A VISION OF THE INTELLIGENT SHIP

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The Digital Ship
Hamburg, 18.3.2015
Fundamental Changes in Shipping

Historic changes:

- From sail to steam
- Coal to diesel
- Introduction of the container ship
- Cross Atlantic airflights (end of the ocean liners)
- etc.

What will be the most fundamental changes in shipping during your career?
Trends
Ship Intelligence

REMOTE CONTROL/OPERATION
- Monitoring
- Machinery control
- Navigation & piloting
- Operation of payload systems

CONDITION MONITORING
- Intelligent systems - self diagnosis
- Smart maintenance schemes
- Remote support
- Maintenance robots

DECISION SUPPORT
- Navigation (routing)
- Situational awareness
- Collision avoidance
- Safety support

OPERATIONS OPTIMISATION
- Onboard energy optimisation
- Fleet optimisation
- Revenue optimisation

Onboard automation
- Automatic reporting
- Automatic systems (e.g. Mooring)
- Robotics
- Full autonomous operation
Ship Intelligence - Customer value

Energy saving
Maintenance cost
Availability
Revenue optimization
Safety
Usability
Data we are logging

- **Product usage specific data**
- **Vessel Position Data**
- **Vessel Operational Performance Data**
- **Selection of Control Systems data**
- **Environmental data**
- **Product condition specific data** (temp, pressures, etc.)

**Other available data:**
- RCI data, safety records, Doc Library,
  maintenance data, ERP/Baan/SAP data, Design
  data from PLM, test records, service reports
Data usage today

Offerings to customers:

• Equipment health monitoring services
• Energy management services
• Marine Care offerings (predictive maintenance)
• Operational performance reporting at customer request.
• Input to Onboard Vessel Optimization functionalities.
• Data analytics to build vessel and fleet performance optimization consultancy business
Unified Bridge
oX – Personal Preferences

1. Adjusting workstations
2. Adjusting HUD graphics
oX – Augmented Reality

1. Augmented Navigation
2. Adjusting HUD graphics

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1. Augmented Assistance
2. Remote Operated Sub-Systems
Unmanned Remote Controlled Ships

Making ship transport more efficient and safe!
The Market Pull

- Reduction in manning costs
- No deckhouse => reduced weight, drag & hotel load => fuel savings
- More cargo, potential for slow steaming

Recruitment and retention

Safer seafaring

Emissions reduction
The Market Push

Other unmanned vehicles: -
• Airplanes
• Helicopters
• Cars
• Trains and subways
• Submarines
• ROV:s
• Offshore installations
• ...

*It is not if, but when... Marine is only following today's trend!*
Crew Trends

Crew size for ocean going ships

Number of crew

1850 1900 1950 2000 2050

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Interpreting Autonomy

Sheridan's Levels of Autonomous Decision-Making

- Offers no alternative actions
- Communicates all feasible actions
- Narrows choice of actions
- Recommends action
- Executes action once approved
- Executes action unless vetoed
- Executes action then informs human
- Informs only if requested
- Decides whether to inform human
- Ignores human

Candidate vessel navigation functions

- Identifies obstacles in vessel’s path
- Assesses risk to safe passage
- Prioritises potential collision hazards
- Suggests heading change
- Changes heading once approved
- Applies collision avoidance regulations
- Evades an imminent collision hazard

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Remote Controlled Ships - Features

No deck house

More cargo

New possibilities
• New machinery locations
• Novel machinery types
• Better cargo handling
• Etc…

No hotel systems
• Water production
• Water heating
• AC
• Sewage treatment
• Etc…

Communications
• Ship-to-shore
• Ship-to-ship
• IT security
• Etc…

Lower costs

Redundant machinery

Better weight distribution

Lower power demand
• Lower resistance from reduced LWT
• Lower hotel load
• Etc…
ROADMAP for Unmanned Ships
Key Development Areas

Remote control centre
- Operations management
- Situational awareness interface
- Human interaction interface

Communications
- Ship-to-shore and ship-to-ship
- Communication infrastructure
- Data filtering and processing

Operation optimization
- Fleet optimization
- e-Navigation and route optimization
- Performance management
- Decision support systems

Health & safety management
- Remote diagnostics and predictive maintenance
- Reliability and redundancy
- Safety and security systems

Remote controlled systems
- Machinery, propulsion and auxiliary systems
- Cargo handling and payload systems
- Mooring
- Ship level integration of functions

Situational awareness systems
- Obstacle detection, classing and tracking
- Near field path planning and execution
- Environmental condition monitoring
- Situational awareness interfacing with remote control center
International Regulatory Obstacles

SOME EXAMPLES OF CONFLICTS WITH PRESENT INTERNATIONAL RULES AND REGULATIONS

- SOLAS Ch. IV 12
- SOLAS Ch. V Reg 11, 14, 22, 33, 44, ...
- COLREG Pt. A-B
- SUA Art. 2-8
- GMDDSS, Ship Registration Convention
- ISPS code
- UNCLOS Art. 94, ISM Code, SALVAGE Ch.2
- ILO C179-180

Features:
- Remote machinery monitoring
- Remote machinery diagnostics
- Remote machinery control
- Automated ship-shore administration
- Machine collision avoidance
- Remote watch-keeping
- Shore-side Bridge Proxy
- Remote deep sea navigation
- Fleet monitoring & control
- Autonomous deep sea navigation

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Potential Timeline For Ship Concepts

<table>
<thead>
<tr>
<th>Year</th>
<th>Ship Concept</th>
<th>Technologies and Functionalities</th>
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<tbody>
<tr>
<td>2015</td>
<td>CABLE FERRY</td>
<td>Remote machinery monitoring</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remote machinery diagnostics</td>
</tr>
<tr>
<td>2020</td>
<td>COASTAL CARGO SHIP</td>
<td>Remote machinery control</td>
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<tr>
<td></td>
<td></td>
<td>Automated ship-shore administration</td>
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<tr>
<td>2025</td>
<td>SEMI-AUTONOMOUS OCEAN GOING CARGO SHIP</td>
<td>Machine collision avoidance</td>
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<td></td>
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<td>Remote watch-keeping</td>
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<td>2030</td>
<td>AUTONOMOUS OCEAN GOING CARGO SHIP</td>
<td>Shore-side Bridge Proxy</td>
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<td>Remote deep sea navigation</td>
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<tr>
<td>2035</td>
<td></td>
<td>Fleet monitoring &amp; control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Autonomous deep sea navigation</td>
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Adoption of the technologies and functionalities towards autonomy is likely to start from locally operating vessels.
The most fundamental change in shipping: Unmanned ships

Ship Intelligence is the main technology trend!