AUTONOMOUS TECHNOLOGIES FOR UNMANNED CARGO SHIPS

MUNIN

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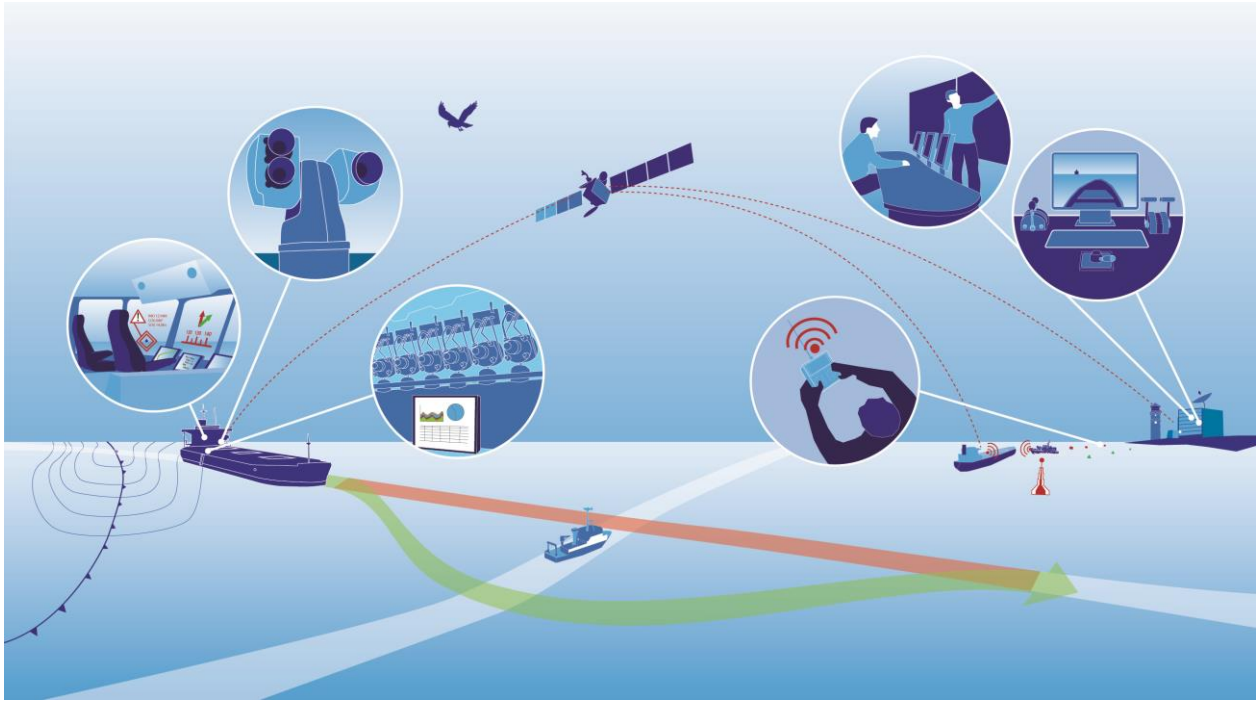
18.03.2015 – Digital Ship, Hamburg



Fraunhofer CML

AGENDA

1. **Fraunhofer CML introduction**
2. MUNIN overview
3. Autonomous Bridge
4. MUNIN Test-bed
5. Conclusion and Outlook

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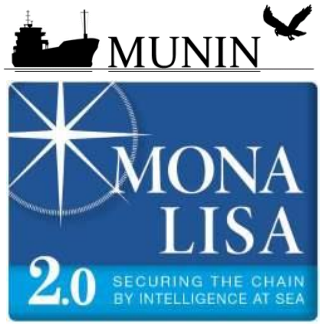
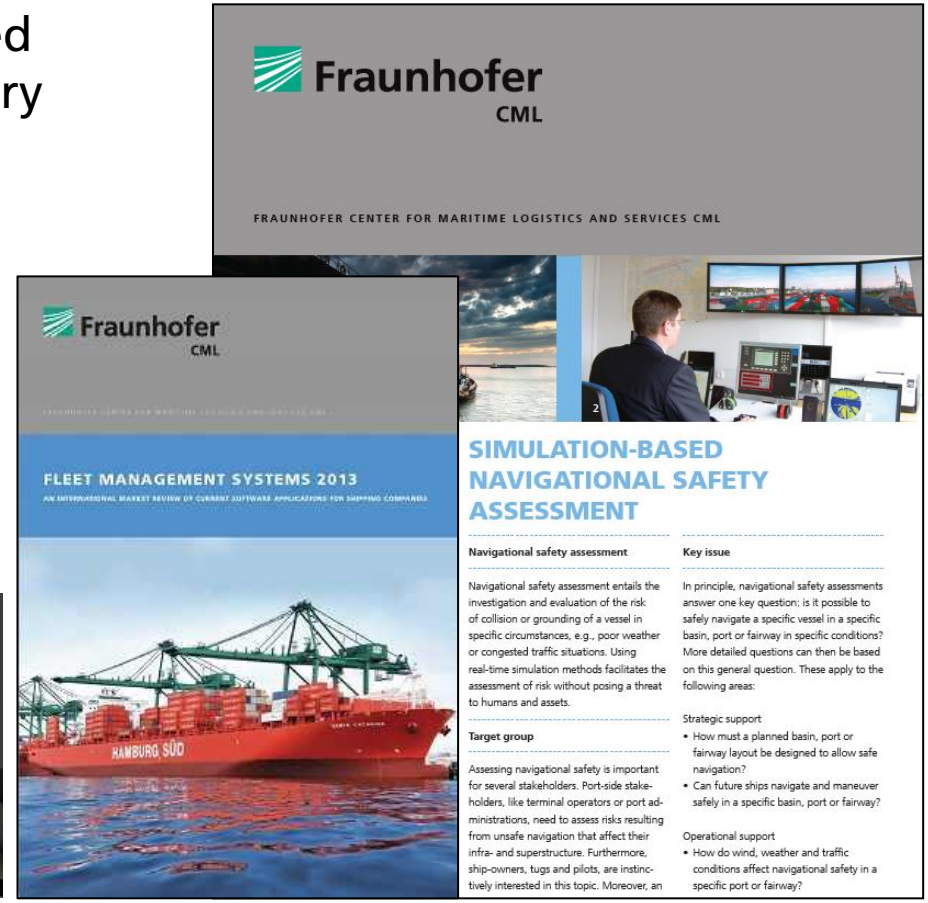
Introduction

Fraunhofer CML conducts applied research for the industry

- Fraunhofer CML conducts applied research for the maritime industry
- Activities (amongst others)
  - Navigational safety and risks
  - Decision support tools
  - Ship-shore-integration
  - Ship management





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Introduction

Focus on commercial and navigational ship operations

Sea Traffic and Nautical Solutions

- Topics
  - Sea traffic's safety
  - Sea traffic's efficiency
  - Navigational solutions
- Tools
  - Ship handling simulation
  - ENC software development
  - AIS data analysis framework

Ship and Information Management

- Topics
  - Maritime information management
  - Ship management
- Tools
  - Mathematical optimization
  - Operations research technologies

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MUNIN's overview

Key facts of the project

Maritime Unmanned Navigation through Intelligence in Networks

- European FP7 project from Sep 2012 to Aug 2015
- 8 partners with 2.9 million € funding
- Focus:
  - Develop a concept for an unmanned merchant vessel
  - Validate concept in a simulator set-up

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MUNIN's Aim

Project definition of the autonomous vessel

Autonomous ship

Next generation modular control systems and communications technology [that] will enable wireless monitoring and control functions both on and off board. These will include advanced decision support systems to provide a capability to operate ships remotely under semi or fully autonomous control.

Autonomous ship

No persons on board for whole or part of the voyage. The ship, with partial help from remote control, must be able to manage the voyage on its own.

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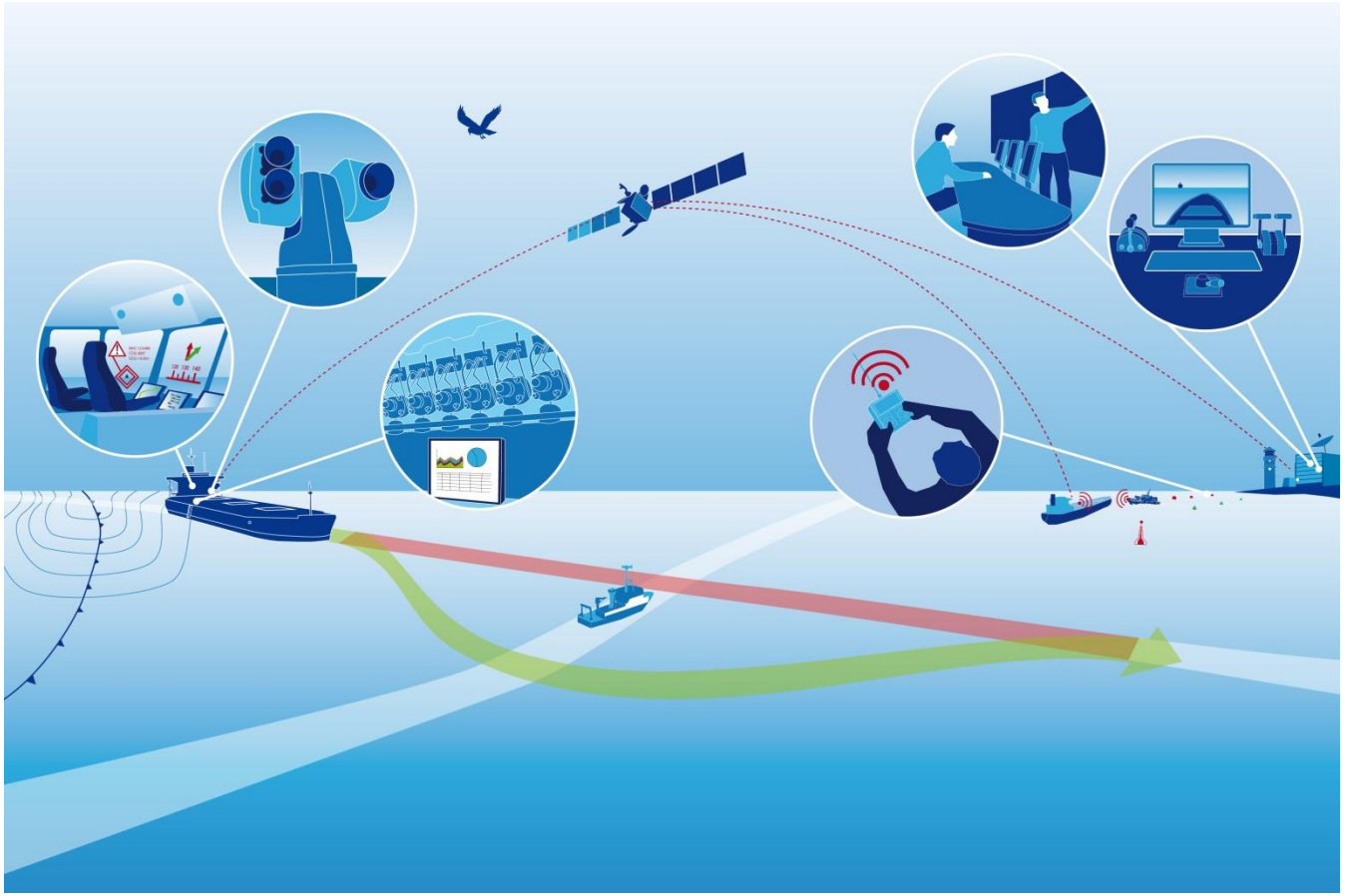
MUNIN's Vision

Unmanned deep-sea voyage



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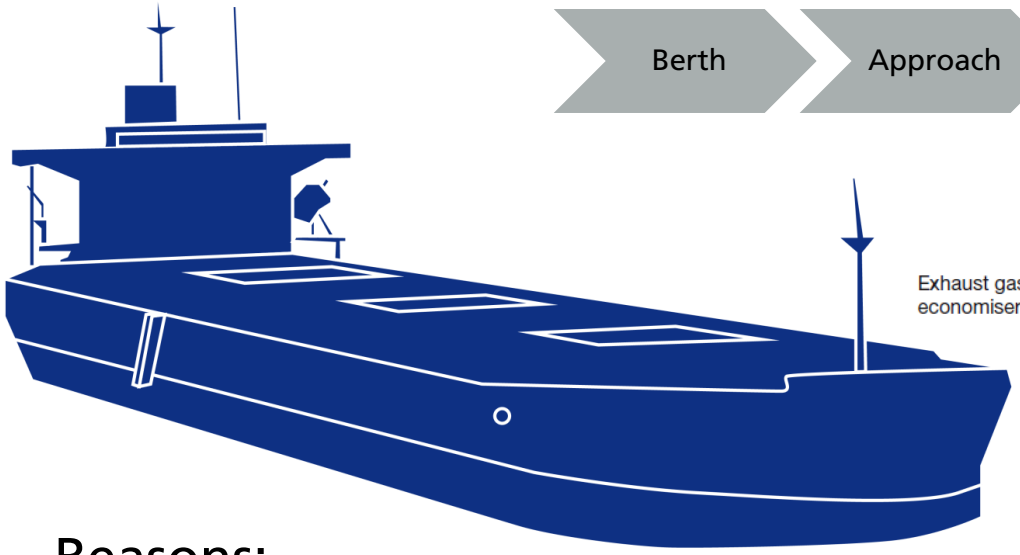
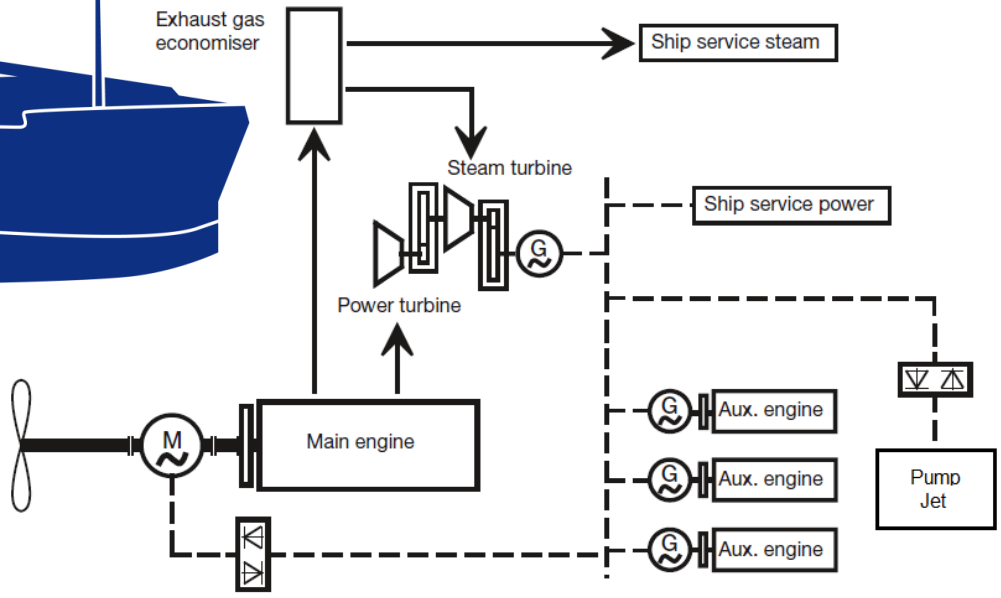
MUNIN's Use Case

Dry bulk carrier on deep-sea-voyage



Berth | Approach | **Transit** | Approach | Berth



Reasons:

- Long deep-sea-voyage
- Low risk cargo
- Slow steaming attractivness

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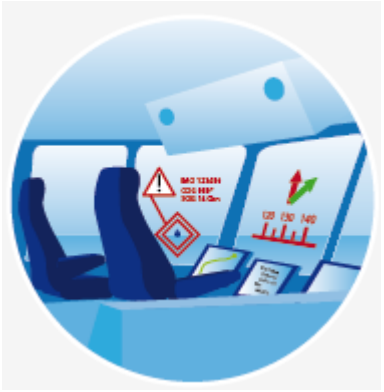
MUNIN's navigational systems

Enabling unmanned navigation during deep-sea voyage

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

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Autonomous Bridge

Short term use case „Watchfree bridge“

- Autonomous Engine Room
  - Partly unattended engine room already exists
  - *Class notation **E-0** which is considered to meet the regulations of the International Convention for the Safety of Life at Sea (SOLAS) for **unattended machinery spaces** […]*
- Autonomous navigation can lead towards **B-0** „watch-free bridge“
  - Flextime work for nautical officers onboard
  - Improved shore intervention possibilities
  - Less manning possible
- Important date: New SOLAS in 2024

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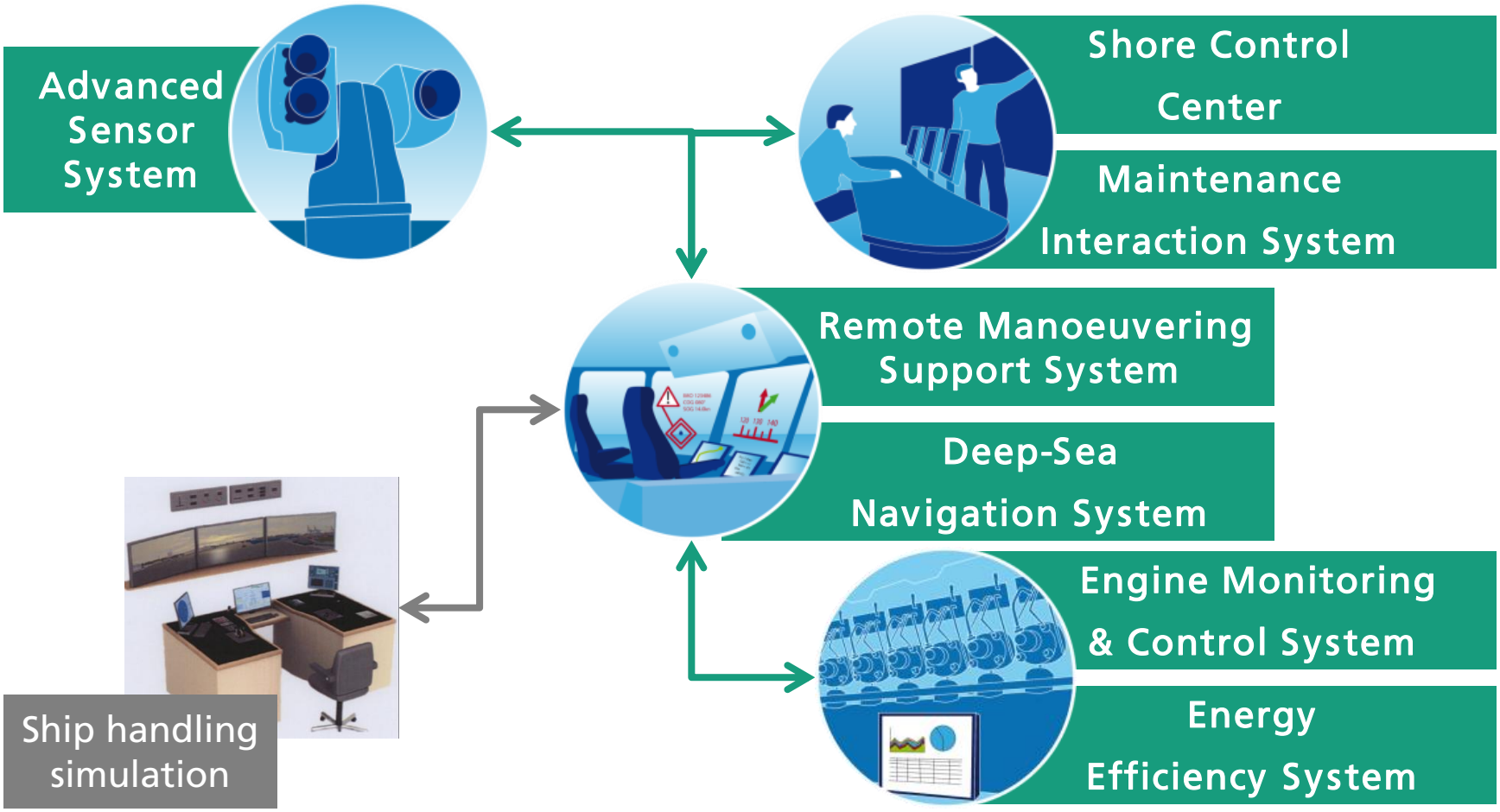
MUNIN Test-bed

Integrated simulation-based environment



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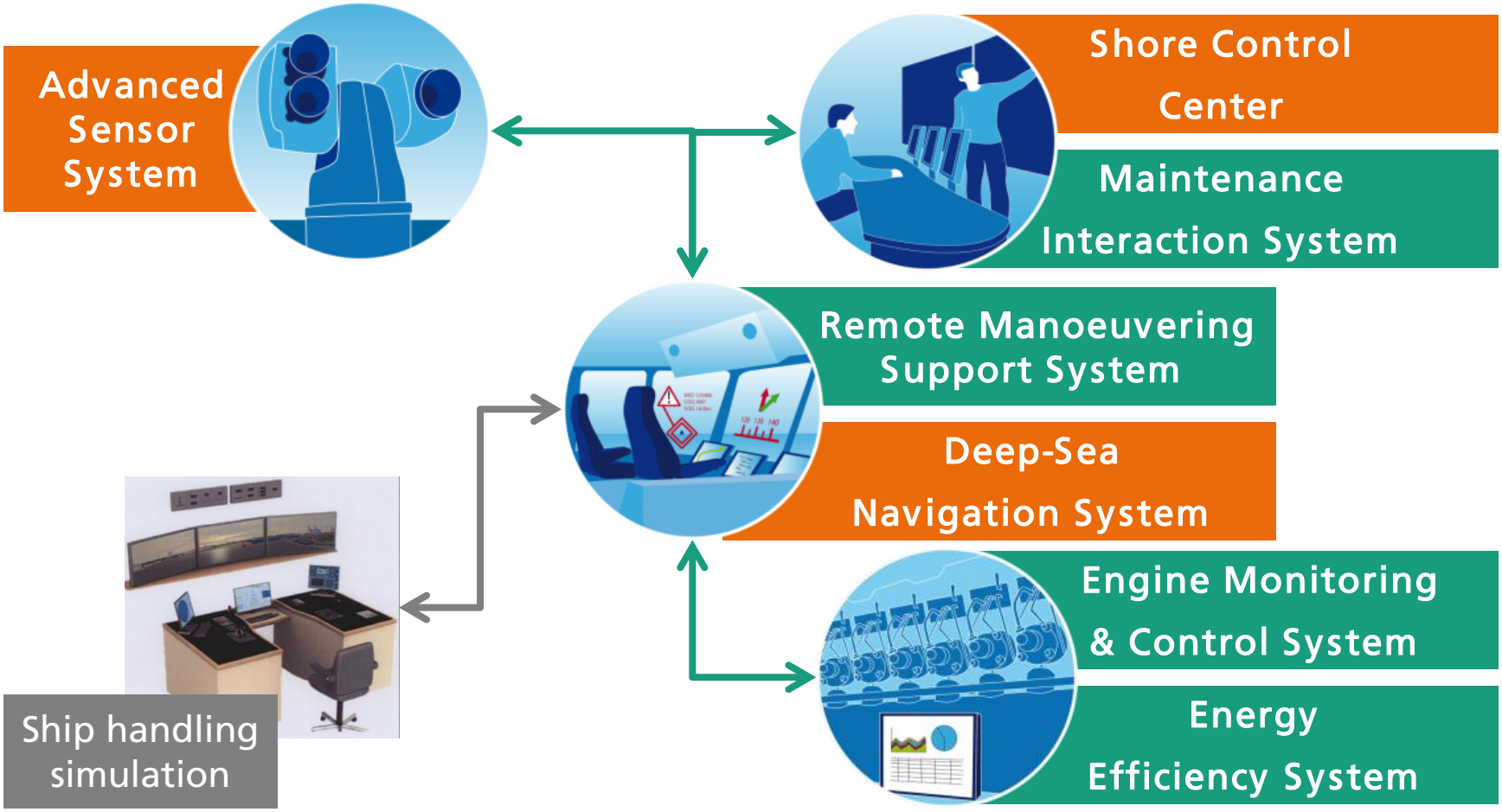
MUNIN Test-bed

Integrated simulation-based environment



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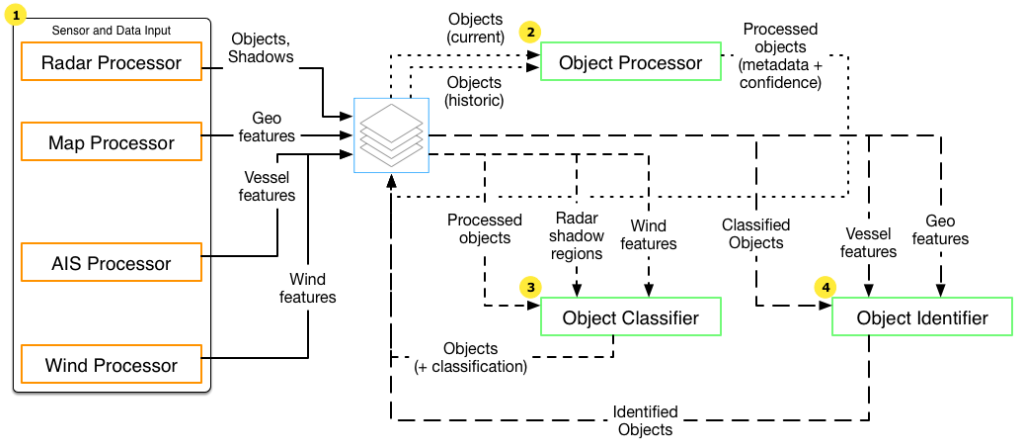
MUNIN Advanced Sensor Module

Sensor fusion approach

COLREG §5

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate […]



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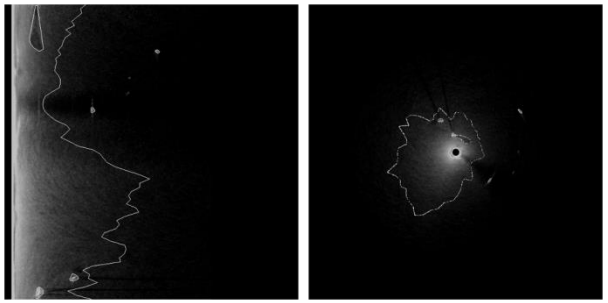
MUNIN Advanced Sensor Module

In-situ tests performed in Norway



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MUNIN Advanced Sensor Module

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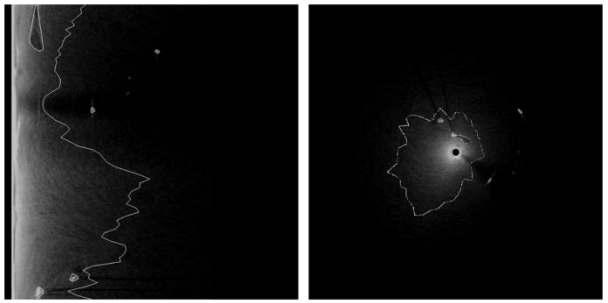

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MUNIN Deep Sea Navigation System
Integration of COLREG and Harsh Weather

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MUNIN Deep Sea Navigation System
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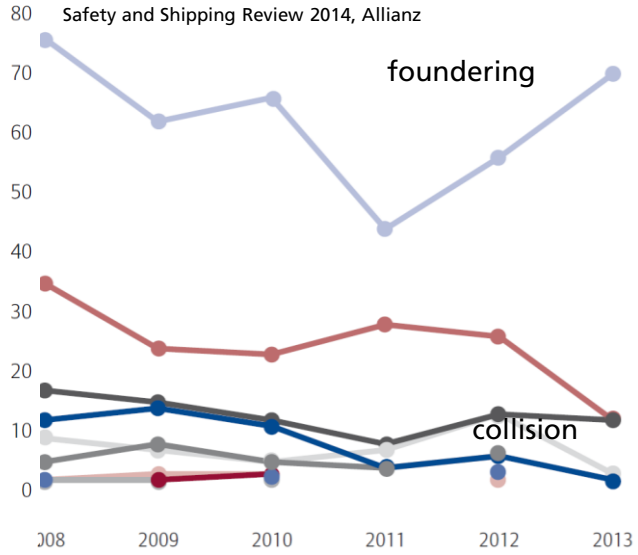

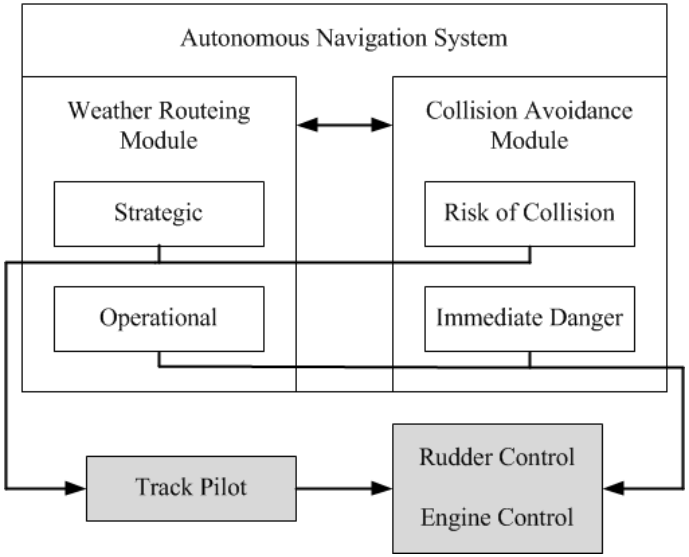

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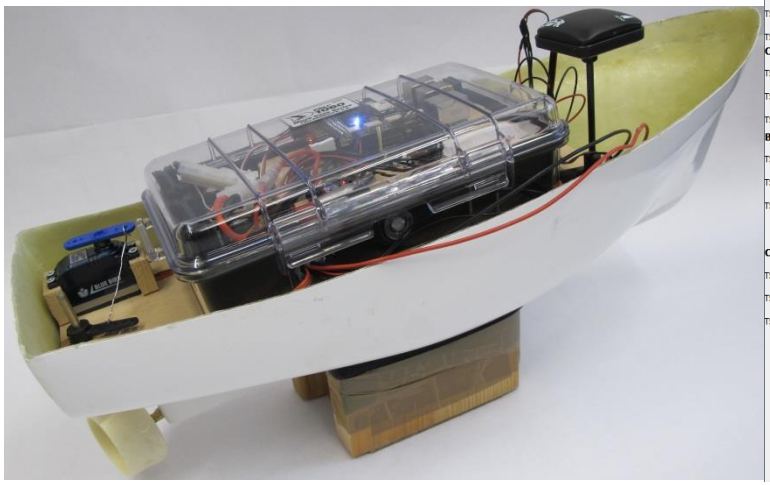
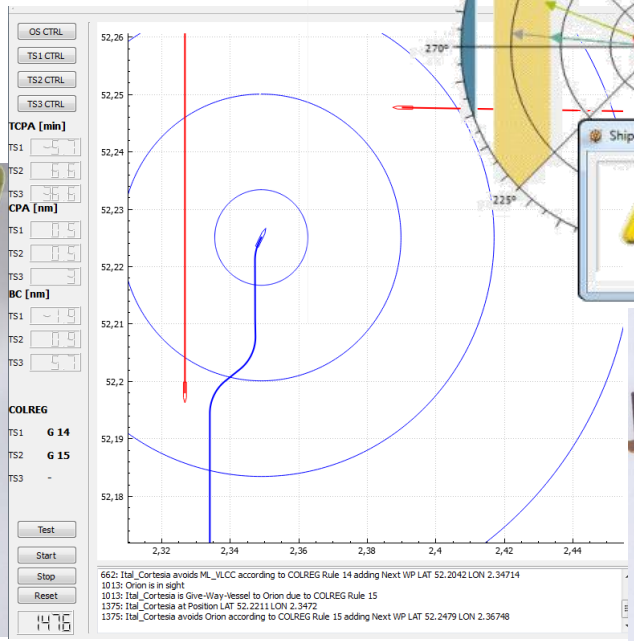
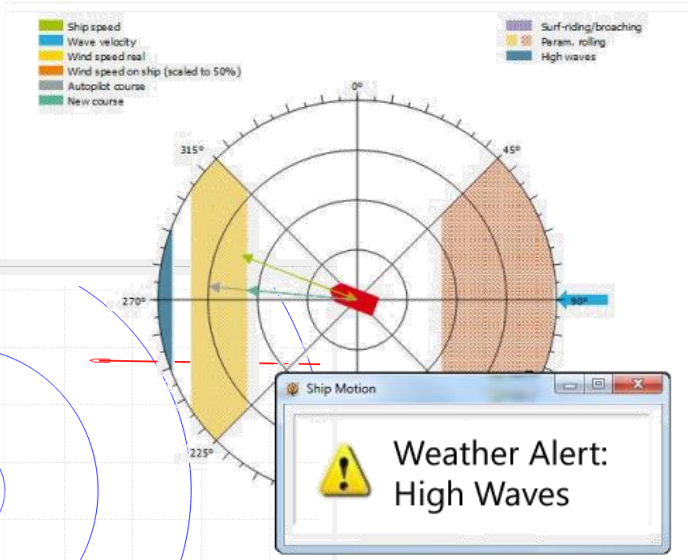
MUNIN Deep Sea Navigation System

Simulation and hardware prototypes







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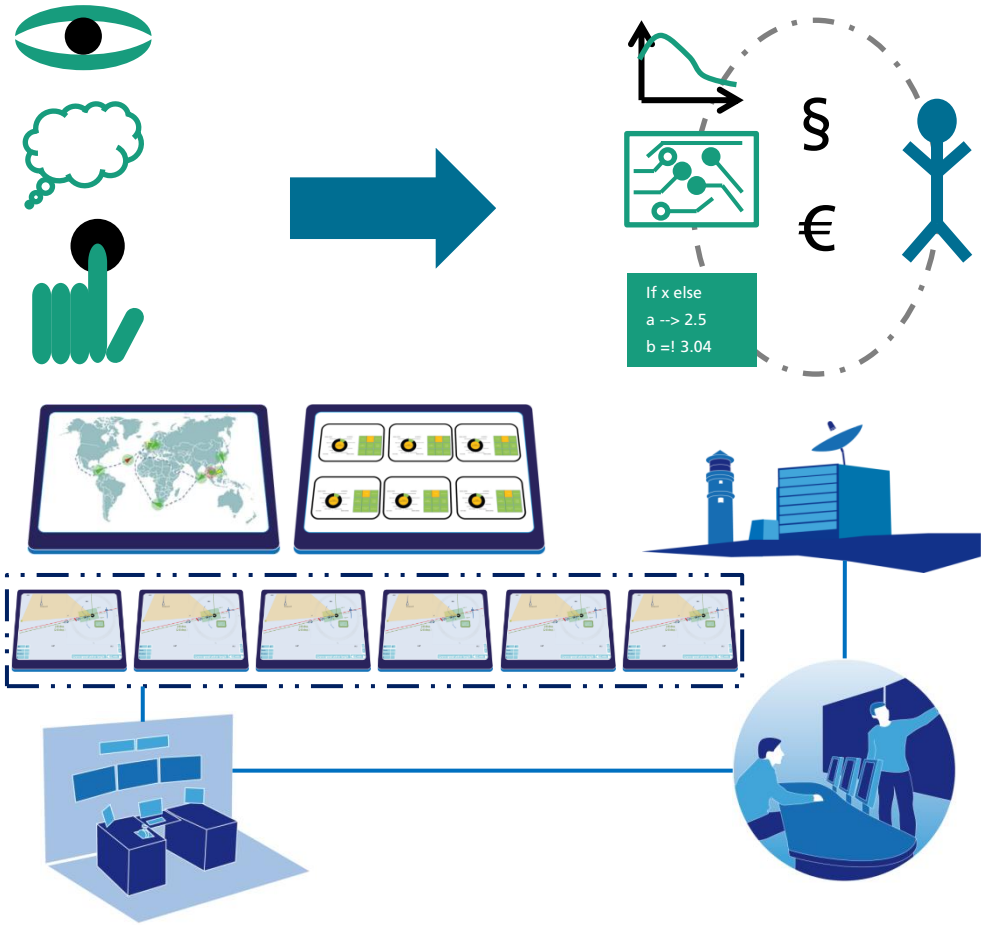
MUNIN Shore Control Center

Human Centered Design

human-out-of-the-loop syndrome

Human

Errorr



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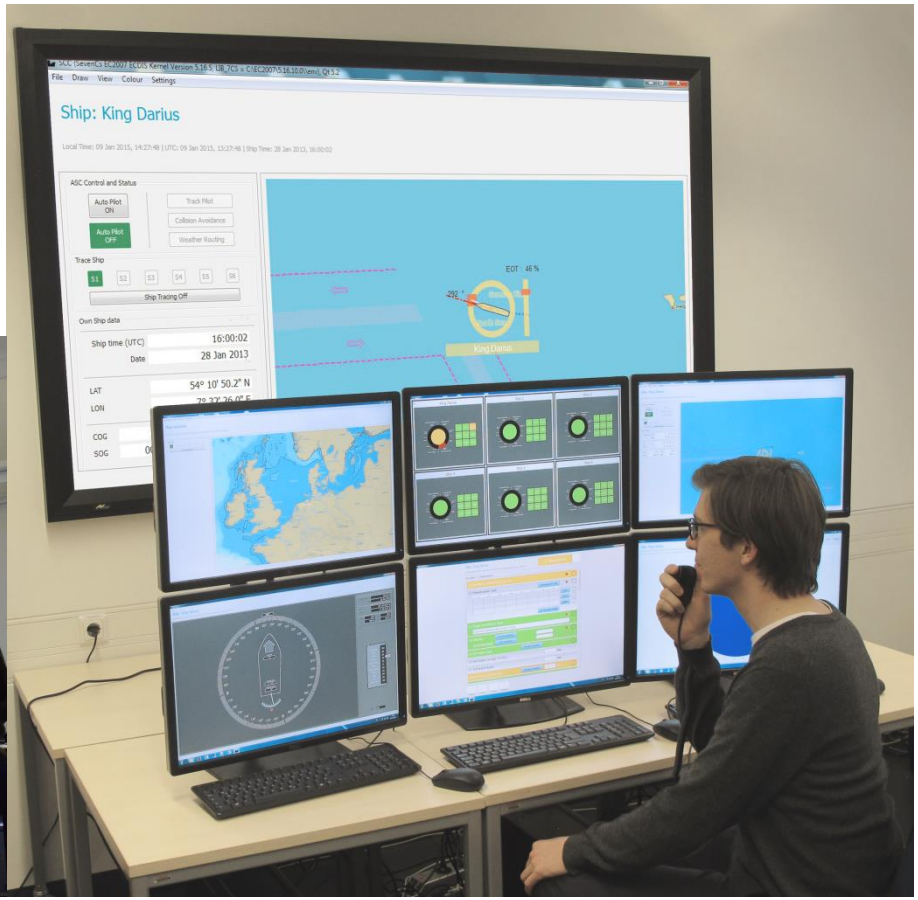
MUNIN Shore Control Center

Fully integrated prototype



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MUNIN Test-bed
Validation methodology

- Sensor emulation
- Four full scale In-situ test

- AIS-Data tests (CA only)
- Ship handling simulation (WR&CA)
- Small-scale in-situ test (CA only) — ongoing

- HMI-Tests in simulator
- Stresstest in simulator — ongoing

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Conclusions

Short-term applications of MUNIN technology developments

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 traffic guidance / Watch from shore

- Human-oriented information management
- Remote situation awareness concept

Combination to B0 possible

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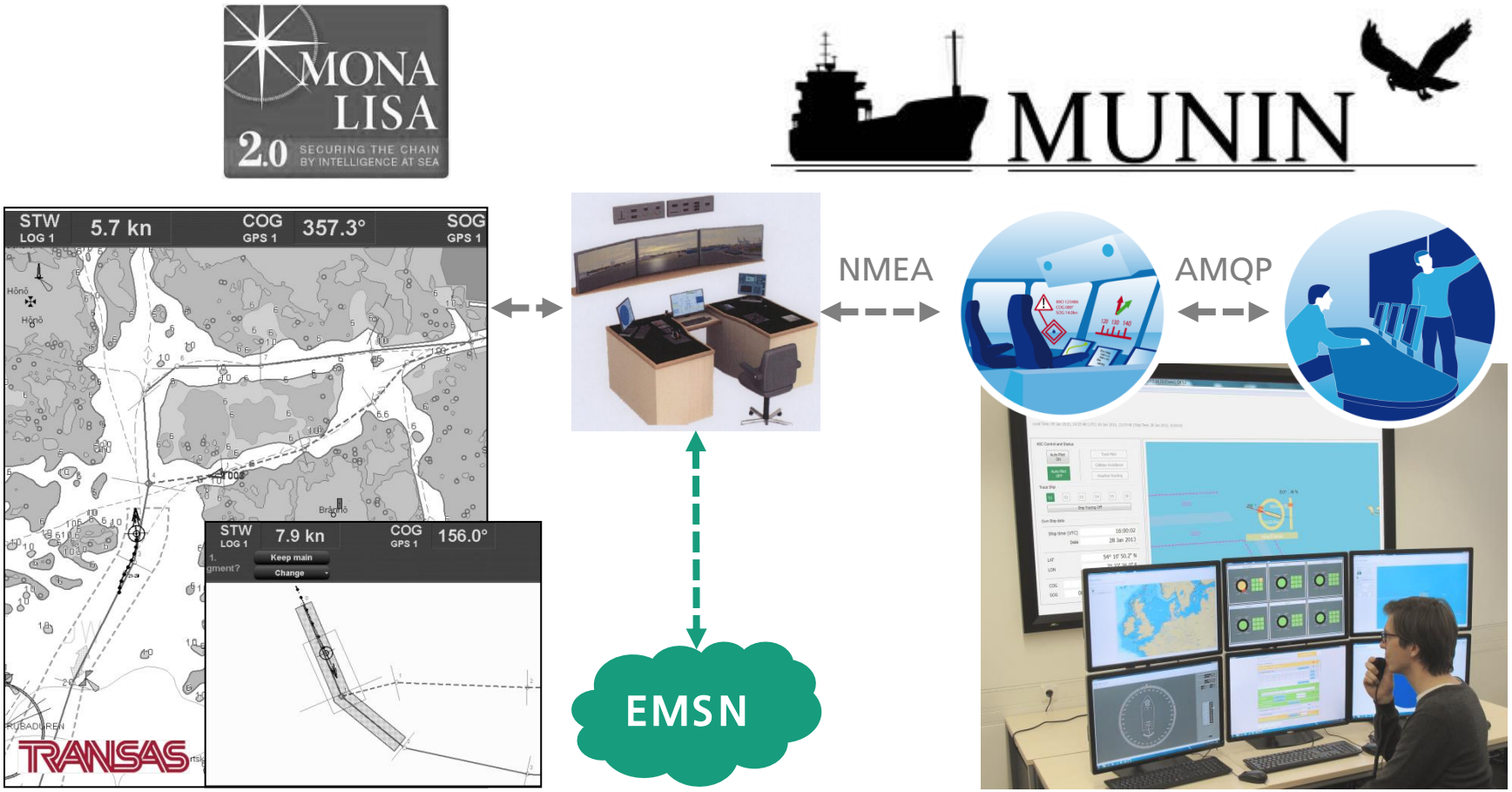
Outlook

Full validation in the EMSN feasible



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Outlook
MUNIN on tour

Date	Event	Location
11.-13.05.2015	Scientific session at COMPIT	Ulrichshusen, DE
03.06.2015	3rd MUNIN Industry Workshop, Norshipping	Oslo, NO
10.-11.06.2015	MUNIN final promotion event	Hamburg, DE
17.-19.06.2015	Scientific session at TransNav	Gdynia, PL

Norshipping workshop including participation from RollsRoyce, Maritime Lawyers further more

Final workshop including technical tour through the MUNIN test-bed

Please check also:

www.unmanned-ship.org

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Thank you - MUNIN receives funding under FP7-GA314286