Introduction of a phased approach to build future regulatory frameworks for MASS

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1. Japan’s view on MASS

2. Regulatory Framework for MASS

3. Conclusion
1. Japan’s view on MASS

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What is MASS? and What for?

Maritime Safety

Working Condition

Economic Benefits

Source: Japan Ship Technology Research Association
1-2 Maritime Safety

- Human error in situation-awareness and decision-making accounts for a high proportion of causes among casualties occurred in Japan

Cause analysis of marine accidents related to manoeuvring (Investigation result of Japan Coast Guard)
It is not a single task for seafarers to operate a ship...

Watch keeping, Manoeuvring, Cargo monitoring, Maintenance of engines and other equipment, Berthing and Mooring, Administrative burdens (Recordbook & Logbook), etc.
Marine accidents will cause huge variety of economic losses

- Opportunity Loss caused by machinery plant trouble, etc.
- Direct Loss caused by sinking, grounding, collision, etc.
- Damage to a third party caused by marine pollution, etc.

It is expected to reduce economic losses by followings:

✓ Introduction of maneuvering support/remote control technologies which may reduce marine accidents caused by human errors
✓ Introduction of technologies to prevent vessel machinery plant trouble which may reduce opportunity loss
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From technology development perspective, ships will make evolution gradually from conventional ships towards MASS.

In foreseeable future, such shiptype as bulker, tanker and container ship would be still be manned.

- New technologies are introduced to ships as decision support systems.
- Some of such system / Remote control officer can perform specific action upon seafarers’ approval.

- Autonomous systems / Remote control officer can perform specific action without seafarers’ approval.

For the limited sea area, special purposes or very small sized ships, “full-unmanned operation” could be technologically and socially feasible.
It is difficult to identify one uniform image of each phase, therefore, followings are one example of images to consider necessary amendments at each phase.

<table>
<thead>
<tr>
<th>Task</th>
<th>Early Phase</th>
<th>Developed Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watch-keeping and maneuvering</td>
<td>Decision Support System (based on land-to-ship communication *)</td>
<td>Advanced Decision Support and Autonomous Navigation System (based on land-to-ship communication*) (“the System”, hereafter)</td>
</tr>
<tr>
<td></td>
<td>➢ Analyze, at the onshore control center, the transmitted onboard data (visual and radar images and data from other navigational equipment), combining externally collected data (weather and sea conditions, VTS information at the congested areas)</td>
<td>➢ Provide enhanced analysis and sophisticated decision support with the onboard data with higher details and precisions through advanced sensors such as LIDAR.</td>
</tr>
</tbody>
</table>
| | ➢ Assist the onboard officers in making optimum decisions by the analysis results via stress-free interface (audio, Mixed Reality) | ➢ Under wider circumstances, provide automatic maneuvering  
Enabling, basically, Bridge–Zero with different levels of involvement of onboard personnel, for example:  
• Officer stand-by on bridge  
• Onboard personnel for quick decisions at the request by the System  
• Onboard personnel only for emergency |
| | ➢ Under limited circumstances, provide a remote controlled navigation upon the approval by onboard officers | |

* The system could function independently without land-to-ship communication in certain conditions
It is difficult to identify one uniform image of each phase, therefore, followings are one example of images to consider necessary amendments at each phase

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<tr>
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<tbody>
<tr>
<td>Berthing and Mooring</td>
<td></td>
<td>Partial / Full automatic berthing with high-precision positioning and 3-dimensional map of the berth/pier through the Advanced Decision Support and Autonomous Navigation System</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Large ships: using multiple tug boats with remote control (networking by onshore System)</td>
</tr>
<tr>
<td></td>
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<td>• Small or medium-sized ships (with CPP and bow thrusters): automatic maneuvering by the System onboard</td>
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<tr>
<td></td>
<td></td>
<td>Partially automatic mooring by the System onboard</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Support System (based on land-to-ship communication)</td>
<td>Advanced Support System (based on land-to-ship communication)</td>
</tr>
<tr>
<td></td>
<td>➢ Monitor conditions of the main engine and other principal equipment and transmit the data to onshore</td>
<td>➢ Perform the same function as the early phase while the scope of the System is enhanced to cover all onboard equipment</td>
</tr>
<tr>
<td></td>
<td>➢ Analyze the obtained data with the historical records of failures and other relevant information</td>
<td>➢ Exercise planned and preventive maintenance at the next call of port; substantial reduction of onboard maintenance/repair works</td>
</tr>
<tr>
<td></td>
<td>➢ Advice maintenance operation to onboard engineers, identifying possible engine/equipment failures</td>
<td></td>
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To operate a ship, it is required to comply with variety of regulations related to e.g. safety, security, environment protection, labour, civil liability and compensation.

It is assumed that the measures to be taken to accommodate MASS would be varied depending on a phase.

### Regulations related to Ships

1. **Nationality, Registry, Measurement (Tonnage Convention)**
2. **Safety, Security, Environment (SOLAS, ISPS, MARPOL)**
3. **Seafarers (STCW)**
4. **Mariner’s Labour (MLC)**
5. **Authority/duty of Master (Each Conventions)**
6. **Traffic rules (COLREG)**
7. **Liability (LLMC, CLC, etc.)**
8. **Others (FAL, Hague-Visby, etc.)**

※Under Convention, ships are required to comply with rules, but, actually shipowners, Masters and Crew need to comply.
<table>
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<tr>
<th>Related Conventions</th>
<th>Matters to be considered (examples)</th>
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<tbody>
<tr>
<td></td>
<td>Early Phase</td>
</tr>
<tr>
<td>SOLAS</td>
<td>● Performance standards for remote control equipment</td>
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<td></td>
<td></td>
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<tr>
<td>SOLAS (ISPS Code)</td>
<td>–</td>
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<tr>
<td>MARPOL, OPRC, OPRC/HNS</td>
<td>–</td>
</tr>
<tr>
<td>STCW</td>
<td>● Training and certificate requirements for remote control officer</td>
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<tr>
<td>COLREG</td>
<td>–</td>
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<td></td>
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<tr>
<td>LLMC, CLC, Fund Convention, Bunker Convention, HNS Convention</td>
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There are several technologies for early phase, but these technologies are not uniform.
- It is difficult to establish prescriptive requirements.
- Interim Guidelines which use risk analysis can cover these technologies.
• Current regulatory framework would be barrier to use MASS
• Depending on the experience gained from Early Phase, separate specific regulatory framework should be considered to accommodate MASS at Developed Phase
1. In parallel with regulatory scoping exercise, develop interim Guidelines

2. Upon a risk analysis based on interim Guidelines, new technologies can be introduced to ship

3. Establish Experience Building Phase (EBP) to promote remote control systems and autonomous systems, and gain experience and knowledge from these systems during EBP

4. Verify the development of technologies and experience and knowledge from EBP

5. Based on the result of verification, identify and take the further action
## 2-9 Way forward to MASS

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<th>-2020</th>
<th>2020-</th>
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<tr>
<td>Scoping Exercise</td>
<td>Verify the experience from EBP</td>
</tr>
<tr>
<td>Develop interim Guidelines</td>
<td>Experience Building Phase (EBP)</td>
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<tr>
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<td>Identify and take further actions</td>
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New technologies introduced
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3 Conclusion

✓ MASS will develop in a phased manner from ships with decision support tools/equipment to autonomous ships, introducing new technologies.

✓ The regulatory frameworks to accommodate MASS should also be developed in a phased manner:

① Early phase
 → Current regulatory frameworks + Interim Guidelines

② Developed phase
 → Development of specific regulatory frameworks

✓ Experience Building Phase can be introduced to gain experience and knowledge from new technologies which will contribute to assess further action including the autonomous operation.
Thank you for your attention