AUTONOMOUS VESSEL DEVELOPMENTS
Content

Developments in maritime autonomy - some views from the industry

Finnish legislation

What is remote pilotage?

Next steps
One Sea – Autonomous Maritime Ecosystem
One Sea Partners

- ABB
- Cargotec
- Ericsson
- FinFerries
- Finnpilot Pilotage
- Meyer Turku
- Rolls-Royce
- Tieto
- Wärtsilä
Towards Autonomous Vessels

2014: DP in Unifled Bridge
2016: R&D Centre to Turku Finland
2016: OneSea – leading ecosystems for autonomous maritime
2017: World’s first automatic crossing system
2017: Google Cloud Partnership
2018: Intelligent Awareness launch
2025: Autonomous vessels

2013: Unmanned Vessels launch
2014: AAIRI – Autonomous vessel initiative
2016: Offshore center concept launch
2017: World’s first remote controlled commercial vessel demo
2017: Chinese alliance for autonomous ships
2017: European Space Agency Partnership
2020+: Remotely operated local vessels

Transparency

Connecting vessels and shore operations with our experts

Vessel
Data capture and real-time optimization

ABB Operations Center
Performance and condition analysis

Customer Operations Center
Fleet management

Digital

- Navigation and positioning
  Situational awareness, docking assistance and automatic crossing

- Decision support
  Decision support to maximize safety, efficiency and up-time.

- Advanced sensors & machine learning
  Higher accuracy and better optimized operations.

- Automation and control
  Latest systems bringing new levels of efficiency.

Digitalization is changing the way ships are designed and operated.
Market will develop gradually

Decisive factors

Legislation
- Safety of Life at Sea
- National administrations granting exemptions

Business Models
- Utilization
- Revenue
- Cost
- Risk and Liability

Technology
“Autonomous and remote-controlled ships shall be as safe as conventional ships of the same type”
Technology will develop at an exponential speed.
Market will develop gradually

Local traffic

Innovations applied differently

- Situational awareness
- Motion control

Ocean Going

Assisting

- Collision avoidance & Object recognition
- Electric and self-healing machinery

Same technology – different applications
The Smart Marine Ecosystem
THE FUTURE OF SHIPPING

Multiple sources of energy

Digital Twin

Simulators

Berthing slot and congestion from VTS

Weather forecasts

Situational awareness

SMART ROUTING AND VOYAGE PLANNING

COllision avoidance and auto-docking

EFFICIENT & GREEN SAILING

SAFE & AUTOMATED OPERATIONS

TRANSPARENT & COORDINATED PORT OPERATIONS

REAL-TIME VISIBILITY OF SHIP ETA AND ETD

REMOTE EMISSIONS & PERFORMANCE MONITORING

HYBRID SHIP

Digital Twin

Simulators

Multiple sources of energy

Vessel route and position (navigation system / AIS)
WÄRTSILÄ SMART MARINE ECOSYSTEM

Berthing slot and congestion from VTS
Weather forecasts
Situational awareness

SMART ROUTING AND VOYAGE PLANNING

COLLISION AVOIDANCE AND AUTO-DOCKING

REMOTE EMISSIONS & PERFORMANCE MONITORING

EFFICIENT & GREEN SAILING

SAFE & AUTOMATED OPERATIONS

TRANSIENT & COORDINATED PORT OPERATIONS

REAL-TIME VISIBILITY OF SHIP ETA AND ETD

HYBRID SHIP

Multiple sources of energy
Vessel route and position (navigation system / AIS)

DIGITAL TWIN

Simulators
Finnish Pilotage Act  
(amenations in force 1.2.2019)

- A “law for the future”
- Allowing the pilot to perform his or her duties somewhere else than onboard the vessel.  
  - Permit applied from Finnish Transport and Communications Agency, valid for 5 yrs.
  - Only Finnpilot Pilotage Ltd may apply the permit and provide remote pilotage.
- Pilotage Act includes regulations on  
  - content of the application,
  - approval process,
  - amendments to permit,
  - reasons for cancelling the permit,
  - conditions of the permit and
  - renewal of the permit.
Remote pilotage

- Pilotage company has to apply for an authorization (permit) from the pilotage authority. The application shall include descriptions on various issues:
  - Where (fairway)
  - To whom: type(s) of ship(s)
  - How (technology, communications, “RPC”, …)
  - Operational procedures
  - Information to be used, its reliability, availability and up-to-date
  - Conditions under which service is provided (environmental conditions, ship condition)
  - Responsible persons and number on personnel involved with remote pilotage
  - Risk assessment
Remote pilotage

Permit for remote pilotage can only be granted if remote pilotage will not as such or in combination with other functions cause any danger to vessel traffic safety or any harm to other vessel traffic or the environment.

- Finnpilot must demonstrate safety and quality of remote pilotage.
- Authority decides finally what is acceptable remote pilotage.
- The master of the ship has always right to refuse from remote pilotage.
- The responsibility of the pilot is limited by law if any technical or communicational problems occur or the operational procedures are not executable.
How to develop (remote) pilotage?

Testing
- Methodology
- Technology
- Operational procedures

Defining
- Means for ensuring the safety of piloted ships including the safety of human lives and the marine environment
- Risk control and mitigation measures
- Potential fairways, ports and ships
- Personnel and competences required and training needed.
Pilotage - What does the customer buy?

- Fairway navigation, ship handling
- Ice navigation and icebreaker assistance
- Cooperation with tugs
- Harbour manouevring
- Local knowledge (conditions, operation, formalities, contacts, responsibilities,...)
- Relevant port call information
Customer segments from safety perspective

"Liner traffic with efficient cargo handling"

"Accurately scheduled production of experiences with high safety standards"

"Safety regardless of price"

Low profit – low costs – low competence?
Finnpilot “market share”

<table>
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<th>Luottasaaliuke Asema</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
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<td></td>
<td>Suomen</td>
<td>Luots - market</td>
<td>Oikea %</td>
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<tr>
<td>Rotka</td>
<td>9,254</td>
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<td>Selkämeri</td>
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<tr>
<td>Koko yhteensä</td>
<td>80,158</td>
<td>28,452</td>
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Statistics from Finnish Transport Agency and Finnpilot

- All port calls
- Foreign traffic (cruise, passenger and ropax traffic excluded)
DATA INTENSITY

- Collecting AIS data
- Internal processes digitalized
- Vessel independent navigation
- Fleet management
- Pilotage data collection
- Pilot Online
- Analysing tool
- Remote controlled cutter
- Analysing process for pilotages
- Data set for pilot from analysing tool
- ePilotage
- Future Fairway Navigation

TODAY
ePilotage concept is a set of actions aimed at the development of the pilotage service process i.e.

- transportation,
- transportation planning,
- resource planning,
- pilotage and
- invoicing.

The main focus of ePilotage is the development of information gathering, production and processing to enhance the pilotage service process.

The outcome of ePilotage is new methods for providing pilotage such as remote pilotage and new solutions to improve the pilotage today.
Remote pilotage – NOT remote operation/control
Information to enhance pilotage

- Weather
- Data from Pilot Plug
- Deviation reports
- AIS
- Pilot’s route plan
- AtoN malfunctions
- Intelligent AtoNs
- Ship’s route plan
- Ice information
- Sweeping information
- Coastal radar data
- Ship manoeuvring
- Ship movement observation systems outside the ship
- Ship movement observation systems inside the ship
- Shared situational awareness
Potential for remote pilotage

• Customer segments - not a service for all!

Customer segments from safety perspective

“Liner traffic with efficient cargo handling”
“Accurately scheduled production of experience with high safety standards”

“Safety regardless of price”
“Low profit – low costs – low competence”

• Quality ships with competent masters/officers

• PEC requires training - why not remote pilotage
INNOVATIVE NEWBUILDINGS

ESL Shipping's newbuildings are full of innovations that decrease the environmental footprint of the vessels and result in more efficient operations. Vessels have been designed in Finland, and European equipment suppliers account for roughly 80 percent of all vessel systems.

High efficiency propeller and rudder
Optimal hydrodynamic design with rudder bulb to optimize the water flow.

Exhaust gas heat recovery
Efficient exhaust gas heat recovery for all combustion engines.

Electrical motors
In general, electric motors of 7.5 kW and above have an energy efficiency class of IEC.

Cargos wash water recovery system
Used in washing and discharge used washing water to port facilities.

VFD equipment
Engine room fans, HVAC, and LNG pumps are equipped with variable frequency drives (VFD) to reduce the power consumption.

Environmental and safety systems
Bulb is designed with low friction, low-toxic paint. No harmful anti-fouling paint is used. Painted bulb cleaning will be performed to reduce the drag of the bulb.

Hydrodynamic hull form
Extensive CFD calculations and model testing were performed to optimize hull form. The bow and stern water-turbine propellers are provided with scoops and anti-heat grids. Special attention for monitoring of hull surface roughness was made during the building stage.

Stator fins
The vessel is equipped with four stator fins in order to optimize the flow to the propeller and to increase propeller efficiency.

Emission reduction
Reduction of direct exhaust emissions with LNG compared to 12.1% for fuel oil.
- 77% for CO2 emissions
- 90% for SO₂ emissions
- 85% for NOx emissions
- 98% for PM emissions

Permanent magnet PT1/PT2 shaft generator with VFD drive
Shaft generator ensures feasible and efficient operation of propulsion and power generation at sea as well as extra power for ice conditions through power take-in power take-out shaft drive.

ENX GL Clean Design notation
The notation requires special features such as fly type bridge water separator, turbocharging, management, ESP 60 (Exhaust gas cleaning potential), GWP 1340 (Global warming potential).

ENX-GL NAUT(AI)W notation
Adherence requirements increase maximum safety and reduce the risk of collision, grounding and heavy weather damage through enhancement of the reliability of the bridge system.

Energy management system
The system enables crew to optimize energy consumption.

All LNG-powered
All engines and turbo burner operating on LNG. Vacuum-insulated IAC-type C tank with low boil-off generation rate.

EEDI
Energy Efficiency Design Index (EEDI) of all vessels is approximately 50% below the current requirement and already fulfilling the 2025 requirements.
Elements of future fairway navigation

I. Autonomous/intelligent ship ("self-sufficient")

II. Autonomous/intelligent ship utilizing Intelligent fairway infrastructure

III. Intelligent fairway infrastructure
Development path to future pilotage services

**Concrete steps:**
- Wärtsilä PPU, Trenz PP, Faults in AtoNs to PPU, AISLAB, etc.

**Concrete steps:**
- Continuous measures to increase data exchange and utilization.

**Concrete steps:**
- Remote operated heavy pilot boat

Research & Development:
- Sea for Value (S4V)
- MasterSIM
- …

**TRA2020**
- Interactive Demonstraatio(t), Technical tour

**The aim**
Availability of required technology and information exchange, equipment, training, competence and the operational procedures for both on-shore and on-board operation.
Main topics in One Sea roadmap

**Technical**
- Technical setup and experiments
- Standardization

**Operational**

**Security**
- Cyber Security

**Ethical**

**Regulatory**
- Input to rules and regulations
- Definitions
- Legal issues

**Traffic control**
- New roles, methods, and services needed in autonomous maritime traffic control

- Business models
- Service concepts
- Human factor
- Artificial Intelligence
Digital and autonomous maritime transport chain

Digital door-to-door supply chain

Electronic corridor
- Cross-border corridor
- Information exchange (ship-to-ships, ship-to-shore)
- Situational awareness (shared within actors)
- Cargo information (electronic documentation, cargo status, ...)
- Timing and ETA's
- Route information

Application domain #1
Smart Harbour

Application domain #2
Smart fairway navigation

Application domain #3
Smart shipping

Port
Fairway
Open sea
Fairway
Port

Road
Rail
Air

Customer

Smart harbour operations and logistics connect the road, rail and maritime transport systems and enable multimodal transportation.

Fairway is the navigation channel by which the existing vessels and future autonomous ships use to travel safely in the transfer of goods.

Asset monitoring, visibility to cargo status, electronic corridors and interconnection are the building blocks of safe and secure shipping in the future.
**Ecosystem approach for joint development**

**Smart harbour**
Smart harbour operations and logistics connect the road, rail and maritime transport systems and enable multimodal transportation.

**Experiments**
- Automated Cargo handling and logistics
- Information flow and APIs

**Companies**
- Ericsson
- Euroports
- F-Secure
- Lingsoft
- MacGregor
- Port of Rauma
- Rolls-Royce
- Satel
- Tieto
- UPM
- Wapice

**Research organisations**
- Aalto
- Novia
- Jyu
- UTU

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**Smart fairway navigation**
Fairway is the navigation channel by which the existing vessels and future autonomous ships use to travel safely in the transfer of goods.

**Experiments**
- Remote piloting
- Robotic systems for VTS & SAR
- Smart aids to navigation

**Companies**
- Alamarin-Jet
- ESL Shipping
- Ericsson
- F-Secure
- Lingsoft
- Meyer Turku
- Port of Rauma
- Rolls-Royce
- Satel
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**Smart shipping**
Asset monitoring, visibility to cargo status, electronic corridors and interconnection are the building blocks of safe and secure shipping in the future.

**Experiments**
- Tallinn-Helsinki electronic corridor for smart shipping

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*Companies and research organisations jointly develop new knowledge and innovations.*
REALITY...
Recent incidents and accidents
Both ropes broke when the pilot was climbing down and the pilot fell onto the boat deck with the ladder.
THANK YOU!