E-NAVIGATION AND AUTONOMY: AN OPERATORS PERSPECTIVE

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Autonomous Operations and E-Navigation Definition

Fundamentally there is an alignment between the two

E-navigation is the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment.

= RELIABILITY
= EFFICIENCY
= SAFETY
The journey towards autonomy

*True autonomy requires bespoke newbuilds*

- AL0 Manual Steering
- AL1 Decision-support on board
- AL2 On-board or shore-based decision support
- AL3 Execution with human being who monitors and approves
- AL4 Execution with human being who monitors and can intervene
- AL5 Monitored autonomy
- AL6 Full autonomy

**CURRENT**

**CURRENT + NEWBUILD**

**NEWBUILD**

CONNECTED

DIGITALIZED

AUTONOMOUS

MAERSK
Fully autonomous vessel

*A complete evolution of modern vessels is needed for true autonomous ULCVs*
Autonomy benefits are not currently calculatable while cost is.

Current industry projects will help to firm up cost-benefit analysis.

Cost is fairly certain to raise exponentially due to needed reliability and redundancy.

Marginal benefits are uncertain as the shape of this curve is unknown.
2018 Testing – Situational Awareness

Unlocking value through new technologies

IMMEDIATE BENEFITS
• BUILDS DIGITAL MAP AROUND VESSEL FOR CREW AND AUTOMATION SYSTEM
• STREAMABLE FOR REMOTE PORT AND TRANSIT PILOTAGE
• MEETS SOLAS REQUIREMENTS ON LINE OF SIGHT

FUTURE BENEFITS
• ENABLES ALTERNATIVE BRIDGE PLACEMENT FOR FUTURE VESSELS
• DATA USED FOR FUTURE AUTONOMOUS COLLISION AVOIDANCE SYSTEM

TECHNOLOGY
• HD DAY & NIGHT (LWIR) 360 DEGREE CAMERAS
• BOW AND AFT LIDAR
• RADAR, AIS, GPS, COMPASS
• SCREENS ON BRIDGE AND SHORE
• VSAT/4G CONNECTIVITY
2018 Testing – Situational Awareness

Unlocking value through new technologies

Pilot sees what vessel sees and gives commands to captain and tugs.
Situational Awareness: The key to future bridge placement
"Autonomy" is not a goal in itself. **Key is to improve the safety, reliability, and efficiency of operations.**

<table>
<thead>
<tr>
<th>Operational improvement</th>
<th>Examples and benefits</th>
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<tbody>
<tr>
<td>Safety</td>
<td>- Collision avoidance</td>
<td>- Enhanced situational awareness</td>
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<tr>
<td></td>
<td>- Severe weather avoidance</td>
<td>- Reduced risk for crew</td>
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<td>- Improved visibility</td>
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<td>Reliability</td>
<td>- Technical trouble shooting between vessel and office-based staff</td>
<td>- Predictive maintenance</td>
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<td>- Early detection/alarms</td>
<td>- Simplified vessel design</td>
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<td>- Centralized maintenance</td>
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<tr>
<td>Efficiency</td>
<td>- Reduced fuel consumption</td>
<td>- System wide energy efficiency</td>
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<td></td>
<td>- Port call optimization</td>
<td>- Increased repeatability</td>
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<td>- Real-time route optimization</td>
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- Shore-ship **connectivity** is the most immediate enabler of operational improvement
- **Unmanning** is not an aim for Maersk Line
- **Regulation** needs to keep up with the pace of technology
Thank You