A VISION OF THE INTELLIGENT SHIP

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The Digital Ship
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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?
Fundamental Changes in Shipping

Next changes:

• LNG will become one of the main marine fuels
• Introduction of hybrid and battery propulsion
• Ship Intelligence
• Introduction of unmanned ships
Information Technology

The dawn of the Ship Intelligence era
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

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Energy Monitoring
Onboard Optimisation metrics

Emissions
- NOx: 0.5 ppm
- SOx: 3.4 ppm
- CO²: 14.3 ppm
- Particles: 5.1 ppm

Trim
- Depth Aft: 8.97 m
- Trim: 1.3 m
- Depth Fwd: 7.89 m

Route
- LAT: 52°11.23' N
- LON: 52°11.23' N
- ETA: 04:30:00
- CDG: 143°
- CTS: 139°
- XTE: 234.5 m
- WP: 7
- DST: 1.4 nm

Propeller

Economy
- Consumption: 78%
- Speed: 14.5 knots

Hull
From ship to fleet optimisation
Data we are logging

- Vessel Operational Performance Data
- Product usage specific data
- Vessel Position Data
- Selection of Control Systems data
- Environmental data
- Product condition specific data (temp, pressures, etc.)
- Fuel and efficiency specific data
- Other available data:
  - RCI data, safety records, Doc Library, maintenance data, ERP/Baan/SAP data, Design data from PLM, test records, service reports

Vibration, Oil monitoring (particles, moisture), speed, load, steering angle
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
Unified Bridge
Unified Bridge - tailored for different ships
oX – Container Vessels
1. Adjusting workstations
2. Adjusting HUD graphics
1. Augmented Navigation
2. Adjusting HUD graphics
oX – Situation Awerness

1. Augmented Assistance
2. Remote Operated Sub-Systems

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Remote opportunities
Ship systems

Large number of different systems

- Air Conditioning
- Ventilation
- Elevators
- Exhaust gas treatment
- Life saving equipment
- Electric distribution
- Communication
- Navigation
- Bridge automation
- Deck equipment
- Winches
- Fuel system
- Electric drives
- Switchboards
- Thrusters
- Electric distribution
- Automation & controls
- Generators
- Replenishment / fuelling systems
- Ballast systems
- Food stores
- Exhaust gas treatment
- Laundry
- Lighting
- Life saving equipment
- Bridge automation
- Ventilation
- Elevators
- Outdoor deck systems
- Cargo deck
- Indoor deck systems
- Propulsors
- Rudders
- Gears and shaft lines
- Main engines
- Energy management
- Bearings and seals
- Steam system
- Automation & controls
- Ship systems
- Ballast systems
- Sewage treatment
- Ballast water treatment
- Cargo deck
- Elevators
- Outdoor deck systems
- Cargo deck
- Propulsors
- Rudders
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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.
Ship Intelligence - Customer value

Energy saving
Revenue optimization
Safety
Maintenance cost
Availability
Usability
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
- AIS
  ECDIS
Intelligent ship tomorrow

Remote control
Autonomous operation

AIS
ECDIS

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

Common automation standard and user interface

Automatic mooring
Automatic cargo handling and optimization

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)
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

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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...
- **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**
- **Redundant machinery**
- **Lower power demand**
  - Lower resistance from reduced LWT
  - Lower hotel load
  - Etc...
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
- SUA Art 2-8
- GMDDS, Ship Registration Convention
- ISPS code
- SOLAS REISSUE 2024?
- COLREG Pt. A-B
- 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
Potential Timeline For Ship Concepts

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

- **2015**: Cable Ferry
- **2020**: Coastal Cargo Ship
- **2025**: Semi-Autonomous Ocean Going Cargo Ship
- **2030**: Autonomous Ocean Going Cargo Ship

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Remote Controlled Road Ferry
The most fundamental change in shipping: Unmanned ships

Ship Intelligence is the main technology trend!
“The best way to predict the future is to create the future.”