Towards Remote Controlled Ships

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10.9.2014 – MUNIN Workshop at SMM
# Rolls-Royce Plc

World leading supplier addressing four global markets:

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<th>Civil Aerospace</th>
<th>Defence Aerospace</th>
<th>Marine</th>
<th>Energy</th>
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<td>• Aero engines</td>
<td>• Aero engines</td>
<td>• Ship Design</td>
<td>• Gas turbines</td>
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<tr>
<td>• Helicopter engines</td>
<td>• Helicopter engines</td>
<td>• Equipment systems</td>
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55,000 employees
Marine Division

- Second largest division in Rolls-Royce
- Over 9,000 employees in 35 countries
- Over 30,000 vessels with our design and/or equipment
Fundamental Changes in Shipping

Historic fundamental changes:

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

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

Today:

- Navigation and station keeping
- Decision support
- Operational real time optimization
- Health monitoring
- Automated reporting

In all areas trend is towards more intelligent and automated systems and the role of crew is in supervising the operation.
Remote Control of Ships - Why?

Making ship transport more efficient and safe!
Remote Controlled Ships – Why?

1. Crew costs
2. Provide better conditions for the seafarers of tomorrow
3. Improved safety
4. Efficiency
1. Crew Costs

- How to best utilise the skills of the crew?
  - What is the core skill of the crew vs. what do they spend their time doing?

- Crew is usually the 2nd biggest element in ship running costs after fuel
2. Better Working Conditions for Safarers

- Access to competent crew
- Attract young people to shipping
- Safe and comfortable working environment close to family and friends
3. Improved Safety

A remote controlled ship must be as safe or safer than a conventional ships!

- New aids to the navigation of ships
- Most marine accidents are related to human errors
- Redundant machinery with predictive maintenance schemes will improve reliability
- 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
Safety

What is safer?

– 20 persons onboard a vessel in the North Sea in a raging storm, or
– 2 persons in a control room on land?
4. Improved Efficiency

• Performance optimization possibilities with BIG DATA
• Ship and fleet level optimization
• Revenue side and wider logistics chain
Remote Controlled Ships - Features

- No deck house
- More cargo
- Communications
- IT security
- No hotel systems
  - Water production
  - Water heating
  - AC
  - Sewage treatment
  - ...
- Lower LWT
Remote Controlled Ships - Features

New possibilities
- New machinery locations
- Novel machinery types
- Better cargo handling
- ...

Better weight distribution

Lower costs

Redundant machinery

Lower power demand
- Lower resistance from reduced LWT
- Lower hotel load
- ...

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Crew Trends – Ocean Going Ships

Number of crew

Diesel

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Other Unmanned Vehicles

- Airplanes
- Helicopters
- Cars
- Trains and subways
- Submarines
- ROV:s
- Offshore installations
- ...

It is not if, it is when...
Marine is only following today's trend!
Terminology - Interpreting Autonomy

Sheridan's Levels of Autonomous Decision-Making

The machine....
- 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

The vessel....
- 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

Candidate vessel navigation functions

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Roadmap Towards Remote Controlled Ships
Key Development Areas

REMOTE CONTROL CENTER
- Operations management
- Situational awareness interface
- Human interaction interface
- Control handover mechanisms
- BIG DATA applications

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

REMOTE CONTROLLED SYSTEMS
- Machinery, propulsion and auxiliary systems
- Cargo handling and payload systems
- Mooring and anchoring
- Ship level integration of functions

HEALTH & SAFETY MANAGEMENT
- Remote diagnostics and predictive maintenance
- Reliability and redundancy
- Safety and security systems

SITUATIONAL AWARENESS SYSTEMS
- Obstacle detection, classing and tracking
- Near field path planning and execution
- Environmental condition monitoring
- Situational awareness interfacing with remote control center

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many of the building blocks are already there, but not built into commercial maritime solutions

need to go from component level to total ship health management...

...and eventually to ultra high reliability

- 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
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, ...
- SUA Art 2-8
- COLREG Pt. A-B
- GMDDSS, Ship Registration Convention
- ISPS code
- UNCLLOS Art. 94, ISM Code, SALVAGE Ch.2
- ILO C179-180
- Remote machinery monitoring
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Potential Timeline For Ship Concepts

Ships operating in restricted areas and not engaged in international traffic can be exempted by the Flag State.

Adoption of the technologies and functionalities towards autonomy is thus likely to start from locally operating vessels.

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Better Power for a Changing World

Thank You for Your Attention!