

3.11.2023 AALTO UNIVERSITY MEC-E1004 SEMINAR

Autonomous shipping

Overview of drivers, markets and technology

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Presenter



Dr. Kalevi Tervo

Corporate Executive Engineer

Global Program Manager

Intelligent Shipping

ABB Marine & Ports

- Has a D.Sc. Tech in Control Engineering from Aalto University, Finland, 2011.
- ABB career started in 2011, leading R&D projects on increasing ship automation and performance through data analytics, optimization and control
- Currently leading a major R&D program developing efficient, sustainable and intelligent shipping

Agenda

01.

ABB Marine and
Ports overview

02.

Autonomy &
societal drivers

03.

Market
maturity

04.

Technology
insights

05.

Key takeaways

06.

ABB talent
community

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ABB talent
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ABB group - Well positioned across global markets

Employees

~105,000

Countries

~100

Revenues

~\$26 bn

Europe

~\$9.6 bn

Americas

~\$7.9 bn

AMEA

~\$8.4 bn

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future.

By connecting software to its **electrification, motion, process automation and robotics & discrete automation** portfolio, ABB pushes the boundaries of technology to drive performance to new levels.

2020 figures

ABB

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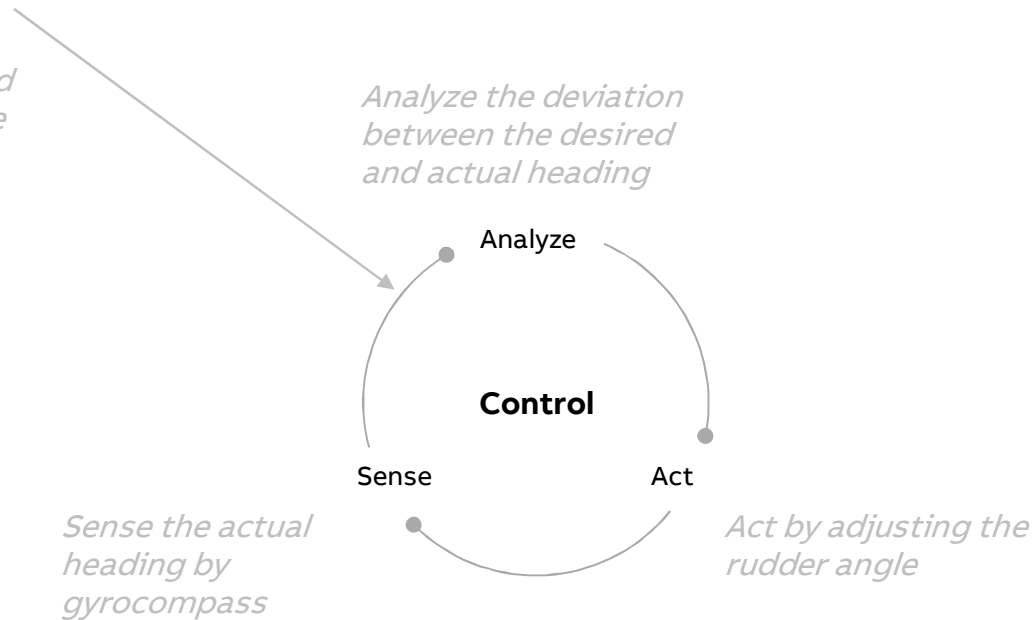
ABB talent
community

Automation

Automation tries to control a process according setpoints

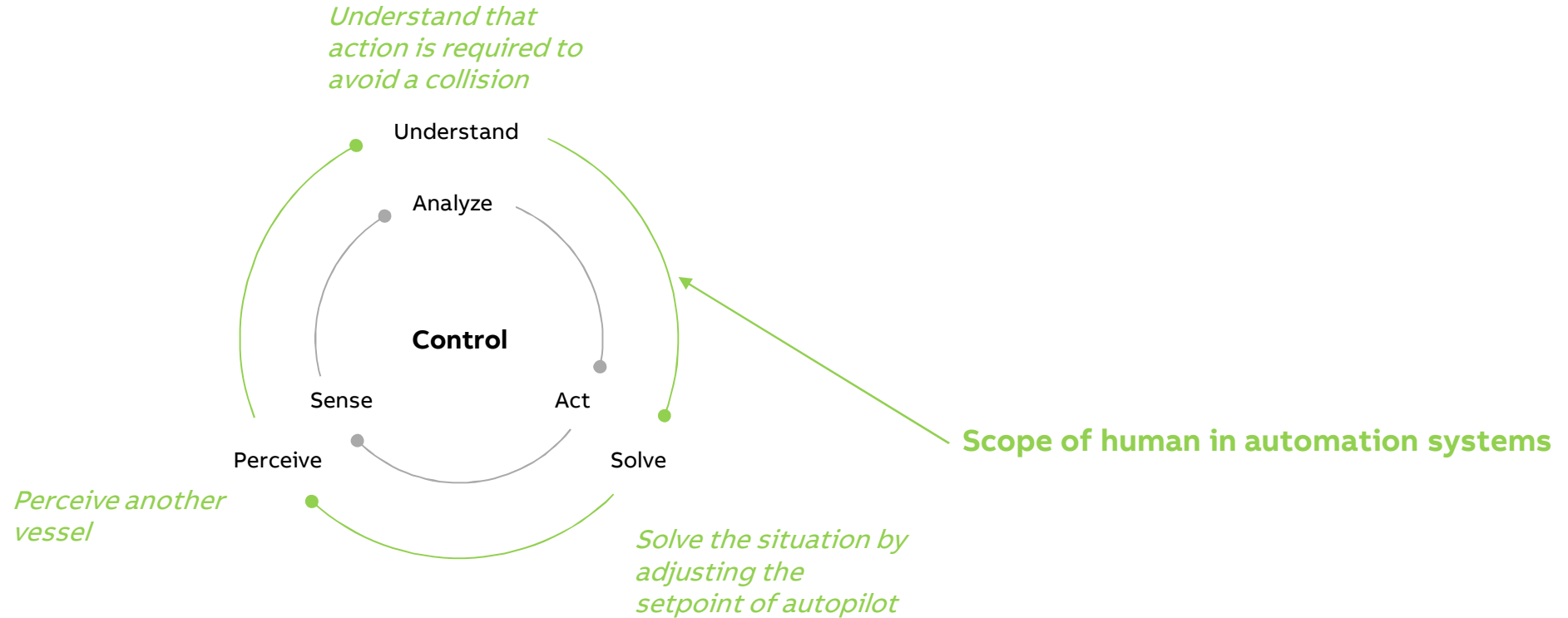
Scope of traditional automation

Automation tries to control a controlled variable by human or a previously made plan, by adjusting the manipulated variables.



Automation

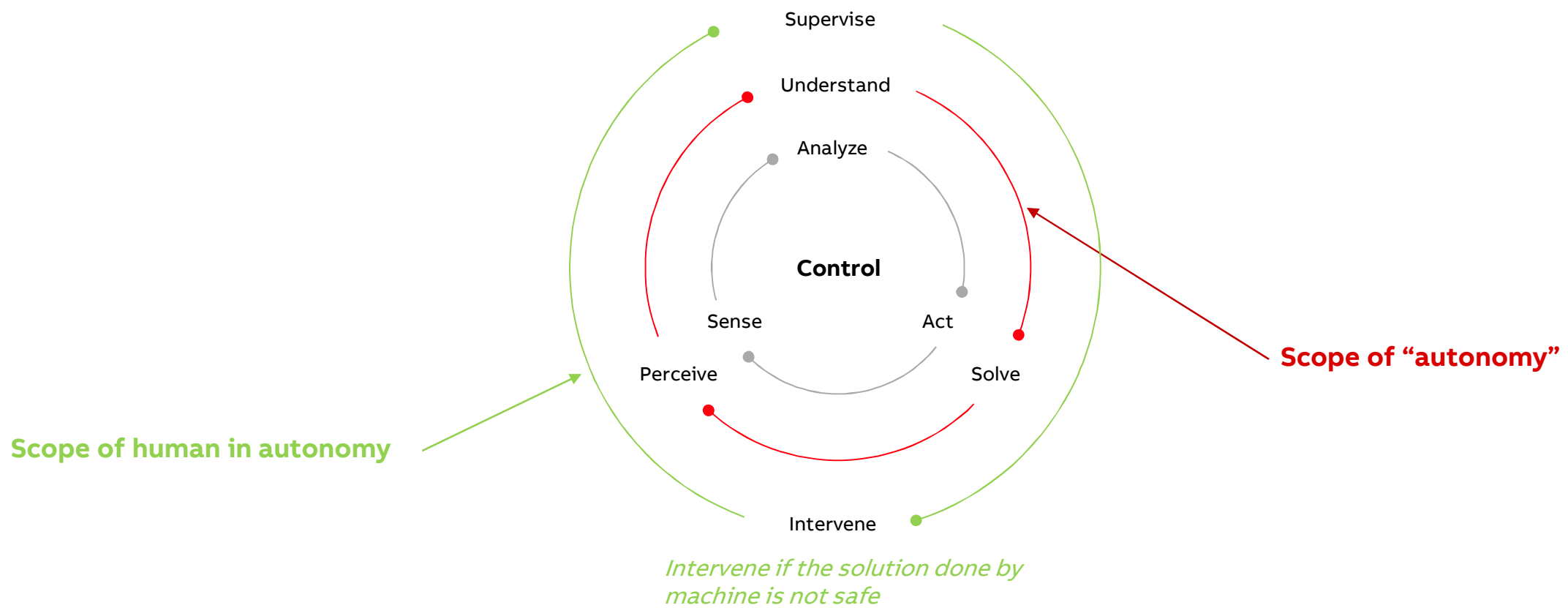
Role of human is to adjust the plan or setpoints of automation if the situation so requires



What is autonomy?

Autonomy pushes human from continuous perception, understanding and solving to the supervisory loop

Supervise that the machine perceives, understands and solves the situation in a correct way



What are the drivers of automation?

Safety and environment



Reuters on August 10, 2020.
French Army command/Handout
via REUTERS

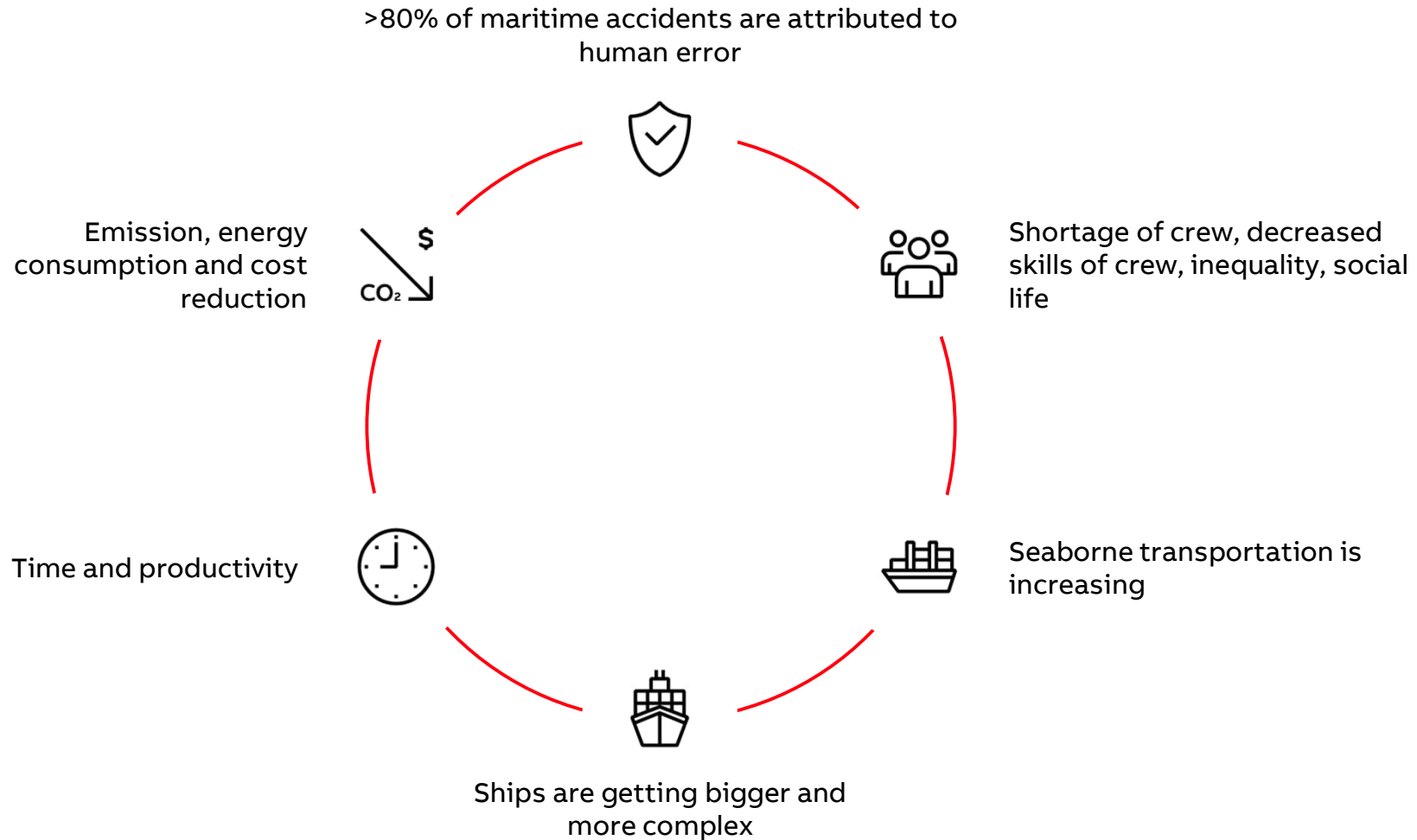


What are the drivers of automation?

Social expectations

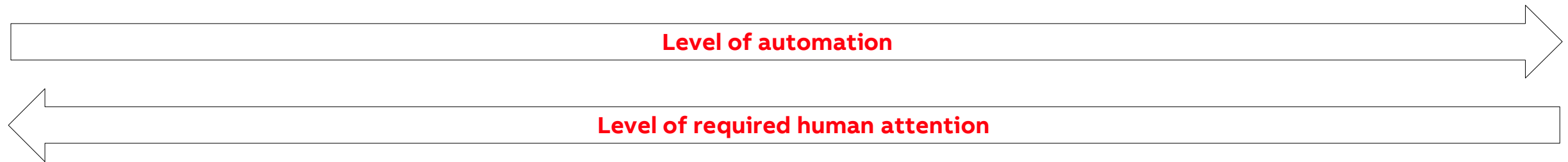
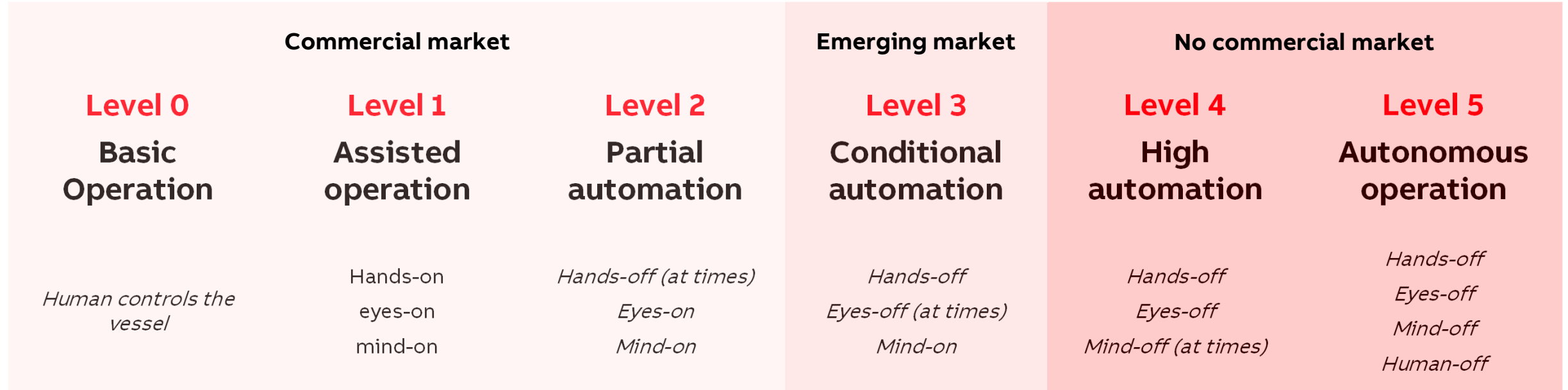


What are the drivers for automation?



Levels of Automation in Shipping

One Sea definition – can also be applied to a specific function only



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Autonomous shipping

Very broad application field

Ports and logistics

Ship-to-shore¹

Remote ops & maintenance

Connectivity and comms²

Ship itself



1. Photo: Cavotec, 2. Photo: GT Maritime, Photo: TS2 Space

Are there any autonomous ships today?

It depends on what do you mean...

Research



Research vessels to develop and showcase the technology

Mayflower autonomous drone

Photo: IBM

Navy



Various naval vessels, patrol vessels, etc.

US Navy Sea Hunter

Photo: U.S. Navy photo by Mass Communication Specialist 3rd Class Aleksandr Freutel

Specific mission boats



Small ferries, survey vessels, etc.

Zeam autonomous electric ferry

Photo: Torghatten AS

Commercial



Pilot projects with autonomous & remote control capabilities

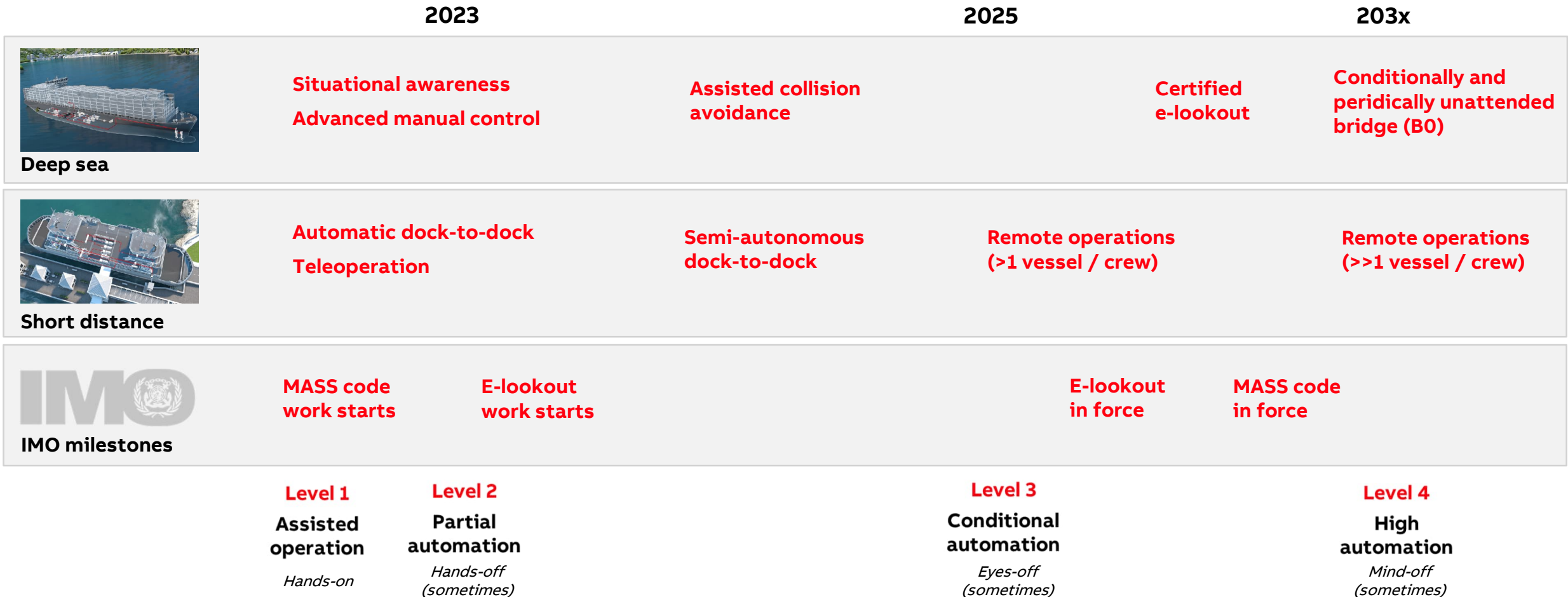
Yara Birkeland

Photo: Yara

Autonomous ships are still in early-stage in commercial deployment → Very interesting topic to work

Projection of market adoption pathways

Deep sea and short distance vessels



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Autonomous control

How does it work?



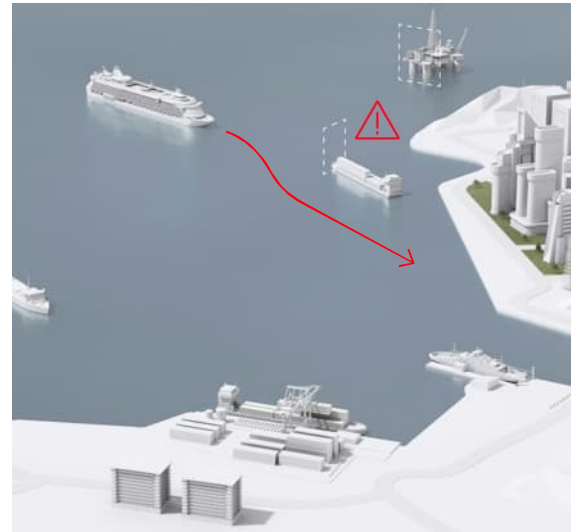
Sense and perceive the environment

SOLAS equipment + cameras + other



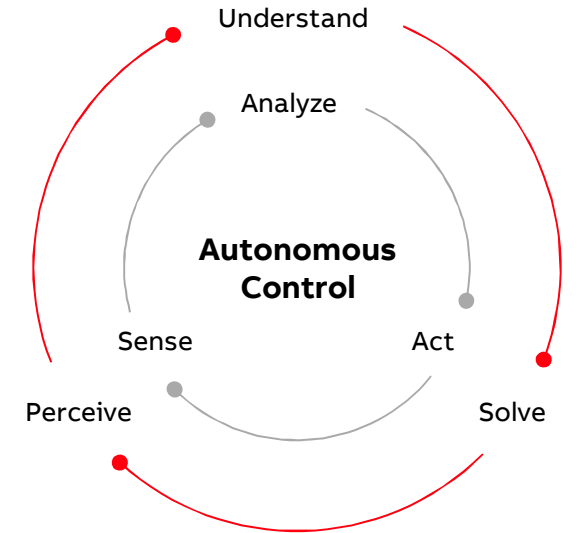
Understand and solve the situation

Planning a safe trajectory



Act upon the solution

Optimal control of the vessel



Observation



Data fusion & positioning



Risk assessment



Decision-making



Control

Corresponding human tasks

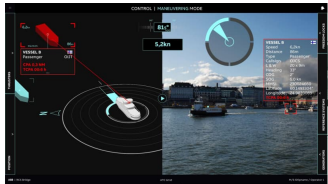
ABB Ability™ Marine Pilot product family

Building blocks for autonomy

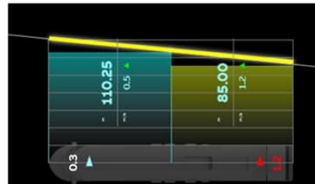
Remote operation / control



ABB Ability™ Marine Pilot Vision



Lookout Assistance



Docking Assistance

Situational awareness

ABB Ability™ Marine Pilot Control



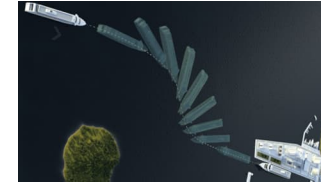
Joystick &
DP



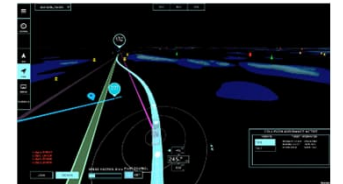
Autopilot

*Continuous and simplified control
throughout the voyage*

ABB Ability™ Marine Pilot Decision



Auto docking
Auto crossing
Braking Assistance



Collision
Avoidance

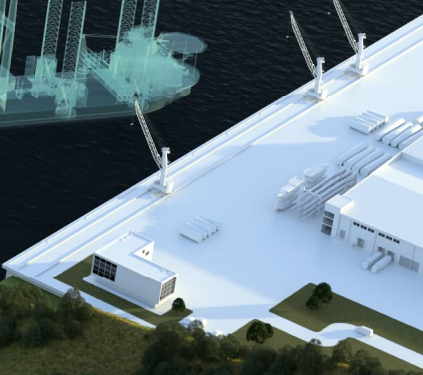
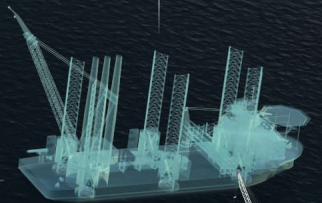
Automated vessel control

DP operation

All speed joystick control

Braking assistance
and collision avoidance

Auto docking



Computer vision technology for electronic lookout

Detection, tracking and measurement



Benefits of visual perception

02.Jun 2021 13:05:32



860m
331°

834m
333°

862m
335°

230m
337°

678m
351°

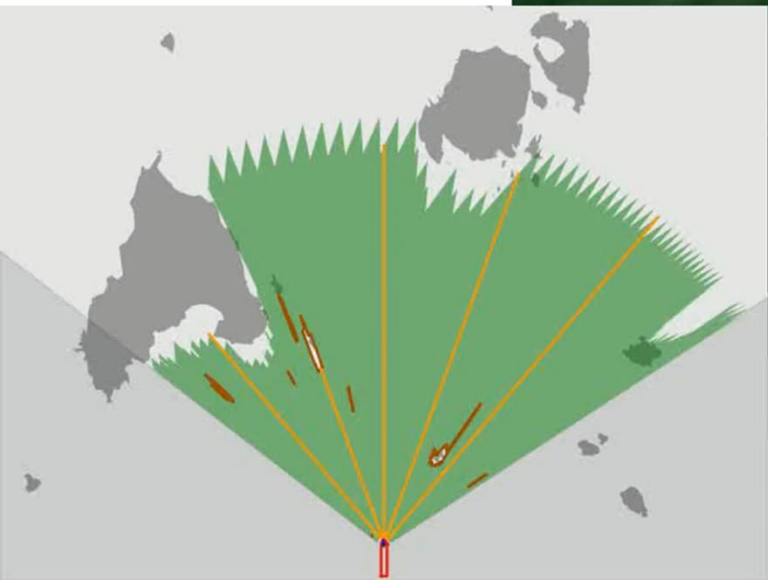
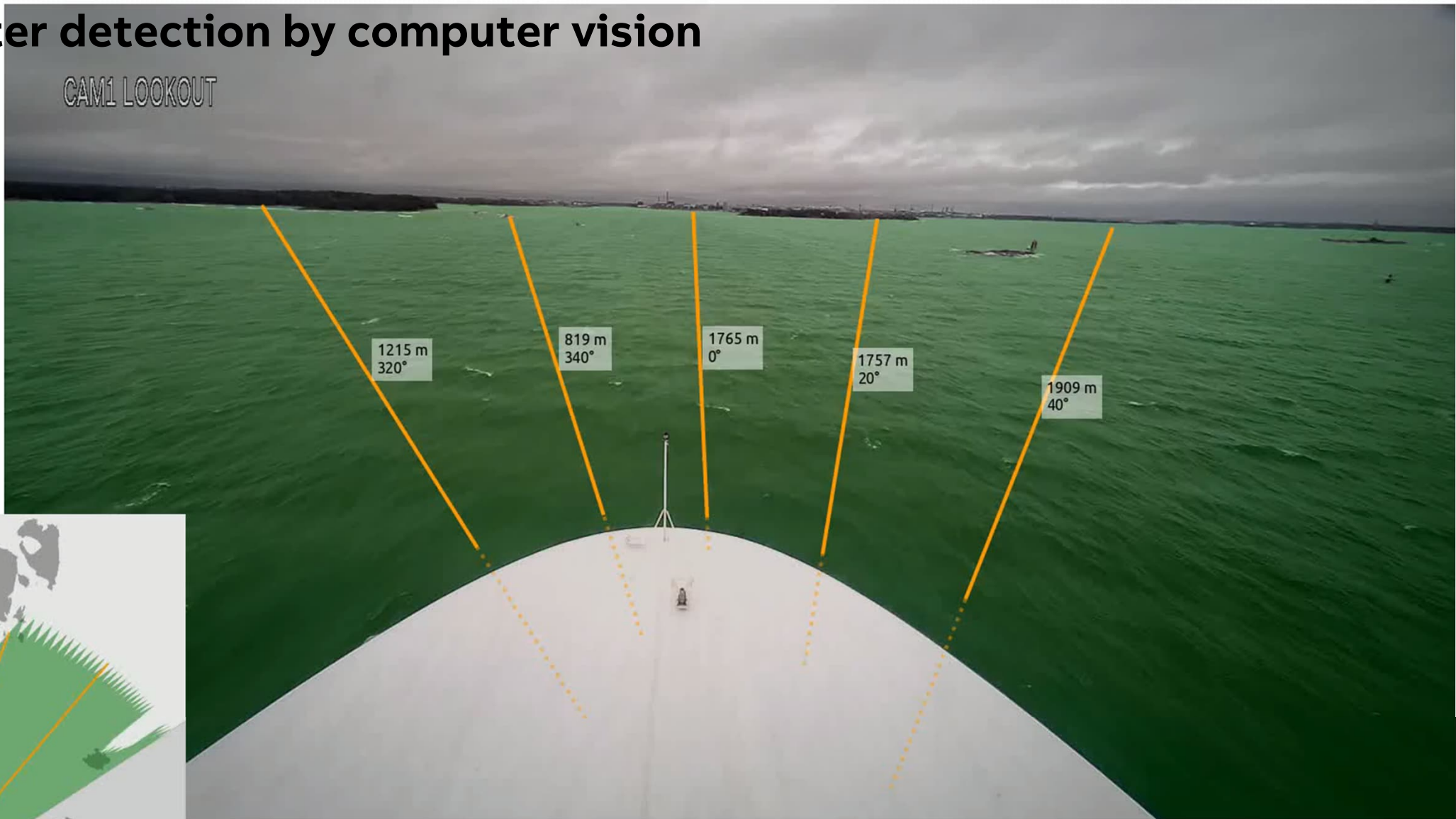
645m
351°

617m
019°

643m
024°

Navigable water detection by computer vision

CAM1 LOOKOUT



Collision detection and collision avoidance

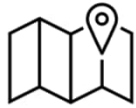
Measurement and detection

Measure data from various equipment.



Estimation and mapping

Using all data sources, estimate own vessel motions, own position, and map the surroundings.



Tracking and fusion

Based on sequence of observations, estimate how the objects move. Fusion of different modalities.



Prediction

Based on the tracking and types of objects, predict their anticipated future trajectories.



Onshore control

Using Marine Pilot solutions



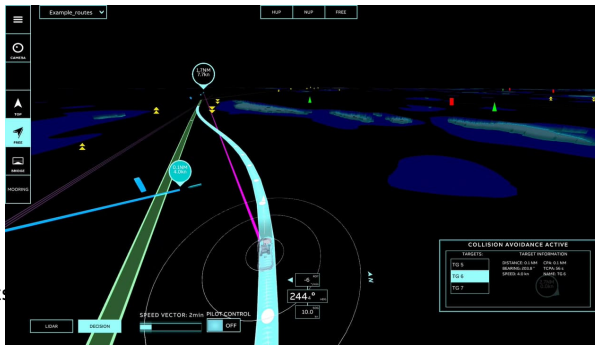
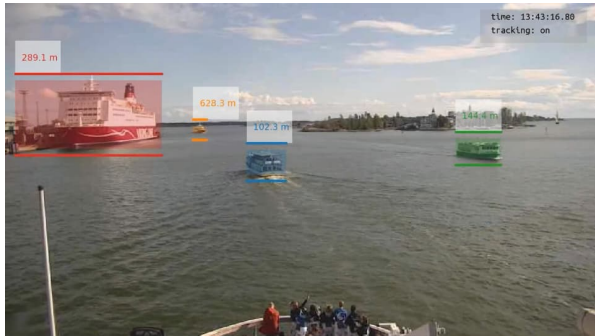
Case example

Keppel Offshore and Marine autonomous tug project



ABB end-to-end autonomous solution delivery

- **AI-based** situational awareness and sensors (Pilot Vision)
- **Automatic** maneuvering and control system (Pilot Control)
- **Autonomous** collision avoidance
- **Onshore** control center and secure connectivity (Pilot Onshore)
- **ABS notation** for remote and autonomous control



Recent highlights

01.

All-speed joystick control, DP and AX Bridge for **the largest cruise ship in the World**



02.

All-speed joystick control and DP for **the largest double-ender in the World**



03.

Braking Assistance delivered to **one of the largest cruise ships in the World**



04.

Demonstration of the **World first autonomous tug with ABS and MPA notations**



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Key takeaways



Development is driven by safety, reduced availability of crew and economical reasons



Market is still at early stage



Very interesting work opportunities – possibility to make an impact for safe and more sustainable maritime

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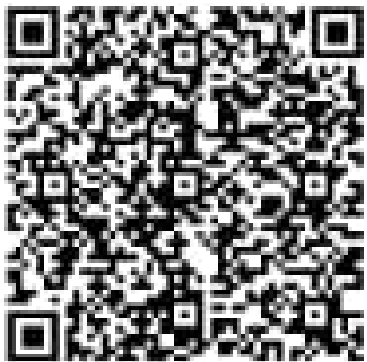
06.

ABB talent
community

ABB Talent Community

Students

- By joining the ABB Talent Community and allowing notifications, you will get more information regarding our career opportunities for students
- If you in addition create a profile on the careers.abb.fi site, you will get personalized job offers



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