Trusted Autonomous Systems

Australian Code of Practice for the Design, Construction, Survey and Operation of Autonomous and Remotely Operated Vessels

Webinar

5 July 2021

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TRUSTED AUTONOMOUS SYSTEMS

Agenda

- Background to the project
- Outcomes of our review into other available codes and standards for autonomous and remotely operated vessels
- Proposed scope of the Australian Code of Practice
- Proposed approach of the Australian Code of Practice

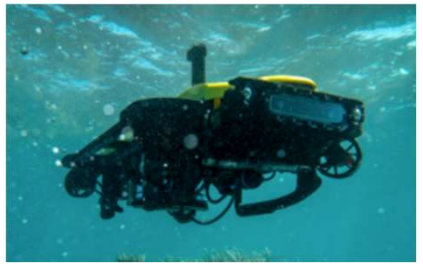
Introduction to Trusted Autonomous Systems (TAS)

- Non-profit cooperative research centre, funded by Defence, Next Gen Technologies Fund, and QLD Government
- Multiple streams of business:
  - Facilitating game changing Defence technology collaborative projects
  - Facilitating common good activities:
    - A1: Ethics and Law of Trusted Autonomous Systems
    - A2: Assurance of Autonomy
      - "Enabling Agile Assurance of Drones in Queensland" (Biarri project)
      - National Accreditation Support Facility Pathfinder Project (NASF-P)

Overview of project

- Purpose: Improve the assurance and accreditation process for autonomous and remotely operated vessels by creating a tailored set of standards that industry can voluntarily use, and AMSA will recognise as best practice
- Process:
  - Part 1: Prepare a report that includes:
    (a) Analysis of available codes and standards
    (b) Consideration of suitability of existing codes and standards for Australian context
    (c) A recommendation regarding the use of an existing code or standard as a base
    Completion date: mid-June 21
  - Part 2: Develop and release draft Code of Practice
    (a) Engage with key stakeholders to create draft Code of Practice
    (b) Undertake broad consultation on draft Code of Practice
    (c) Release and promote draft Code of Practice
    Completion date: early October 21
- Team: Led by Maaike Vanderkooi for TAS, supported by Rachel Horne (TAS) and Robert Dickie (Frazer-Nash Consultancy)

Vessel examples



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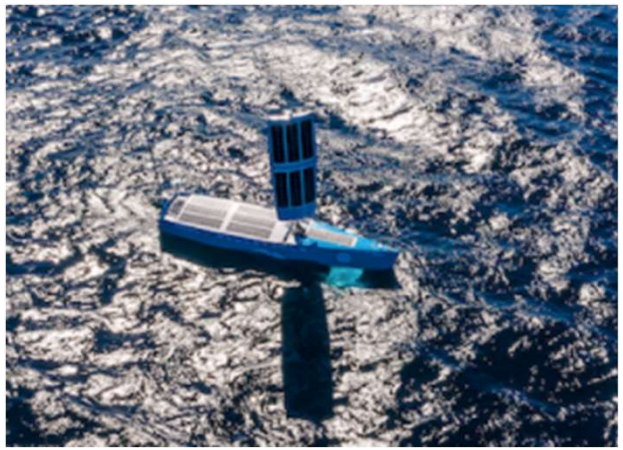
Why do we need this Code, and the other related TAS projects, in 2021?

- Increasing use in industry
  - HIPP program/hydrographic surveying
  - oil and gas
  - scientific research/data gathering
  - development for future Defence purposes
- Increasing use for border protection
- Increasing use by Defence
  - Navy SEA1905 [Mine countermeasures and military survey, $1 billion investment]
  - Autonomous Warrior Exercises
  - DST



Australian Code of Practice for the Design, Construction, Survey and Operation of Autonomous and Remotely Operated Vessels

Part 1: Review of available codes and standards

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Review of available codes and standards

- Three available codes and standards were reviewed:
  - UK Code for Maritime Autonomous Ship Systems
  - LR Code for Unmanned Marine Systems
  - DNV Guidelines for Autonomous and Remotely Operated Ships
- Comparative analysis of the requirements of each of the codes
  - What aspects of the vessel and its operations are covered by the code?
  - What are the requirements for each vessel aspect?
- Considered the codes in the Australian regulatory context for domestic vessels

Key findings of the review

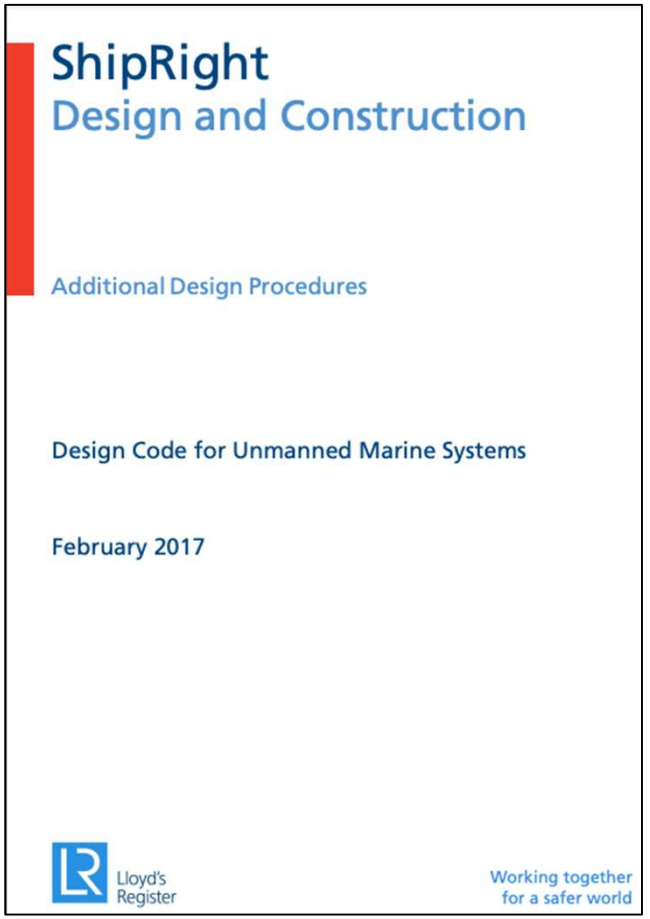
- None of the available codes and standards provide a template that could be tailored for use in Australia with only minor modifications
  - Generally focussed on larger, more sophisticated vessels which comply with international conventions
  - Do not easily accommodate the kinds of autonomous vessels that are operating in Australia today
  - Do not align with the Australian regulatory requirements for domestic commercial vessels
- However, the requirements of each of the codes will inform the modifications and additions to the standards that already apply to commercial vessels operating in Australia, particularly the requirements for:
  - electrical systems and propulsion and manoeuvring (machinery)
  - navigation and control systems
  - verification / survey
  - software integrity and cyber security
  - operations (including crewing)

UK Code for MASS

- Applies to surface MASS up to 24m
- Performance-based, with guidance
- Covers the design, construction, survey and operation (including crew competencies) of MASS
- Significant focus on operations – tasking of MASS, hierarchies of control and operator competencies
- Tailored towards vessels which comply with international conventions
- Includes performance requirements for all aspects of the design, construction and operation of the vessel, even those covered by conventional vessel standards

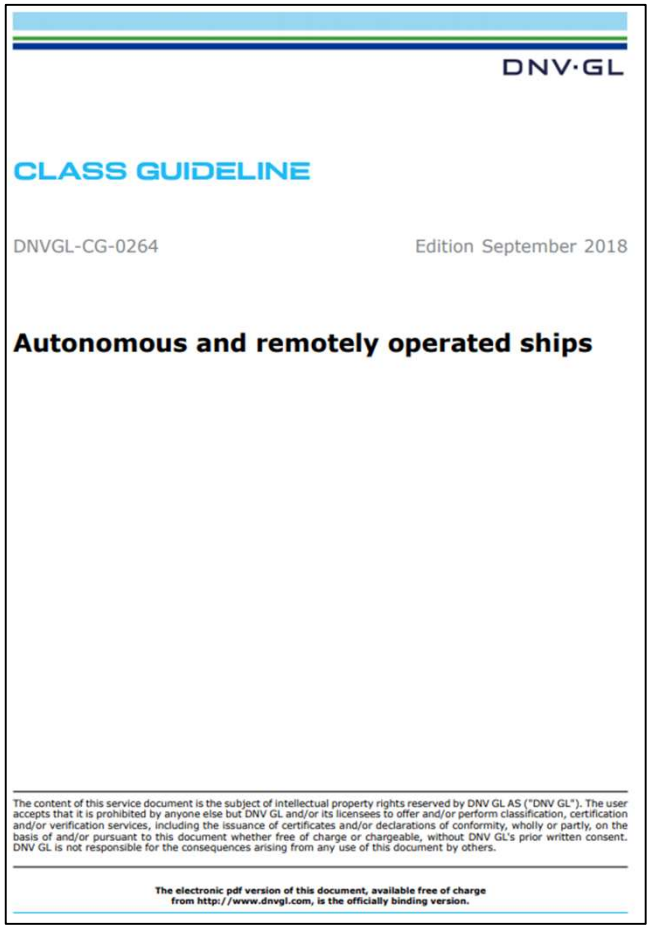
LR Code for UMS

- Applies to surface vessels and submersibles that can be operated without personnel on-board
- Focuses on vessel design and construction and ability to operate safely
- Includes detailed performance requirements for all aspects of the vessel, even those for which conventional vessel requirements would apply
- However, in practice, vessels would be expected to meet the LR Class Rules for most aspects of the vessel
- Where relevant rules or standards do not exist, the performance requirements must be met by risk-based analysis



DNV Guidelines

- Very detailed process for DNV to assess and approve novel technologies for the autonomous and remote control of ship functions
- Focuses on the different requirements for autonomous vessels, and does not contain requirements covering the whole of the autonomous or remotely operated vessel
- Autonomous and remotely operated vessels must be verified and approved as meeting the same level of safety as a conventional vessel



DNV·GL

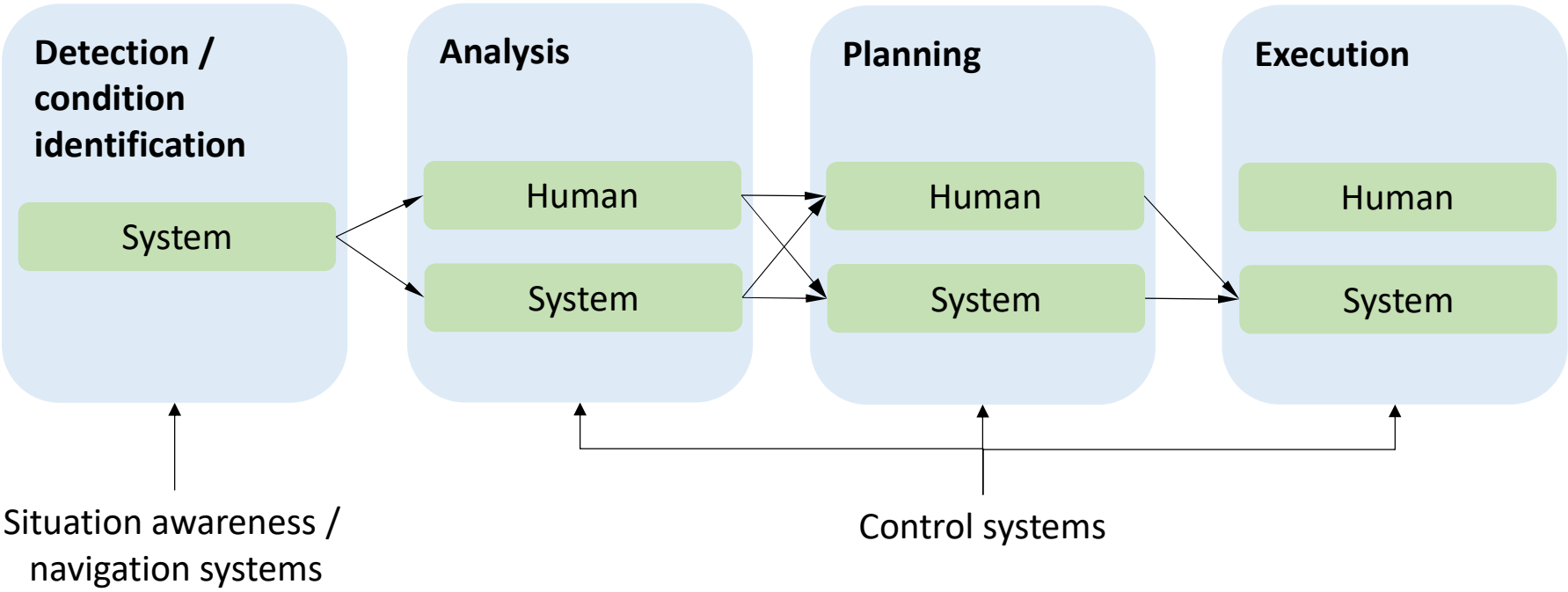
CLASS GUIDELINE

DNVGL-CG-0264 Edition September 2018

Autonomous and remotely operated ships

Situational awareness and control systems

(DNV Guidelines – example only)



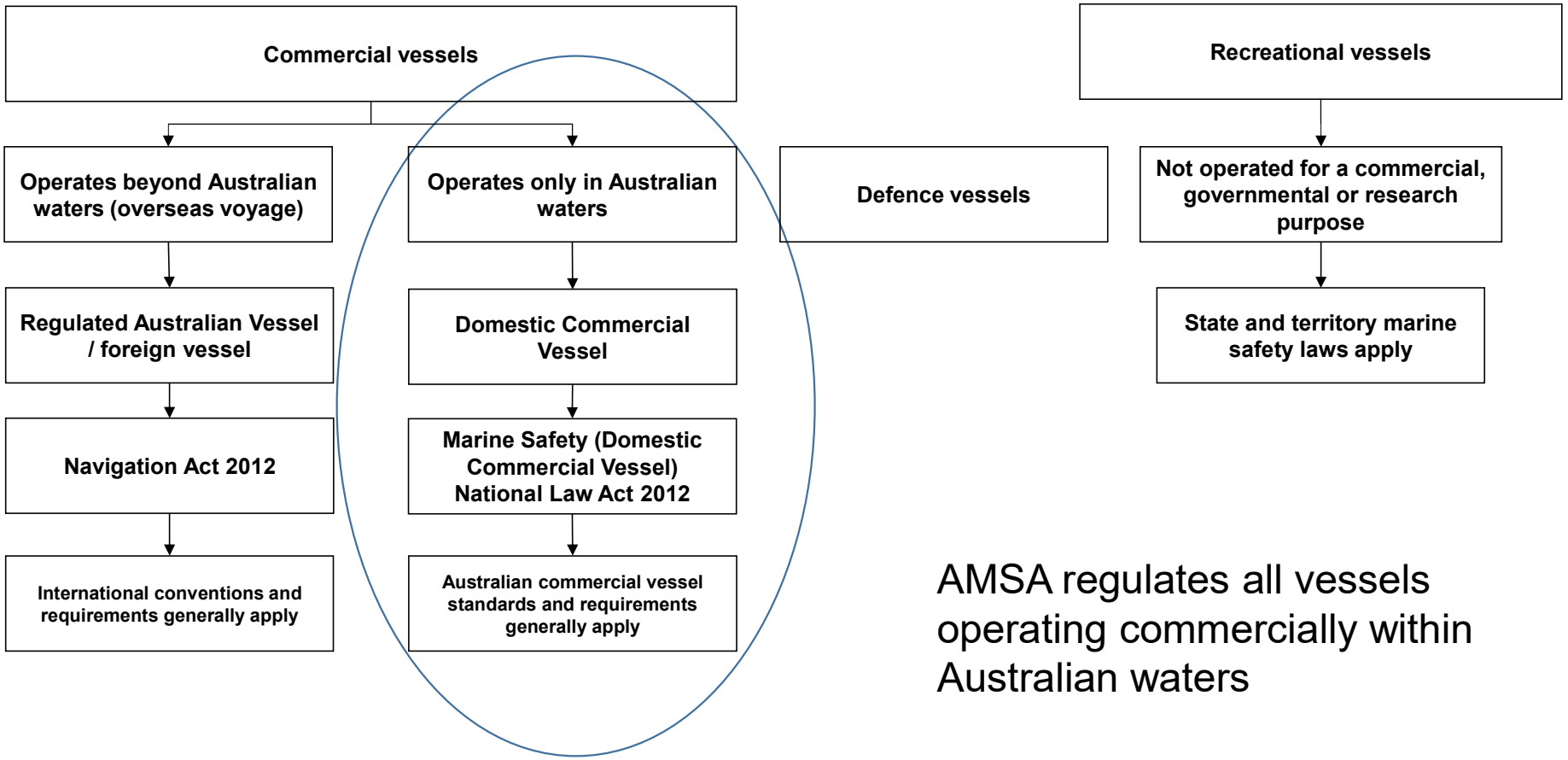
Control system requirements

	UK Code	LR Code	DNV Guidelines
Performance requirements	Must be able to operate in compliance with COLREGS. Requirements for data interpretation (analysis) and decision making, either by a system or human. Requirements for vessel control (execution of decisions).	High level performance requirements, such as: *control system is to respond in a timely, accurate and predictable manner commensurate with the equipment limitations and manoeuvring capability of the UMS.*	Must be able to operate in compliance with COLREGS. Requirements apply to each element of control (detection, analysis, planning and execution), and depend upon whether a human or system is responsible for the control element. For example, there are performance requirements for object detection and classification systems.
Risk assessment	Risk assessment must be undertaken focussing on potential failures (eg FMEA).	Control system must be designed and arranged to meet the required level of integrity, determined by assessing the effect of all reasonably foreseeable system failures and their consequences	Risk assessment (eg FMEA) on operational aspects of vessel. Risk assessment on any novel technology used as part of the control system (eg FMEA).

Snapshot of the available codes

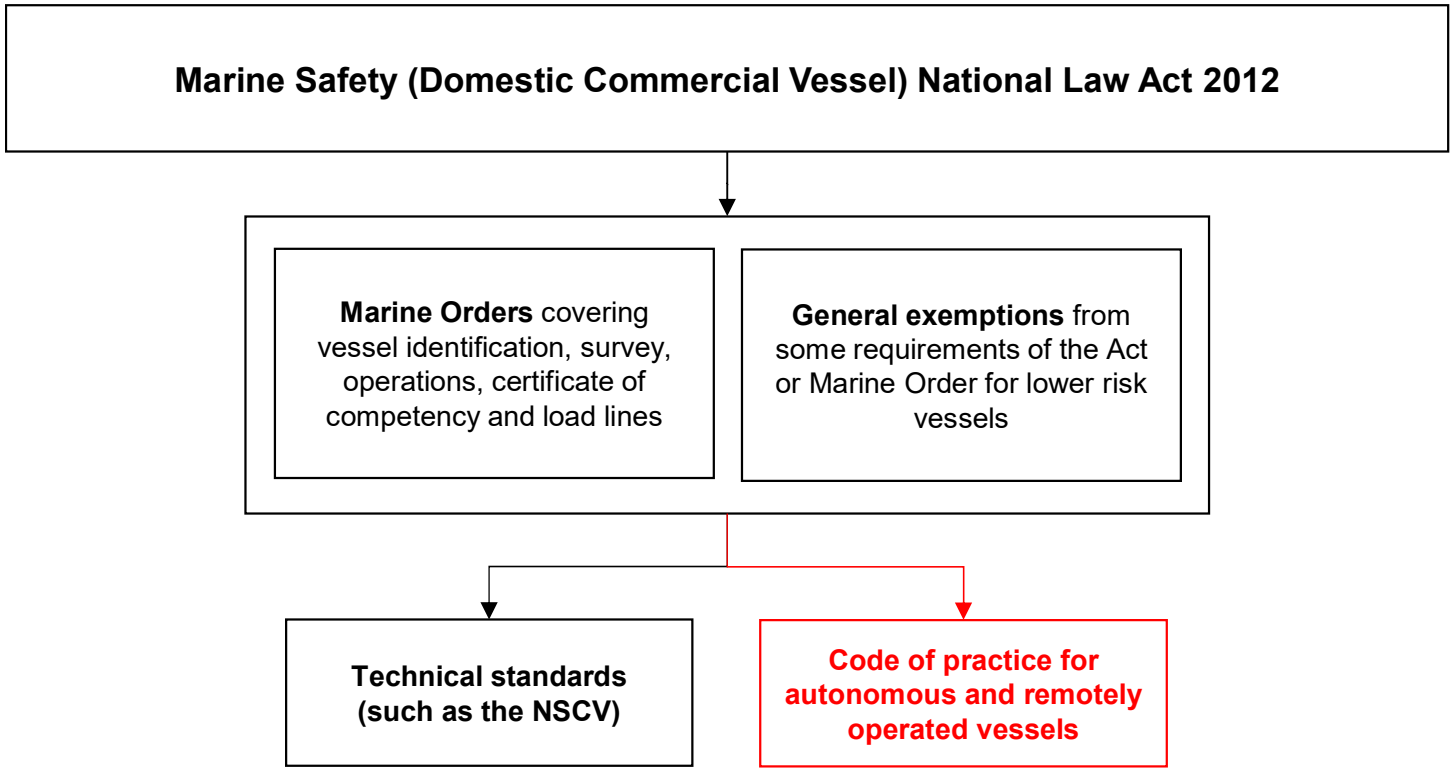
	UK Code	LR Code	DNV Guidelines
Design and construction (general)	Designed, constructed and maintained in compliance with the requirements of a classification society or in accordance with applicable national standards Justifications for departures	Detailed performance requirements	Process for approval of new approach or new technology
Engineering	Some additional requirements (eg redundancies)		Performance requirements and detailed guidance
Communications	As per conventional vessels		
Navigation equipment & situation awareness	Must enable the vessel to comply with COLREGS		Must enable the vessel to comply with COLREGS Detailed performance requirements
Control	Risk assessment / failure mode analysis	Risk assessment / failure mode analysis	Risk assessment / failure mode analysis
Safe states and contingency planning	✓	✓	✓
Control centre	✓	✓	✓
Hierarchy of control	✓	✓	
Operator competencies	✓		
Software integrity & cyber security	✓	✓	✓

Australian regulatory context

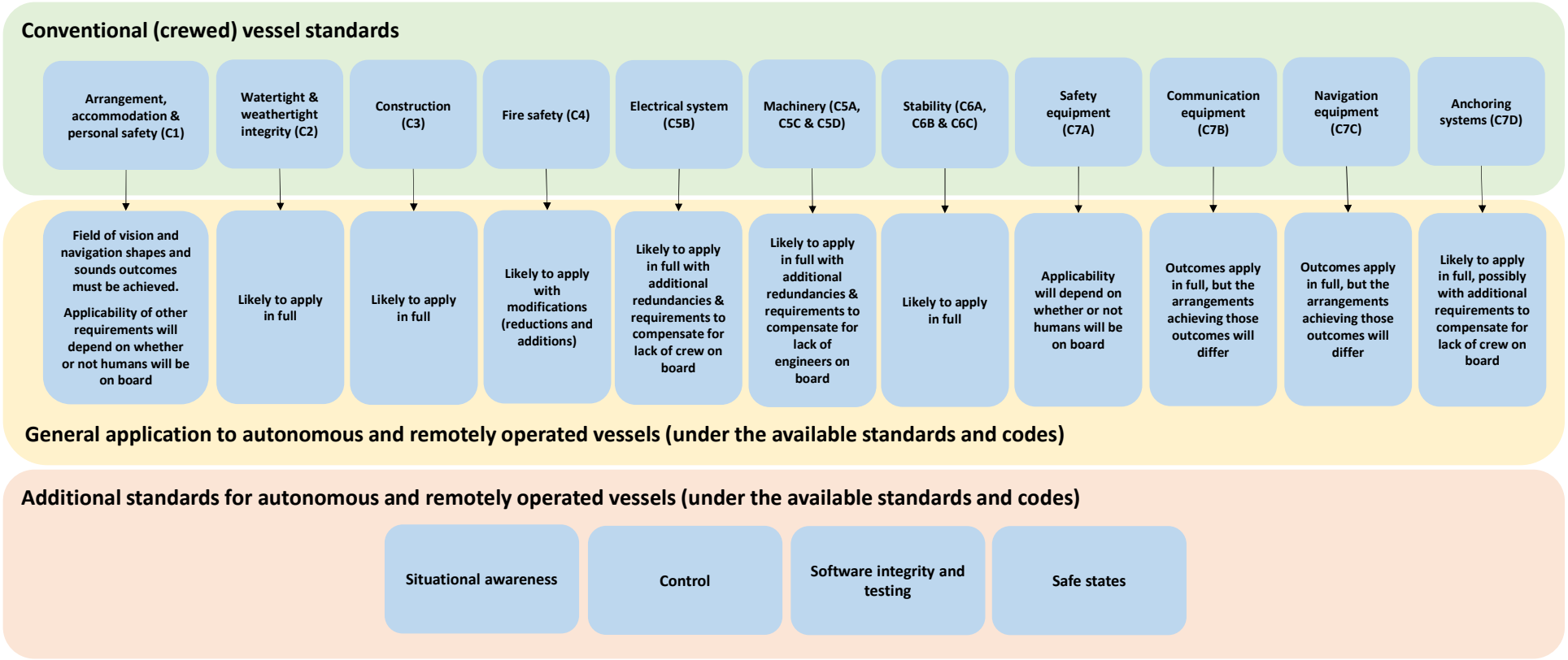


AMSA regulates all vessels operating commercially within Australian waters

Australian regulatory arrangements – domestic commercial vessels



Considering the codes in the Australian context



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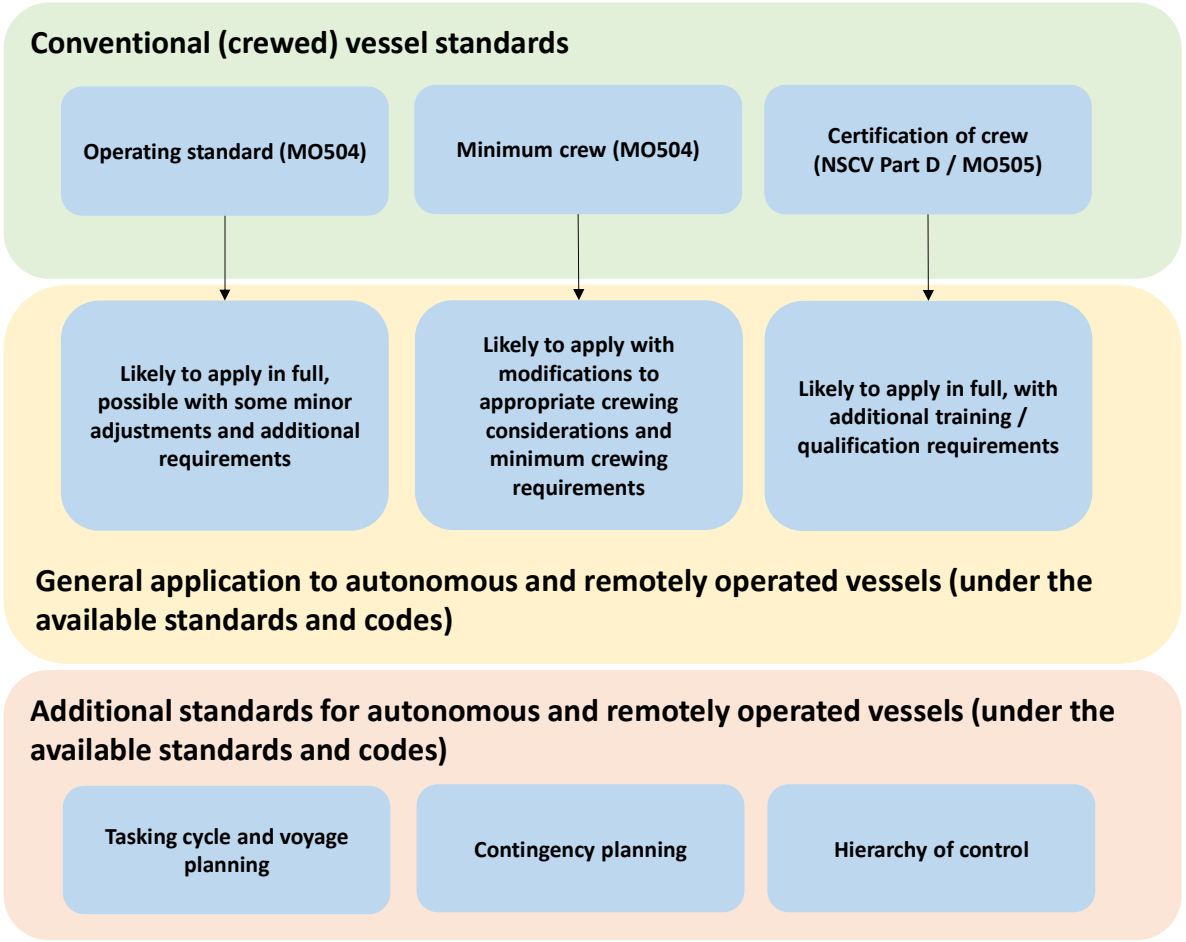
Considering the codes in the Australian context



Australian Code of Practice for the Design, Construction, Survey and Operation of Autonomous and Remotely Operated Vessels

Part 2: Development of the Code of Practice

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Proposed application of Code

- **Surface and sub-surface vessels**
- **Domestic or international vessels**
  - Tailored towards domestic commercial vessels (DCV)
  - Informative for regulated Australian vessels (RAV) (vessels that operate beyond Australian waters, noting that additional international conventions and requirements may apply to RAV, beyond the Code)
- **Autonomous and remotely operated**
  - Tailored towards vessels that are not designed to accommodate persons (except for limited or defined periods eg trials or while docking)
  - Encompasses all vessels *capable* of operating without a master or crew onboard
- **Size**
  - Tailored towards vessels <12m
  - Encompasses vessels of all sizes
- **Class**
  - Tailored towards non-passenger vessels
- **All operational areas (domestic)**

Proposed approach of Code

- **Establish requirements that align with vessel risk**
  - Introduce a new category of ‘autonomous marine equipment’ for very low risk autonomous vessels
- **Align with the Australian regulatory context**
  - Comply with the National Standard (NSCV) as applicable – with modifications / additions
  - Allow for the re-configuration of conventional vessels
  - Allow for partial autonomation
- **Utilise existing requirements and approaches**
  - Use the performance requirements of the NSCV, where possible
  - Apply widely accepted methods for risk-analysis, such as FMEA
- **Safety outcomes: the risks posed by remotely controlled and autonomous vessels should be minimised so far as reasonably practicable**
- **The code should allow for and facilitate technological innovation**

Vessel categories

- Code will identify different categories of autonomous vessels so that the requirements can be aligned with risk
- Example: **Autonomous marine equipment**
  - Small, light surface and sub-surface vessels which are not capable of inflicting significant damage or causing significant safety risks
  - Treated as marine equipment, rather than vessels

Issues for discussion at the stakeholder workshops

- Requirements for the different categories of vessels
- Example: **autonomous marine equipment**
  - Monitoring requirements
  - Support vessel requirements
  - Requirement to be able to be collected within a reasonable period if the vessel stops operating
  - Visibility (when on surface) requirements
  - Must not pose a risk to the environment
  - Safety Management System requirements
  - Requirement to inform waterway manager of operation
  - General crew competency requirements plus additional training or certification

All vessels: the approach to COLREGs

- The International Regulations for Preventing Collisions at Sea (COLREGs) outline internationally agreed rules for safe navigation, including ‘give way’ rules and requirements for lights, shapes and signals to be used to prevent collisions
- Full compliance to COLREGs unrealistic for autonomous and remotely operated vessels at this point
- Extent of COLREGs compliance, and ability to use alternative systems to achieve equivalence, may determine the operations that can be undertaken by the vessel
- Separate TAS separate project on COLREGs compliance
  - Work on the COLREGs project will feed into the Code
  - Led by Robert Dickie, Frazer-Nash

Next steps

- Develop draft framework and content for the Code
- Stakeholder engagement on draft content
  - AMSA workshops
  - Stakeholder workshops: Thursday 22 July to Monday 26 July
- Public consultation on draft code (August)
- Final draft released later in the year
- Code will then continue to be reviewed and updated

Questions?

Please email additional questions and comments to:
maaike@vanderkooiconsulting.com.au