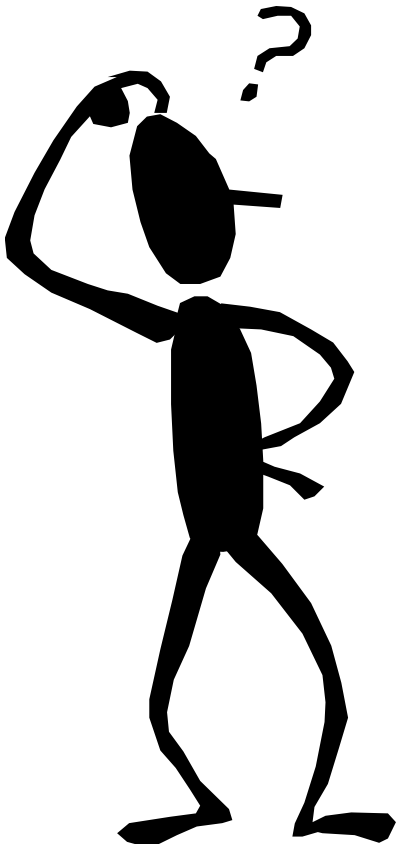
VOLKER BERTRAM, TORSTEN SCHROEDER

Aktuelle Entwicklungsszenarien für Smart und Unmanned Shipping und ihre Auswirkungen auf das HRM

Introduction: Why Smart and Unmanned?



Definitions

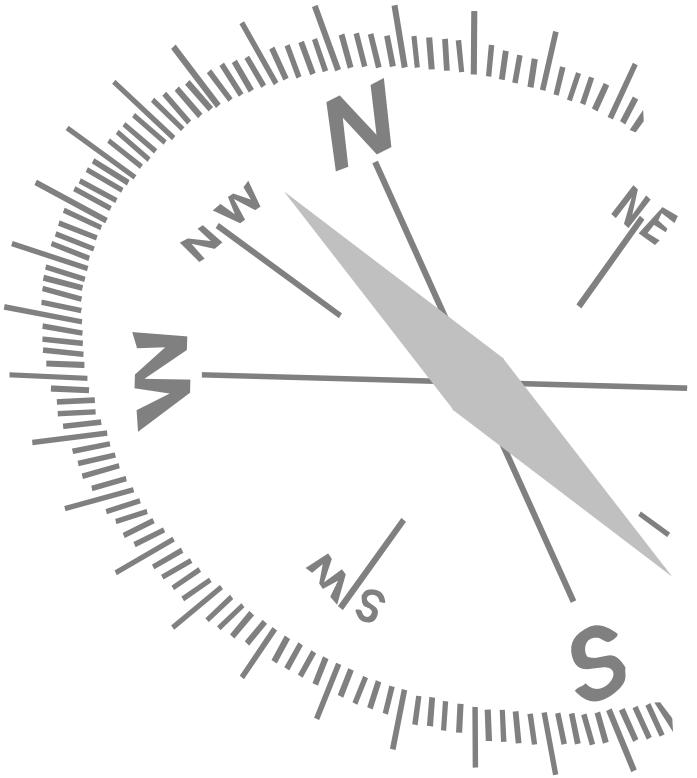
- A ship with autonomous **(Smart)** technologies is navigating and making evasive maneuvers based on an automated software system. **An autonomous ship does not have to be unmanned**.

- An unmanned ship is a ship with no humans onboard. **An unmanned ship does not have to be autonomous; it can be under autonomous control but it can also be under remote control**.

Porathe, T. (2013)

Navigator

- Unmanned Vehicles – Land & Air
- Visions
- Key tasks & potential solutions
- Changes to work and competencies
- Consequences for HRM
- Discussion



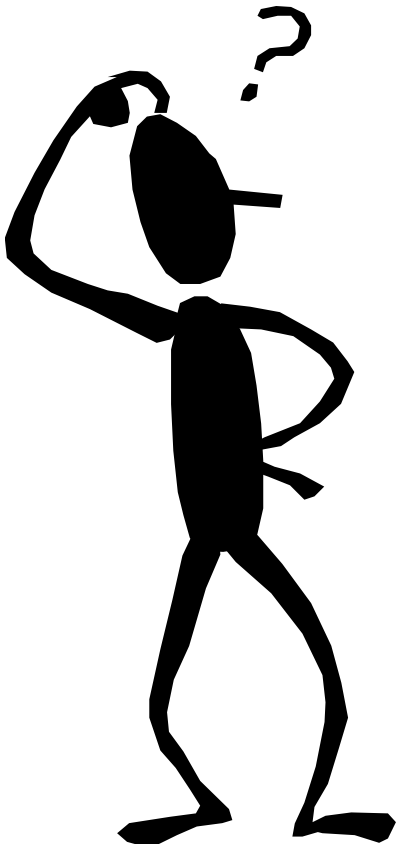
Drones on land

Google car 2014

Autonomous truck 2015

Fighter drone UCAV 2013- operate in Swarms

What about an “unmanned ship”?



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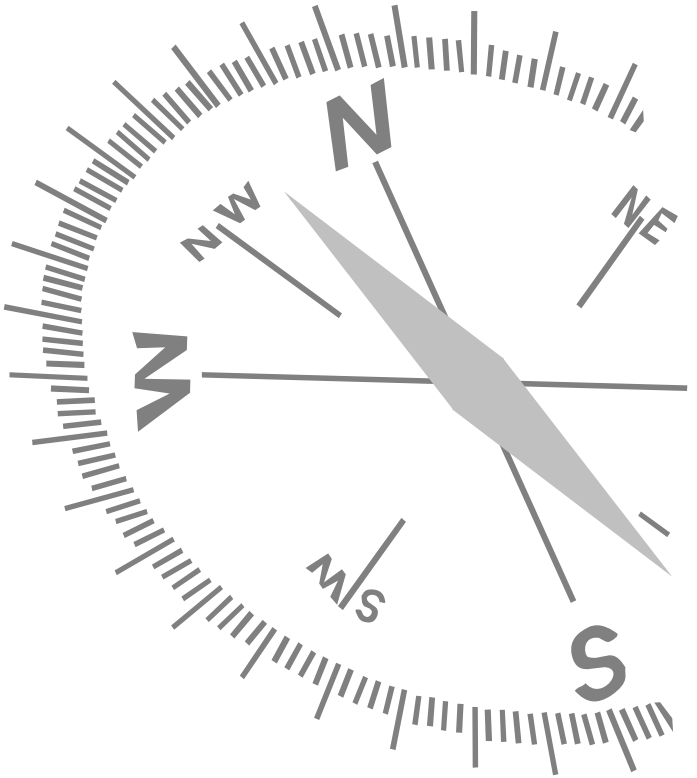


No shortage of visions for unmanned ships

1970s

1980s

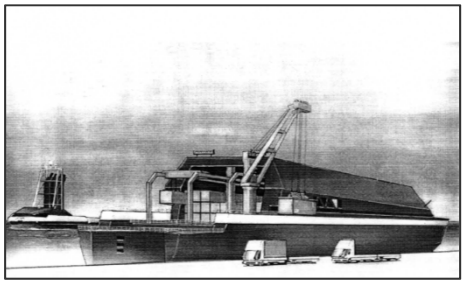
1990s

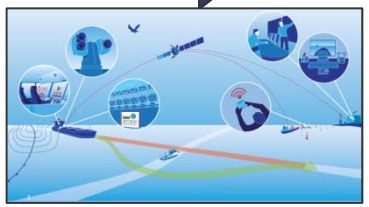
2000s

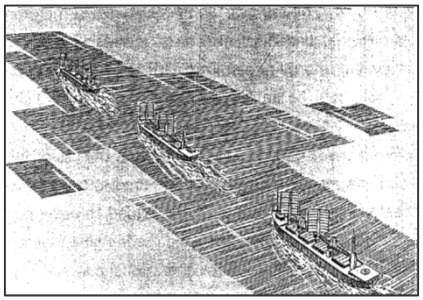
2010s

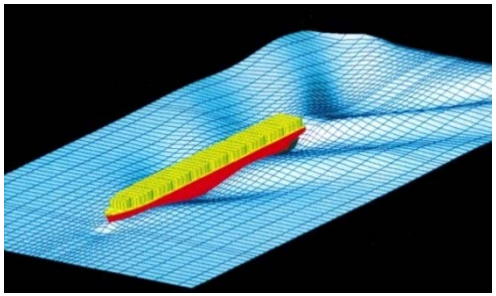
time

https://youtu.be/vg0A9Ve7SxE







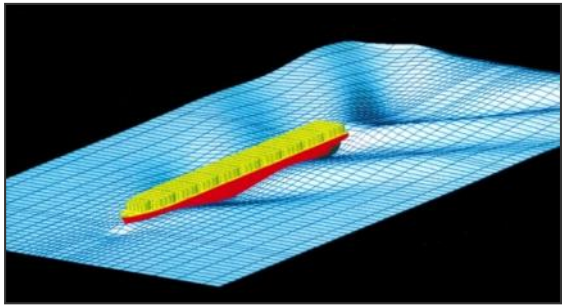


Autonomy and remote control usually combined

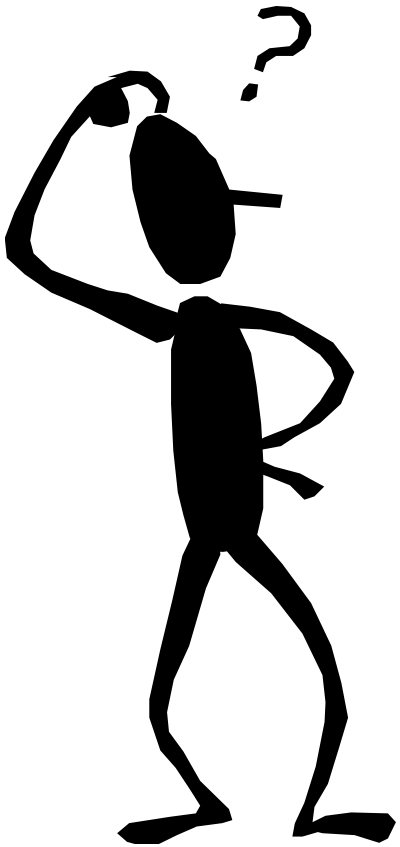
Line-of sight remote control

Satellite remote control

Onboard autonomy



What is already feasible?



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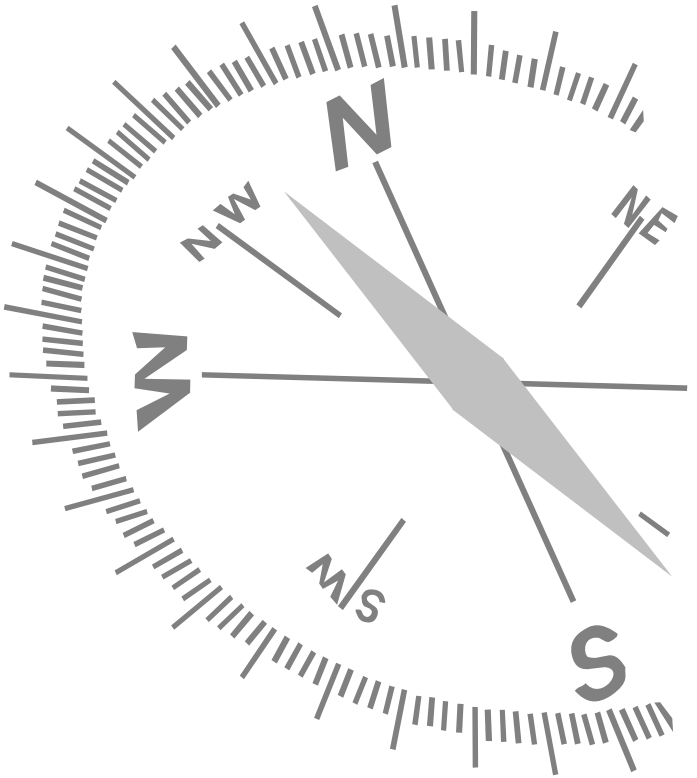


Collision avoidance – Hurdles & solutions

Radar shortcomings:

- **Ship type** (required for COLREGs)
- **Plastic / wood / ice / drifting containers**

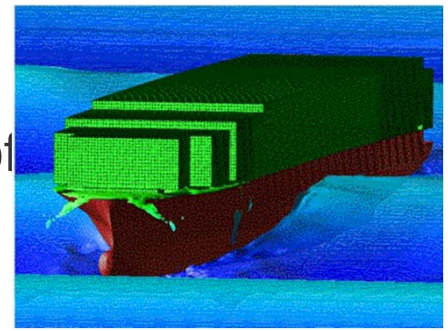
Possible solutions:

- Use LADAR for detection
- Use transponders for detection
- Use automatic identification
- Use ECDIS + iceberg tracking
- Use remote human vision and machine

Voyage execution

Avoid excessive loads

Substitute human “feel” by sensors & sof



- Ship acceleration sensors
- Strain gauges
- Short-term routing software

Route planning

Already frequently performed on-shore

Both strategic & operational planning fea

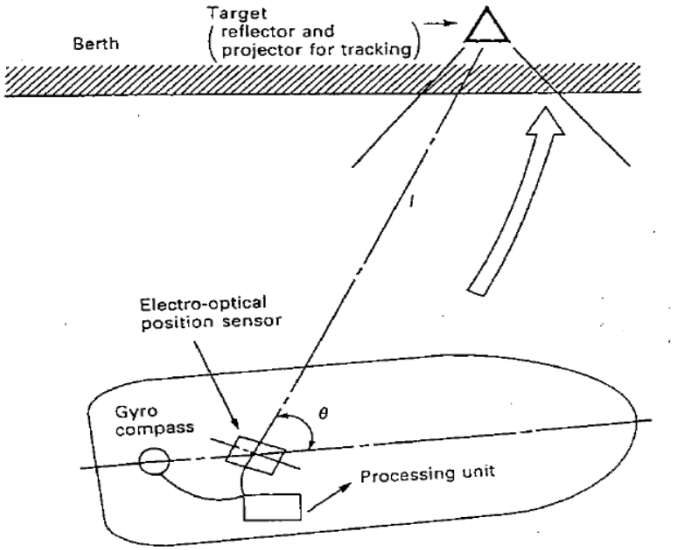
Berthing – “Normal” ships requiring tug assistance

- Remote control (successful simulations in Japan (1990))
- Automatic **tug connection** via tug lines (successful sea trials in 2013)
- RAmora – unmanned tug (2016)

Berthing – Highly manoeuvrable ships

- Lidar (electro-optical system)

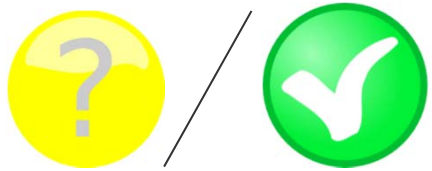
  successful field test in Japan (199
- DGPS
- DP technology for control strategy



DP = Dynamic Positioning

DGPS = Differential GPS

Mooring & Anchoring



Automatic **anchor handling**

- simulations in 1980s in Japan

Automatic **mooring**

- Magnetic systems (already use
- Suction systems

Cargo document handling

Moving towards “paperless” document handling:

- Automated **electronic report** making & transmission

Driven by general logistics industry

“Just” needs to be implemented in practice

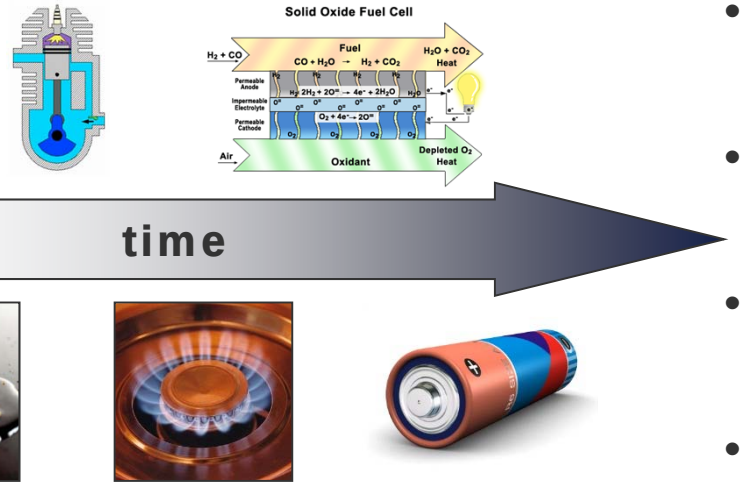
Machinery

Machinery requires care:

- Maintenance (lubrication, filters, …)
- Repairs

Classical “show-stopper” for unmanned ships

Low-emission paradigm change makes things easier



- Fuel cells using LNG as fuel 2018 onwards
- Redundancy of electric propulsion
- Fault diagnosis by expert systems through sensors
- Condition based maintenance

Emergency Response

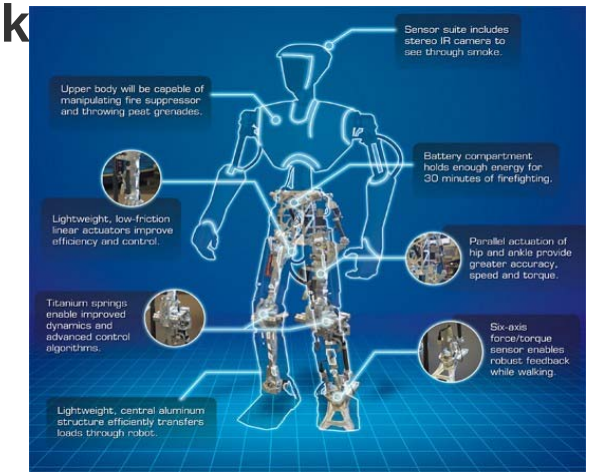
Fire & Co.

- Respond quickly
- Keep calm

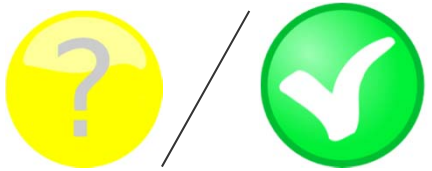
Expert systems exist

Robots better for **dangerous task**

- Smart sprinkler systems
- Fire-fighting mobile robots



Communication



- All on-board systems efficiently linked with each other
- Automatic data exchange with other ships and with shore stations
- Automatic subsystems, external communication, and sensors will create a flood of data to be screened and condensed, filtering unnecessary data before passing it on to the main operating system

Smart Ship Scenario: Tanker which is still manned

- Crew of 4 to 6
- Operator eye tracking software for fatigue detection
- Ladar object, obstacle and range detection through scanners at bow and stern,
- Automatic ship type identification based on wide-angle cameras
- Ship-specific hydrodynamic CFD-based knowledge base, (trim optimization, weather routing and manoeuvring)
- Autonomous collision avoidance route planning: Sensors provide a clearer “map” of the ships environment. Expert systems, plan and offer updated collision avoidance routes.
- Fail safe autonomous collision avoidance: **If the crew does not respond to alarms, the bridge initiates an avoidance manoeuvre autonomously .**

Obstacles for realisation:

Economics and Maritime Regulations (e.g. allowed level of autonomy in IMO Conventions:

But: IMO lawyers working group is at work to assess

Unmanned Ship Scenario: Container feeder with electric propulsion for Norwegian short sea shipping

- Navigates without human interference **on designated routes**.
- Supervised by a shore-based control centre that can take control
- Automatic communication with VTS and other traffic,
- Dynamic positioning (DP) capability (can go into DP mode as a fail-safe measure in case of emergency.)
- Collision-avoidance autonomy in navigation.
- All maintenance work delegated to shore
- Automatic berthing systems
- Autonomous cargo handling systems in port for rapid turn-around times
- Recharge batteries during port

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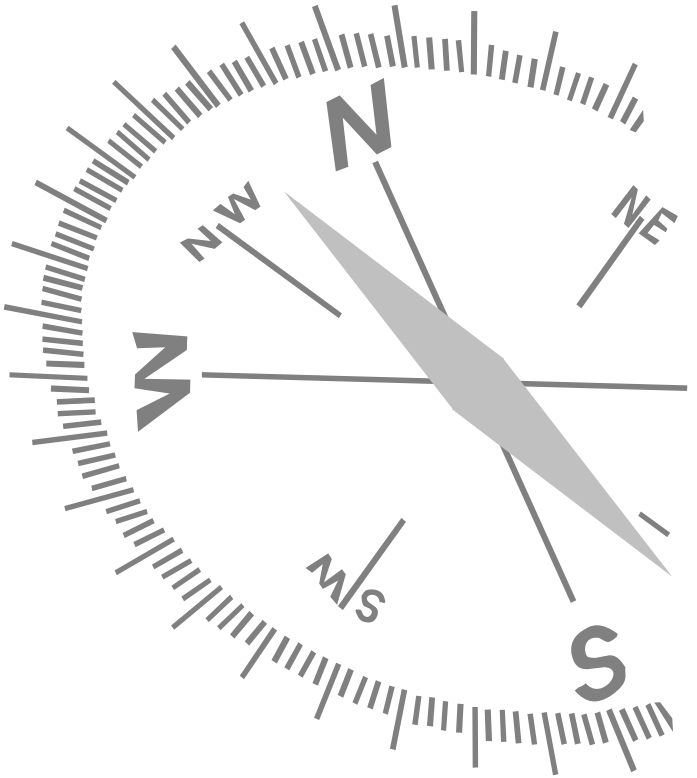


Changes to work and competencies **aboard manned ships with smart autonomous technology –** A sociological assessment

- Nautical Officers
  - Transition from analysing system operators **to operate within the system of expert and support systems**
    - Potentially fewer sources of information through pre-processing expert systems
    - Less chances to critically evaluate the solutions provided by the expert systems (Black-Box)
    - **Willingness to take responsibilities for decisions taken by machines**
- Still high emergency competence required
- How to motivate themselves and stay alert?
- Higher social competence required-communication/conflict/coping with isolation

Changes to work and competencies **aboard manned ships with smart autonomous technology –** A sociological assessment, cont.

- Engineer Officers
  - May become “Mechanics”:
    - **Expropriated comprehensive system knowledge**
    - **Substituted by augmented reality** through integrated expert systems or shore-based experts providing real-time support

- Deck and engine ratings
  - May disappear
    - port and maintenance jobs delegated ashore,
    - cargo supervision by systems

Changes to work and competencies **aboard unmanned ships –** A sociological assessment

- Nautical Officers
  - Needed ashore only
    - **How to gain the seagoing and ship handling experience needed to evaluate the situation of a vessel in demanding circumstances (severe weather conditions, approaching rivers and ports, emergencies?**)
- Engineer Officers
  - Needed ashore only
  - May become “Service Technicians” who board the vessel in port only
  - **Condition based maintenance**
  - Either with comprehensive system knowledge and understanding or again not in depths knowledge

Navigator

Unmanned Vehicles – Land & Air

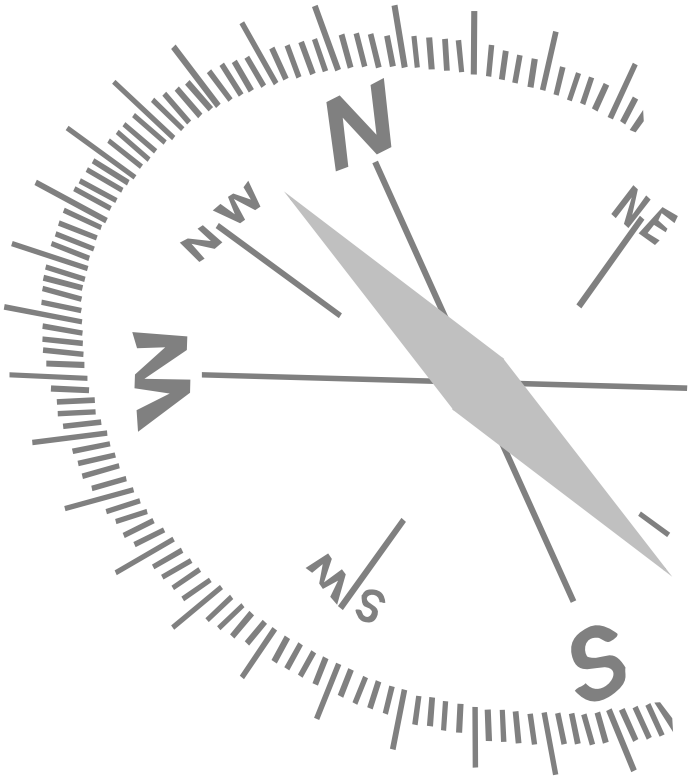
Visions

Key tasks & potential solutions

Changes to work and competencies

Consequences for HRM

Discussion



Definitions

- **Human Resource Management (HRM) =**
  - Crew size/safe manning
  - Competence requirements and competence management
  - Hiring process and retention

Crew size / safe manning

- Possible reduction to 4 to 6 persons aboard
- Possibly no more AB Deck or Engine
- Relatively low manning costs compared to other operation costs – shorter tours of duty?
- Rethinking crew compilation: Single nationality crews again?

Competence requirements – definition and competence management

- **Formal qualification**
  - Integrated system operators (nautical) and mechanics (engine)?
  - Clearly defined competencies mapped and controlled
- **Knowledge**
  - Clearer defined
- **Experience**
  - Clearer defined but how to gain? On special training ships?
- **Attitude/social competence**
  - Clearer defined and more attention (aviation industry)?

Hiring process and retention

- More efforts and attention - defined competencies due to individual technological vessel layouts
- Closer management and control of crewing agencies (if any…)
- Individual technological vessel layouts support drive to retain people
- Constant monitoring of competencies and closing of gaps through training and planned experience – thus higher costs/investments per person

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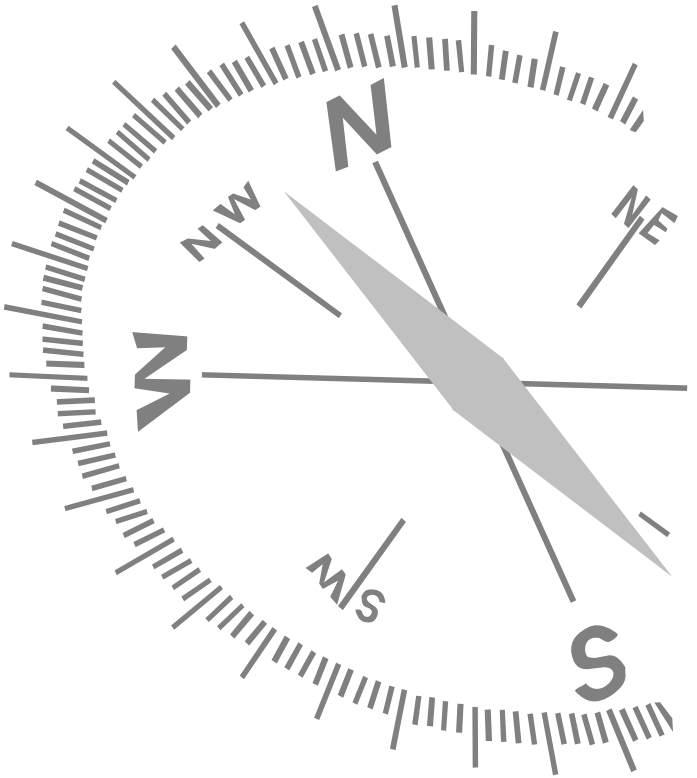

Thank you for your attention!

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