MUNIN's perspective on feasibility of unmanned ships

MUNIN Workshop: Professional insight on unmanned ships
Norshipping, June 3rd 2015, Lillestrøm, Norway

Ørnulf Jan Rødseth, MSc
Senior Scientist
MARINTEK Dep. Maritime Transport Systems

http://www.unmanned-ship.org

SST.2012.5.2-5: Grant no. 314286
E-guided vessels: The 'autonomous' ship
MUNIN concept study: Handymax Dry Bulk Carrier

- 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
Contents

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

- Why unmanned ships?
- What will the unmanned ship look like?
- What are the new technology components?
- What are risks?
- Conclusions and summary
There is significant interest!
There is significant interest!

... 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
Contents

- Why unmanned ships?
- What will the unmanned ship look like?
- What are the new technology components?
- What are risks?
- Conclusions and summary
No accommodation section

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

- ... or in some cases a minimum cabin for short stays.
Minimize onboard 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.
Fully automated on board operations

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

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 Angeles
  - 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 ...

© Bibby ship management
Contents

- Why unmanned ships?
- What will the unmanned ship look like?
- **What are the new technology components?**
- What are risks?
- Conclusions and summary
A new design methodology

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

Risk reduction principle covering both operation and design.

Validation through hypothesis testing.

**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.
An improved 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
The new MUNIN sub-systems

- Advanced Sensor System
- Shore Control Centre
- Maintenance Interaction System
- Remote Manoeuvring Support System
- Deep-Sea Navigation System
- Engine Monitoring & Control System
- Energy Efficiency System
- Engine Monitoring & Control System
Sensors and autonomous navigation Concept

**Advanced Sensors System**
- Electronic lookout
  - Detect small objects
  - Detect weather phenomena

**Autonomous Navigation System**
- Op. decision-making
  - Avoid collisions
  - Ensure stability in harsh weather

**Shore Control Centre**
- Human element
  - Monitor voyage and vessel
  - Problem-solving
Sensors and autonomous navigation
Feasibility tests

**Advanced Sensors System**
- Electronic lookout
  - Detect small objects
  - Detect weather phenomena

**Autonomous Navigation System**
- Op. decision-making
  - Avoid collisions
  - Ensure stability in harsh weather

**Shore Control Centre**
- Human element
  - Monitor voyage and vessel
  - Problem-solving
Autonomous engine room Concept

Autonomous Engine Monitoring and Control
- Condition measurement
  - Detect functional degradations
  - Ensure efficiency

Shore Control Centre
- Human element
- Maintenance planning
- Problem-solving
Autonomous engine room
Feasibility tests

Autonomous Engine Monitoring and Control
Condition measurement
- Detect functional degradations
- Ensure efficiency

Shore Control Centre
Human element
- Maintenance planning
- Problem-solving
Integrated simulations for validation
Integrated simulations for validation

- **Advanced Sensor System**
- **Deep-Sea Navigation System**
- **Remote Manoeuvring Support System**
- **Engine Monitoring & Control System**
- **Energy Efficiency System**
- **Shore Control Centre**
- **Maintenance Interaction System**

Ship handling simulation
Contents

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

- UNCLOS
- SOLAS
- Contracts
- Insurance
- Liability
Hostile attacks

- Pirate attack
- Terrorist hijack e.g. by GPS spoofing
- 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!
Contents

- Why unmanned ships?
- What will the unmanned ship look like?
- What are the new technology components?
- What are risks?
- Conclusions and summary
Initial validation in-situ and in simulations soon finished
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.
B0 – Periodically unattended bridge
Coming soon?

Automated Lookout / Watch free bridge
- Single source of reliable data provision
- No reduced lookout capability due to fatigue

Autonomous deep-sea navigation
- COLREG compliance
- Hull and motion monitoring in harsh weather

Shore-side situation monitoring / Backup watch from shore
- Human-oriented information management
- Remote situation awareness concept
Thank you for your attention

MUNIN
FINAL EVENT

10th – 11th June 2015 • Hamburg • 53°7,8’N 009°58,1’E

www.unmanned-ship.org

Is unmanned and autonomous shipping feasible? • And is it desirable?