

Autonomous Ships/Vehicles: Classification Society Perspective



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Agenda

- Trends
- Regulatory DevelopmentABS Activities
- - Building Blocks Cyber, Software, Data
 - Smart to Autonomous



Trends in Autonomy in Commercial Shipping

- Increasing application of technology to augment and replace personnel
- Significant industry activity focused on navigation and bridge level crew augmentation
- Dedicated routes/short shipping routes (repeatable operational profile) allowing actual autonomous operations with human oversight



IMO Scoping Exercise

MARITIME SAFETY COMMITTEE

Maritime Autonomous Surface Ships (MASS) – Proposal for a regulatory scoping exercise

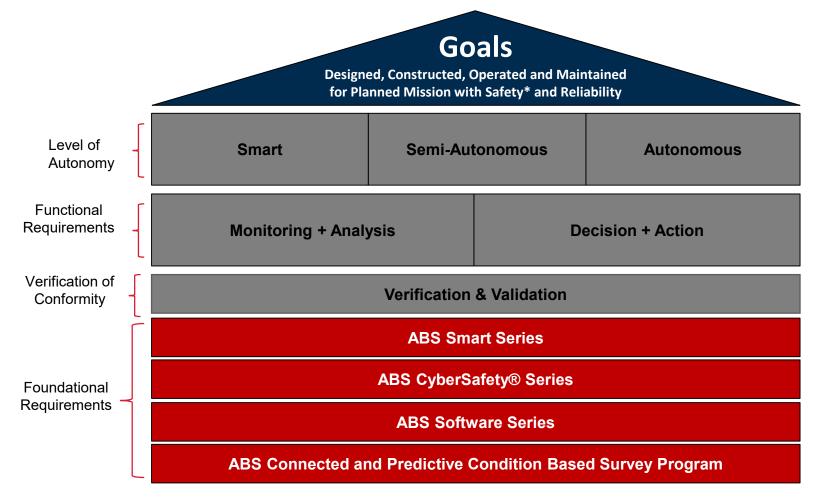
Degrees of Autonomy

- Ship with automated processes and decision support
- Remotely controlled ship with seafarers on board
- Remotely controlled ship without seafarers on board
- Fully autonomous ship

Source: MSC 100



Smart to Autonomous Framework



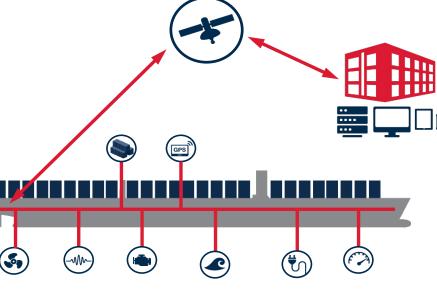
^{*}Safe execution of mission has to consider the impact on/consequences to people, environment and the vessel



Functions of a Smart Vessel

Structure Health Mon.

- Monitor structural loads, response, and health conditions
- Enhance safety and integrity
- Avoid damage and failures



Crew Asst. & Augmentation

- Assist crew activities
- Augment crew's ability, such as night vision, obstacle detection, collision avoidance, etc.

Asset Eff. Monitoring

- Assess system efficiency
- Optimize maintenance and tune-up activities



Machinery Health Mon.

- Monitor health and conditions of onboard machinery
- Detect operational anomalies
- Prevent system failure and unplanned downtime

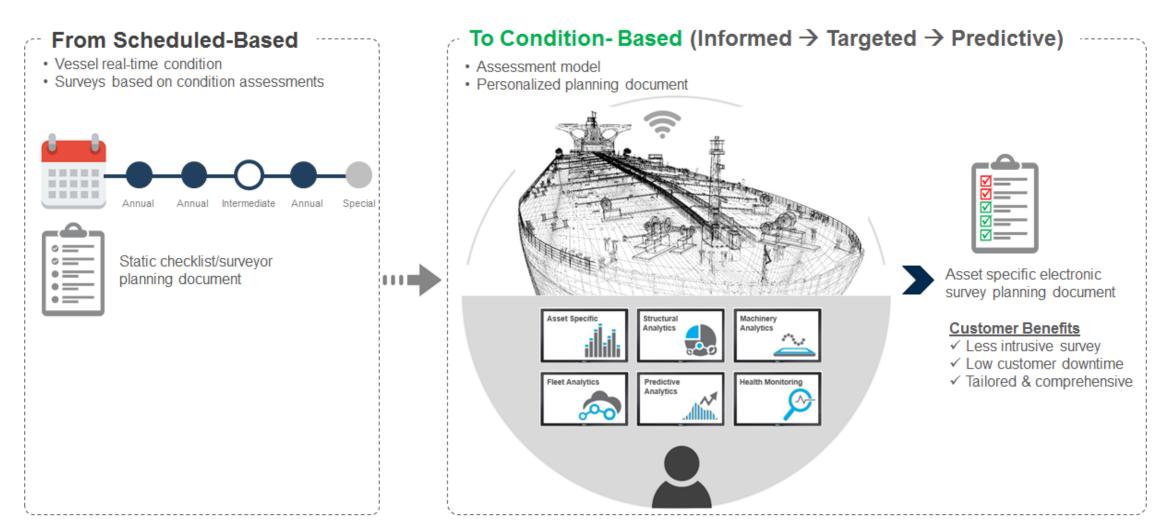


Ops Performance Mgmt.

- Monitor operational conditions
- Optimize operational parameters



Shift to Condition-Based Class





Maturity Levels

Manual

No system augmentation of human functions

Smart

- · Passive decision support
- System augmentation of human functions (i.e. Health Monitoring)

Semi-Autonomy

- Human augmentation of system functions
- · Human in the loop for supervisory/override

Full Autonomy

- No human augmentation of system functions.
- Human out of the loop (informed as request)



ABS System Autonomy Levels

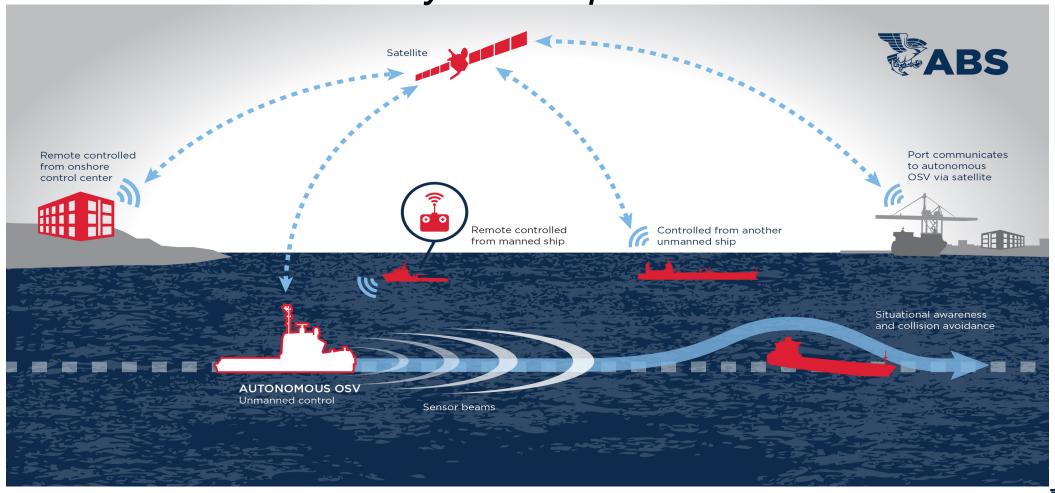
ABS System Level of Autonomy		Integration and Application to Decision Loop			
		Monitoring	Analysis	Decision	Action
1	Smart	M	M	Н	Н
2	Semi-Autonomous	M	M	H/M	H/M
3	Autonomous	M	M	M	M
Notes: 1. H-Human, M-Machine					





Autonomous Operations

Beyond Ship Itself





Supporting the Journey to Autonomy

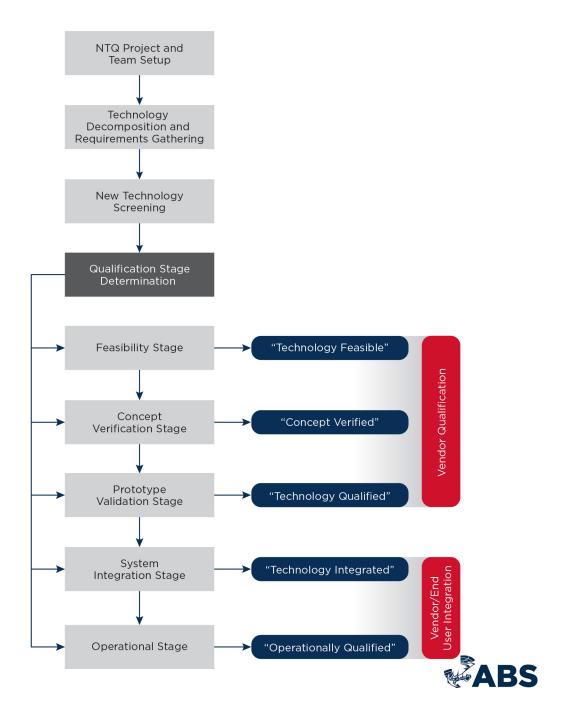
- Industry collaboration via MASS projects
- Refining foundational requirements: cyber, software, data
- Defining autonomy requirements
- Utilizing Novel Concept Approach: risk assessment and system engineering-based verification





New Technology Qualification

- Five stage process compatible with API RP 17N/Q, ISO 16290 and US DoD
- Tailored for new/unproven vendor applications
 - System, Sub-system, Equipment, Component or materials
- Autonomous Review is aligned to a Goal Based Framework.





Challenges

- Technology
- Human factors
- Regulatory Framework







Thank You

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