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# Människan och de autonoma skeppen: Hur ser lägesbilden ut i landcentralen?



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HOME

PRODUCTS

CONTACT US

TRAINING

SUPPORT

Home > Products > Products by product area > Bridge systems > Navigation systems > Autonomous surface vessel control system >

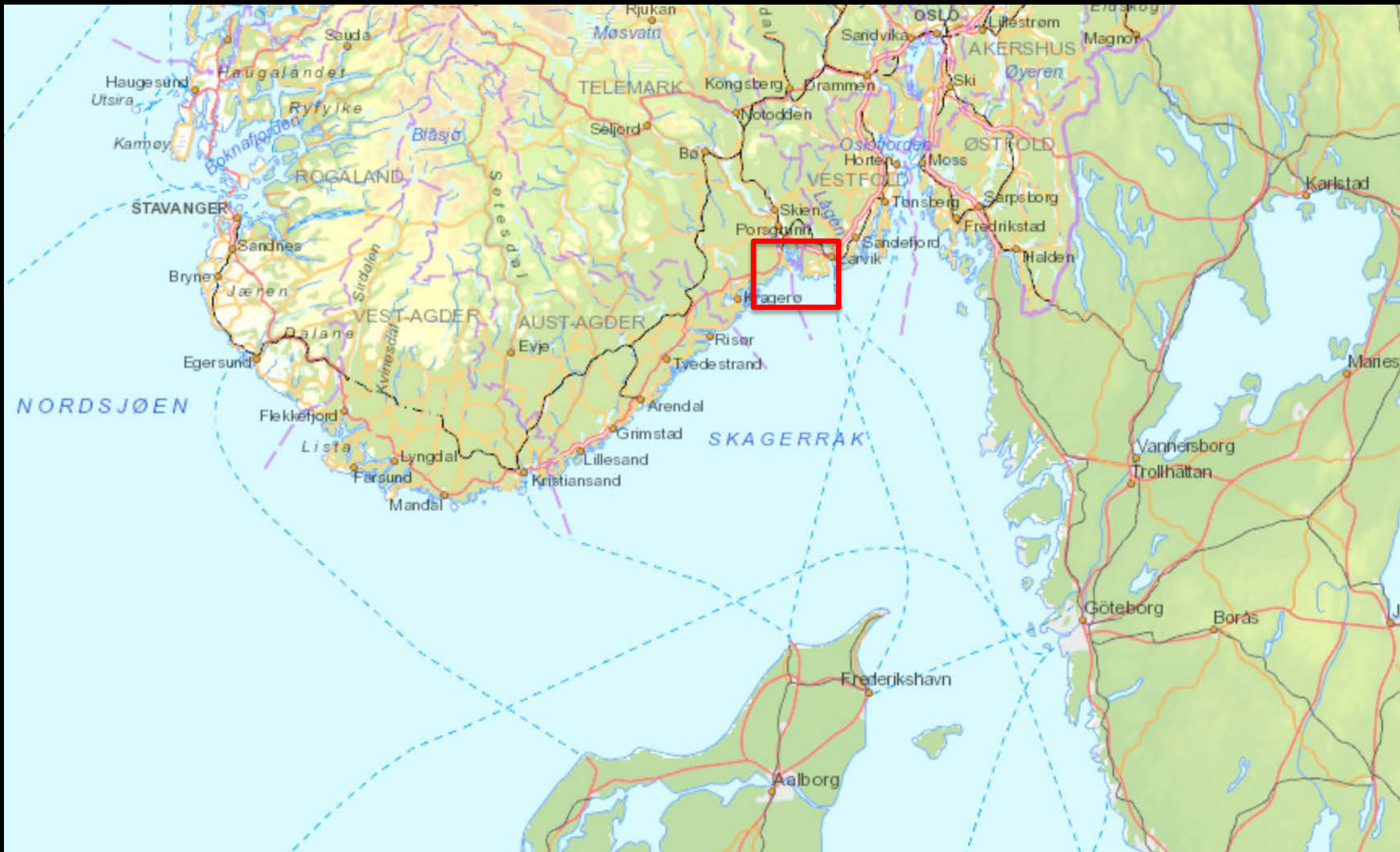
## Autonomous ship project, key facts about YARA Birkeland

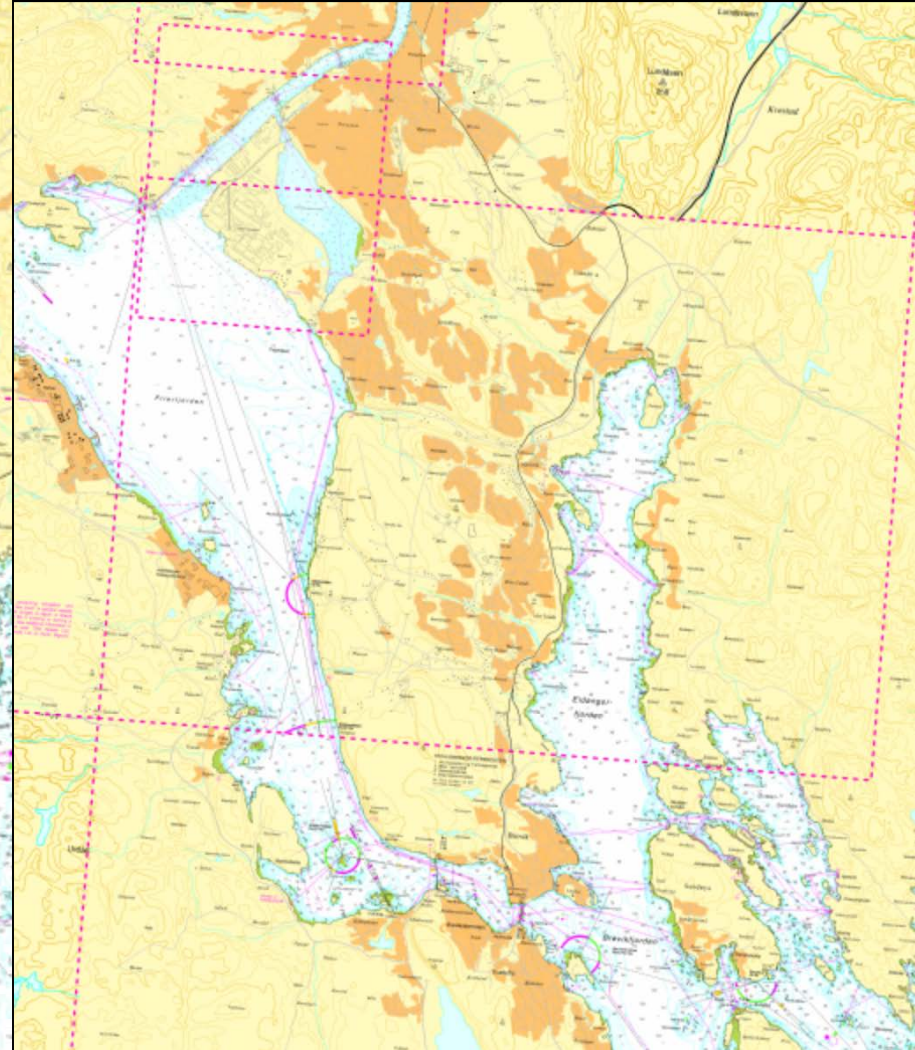
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The autonomous ship YARA Birkeland as designed by Marin Teknikk.

<https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/4B8113B707A50A4FC125811D00407045?OpenDocument> [acc. 2018-02-04]









<p><b>Estimated facts &amp; figures</b></p> <p><b>Main particulars</b>  <b>Length o.a.:</b> 79,5 m  <b>Length p.p.:</b> 72,4 m  <b>Width mld.:</b> 14,8 m  <b>Depth shelter deck:</b> 10,8 m  <b>Draught (full):</b> 6 m  <b>Draught (ballast):</b> 3 m  <b>Service speed:</b> 6 knots  <b>Max speed:</b> 13 knots</p>	<p><b>Capacity</b>  <b>Cargo capacity:</b> 120 TEU  <b>Deadweight:</b> 3 200 mt</p> <p><b>Propulsion system:</b> Electric  <b>Propellers:</b> 2 Azimuth pods  <b>Thrusters:</b> 2 Tunnel thruster  <b>Battery pack:</b> 7 – 9 MWh</p>	<p><b>Proximity sensors</b>  Radar  Lidar  AIS  Camera  IR camera</p> <p><b>Connectivity &amp; Communication</b>  Maritime Broadband Radio  Satellite Communications  GSM</p>
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<https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/4B8113B707A50A4FC125811D00407045?OpenDocument> [acc. 2018-02-04]



Smartphone connects wirelessly to vehicle to control steering, brakes and throttle.

The Remote Control system allows the driver to control steering, brakes and throttle via a smartphone from outside the car. This allows the driver to check the precise positioning of the vehicle when negotiating challenging terrain or even difficult parking situations, whilst walking alongside the car at a maximum speed of 4mph.







NTNU-project: Autonom passagerar-/cykelfärja över hamnkanalen i Trondheim





First technical sea trials on Saturday November 11 2017



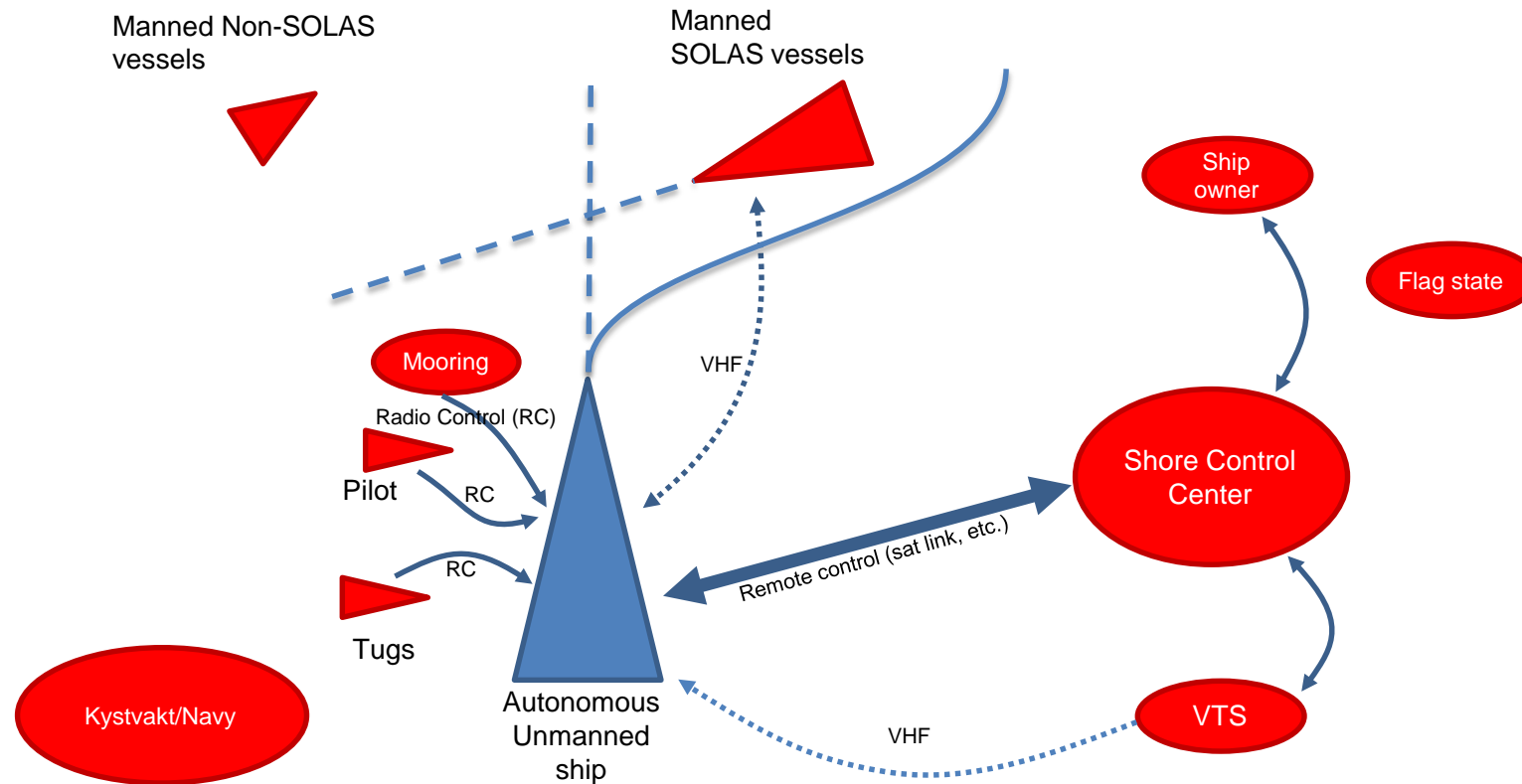
Further testing in December 2017

## **Major research question:**

We know that the vast majority of all accidents at sea to some degree depends on "human error."

**If we remove the human from direct operation of vessels, can we then decrease "human error"?**

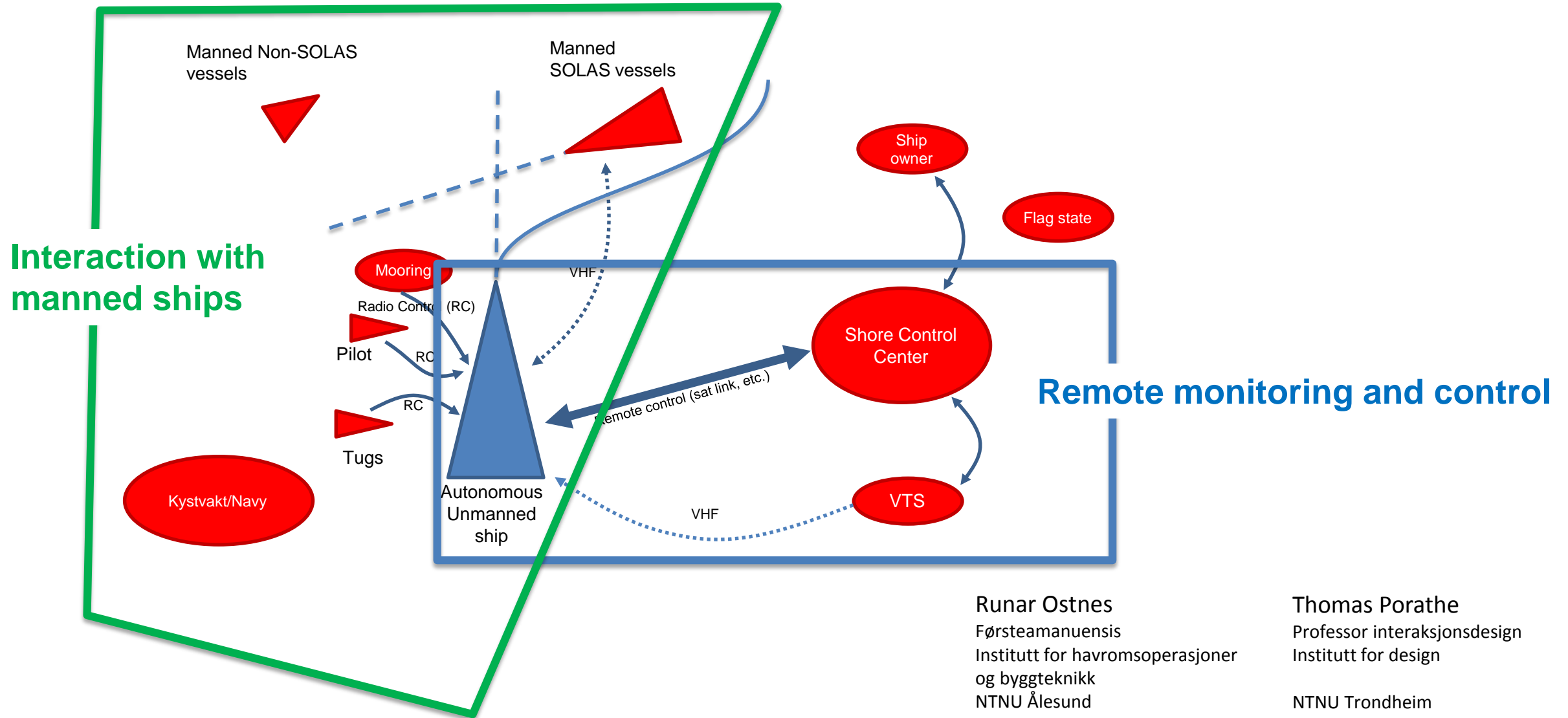
# Humans in the unmanned ship system



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# Humans in the unmanned ship system



Runar Ostnes  
Førsteamanuensis  
Institutt for havromsoperasjoner  
og byggtknikk  
NTNU Ålesund

Thomas Porathe  
Professor interaksjonsdesign  
Institutt for design  
NTNU Trondheim



Research questions:

**What will the HMI for remote control centres look like?**

**Who is manning these centres: navigators or operators?**

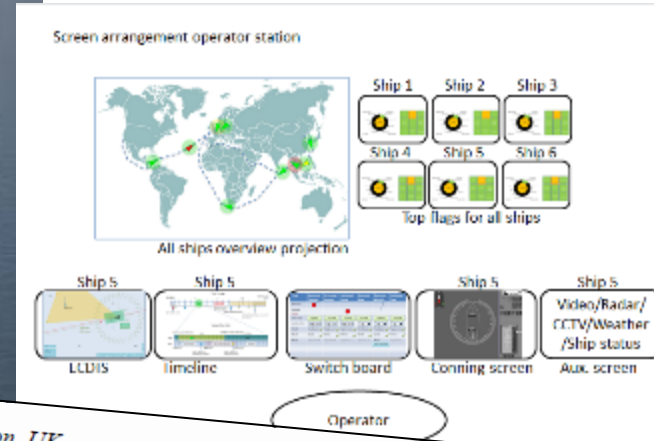
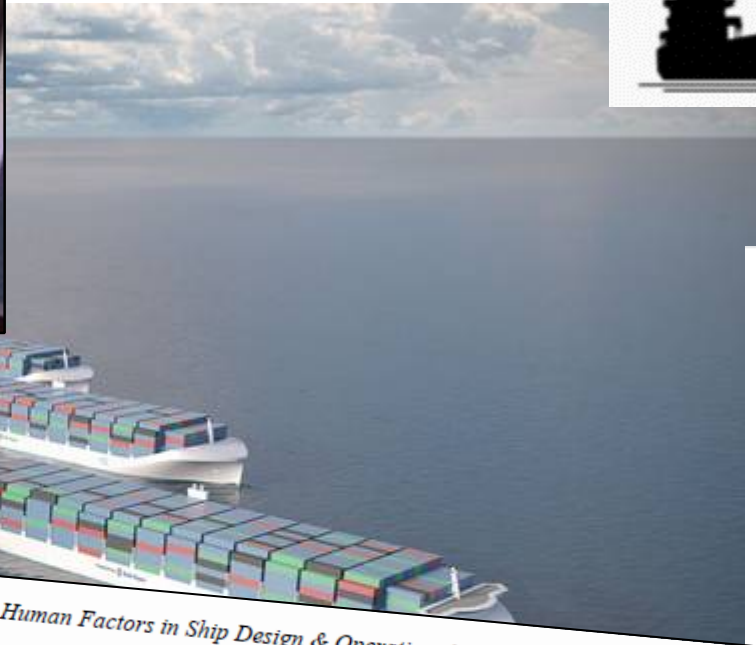
**What will their tasks be? What is automated, what is manual?**

**Workload; Situation Awareness; Out-of-the-loop syndrome?**





**Rolls-Royce vision of the future shore control centre**



*Human Factors in Ship Design & Operation, 26-27 February 2014, London, UK*

# SITUATION AWARENESS IN REMOTE CONTROL CENTRES FOR UNMANNED SHIPS

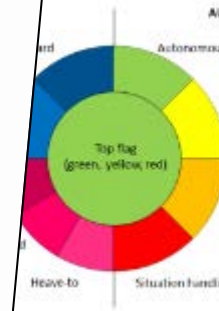
T Porathe, J Prison, and Y Man, Chalmers University of Technology, Sweden

## SUMMARY

The feasibility of unmanned, autonomous merchant vessels is investigated by the EU project MUNIN (Maritime Unmanned Navigation through Intelligence in Networks). The ships will be manned while departing and entering port and unmanned during ocean-passage. When unmanned, the ships will be controlled by an automatic system informed by onboard sensors allowing the ship to make standard collision avoidance manoeuvres according to international regulation. The ship will be continuously monitored by a remote shore centre able to take remote control should the automatic systems falter. For the humans in the shore control centre the usual problems of automations remains as well as a pronounced problem of keeping up adequate situation awareness through remote sensing. The big challenge for the project will be to show that an unmanned system is at least as safe as a manned ship system, and to provide the shore control operators with adequate situation awareness.

## 1. INTRODUCTION

Maritime Unmanned Ship, through the MUNIN project, is supported by the German Research Foundation (DFG) at CML, in Hamburg, Germany.





# Automatic Sensor System (Aptomar)

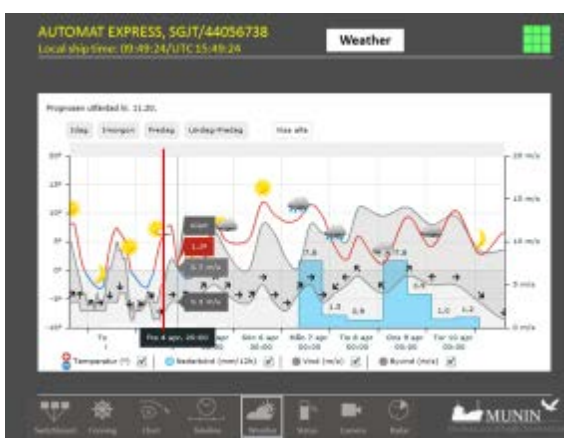
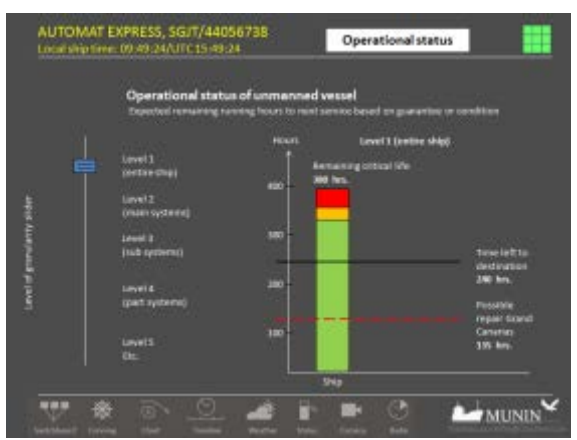
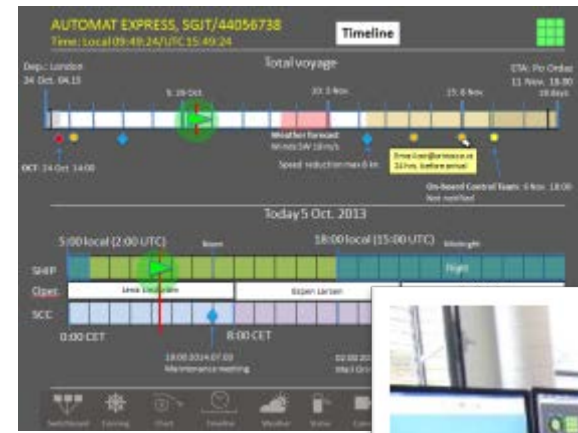
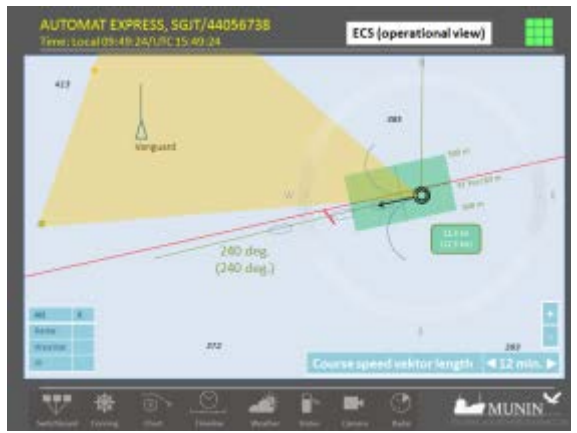
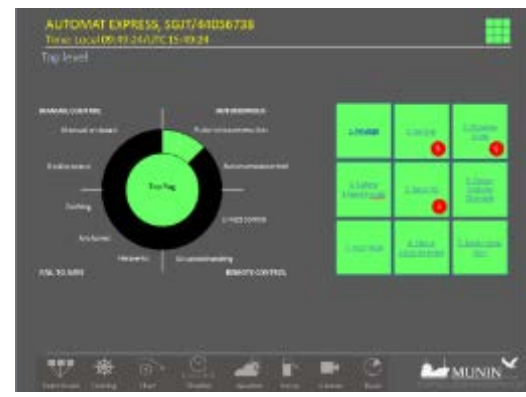
- Automated evaluation of navigational data
- ASM's capabilities:
  - Detect objects
  - Classify objects
  - Identify objects
- Single source of information
  - Fusion of data from radar, AIS and visual sensors



Lägesbilden är i hög grad beroende av bandbredd



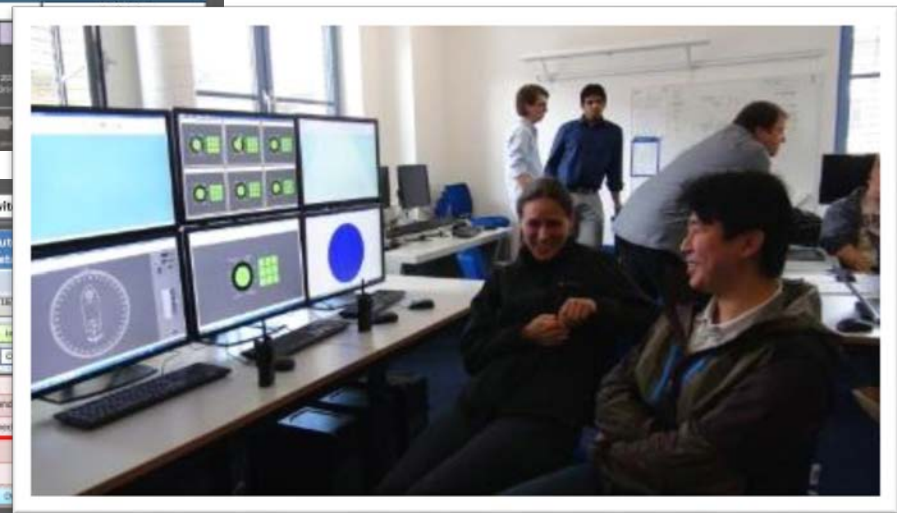
2013-2015



	Automat Express	Automat Emma	Automat Luna	Automat Beta
Available	●	●	●	●
Accounting ratio	100%	100%	100%	100%
Logbook	Logbook	Logbook	Logbook	Logbook
MCC crewed transfer	Op. 1	Op. 1	Op. 1	Op. 1

Watch schedule Wednesday 2014-08-18	Hand-over	Hand-over	Hand-over	Hand-over
07:30	✓	✓	✓	✓
08:30	✓	✓	✓	✓
08:45	✓	✓	✓	✓
09:25	✓	✓	✓	✓
09:30	✓	✓	✓	✓



## Small steps to autonomous ships

### **Phase 1.**

Remote monitoring  
from shore of  
manned ship

Transfer of radar,  
IR/video, VHF from  
ship. Text and voice  
communication from  
shore

### **Phase 2.**

Remote monitoring  
and control of  
manned ship

As in previous service,  
but control of  
autopilot, speed, and  
VHF from shore.

### **Phase 3.**

Remote monitoring  
and automatic  
control of partly  
manned ship

As in previous service,  
but automation will be  
alone on the bridge,  
however with  
operators onboard

### **Phase 4.**

Remote monitoring  
and control of fully  
autonomous  
unmanned ship

As in previous service,  
but automation will be  
alone onboard

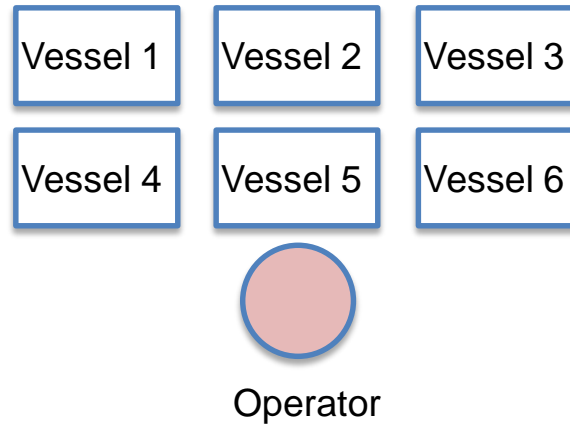
# What information needs to be transferred from the vessel to the Shore Control Centre in order to achieve enough situation awareness?



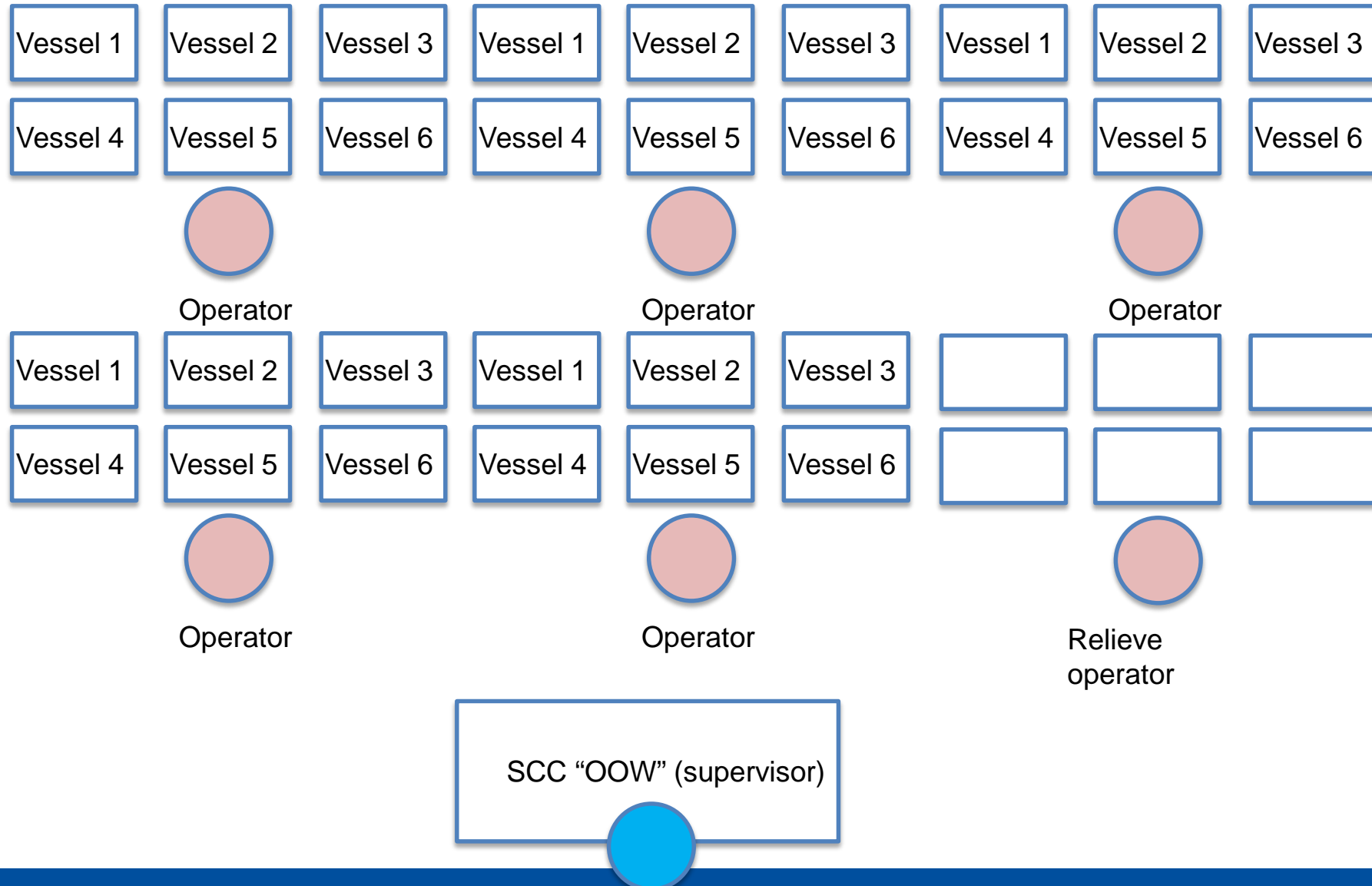
Focus group with 6 nautical officers currently working within nautical education at Chalmers' department of shipping and marine technology. The participants had a broad seagoing experience from different types of vessels, e.g. cruise ships, car carriers, long and short haul dry and wet cargo and ferries.

## 145 information items in 9 groups

## Shore Control Center (SCC)

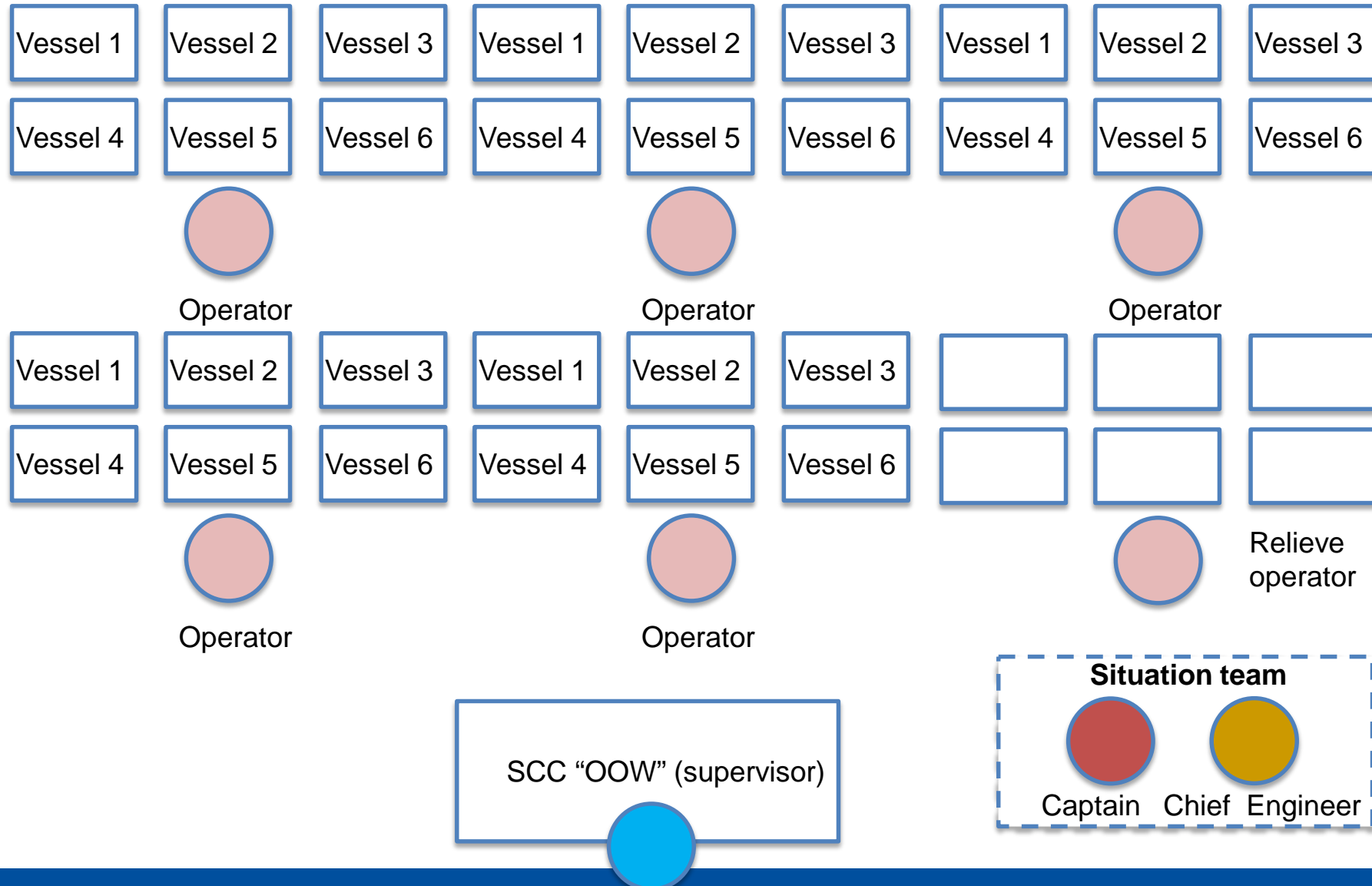


# Shore Control Center (SCC)

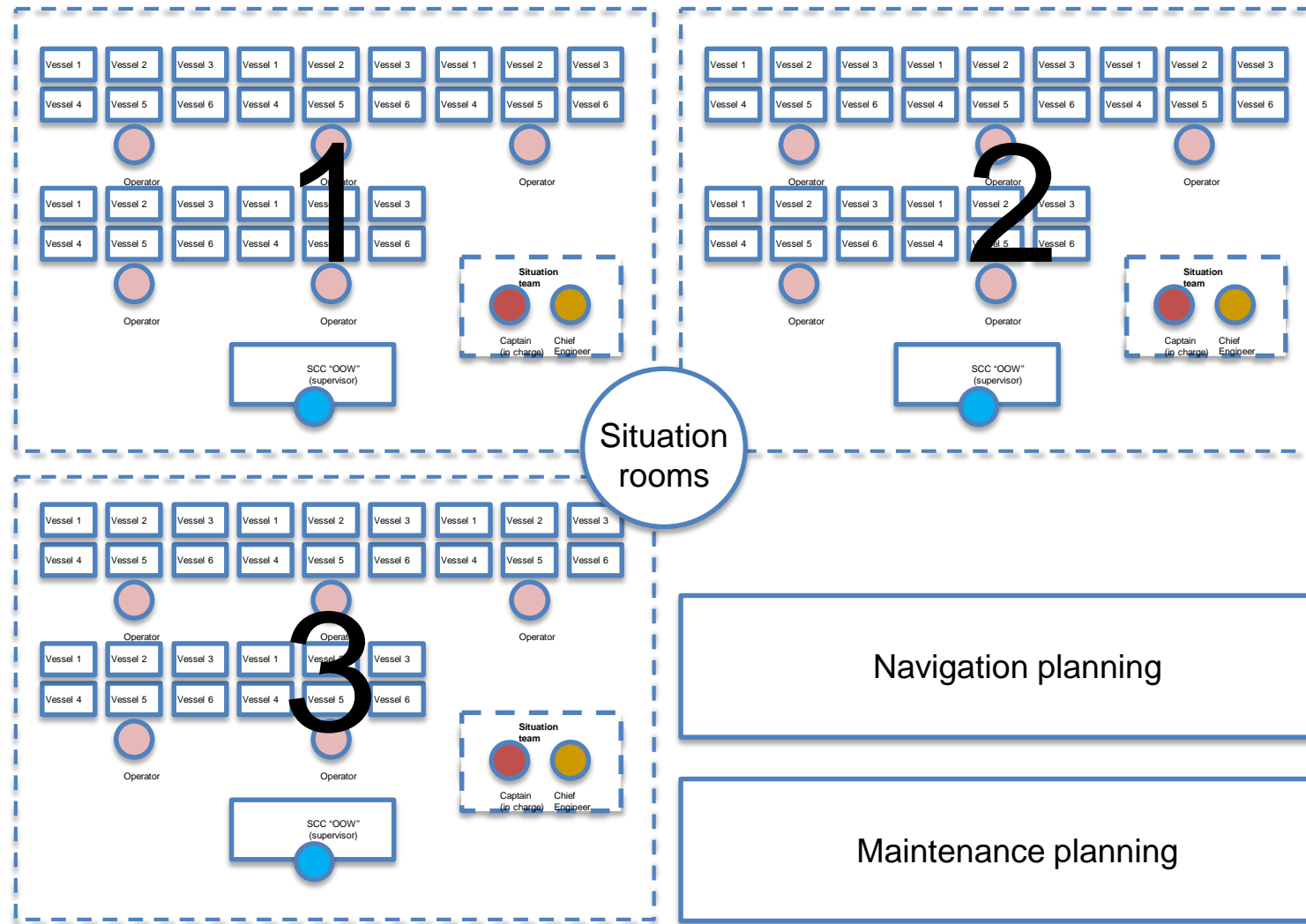




# Shore Control Center (SCC)

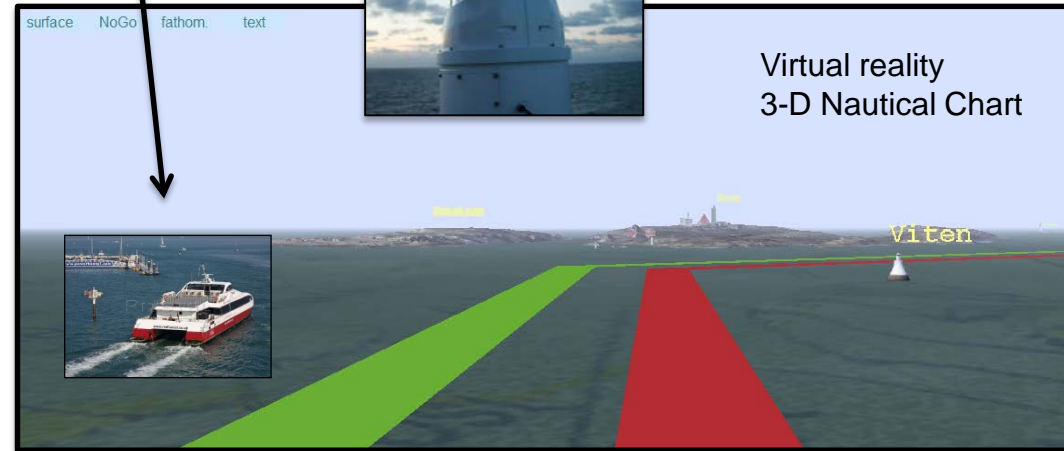


# Shore Control Center (SCC)



# “Situation room”

Picture insert from video/IR camera



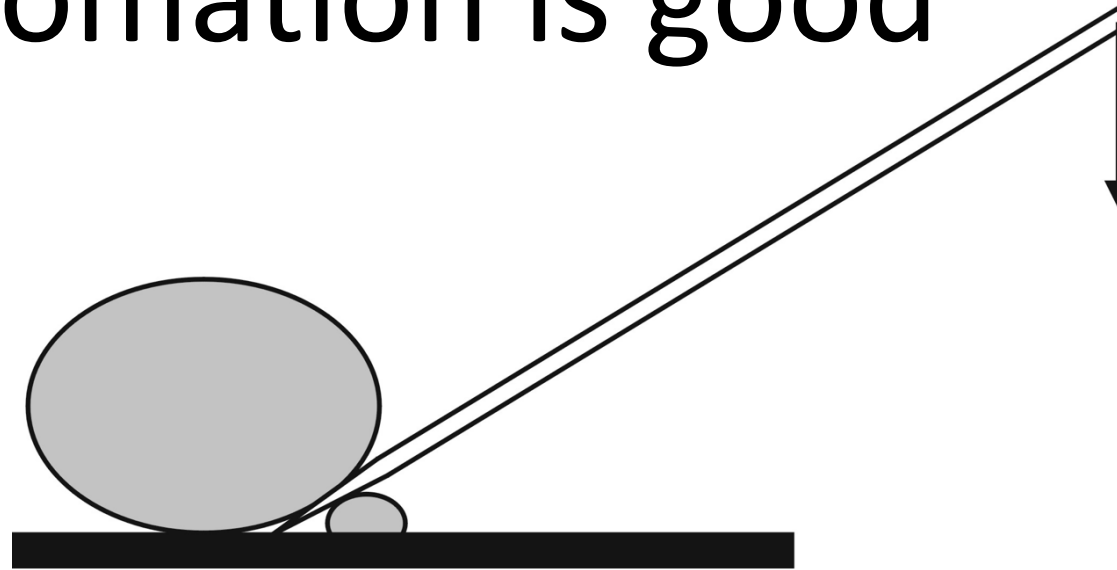
## Low level control

- Situation handling
- Monitoring
- Indirect control
- Direct control



Situation room: Team work, Immersion

# Automation is good



Amplifying human abilities

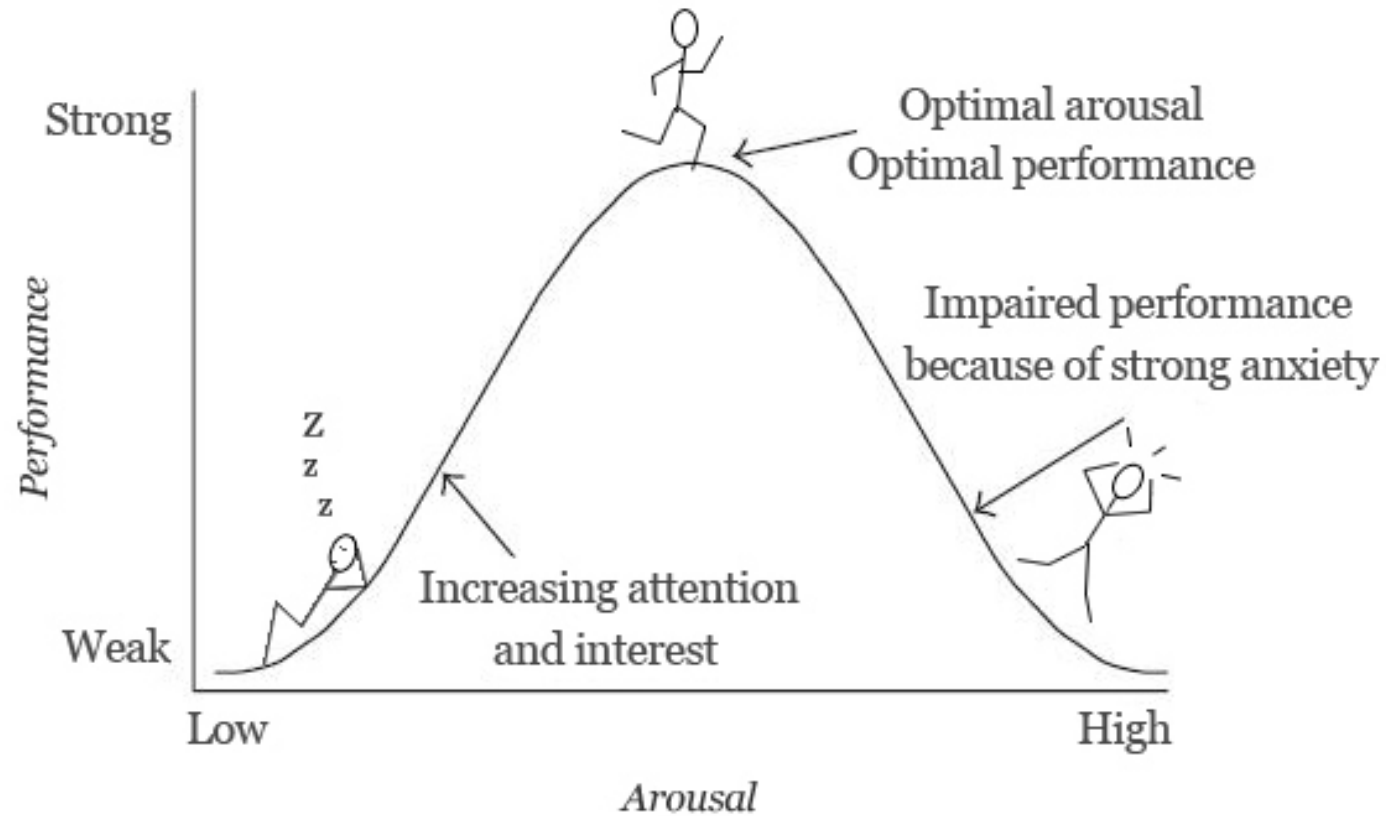
# Automation is good

- but have some problems

# ”Boredom induced accidents”

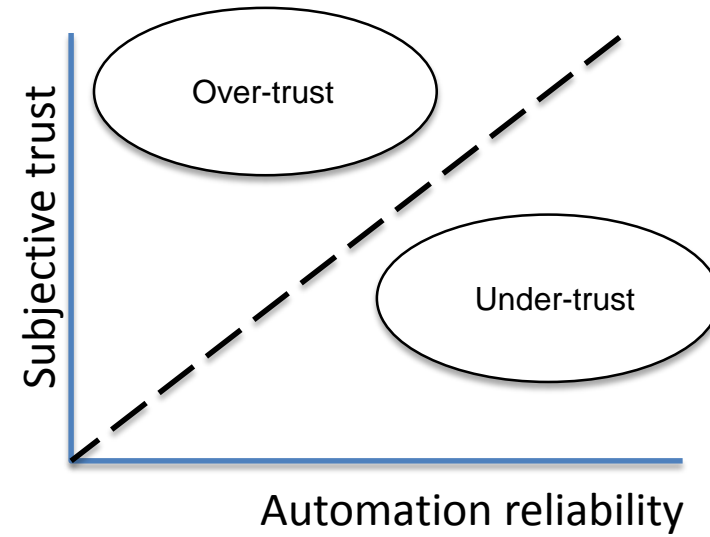
*Captain Andy Moll  
Marine Accident Investigation Branch, UK*

RIN conference Human Cognition: Enabling Navigation Exploring Humanity’s relationship with Technology in Navigation  
Trinity House, London 10<sup>th</sup> June 2015



**The Yerkes–Dodson law**

# Automation bias





# **The 'problem' with automation is inappropriate feedback and interaction, not 'over-automation'**

(Donald Norman, 1990)

Norman, D. The problem of automation: Inappropriate feedback and interaction, not over-automation. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol. 327, No. 1241, Human Factors in Hazardous Situations (Apr. 12, 1990), pp. 585-593

# Human factors issues related to remote monitoring and control of unmanned ships

1. **Situation awareness** in the SCC: mistakes due to not understanding the true situation of the vessel.
2. **Misunderstandings in interaction with manned vessels:** latency in VHF communication, bad communication links, language issues same as for manned systems, but worsened by lack of situation awareness.

# Human factors issues related to remote monitoring and control of unmanned ships

3. Delays in decision making due to lengthy time for operator to get into the loop (**human-out-of-the-loop syndrome**).
4. **Stress and information overload** because several ships might need the operators attention at the same time.

# Human factors issues related to remote monitoring and control of unmanned ships

5. Human error due to “**carry over effects**” between two vessels as operator monitors several vessels at a time.

# Non-acceptable risks

- Five hazards were found in this category
- No obvious quick-fix

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

# Main risk 1

- Interaction with other ships, whether they follow COLREGS or not, is a critical issue.



## Main risk 2

- Propulsion system breakdown will render the ship unable to move. This can cause groundings and collisions or blocking fairways.



## Main risk 3

- Failure in object detection, particularly in low visibility, can cause powered collisions.





# Main risk 4

- Very heavy weather may make it difficult to maneuver the ship safely.

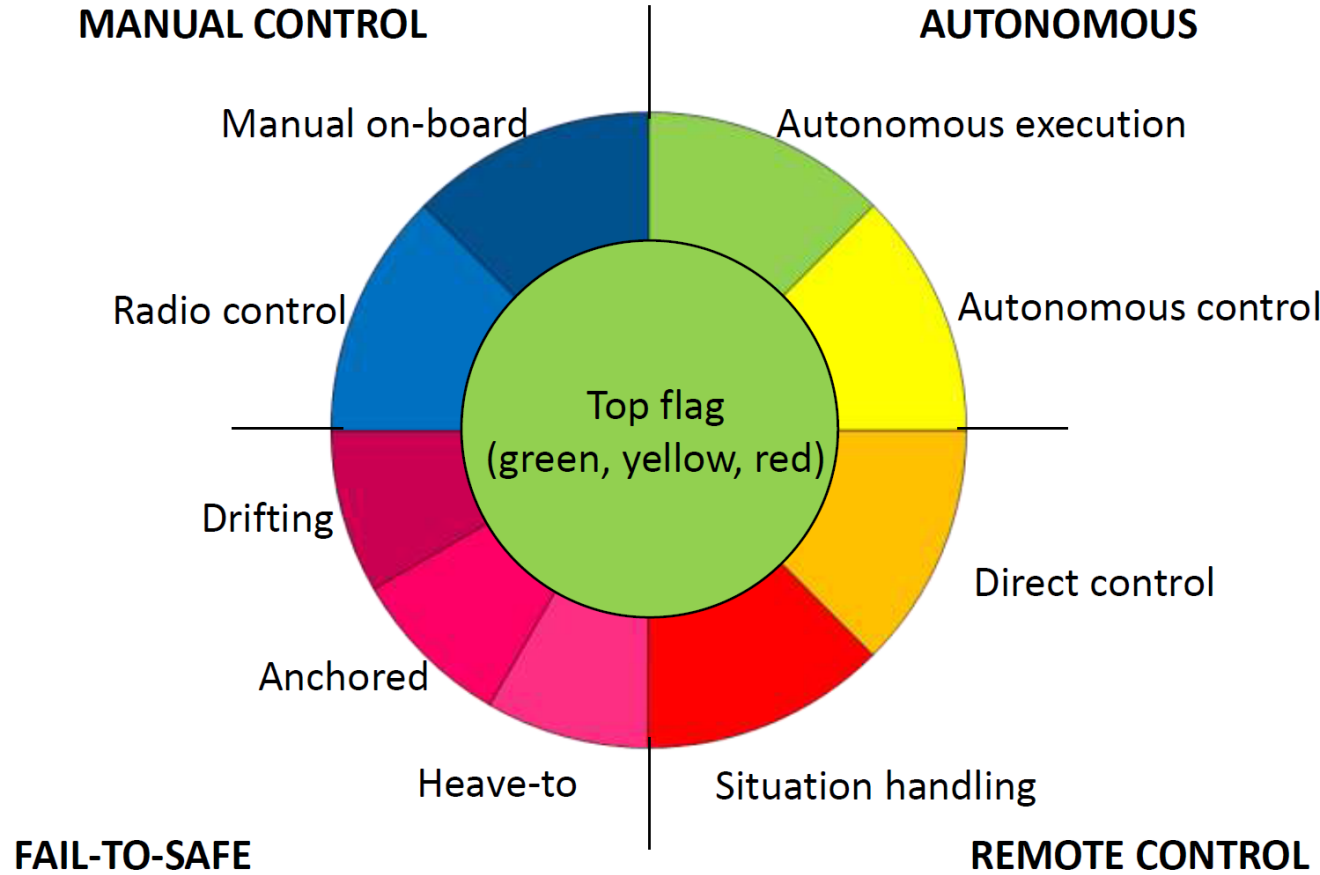


# Main risk 5

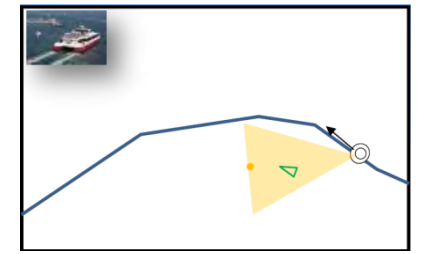
- Errors in detection and classification of small to medium size objects is critical as it may be wreckage, persons, life boats or other objects that need to be reported to authorities.



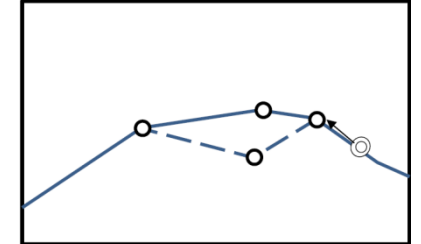




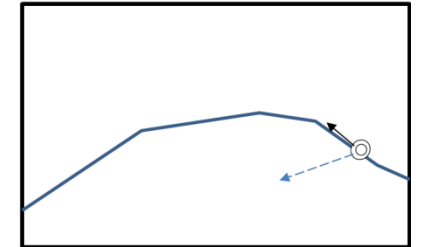
Monitoring



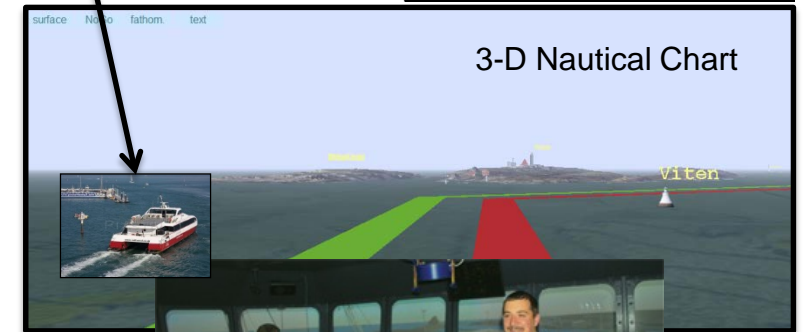
Indirect control



Direct control  
Situation handling



Picture insert from  
video/IR camera



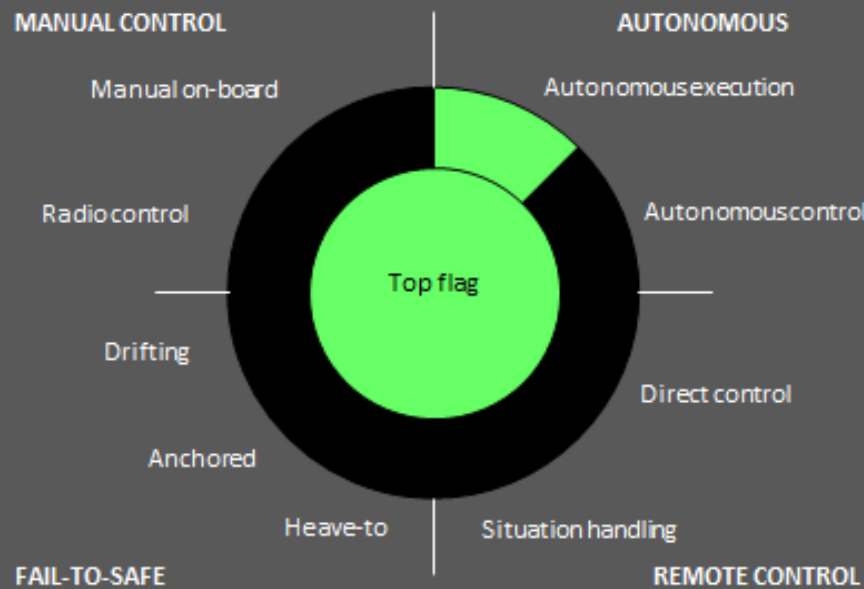
Situation room: Team work, Immersion

# AUTOMAT EXPRESS, SGJT/44056738

Time: Local 09:49:24/UTC 15:49:24



Top level



<a href="#">1. Voyage</a>	<a href="#">2. Sailing</a> 5	<a href="#">3. Observations</a> 9
<a href="#">4. Safety Emergencies</a>	<a href="#">5. Security</a> 1	<a href="#">6. Cargo Stability Strength</a>
<a href="#">7. Technical</a>	<a href="#">8. Shore control centre</a>	<a href="#">9. Administration</a>



Switchboard



Conning



Chart



Timeline



Weather



Status



Camera



Radar





The image displays a collection of 30 screenshots from the SIMATIC Manager software, arranged in a grid. Each screenshot shows a different configuration or monitoring screen for an AUTOMAT EXPRESS SGT4400718 system. The screens are organized into several sections:

- Top Row (Screens 1-8):** Overview, parameter settings, measurement data, security register, on-board diagnostics, diagnostic message register, technical overview, and control center.
- Second Row (Screens 9-16):** Administration, setpoint configuration, speed control, dynamic production, positioning, and various technical details.
- Third Row (Screens 17-24):** Positioning, positioning, positioning, positioning, positioning, positioning, positioning, and positioning.
- Fourth Row (Screens 25-30):** Positioning, positioning, positioning, positioning, positioning, and positioning.



# AUTOMAT EXPRESS, SGJT/44056738

Local ship time 09:49:24/UTC 15:49:24

1. Voyage (1/2)



Top level > 1 Voyage

1.1 Top Flag colour

Post-it note



1.2 Voyage Flag colour

Acknowledge and silence alarm



1.3 Upload extended voyage plan

Browse

Execute voyage plan from next waypoint

Voyage plan London Orinoco 20140413 1652.txt

Upload



1.4 Upload operational envelope

Browse

Operational envelope 20140413 1652.txt

Upload



1.5 Show next itinerary item

20140413 1652 Mail ship data to Ushant Traffic



1.6 Type in new itinerary item



Time: 21 aug. 2014



Position: Type Longitude and Latitude

Type date and time. Type your text.

Select symbol:



Upload



Switchboard



Conning



Chart



Timeline



Weather



Status



Camera



Radar



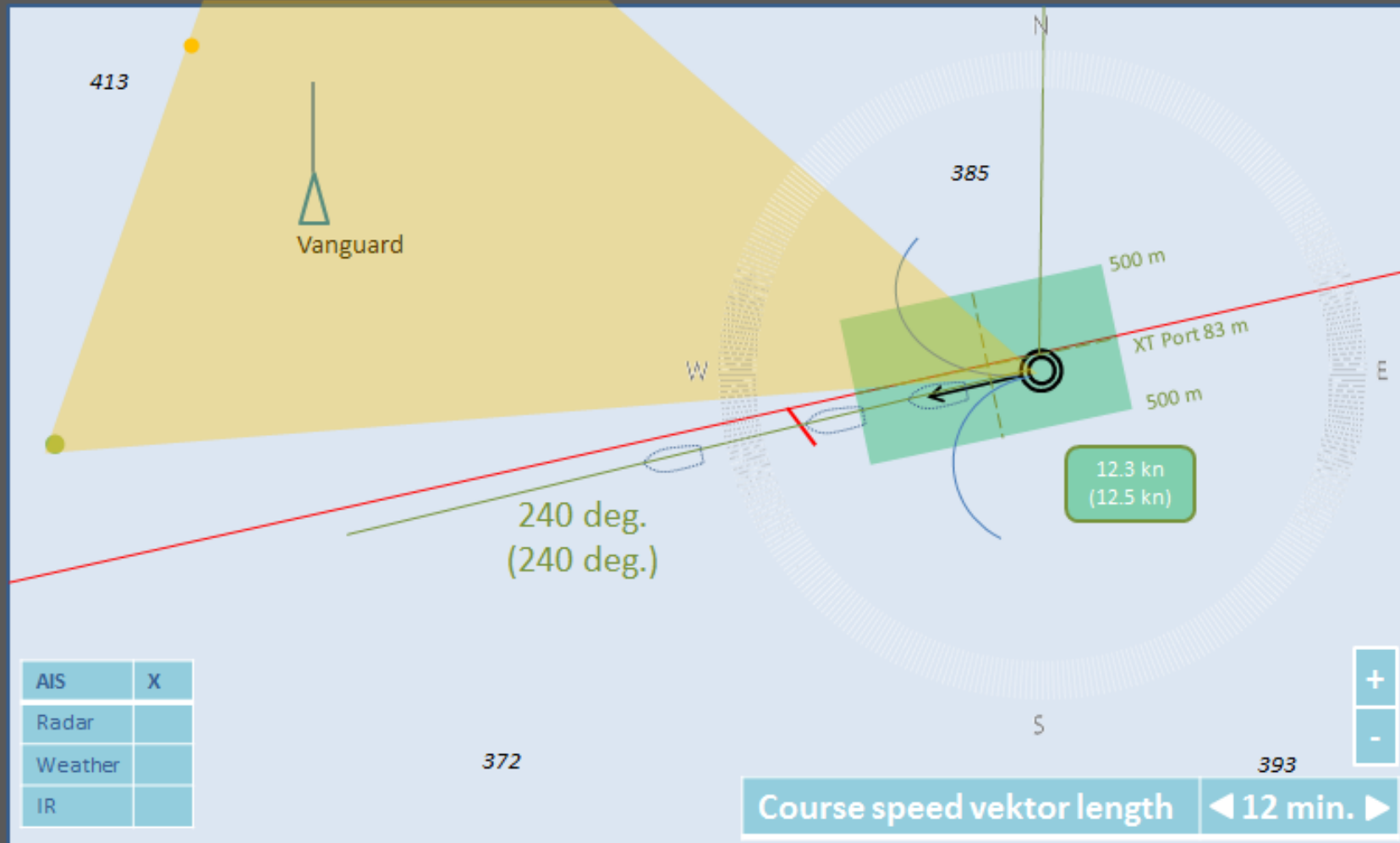
MUNIN

thomas.porathe@chalmers.se

# AUTOMAT EXPRESS, SGJT/44056738

Time: Local 09:49:24/UTC 15:49:24

ECS (operational view)

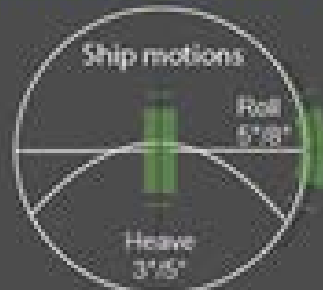


AIS	X
Radar	
Weather	
IR	

Switchboard Conning Chart Timeline Weather Status Camera Radar

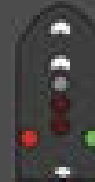
MUNIN  
thomas.porathe@chalmers.se





Ship in Autonomous execution

Go to Situation handling



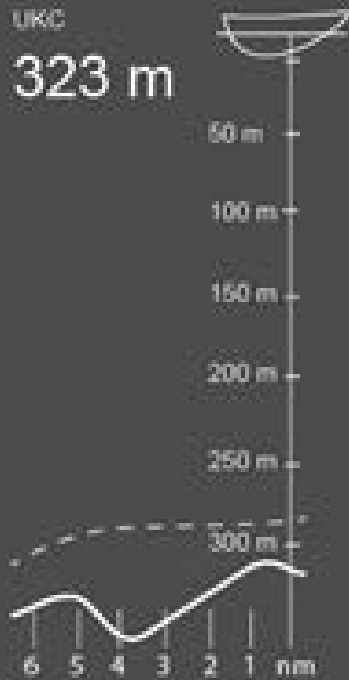
Ship (UTC) 10:59:42  
Date 2014-07-08

LAT 51°11.23'N  
LON 011°16.36'E

COG 67.0° HDG 63.4°  
SOG 12.3 kn STW 12.7 kn

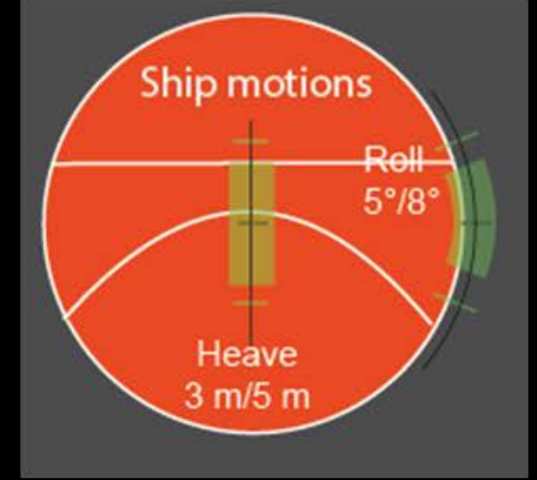
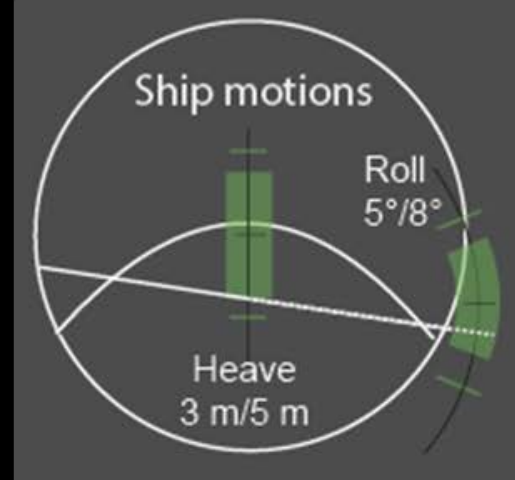
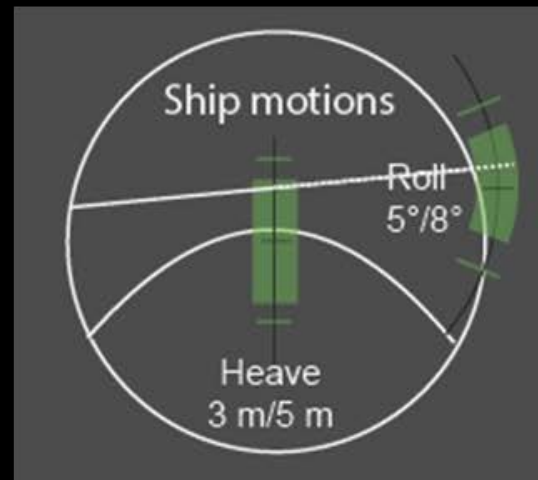
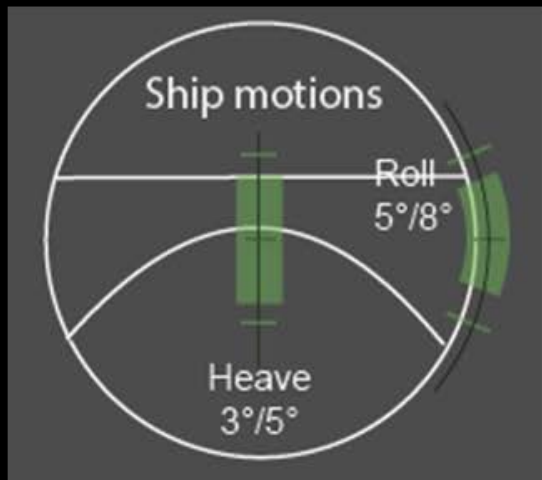
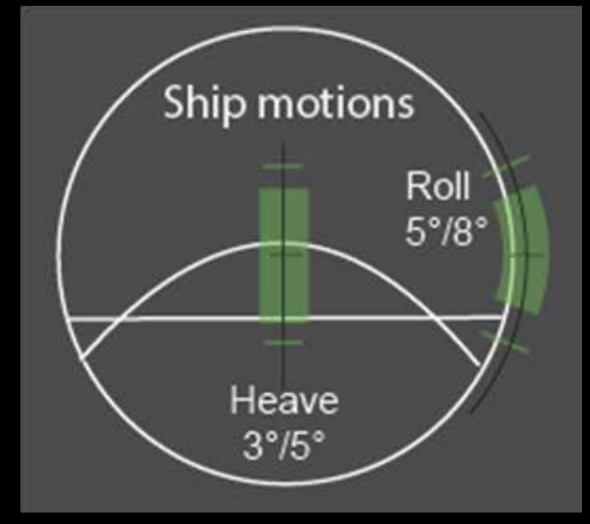
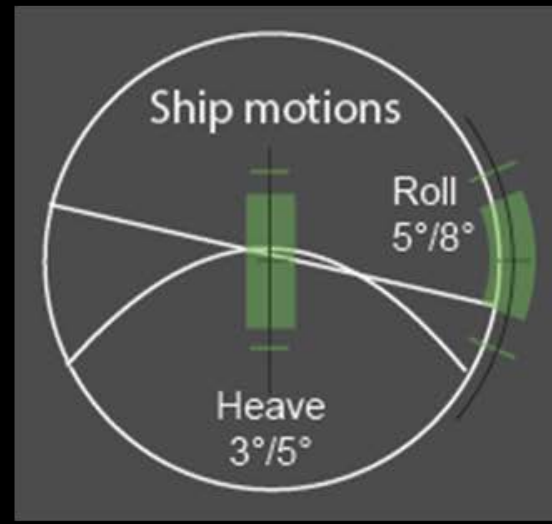
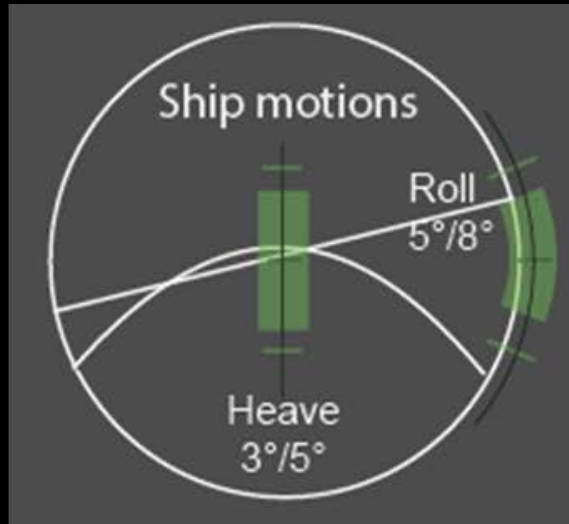
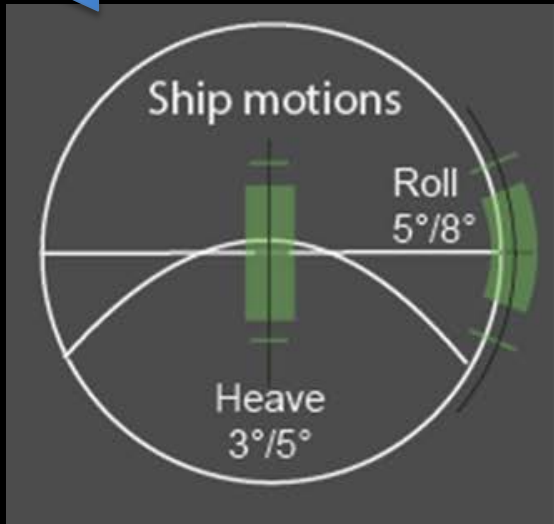
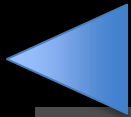
UKC

323 m



Switchboard Conning Chart Timeline Weather Status Camera Radar

MUNIN  
thomas.porathe@chalmers.se



# AUTOMAT EXPRESS, SGJT/44056738

Time: Local 09:49:24/UTC 15:49:24

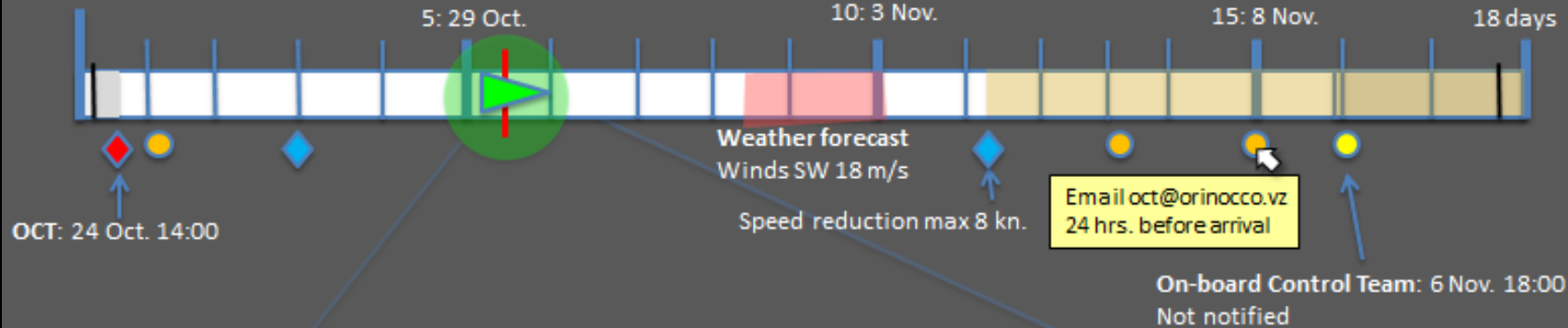
## Timeline



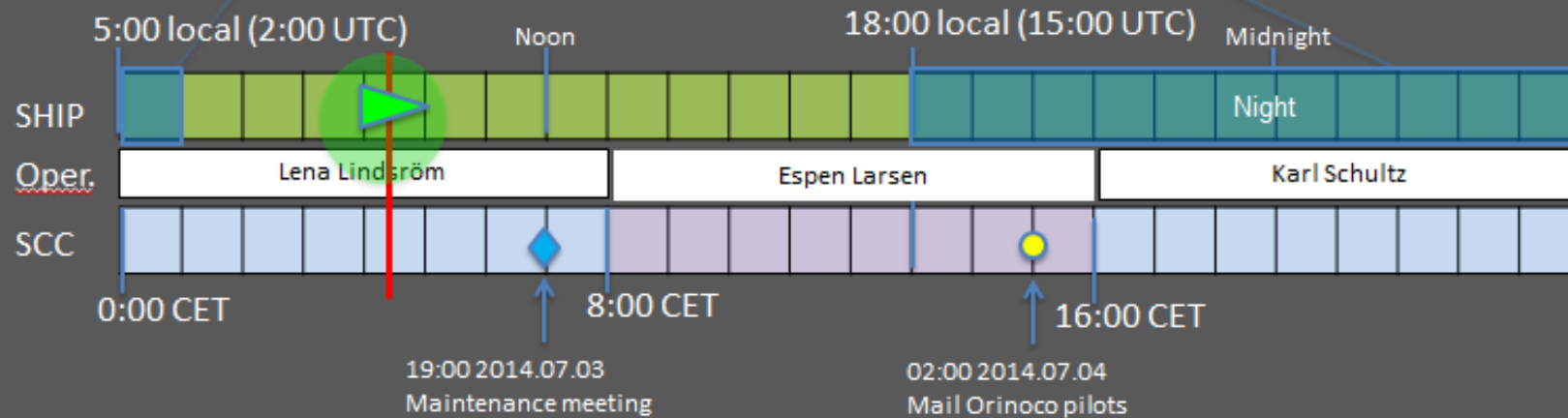
Dep.: London  
24 Oct. 04.15

### Total voyage

ETA: Po Ordaz  
11 Nov. 18.00  
18 days



### Today 5 Oct. 2013

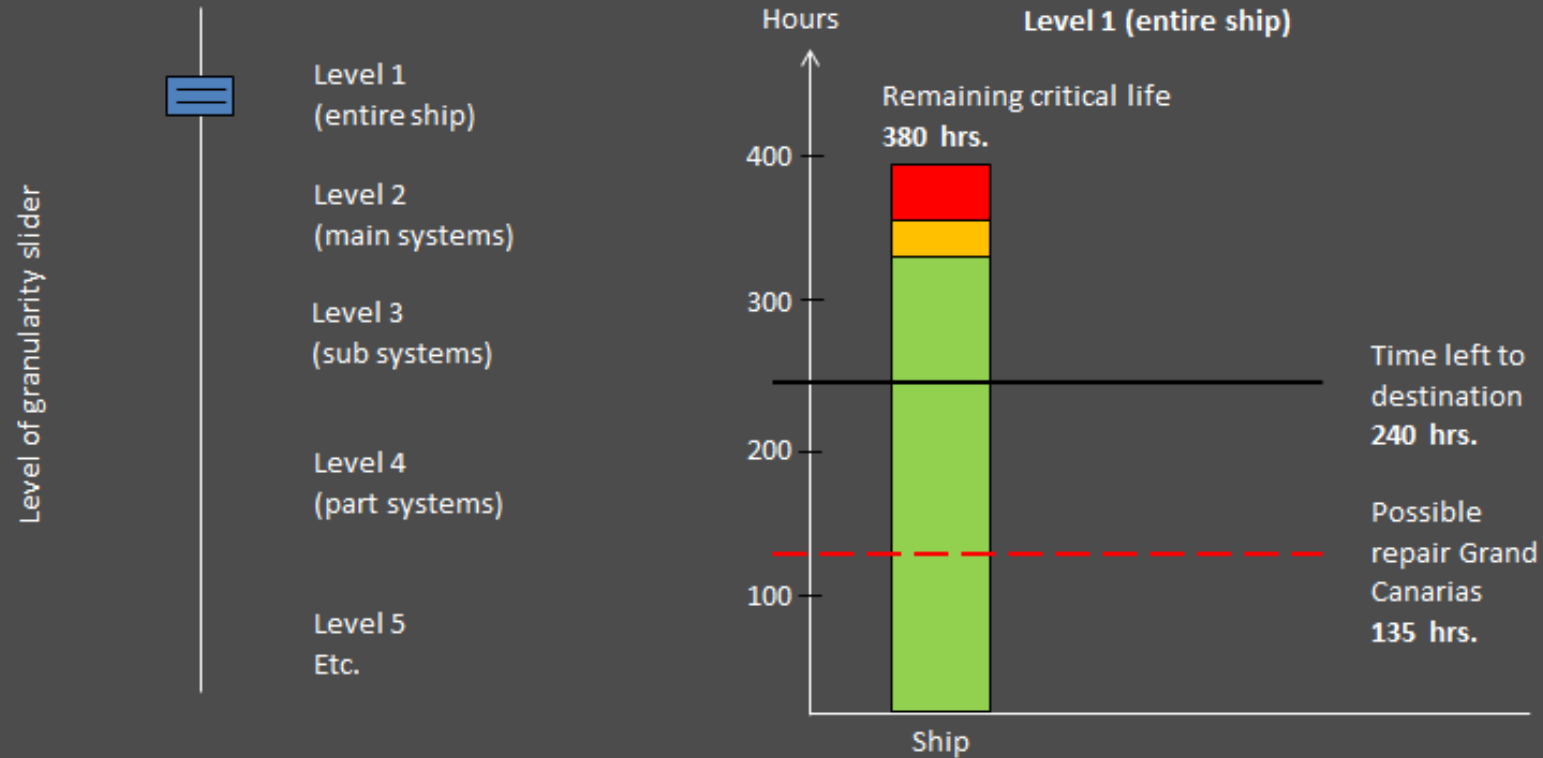


Navigation icons: Switchboard, Conning, Chart, Timeline, Weather, Status, Camera, Radar. Logo: MUNIN thomas.porathe@chalmers.se



### Operational status of unmanned vessel

Expected remaining running hours to next service based on guarantee or condition

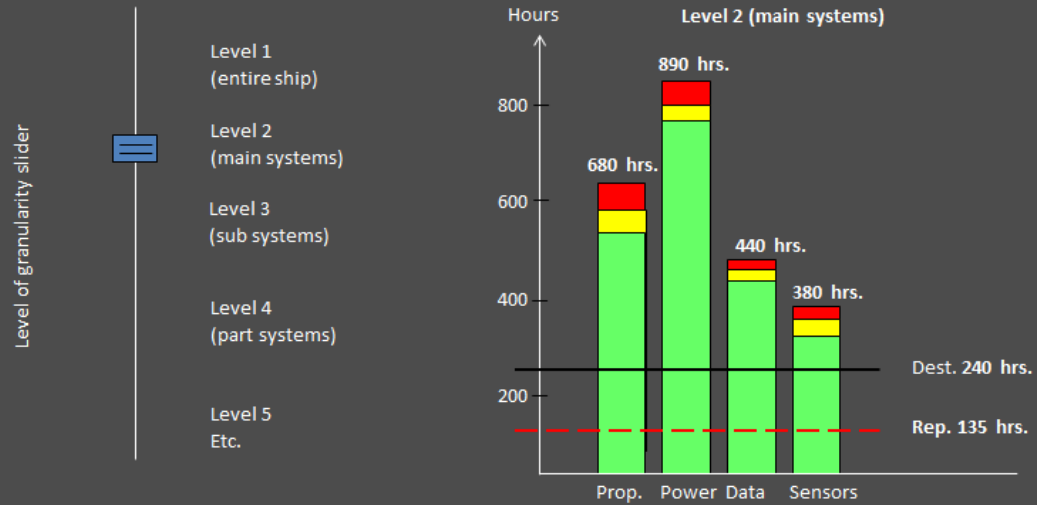


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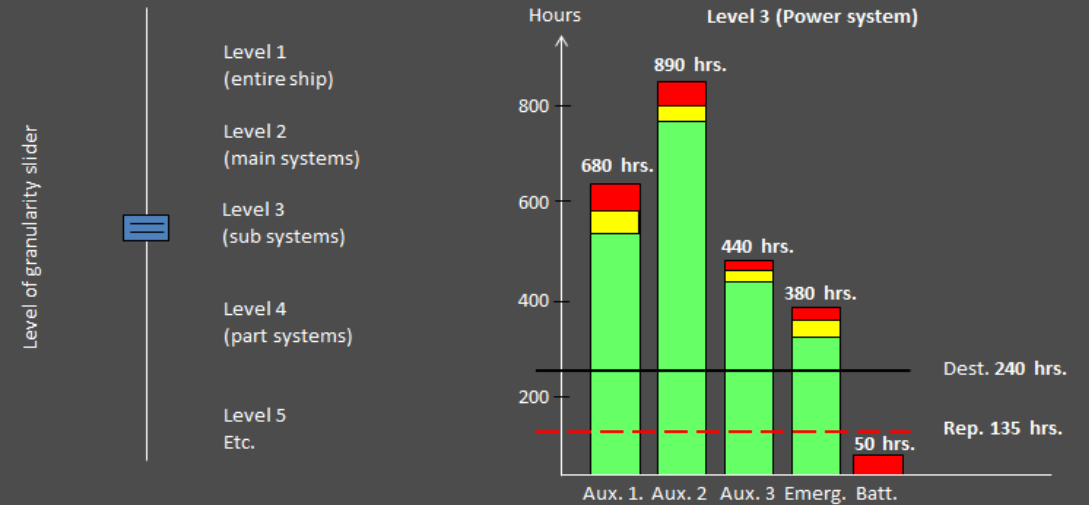
### Operational status of unmanned vessel

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### Operational status of unmanned vessel

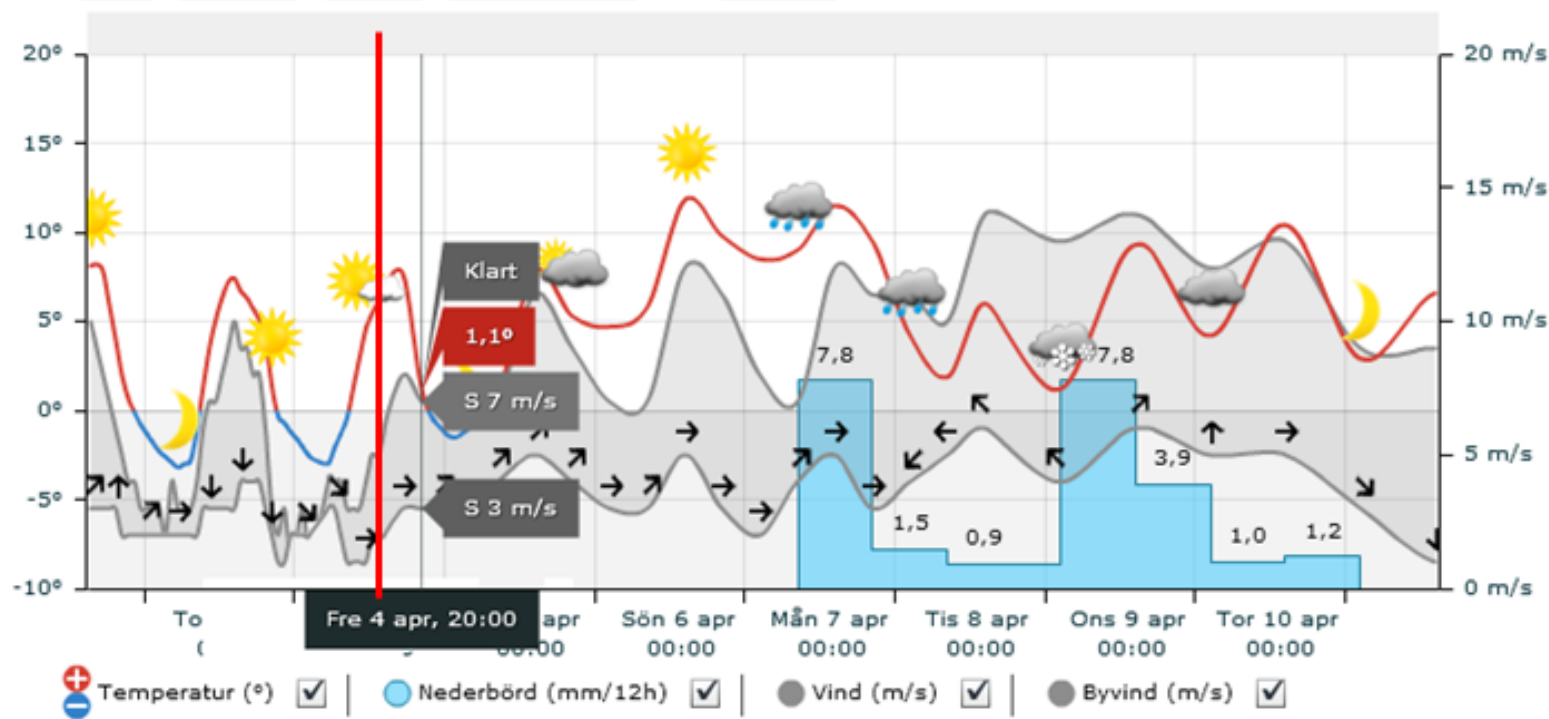
Expected remaining running hours to next service based on guarantee or condition





Prognosen utfärdad kl. 11.20.

Idag Imorgon Fredag Lördag-Fredag Visa alla



Switchboard
Conning
Chart
Timeline
**Weather**
Status
Camera
Radar
MUNIN
thomas.porathe@chalmers.se

# AUTOMAT EXPRESS, SGJT/44056738

Local ship time: 09:49:24/UTC 15:49:24

Switch board view



	Automat Express	Automat Emma	Automat Luna	Automat Beta	Automat Victoria	Automat Fox
Show ship						
Incoming radio	16/72/2182 Sq: 6	16/72/2182 Sq: 6	VHF ch. 16	16/72/2182 Sq: 6	16/72/2182 Sq: 6	16/72/2182 Sq: 6
Logbook	Logbook	Logbook	Logbook	Logbook	Logbook	Logbook
SCC vessel transfer	Op. 1 ▼	Op. 1 ▼	Op. 1 ▼	Op. 1 ▼	Op. 1 ▼	Op. 1 ▼

Watch schedule Wednesday 2014-08-18

07.30	Hand-over ✓	Hand-over ✓	Hand-over ✓	Hand-over ✓	Hand-over ✓	Hand-over ✓
08.30	Checked ✓	Checked ✓	Checked ✓	Checked ✓	Checked ✓	Checked ✓
08.45					Boarding CL	
09.25		♦			OCT boards	
9.30	Check CL	Check CL	Check CL	Check CL	Check CL	Check CL

Enter schedule note for: Automat Emma ▼

Date time

Write free text

Enter

