MASS (Maritime Autonomous Surface Ships)

: Proposals of Amendment to STCW Convention regarding MASS

The 2018 Mock IMO Assembly Team MASSY
INDEX

01 Background
02 Why Necessary
03 Proposal
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01 Background
The **Fourth Major Industry Era** since the initial Industrial Revolution of the 18th century.
**Definition & Theory**

**[Definition of MASS]**

“Hybrid-type smart ships that operates completely independently without the supervision and instruction from the shore vessel operator”

“Ships that use automated systems for handling navigation and engine control”

“Ships equipped with a wide range of sensor equipment and automated navigation, propulsion and other auxiliary devices to detect and execute commands on their own”

“A ship which, to a varying degree, can operate independently without human interaction”
Background

~1990

- First developed for military purposes, in the World War II.
- Used for Removal of mines and tests for radioactive contamination by the U.S. Navy
- Canada unmanned ship: COMOX, etc.

2000

- Integration with sensors, driving methods, information and communication technologies, etc.
- A variety of high-tech applications spread

1990 ~

- Expanding utilization for specific purposes, such as scientific investigation and port monitoring

### Military Purpose
- Asymmetric threat
- Symmetric threat
- Mine removal
- Security & Monitoring
- Artillery drill

### Security
- Pirate
- Illegal immigration
- Illegal operation
- River security

### Marine Safety & Environment
- Suppression of a fire
- VMR
- Pollution control
- Ocean survey
- Water quality & Marine Pollution

2010 ~

- Efforts to develop large unmanned vessels such as trade/cargo ships began
- Efforts and confidence to justify the economy / safety, etc.
Status of MASS Development

[Roadmap to Marine 4.0: Ship Intelligence]

2035 ➢ Autonomous unmanned ocean-going ship [2035]

2030 ➢ Remote controlled unmanned ocean-going ship [2030]

2025 ➢ Remote controlled unmanned coastal vessel [2025]

2020 ➢ Reduced crew with remote support and operation of certain functions

The system is able to make decisions and determine action by itself

From Rolls Royce marine 4.0
The Technology of MASS

Background

- Environmental Monitoring
- Energy Efficiency Optimization
- Fuel Economy Analytics
- Remote SOX, NOX management
- Autonomous Navigation Technology
- Autonomous Engineering Technology
- Collision Avoidance System
- Port sync. Navigation
- Image Processing
- Communication Relay System
- Status Monitoring
- Remote Maintenance
- Big Data
- Twin Tech.
- Sensor Module
- Ship Cyber Security
- VHF Exchange Data System
- INMARSAT Exchange Data System
- Route Interchange
- Enhanced PNT Technology
- Autonomous Control & Network
- Communication System
- Remote Control
- Environmental Technology
- Autonomous Technology
- Big Data
- Twin Tech.
02 Why Necessary
Why Necessary

The Transition of Seaman

(Lloyd’s Register Autonomy Level)

• AL0: (Manual steering) The Operator is on board or performs remote control via radio link.
• AL1: (Decision-support on board) The Operator monitors and changes the course and speed, if necessary.

• AL2: (On-board or Shore-Based decision support) Monitoring operation and surroundings. Proposals for interventions can be given by algorithms.
• AL3: (Execution with human being who monitors and approves) Monitoring the system’s function and approving actions before they are executed.
• AL4: (Execution with human being who monitors and can intervene) Monitoring can be shore-based. Only if considered necessary.

• AL5: (Monitored Autonomy) Overall goals have been determined by an operator. Monitoring may be Shore-Based.
• AL6: (Full Autonomy) the system makes its own decisions. Overall goals may have been established by the system. Shore-Based monitoring.

<Vessel> Conventional

Remote Controlled

Onboard crew

<Seafarer> Onboard & Shore (= Operator)

Shore (= Operator)

10 Lloyd's Register Autonomy Level
As the IMO percepts the significance of MASS,
- The definition and new terms for Operator is needed!
- Proposals of Competences for Operators needs to be discussed!

Recent Discussions in IMO

- Recent IMO documents shows strong emphasis on Autonomous ships.
- Majority are in compliance to the rise of MASS technology.

On the 2018-2023 List of Outputs, announced by the IMO, MASS is included in the SD2(Output number; 2.7) category
1. STCW Purpose:

“to promote safety of life and property at sea and the protection of the marine environment”

2. Article IX of the Convention for flag States:

“Educational and training arrangements, including those involving seagoing service and shipboard organization especially adapted to technical developments and to special types of ships and trades

- MSC 99/INF.3 -
Why Necessary

Shore Based Ship Operator

[Duty of SBSO]

1. Ship’s position & bearing
2. Mapping, navigation and reactive collision avoidance
3. Situational awareness

13
Why Necessary

Feature of S.B.S.O

1. SBSO is included in the boundary of seafarer
2. 66% of required skills is maritime skills
3. Works in a Shore Based Center
4. Dual Officer

Shore Based Ship Operator (SBSO)

Conventional Operator

MASS technology

- Autonomous Tech.
- Monitoring
- Remote Control
- Communication & Network
- Environmental Tech.

Seafarer

Deck Officer
Engineer Officer

NAVIGATION
ENGINEERING
IT & A.I
3. General requirements regarding base qualification

1. A maritime base qualification referred to in paragraph 2.1 should meet the requirements listed in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW), as amended. Similarly, an aviation base qualification should meet the requirements of the International Civil Aviation Organization (IACO), listed in the Chicago Convention on International Civil Aviation, 1944, as amended.
03 Proposal
Proposals to the IMO

[3 Main Proposals to the IMO]

1. Amending the title of Chapter VII
2. The definition of the SBSO
3. Proposing the competences of the SBSO

Amendment to the STCW Convention will be done
Proposals to the IMO

Amending the title of Chapter VII

1. Chapter VII  Alternative certification

2. Chapter VII  Shore Based Ship Operator

Why?

1. The current Operator policy is ineffective

2. Similarities competences

3. Proposal of Chapter VII
Shore-Based Ship Operator means a person who takes care of or monitors the navigation of one or more autonomous ship in a shore-based center and hold a qualification in accordance with the provision of Chapter XII of the Convention.

1. Features of the SBSO

2. Definitions from the IMO

"OPERATOR: A person holding the required qualifications who takes care of or monitors the navigation of one or more autonomous ships without being physically on board the ship"
<table>
<thead>
<tr>
<th>Functions</th>
<th>Navigation at the operational level</th>
<th>Cargo handling and stowage at the operational level</th>
<th>Controlling the operational and care for persons on board at the operational level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Plan and conduct a passage and determine position</td>
<td>- Monitor the loading, stowage, securing, care during the voyage and unloading of cargoes</td>
<td>- Ensure compliance with pollution prevention requirements</td>
</tr>
<tr>
<td></td>
<td>- Maintain a safe navigational watch</td>
<td></td>
<td>- Maintain seaworthiness of the ship</td>
</tr>
<tr>
<td></td>
<td>- Use of radar and ARPA to maintain safety of navigation</td>
<td></td>
<td>- Monitor compliance with legislative requirements</td>
</tr>
<tr>
<td></td>
<td>- Use of ECDIS to maintain the safety navigation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Use the IMO Standard Marine Communication Phrases and use English in written and oral form</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Transmit and receive information by visual signaling</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Maneuver the ship</td>
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<tr>
<td></td>
<td>written and oral form</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Transmit and receive information by visual signaling</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SBSO Competence as Navigator

Chapter VII  Shore Based Ship Operator
### Competences of the SBSO (NAV.)

#### Deck Officer Section A-VII/5 (Column 1)

**SBSO Competence as Navigator**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Navigation at the management level</th>
<th>Cargo handling and stowage at the management level</th>
<th>Controlling the operational and care at the management level</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Plan a voyage</td>
<td>- Plan and ensure safe loading stowage, securing and unloading of cargoes</td>
<td>- Control trim, stability and stress</td>
<td>- Monitor and control compliance with legislative requirements and measures to ensure the protection of the marine environment</td>
</tr>
<tr>
<td>- Determine position and the accuracy of resultant position fix by any means</td>
<td>- Assess reported defects and damages to cargo spaces, hatch covers and ballast tanks and take appropriate actions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Establish watch-keeping arrangements and procedures</td>
<td>- Carriage of dangerous goods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Maintain safe navigation through the use of radar and ARPA and modern nav. sys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Forecast weather and oceanographic condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Manoeuver and handle a ship in all conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Operate remote controls of propulsion plant and engineering systems and services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Operate remote controls of propulsion plant and engineering</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Chapter VII

**Shore Based Ship Operator**
3 Competences of the SBSO (NAV.)

**Deck Officer Section A-II/3**

- **Deleted**
  - Ships of 500 GT or less

**No need of tonnage standard**

**Deck Officer Section A-II/4**

- **Deleted**
  - Quartermaster
  - Duty Officer

**Need support level seafarer**

**No need of support level seafarer**
### Competences of the SBSO (ENG.)

#### Engineer Officer Section A-III/1 (Column 1)

#### Engineer Officer section A-VII/6 (Column 1)

<table>
<thead>
<tr>
<th>Function</th>
<th>Marine engineering at the operational level</th>
<th>Electrical, electronic and control engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Maintain a safe engineering watch</td>
<td>- Use English in written and oral form</td>
<td>- Operate electrical, electronic and control systems</td>
</tr>
<tr>
<td>- Use English in written and oral form</td>
<td>- Operate main and auxiliary machinery and associated control systems</td>
<td></td>
</tr>
<tr>
<td>- Operate fuel, lubrication, ballast and other pumping systems and associated control systems</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Application of leadership and team working skills
- Contribute to the safety of personnel and ship

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**Chapter VII**  
**Shore Based Ship Operator**
## Competences of the SBSO (ENG.)

### Engineer Officer Section A-III/2 (Column 1)

- Plan and schedule operations
- Start up and shut down main propulsion and auxiliary machinery, including associated systems
- Monitor and evaluate engine performance and capacity
- Maintain safety of engine equipment, systems and services
- Manage fuel and ballast operations

### Engineer Officer Section A-VII/7 (Column 1)

<table>
<thead>
<tr>
<th>Function</th>
<th>Marine engineering at the management level</th>
<th>Electrical, electronic and control engineering at the management level</th>
<th>Maintenance and repair at the management level</th>
<th>Controlling the operation of the ship care at the management level</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Use internal communication systems</td>
<td></td>
<td>- Operate electrical and electronic control equipment to operating condition</td>
<td>- Detect and identify the cause of machinery malfunctions and correct faults</td>
<td>- Control trim, stability and stress</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Tests, defect faults and maintain and restore electronic and electrical and electronic control equipment</td>
<td></td>
<td>- Monitor and control compliance with legislative requirements and measures to ensure protection of the marine environment</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>handles emergency situations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- Organize and manage the maintenance and repair at the ship care at the management level</td>
</tr>
</tbody>
</table>

**SBSO Competence as Engineer**
Proposals to the IMO

3 Competences of the SBSO (ENG.)

Engine Officer Section A-II/3

Ships powered by main propulsion machinery of between 750kW and 3000kW propulsion power

No need of propulsion power standard

Deleted

Engine Officer Section A-III/4

Need support level seafarer

Deleted

Duty Engineer

SBSO

No need of support level seafarer
Proposals to the IMO

3 Competences of the SBSO (TECH.)

Operator Section A-VII/8

MASS Technology Competence

1. Remote Control
   - Image processing
   - Communication Relay System
   - Status monitoring
   - Remote maintenance
   - Big Data
   - Twin Tech.

2. Communication & Network
   - Sensor Module
   - Ship Cyber Security
   - VHF Exchange Data Sys.
   - INMARSAT Exchange Data Sys.
   - Route Interchange
   - Enhanced PNT Technology

3. Autonomous Technology
   - Autonomous Nav. Technology
   - Electronic Nav. Technology
   - Collision Avoidance System
   - Obstacle Detection

4. Environmental Technology
   - Environmental Monitoring
   - Energy Efficiency Optimization
   - Fuel economy Analytics
   - Remote SOX, NOX management
04 Conclusion
Proposals of amendment to STCW convention

Amendment to the STCW

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>General provisions</td>
</tr>
<tr>
<td>II</td>
<td>Master and deck department</td>
</tr>
<tr>
<td>III</td>
<td>Engine department</td>
</tr>
<tr>
<td>IV</td>
<td>Radiocommunication and radio personnel</td>
</tr>
<tr>
<td>V</td>
<td>Special training requirements for personnel on certain types of ships</td>
</tr>
<tr>
<td>VI</td>
<td>Emergency, occupational safety, medical care and survival functions</td>
</tr>
<tr>
<td>VII</td>
<td>Shore Based Ship Operator</td>
</tr>
<tr>
<td>VIII</td>
<td>Watchkeeping</td>
</tr>
</tbody>
</table>
Chapter I  General provisions

Regulation 1/1
Definitions and clarifications

1. For the purpose of the Convention, unless expressly provided otherwise:
   (…)

   25. Seagoing service means service on board a ship relevant to the issue of a certificate or other qualification;

   26. INSERT the following sentence

      *Shore-Based Ship Operator* means a person who takes care of or monitors the navigation of one or more autonomous ship in a shore-based center and hold a qualification in accordance with the provision of Chapter XII of the Convention.
Chapter VII Shore Based Ship Operator

Regulation VII/1

Mandatory minimum requirements for the certification of the Ship Shore Based Operator

1. Every candidate for certification shall

   . 1 be required to demonstrate the competence to undertake at the navigational level, the task, duties and responsibilities listed in column 1 of table A-VII/4 and A-VII/5

   . 2 be required to demonstrate the competence to undertake at the engineering level, the task, duties and responsibilities listed in column 1 of table A-VII/6 and A-VII/7

   . 3 be required to demonstrate the competence to undertake at the technological level, the task, duties and responsibilities listed in column 1 of table A-VII/8
## Amendment to the STCW

### Table A-VII/4

**Specifications of minimum standard of competence for Shore Based Ship Operator as NAVIGATOR**

<table>
<thead>
<tr>
<th>Functions</th>
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<td></td>
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<td>- Monitor compliance with legislative requirements</td>
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</tr>
</tbody>
</table>

### Table A-VII/5

**Specifications of minimum standard of competence for Shore Based Ship Operator as NAVIGATOR**

<table>
<thead>
<tr>
<th>Functions</th>
<th>Navigation at the management level</th>
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</tr>
</thead>
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<tr>
<td></td>
<td>- Plan a voyage</td>
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<td>- Plan and ensure safe loading stowage, securing and unloading of cargoes</td>
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<td>- Control trim, stability and stress</td>
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</tr>
<tr>
<td></td>
<td>- Monitor and control compliance with legislative requirements and measures to ensure the protection of the marine environment</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Amendment to the STCW

#### Table A-VII/6

**Specifications of minimum standard of competence for Shore Based Ship Operator as ENGINEER**

<table>
<thead>
<tr>
<th>Function</th>
<th>Marine engineering at the operational level</th>
<th>Electrical, electronic and control engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Maintain a safe engineering watch</td>
<td></td>
<td>- Operate electrical, electronic and control systems</td>
</tr>
<tr>
<td>- Use English in written and oral form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Operate main and auxiliary machinery and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>associated control systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Operate fuel, lubrication, ballast and</td>
<td></td>
<td></td>
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<tr>
<td>other pumping systems and associated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>control systems</td>
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</tr>
</tbody>
</table>

#### Table A-VII/7

**Specifications of minimum standard of competence for Shore Based Ship Operator as ENGINEER**

<table>
<thead>
<tr>
<th>Function</th>
<th>Marine engineering at the management level</th>
<th>Electrical, electronic and control engineering at the management level</th>
<th>Maintenance and repair at the management level</th>
<th>Controlling the operation of the ship care at the management level</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Plan and schedule operations</td>
<td></td>
<td>- Operate electrical and electronic control equipment</td>
<td>- Detect and identify the cause of machinery malfunctions and correct faults</td>
<td>- Control trim, stability and stress</td>
</tr>
<tr>
<td>- Start up and shut down main propulsion</td>
<td></td>
<td>- Tests, defect faults and maintain and restore electronic and</td>
<td></td>
<td>- Monitor and control compliance with legislative requirements</td>
</tr>
<tr>
<td>and auxiliary machinery, including associated</td>
<td></td>
<td>electrical and electronic control equipment to operating condition</td>
<td></td>
<td>and measures to ensure protection of the marine environment</td>
</tr>
<tr>
<td>systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Monitor and evaluate engine performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Maintain safety of engine equipment,</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>systems and services</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>- Manage fuel and ballast operations</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>
### Amendment to the STCW

**Table A-VII/8**

*Specifications of minimum standard of competence for Shore Based Ship Operator as TECHNICIAN*

<table>
<thead>
<tr>
<th>SBSO Competence as Technician</th>
<th>Remote Control</th>
<th>Communication &amp; Network</th>
<th>Autonomous Technology</th>
<th>Environmental Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Use computer algorithms to perform image processing on digital.</td>
<td>- Sensor module</td>
<td>- The activity of autonomously defining a trajectory through the environment in order to reach a specified location</td>
<td>- Monitor the quality of the environment</td>
</tr>
<tr>
<td></td>
<td>- Use satellites as components of a communication system to relay signals</td>
<td>- Protect ship’s cyber security from outside’s threat or hacking</td>
<td>- Electric Navigation technology</td>
<td>- Energy Efficiency Optimization</td>
</tr>
<tr>
<td></td>
<td>- Act of diagnosing a given symptom, issue or problem from a distance</td>
<td>- Exchange data between ship to ship, ship to shore through VHF</td>
<td>- System that makes ship prevent or reduce the severity of a collision by herself</td>
<td>- Fuel Economy Analytics</td>
</tr>
<tr>
<td></td>
<td>- Remote maintenance</td>
<td>- Exchange data between ship to ship, ship to shore through INMARSAT</td>
<td>- Ability to detect upcoming obstacle</td>
<td>- Manage SOX and NOX form distance</td>
</tr>
<tr>
<td></td>
<td>- Collect extremely large data sets to reveal patterns, trends, and associations</td>
<td>- Set route to interchange data between ship to ship, ship to shore</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Twin Technology; compare more than one virtual and physical worlds, analysis of data and monitoring of systems to head off problems</td>
<td>- Ability to enhance and operate Positioning, Navigation, and Timing technology</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
“New technologies will dramatically change the nature of work across all industries and occupations.”

— Klaus Schwab,
> International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978

> MSC / 99 / inf. 3

> IMO LEG 105/11/1

> DMA report Dec. 2017

> Autonomous ship the next step – Rolls-Royce

> Autonomous ship | NUNIN - MUNIN

> Smart Ship Technology and Policy Trends in Europe -KIAT


> Introduction policy seminar of autonomous ship- main technology of autonomous ship-(Jang Hwa Seop)

> Introduction policy seminar of autonomous ship- Policy Direction for Autonomous Ship -(Yun Hyun Su)

> 171211_The 2nd Conference of stakeholders for Autonomous ship (KMOU)

> [KB Education Group] Current and Future of Autonomous Ship -industrial research team (Jang Kung Suk)
THANK YOU

Do you have any Questions?