MUNIN - A concept study for the unmanned and autonomous ship

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http://www.unmanned-ship.org
Technology developments where MARINTEK has actively contributed.
Content

- Introduction to MUNIN
- Rationale for unmanned ships
- Problems with unmanned ship
- Some possible solutions
- Conclusion and summary
Munin ("mind") is one of the old Norse good Odin's two ravens flying out in the morning and reporting news of the world to their master in the evening.

Hugin ("thought"), the other raven, is also the name of a commercially successful autonomous submarine (AUV).

... and now our EU supported R&D project MUNIN.
Partners in MUNIN

- Fraunhofer CML (DE) – Research, Coordinator
- MARINTEK (NO) – Research
- Chalmers (SE) – University
- Hochschule Wismar (DE) – University
- Aptomar (NO) – Industry
- MarineSoft (DE) – Industry
- Marorka (IS) – Industry
- University College Cork (IE) - University
Project details

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

- Develop and test unmanned ship concepts
- Technical investigations on navigation, engine, remote control etc.
- Verify concepts in simulators and by analysis
- Examine legal and contractual constraints
- CBA and applications in today's shipping as well as other ship types
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WaterBorne TP

Route Map EO 3 Autonomous Ship

- STRATEGIC RESEARCH AGENDA
-ongoing programmes
- development milestones
- exploitation outcomes

TODAY
- adoption
- EU projects
- Flagship
- SAFETY
- NATURE
- البحرية

2020
- vision targets
- autonomous ship

- PILLAR 1
  - improved safety at sea and by European and globally will be extended remotely.
  - Detect and assist in Europe will only be possible and services available in the most severe conditions (e.g., storms, ice, etc.).
  - Ships in Europe will be equipped with an enhanced system for performance monitoring, which can support safe navigation and life-cycle management.
  - In 2020, the sensor monitoring, identification, communication, and route management systems will be operational. The system will improve the coordination and efficiency of operations.
  - In 2020, the cost and safety of more secure transport will continue to be clearer than other transport modes.

- PILLAR 2
  - In 2020, European deep-sea shipping will be led by European transport. European deep-sea shipping and inland waterway transport will be the backbone of the future of shipping.
  - In 2028, Europe’s deep-sea shipping and inland waterway transport will be the backbone of the future of shipping.
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- PILLAR 3
  - Increased use of inland waterway will offer enhanced streamlined transport operators, making short sea shipping and inland waterway to clearly
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Autonomous Slow Steaming

- Environmentally
  - Reduce CO$_2$ emissions with 54% (reduce speed from 14 to 10 knots)

- Economically
  - Lower fuel costs (but higher hire)
  - Offset increased crew costs due to longer voyage: Up to three weeks

- Societal
  - Make crew available for more demanding tasks, closer to home, offset lack of crew, increase job attractiveness
New ship concepts

Source Rolls Royce Holdings
New ship concepts

Source Rolls Royce Holdings
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Communication technology and information transfer

- Dependent on trade area and cost one have to expect varying degree of communication service (bandwidth, latency and reliability)!

AMVER July 2012: www.amver.org
Iridium has some limitations in quality of service

High latencies and variance for certain types of message exchanges

Very high latencies and variance for a small number of message exchanges

85 outages less than 900 seconds, 19 longer. Some up to 10 hours.
Lookout and collision avoidance

- Radar and AIS are on board – enhancements are available.
- Small object detection radar, IR cameras, low light cameras etc. are available.

Key challenges are to integrate sensors and to classify objects automatically.
Manoeuvres in difficult conditions

Less of a problem for bulk carriers.
Today ship safety is to some degree based on the ability to repair equipment during voyage.

Autonomous ships need high confidence level against critical failures during sea leg!

High reliability, redundancy and fail-to-safe mechanisms required!

New approaches to component redundancy as well as preventive maintenance are required.
Legal and contractual issues

- Who is in charge of the ship – no master?
- Flag state jurisdiction without master?
- COLREGS?
- Insurance and liability?
- Safety at sea – SAR?
- Public opinion, workers' rights
- ...

It will take time before we see the first fully autonomous ship!
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All in all: We need to limit complexity!

- Right level of autonomy
- Make use of human support on shore
- Do not challenge technology unnecessarily
- Develop fail-safe solutions and procedures
- Ensure safety and reliability at a sufficient level
The right level of autonomy

Degree of autonomy

- Intelligent
- Autonomous
- Automatic
- Fail to safe
- Remote control

Degree of uncertainty

- None
- Simple and robust
- Flexible, known response
- Constrained freedom
- Full freedom

Onboard route planning
Collision avoidance
Track keeping
Emergency stop
Shore side operation centre

MUNIN Focus

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Need a good method for responsibility sharing between AS and human control
Organisation of a Remote Control Centre

General case (Assumptions)
1 SCC per 100 vessels
1 operator per 6 vessels
1 supervisor per 30 vessels (5 operators)
1 relieve operator (with workstation for 6 ships) per 30 ships
1 situation room per 30 vessels
1 engineer per 30 vessels
1 captain per 30 ships
Manage risk

- Define manageable use cases
- Remove complexity
- Simplify operations
- Provide redundancy
- Quantify risks
- Verify assumptions
- ...

Fail to safe

SCC: Initiate recovery
Address the challenges:
Fit the use cases to the restrictions!

Dry bulk ship on inter-continental voyage. LNG as fuel?

Select:
- Long deep-sea-voyage
- Low risk cargo
- Slow steaming attractiveness
- Avoid complications near shore
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Is the autonomous ship possible?

- Technology is mostly available: Need to be integrated and improved
- Integration in maritime transport system is a challenge: Shore, other ships, SAR
- Keep it simple and stupid
- Public opinion, legal issues and liability clearly a delaying factor today
…and afterwards to full scale tests!

Thank you for your attention!