Towards Unmanned Ships

Oskar Levander, VP Innovation, Rolls-Royce Marine

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Information Technology

The dawn of the Ship Intelligence era
Ship Intelligence

REMOTE CONTROL/OPERATION
- Monitoring & Control
- Navigation & Piloting
- Operation of payload systems

DECISION SUPPORT
- Navigation (e.g. Routing)
- Situational awareness
- Collision avoidance
- Safety support

NAVIGATION & POSITIONING
- Situation awareness & Sensing
- Dynamic Positioning & Auto pilot
- E-Navigation

CONDITION MANAGEMENT
- Health monitoring
- Self diagnostics
- Smart maintenance schemes
- Remote support
- Maintenance robots

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

ONBOARD AUTOMATION
- Automatic reporting
- Automatic systems (e.g. Mooring)
- Robotics
- Full autonomous operation
Intelligent ship today

Decision support
Weather routing
Onboard optimization
(energy, power management, etc.)

Common controls

Condition based maintenance
EHM on main components
Ship sensors

E-Navigation
AIS
ECDIS

Fleet monitoring
Intelligent ship tomorrow

Remote control
Autonomous operation

E-Navigation
AIS
ECDIS

Common automation standard and user interface

Fully sensored (ship awareness), feedback to operator
EHM on all ship systems
(machinery, ship systems, payload systems,..)
Predictive maintenance
Remote expert support

Fleet optimization for best profit
Total fleet routing
(revenue (cargo), weather, current, ship performance, bunker prices, maintenance schedules)
Decision support
(collision avoidance, risk mitigation, emergency reaction)

Automatic mooring
Automatic cargo handling and optimization

Intelligent ship tomorrow
Unmanned Remote Controlled Ships

Making ship transport more efficient and safe!
Remote Controlled Ships

- Reduced crew costs
- Access to competent crew
- Better working conditions
- Improved ship efficiency
- Improved safety
Unmanned Trend in Society

It is not IF, but WHEN...
Marine is only following today's trend!
Crew Trends

Crew size for ocean going ships

Number of crew

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Remote Controlled Ships - Features

- No deck house
- More cargo
- Lower costs
- New possibilities
  - New layouts
  - Rethinking the ship design
- New level of Automation
- Communications
- Redundant machinery
- Lower power demand
  - Lower resistance from reduced LWT
  - Lower hotel load
  - Etc…
- No hotel systems
  - Water production
  - Water heating
  - AC
  - Sewage treatment
  - Etc…
Remote Control or Autonomous?

Remote control
- Port operations
- Navigation in congested areas
- Advanced manoeuvring situations
- ...

Autonomous operation
- Navigation at open sea
- Total ship traffic overview
- Route and speed optimisation
- ...

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Safety

As safe or safer than a conventional ships!

- New technology to aid the navigation of ships
- Avoid human errors
- Redundant machinery with predictive maintenance
- Automatic safe mode if loss of control occurs

Unmanned operation is not suited for all types of ships – we will still have seafarers at sea in the future
Key Development Areas

- Remote control center
- Communications
- Operation optimization
- Remote controlled systems
- Health & safety management
- Situational awareness systems
International Regulatory Obstacles

Examples of conflicts with present international rules and regulations

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

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Unmanned ships will most likely start with local applications!
Early Opportunities with Remote Operations

Remote support and operations will enable lean ships with reduced crew
LEAN RoRo

Market:

- RoRo cargo: 1500 lanemeters, double stack containers on cassettes and trailers
- Short routes in Northern Europe
- Existing fleet is old and in need of replacement
- Small ship will enable traffic from ports with limited cargo volumes
- Operators are today forced to focus on larger ships and to concentrate operation on fewer but larger ports
- Very low cost needed to make small ship feasible
Design Philosophy - LEAN

Low operating costs

• Minimum crew
  - 1 person on bridge at all times - 3 person rotating shifts
  - 1 multi purpose deck hand

• Remote machinery support
  - Expert support from shore centre

• Automatic mooring

• No ”hotel” crew onboard
  - Pre fabricated food prepared ashore
  - Washing and cleaning done in port

Low fuel cost

• High efficiency
• Low lightweight
• LNG
• Modest operating speed
Design Philosophy - LEAN

Low building cost
- Lean design
- Number of systems minimised
  - No steam system
  - No diesel system
  - No water production – bunker water in port
  - No sewage – return sewage to port
  - HVAC in deckhouse with direct electricity (no steam or cold water circuit)
- Small deck house
- One cargo deck, no internal roro ramps
- No enclosed cargo deck – lower steel weight
Installed power: 7.0 MW
Service speed: 17 kts (15% SM at 83% MCR)
Max speed: 18 kts (15% SM at 94% MCR)
### Main Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Second hand ref. vessel</th>
<th>Conventional new build</th>
<th>Lean RoRo</th>
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</thead>
<tbody>
<tr>
<td>LPP [m]</td>
<td>128</td>
<td>128</td>
<td>150</td>
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<tr>
<td>Breadth [m]</td>
<td>22.7</td>
<td>22.7</td>
<td>29</td>
</tr>
<tr>
<td>Draught [m]</td>
<td>6.7</td>
<td>6.7</td>
<td>5</td>
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<tr>
<td>Lane meters</td>
<td>1500 (only partial double stack)</td>
<td>1500 (only partial double stack)</td>
<td>1500 (double stack)</td>
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<tr>
<td>Displacement [ton]</td>
<td>12 200</td>
<td>12 200</td>
<td>10 280</td>
</tr>
<tr>
<td>Service speed [kts]</td>
<td>20</td>
<td>17</td>
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</tr>
</tbody>
</table>
Operating and Investment Costs

**OPEX**

- **Fuel**
- **Maintenance**
- **Crew**

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**CAPEX**

- **Second hand cost**
- **Ship Systems**
- **Machinery**
- **Accommodation**
- **Ship Outfitting**
- **Superstructure**
- **Hull Structures**
- **RoRo Equipment**
- **Tests and Trials**
- **Design**

50% value of new build

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**FOR GUIDANCE ONLY**

Assumptions:
- MGO $600 /ton
- LNG $11 /mmBTU = $511/ton
- EURO/USD 1.19

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Total Annual Costs

Annual costs [M€]

Lean RoRo | Conventional newbuild RoRo | Second hand RoRo

OPEX | CAPEX

Second hand value assumed to be 50% of new build

FOR GUIDANCE ONLY
Unmanned ships will most likely start with local applications!
Timeline
Unmanned Battery Ferry Concept
Conclusions

We are at the dawn of the Ship Intelligence era

Unmanned ships will be the most fundamental change in shipping that we will experience
The best way to predict the future is to create the future.