MUNIN-prosjektet: Skip uten mannskap

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MARINTEK

Norsk Marinteknisk Forskningsinstitutt

SINTEF

A concept study for a fully unmanned handymax dry bulk carrier on an intercontinental voyage.

- Duration: 01.09-2012 – 31.08.2015
- Funding: 2.9 million EUR of budget 3.8 million EUR
- Activity code: SST.2012.5.2-5: E-guided vessels - the 'autonomous' ship

Fraunhofer CML MARINTEK aptomar CHALMERS HOCHSCHULE WISMAR MARINE SOFT MARORKA UCC

Contents

- Why unmanned ships ?
- What will the unmanned ship look like ?
- What are the new technology components ?
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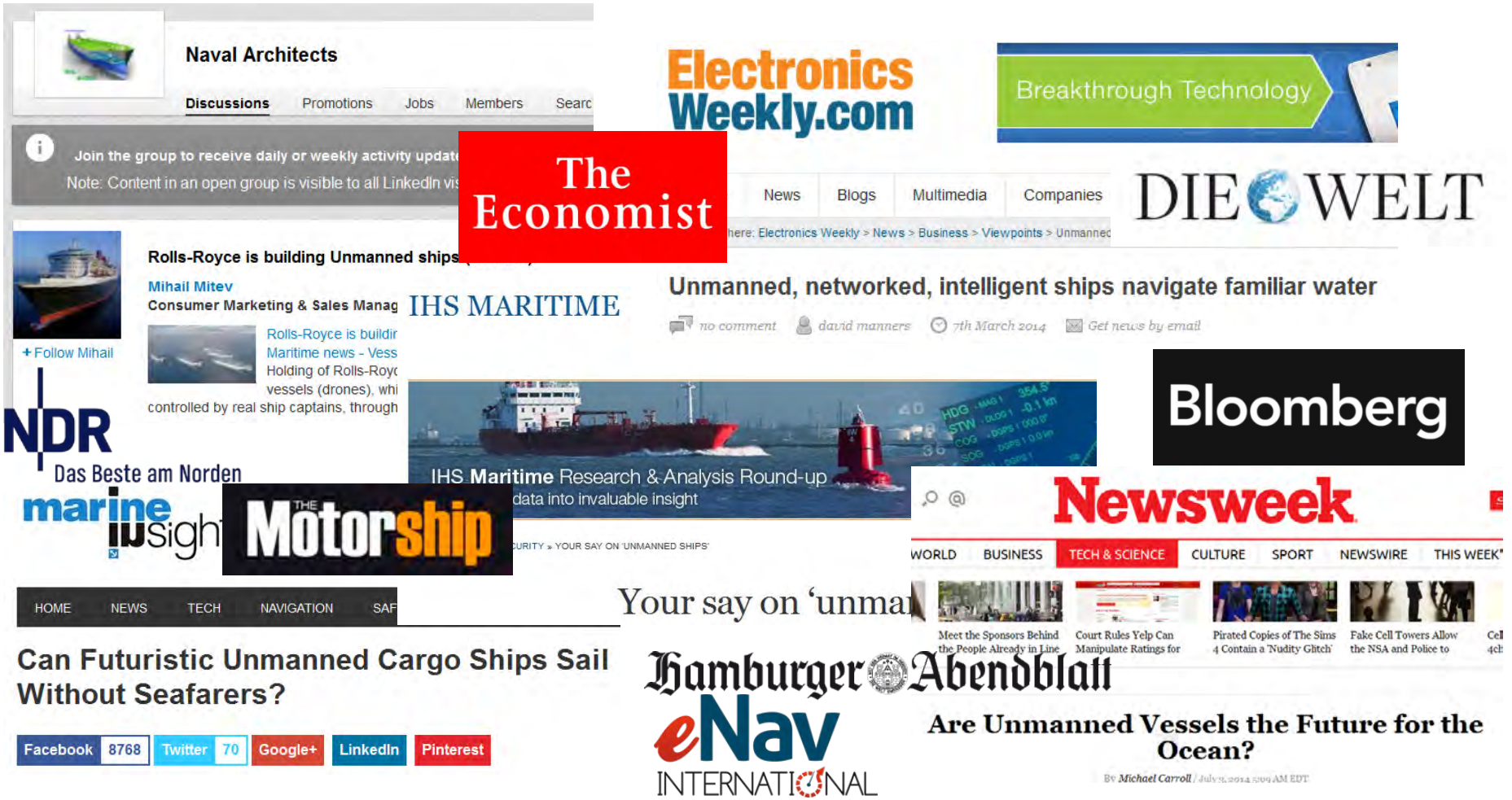
- Conclusions and summary

There is significant interest!



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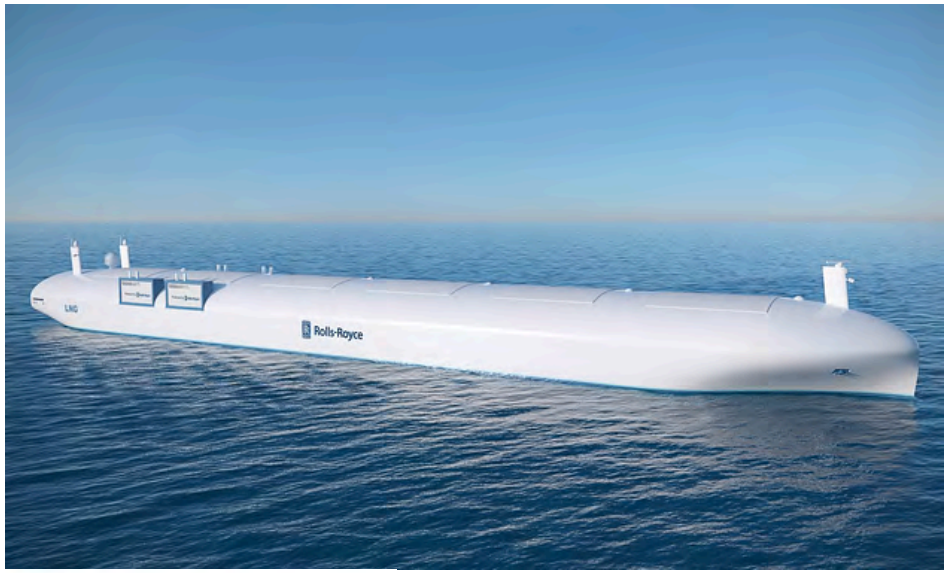


Rolls-Royce

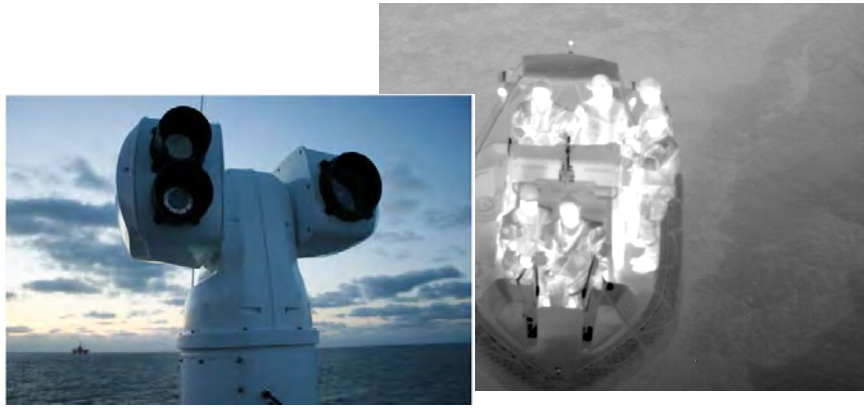
DNV·GL

… also from the professional sector.

What are the possible benefits ?
Safety

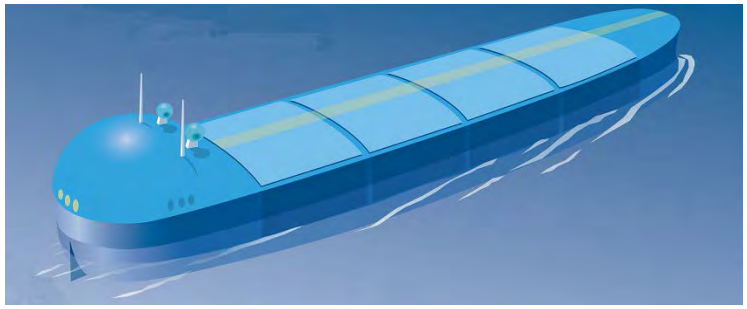
Own ship: No crew

Other ships and environment: Less human errors



Lookout: Better sensor systems

What are the possible benefits ?
Costs



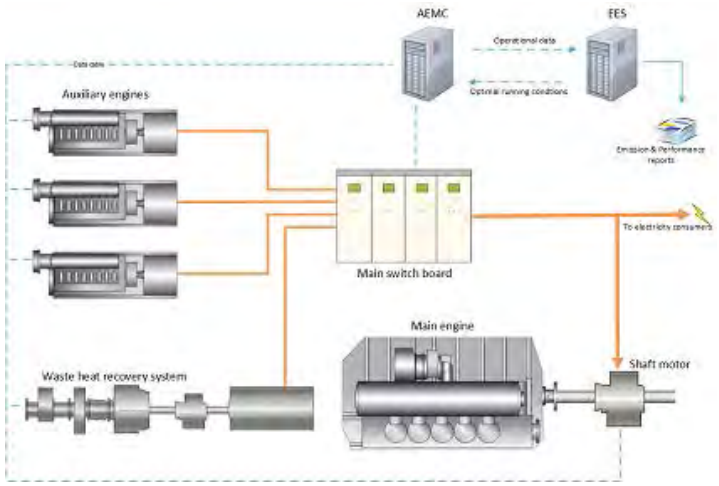
No accommodation

Less power

More cargo

No crew

No crew related costs



Improved technical systems

Less off-hire

Better efficiency

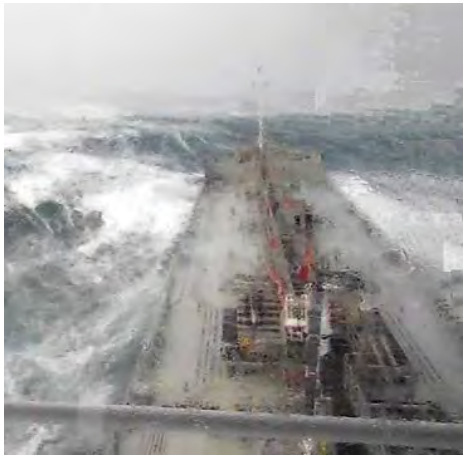
What are the possible benefits ?
Societal

European maritime competitiveness

Availability of seafarers

European employer attractiveness

Improved transport systems

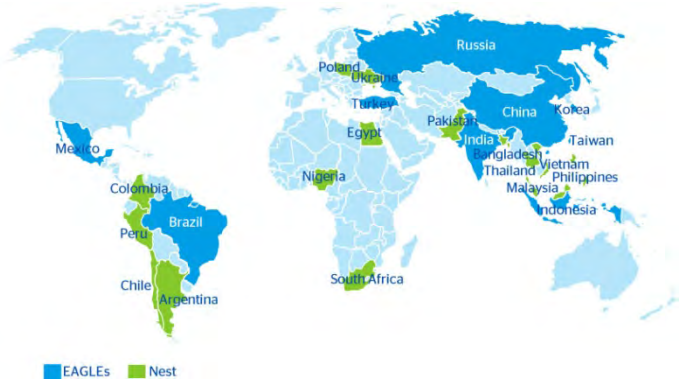


Less dangerous work

Periodically unmanned bridge

Shorter stays away from home

More interesting work



The world's need for

low cost transport

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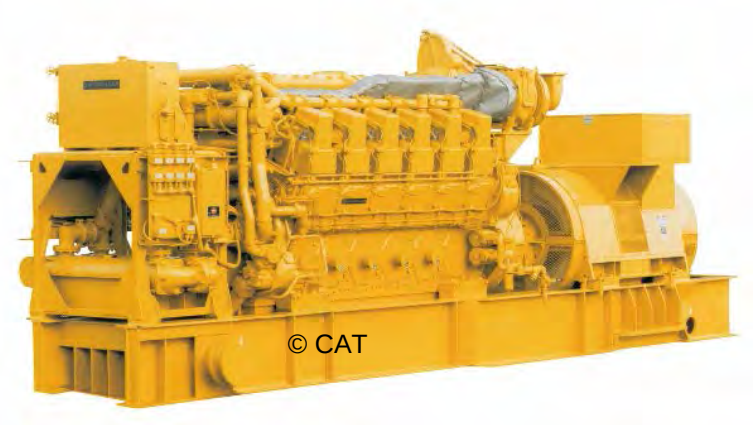
No accommodation section

- Lower construction cost
- Less energy use
- More cargo space

Rolls-Royce

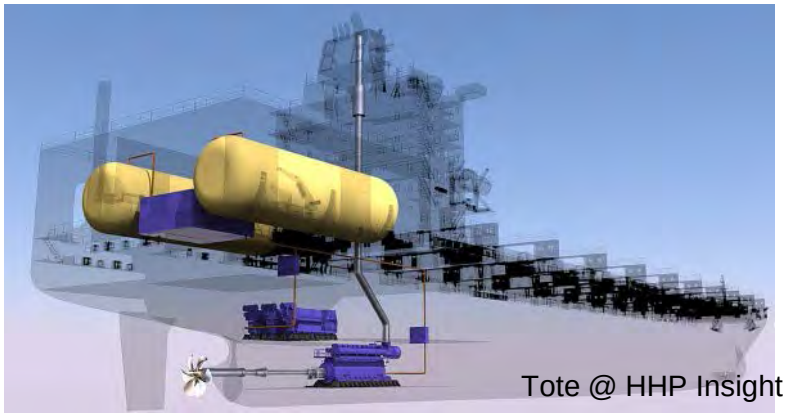
Minimum on board maintenance

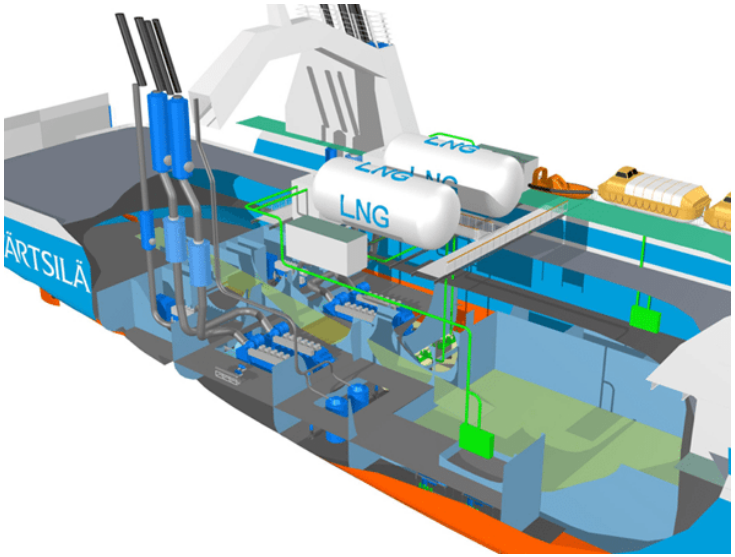


- Redundant propulsion and power generation/distribution.
- Redundant control and communication.
- Improved coatings.
- Diesel-electric with gensets in containers on deck – easy replacement in port.

All operations on board are automated

Heavy fuel oil may require too complex operations: LNG or other clean fuel may be the alternative


Tote @ HHP Insight



No accommodation or other design features may allow fuel tanks on deck.

Continuously manned shore control centre (SCC)

Remote monitoring

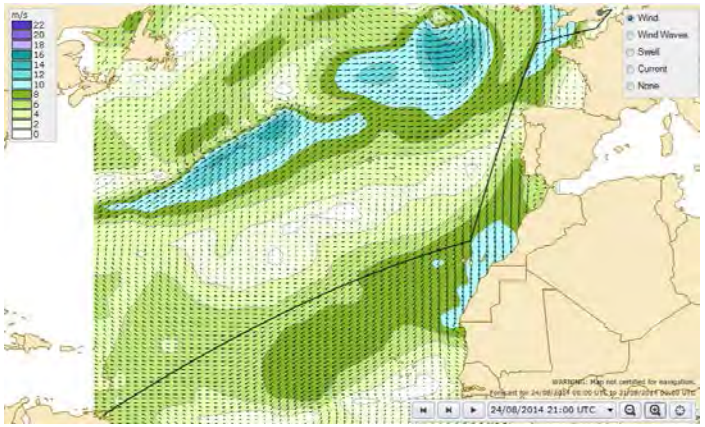
Status intervention

Remote control

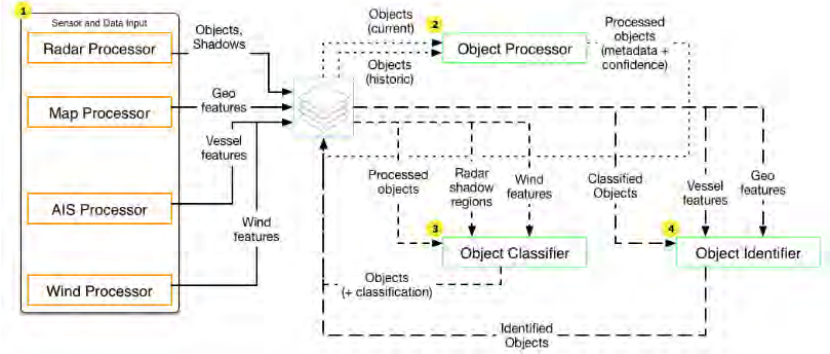
The concept of a shore control center to supervise and control the ships. Responsibility transferred from master to shore.

Avoid difficult to handle situations

Remote control and escort in high traffic areas and for departure and arrival.



Routing to avoid heavy weather.



Advanced automation, but call SCC operator when in doubt.

Deep sea example

- 20 000 TEU container vessel
- Shanghai – Los Angles
  - Two states involved
  - 6000 nm, open sea
  - No channels
  - Short port approach
  - Remote control to port
- Dual propulsion systems
- Two stroke diesels
- Biofuel, methanol …

Short sea example

- Offshore supply vessel
- North Sea, Mexican Gulf
  - One state involved
  - 3-6 day roundtrip
  - Base near open sea
  - Infrastructure at base/rig
  - Remote controlled at base/rig
- Dual propulsion systems
- Diesel-electric
- LNG, biofuel, methanol …

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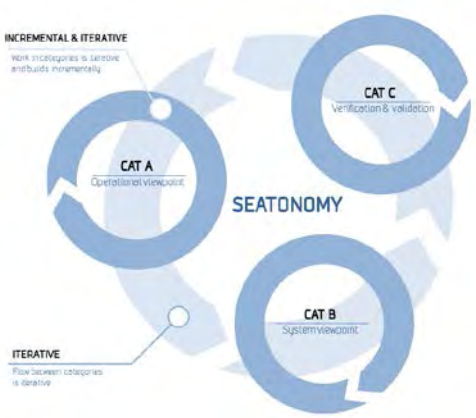
A new design methodology



Iteratively look at the operational issues in the context of the system design and vice versa.

SEA TONOMY

RISK OUTCOME
Low
Moderate
Significant
High

Likelihood	Consequence				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Almost Certain 5	5	10	15	20	25
Likely 4	4	8	12	16	20
Possible 3	3	6	9	12	15
Unlikely 2	2	4	6	8	10
Rare 1	1	2	3	4	5

Risk reduction principle covering both operation and design.

MUNIN's hypothesis: Unmanned ship systems can autonomously sail on intercontinental voyages at least as safe and efficient as manned ships.


The Autonomous Sensor Module can sense sufficient weather and traffic data to ensure navigation and planning function on autonomous ships and enable situation awareness in an operation room.

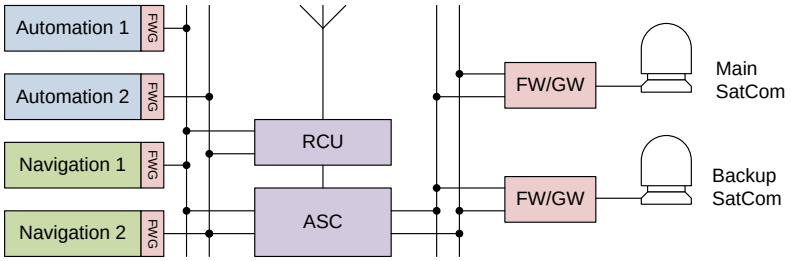

A Deep-Sea Navigation System can autonomously navigate a ship safely and efficiently along a predefined voyage plan with respect to weather and traffic conditions.


A ship engine can reliably operate for 500hrs without physical interference from a human in the ship's engine room.


The Shore Control Centre operator will be capable to monitor and control six unmanned ships at the same time.

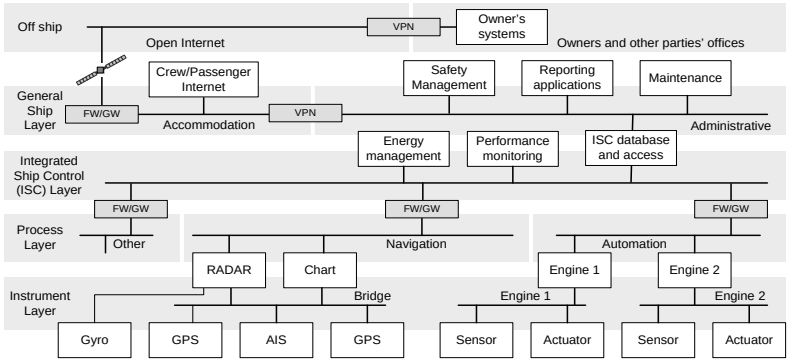
Validation through hypothesis testing.

An emerging ICT architecture



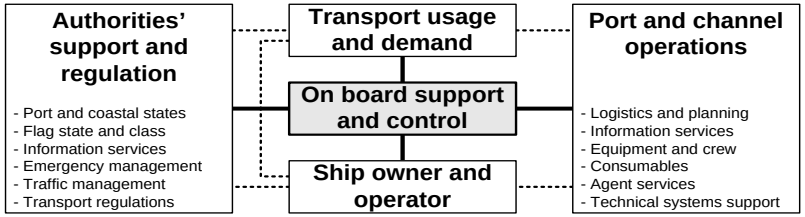
General ship system redundancy and communication systems integration.

IEC 62940



Network architecture for safety and security.

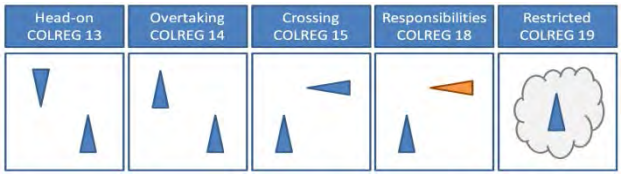
IEC 61162 series



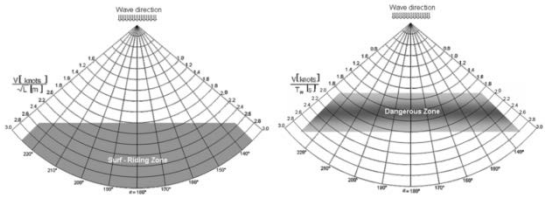
Data structures and semantics.

ISO 28005 series

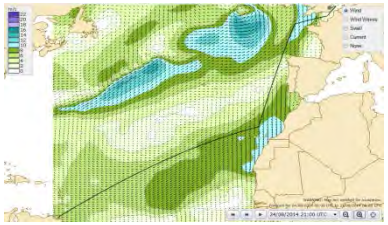
New navigation functions



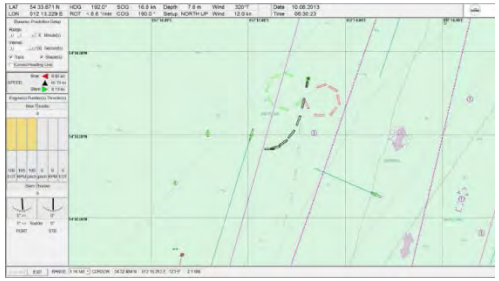
Deep sea collision avoidance: Tactical and last minute.



Avoid dangerous sea conditions: Surf riding, parametric rolling, broaching etc.

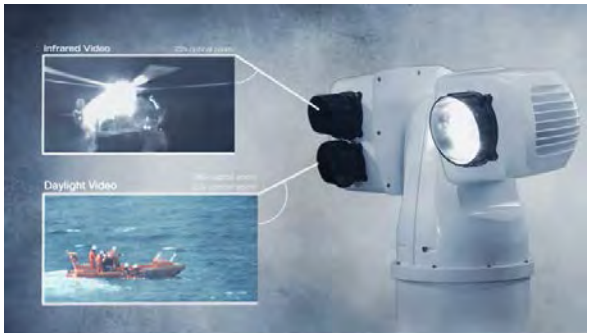


Tactical weather routing.

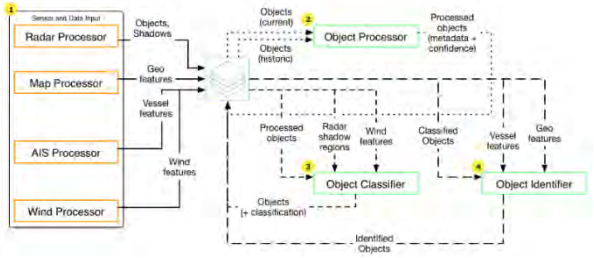


User decision support for remote control.

New sensor functions



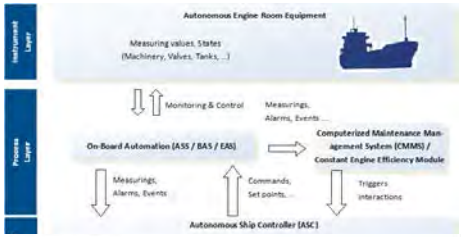
New detectors in IR and daylight video.

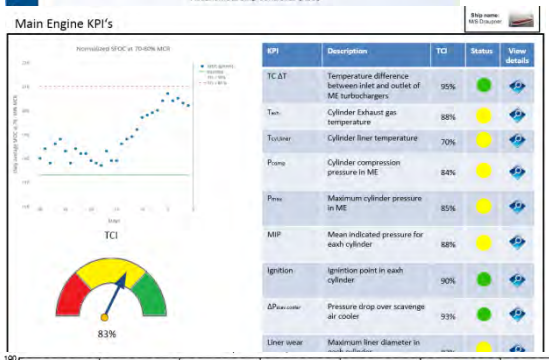


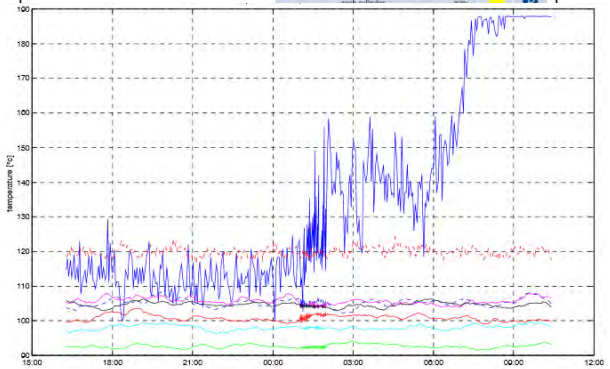
Sensor fusion and classification: AIS, Radar and video.

SCC decision support.

New machinery and maintenance functions





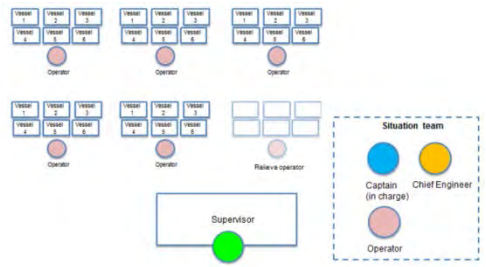


Prototype operation and maintenance concept for unmanned ship.

KPI based energy efficiency and maintenance planning system.

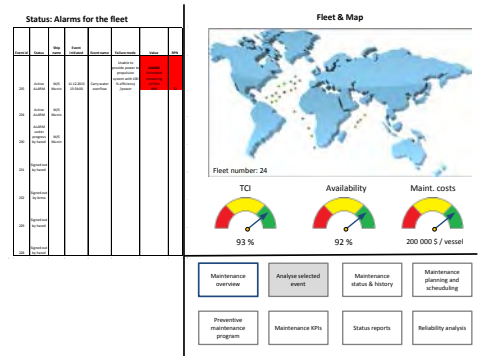
New condition monitoring systems and approaches.

Shore Control Centre (SCC)



General organizational principles and staffing.

Ship status monitoring.



Ship intervention on different levels: Monitoring, new instructions, detailed analysis and support – all ship systems.

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Cost-benefit

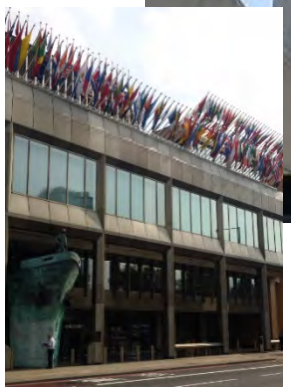
- No hotel
- No crew
- Improved efficiency
- Less off-hire

- Dual propulsion, no HFO
- Shore Control Centre
- Longer dockings
- Costlier instruments

Legal and liability issues

- Contracts
- Insurance

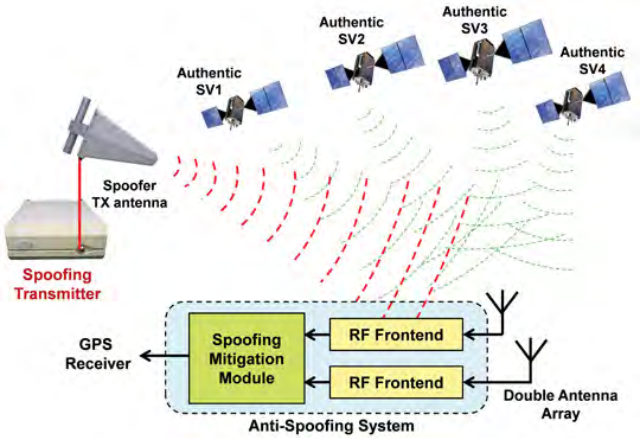
- UNCLOS
- SOLAS



- Liability

Hostile attacks

- Terrorist hijack e.g. by GPS spoofing

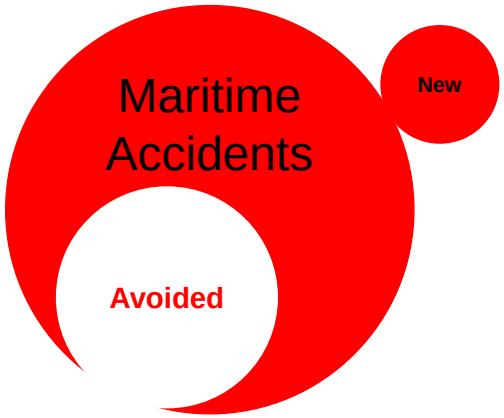


- Pirate attack

- Governmental backdoor

"Autonomy assisted accidents"

First radar assisted collision: Andrea Doria and Stockholm off Nantucket in 1956



Some new accidents are probably unavoidable. Question is the totality!

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Conclusions and summary

- A three year concept study with a host of public reports is soon completed.
- Overall conclusion is that the unmanned ship will come.
- There are no obvious long term show stoppers.
- There are also many intermediate benefits from emerging technology.

Thank you for your attention!