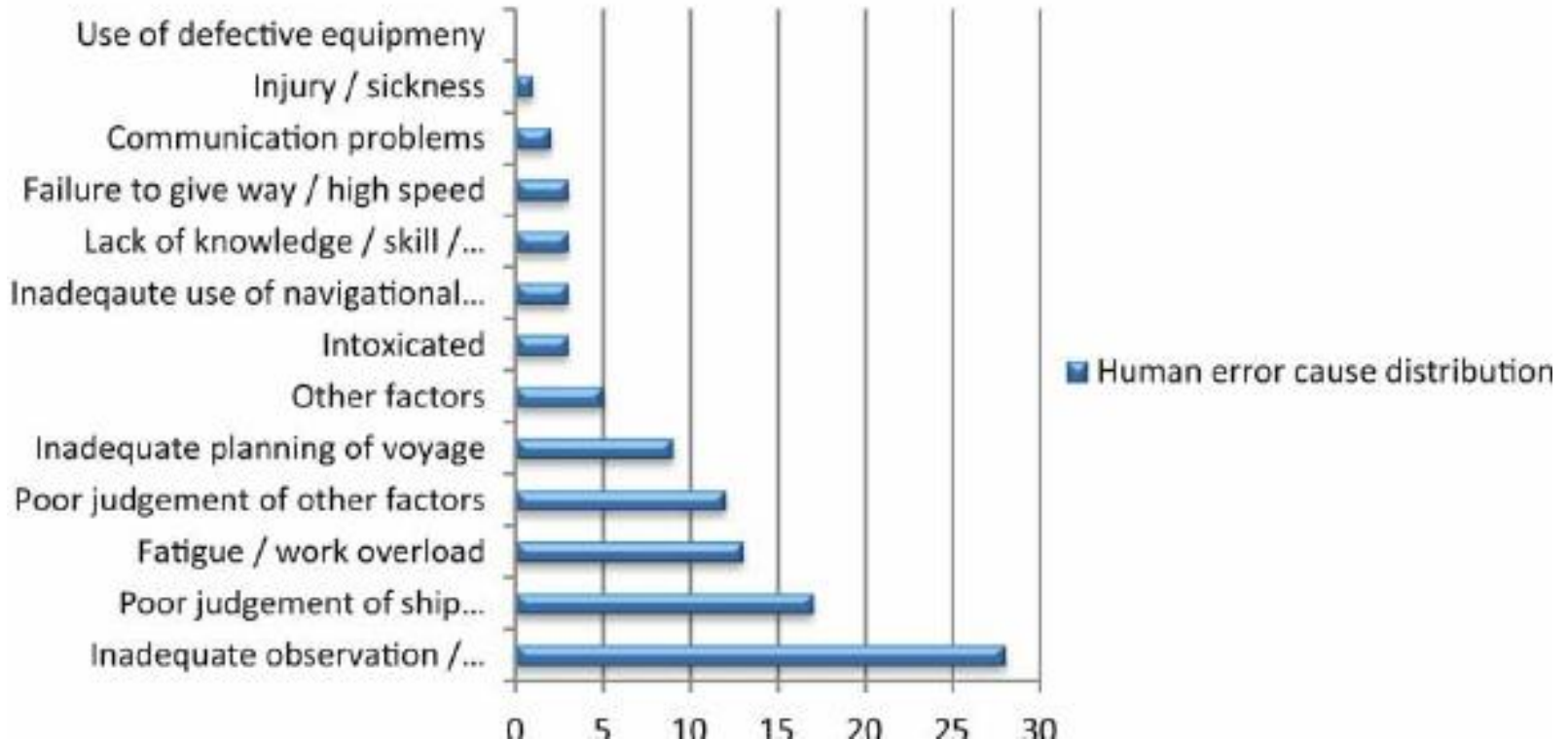
SANCHI 2018

About 75-96% of marine casualties are caused, at least in part, by some form of human error. Studies have shown that human error contributes to:

- 84 - 88% of tanker accidents
- 79% of towing vessel groundings
- 89 - 96% of collisions
- 75% of allisions
- 75% of fires and explosions

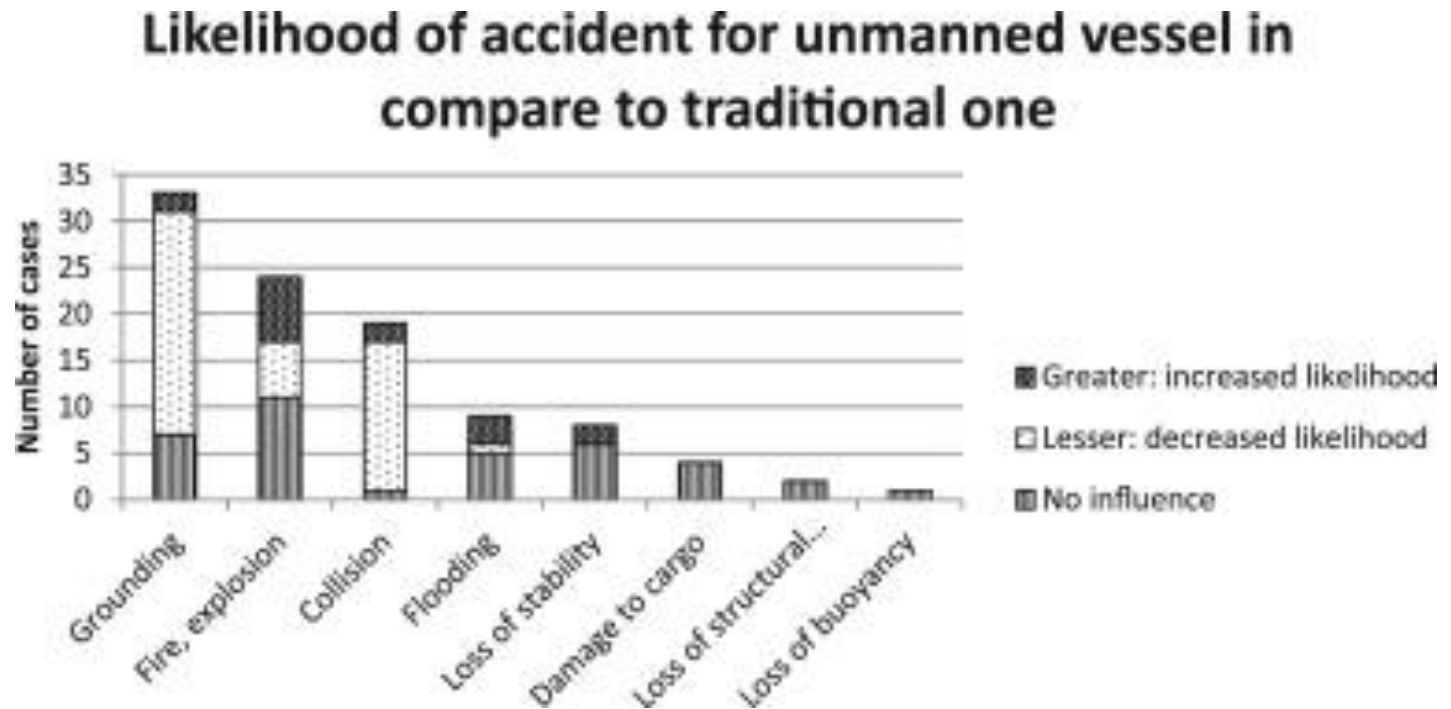
# Maritime Accidents

Human error cause distribution



Source: International Maritime Organization, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, International Maritime Organization, London, 2011, p. 30.

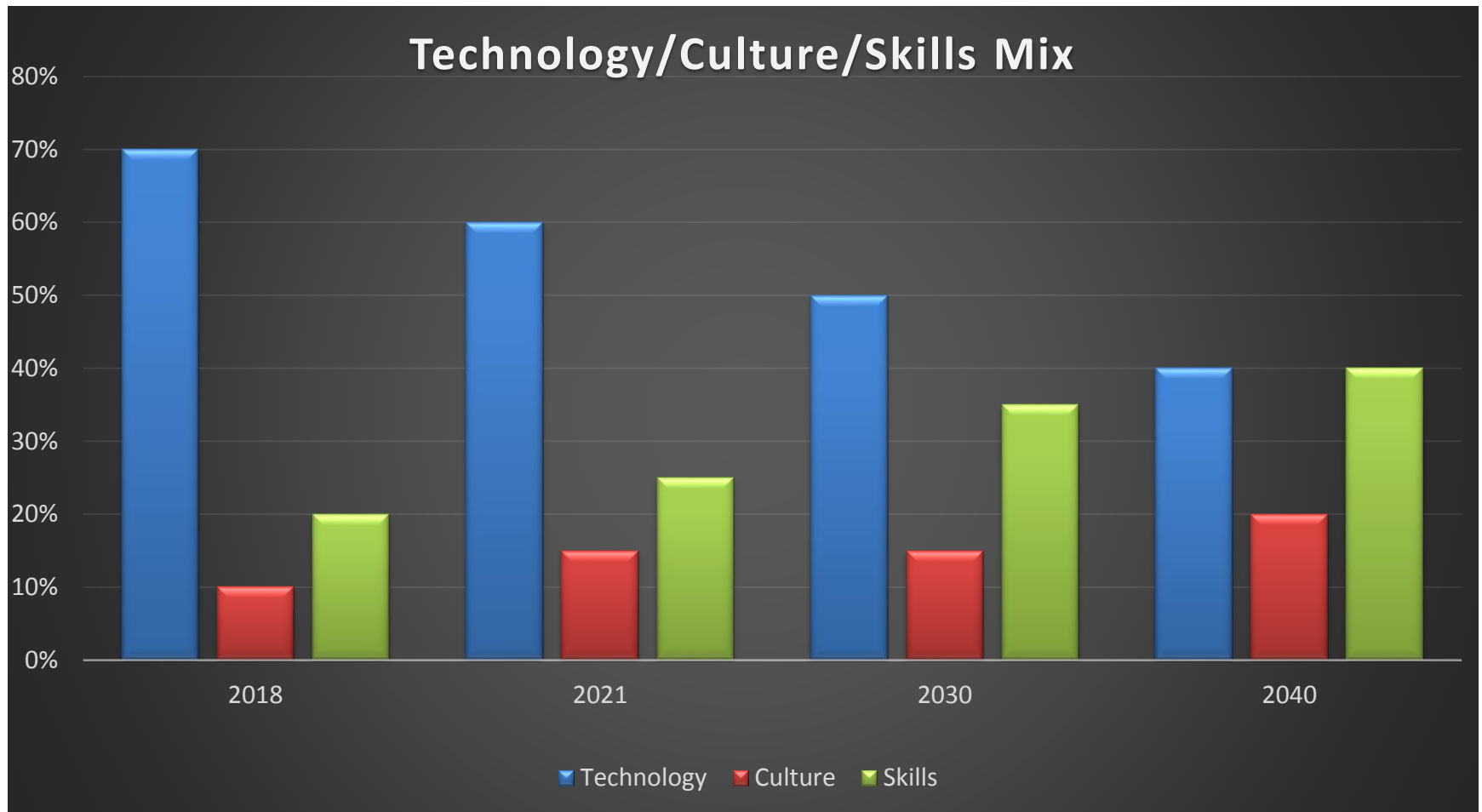
# Maritime Accidents



This conclusion was made by three academics from the Gdynia Maritime University in Poland, the Aalto University in Finland, and the Finnish Geospatial Research Institute



# Safety at Sea in the Autonomous Era

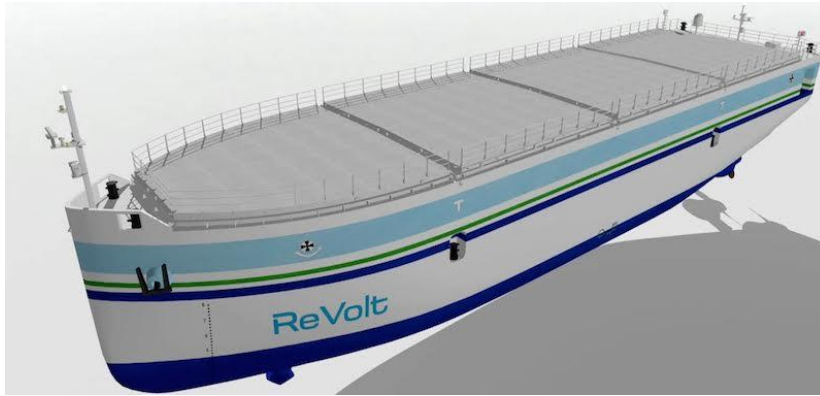


# European Inland Waterways





# European Inland Waterways



# Maritime Autonomous Systems

- **Inland Waterway operations**
- **Commercial operations**
- **Oil and Gas**
- **Marine Scientific Research**
  - **Marine Survey**
  - **Oceanography**
  - **Passive acoustic monitoring**
  - **Offshore research**
  - **Deep sea mining**
  - **Fishing and aquaculture**
- **Underwater asset management**
- **Defence operations**
- **Maritime and Border Security**
- **Communications Relay (e.g. SAR)**



# Maritime Autonomous Surface Ships (MASS)



**AutoNaut**



SEA-KIT International



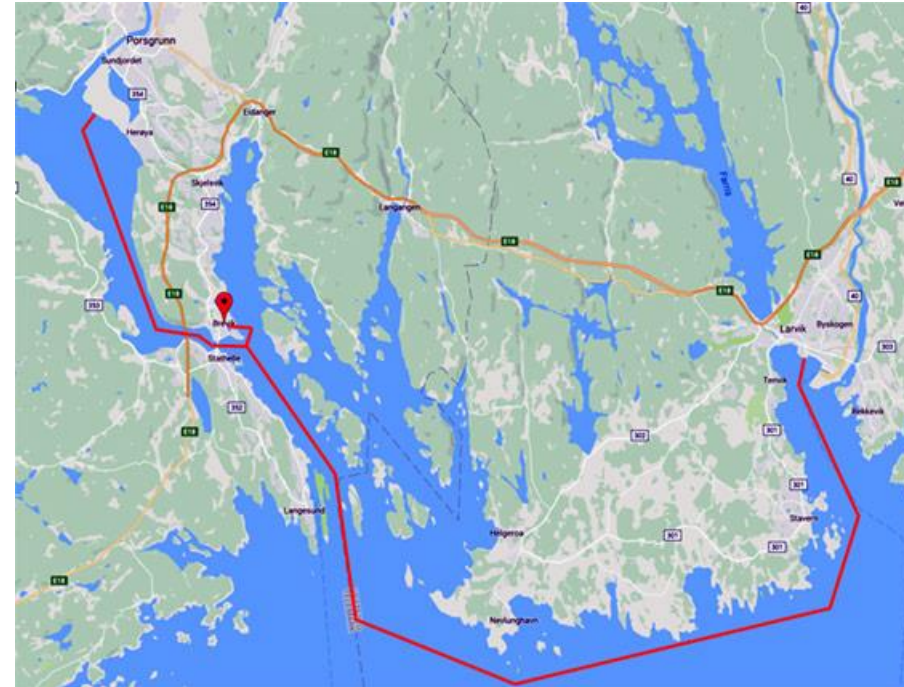
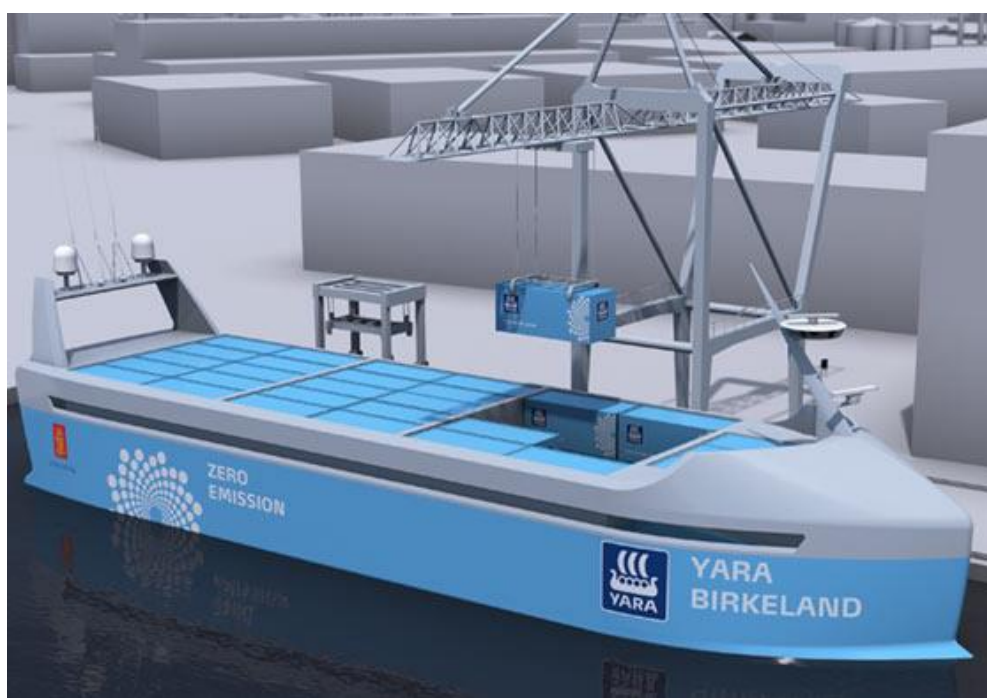
ASV C-Sweep



# MASS Vessel Types

- **Smart Vessels – Manned vessels with a high level of automation**
- **Hybrid solutions with remotely operated vessels and/or unmanned vessels in a convoy guided by a manned vessel**
- **Short-manned vessels where 12 hours of manned watch followed by 12 hours of control from an onshore control centre**
- **Unmanned vessels that are remotely operated from an onshore control centre**
- **Fully Autonomous vessels**

# Yara Birkeland



- **LOA:** 80 m **Beam:** 15 m
- **Draught (full):** 5 m
- **Service speed:** 6 knots

**Depth:** 12 m  
**Draught (ballast):** 3 m  
**Max speed:** 10 knots

• **Cargo capacity:** 120 TEU **Deadweight:** 3 200 mt

## Capacity

## Propulsion

- **Propulsion system:** Electric
- **Thrusters:** 2 Tunnel thruster

**Propellers:** 2 Azimuth pods  
**Battery pack:** 7,5 – 9 MWh



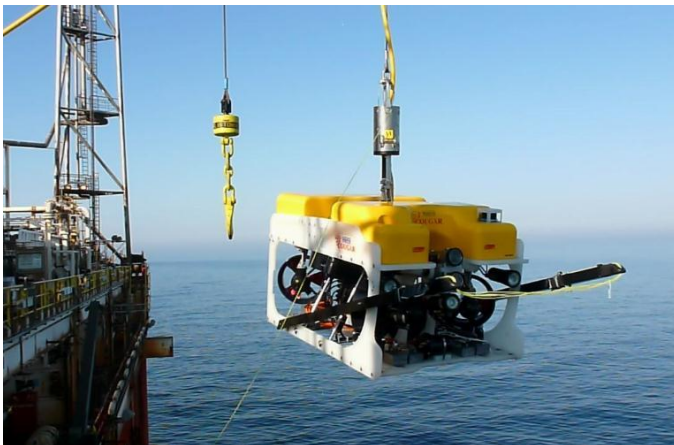
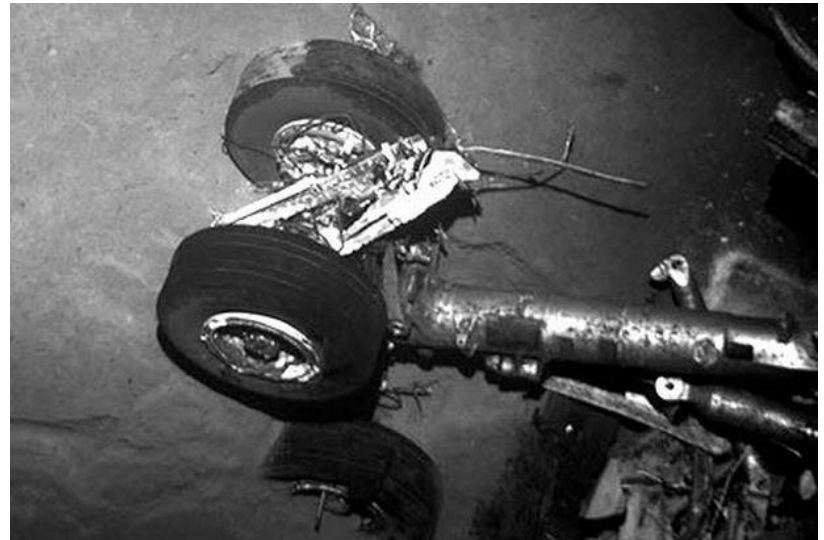
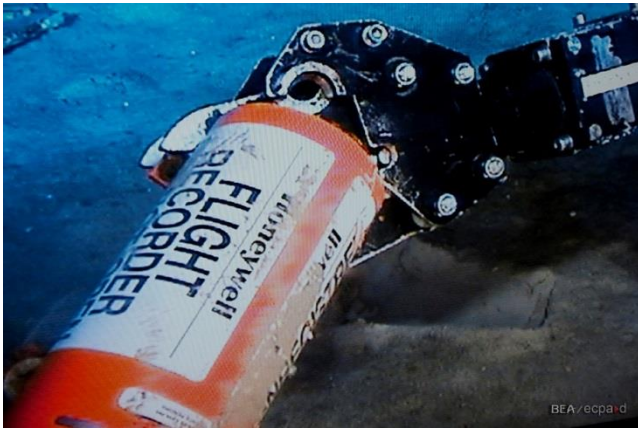
**KONGSBERG**

# ASV Base Control Station





# Unmanned Underwater Vehicles and Remotely Operated Vehicles



# Unmanned Underwater Vehicles operated from a MASS



SEA-KIT with embarked Hugin UUV



# Unmanned Air Systems at Sea



# MASS Safety

- **Responsible Ownership**
- **Safe Operation**
- **Recognised Accreditation, Training and Standards**
- **Effective Integration into the Maritime domain**



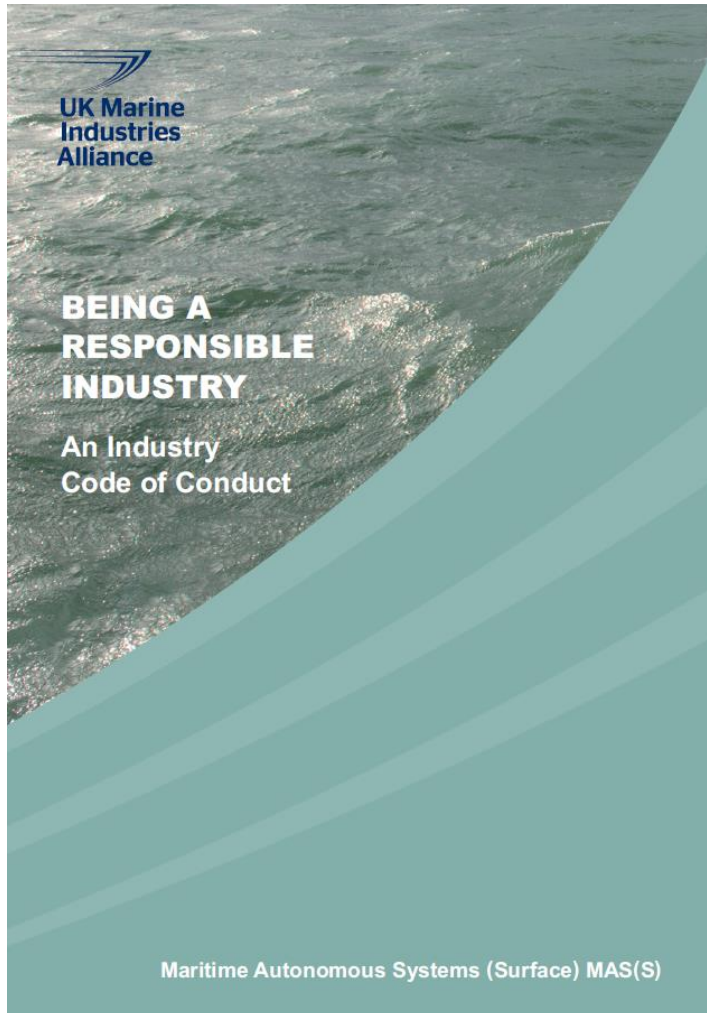
# MASS Regulation Challenges

- **Harmonised Definitions**
- **Application**
- **Common Standards**
- **International Consensus**
- **Flexibility, Innovations & Mutual Trust**
- **Legal Precedents**
- **Education of Mariners**

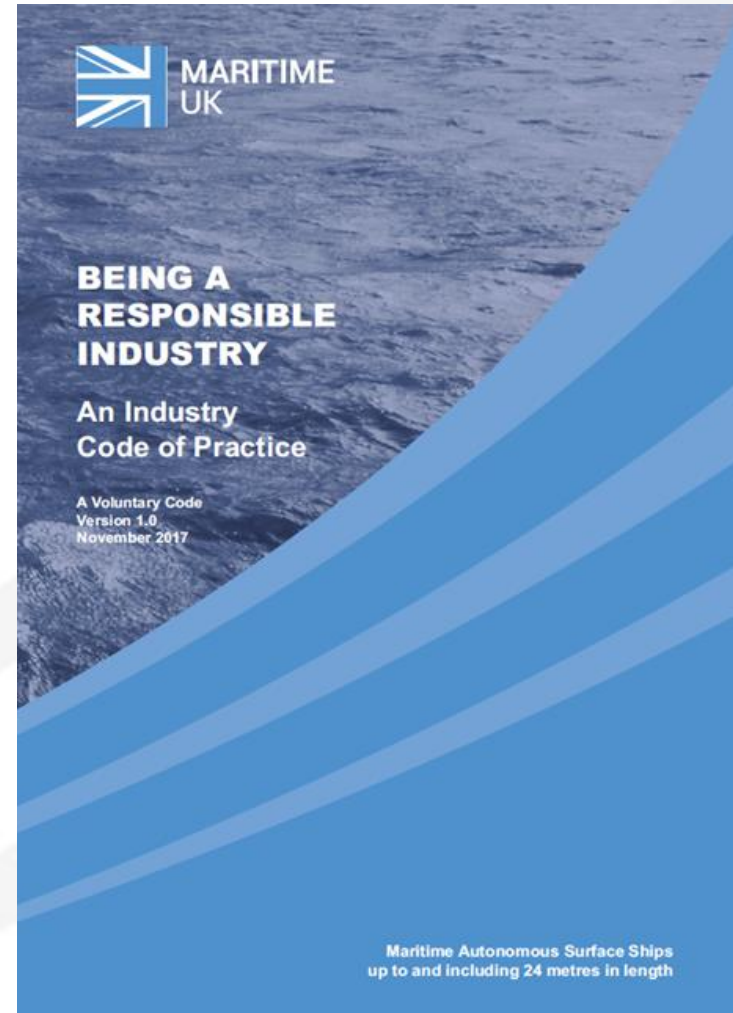
# Industry Codes

- **Pan industry agreement on aspects of MASS development, design, production and operation**
- **Best practice**
- **Assurance**
- **Safety and professionalism**
- **Training, conduct and personal responsibility**
- **Compliance and self-regulation**
- **Improved communications within the industry and the wider maritime community**

# Codes of Conduct & Practice



Published March 2016



Published November 2017



# Lloyds Register



## Foresight review of robotics and autonomous systems

There's a revolution. Smart, connected machines are acting as tools to support us, working alongside us or alone, making independent decisions and even learning.

## ShipRight Design and Construction

Additional Design Procedures

LR Code for Unmanned Marine Systems

February 2017



Working together  
for a safer world

# International Regulation

- **IMO Instruments**
  - International Regulations for the Prevention of Collisions at Sea (COLREGS)
  - Marine Pollution (MARPOL)
  - Safety of Life at Sea (SOLAS)
  - Standards of Training Certification and Watchkeeping (STCW)
- **MASRWG IMO Interaction**
  - Short INF Paper – MSC 95, June 2015
  - IMO lunchtime brief – MSC 96, May 2016
  - **IMO Scoping Exercise at MSC 99 – May 2018**
- **MASRWG Links with International Partners and Organisations**

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