UK Code of Practice

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Overview

- MASS - A maturing Industry
- Life before an Industry Code of Practice
- Development of the Code of Practice
- Contents and development going forwards
- Application

MASS - A maturing Industry, ASV's experience

ASV SASS - 2002

ASV FMTD4000 - 2007

ASV C-Cat 4 - 2011

ASV C-Sweep / Thales MMCM - 2017

System of Systems

New applications

Larger sizes / OTH / Open Ocean

Early R&D

Proof of Principles

Bigger / Faster vessels

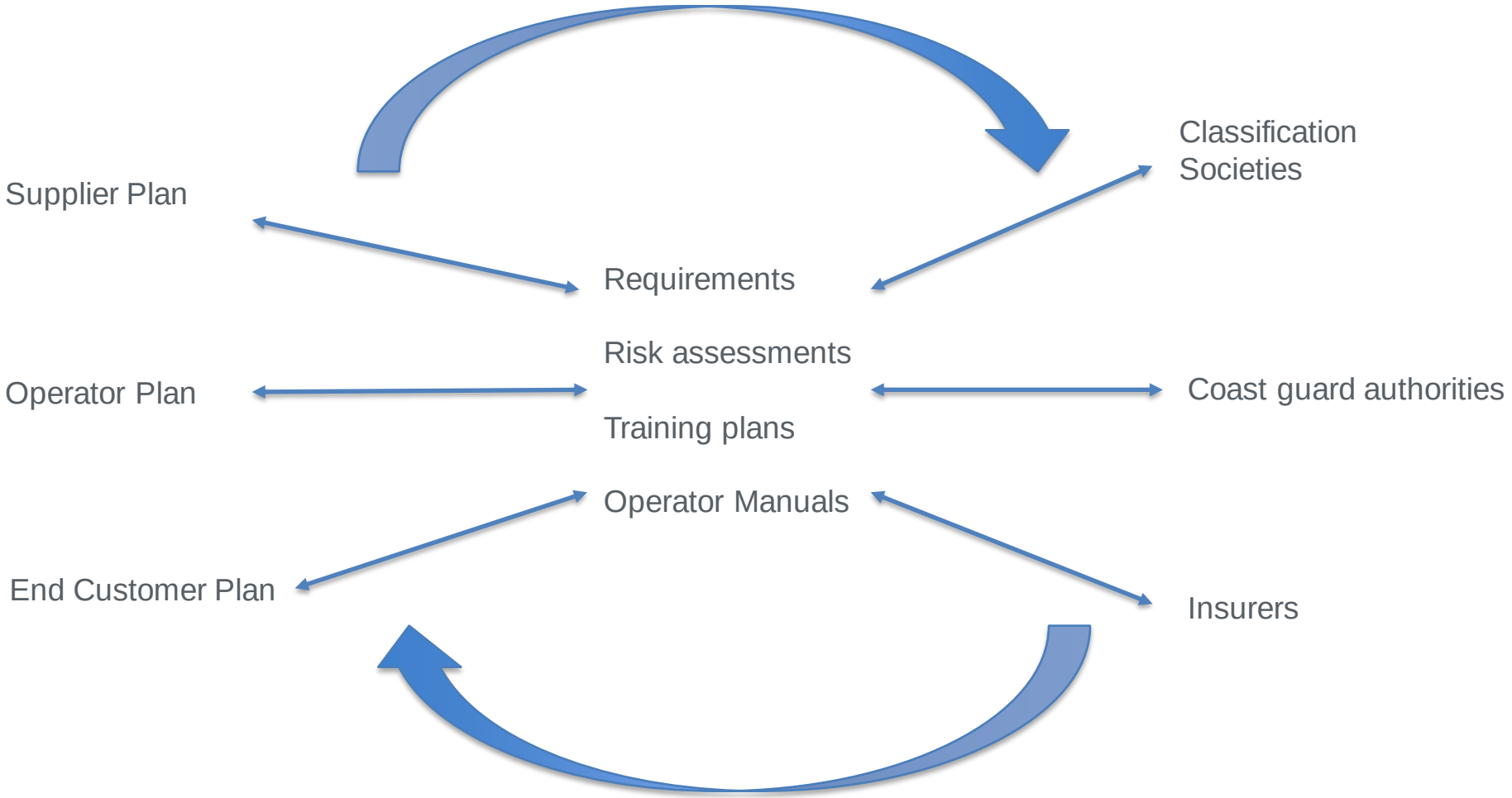
Increasing complexity / capability

Business case impact

Training / Operations / Regulations

~ 14% CAGR in market

Life before a Code of Practice



Took a long time

Expensive

Confusion in terminology

Lack of ‘something’ to comply with

Unsure of responsibilities

Hard to scale an industry or business this way

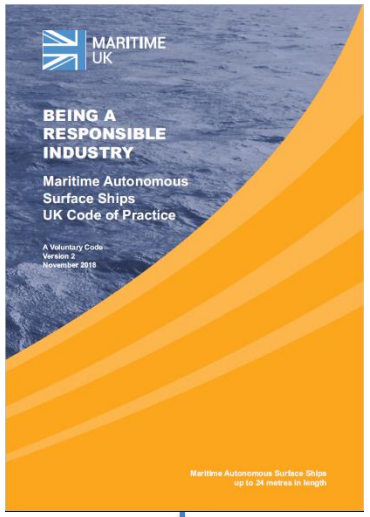
As many questions as answers

Life with the Code of Practice

Supplier Plan

Operator Plan

End Customer Plan



Classification Societies

Coast guard authorities

Insurers

Requirements

Risk assessments

Training plans

Operator Manuals

Operator Responsibility

Single point of reference

Continuous improvement

Gives customers something to reference in contracts

Gives operators something to reference in contracts

Working document that can reference and link to other codes / guides / rules.

Still not perfect but big improvement

Development of Code of Practice

UK Maritime Autonomous Systems Regulatory Working Group (MASRWG)

Chairmanship of James Fanshawe, support of Maritime UK

Combined efforts of approximately 60 people across 30+ organisations

Regular meetings, sub-committees and lots of voluntary time. (Huge Thanks!)

- The UK Maritime and Coastguard Agency
- Atlas Elektronik UK Ltd
- AutoNaut
- BAE Systems
- BMT Group
- Birch Reynardson & Co
- British Marine
- DSTL
- Dynautics Ltd
- EP Barrus
- Frazer-Nash Consultancy Ltd
- Fugro
- HT Chambers
- International Association of Institutes of Navigation (IAIN)
- IMarEST
- L3 ASV
- Lloyds Register EMEA
- Ministry of Defence – Naval Authority Group
- MSubs Ltd
- National Oceanography Centre
- The Nautical Institute
- University of Plymouth
- QinetiQ
- Rolls Royce
- RYA
- Seebyte
- Seiche
- Sonardyne International Ltd
- Thales UK
- The UK Chamber of Shipping
- UKHO
- University of Southampton
- Valeport Ltd
- Warsash Maritime Academy – Southampton Solent University

Contents

#	Topic
1	Foreword
2	Definitions
3	Application
4	Operations
5	Design / Manufacture
6	Nav Lights / shapes
7	Situational Awareness / Control
8	Communications Systems
9	Base control station operation
10	System integrity cert. and test
11	Operator standards of training
12	Identification, registration, certification
13	Safety management
14	Security
15	Prevention of pollution
16	Carriage and transfer of cargoes
17	Rendering of assistance to persons in distress
18	Salvage and towage

Version 2.0 available from Nov 18.

Process of continual improvement

The more people that read it and apply it the more input we will get, the better it will become.

These are all guidelines but aiming for an industry led record/guide of best practice.

Sure chapters, content and detail will come and go.

We are open for input!

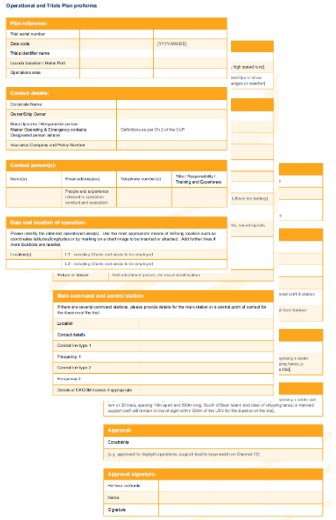
Application at L3 ASV – approach and lessons so far

L3 ASV Principles

- Be safe and responsible
- Follow and help develop industry best practice
- Obtain permissions from stakeholders
- Use systems engineering approaches for functional safety
- Obtain, develop and provide appropriate training
- Keep systems well maintained and in good working order
- Combine industry code of practice with own company experience / best practice
- Be realistic about the level of autonomy/supervision for the environment and application
- Take a wider industry approach, need to work with competitors and partners alike

Discussions with customer from the start, part of contract

Company Plan for deployment / operations → Apply Code of Practice (inc. registration) → Develop Risk Assessment → Inform MCA or equivalent → Ensure sufficient insurance in place → Conduct operations in accordance with plan


Operational and Trials Plan proforma

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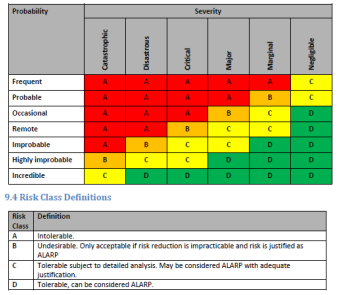


Probability	Severity					
	Catastrophic	Disastrous	Critical	Major	Marginal	Negligible
Frequent	A	A	A	A	A	C
Probable	A	A	A	A	B	C
Occasional	A	A	A	B	C	D
Remote	A	A	B	C	C	D
Improbable	A	B	C	C	D	D
Highly improbable	B	C	C	D	D	D
Incredible	C	D	D	D	D	D

9.4 Risk Class Definitions

Risk Class	Definition
A	Intolerable.
B	Undesirable. Only acceptable if risk reduction is impracticable and risk is justified as ALARP.
C	Tolerable subject to detailed analysis. May be considered ALARP with adequate justification.
D	Tolerable, can be considered ALARP.

mca Maritime and Coastguard Agency

Australian Government Australian Maritime Safety Authority

List of requirements:

AIS
Risk Assessment
Definition of emergency response plan, location of guard/response vessel

SHIPOWNERS HISCOX SURE Chartered Insurance Brokers

Others offer policies

ASView Software
Operations Manuals
Continual training
Daily reporting

Company Plan for deployment / operations

Operational and Trials Plan proforma

Plan reference:		
Trial serial number		
Date code		[YYYY-MM-DD]
Trials identifier name		
Launch Location / Home Port		
Operations area		

Contact details:	
Corporate Name	
Owner/Ship Owner	
Main Operator / Responsible person Master Operating & Emergency contacts Designated person ashore	Definitions as per Ch 2 of the CoP
Insurance Company and Policy Number	

Contact person(s):			
Name(s)	Email address(es)	Telephone number(s)	Title / Responsibility / Training and Experience
	People and experience relevant to operation conduct and execution		

Date and location of operation:	
Please identify the intended operational area(s). Use the most appropriate means of defining location such as coordinates latitudes/longitudes or by marking on a chart image to be inserted or attached. Add further lines if more locations are needed.	
Location(s)	L1: including Charts and areas to be employed
	L2: including Charts and areas to be employed

Schedule:		
Dates / times	Location	Activities
	[e.g. L1]	[e.g. station keeping, target towing, high speed runs]
		[or detail Operational window for trials/Ops to allow flexibility for delays, programme changes or weather]

Unmanned craft details:			
Total number of unmanned craft		Telephone number(s)	
Please complete the following, and create a separate table for each craft involved in the trial:			
Name(s)			
AIS Transmission?	Yes/No. Note – AIS should normally be fitted.	MMSI:	
Length overall		Beam	
Draught		Displacement	
Max speed		Operational speed	
Propulsion type	[e.g. twin propeller]	Fuel	[e.g. Lithium ion battery]
Payloads	[and detail any towed sensors: size and depth]		
Visual & sound identification	[e.g. port of Origin & Destination, vessel description; shapes, lights, sound signals, flags]		
Design and Build Assurance details if available (Including Load Line requirements if appropriate)			
Picture of Vessel	Add attachment picture, for visual identification		

Main command and control station:	
If there are several command stations, please provide details for the main station or a central point of contact for the duration of the trial.	
Location	
Contact details	
Control link type 1	
Frequency 1	
Control link type 2	
Frequency 2	
Details of OFCOM license if appropriate	

Safety Case:	
Safety Case / Risk Assessment	Reference to attached Documents
Please specify the consequences in the event of a failure of command and control datalink:	
[e.g. propulsion will stop after a timeout of 15 seconds] Include use of guard ship/support vessels employed or on immediate stand-by Immediate salvage of 'vessel not under command' (Total power loss or Command Link failure)	

Support craft:	
Number and type of support craft	
Name / call sign	
Phone number	
MMSI if transmitting on UAIS	
Intended role during trial, and station/proximity during trial/Ops	[including, Time to close to unmanned craft & station keeping requirements]
Unmanned craft recovery method	[Including role to tow vessel to and from harbour facility or launch area]

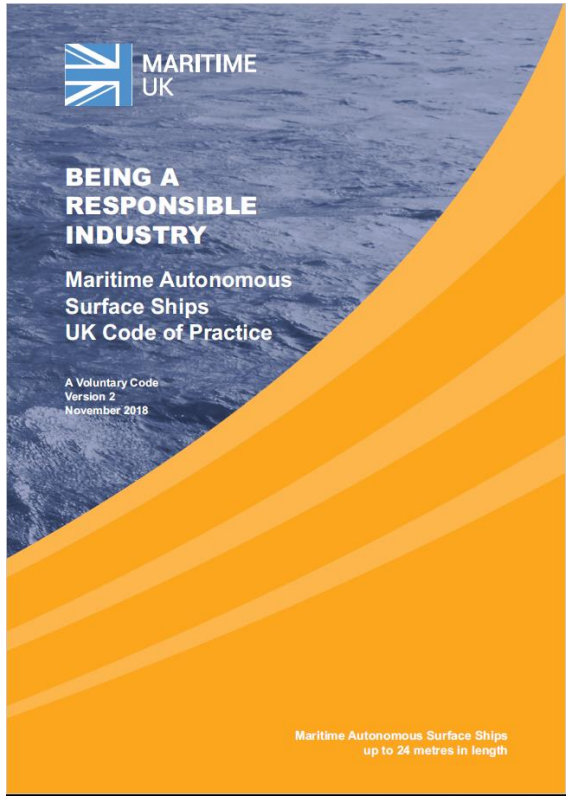
Brief description of trials operations:
Please provide a description of intended operations
[e.g. – the USV will be running a survey pattern in an area South of Bear Island, typically comprising a raster pattern or 20 lines, spacing 10m apart and 500m long, South of Bear Island and clear of shipping lanes; a manned support craft will remain in line of sight within 300m of the USV for the duration of the trial].

Additional information:
[e.g. – the USV will be running a survey pattern in an area South of Bear Island, typically comprising a raster pattern or 20 lines, spacing 10m apart and 500m long, South of Bear Island and clear of shipping lanes; a manned support craft will remain in line of sight within 300m of the USV for the duration of the trial].

Approval:
Constraints
[e.g. approved for daylight operations, support boat to keep watch on Channel 13]

Approval signature:			
Harbour authority			
Name			
Signature			

Apply Code of Practice (inc. registration)



#	Topic	Compliance (ASV produce a document with customer)
1	Foreword	
2	Definitions	Agree and understand environment, area of operation, level of control
3	Application	Agree class of MASS
4	Operations	Complete operation / trials plan – template provided
5	Design / Manufacture	Design, construct, maintain in compliance with requirements of Class. Society or applicable national standards with equivalent level of safety.
6	Nav Lights / shapes	In accordance with COLREGS, exemptions to be justified with link to safety case / risk assessment
7	Situational Awareness / Control	Show compliance on a vessel by vessel basis
8	Communications Systems	Show compliance on a system by system basis
9	Base control station operation	Show compliance on a system by system basis
10	System integrity cert. and test	Document test procedures, pass criteria and results.
11	Operator standards of training	Show equivalence to manned operation and vessel specific content
12	Identification, registration, certification	Select as required for operating area / size, work with national body
13	Safety management	Develop for operation and show compliance
14	Security	Equivalence / Compliance to IMO ISPS, generate security assessment and plan
15	Prevention of pollution	Show compliance on vessel by vessel basis
16	Carriage and transfer of cargoes	Define if applicable
17	Rendering of assistance to persons in distress	Include in operating plan / training
18	Salvage and towage	Define towage plan, comply with slavage law

https://confluence.asvglobal.com/pages/viewpage.action?spaceKey=SE&title=TEMPLATE+-+MASRWG+Code+of+Practice+V2.0+Compliance+Sheet

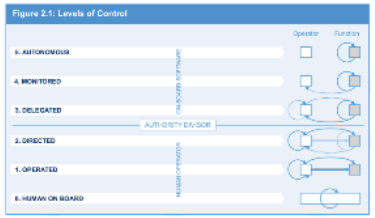
Systems Engineering

Pages
Blog

SPACE SHORTCUTS
Meeting notes
Product requirements

PAGE TREE
Admin
Bibliography
CE Marking
Configuration Process
Engineering Director Agenda - Proje
Generic IVVQ Plan
Intellectual Property
Issue Log
Meeting notes
Process
Bid
Electrical Design
Engineering Management
Mechanical Design
Operations
Production
Project
Acceptance & IVVQ
Compliance
CE Marking Process
Regulatory Bodies for Autonc
DNVL Class Guidelines
MASRWG Code of Practice
MASRWG Code of Practice
MASS Signoff
P479 Background
Regulatory Background
TEMPLATE - MASRWG Co
Configuration Control
Lessons Learnt - Project
Reviews
Software & Control
Product requirements
Project Engineering
Projects Dashboard
Resources
Systems Engineering Introduction

Space tools

CoP Reference	CoP Text	ASV Compliance Statement	Noted Deviations
4.3.1	Operation Type	• Long-term monitoring or survey voyage	
4.3.3	Areas of Operation (from Table 2.1)	SATs have demonstrated the following: • Area Category 3 (up to 20 miles form a safe haven)	
4.4.1	Ship Type	• Purpose : Survey • Cargo Type : Not Applicable • Propulsion method : 2xDC Brushless Motors	
4.4.3	Physical Specification	• Length: 4.75 m • Beam: 2.19 m • Height: 3.44 m (keel up, from base) • Draft: 0.68 m keel up • *Weight: kg lightship* Weight will be stated on the hull plate	
4.4.4	Operating Speed	• Maximum : 5 kts • Typical : ~3 kts • Minimum : ~0 kts Results are available from a instrumented Sea Trial on 3rd September 2018, and ASV shall deliver an updated propulsion report in document ASV-480-4-200	
4.5.1	Control Method(s) (from Figure 2.1& Table 2.3)	Referencing the specific definitions of the CoP from Figure 2.1 Figure 2.1: Levels of Control  And Table 2.3 Table 2.3: Level of Control Definitions Level | Name | Description 0 | Manned | Vessel/craft is controlled by operators aboard 1 | Operated | Under Operated control all cognitive functionality is controlled by the human operator. The operator has direct contact with the Unmanned Vessel over e.g., continuous radio (R/C) and/or cable (e.g., tethered UUVs and ROVs). The operator makes all decisions, directs and controls all vehicle and mission functions. 2 | Directed | Under Directed control some degree of reasoning and ability to respond is implemented into the Unmanned Vessel. It may sense the environment, report its state and suggest one or several actions. It may also suggest possible actions to the operator, such as e.g. prompting the operator for information or decisions. However, the authority to make decisions is with the operator. The Unmanned Vessel will act only if commanded and/or permitted to do so. 3 | Delegated | The Unmanned Vessel is now authorised to execute some functions. It may sense environment, report its state and define actions and report its intention. The operator has the option to object to (veto) intentions declared by the Unmanned Vessel during a certain time, after which the Unmanned Vessel will act. The initiative emanates from the Unmanned Vessel and decision-making is shared between the operator and the Unmanned Vessel. 4 | Monitored | The Unmanned Vessel will sense environment and report its state. The Unmanned Vessel defines actions, decides, acts and reports its action. The operator may monitor the events. 5 | Autonomous | The Unmanned Vessel will sense environment, define possible actions, decide and act. The Unmanned Vessel is afforded a maximum degree of independence and self-determination within the context of the system capabilities and limitations. Autonomous functions are invoked by the on-board systems at occasions decided by the same, without notifying any external units or operators. ASV mark the following definitions of capability for this vessel with justification: ☐ Human on Board : NO ☑ Operated : YES - direct operation from the helm ☑ Directed : YES - standard ASView autopilot functions such as heading hold, go to waypoint, line-following, etc. ☑ Delegated: YES - AIS-based collision avoidance system	

Developed a compliance tool within Confluence.

Some elements are standard for all ASVs.

Some elements are specific to particular vessels or operations.

Format we can share within the design, build, operations teams and with the customer.

Develop Risk Assessment

Look at stages and consider risk severity, probability and mitigation at each;

- Design
- Build
- Trials / Commissioning
- Training
- Logistics / Transport
- Launch and recovery
- Operations
- Maintenance
- Modification / Upgrade
- End of life

Probability	Severity					
	Catastrophic	Disastrous	Critical	Major	Marginal	Negligible
Frequent	A	A	A	A	A	C
Probable	A	A	A	A	B	C
Occasional	A	A	A	B	C	D
Remote	A	A	B	C	C	D
Improbable	A	B	C	C	D	D
Highly improbable	B	C	C	D	D	D
Incredible	C	D	D	D	D	D

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D	Tolerable, can be considered ALARP.

Inform MCA or equivalent

- Current guidance from MCA;
- Give early indication of plans / operations
- Use operation planning templates, Code of Practice, Risk Assessment
- Testing / Operating in UK Waters (current advice – Katrina Kemp, January 2019)
    - Ensure the vessel is fitted with a functioning and always-on **AIS** beacon to broadcast the vessel's location to local maritime traffic & relevant authorities;
    - Ensure the vessel is fitted with appropriate **lights and sounds** to alert local traffic to the unmanned vessel's presence;
    - Deploy a **guard vessel** (or suitable alternative capable of providing an equivalent function) alongside the MASS during deployment and operations; - *Note from L3 ASV/MCA, discuss what vessels could be used that are already in the area, response time from vessel on standby etc, consider environment and traffic.*
    - Undertake a **Risk Assessment** for the proposed operation – to include an operations brief/method statement, identified risks and mitigation measures and relevant diagrams, tables & images etc;
    - Prepare an **Emergency Response Plan** (ERP) – to include an appropriate emergency response workflow and emergency contact details in the event of an incident etc;
    - Within categorised waters: operators should notify the relevant navigation authority of their proposed activity and seek further guidance to facilitate operations;
    - For unmanned craft operating at sea i.e. outside of categorised waters:
        - Vessels should be surveyed against **Load Line** requirements and obtain either a Load Line exemption or a Workboat Code certificate (as appropriate);
        - Issue a **local Notice to Mariners** to relevant stakeholders (including the MCA & HM Coastguard) – to include an operations brief/method statement, relevant diagrams, tables & images, and emergency contact details etc;
        - Where appropriate, issue a **radio navigation warning** (RNW; WZ) via the UK Hydrographic Office.

Ensure sufficient insurance in place

- Increasing number of organisations offering MAS insurance policies
- Suggest contacting them early with operations / vessel plan
- Work completed on vessel design, code of practice compliance, risk assessment and operations plan all help communication with insurer to ensure comprehensive coverage.
- Company responsibility to check with customers and discuss this topic

Conduct operations in accordance with plan

- Make sure operations team are fully briefed in the preparation for the operation and aware of the:
  - Plan for deployment
  - Code of Practice compliance (including training obligations)
  - Risk Assessment
  - Discussions, agreements and guidance with MCA and equivalents
  - Emergency response plans are in place
  - Insurance is in place
  - How to complete the deployment in accordance with the above and any other company or local requirements.

Recent Deliveries / Projects

Code of Practice Going Forwards

Process of continual improvement. Expect it to be applied on 10's of systems this year. A lot will be learnt.

The focussed workshops will now involve four sub groups;

a. **Governance and Regulation** - Covering Leadership, Stakeholder engagement, regulatory framework, technology developments, Conference and Registration. (Chair – Richard Westgarth)
b. **Codes and Operations** - Covering the codes of Conduct and Practice, Infrastructure, Test and demo environments. (Chair – Andy Higgins)
c. **People and Skills** - Covering Training and skills, Human element and ethics. (Chair – Captain Bob Hone)
d. **Services** - covering Legal, Insurance, Business services and trading. (Chair - Camilla Slater)

Encourage continued support from international stakeholders, synergistic links to other working groups and codes. Strength will come from working together on this.

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ASV

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