Towards Smart Shipping: A Standardization Perspective

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In the IMO

IMO INTERNATIONAL MARITIME ORGANIZATION

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MARITIME SAFETY COMMITTEE
98th session
Agenda item 22

MSC 98/22/7
28 March 2017
Original: ENGLISH

ANY OTHER BUSINESS

Impact of new and advancing technologies to maritime transport and the regulatory framework

Submitted by Denmark, Estonia, Finland, Japan, Norway, Singapore, Sweden and IMarEST

SUMMARY

Executive summary:	This document provides information on future possibilities for developments in the automation of ships, digitalization and the use of information technology
Strategic direction:	5.2
High-level action:	5.2.1
Output:	No related provisions
Action to be taken:	Paragraph 15
Related documents:	None

IMO INTERNATIONAL MARITIME ORGANIZATION

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MARITIME SAFETY COMMITTEE
98th session
Agenda item 20

MSC 98/20/2
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WORK PROGRAMME

Maritime Autonomous Surface Ships
Proposal for a regulatory scoping exercise

Submitted by Denmark, Estonia, Finland, Japan, the Netherlands, Norway, the Republic of Korea, the United Kingdom and the United States

SUMMARY

Executive summary:	The use of Maritime Autonomous Surface Ships (MASS) creates the need for a regulatory framework for such ships and their interaction and co-existence with manned ships. This document invites the Committee to undertake a regulatory scoping exercise to establish the extent of the need to amend the regulatory framework to enable the safe, secure and environmental operation of MASS within the existing IMO instruments.
Strategic direction:	5.2 and 5.4
High-level action:	5.2.1, 5.2.2, 5.2.4 and 5.4.1
Output:	No related provisions
Action to be taken:	Paragraph 25
Related document:	MSC 95/INF.20

TC 8 Bulletin

- The linking instrument between the IMO and the industry: IMO regulations, Market needs and New technology trends are main driven forces of TC 8's work.

- In September 2017, ISO/TC 8 held its 36th Plenary meeting in Buenos Aires, Argentina.

- TC 8 identified five strategic fields: maritime safety, marine environment protection, maritime security, maritime education and marine technology.

Smart Shipping in TC 8

ISO/TC 8

Chairman

Chairman's Strategic Advisory Group (CSAG)

Sub-Committee 1 Maritime Safety	Working Group 3 Special offshore structures, OSVs
SC 2 Marine environment protection	WG 4 Maritime Security
SC 3 Piping and machinery	WG 5 ISO 30001, 30006 and 30007
SC 4 Outfitting and deck machinery	WG 8 Liquid and gas fueled vessels
SC 6 Navigation and ship operations	WG 9 Polar (Arctic/Antarctic) regions
SC 7 Inland navigation vessels	WG 10 Smart shipping
SC 8 Ship design	WG 11 Dredgers
SC 11 Intermodal and Short Sea Shipping	WG 12 Aquatic nuisance species
SC 12 Large yachts	WG 14 Maritime education and training
SC 13 Marine technology	N.B. *A TC-level WG is an ad hoc group set up for specific tasks to timely meet emerging demands.*

- Smart shipping relates to all the five strategic fields of ISO/TC 8.

- TC 8 decided to establish a high-level working group at its 35th Plenary Meeting in 2016.

- WG 10 scope: standardization in the field of computer applications (big data and processing, IoT, sensor etc.) in shipbuilding, operation of ships and marine technology.

- WG 10 held its kick-off meeting in June 2017.

The Smart Era

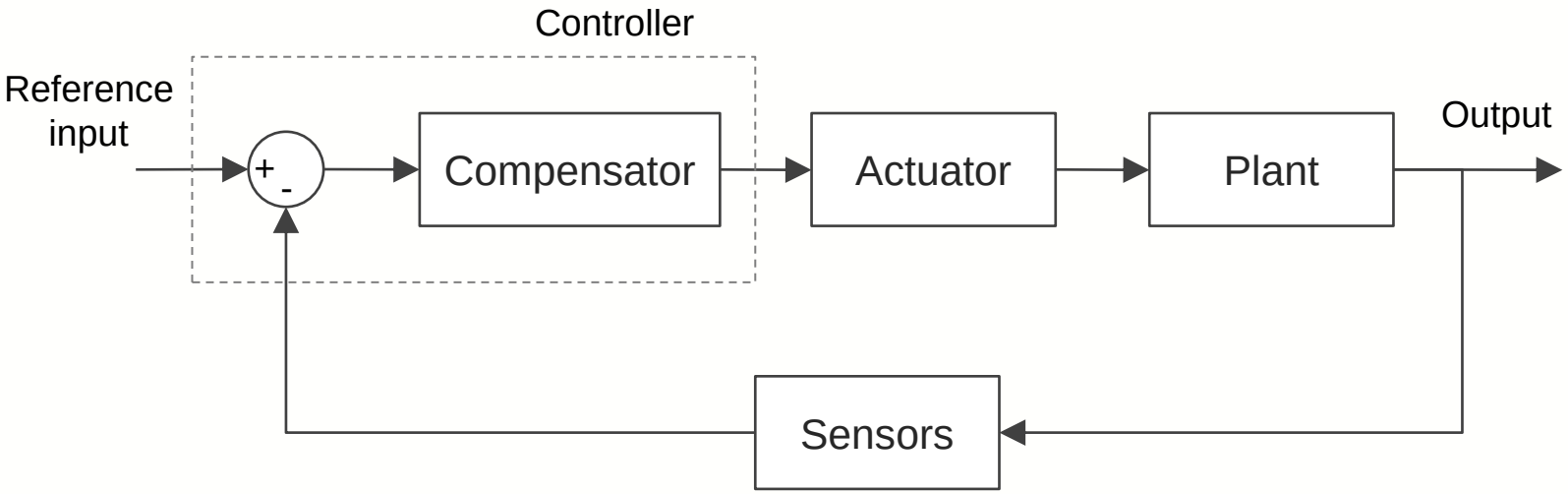
Characteristics of a smart system

- Status perception
- Real-time analysis
- Autonomous decision-making
- Precise execution
- Self-learning

AlphaGo grilling human beings …

Smart Systems

A smart (closed-loop) system



Status perception	Sensors	**Precise execution**	Actuator
Real-time analysis	Controller	**Self-learning**	Upgrading of control algorithms
Autonomous decision-making			

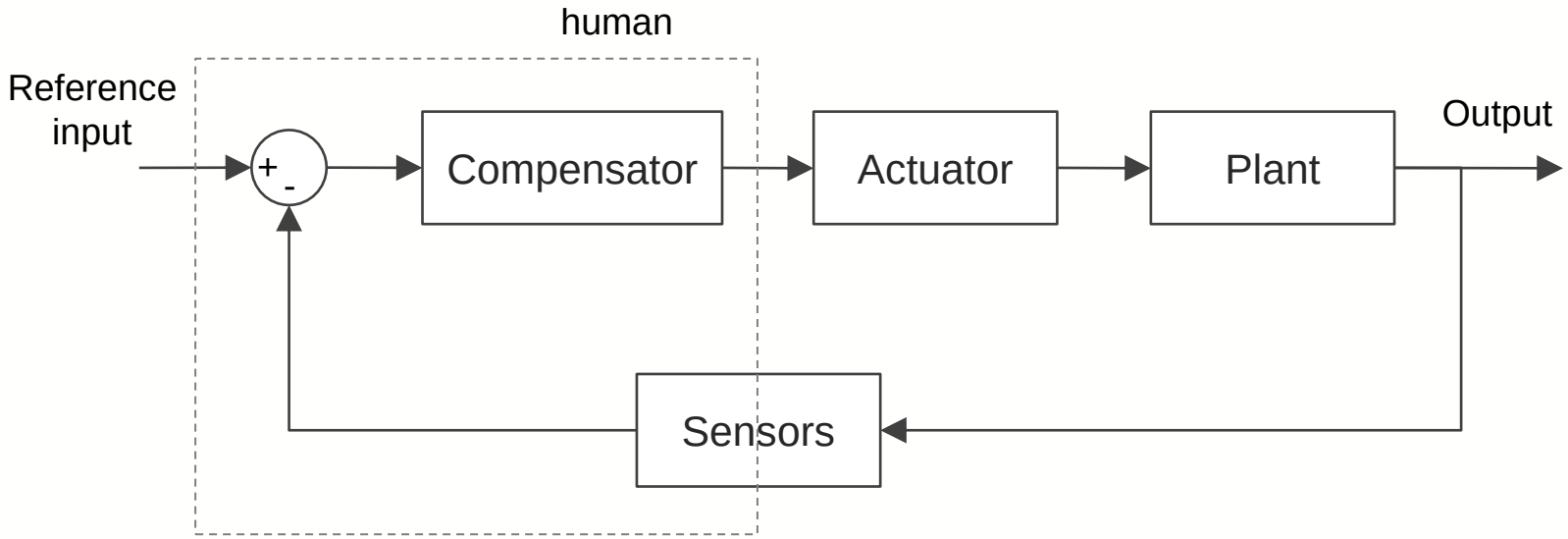
Smart Shipping

"Ship transport is in many ways the original intelligent transport system: Navigation tools have been used by mariners since before written history. Shipping was among the first sectors to be allocated radio communication frequencies around 1910. Electronic navigation systems emerged in the 1930s and ships were among the first civilian adopters of satellite navigation. Anti-collision radar was made mandatory on ships from 1974 and automatic identification transponders from 2002."

Ørnulf Jan Rødseth, 2011

"Human error" contribution to shipping accidents:

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

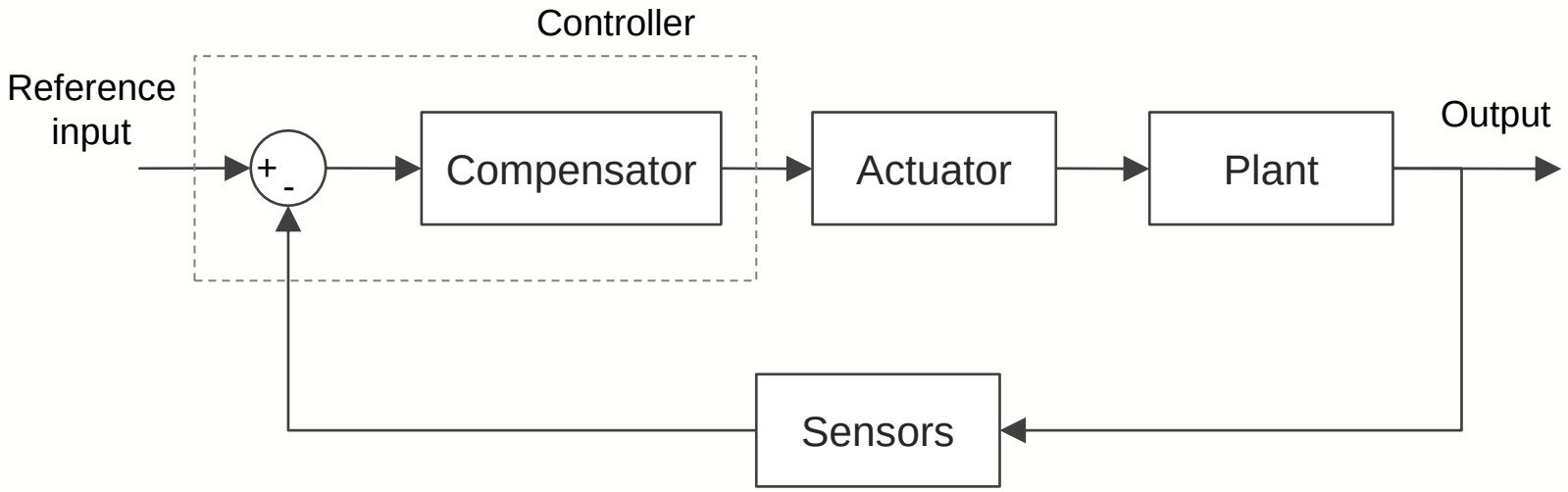


ISO/TC8
Ships and Marine Technology

Smart Shipping

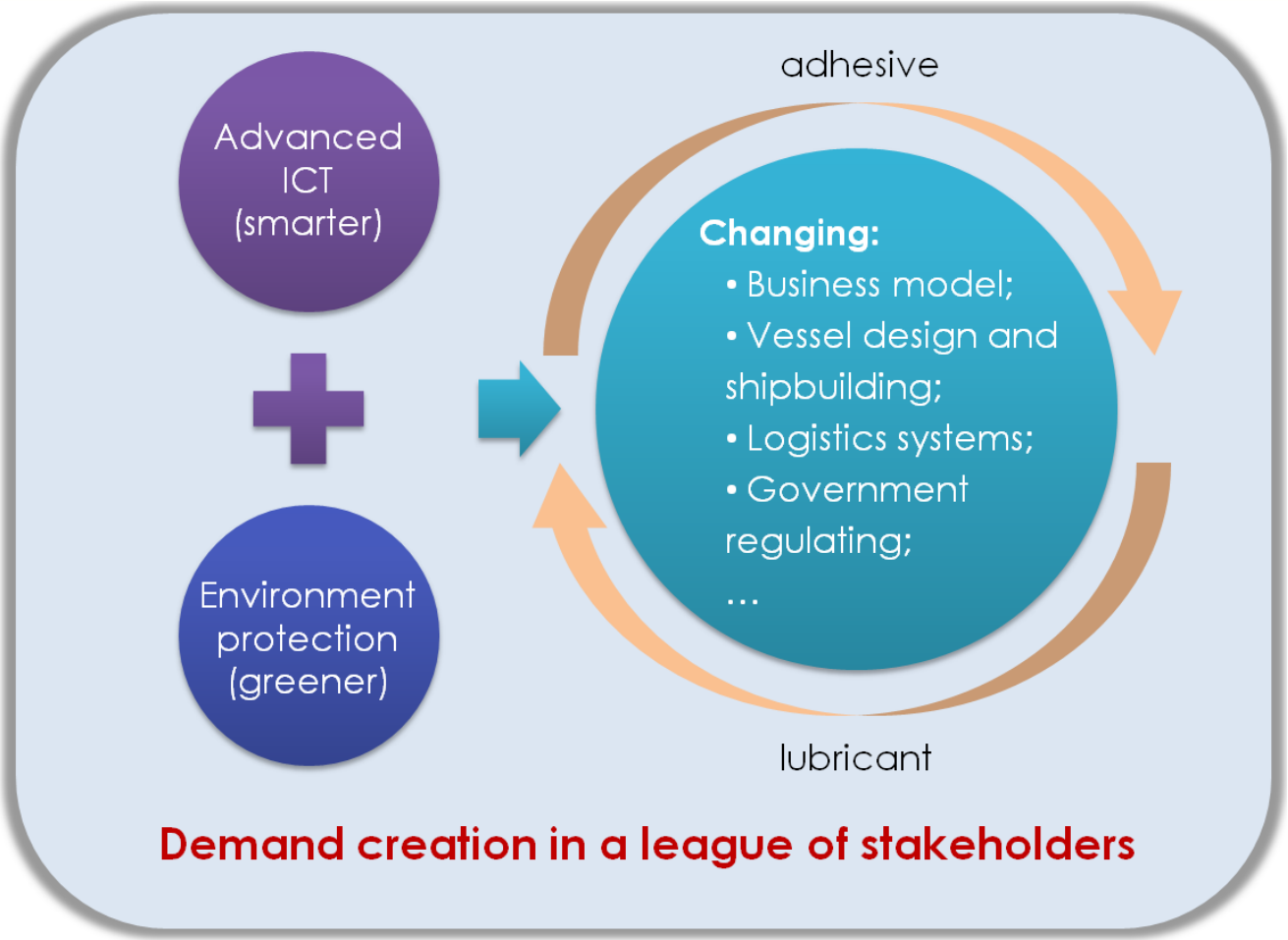
Autonomy level	Name	Description	Operator role
AL 0	Manual steering	Steering controls or set points for course, etc. are operated manually.	The operator is on board or performs remote control via radio link.
AL 1	Decision-support on board	Automatic steering of course and speed in accordance with the references and route plan given. The course and speed are measured by sensors on board.	The operator inserts the route in the form of "waypoints" and the desired speed. The operator monitors and changes the course and speed, if necessary.
AL 2	On-board or shore-based decision support	Steering of route through a sequence of desired positions. The route is calculated so as to observe a wanted plan. An external system is capable of uploading a new route plan.	Monitoring operation and surroundings. Changing course and speed if a situation necessitates this. Proposals for interventions can be given by algorithms.
AL 3	Execution with human being who monitors and approves	Navigation decisions are proposed by the system based on sensor information from the vessel and its surroundings.	Monitoring the system's function and approving actions before they are executed.
AL 4	Execution with human being who monitors and can intervene	Decisions on navigation and operational actions are calculated by the system which executes what has been calculated according to the operator's approval.	An operator monitors the system's functioning and intervenes if considered necessary. Monitoring can be shore-based.
AL 5	Monitored autonomy	Overall decisions on navigation and operation are calculated by the system. The consequences and risks are countered insofar as possible. Sensors detect relevant elements in the surroundings and the system interprets the situation. The system calculates its own actions and performs these. The operator is contacted in case of uncertainty about the interpretation of the situation.	The system executes the actions calculated by itself. The operator is contacted unless the system is very certain of its interpretation of the surroundings and of its own condition and of the thus calculated actions. Overall goals have been determined by an operator. Monitoring may be shore-based.
AL 6	Full autonomy	Overall decisions on navigation and operation are calculated by the system. Consequences and risks are calculated. The system acts based on its analyses and calculations of its own capability and the surroundings' reaction. Knowledge about the surroundings and previous and typical events are included at a "machine intelligent" level.	The system makes its own decisions and decides on its own actions. Calculations of own capability and prediction of surrounding traffic's expected reaction. The operator is involved in decisions if the system is uncertain. Overall goals may have been established by the system. Shore-based monitoring.

Autonomy levels (AL) adapted from Lloyds Register



Sensing	Condition monitoring, Integration of sensor data, Onboard inspection, Performance monitoring, etc.
Controlling (analysis and decision-making)	Decision-making support, Energy efficiency, Energy optimization, Route optimization, Remote control, etc.
Actuating	VR/AR/MR supported manipulations, etc.
Self-learning	ANN-based studies exist, but not many yet.
Infrastructure	Big data, Cyber safety, Data format, Data acquisition, IoT, Wireless network, etc.

Potential Demands for Standardization



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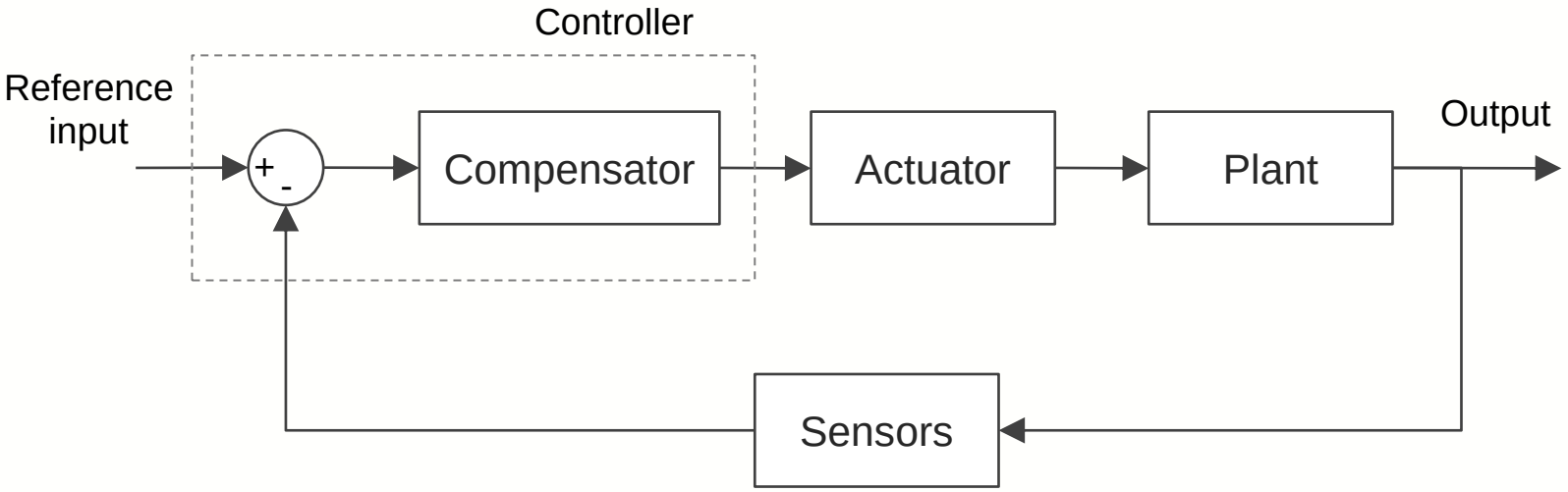

Status indicators	Environment, Location, Machinery, Propulsion, Visibility, Weather, etc.
Data exchange	Coding, Communication bandwidth, Data structure (e.g. ISO/DIS 19848), Protocol (e.g. Shipdex), etc.
Infrastructures	Ship communication networks (e.g. ISO 16425), Shipboard data servers (e.g. ISO/DIS 19847), Cyber security/safety, etc.
Others	Application services, Education and training, etc.

Future Work within TC 8

Stakeholders interconnected by ISO/TC 8

- **Project 1: A Roadmap**
  - Review existing standards;
  - Review other standards subject to change for smart shipping;
  - Submit papers to future IMO meetings.
- **Project 2: Standard on Software Maintenance of Shipboard Equipment**
  - Increasing awareness/visibility of situation on board;
  - Ensuring effective planning of SW maintenance.
- **Call for experts**
- **Call for new proposals**

THANK YOU!

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