A Vision of the Future Ship and Marine Safety

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Rolls-Royce markets

Aerospace
- Civil
- Defence

• Aero engines
• Helicopter engines

• Aero engines
• Helicopter engines

Land & Sea
- Marine
- Energy & Nuclear
- Power Systems

• Equipment systems
• Ship Design

• Gas turbines
• UK’s nuclear powered subs

• Marine and land based power systems

55,000 people - in 45 countries
Marine division

- Over 6,400 employees in 34 countries
- Over 30,000 vessels with our design and/or equipment
A comprehensive range of products

- Focus on environmental friendly solutions based on the widest range of products in the marine industry

- Ship design and integrated ship systems
- Diesel and gas engines
- Gas turbines
- Automation and control (DP)

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Marine Trends
Information Technology

The dawn of the Ship Intelligence era
Safety and Ship Intelligence

Situational awareness
- Sensor fusion
- Augmented reality

Human errors
- Remote and autonomous operations
- Automation

Dangerous working areas
- Robotisation

Navigation
- E-navigation
- Collision avoidance

Ship complexity
- Automation
- Common control

Cyber security

Reliability
- Health management
- Predictive maintenance

Usability
- Operation experience
- User interface
Ship Systems

**ROLLS-ROYCE SCOPE**

- Propulsion
- Steering gear
- Rudders
- Main engines
- Energy management
- Auxiliary engines
- Electric drives
- Fuel systems
- Switchboards
- Thrusters
- Launch and recovery
- Winches
- Deck equipment
- Bridge automation
- Stabilizers
- Generators
- Electric distribution
- Etc.

**ADJACENT TO ROLLS-ROYCE SCOPE**

- Exhaust gas treatment
- Communication
- Navigation
- Steam system
- Sewage treatment
- Ballast water treatment
- Ballast systems
- Fire fighting

**DISTANT TO ROLLS-ROYCE SCOPE**

- Air Conditioning
- Ventilation
- Lightning
- Laundry
- Elevators
- Life saving equipments
- Cargo deck
- Deck systems
- Ramps
- Etc.
System complexity - Marine

- Physical I/O points
- Storable data points
- Software code lines
- Software integration interfaces
- Physical I/O points
"Information web"

10,000 signals
100 computer screens
High-speed data communications
Remote access to shore centres
Complexity vs competency

• Ships are becoming more complex
• More integration of systems

• Will there be enough competent seafarers?

• There’s a gap opening up between complexity of ships and the availability of competent crews.
Common Look & Feel Style-guide
The new Icon DP, Acon IAS, Alarm Management System, Power Management System and thruster controls are purposely designed for Unified Bridge integration.

Common functions:
Multi-function screens, common dimming, day/dusk/night mode
Unified Bridge - tailored for different ships
oX – future bridge concept
1. Augmented Navigation
2. Adjusting HUD graphics
1. Augmented Navigation
2. Adjusting HUD graphics
1. Augmented Assistance
2. Remote Operated Sub-Systems
Data we are logging

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

- Product condition specific data
- Vessel Operational Performance Data
- Selection of Control Systems data
- Environmental data
- Product usage specific data
- Vessel Position Data
- Vibration, Oil monitoring (particles, moisture), speed, load, steering angle
- Fuel and efficiency specific data
- Product condition specific data (temp, pressures, etc.)
Products we are collecting the data from
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
Rolls-Royce capability - Aerospace

- 13,000 gas turbines in service
- 72% covered by TotalCare
- Real time monitoring
- Complex data streamed from engine sensors
- Typical Trent engine – measuring 20 performance parameters (e.g. vibration, oil pressure, temperature etc.)
- Engines have 20+ year life
- We maintain, repair and overhaul.
- We analyse fleet-wide data
- Knowledge builds capability for next generation of engines
Remote opportunities
Safe working areas
Intelligent ship today

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

- Common controls

- Condition based maintenance
  - EHM on main components
  - Ship sensors

- Fleet monitoring

- E-Navigation
  - AIS
  - ECDIS
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

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
Unmanned Remote Controlled Ships

Making ship transport more efficient and safe!
Remote Controlled Ships

- Reduced crew costs
- Access to competent crew
- Better working conditions for the seafarers
- Improved ship efficiency
- Improved safety
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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Crew Competence

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
Remote Operations

Better working environment
• Safe
• Comfortable
• Close to family and friends

Attract young people to shipping
Safety

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

- New technology to aid 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?
Piracy

Unmanned ships
• easier to protect
• more difficult to take control over

No hostages

IT security is vital
Remote Controlled Ships - Features

- **No deck house**
- **More cargo**
- **New possibilities**
  - New machinery locations
  - Novel machinery types
  - Better cargo handling
  - Etc…
- **Communications**
  - Ship-to-shore
  - Ship-to-ship
  - IT security
  - Etc…
- **No hotel systems**
  - Water production
  - Water heating
  - AC
  - Sewage treatment
  - Etc…
- **Lower costs**
- **Better weight distribution**
- **Lower power demand**
  - Lower resistance from reduced LWT
  - Lower hotel load
  - Etc…
- **Redundant machinery**
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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ROADMAP for Unmanned Ships
Key Development Areas

Remote control center
- 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, ...
- SUA Art 2-8
- GMDDS, Ship Registration Convention
- ISPS code
- COLREG Pt. A-B
- UNNIW
- ILO C179-180
- UNCLOS Art. 94, ISM Code, SALVAGE Ch. 2

- Remote machinery monitoring
- Remote machinery diagnostics
- 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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Unmanned ships will most likely start with local applications!
Road Ferry
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 in the near future?
The most fundamental change in shipping: Unmanned ships

Ship Intelligence will make shipping more efficient and safer!
“The best way to predict the future is to create the future.”