Antti Rinkinen

Remote Pilotage

Pilots' professionalism involved in the development

The publisher of this book, the Pilot Library, was founded in 1962. It was founded by author Toini Havu, who also received the unique title of a Library Pilot. Pilot stations had had pilot libraries since the 1860s, but the determined expansion of libraries and the acquisition of books began with the establishment of the Pilot Library.

The pilot library has also been engaged in publishing since the 1980s. Three histories have been made of the library itself. In addition, it has published the comic book Pilottinen, a book about stories on tramp ships and memoirs of sailors. The library has also published a picture work of life on pilot stations.

The pilot library is owned by the Pilots' Association.

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Antti Rinkinen/Rinkisen jutut

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Photo: ©Luotsiliitto/Matti Elomaa

Foreword

For more than ten years, the Pilot Library, managed by the Finnish Maritime Pilots' Association has, in addition to traditional library activities, engaged in publishing. The pilot library has mainly published historical works related to shipping and pilotage. The pilot library has mainly worked with grants in recent years from the Jenny and Antti Wihuri Foundation.

The Pilotage Act was amended in 2019 so that the pilot could also carry out his duties from outside the vessel. The law was peculiar in that the capacity required by law to act as a remote pilot was not yet even at a trial level. For this reason, the Pilot Library decided to make its own publication and comprehensive work on the current situation of the remote pilotage project. The pilot library applied for and received a grant for the work publication.

The work was edited by the writer Antti Rinkinen, Master of Social Sciences. He was already familiar with the history and current situation of pilotage when editing the Finnish Maritime Pilots' Association's 100th anniversary book in 2018. The Pilot Library thanks Antti Rinkinen for his extensive work in this task where the related research data was scattered and in its early stages.

Special thanks to the Jenny and Antti Wihuri Foundation, with the grant of which it has been possible to publish this work.

Tapio Tuomisto
Executive manager
Pilots' Association / Pilot Library

From the author

When this book began to be considered with the Pilot Library and the Finnish Maritime Pilots' Association in 2018, the future of shipping and remote pilotage looked very different from 2021. The idea was to make a book about remote pilotage first and foremost, but also about self-moving ships, remote control, and smart fairways. After all, this upheaval was coming in a couple of years, as was believed then.

Digitalisation and autonomous vessels had been talked about for years, but the hype – or bustle like one of the interviewees put it – was starting to be over. Videos of self-driving ships from a few years ago were on the minds of the general public, and the publicity had awakened the industry itself to discuss future changes. Maritime professionals had noticed that the most optimistic marketing talk, and reality did not always match. Maybe a lot of people thought shipping was developing like before: slowly but steadily.

Development and ideas have not always considered the human factor. Change is often frightening, and new technology is opposed – especially if it is introduced in the middle of development and as poorly functioning. Sometimes new technology has added workload, not reduced it. When designing something new, it is important to take care of removing the old as well.
Pessimists may have laughed at those wildest dreams. But maybe they missed the change. In a few years, there has been a huge amount of development – especially in Finland. Digitalisation may be progressing a little unnoticed. We are no longer talking so much about autonomous vessels, but discussing the addition of automation, its alternatives, cost and consequences. Climate change rejection has also become important.

It now seems certain that digitalisation is rapidly changing shipping, and shipping is becoming a high-technology industry. Data is being used more and more, it moves fast, across a wide range of devices, for a

wide range of needs. Now it's more about each user receiving the kind of data they need and when they need it, to the device they use – and before all else that the data is reliable. Cybersecurity is an important part of shipping.

One of the factors behind the change in shipping is the Government's policies and government programmes. In Prime Minister Sanna Marin's Government Programme, reducing emissions plays an important role. Traffic emissions account for one fifth of Finland's greenhouse gas emissions and are expected to be halved by 2030. The savings target also applies to shipping. The Government Programme also emphasises the use of digitalisation traffic – one part is smart fairway solutions. One dimension of them is the development of remote pilotage. According to the Government Programme, Finland will ensure a high level of competence and sufficient professionalism in the sea areas. In the case of remote piloting, this means training pilots and ship crews.

Generally accepted definitions for automated vessels and remote pilotage either do not exist or are vague – things can be defined in many ways, and with developments it has become clear that things will not be either-or. There are different views on the development of shipping. Increased automation may mean to some that ships control themselves completely automatically, with algorithms and artificial intelligence. Automation can also be seen to have several levels: the vessel may be running on the high seas without humans on the bridge, but on the coast, automation is controlled by a human, and the control in the archipelago is an entirely human responsibility.

Remote pilotage as a term is also yet to be determined. This may mean that there is no pilot on board at all, and the entire pilot service is provided from land at the remote pilotage centre. It can be providing services from another ship. It may also be that the pilot does not board

the ship until near the port. It could also be that the ship is piloted, and another pilot assists remotely from land.

International definitions also often have several levels, rather than unambiguous or uniform definitions, and there are no united legal acts, agreements, or legislation.

For some, perhaps a very early but necessary step to remote piloting was the Pilotage Act renewal in 2019. It enables remote pilotage. In the absence of legal barriers, it is possible the conditions for remote piloting are developed in many ways.

Automation and autonomous vessels have also been tried at sea. Many tests have been successful; however, land-guided, or autonomous vessels are hardly in use so far. There should be working technology available, but for now the price is still an obstacle. Shipping companies have no desire to invest in technology unless they obtain sufficient financial benefit from the acquisition. However, technology is evolving all the time, and its cost decreases.

Numerous projects and programs are underway in Finland to develop shipping. Several of these projects involve a wide range of industry players: industries, universities, research institutes, public authorities. The emphasis is on essential features of Finnish society: trust and co-operation.

Digitization is also advancing to ports, and through them to the entire logistics chain.

Educational institutions have been active in monitoring the digitalisation of shipping. Several theses have been written about this in polytechnics. A dissertation on remote piloting is also underway.

Finnpilot Pilotage Ltd not only actively monitors the development of remote piloting conditions, but it is also active in several projects. Finnpilot estimates that pilotage will be digitized step by step. In early

2022 the first remote pilotage experiment is to be conducted, and the first remote pilotage permits may be applied for in 2025, estimates Finnpilot.

One part of the development work is developer pilots. In the spring and winter of 2021, Finnpilot selected three developer pilots with the task of, on one hand, to assist experts in creating definitions of pilotage and, on the other hand, to export information on developments for pilots. They are also becoming experts in remote piloting. The professionalism of pilots is also desired in the development of remote piloting. Consultation of experts in the preparation phase is not quite usual.

Developer pilots are cautiously curious about remote piloting. They think it is more important to move forward sensibly rather than quickly. Some type of a hybrid model might be good. When there has been so little information so far, the pilots have not yet discussed remote piloting very much.

Remote piloting is of interest to others as well as Finnpilot and pilots. Many maritime actors emphasize the importance of cooperation in the development of remote pilotage and maritime transport as a whole. Even rapid progress is possible, but there are no financial incentives.

This book presents a wide range of perspectives on the development of maritime and remote pilotage and its development.

I want to thank all the people interviewed for this book. Special thanks to Tapio Tuomisto, Executive Manager of the Finnish Maritime Pilots' Association for the discussions and varied assistance. Thank you also to the Pilot Library, which published this book.

In Lappeenranta on June 10, 2021
Antti Rinkinen

Photo: ©Finnpilot

Traficom: A unified understanding of the development of automation

The Finnish Transport and Communications Agency Traficom published a report on the development of maritime automation in 2019. It presented the results of a research program on marine automation and digitalisation launched the previous year. The program aims to form a unified understanding of maritime automation development and the direction in which development should be directed. The aim was also to obtain information on which it is possible to prepare Finland's views on developing international regulations and national regulations, authorization procedures and control for the new needs of maritime transport.

The report had three research questions: 1) How maritime regulation should be adapted to automation and digitalisation needs? 2) How will the development of ship automation affect human and machine communication and authority? 3) How do traditional traffic and automatic ships reconcile in normal and emergency situations?

Regulatory adjustment

According to the UN Convention on the Law of the Sea, every ship must have a master with the appropriate authority competence. In the case of autonomous and remote-controlled vessels, it must be decided how the master is to be determined.

The IMO has three conventions that affect the development of autonomous ships. International STCW Convention applies to training, certification and watchkeeping. International COLREG rules concern the prevention of collisions. The international convention SOLAS defines human life

safety at sea. The IMO is considering their application to autonomous ships.

Traficom points out that regulatory challenges are difficult to assess because these are no details of the development of automation and digitalization. However, current legislation does not seem to preclude experimentation development.

The study highlighted six aspects of regulation that need to be addressed: navigation and maritime developments collision prevention; crew and future seafarers; protection of the marine environment; ships structural and technical requirements; liability, compensation and insurance issues; and cyber security and anti-terrorism measures.

Human-machine communication

Traficom estimates that changes in human-machine communication will occur gradually. The operating environment makes it possible to use new innovations, and their benefits will outnumber costs.

It is likely that initially communication will increase as remote control from land is introduced alongside traditional shipping. With development, this communication decreases and changes – the importance of artificial intelligence increases and the importance of a human decreases. However, the report points out that the evaluation of human-machine communication is more uncertain the farther the estimate goes in the development of ship automation. However, uncertainty can be controlled at least to some extent.

Communication challenge

According to the report, the main theme in the literature on autonomous vessels is vessels avoiding a collision. It is estimated in the literature that algorithms are already so advanced that the autonomous vessel can make the necessary evasive manoeuvres. However, the report points out that

there is no specific coordination of autonomous and traditional vessels in the research literature reviewed.

New technology could already be integrated in new ships and would not be particularly expensive. In the case of old ships, on the other hand, integration was very difficult.

Traficom estimates that remote-controlled and autonomous vessels are compatible with other traffic under normal conditions. Challenges exist when ship-to-ship communication with another ship is required to ensure its intentions. There has been little review of problem situations in the literature, such as black outs or fire.

According to the report, autonomous traffic will for a long time be "supervised autonomy". The vessel is monitored from the bridge or from a remote-control room.

Suggestions

The Traficom report presents five measures.

Authorities, commercial operators, educational institutions, and researchers should work together to develop a vision of where we aim at ship automation in the long run, considering realities.

Second, the principles that guide the development of ship automation should be defined. Here you must remember that automation vessels must be at least as safe as traditional vessels.

Third, a strategy is needed to move towards previously established visions. Development should move forward step by step so that safety is always ensured before moving on to the next level.

The regulation of ship automation must be promoted internationally and nationally. New control procedures solutions are sought, as well as standardization of equipment and information.

Fifth, Traficom sees a need to continue experiments at different levels of ship automation. For new information, international cooperation is needed. Good practices applicable to shipping are examined from e.g. aeronautics, space technology, nuclear power and mining.

Multi-level definitions

There are several different views and definitions of an autonomous vessel. What they have in common is that the degree of autonomy is defined in several ways. Thus, autonomy is not either or. For example, Lloyds has defined a 7-point scale. There are four steps in the International Maritime Organization IMO's definition. In Finland, there are four levels in Traficom's definition, but each level is also divided in four depending on the stage of the ship's voyage.

Autonomy is gradually evolving. The fastest change is expected to be control, communication in the development of navigation systems. The creation of remote control systems is also evolving rapidly. Own legal changes and international standards and agreements also play a role. Their own specific characteristics apply to remote piloting.

There are also development problems in responsibility and regulation.

The timetable for the introduction of autonomous vessels is not yet known either. Some think that the first autonomous vessel will be introduced in the next few years.

The extremes are common among different definitions: at the lowest level, all operation is done by the crew and at the highest level, the vessel operates autonomously, without a crew.

Traficom divides the levels into four: port maneuvering, coastal and archipelago navigation, offshore navigation and exceptional situations. The classification follows the IMO classification.

At level 1, operations are carried out by the ship's crew. In exceptional situations, MIRG, a Maritime Incident Response Group, can help.

At the second level, in ports as well as on the coast and in the archipelago, the crew operates the vessel and makes decisions. In the open sea opera-

tion and decisions are made remotely from land. In exceptional cases, the crew is responsible and can get help from MIRG.

At the third levels, operation and decision-making in the port, on the coast and in the archipelago, and in emergency situations is done on land. On the high seas, the vessel navigates autonomously.

At the fourth level, the vessel operates autonomously at all stages of the voyage.

THE FOUR LEVELS OF THE IMO

The IMO accepted the definitions of autonomy in 2018.

At level one, the manual level of autonomy, means that decision-making and control is on board with the crew. Autonomy is limited to assisting decision-making, navigation, and manoeuvrability support schemes.

At the second level, the ship has a crew, but the ship is remotely controlled. At the delegated level, decision-making requires always human acceptance. Operational control may be transferred to the ship's crew at any time.

The third level is called the supervised level. The ship is remotely controlled and has no crew. However, knowledge of all decisions made by the system is constantly sent to the operator who can take control of the vessel at any time.

At the fourth level, the ship is self-steering and unmanned. The operating party receives information on exceptional and accident situations if predefined limit values are exceeded. The operating party receives control decision-making power only when thresholds are exceeded.

Lloyds divides the levels in much the same way, but separates the crew and system actions slightly more specifically.

A model has been developed at the Hamburg University of Technology to take account of complexity, occupation, and level of autonomy. These are

interrelated. The classification is based on the premise that the ship can move through multiple levels of automation during the same journey. The model is considering whether the ship is on the high seas, on the coast or in the archipelago, and how busy other traffic is. The crew can be on the bridge, elsewhere on board, or the ship may also be unmanned. At the lowest level, the vessel is operated by a crew or a remote operator on an ongoing basis. At the second level, navigation is the responsibility of automation, but the crew can take responsibility for themselves. At the highest level, the crew does not interfere with the passage of the ship but a program utilizing artificial intelligence ensures the passage.

One definition is in the security of supply organization report 2018 *Maritime security of supply and Business in Finland*. It defines the autonomous vehicle and vessel as follows: Automated vehicle or vessel capable of operating without a driver or pilot and without contact with other vehicles, vessels or infrastructure.

Classification has been made mainly for road transport in the United States, which is also applicable to shipping. There the human role is central to the first three levels, and on the next three levels the program is responsible for environmental monitoring and may also be responsible for control. At level 0 there is no automation, at level 1 instructor support is necessary and level 2 uses partial automation. At these levels, a human monitors the traffic environment. From the third level onwards, monitoring the environment is the responsibility of the system. At the third levels, automation is conditional; an example is the use of an autopilot on the high seas. On the fourth level automation is at a high level: the ship may be unmanned from time to time. At the fifth, fully automated level are unmanned vessels.

The meeting of ships in the ice fairway requires expertise.

Photo: ©Luotsiliiton arkisto

The Pilotage Act defines

Pilotage is regulated by the Pilotage Act. The purpose of the law is to promote the safety and prevention of damage caused by shipping. The law defines the obligation to use a pilot on public waterways defined as pilotage routes in Finnish waters and on the Saimaa canal in the rental area. According to the law, pilotage services may only be provided by a pilotage company as provided by law. The pilot shall have the right to pilot on the routes on which he has obtained the right to pilot, which are granted by the Finnish Transport and Communications Agency Traficom.

The Pilotage Decree defines the use of pilots, the pilot's duties and rights, and the pilot licenses and line pilot licenses.

The Pilotage Act is from 2003 and the Pilotage Decree is from 2016.

The law was reformed in 2010 and 2016.

A significant change was made in 2019 – at that time remote piloting was made possible. The change was related to Sipilä's government's goal of digitization, experimentation, and deregulation. Streamlining legislation was one of the government's top projects. The measures were the deregulation of regulations, the dismantling of unnecessary regulation and reforming the necessary legislation.

The law allowed for experiments in which a pilot can perform his duties from outside the piloted vessel. Permission issued by the Finnish Transport Safety Agency. At the request of the pilotage company, the agency could issue a permit for new trials of pilotage services for a limited period. The aim of the law was to allow experiments with new technolo-

gies and the wider use of information in pilotage activities. The law supported the goals of the government program for the use of an experimental culture and building a growth environment for digital business.

The change in the law promotes remote piloting

The Pilotage Act was amended in 2019 to make remote piloting possible.

The law seeks to improve the safety and efficiency of pilotage. The goal is to experiment with new technologies and making greater use of knowledge in pilotage. The change in the law is based on Juha Sipilä's Board of Directors' aim for building a growth environment for digital business and introducing a culture of experimentation.

Prior to the change, the premise of the law was that the pilot should perform his duties physically on board.

According to the law, remote pilotage is “an activity in which a pilot is piloting a vessel from elsewhere than on the vessel being piloted”.

The law does not specify how a pilot performs his or her duties.

The law sets out the pilot's responsibilities and obligations as follows: “The pilot is responsible for remote pilotage, unless the technical implementation of remote pilotage, the operating model or a disruption in communication links prevents the pilot from carrying out their duties”.

According to the law, pilotage begins when the ship leaves the berth or anchorage, and when entering the port, pilotage ends when the vessel is anchored or moored at berth. Otherwise, pilotage begins when the pilot has boarded a ship and commenced pilotage and ends when the pilot has

handed over the pilotage to another pilot or has ended the pilotage. However, remote piloting can start and end as how the remote piloting chapter provides.

Remote piloting requires a permit issued by the Ministry of Transport and Communications. Permission is granted to the pilotage company on application for a maximum period of five years. The permit can be renewed if necessary. Permission is granted, provided that remote pilotage does not endanger the safety of shipping environment or harm other shipping.

In the application, the pilotage company must describe the methods, technology and operating models and means used to ensure the safety and risk management of the environment and shipping, remote pilotage routes; or the parts of the fairway and the number of staff to be used for remote pilotage and to designate those responsible for the remote pilotage. In addition, the application must provide the necessary information on remote pilotage and its effects as well as other relevant factors for the assessment of the permit application. The Finnish Transport and Communications Agency admits permission for remote pilotage if the activity meets the requirements of the law and the issued regulations.

The remote pilotage permit shall specify the routes on which remote pilotage is permitted and the vessels, such as the start and end points of remote pilotage. A wide range of requirements and conditions can be specified in the permit, such as procedures, technologies, security, reporting, control and weather restrictions.

According to the law, a pilotage company and other actors involved in remote piloting have the right to receive necessary information from, among others, the Finnish Transport and Communications Agency, the Finnish Transport Infrastructure Agency, and the Finnish Meteorological Institute.

The master of the vessel has the right to refuse remote pilotage - however, this must not prevent getting a pilot on board the ship.

Pilots also have the right to refuse remote piloting or to suspend remote pilotage much like in traditional pilotage if they think that the vessel, persons, other waterways or environmental safety is at stake. The reasons shall then be notified immediately to the master of the vessel. Vessel Traffic Services must also be notified of the refusal or suspension.

The responsibilities regarding remote pilotage are similar for the pilotage company, the port authority, the pilot and the master as those in other pilotage.

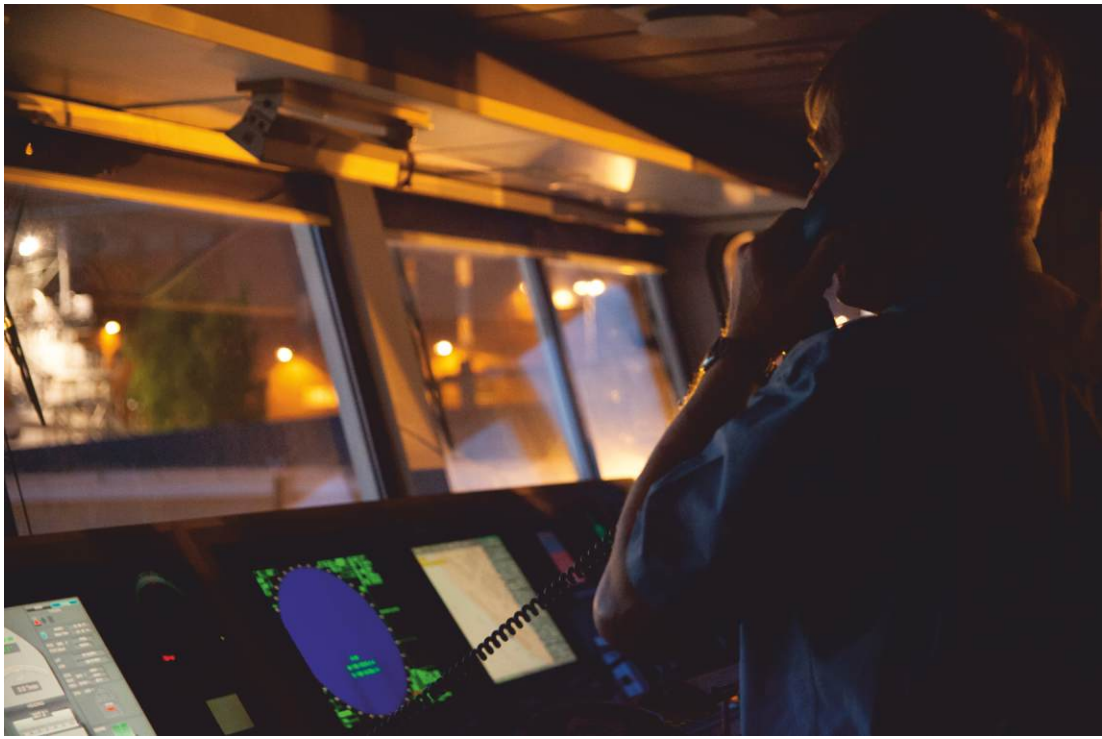


Photo: ©Finnpilot

Digitalisation is changing legislation

The new pilotage act was based on digitalisation. Shipping is digitalizing like the rest of society. Digitalisation has changed and will change ships and pilotage as well. In the future, ships may not have people on them - no crew or pilots, when things can be handled remotely.

Part of digitization is electronic nautical charts, which are mandatory in much of the international world traffic. The map image shows not only the ship, but also other ship traffic.

Autonomous – unmanned and remotely operated – ships are being developed around the world in numerous projects. Their development presupposes the development of all shipping. Digitization also includes new technologies and business ecosystems that combine ships, pilotage, ports as well as the whole logistics chain.

Finland has been at the forefront of development with the Bothnian Sea test area and the smart fairway project. In pilotage, digitalisation is reflected in a mobile ERP (enterprise resource planning) system, among other things.

One of the goals of the reform of the Pilotage Act was to experiment with new technologies and improve knowledge utilization in pilotage activities. Improving pilotage efficiency and safety digitalisation was a central goal.

Better safety and efficiency

The objectives of the reform of the Pilotage Act were to improve the safety and efficiency of pilotage operations. Also experimenting with new technologies and making greater use of knowledge were the goals.

Safety would be improved when the pilot does not have to board the ship in difficult conditions. Efficiency would improve among other things, such that there would be a reduction in pilot transportation which would result in time savings.

The aim was to make remote pilotage subject to a permit, and to issue permits for a fixed period. This could mean defining requirements for safe pilotage. In the initial phase, the possibilities of utilisation had to be clarified regarding remote pilotage. The goal of the law is to experiment with several different technologies in pilotage under real conditions. The purpose is to find out, among other things, what data and what kind of data transmission connections are required, as well as which actors are involved in the fairway navigation. The government justified the permit requirement to better ensure the safety of shipping and the prevention of environmental damage.

Permit granting is also a means of identifying the technology, practices, and interactions required by masters and pilots.

Changes in operating methods always include risks, and attention must be paid to managing them, and varied cooperation is therefore needed between pilots, authorities, ships and industry.

Access to information and interaction between the pilot and the ship is key. It has been suggested in the literature that remote pilotage is limited to specific vessels, processes and communication practices are standardized and that the ship is well connected.

The government's proposal emphasizes that remote piloting should be started on easy routes and initially it would not be done for large passenger ships and tankers. The Finnish Transport and Communications Agency could limit experiments for specific vessel types and specific areas.

Remote piloting is intended to start with small-scale experiments.

In connection with the renewal of the act, there was no desire to renew the Pilot Licenses, PECs and Exemptions or those related to pilot exams approved by Traficom. An assessment of these may become necessary if remote piloting expands.

Photo: ©Tapio Tuomisto

The Agency issues a permit for remote pilotage

According to the Pilotage Act that was renewed in 2019, remote pilotage requires a permit in Finnish waters and on the leased Saimaa Canal area, as well as on other public waterways defined as navigable fairways in the Finnish Transport and Communications Agency's permission. The Ministry issues a permit to a pilotage company for a maximum period of five years upon application. The permit can be renewed if necessary.

The condition for granting the permit is that the remote pilotage does not endanger alone or in combination with other activities the safety of shipping and the environment.

The application must describe the methods, techniques and operating models, the environment and means of ensuring safety and risk management in shipping, remote pilotage routes or parts thereof, and number of staff. The persons responsible for remote pilotage must also be appointed.

The application shall also provide the necessary information on remote pilotage and its effects, and other relevant matters.

The Agency issues a permit for remote pilotage if the activity meets the requirements of the law and regulations.

The Agency may also adopt more detailed technical rules concerning the application for an authorization, the content of the application and other reports.

The permit shall also specify, in addition to fairways and partial fairways, the vessels participating in the remote pilotage. Likewise, the start and end points of remote pilotage are determined.

The permit may also set a wide range of requirements to promote the achievement of the objectives as well as conditions, including procedures,

information, technology, security, reporting, control, and inspections. There may also be geographical, weather and ice restrictions in the permit.

The operations must be included in the pilotage company's operations manual.

The Finnish Transport and Communications Agency has the right to amend the permit for a justified reason after consulting the pilotage company or at the request of the company. The permit may be revoked if the pilotage company repeatedly violates the provisions of the law or permit conditions or remote pilotage endangers safety or the environment or causes harm to maritime transport.

The pilotage company receives information that is necessary for the performance of the duties of the pilotage act. Information is available at the request of the Finnish Transport and Communications Agency, the Finnish Maritime Administration, the Finnish Meteorological Institute, and from the vessel traffic service provider. The information is obtained electronically.

The pilotage company, in turn, must provide the Finnish Transport and Communications Agency with the information it needs to carry out their tasks.

The master of the vessel has the right to refuse remote pilotage. Refusal shall not affect obtaining a pilot to the ship.

In the case of pilotage, the same provisions apply to remote pilotage as otherwise to pilotage refusal or suspension of pilotage.

The provisions of sections 4 a – 4 c, 7 and 8 shall apply to remote pilotage as they do to the pilotage company, the port authority, the pilot, and the responsibility of the master. Similarly, the responsibilities of the pilotage company, the port authority, the pilot, and the master are similar to traditional pilotage.

There are no international regulations

There are no international regulations on pilotage at all, nor is there any EU legislation. However, nationally the legislation is very similar in the EU countries – especially in Finland, Sweden, and Norway it is essentially the same.

The concepts of remote piloting are not defined internationally and can mean different ways of piloting from outside the vessel. English terms include at least remote pilotage and shore-base pilotage (land pilotage).

Perceptions of the meaning of terms vary from state to state. Piloting from land can means, for example, that the pilot assists the master of the vessel or the pilot on board from the shore. It can also mean navigation assistance provided by VTS, or remote pilotage from a pilot cutter. In some countries – such as Norway, Romania and Estonia – the pilot may instruct the master of the vessel only by being on either a piloted ship or another ship. In Norway, this is perceived as pilotage conducted from land.

Remote piloting in other countries can therefore mean different activities than in Finland.

In Denmark, it was already stated in 2014 that remote piloting is technologically possible, but because of little experience, its implementation must be done carefully and gradually through tests.

Pilotage from land has been allowed for at least ten years in 12 EU Member States; including the Netherlands, Belgium, Italy, Norway, Germany, and Denmark.

According to French law, the pilot must be on board - although in bad weather it is also possible to pilot from land. In many other countries,

pilotage has been done from land for safety reasons when the pilot is unable to board.

In the Netherlands, Latvia, Lithuania and Germany, pilotage from land is offered as an additional service.

In Italy, up to a third of pilotages are handled on land. It is used only by those visiting the same ports ferries and ro-ro ferries whose captain holds a certificate of approval for land pilotage. The cost of pilotage done from land is a third of the traditional. There have been no accidents.

Internationally, the Automatic Identification System (AIS) is regulated. It is also related to pilotage and safety. There is national legislation concerning the system.

18 statements on the bill

In 2018, the Ministry of Transport and Communications LVM requested statements on the Finnish government's draft proposal to amend the Pilotage Act (940/2003). A total of 18 statements were received.

The following is a summary of the statements. Some commenters said they had nothing to say. Some had been involved in preparing the presentation.

Business Finland

The statement of the innovation finance centre Business Finland stated that the promotion of digital solutions was important for Finland. There is also a need to increase cooperation with public actors and the business sector and accelerate the development of digital tools.

“Achieving commercial benefits in both the remote piloting market and autonomous shipping market requires pioneering. Only this has the potential to ensure the investments and interest of high technology pioneer companies in Finland in the future as well,” stated Business Finland.

According to the statement, it is important to know in real fairway conditions, what kind of technologies, knowledge and operating models are required.

Finnpilot Pilotage

Finnpilot Pilotage stated that the changes will make experiments possible to a sufficient extent. Experiments allow you to find out what kind of technology, practices, interactions and information both the ship's officer and the shore-based pilot would need to provide pilotage from outside the ship as a pilotage service. Experiments are needed to determine these.

Finnpilot supported the permit application procedure and emphasized the importance of obtaining information for the success of the experiment.

According to the statement, in addition to technological know-how, a risk assessment of policy change is needed. The need for training for pilots and ship's officers was also emphasized.

“The development of remote piloting into a safety-enhancing service requires careful and multidisciplinary development work”, the statement emphasized.

Finnpilot considered the addition of a temporary pilotage place to the law to be a good reform.

It could be problematic, if the Defence Forces released a foreign state ship from the obligation to use pilots. In Finnpilot's opinion, this would be the task of the Finnish Transport and Communications Agency.

The Finnish Ship's Officers' Union

In the statement of the Finnish Ship's Officers' Union, it was too early to reform the pilotage legislation.

“The reliability of the technology does not yet meet the practical requirements for remote control or pilotage needs in varying weather conditions. In those foreign ports where remote pilotage is possible, there have been special situations in these cases, mainly due to weather conditions. The pilotage has generally been short and devoid of similarly challenging archipelago conditions and other bottlenecks that exist in Finland.”

The Union emphasized that the data transmission between the piloted vessel and the land-based centre has not yet been achieved without delay. The pilot would have no real-time view of the actual conditions of the ship or immediate risks. The decision to manoeuvre could come late.

“In icy conditions, remote pilotage should not be allowed, even on an experimental basis or even in a limited area closed for other traffic. ”

The union wanted to exclude ships carrying dangerous goods from all experimentation. It pointed out that the responsibilities of the pilot and the master should not be increased in the experiment.

Traffic Law Association

The Traffic Law Association recalled that, although maritime traffic is international, there are no uniform definitions for the general remote pilotage - and this is also reflected in the explanatory memorandum to the proposal. The description of international organizations' descriptions would therefore require clarification.

The opinion suggested that the granting of remote pilotage licenses should be subject to adequate conditions of the arrangement the types of vessels, fairways, and parts of the fairway to be excluded. The opinion

considered whether the board should be entitled to change remote piloting to traditional after pilotage has already begun. Start of remote pilotage and the end should be clearly defined.

“The biggest risk of the experiment is based on the fact that the ship is missing the person who should be able to prevent the ship from grounding. The pilot is an additional external resource whose presence and expertise can in various tight situations be crucial for safety. There is no similar advantage in remote piloting,” the opinion said.

The Traffic Law Association wanted to extend the right to remote pilotage: “we would consider that all operators who meet the criteria set out in the proposed law would be entitled to engage in remote pilotage. " Such a company should have sufficient assets or insurance to cover any liability for damages.

The association proposed the implementation of a remote piloting experiment in connection with VTS centres.

Finnish Maritime Pilots' Association

In its opinion on the bill, the Pilots' Association emphasized that the remote pilotage experiment and the actual pilotage service is to be clearly distinguished.

“The experiment requires completely new solutions to be able to implement the desired activity reliably and safely. In addition to the pilotage company and its pilots, customers, and other stakeholders and decision makers also partake in the experiment. The conclusions of the experiment are the sum of many actors,” the association pointed out.

The Pilots' Association emphasized the importance of traditional maritime and navigational skills, but also training importance.

“The professionalism of the pilot is a significant enabler, but in the future attention must be paid to what is needed to ensure education and skills. "

The Association was concerned that pilotage would only take place on routes designated by authorities, and a significant portion of waters do not belong into this area.

"There are real examples of significant problems with maritime and environmental safety when the traffic occurs freely in Finnish waters and waterways. Operation of ships subject to pilotage in Finland without a qualification in accordance with the provisions of law shall be prevented."

Neste Corporation

In its statement, Neste Corporation considered it necessary to experiment with remote pilotage subject to a permit. The company believed that technological developments would make it possible to use this approach safely in the future.

The company was unsure about extending remote pilotage to tankers in the future due to security issues. "The technology that enables remote piloting is not yet well-enough tested and its use cannot yet be considered safe enough," Neste said.

The opinion expressed reservations about the use of remote pilotage on fairways used by tankers.

"Both aspects can be re-examined later when remote piloting practices are well-established and found to be reliable", said Neste.

Board of Education

The concise statement of the Board of Education suggested that "the application for a trial permit should also include a plan for new pilotage services to generate new and changed training needs".

Ministry of Defence

The Ministry of Defence considers it worthwhile to try remote piloting.

According to the Ministry, a provision had been added to the bill for the exemption of foreign state ships from the obligation to use a pilot. The proposal was finalized in collaboration with the Department of Defence.

The Ministry proposed that when the Defence Forces participate in supporting the manoeuvring of a foreign ship, the Defence Forces shall not be liable for any damage caused to the ship, nor shall the pilot. The master of the ship is always responsible for steering his ship, the ministry stressed.

Finnish Ports Association

The Finnish Ports Association supported remote piloting experiments and announced that the ports have shown interest to act as partners in the experiment.

According to the association, experiments should not be limited to easy routes: “Best experiences come from places of diverse transport and where the benefits and set goals are also identified in regard to remote piloting.”

According to the statement, the definition of pilot responsibility and the possibility of refusing to pilot remotely similar to traditional pilotage is justified. The master's right to refuse remote pilotage by the Ports Association would have to be clarified.

The association considers it a good choice not to try to define remote piloting precisely in a situation where through experiments, the utilization of different technologies is outlined.

SYKE

The Finnish Environment Institute SYKE pointed out that the Italian remote pilotage mentioned in the explanatory memorandum to the law cannot be compared with Finland, whose fairways are often lower, more complicated, and narrower. This must be considered when the experiment is extended further.

Exemption for the Defence Forces from the release of foreign government vessels, SYKE considered the pilotage obligation questionable at this stage of the experiments. The opinion recalled that even relatively large warships have taken part in the military exercises.

SYKE emphasized the need to ensure access to information and the transmission of correct information between the remote pilot and the remotely piloted vessel. The statement therefore noted the importance of testing different precautionary systems in the experiment.

SYKE wanted an interim reporting obligation for the licensee. SYKE needed more accurate provisions to evaluate the effects of the experiment.

TEM

The statement of the Ministry of Employment TEM stated that the description of personal and environmental related and assessment of the risks involved should play a key role in assessing the impact of the proposal. It should not describe the aims of the presentation.

The Ministry of Employment and the Economy estimates that enabling remote piloting could lead to new types in the future the entry of pilotage services into the market. The promotion of competition should therefore be considered. The proposal does not explicitly mention the possible emergence and market entry of new types of pilotage services.

The Ministry of Employment and the Economy considers the proposed amendment on the protection of privacy to be justified in order to clarify the situation.

Trafi

Trafi provided some clarifications to the proposal.

For the transfer of the temporary pilotage areas, Trafi wanted to add a provision based on which the permit would be granted.

In the proposal, the transfer would take place in cooperation with the Finnish Transport and Communications Agency and other parties' decision.

Trafi wanted to specify the provisions of the Pilot License so that the Pilot License must be valid.

The opinion also provided details of the competent court, the appeal, and the placement of articles.

Trafi also wanted to specify the provisions for revoking a remote pilotage license. Trafi was involved in preparing regulations.

Finnish Shipowners' Association

Finnish Shipowners' Association needed a presentation that would describe the structure of the experiment in more concrete terms - now we stayed on regulation of the permit application process alone.

“If the ultimate reason for this pilot project is Oy Suomi-Finland Ab's image building abroad as a pioneering country where all types of experimental activities are possible, this is only halfway there. This does not make Finland a leading country in digitalisation,” the Association stated.

According to the statement, the good thing about the presentation was the goal of encouraging the experimentation of new technologies, and through that pilotage development and security.

In the opinion of Finnish Shipowners' Association, the remote pilotage license should not have been granted as an exclusive right to Finnpilot Pilotage.

“It is not clear from the draft proposal who is responsible for the pilotage event in the event of a technical failure preventing the continuation or commencement of remote pilotage,” the Finnish Shipowners' Association stated.

According to the statement, a remote pilotage company should be required to acquire relevant information in remote pilotage insurance cover, at least one million EUR per claim.

The Finnish Communications Regulatory Authority (FICORA)

In its statement, FICORA referred to its previous statement on remote pilotage experiments.

The new statement was concise: “FICORA supports the proposal and welcomes the proposal's objective of remote pilotage's use to identify, among other things, what kind of data transmission connections are needed in remote pilotage and what technologies could be utilized in it. Starting remote pilotage with a license would mean that the Finnish Transport and Communications Agency ensures the conditions for safe remote piloting on a case-by-case basis before authorization for remote pilotage.”

Remote control was tested on the Suomenlinna II ferry in 2018. Experiences were gained in the experiment, e.g. regarding situational awareness transfer.

Photo: ©ABB

Lots of tests, lots of dreams, lots of development

There have been many hopes, especially for the digitalisation of shipping and, in particular for autonomous vessels in the mid-2010s. In the wildest dreams and in the most amazing videos autonomous ships would sail the world's seas on their own, guided from land or guided by artificial intelligence as early as the 2010s.

There was a lot of hype involved in digitalisation - over-expectations, advertising, marketing, but also real views. The hype also brought with it the media and with it the interest of people, a lot spectacular articles, great pictures.

The wildest dreams have not come true. Development has been slower than some, at least market-oriented speeches, made it to be.

However, development work has been done. A lot of steps have been taken. The steps have often looked small but have moved forward. According to many, the technical conditions for autonomous vessels and for remote pilotage are already ready. The main obstacle to implementation is the economy. Functional systems could be installed to ships already, but an investor cannot be found.

Finland is at the forefront of technological development in the world. Of course, significant development work has been done elsewhere, including Singapore and Norway. An autonomous ferry has been tested in Finland in the Turku archipelago and Helsinki city Transport ferry in Helsinki. The results have been promising, but they are not for commercial use yet. In Turku, the possibility of an intelligent traffic crossing for the Aura River was looked at.

Yara Birkeland, which runs autonomously in Norway, was supposed to come into service in 2020, but the project is postponed so far.

An interesting experiment is the Mayflower ship's voyage across the Atlantic. Artificial intelligence driven, about 15-meter-long ship is scheduled to pass from Plymouth, England to the United States. By the time the book was published, it was estimated that the ship will set sail in June.

The following are examples of experiments.

The world's first fully autonomous ferry trip was made in December 2018.

Photo: ©Finferries

Autonomous ferry experiment in 2018

Presumably the world's first fully autonomous ferry voyage was made in the Turku archipelago in December 2018. In collaboration with Finferries and Rolls-Royce, the ferry Falco made an autonomous voyage Between Pargas and Nauvo. It made the return trip remotely. About a hundred people took part in the trip.

Falco used Rolls-Royce Ship Intelligence technology and systems. It included sensors, cameras and radars. With the help of the autonomous navigation system, the vessel also berths on the pier.

A situational picture of the technical aids was also transmitted to Finferries' remote operations centre in Turku. There the master supervised the autonomous operation and was prepared to intervene in the control of the ship if necessary.

Falco is a 53.8-meter-long road ferry. It was operated from 1993 to 2017 between Parainen and Nauvo.

Finferries and Rolls-Royce had previously had a joint AAWA (Advanced Autonomous Waterborne Application) research project. It was continued with the SVAN (Safe Vessel with Autonomous Navigation) project.

Even before Falco, Finferries tested the world's first hybrid ferry Elektra between Parainen and Nauvo. In addition to electricity, Elektra, which has replaced Falco, operates with diesel in addition to electricity when needed.

According to Pasi Roos, Finnferries' safety and traffic director and project manager for the experiment, the experiences were very positive.

“The one-day demonstration went well and as expected, in some sections even better. The experiment was concerning navigation. The engine room

and other functions were excluded when there is no automation level such that it would be possible to operate without a crew. The crew was also involved in ensuring safety," Roos says.

Two masters were trained to operate the experiment. According to Roos, they successfully got the gist of the remote control – although the vibration of the ferry and the other sense of presence were absent.

Finnferries has no further plans to increase remote control and autonomy so far.

"We are now investing more in environmental friendliness and fuel economy, as well as on the electrical side. A couple more electric ferries are coming and there are our own development projects on the ferry side. We had good experiences with the Falco experiment regarding, for example, automatic berthing at the pier. For us, an important part of the service, especially in summer, is also advising tourists, and the crew is asked a lot of local advice."

Roos estimates that the sale of Rolls-Royce to Kongsberg and the transfer of operations to Norway may have slowed the spread of experiments.

"In the long run, technology will evolve, and components will become cheaper. Maybe it could be that some day we will move in the direction of automation", says Roos.

By remote control to Suomenlinna

In December 2018, the remote control of the Suomenlinna II ferry was tested in Helsinki between ABB and Helsinki Region Transport Authority (HSL). During the test run, the ferry captain controlled the ferry remotely from the Market Square temporary control centre. The remote control used the ABB Ability ™ Marine Pilot Control -system.

According to ABB, the system seeks technologies that improve efficiency and safety.

The test was carried out outside the ferry's operating hours and without passengers in an area where there were no other passenger ships. Remote control was used only in this test.

Remote control was tested on the Suomenlinna II ferry in 2018. ABB technology was used. The picture shows a view of the remote control centre. Photo: ©ABB

Suomenlinna II was built in 2004. It has an ABB Azipod® propulsion system. In the year before the test, ABB Ability ™ Marine Pilot Vision - situational awareness system was installed in it.

Learning in practice for ABB

From ABB 's point of view, the experiment with Suomenlinna II has been a good opportunity to test real-time remote control and technological conditions for situational awareness transfer.

“The experiment also found bottlenecks and learned things. We were able to make sure which ones are the working technologies,” says Kalevi Tervo from ABB.

ABB's system is still on the ferry. It has been tested from time to time, but it is not in active use.

“Devices collect data. They also allow us to test new technologies”, says Tervo.

The Suomenlinna II ferry was selected for the ABB test, partly because of the ABB propulsion system. It was good to design new technology around your own system. The system installation was not a big job: mainly cable pulling. It took about a week.

“The experiences were good, and the experiment has helped us strengthen the productization of the system. We have sold similar systems. For example, the port of Singapore is undergoing an autonomous remote tugboat project. Such technology can be clearly profitable and justified in certain segments,” says Tervo.

“Doesn't fit everywhere”

According to Lasse Heinonen, the captain of the ferry, Suomenlinna II is an extremely agile and a sensitive ferry to handle - but you have to be skilled at handling.

“The remote-control systems worked, but in this case, it remained a dream that the computer-based system would handle the ferry. On a larger and calmer ship, remote control may work well, but the ferry was not easy to handle. The test showed that sufficient technology exists, but it cannot be transferred to any ship,” says Heinonen.

According to him, Suomenlinna II is sensitive and has effective propulsions. It requires a considerably longer type training than, for example, the Suomenlinna service ferry Ehrensvärd.

“When you have the skills, Suomenlinna II is a terribly good ferry, but the handling is complicated. The hull of the ferry is sensitive and there is a delay in azipodes. In remote control, predictability became too difficult at least in the test.”

For the experiment, Suomenlinna II was equipped with versatile technology – Heinonen says that there was probably more technology and detection equipment in it than in the above-average warship.

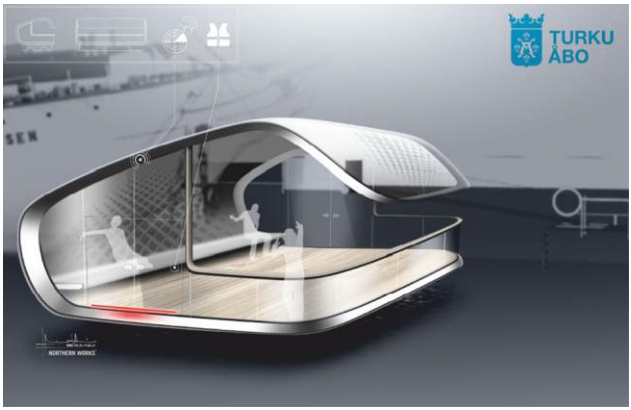
“The raft should be handled with a joystick. In practice, it went wherever even at the smallest steering movement.”

Technology companies praised the test results in their bulletins. Heinonen has a different view.

“As I told the media back then, at least I have to say that the development work will continue.”

Heinonen is somewhat sceptical about remote control.

“Who wants to let a ferry they own go somewhere so that there's no one there to monitor it? It is claimed that people are expensive, but million-dollar devices would rely on digital technology. What is remote guidance needed for at this stage, and who needs it”, Heinonen marvels.



Futuristic looking devices were planned for the Turku smart ferry project. Photo: ©Northern Works

The smart ferry was tested out in Turku

In Turku, the possibilities of a smart ferry were explored. The project was completed in the summer of 2020.

The smart ferry would be an autonomous river ferry crossing the Aura River. The project sought to create knowledge that would make it possible to acquire a ferry. The ferry was justified for several reasons: the city wants to condense the urban structure downstream of the Aura River, a new bridge would not be possible, and a tunnel would be too expensive. The ferries in Turku have a long history of crossing the Aura River, and the smart ferry would bring with it a round-the-clock and annual traffic.

The smart ferry was estimated to offer several benefits, but building the whole entity might have been more difficult than evaluated, and at least

Sensor technology was tested on the ferry together with Brighthouse Intelligence Oy and Åbo Akademi. Photo: © Turun kaupunki.

still required a lot of clarification. Ferry navigation sensors, communications, and cybersecurity require development. If there were no crew in the ferry, passenger safety would have to be ensured in some way. In emergencies, you should be able to ensure the right kind of actions of the people on board. The sensors must operate in icy drizzle and snowfall. The ferry must be able to operate in moderately thick ice as well.

The idea was to install video cameras and sensors required by the autonomous ferry in and around the current ferry.

"The city did not continue the project after August 2020. The idea of the smart ferry was spun for several years. Research and initial investment would have been reasonably large, but after that, the transport would have been affordable. The thought as such was very good, and a city that implements such a thing has a huge competitive advantage," says project manager Jakke Mäkelä.

During the smart ferry research, some research has been done on the topic, and product and service concepts were devised.

Yara Birkeland was built in Romania and brought to Norway to be equipped and tested in the spring of 2020

Photo: ©Yara International ASA

The Norwegian autonomous vessel will be delayed

Norway is trying to get an autonomous ship into service. Originally, Yara Birkeland was supposed to be in use already in 2020, but the project has been delayed. Development work was suspended in May 2020. The reported reason was the Covid pandemic.

The Yara Birkeland is set to be the world's first unmanned, autonomous cargo ship. It transports fertilizers from the Porsgrunn plant to the export ports of Larvik and Brevik. The length of the trip is 31 nautical miles. The project also includes the automation of port operations. In the initial stage, the board has crew, but the goal is a completely unmanned operation.

The project began in 2017 when fertilizer company Yara and technology company Kongsberg decided to build the world's first autonomous and zero-emission cargo ship. The vessel would reimburse 40,000 truck journeys a year, would reduce emissions and improve road safety.

The battery powered Yara Birkeland is 80 meters long and 13 meters wide. It was lowered into the waters in Romania in February 2020. From there it was transferred to the Vard Brattvåg shipyard in Norway, where control and navigation systems were installed into it. The ship was tested in the winter of 2020.

The project has been delayed from the original schedule. Autonomous land logistics in particular have been challenging. The construction of steering and navigation systems has also been delayed.

Yara's goal remains to complete the project and bring the zero-emission vessel into commercial use. Different ownership models and partnerships are still being evaluated in terms of operations and commercialization.

An autonomous journey across the Atlantic – artificial intelligence as a captain

The autonomous, unmanned vessel was scheduled to cross the Atlantic in the summer of 2021. The vessel is called The Mayflower Autonomous Ship MAS. The ship's predecessor was also Mayflower – it carried pilgrims from Plymouth, England to America in 1620. This time, the captain's duties would be performed by artificial intelligence.

The ship was due to leave Plymouth, England in mid-April, but departure was delayed. When this book went into printing, the departure was expected to take place in June 2021.

The new Mayflower was launched in the fall of 2020. It was tested almost a year before crossing the Atlantic.

The design of the ship took five years. There were teams from ten countries in the development work. Main responsibility for the project was held by ProMare and IBM. The ship was to celebrae the 400th anniversary of the original Mayflower in 2020.

During his voyage, Mayflower primarily collects information about the state of the sea. It is believed to bring knowledge to the research and development of autonomous vessels. The MAS project is hoped to bring knowledge to the questions of climate warming, ocean microplastics and the protection of marine mammals.

The first Mayflower transported 102 pilgrims from England to the new continent in 1620. They established the first permanent colony, Plymouth, in New England.

Mayflower was tested off the coast of England in April of 2021.
Photo: ©Promare/IBM.

Information about the ship can be found at https://mas400.com. The project also reports its results in numerous social media outlets.

Wärtsilä technology

Wärtsilä is involved in the Mayflower project as part of a global consortium of technology companies.

When navigating across the Atlantic, Mayflower uses IBM artificial intelligence and cloud solutions as well as edge computing, Red Hat Open Source solutions and server expertise. The ship identifies environmental events by using machine vision, radar systems and numerous sensors transmitted data. An artificial intelligence developed by IBM, AI Captain, is able to make the necessary changes to the course independently. The core of the AI Captain is Wärtsilä's high-speed, high-resolution RS24 radar system, combined with cameras and AIS and navigation systems.

The Mayflower is a 15-meter-long, 6.2-meter-wide three-hull vessel. The weight is 5 tons. The basis is built of aluminium and composite materials. It has lithium-ion batteries and solar panels to use motors and computers. The Mayflower has two 20 kW electric motors. The freight can hold 700 kilos - there is scientific equipment on board going across the Atlantic.

Because of its agility, the Mayflower benefits from a fast-reacting short-range radar that helps the vessel detect and avoid obstacles. Wärtsilä's RS24 radar is designed to work exactly in an environment like this and plays a key role in securing Mayflower's journey.

Forecast: Autonomy is everyday life in 2040

Predicting the future is difficult - including shipping. It has been shown by the wildest autonomy dreams in the early 2010s.

One forecast of the autonomous vessels was made by Iiro Lindborg, a founding member of Groke Technologies in the World of Technology magazine in the spring of 2020. Lindborg previously worked for Rolls-Royce as Director of Development of Remote and Autonomous Ships in Maritime Operations.

Lindborg estimates that in 2025, existing vessels will benefit from new types of situational picture systems and automatic collision avoidance systems to aid navigation. Critical systems for autonomous vessels are there to assist the crew. During long voyages on the high seas, they may allow the bridge to be unmanned, and the responsibility for control and monitoring lies with the computer, which is supported by remote monitoring and control from land.

In 2035, the breakthrough in autonomy will accelerate as there begins to be problems with crew availability. Half of new vessels will be built so that they can be operated autonomously, and the rest will be ready for autonomy. Shipping companies charter vessels as a whole, no longer owning them. Responsibility control of autonomous vessels is the responsibility of service providers.

In 2040, autonomy will already be commonplace, and most ships will be autonomous. Ferry traffic is autonomous. At the same time, road congestion is alleviated when freight is transported in inland waterways on autonomous ships. Man performs expert and supervisory tasks. Emissions from autonomous vessels are zero.

Photo: ©Luotsiliitto/Matti Elomaa

Remote piloting and digitalisation are being explored in many projects

There are several ongoing projects in Finland related to the digitalisation of shipping, autonomous shipping and for remote pilotage as well. Some of them are mentioned here.

The One Sea ecosystem began operations in 2016. It involves the shipping and IT industries experts. Its goal is to develop an ecosystem of autonomous ships.

The mission of the Sea4Value project is to create models for the digitalisation of maritime transport and the flow of information that support existing vessels and prepare autonomous shipping. It produces research-based recommendations for business, regulation, data use and sharing, and standardization. The program aims in particular to produce experiments. Sea4Value operates under DIMECC.

Satakunta University of Applied Sciences' SAMK Istlab test laboratory (Intelligent Shipping Technology Test Laboratory) is an intelligent maritime research environment. A special target area is the Port of Rauma and the smart fairway leading there. As part of it, a rough prototype of a remote piloting point was created in 2019. The simulator is supplied by Wärtsilä.

MasterSim is a Novian/Aboa Mare simulator development project. Its purpose is to create into the existing a remote operating environment to be connected to a ship simulator. The project has already produced descriptions of various types of remote piloting steps. MasterSim is looking for solutions for remote control of ships. The project will end in June 2021.

The AAWA project was the first to explore autonomous shipping. It operated from 2015-2017. The Tekes-funded project involved universities, research institutes and companies. The project planned and developed the technology of an autonomous, unmanned ship.

The RAAS project brings together two hundred researchers and twenty universities and polytechnics to study opportunities for autonomous systems. The research and development project explores autonomy in maritime transport, as well as including other modes of transport and remotely operated machinery.

In Finland, the development of the smart way is also being actively studied.

Finnpilot is involved in One Sea, Sea for Value, ISTLAB and MasterSIM.

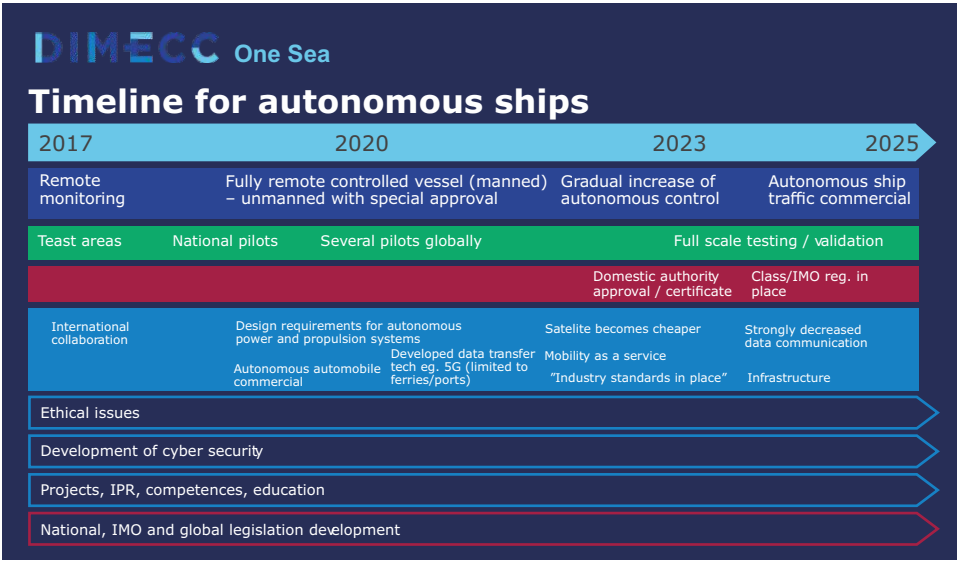
In addition to the projects presented here, companies naturally have their own, even large projects. Many companies are also involved in international and global development projects.

New projects are also pending.

One Sea ecosystem

One Sea Autonomous Maritime Ecosystem aims to develop the world's first autonomous marine ecosystem. It is a strategic research, digital solutions and business coalition. Founded in 2016, the project involves experts from the maritime and IT fields. The original goal was that autonomous commercial maritime transport could begin by 2025. The project aims to increase autonomous technologies to improve the safety of maritime transport, new commercial opportunities and to reduce the environmental footprint.

One Sea's founding members are ABB, Cargotec, Ericsson, Meyer Turku, Rolls-Royce, Tieto and Wärtsilä. The Maritime Industry Association acts



One Sea ecosystem defined the timeline of autonomous ships. Photo: ©One sea.

as a sponsor and Tekes as a financier. One Sea is led by DIMECC (Digital, Internet, Materials & Engineering Co-Creation). In 2019, the leading actors of global seafaring, Inmarsat, MTI and the Royal Institution of Naval Architects joined.

One Sea is one part of the digitalisation of shipping. The companies involved have been working for a long time to develop products, services and solutions that enable autonomous transport.

The project's aim is to ensure Finland's leading position in the development and utilisation of smart and autonomous maritime transport solutions.

The task groups have been active since 2018.

In 2020-2021, One Sea will fully clarify the operation of remotely operated, manned vessels. In the following years, autonomous control is to be gradually increased. According to current ideas, autonomous commercial shipping could start in 2025. Pilot projects will be implemented in the early 2020s, and around 2023, full-scale testing could be achieved.

In 2017-2025, numerous technical conditions for autonomous vessels will also be continuously developed. The ecosystem also considers ethical considerations, cybersecurity, education, and national and international law.

Päivi Haikkola:

The gaze turned to the world

When the One Sea program was launched in 2016, the idea was to develop maritime to the needs of Finland and the Baltic Sea.

“We were very Finland-centric, but suddenly it was noticed that there are new markets for the marine side everywhere, not just in one corner of the world. After that, we started to have a stronger influence in international organizations, and over the years they have increased in importance,” says Päivi Haikkola, Director of One Sea.

Another big change in the past five years has been that at the start the videos on display which some even described as sci-fi videos were on display in the beginning of marketing materials.

“That's when we were visualizing strongly when thinking about what this new thing would be, and immediately jumped really far. Now that the work on maritime autonomy has really been done, we have progressed step by step and product by product. The aim is to increase safety on board ships and in ports.”

She describes the vision as changing very radically. Work is more drilling, maybe not so fun but realistic. At the same time, the members of One Sea involved have become strongly internationalized.

The enthusiasm of the early years can also be seen in the road map at the time. According to Haikkola, you can see it as funny now, but she emphasizes that One Sea is on schedule for that.

“We will see when autonomous ships are in traffic, but preparations, environmental factors and testing are part of the road map, and in many ways, we are even ahead of schedule. For example, several tests have been performed years earlier than originally assumed. ”

There is no need for a test area

The Jaakonmeri test area initially raised high hopes. It was set to be the area where tests and demonstrations were carried out on large ships.

“Bringing in a big ship would have taken a couple of weeks, testing a couple of weeks and the return a couple of weeks. Costs would have been shocking. Now we think that the solutions can be tested in normal operation. Autonomous solutions, remote control and remote piloting are added alongside the traditional ones and the captain is ready to take control – then we are going by the rules. Tests can be done among traffic and the anticipated need of the test area did not materialize eventually, at least on the expected scale”, Haikkola says.

According to One Sea's original goal, by 2025, autonomous ships would start operating.

“It still seems reasonably likely that this could happen. It doesn't matter who does it, our members or someone else. There are already small, archipelago ferry-type solutions in use in some countries. There are also existing solutions on the tug side.”

Haikkola reminds that autonomous traffic will be introduced gradually. When the life cycle of the ship is 20, even 60 years, change is slow.

In Norway, the autonomous Yara Birkeland was supposed to be already in use, but the project has been significantly delayed. According to Haikkola, the experts saw at the outset that the timetable was unrealistic: the shipyards did not simply have the capacity to build a ship. In addition, the ship was ordered by the company Yara – a fertilizer company that does not have experience nor understanding of the amount of work required.

“In Norway, the official procedure may not have been as smooth as in Finland. Approval processes have been protracted. For operation, three networks were reached – two land networks and a satellite network. Building network infrastructure costs a shameless amount. Such requirements slow down the process.”

According to Haikkola, traditional shipping companies have not been as interested in autonomous vessels; there has been more interest from non-traditional actors. The reason is at least that the economic situation of the current shipping companies does not provide opportunities for new solutions. Development may be slowed down by the lack of knowledge of interested parties when it comes to the ship building process.

Finland's strength

The Americans have asked Finns many times why their maritime transport autonomy drags behind when compared to Finland. Sure, the U.S. Navy is well on its way, but commercial solutions are advancing slowly.

“In Finland, co-operation between the authorities and industrial actors is going well. Finland’s great strength is that everyone is collaborating, and new solutions can be brought in quickly. It is, of course, important for the industry that the solutions are secure. If a single accident occurs, the development will easily stand for 30 years. We have wanted to ensure that there is a direct conversation connection and a strong team spirit,” says Haikkola.

One important thing for the development of remote pilotage is that the legislative side of it was done first and it was also prepared in co-operation.

“We have been strongly goal-oriented in Finland. We see that Finland has the opportunity to be at the forefront of maritime development and we are working to make it so.”

S4V creates capabilities

DIMECC's Sea for Value program (S4V) creates capabilities for automated maritime traffic. It develops new types of services and data flows and creates capabilities for autonomous operations and navigation. The program produces research-based recommendations related to standardization, business, regulation and access to and sharing of data. There are several projects in the program – the first of which is Fairway, which focuses on remote piloting and the development of fairway services.

Sea for Value began in February 2020 and will end at the end of 2022.

In terms of pilotage, new technologies may enable new pilotage services.

“Our goal is to illustrate and test things that are important milestones on the way to smart and autonomous maritime traffic. It is great that DIMECC programs are developing technologies which are central to the One Sea ecosystem's roadmap towards maritime autonomy”, said Finnpilot Pilotage's Director of Pilotage Sanna Sonninen in a press release in February 2020 from Finnpilot's online service.

According to Finnpilot's 2019 annual report, Finnpilot pursues risk analyses concerning remote pilotage and the possibility to test new data transmission technologies with the project.

In Finland, it is believed that the market for smart autonomous maritime transport technology is growing internationally, and it can create economic growth and jobs in Finland. With the program it is intended to develop smart and autonomous services and products. The environment benefits from it as well when efficiency increases and emissions decrease.

S4V's goals are safer, more efficient, and more sustainable maritime transport.

The first project involved industrial partners Awake.ai, Brighthouse Intelligence, Finnpilot Pilotage, Ericsson, Meyer Turku and Tieto. The research is carried out by Aalto University, Tampere, Universities of Jyväskylä and Turku and Novia University of Applied Sciences. Transport and communications authority (FICORA), Finnish Railways, Finnish Border Guard, ESL Shipping, Neste, Finnish Meteorological Institute, Finnpilot Pilotage, Finnish Shipowners' Association, Ports of Rauma, Turku and Helsinki and Business Finland are also involved.

The Fairway project is funded by Business Finland and industrial partners.

Seppo Tikkanen:

Shared interest

The Sea for Value project (S4V) involves more than 20 actors.

“All the organizations involved have an interest in doing things. Everyone develops things together, but also for themselves, and through this a whole is formed. We develop the basics. They are being tried, and at some point we get to try remote piloting of a ship on the fairway,” says Program Manager Seppo Tikkanen from DIMECC.

In his opinion, Finland's advantage and strength is that development is often based on a society of trust.

“When we do things, they don't have to be done through an agreement tuned by lawyers. This, of course, applies to other projects as well, not just shipping. Sea for Value helps and serves the organizations involved in their own tasks. Everyone knows you can't do things alone. We can trust other partners and the cooperation works, ”says Tikkanen.

By working together, you can learn what should be done right, which is OK. For example, Brighthouse is developing a sensor station, making for itself a platform on which to develop the product. However, the development work is done jointly as part of the project. Similarly, Awake develops ship-related applications; the company's goal is to sell a product, but working together brings benefits. The authorities also have an interest in the joint project: they learn what are relevant things and what are not. Research institutes and universities have access to projects so they can develop and apply their own knowledge and explore new ones.

Tikkanen emphasizes that it is a great advantage in the development of remote piloting that legislation has been developed in a front-loaded way. It allows companies to have a desire to invest in development, at least when there is no law as an obstacle.

According to Tikkanen, things are developing gradually in maritime development and remote piloting.

“There are many things about autonomy. Even if it were a goal, we would not suddenly move on to it, but step by step and in a longer arc.”

According to Tikkanen, a good analogy is the car's windshield wipers. The first versions were moved by hand. The automation came gradually: first the wipers were put on the switch, then their speed was able to be adjusted. Current systems detects rain, and can adjust the sweep speed with a function involving driving speed and rainfall. New functions were added one at a time. Tikkanen estimates that this will also happen in the development of autonomous maritime traffic and remote pilotage - step by step, when it is economically sensible and sufficiently useful. However, not everything is measured in money; security is one important aspect as well.

Tikkanen emphasizes that, for example, the smart fairway is by no means an unambiguous concept. There are different levels and sub-levels of

automation used in airports. These determine in what kind of weather the plane can land. A similar breakdown could perhaps be applied to the fairways. Not all fairways will ever become smart: some will remain as basic routes in the future too, some have some level of smart features and some might have everything possible available.

The Sea for value project will end in January 2022, when Business Finland's 2-year funding ends.

“A lot of things are still going on then. Let's see how and what things go on. Some continue in companies and some in research institutes. Discussion has begun on how to proceed with this project. We will definitely have something similar and something different. The continuation also depends in part on the companies, and of course the opinion of the financier. At this point, I believe that we are moving forward in some form - it is still difficult to say about the volume.”

DIMECC

DIMECC Oy is a Finnish innovation platform, the purpose of which is to combine the best in industry and research competence. It is owned by leading companies and research institutes. It involves more than 400 organizations and 2000 people.

Under DIMECC, three ecosystems will operate in the spring of 2021, including the One Sea Autonomous Maritime System. There are four ongoing programs and projects. Among them, Sea4Value – Fairway is related to shipping.

Remote control options are tested at the Istlab laboratory.

Photo: ©Janne Lehtonen

Istlab is a smart transport technology laboratory

Satakunta University of Applied Sciences' SAMK's Istlab is a smart transport technology test laboratory. There, among other things, remote piloting is simulated. The project develops smart maritime research. Istlab is located on the premises of Rauma Maritime School. SAMK has the main responsibility and the co-implementers are the Finnish Meteorological Institute and Spatial Information Center of the National Land Survey of Finland. Traficom, Fairway Agency, Finnpilot Pilotage Oy, Port of Rauman, Wärtsilä Finland Oy/Wärtsilä Voyage Solutions, VTS Finland and WinNova West Coast Education Ltd are also involved.

Istlab comes from the words Intelligent Shipping Technology Test Laboratory.

The remote pilotage station RPS of the Istlab enables versatile simulation of remote piloting as well as voice communication and data transmission between the remote pilot station and the vessel to be piloted.

According to Istlab's website, the project is based on the development of smart waterways, smart ports, the gradual introduction of remote pilotage and remote-controlled and independent vessels in the coming years and decades. The change is predicted to cause a revolution in the entire maritime cluster. Shipping actors need research information on evolving technologies. The need for highly educated and skilled staff is also growing.

The test laboratory Istlab combines the polytechnic's navigation simulator and innovation environment. The project was originally intended to provide a remote-controlled or autonomous test vessel, but it has been abandoned.

One part of the project is the remote pilotage station (RPS) included in the simulator, which can be used to simulate remote pilotage and to test and develop voice communication and data transmission between RPS and the remotely piloted vessel.

Istlab thinks remote piloting may be the first commercial breakthrough technology. The need is global, as is the financial incentive. Remote piloting is considered and developed in many ways. Part of the study considers the interaction between the pilot and the ship, part looks at the traffic situation as a whole. Some studies consider the fairway structure as a producer of situational information.

The simulator system also includes an autonomous vessel remote monitoring and control unit (MCU). With that the ship device measurement data is collected and stored in real time and presented to the user. The laboratory also includes equipment for analysing the user interface and user functions of the MCU and RPS.

The project also provides a unique platform for the development of intelligent shipping on a global scale. It makes research into new and intelligent maritime solutions possible. It can also simulate varying conditions and identify needs for further development. Istlab also enables the production of scientific publications and studies. One part is also developing curricula for future needs.

The Naval Academy has five bridge simulators. One of them is the bigger 360 degree bridge. Laboratory Experts from SAMK and Wärtsilä Voyage Solutions have been responsible for the design and construction

The laboratory has a centralized Monitoring and Control unit (MCU) and Remote Pilotage Unit RPU. From them, operators see real-time information. The simulators also partially include Rauma deep-water map material.

So far, it has been studied, among other things, what the pilot's gaze is on at the remote pilot station as well as what and in what form the data would be most optimal to be available. Rauma is also considering what kind of skills are needed on board to make remote piloting safe.

Communication standards are also issues to be clarified. In the early stages, the communication between the remote pilot station and bridge was handled over a VHF connection. Communication could take place in other ways than by voice - even by combining voice and visual communication. It will also be clarified whether the pilot could send a message on the ECDIS display of the piloted vessel drawing attention to the point of interest.

Meri-Maija Marva:

The Hype died down, but development accelerated

The history of Istlab began in 2017. At that time, in Finland - and the rest of the world – the hype for autonomous ships was still strong. At Satakunta University of Applied Sciences, they were also considering and processing the future of shipping. The beginning of the project was the sum of many things.

“The factories of the then Rolls-Royce, now Kongsberg, are about 500 meters away from us, and we had been co-operating for a long time. We learned that Traficom is intellectualizing the Rauma deep fairway. At the same time, there were reports of the Jaakonmeri test area which is 10 nautical miles away. The Rauma shipyard had already been renovated,

and we have a very interactive relationship with them. Rauma Harbor and the harbour basin are 300 meters away. Our view was that all the key factors are close by and we need to hop on to the maritime development. It did not make sense for the University of Applied Sciences to wait for others to develop a new normal and then we wpuld jump in 10 years from now," says Istlab's project manager Meri-Maija Marva from the Satakunnan University of Applied Sciences SAMK.

It was important for the educational institution to understand how the new knowledge was born and to export it as much as possible and as quickly as possible to teaching processes.

SAMK had already submitted an application for funding when the world began to change. Rolls-Royce was sold to Kongsberg, Wärtsilä acquired SAMK's long-term partner Transas. SAMK contacted Wärtsilä and expressed its interest in having a test laboratory at the simulation centre and shared other learning development ideas. Wärtsilä became interested.

"We started wondering if there could be others involved. Condition information was, of course, important, and the Finnish Meteorological Institute was excited. Spatial data is needed, and the National Land Survey of Finland's Spatial Data Center came along, and through that we got in-depth knowledge of cybersecurity as well. The three subcontractors set out to take the matter forward," Marva recalls.

Information about the project spread, Väylä joined, then VTS Finland, and Finnpilot Pilotage too. The matter was further considered, research problems were considered, and through science and dissertations, Aalto University was also involved – a little to the outer perimeter, Marva says, but included, nonetheless.

The Rauma shipyard also expressed its interest, and the Finnish Border Guard and the Defense Forces. Istlab kept them aware of what they were doing.

The project also aroused worldwide interest. According to Marva, only Singapore has a similar project, but there the sea conditions are quite different.

“Perhaps what is unique is that maritime substance experts, real in-depth experts, are involved. Workshops have seen a lot of enthusiasm. They are marked by the fact that we are on the verge of something new and there are no answers, but we find them ourselves. I think we are going in the right direction, and that will probably create interest toward us,” Marva thinks.

In her opinion, the project has progressed practically, humbly and through mundane doing, but it has found something new.

Changes have taken place over the years. The original idea was to get a miniature ship to be steered remotely. But then came the idea that in the development of shipping, ships come last. Their construction is a matter for shipping companies, but before an autonomous vessel can pass, all the infrastructure must be ready. Planning for the acquisition of the miniature vessel was abandoned.

“SAMK's core mission is to increase the skills and future of seafarers, and we cannot take care if we are not involved in development projects,” says Marva.

MasterSIM clarifies remote access

The digitalisation of shipping is also being considered in the Novia University of Applied Sciences' MasterSIM project.

The research and development project aims to meet the needs brought by the digitalisation of shipping. The project clarifies the requirements of autonomous maritime trends, in particular the remote operation of vessels. The project is coordinated by Novia UAS.

The project will develop the Aboa Mare remote access centre Amocia. Amoc works for remote access to the vessel as a training and research platform. It connects to the Aboa Mare simulator and training environment. In the future, it is expected to be able to receive data from real ships for research and for testing. Amoc simulates remote real-life operations of ships for both normal operation and during emergencies.

The aim of the project is also to make a remote access concept and a preliminary training plan for remote centre employees.

The MasterSIM project is primarily funded by the Ministry of Education. Other financiers are Novia University of Applied Sciences, Kongsberg Marine Finland Oy, Finnpilot Oy and Finnferries Oy.

Smart fairways clarified since 2016

One of the prerequisites for autonomous maritime transport and remote pilotage is improved and up-to-date fairways getting information from fairways. The Fairway Agency launched the first part of the Maritime Smart fairways project in 2016.

The three-year digitization project investigated, among other things, the production of fairway data, information maintenance and distribution. There were six subprojects, one of which was the maritime smart fairway. There were about 70 different projects within the project. In addition to shipping, other modes of transport were also involved.

One premise was that the predictability of fairway maintenance needs to be improved. That will be achieved with continuous data collection, advanced telecommunications connections and the development of information systems. The project aimed to develop digital tools and processes.

The project aimed to increase competence and productivity.

The Maritime Smart fairway project developed information products and services that are important for navigation. The aim was to make the information needed for navigation available to ships as far as possible through automated processes.

Efforts were made to improve navigation and pilotage by developing depth models and water level data, researching marine data and remote control of safety devices, and testing products in experimental environments.

The study sought efficiency and safety. Efficiency would be increased in route planning and navigation with more comprehensive and reliable

data. When information on depth ratios and water levels is reliable, cargo volumes can be optimized. Safety is improved by basing navigation data on internationally recognized standards, which facilitates the use of data. The smart fairway makes navigation easier in different conditions, which in turn reduces the risk of grounding and collisions.

The smart fairway survey includes several sea lanes across the coast, and from 2020 also Saimaa. A vessel approaching the smart fairway will receive up-to-date information on weather and water level and a seabed model directly to bridge systems. Smart fairway safety devices adapt to conditions and traffic needs.

The experiment will test real-time situational pictures and digital services of vessels and traffic management systems. The goal is better navigation and better pilotage.

There are several projects in the experiment. They explain the transition to the N2000 altitude system, dynamic reserve water management, maritime safety data sheets, depth model, water level and sea conditions data, remote management of safety equipment and ship and ECDIS piloting. The digital Saimaa channel is also included in the projects.

The goal is to increase efficiency and safety. The smart fairway for route planning and navigation has more comprehensive, diverse and reliable data available. Reliable information on depth ratios and water level makes it possible to optimize cargo volumes and increase transport efficiency. When data and data transfer are based on internationally known standards, data utilization becomes easier. It also makes it easier for ships to navigate the fairways in different conditions – risk of grounding and collisions decrease.

eFairway promotes intelligent transport

VTS Finland's eFairway project is developing a more comprehensive digital situational picture of automated maritime transport. The aim is the efficient and real-time movement of data between ships, between ports and port operators, and at the same time more efficient, smoother, and safer maritime transport. The aim is also to better link maritime transport with other modes of transport.

With the eFairway project, VTS Finland wants a clearer role than before as an information exchange platform, as a provider of information services and a better picture of the situation.

The snapshot consists of the vessel's more accurate position and movement factors, other traffic, operational deviations, real-time condition information and the status of safety devices. For the remote pilot operator, it offers a low threshold for the transition to digital services.

It is intended that up-to-date arrival and departure data for merchant ships in 2021 will be published as a eFairway service. The service will be developed over several years.

AAWA clarified autonomous shipping

One of the first and largest projects investigating autonomous shipping was the in 2015-2017 implemented AAWA (Advanced Autonomous Waterborne Applications) project. The project was funded by Tekes (Centre for Advancement of Technology), and involved universities, research institutes and companies.

The purpose of the project was to design and develop the technology for an autonomous, unmanned ship.

AAWA investigated location information and autonomous navigation technologies, regulatory requirements, and security. Additionally, it investigated he entry of innovations into the market – and the redefinition of shipping was clarified.

Researchers at AAWA at the time estimated that autonomous processes would be put into commercial use within 2-3 years. The project estimates that the pace of technological development in the 2010s, there would be a vessel in use with a smaller crew with some autonomous features in 2020. In 2030 an unmanned and remotely piloted offshore vessel would be available for the experiment. Fully independent, autonomous and an unmanned offshore vessel would be in service by 2035.

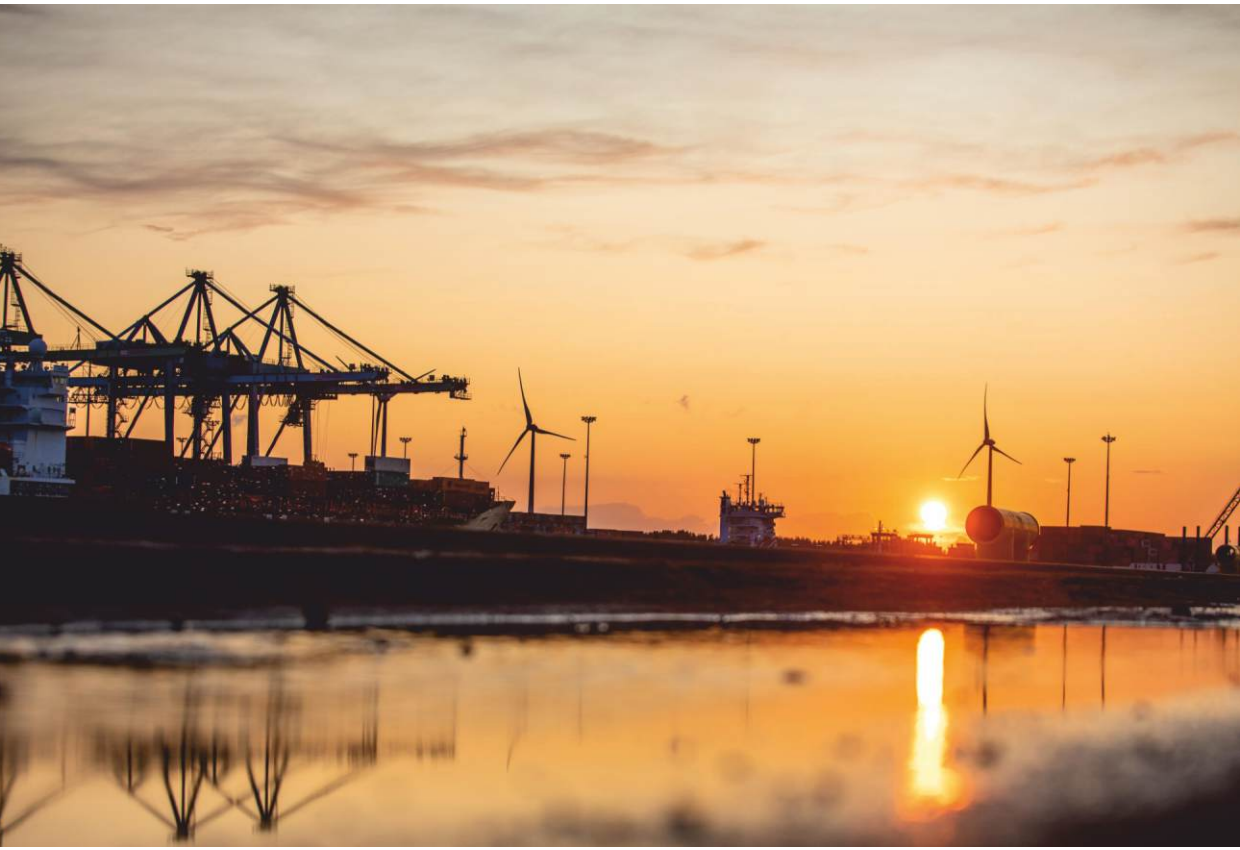
RAAS clarifies autonomous systems

One of the Finnish projects related to autonomous shipping is RAAS. It is autonomous systems and security research and development project. More than 200 researchers out of 20 organizations are involved, mainly universities and polytechnics. There are ten international partners, including Sweden, Norway, Estonia and South Korea.

RAAS provides access to information, collaborative networks and research and development services. It clarifies the operation of autonomous systems not only for maritime transport and ports but also between cities and in internal transport and in rural areas. Unmanned air, water, land and space systems are of interest to RAAS as well. RAAS also explores the usage of natural resources with the help of remote and autonomous systems.

According to RAAS, autonomous systems offer better efficiency and safety as well as new business opportunities. They enable seamless logistics chains, and the reduction of energy consumption and environmental impact, as well as hazardous work. In addition to autonomous systems, the study involves semi-autonomous, intelligent-assisted and remote-controlled automated systems.

The main goal of the RAAS consortium is to promote research in autonomous transport and logistics globally on the market.



One-fifth of Finnish ports are making investments related to digitalisation.
Photo: ©HaminaKotka Satama Oy

Ports are preparing for digitalisation

Finnish ports are beginning to prepare for the digitalisation of traffic and are investing heavily in operations development in 2021-2025. The ports estimate that they will invest more than one billion euros in five years. The amount is 17 percent higher than the investments in 2016-2020. Some ports begin building digital capabilities.

The figures can be found in the Finnish and Communications Agency's Traficom's port investment report.

About 20 per cent of port authorities also stated that they would make investments related to digitalisation. All ports planning to invest over 10 million euros will also invest in digitalisation for the next 2-3 years. There are 15 of these ports.

According to Traficom, digitization projects are also a significant opening for smart ports and digitalisation in shipping.

International cooperation

Finland is involved in international co-operation in the development of autonomous vessels and port operations and their merging. In addition to Finland, the MASSPorts project involves Denmark, Norway, the Netherlands, Japan, China, Korea, and Singapore. The project was launched in August 2020. The international Maritime Organization IMO was also involved, as well as the International Lighthouse Association IALA and the International Union of Ports IAPH.

The aim of cooperation shall be to improve the exchange of information and experience between the participating countries and between

organizations. The idea is to make concrete pilot runs that promote the standardization and interoperability of autonomous vessels and port traffic. The aim is to also develop the international agreements of IMO. The key standardization concerns communication between ports and autonomous vessels.

Finland is pushing for multimodal solutions and a legal framework that allows the development of technology internationally and future innovation. In Finland's view, the deployment of smart systems and clear responsibilities for automated transport and operational and safety assessment transparency is important.

Finland is one of the world's leading countries in introducing new technology into shipping. The aim is to influence international development through the network.

Fast, safe and green digital ports

Smart ports are part of DIMECC's One Sea program. In March 2021, the SMARTER project was launched (Smart Terminals). It will create the capacity for smart and self-guided maritime transport. The project digitizes port operations and produces easily reproducible solutions for freight passenger terminals. Ports link maritime transport to other modes of transport and are a central part of the transport chain.

The aim of the project is to raise the level of digitalisation throughout the transport chain. Combining particles and data sharing improves the whole chain of automation, efficiency, and environmental friendliness. When, for example the exact time of arrival of the ship is known in real time, the trucks can schedule their arrival and route correctly and the cargo is unloaded and loaded quickly.

The ports of Helsinki and Turku are included in the program. Their traffic passes through cities. The project allows traffic flows to be managed safely and smoothly.

From the point of view of passenger traffic, safety, such as safe distances, can be improved quickly in exceptional circumstances as well. SMARTER is the second project of the Sea for Value (S4V) program. The first project was Fairway focusing on fairway and remote pilotage launched in 2020.

DigiPort was looking for digital solutions

The impact of digitalisation on ports was investigated in the Merikotka DigiPort project in 2018-2019. The project looked for solutions that improve fluency, performance, safety and comfort at work. In terms of ports, solutions that did not require large investments were sought.

The final evaluation of the project considered the implementation of the project and its social impact through four perspectives: open data awareness and knowledge, the impact of research data on ports digital development, data opening and publishing, and open data-based port innovations.

As a result of the development work, the data platform datasatama.fi was created in Xamk. The information was obtained from the infra databases opened by Hamina, Kotka and Turku ports. According to the project, the emergence of a new operating model and the infrastructure opening will allow application developers to develop fluency, performance, security and environmentally friendly digital services for ports.

Digital innovations were discussed at an event held in the spring of 2019 in Kotka. Twenty students took part in the discussions.

Suvi-Tuuli Lappalainen:
Ports worried about berthing operation

From the port's point of view, the main concern in remote piloting is berthing operations, says Development Manager Suvi-Tuuli Lappalainen from the port of HaminaKotka. She is a sea captain (master of higher education) and Master of Science in Chemical Engineering.

“When a ship enters a port, VHF work between the ship, the pilot, the tug and the crew is high art. It is active and intense when it comes to communicating meters, being aware of cranes. The conversation is about many things. It requires the eyes and ears of the pilot, tug and linesmen. How is it done in remote piloting if the pilot's eyes and ears are left out,” says Lappalainen.

When a container ship enters a port, the stern or bow of the ship may be hitting a crane.

“It needs to be seen visually and communication needs to happen immediately. No data system sees that so far.”

According to Lappalainen, one of the challenges is also the language barrier. The working language of port service staff is Finnish and even if the master of a Chinese ship speaks English well, communication through VHF can be difficult, if it is handled directly between the master and the linesmen.

“I think remote piloting may be suitable for some ships and some piers. For example, we have Hietanen ro-ro ships in the port, which the port does not have to steer to the right place. There are no similar obstacles as at other piers. In Hietanen, however, most ships are liners and do not use pilots. Oil piers on the other hand have their own tricks,”says Lappalainen.

HaminaKotka Harbour's development manager Suvi-Tuuli Lappalainen thinks that remote pilotage could be fit for some ships and some piers.

Photo: ©HaminaKotka Satama Oy

In her opinion, there are both pros and cons to remote piloting in general:

"I am especially pleased that the pilot would not need to bob in a boat and climb on board."

"If the weather is terribly bad, it might even make more sense for the pilot not to have to take a risk. After all, Europe already has the practice now that in bad weather the pilot does not board the ship at all."

"The downside for pilots is, of course, that the remote pilot does not receive a pilot bottle," says Lappalainen jokingly. Her husband is a pilot.

Digitization makes it easier

Remote piloting is one part of the digitalisation and automation of shipping. Digitalisation has already been developed in ports for a long time and to a large extent.

“We have information about ships coming to port through the Port Data System. The PDS System has been developed by Satamatieto Ltd, owned by the ports. The same system is used in a few other ports. Through it the shift supervisors will be informed when the ship is coming to which berth. We also have information about pilot list, and we get accurate information to the minute from there. It is essential for us to know who is piloting what ship and if they'll be using tugboats,” says Lappalainen.

MarineTraffic is also in use, in addition to camera systems in the port area and, of course, e-mail and telephone.

“Now the shift managers have a pretty good picture of ship traffic. The information available is relevant and it is also quite accurate. But the data is in many different systems. It is still in use as well printing paper and paper booklets. "

There is a lot of information, but in part it is scattered. However, progress is rapid. The Port Activity App developed by the Finnish Unikie combines data from different data sources into one package - the app is also coming to Hamina-Kotka for port use.

“One app may not revolutionize the world, but it certainly makes it easier for us to get the data together. Likely the use of this application will be extended to all ports. Of course, there are many options and similar applications on offer."

The systems developed by many IT companies are great. They can give a detailed overview of traffic flows.

“But no one needs a complete picture. Everyone needs something tailored to their own use and an overview from their own point of view. The information needed by stevedores, pilots and customs is different.”

Cooperation

According to Lappalainen, digitalisation involves many different projects, including cyber security. Ports are interested in them and want to be involved.

“My idea is for ports to get involved on a demand-driven basis - not to introduce systems just because they are available and are nice. It would be good to think together about what could be done better and how to increase efficiency. We actively engage in dialogue with a wide range of stakeholders.”

During the Covid period, port communications have improved.

“With ports along the coast, we've never had the opportunity to hold a weekly meeting with most ports. Remote meetings have been hugely useful. There are many topics in the discussions, such as digitalisation, security, environmental issues, cruise transport. You could say that because of covid, we finally have a forum for discussion. "

One of the changes brought about by digitalization is the increased need for education. In ports, working careers are very long and labour-intensive turnover is small.

“Often, proper training in the use of new systems seems to be forgotten. The challenges, of course, are that for example, some of the shift supervisors are substitutes and they rarely use the systems, and no use is made into a routine. The port must take care of organizing the training and the system supplier must create the contents.”

Traffic struggles during harsh winters in packed ice fairways.
Photo: ©Luotsiliiton arkisto

Research and theses

Remote piloting and the change in shipping are being studied at both universities and polytechnics. Here are some results.

At least one dissertation is in progress: Janne Lahtinen's research at Aalto University. In polytechnics there have been several studies from different perspectives. Theses have been searched in the Theseus database in several different ways with keywords. In terms of time, the work here is limited to after 2015, although work has been done before it as well, but the change is so rapid that older works are at least partially obsolete.

The selected works are examples of the diverse research on the digitalization of shipping. These are not comprehensive presentation of the selected works.

Janne Lahtinen's dissertation:
More research is needed

Janne Lahtinen's dissertation on remote piloting at Aalto University is in progress. The dissertation is completed in two parts.

The text *The Risks of Remote Pilotage in an Intelligent Fairway – preliminary considerations* was presented in September 2019 at the International Seminar on the Safety of Autonomous Ships in Helsinki.

Remote piloting in an Intelligent Fairway – A Paradigm for future pilotage has been published in the Safety Science publication in 130/2020.

Lahtinen has conducted the research together with Osiris A. Valdez Banda, Pentti Kujala and Spyros Hirdaris.

The first study concludes that academic research on intelligent shipping is focused on the risks of on-board navigation solutions. The focus has been on exploring the intelligence on the fairway much less, as well as considering the infrastructure associated with an autonomous vessel. Essentially for remote piloting it involves the pursuit of risk reduction, the challenges of new technologies and risk management and policy development.

According to the text, new technologies will improve the conditions for safe piloting when positioning information becomes more precise on the underwater profile of the fairways. Data analytics can help with real-time risk management of pilotage. New, intelligent systems also bring challenges - the risks of technology must be understood.

According to the study, VTS should be a part of risk management in smart fairway pilotage. Therefore, communication between the vessels and the VTS should be improved.

The challenges of remote piloting are mainly related to technology as well as risk management and the shortcomings of uniform guidelines.

The latter study investigated remote pilotage on Rauma's 12-meter fairway. According to the results, even more in-depth information is required on the role of the fairway in navigation decisions. Among other things, there are risks associated with human behaviour and ergonomics. On the other hand, remote piloting would reduce pilot travel to the piloted vessels, and it would optimize the use of expensive expert resources. Further research is required also for different fairways, environmental conditions, vessel types and crew.

According to the study, more information is needed to model remote pilotage and identify risks. Data transfer is key – the delay must be kept to a minimum and cybersecurity is to be kept at a high level. Critical equipment of navigation on both the ship and the fairway must be highly fault tolerant as well. Policies in the event of extreme circumstances and emergencies must be agreed on.

The study was conducted in a static environment: on the same fairway, on the same vessel, with the same crew and pilot. Further research is needed so that the importance the weather conditions, the geographical location, the different types of vessels and the importance of crew competence is better understood. The safe integration of the Pilot, ship, VTS and fairway infrastructure requires well-established operating models, the study finds.

Antti Äijälä

Risks in the operation of an unmanned vessel, KyAMK 2015

The thesis presents the arrival of unmanned shipping to vessels and how in the future the safety and risks change as a result and how to prepare for them. The work was commissioned by Rolls-Royce Oy Ab.

The work presents the legal conditions of the operation, the person, equipment, benefits and savings, back-up systems and emergency management.

According to the work, the redundancy of systems, the development of technology, ensuring operational continuity and identifying future experience are ways to minimize the risks to an unmanned ship. According to Äijälä, the absence of people from ships increases maritime safety. The most risks were identified to be the transfer of sensory knowledge to a remote control room, mapping systems and positioning reliability and the threat of future cyber piracy.

In his work, Äijälä concludes that a ship operating independently and supervised from a remote operation centre is possible in the future if it is carried out with a large enough investment, considered and tested in the development phase and done through cooperation.

Äijälä aimed to draw an overall picture of the unmanned ship of the future, taking it into account risks to be considered and its potential to act as a maritime reformer.

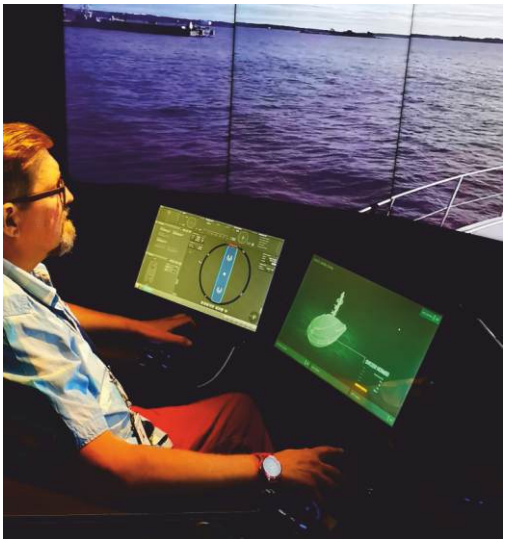
Shipping needs to change with human development, he pointed out.

“Technology has to change with a new generation accustomed to technology. They need an easy, fun, sophisticated and stimulating work

environment and easy access to social media. Maritime transport must also respond to change by evolving and meeting challenges."

He estimates that the steering of ships will remain the same, but it will only change its shape. The master and mates must be maritime professionals bound by the same responsibilities, whether on board or not. No ships can be made completely risk-free. Minimizing risks is ensuring operational continuity and predicting the future experience of the ship.

"The overall operation of an unmanned vessel involves specialists in many fields. So to make the whole complex work in the future, everyone must develop solutions for this common goal to achieve it. It is not a matter of competition or winner, but of maritime reform as a whole and a change in mindset," Äijälä writes.



Introduction to remote control at Rolls Royce Research Centre in Turku 2018.

Photo: ©Tapio Tuomisto

Marko Lindholm

Digitalisation in marine technology and maritime sector

KyAMK 2016

In his thesis at Kymenlaakso University of Applied Sciences, Marko Lindholm dealt with ship engineering and the problems and challenges of maritime digitalisation from the perspective of a maritime professional. Lindholm estimates the impact of digitalisation on ship technology, the maritime industry and maritime professionals.

Lindholm saw the problems and challenges of data transfer constraints in the marine environment, system integration challenges, mass data challenges, lack and fragmentation of standards, legislative and commercial challenges as well as personnel challenges. The work also covered the operation and maintenance of ships, energy efficiency and environmental impact, safety, commercial activity and government action as well as shipbuilding.

In the thesis, Lindholm stated that the scope of digitalization, its rate of change and the future the associated developments make predicting challenging due to the implications. The results can be considered as indicative only.

In summary, the effects of digitalisation on marine technology, the maritime sector and personnel are extensive. In addition, the rate of technological change brought about by digitalisation is high.

The consequences of this large-scale and rapidly evolving phenomenon in the future are impossible to predict completely reliably.

According to the author, the content of the thesis can be thought of as possible developments and technologies.

The change and development brought about by digitalisation are fast-paced phenomena and knowledge is aging rapidly – Lindholm therefore believes that the ideas of the work must be seen mainly as possible developments.

A bulk carrier piloted to the bulk terminal in Mussalo, Kotka. The approach of the ship and its movements are drawn on the ship's ECDIS.

Photo: © Tapio Tuomisto

Kaj Degerholm

Technical innovations that support the deck side operation of autonomous ships

SAMK 2017

In his thesis, Kaj Degerholm has considered technical innovations that support the development of deck side operation on autonomous ships. The Satakunta University of Applied Sciences' maritime degree program thesis was approved in 2017. It was implemented in collaboration with Rolls-Royce Marine. The dissertation looked at technical innovations that make autonomous vessels possible.

Degerholm points out that the development of autonomy is focused on in Finland and Norway. He defines an autonomous ship as a ship that "sails safely in accordance with the rules of the sea and makes decisions independently without the full supervision of a maritime professional. Movement of autonomous vessels is controlled from a remote-control station at the remote control centre, which acts as a bridge for ships".

Autonomous vessels could possibly relocate pilotage to happen from land. The pilot would give remote instructions to the operator controlling the ship. This would reduce the risk on pilot onboarding especially in bad weather.

Remote Operation Centres (ROCs) could monitor dozens of ships at the same time. Shipowners' centres shall plan and approve route plans and decide which ships need remote control and for which control alone is sufficient. The centres would also supervise the operation of marine machinery by means of sensors and cameras.

The centres would have Remote Control Stasions (RCS) where the operator would monitor and if needed, would also steer the individual vessels. The RCS would act as the ship's bridge.

The monitoring and manoeuvring of ships would be carried out through a Situational Awareness System. It would combine data from cameras, sensors, radars, smart buoys, VTS centres and ports. The system would also share information to e.g. pilots.

Better connections needed

Degerholm points out that current internet connections are not sufficient. Connections are made in 4G/5G with the help of connections, satellites, IoT and mesh net. Among other things, strong data security is required for connections, as well as accurate positioning.

A lot of versatile and diverse technology is required to replace the human eye. Degerholm believes that the information they bring can be used to create an overall picture that makes safe navigation possible.

Digitalisation and artificial intelligence are also making ports autonomous. The world's first automatic office terminal is in Qingdao port in China. Container ships and harbour machines are working automatically. The artificial intelligence of the machines retrieves and transfers the right container to or from the ship. Smart port increases security and efficiency and optimizes operations when information is exchanged intelligently and quickly with stakeholders. The system builds an overall picture with day, night and thermal cameras, microphones, radars, lidar-units, AIS data, intelligent routes, weather service and remote pilotage centres.

According to Degerholm, autonomy would change, among other things, the seafarer's job description: long periods of work on board would change to shift work on land.

There are no answers yet. “How is security guaranteed when labour is no longer used? How to ensure 100% functionality of connections to avoid dangerous situations? What is the role of artificial intelligence in a society of the future and how can it be exploited in the maritime industry,” Degerholm asks.

Tall Ship Race 2007 Photo © Luotsiliiton arkisto

Pihla Lehto

Mental strain on remote control centre staff and work shift systems Novia 2018

In her thesis, Pihla Lehto investigated the mental stress factors of the personnel of the remote-control centre supervising autonomous ships, as well as the working time and shift arrangements suitable for them in terms of safety, efficiency and employee well-being. The thesis has been commissioned by Rolls-Royce Oy's Ship Intelligence development unit.

The reference areas of the work were traditional shipping, vessel traffic service and air traffic control. Although remote pilotage was not dealt with separately in the work, the results can be applied to the work of a remote pilot, at least with reservations.

According to Lehto, the work of the personnel of the remote-control centre includes monitoring of several ships as well as remote control, which requires a good level of alertness and concentration. The need for remote control can also come as a surprise and be long lasting. The actions of the remote-control centre staff have an immediate impact on the real situations at sea, which may be opposed by other people. For these reasons, a vessel traffic controller's shift of more than 12 hours is not suitable for a remote-control centre.

According to the results, the intensity of the work and the sustainable safety-critical operation with a small margin of error are essential factors in the operation of the remote-control centre staff. The safety of the remote-control centre and the well-being of the staff are best guaranteed

in a shift system where the working hours are 7-8 hours during the day and 10-11 hours at night, including a long break. Coping at work is also affected by social relationships

Uncertainty about the timing, duration and complexity of remote control can increase the psychological burden of remote controlling.

“The level of alertness, manoeuvring experience, prevailing environmental conditions and traffic density of the person performing the remote control affect the mental load of the remote controller. Remote control personnel are therefore required to have a good level of alertness, as the decisions they make can have a direct impact on the safety of other people or the environment, and because remote control, which requires good performance, is included in the shift either as planned or occurs unexpectedly. Working hours of more than 12 hours are too long for remote control centre staff,” says Lehto.

The work can be irregularly intensive if several ships receive alerts at the same time, the ships are operating in a busy area, the weather conditions are bad for one or more ships, or there are equipment or communication failures at the remote-control centre. Thus, the intensity can be predictable or surprising.

Lehto proposes that the remote-control centre staff work 7-8 hours a day. Defining a night shift is more cumbersome but can be more than eight hours long when a longer break is included.

Jere Kuitunen

Watchkeeping in the remote control centre.

Problem management and situational awareness. XAMK 2019

“Watchkeeping will change in the future when the vessel is controlled from a remote-control centre. As a result, the management of problem situations will also change. The aim was to find out how problem situations are detected and managed in the remote-control centre,” writes Jere Kuitunen about the purpose of his thesis.

He pondered how to identify threats and avoid incidents at the remote-control centre.

Kuitunen emphasizes that problem situations must be reacted to in advance in the design of software and autonomy. The management of problem situations will ultimately be the responsibility of the operator and the staff of the remote control centre, and the effects of autonomy and automation on situation awareness is to be evaluate when developing a new system.

In order to improve the safety and cost-effectiveness of personnel and the environment in shipping, new systems need to be better, more reliable and safer than the old system.

In Kuitunen's opinion, it is important that the current unsafe ways are not transferred to remote control.

“The operator may have little time to get a realistic snapshot and take action. This could be helped by the system notifying you of any action, such as a change of route plan or speed. This gives the operator a better

idea of the current situation and has more time to react if the situation changes."

“Problem situations can be managed through active action, such as changing a ship's route, speed, or making radio contact with other ships. In addition, proactive measures can be taken in the route plan or stand-alone software. In addition to these, it would be good to have operating instructions for various problem situations,” Kuitunen suggests.

He emphasizes the importance of situational awareness in managing problem situations.

Photo: ©Luotsiliitto/ Tapio Tuomisto

Markus Raitio

Maritime automation.

Autonomous and remote controlled maritime transport and division of responsibilities. JAMK 2020

In his thesis for Jyväskylä University of Applied Sciences, Markus Raitio examines maritime automation as well as autonomous and remote controlled maritime traffic and division of responsibilities. In his view, technological innovation alone is not enough: a functioning and safe autonomous maritime transport also requires social, regulatory and economic development.

Shipping per se seems to be evolving with automation playing a key role. Even critical statements are mainly about the timetable. There is also a strong state of mind for the development of automation. Although there are many challenges, they are also being addressed internationally. In his work Raitio emphasizes the importance of international cooperation - otherwise there is a fear that the reforms will take place only in individual countries or truncated into individual research projects.

For example, there is no common view on the definition of a remote-controlled or autonomous vessel. At present, the safe upper limit for the use of artificial intelligence is considered to be that, although artificial intelligence manages the process, man oversees it. Such views have been expressed by, among others, the EU and the IMO. Indeed, Raitio notices that even a fully autonomous ship would in fact be under human control - even if the ship did not have a crew.

Raitio estimates that the increase in automation will also change the legislation. Existing national laws are sufficient, at least as long as auto-

mation is maintained in bridge systems and remotely operated ships, but the definition of liability in particular requires clarification of the legislation.

In Finland, special regulation only applies to remote piloting - from the point of view of automation development, remote piloting and the formation of a definition are valuable, Raitio states. In his view, the law defines remote pilotage in a simple but exhaustive way. By law, remote pilotage is an activity in which a pilot pilots a vessel elsewhere than on the vessel being piloted.

“However, the definition reveals that the person who manages the ship's navigation in the pilotage position from outside the ship is also a pilot to whom the regulations on the responsibilities and obligations of the pilot apply,” Raitio states.

According to the law, in remote pilotage, the pilot is responsible unless the technical implementation of the remote pilotage, the operating model or the disruption of communication connections prevent the pilot from acting in accordance with the task. The law excludes from the pilot's responsibility matters beyond the pilot's control.

According to Raitio, the same type of definition should be done for the master of the ship.

“At the very least, it should be decided who is the master of the remotely piloted vessel or who is responsible for it. The limits of liability should also be defined,” Raitio writes.

Errors are reduced – new problems appear

A key rationale for automation and autonomous maritime transport is that it improves maritime safety when human errors are significantly reduced.

“However, there are new types of problems associated with the large-scale exploitation of artificial intelligence, which can lead to damage that has very little to do with human activity. At a theoretical level, a conclusion was reached that advanced artificial intelligence could be considered as some kind of independent actor to which, for example, an obligation to pay damages would apply (Kurki 2018, 832-834). For example, from the point of view of autonomous maritime transport, this may be completely impossible for the time being, as the software lacks, among other things, the ability to suffer punitive penalty and the independent ability to fix the damage. Therefore, the responsible body for autonomous maritime transport must be sought elsewhere,”says Raitio.

In Finland's view, clear responsibilities are important in the deployment of smart systems and automated traffic.

Photo: ©HaminaKotka Satama Oy

Sami Uolamo

Shipping 4.0 underway

XAMK 2019

The digitalisation of shipping from the point of view of ports has been studied by Sami Uolamo in his dissertation for the University of Applied Sciences of South-East Finland in 2019. Uolamo examined the digitization of ship and port services and port operations in the Port of Oulu. The purpose of the work was also to create basic information to support the wider digitization of port operations

"Digitalisation can be said to have begun to change shipping and maritime logistics in an irreversibile way and it is not at all unreasonable to talk about a new, big change in the industry, shipping 4.0," Uolamo writes.

According to him, ports, waterways, ships and information networks and warehouses are integrated into large entities, where decisions are made taking into account safety, energy efficiency, efficiency in general and the environment. The use of artificial intelligence reduces the possibility of human error.

"Shipping 4.0 is a trend of change whose speed and impact cannot be fully predicted. The development of technology and the cheapening of components enable new innovations, and through digitalisation it will transform the industry, initially hidden in the background and basic functions, but inevitably becoming part of everyday life by changing it," says Uolamo.

Job tasks and labor needs may change faster than education can. The advent of new technology, in addition to old jobs, weakens the resilience of ship crews.

According to Uolamo, a wealth of information is available on the digitalisation of shipping, but for ports, digitization projects are frag-

mented into many sub-areas. Shipping and ports still seem to be strongly independent and separate, although joint action has been sought.

Uolamo also wanted to find out the views of the ships that regularly visit the Port of Oulu, but there were hardly any answers.

According to Uolamo, further research is needed in Finland, for example in the changes of the national single window system and the use of open data. Single window system means one-stop shops. There are also development needs in many other functions.

According to the thesis, it is of paramount importance to involve the staff in the reform work – only through that will the result become functional, and no new tools will be created on a non-functioning basis.

Uolamo emphasizes the speed of change in shipping and port operations. It is therefore important to monitor developments at both national and international levels.

Jere Tamminen

Challenges and advantages of e-Pilotage from the perspective of traditional pilotage

SAMK 2021

Jere Tamminen's thesis, completed in May 2021, considers the challenges and benefits of e-Pilotage from the perspective of traditional pilotage. In his work, Tamminen, for example, interviewed pilots.

According to Tamminen, the most significant challenge in remote piloting is related to obtaining a situational picture similar to traditional pilotage. The biggest benefit, in turn, is improved pilot safety. However, he points out that the development of remote piloting may change current perceptions.

“Planned remote piloting is a natural consequence of general technological developments. Its realistic application requires a lot of development work. The whole subject is new and perhaps all the necessary technologies and equipment do not yet exist and need to be developed. On the other hand, there is nothing in the study to suggest that the planned remote piloting would be impossible,” says Tamminen.

He recalls that over the past decade, automation and the electrification of operations have also developed rapidly in shipping. Electronic nautical charts, AIS systems and an almost uninterrupted internet connection between operators have fundamentally changed shipping. The reform of the Pilotage Act, which entered into force in 2019, also creates the conditions for remote pilotage. The first remote pilotage permits are expected to come in 2025; before that, all parties should have a common understanding of the requirements in spring 2022.

In traditional pilotage, the importance of the pilot's professional skills is often emphasized in exceptional situations, such as bottlenecks, malfunctions of the ship's equipment, and difficult ice conditions. Tamminen's work investigates these situations and considers what kind of traditional pilotage issues need to be taken into account when planning and implementing remote pilotage.

Tamminen clarified pilotage practices with a survey and interviews.

The thesis emphasizes that there are currently several parties involved in pilotage: in addition to the pilot, the VTS centre, the ship's agent, the pilot's order centre, the pilot's boat crew, ports, berth personnel, tugs and sometimes also icebreakers.

Tamminen reminds that each pilot usually has his or her own personal way of operating. Remote piloting means that the pilot is not physically on board. Pilotage or parts thereof may be carried out from a pilot vessel, other support vessel or from land. Remote piloting contains information on the speed of the vessel being piloted, and its course and location. Information on other vessel traffic is also essential information.

The concept of remote piloting was added to the Dutch Pilotage Act as early as 1983. Remote piloting is often referred to as Shore-Base Pilotage (SBP). The background are the occasional difficult weather conditions when it has been dangerous or even impossible to get on or off the ship. In practice, the ship entering the port is remotely assisted to a more sheltered place where the pilot has boarded the ship.

Tamminen classifies e-piloting as one of the remote piloting methods.

According to Tamminen, the difference between SBP and e-pilotage is essential. The implementation and conditions of e-pilotage are strictly defined by the Pilotage Act. E-piloting requires a vessel-specific permit. In e-pilotage, the piloted vessel must have equipment that enables the pilot to perform his duties and provides the pilot with sufficient information. In

e-pilotage, the master of the vessel must be well prepared in advance. Thus, for example, difficult conditions do not come as a surprise.

Tamminen states that the differences between SBP and e-pilotage will become clearer in the future as e-pilotage develops.

By law, the persons responsible for e-pilotage must be appointed in advance. The purpose of Finnpilot is to prepare and train managers and crew for e-piloting in advance. This still requires in-depth testing so that e-piloting is developed at the background of traditional pilotage.

Tamminen estimates that e-piloting will not be possible on Lake Saimaa and the Saimaa Canal, at least until ship technology develops significantly.

Survey guidelines

As part of his thesis, Tamminen conducted an online survey for pilots, and received 168 responses.

According to the answers, the co-operation between the master and the pilot goes almost without exception. Likewise, pilots have a positive perception of a master's language skills - and that is essential to the success of e-piloting. With other bridge crew, potential problems can be clarified in traditional pilotage easily, but in e-piloting this can be challenging. According to Tamminen, arranging communication in remote piloting can be challenging even if there are several people on the bridge.

The manoeuvring of the vessel was carried out by the master himself in 72 responses, and according to the instructions given by the master to the pilot in 45 responses. The pilot was responsible in 46 responses. Tamminen points out that in e-pilotage, this can be challenging: how to get the pilot's awareness of the situation to the same level as the master's.

According to Tamminen, the results of the survey give a clear picture of the current situation of pilotage. He estimates that the results may provide guidelines for e-pilot design.

For and against – rightly so

In his work, Tamminen thinks that e-piloting can cause strong views for and against in advance – and there are strong grounds for both views. He estimates that e-piloting may be much safer and more pleasant, and also more environmentally friendly, but in practice it means many more challenges.

“Simply put, e-piloting can eliminate many disadvantages, but at the same time bring a significant amount new problems to be solved,” says Tamminen.

In his work, he looks at the benefits of e-piloting. These include, for example, risks of onboarding and disembarking. When the pilot does not have to be transported on board, the use of time is more efficient, costs are reduced and security increases. The environment also pays off when Finnpilot's annual need of 1.5 million litres of fuel decreases. Pilotage delays are also reduced. And in the time of Covid, it is also irrelevant that that the risk of transmittable diseases is reduced.

According to the current ideas of spring 2021, the whole e-piloting would be done remotely, but it is also not excluded that only a part would be remote piloting.

According to Tamminen, e-piloting should be done in the same way as SBP. If required due to weather conditions with traditional pilotage, the ship could be piloted remotely to a location where the pilot can board the ship safely.

Tamminen estimates that a person approved by the port could also assist the master in the port area. One alternative could be to use e-pilotage on the fairway up to the port area and in the por, the ship would be assisted by an adviser approved by the port staff.

How to create the situational picture

Traditional pilotage is very much based on the pilot's situational awareness. The big challenge is to create a realistic and useful situational picture for e-pilots. This still requires clarification by different technicians and standardization.

Studies show that human error is the most common factor in accidents. The background may be inappropriate attitudes, insecure corporate culture and lack of cooperation and communication. In addition, fatigue, stress and inactivity of available resources may be affected. The pilot should recognize these – remotely it can be difficult.

According to Tamminen, the pilot on the bridge can observe and influence the crew's activities. At a distance, the pilot may find it difficult to act as part of the bridge crew credibly. If the crew does not act appropriately, the bridge can respond immediately. It can be difficult to do so remotely.

Pilots are obliged to report to VTS in, for example, safety, ship, crew and environment matters. Often these are observed visually – Tamminen thinks that in e-pilotage visual observation is limited, as is the ability to report problems to authorities.

In e-pilotage, contact between the pilot on land and the ship's crew must be uninterrupted and undisturbed. VHF radio as a primary medium is out of the question. In addition to verbal communication, the pilot needs information about the movement of the ship. Tamminen estimates that the mobile device's internet connection could be suitable. There are also challenges in its reliability and connections - for example, in severe weather conditions. On some Finnish fairways, internet connection depends on the network of foreign operators.

There is also a lot of communication with third parties in pilotage. Tamminen points out that the need for communication varies.

“Communication that is not directly related to safety or ship handling can be handled on cell phones. These situations can be discussions with an icebreaker, tug, or port staff. In any case, the connections must improve the pilot's awareness of the situation,” Tamminen writes.

Problems positioning

Four systems are used for positioning: Galileo in Europe, GPS, GLONASS in Russia and Chinese BeiDouta. Tamminen reminds that although the systems cover the whole globe, they are vulnerable. Global Navigation Satellite System GNSS cannot be the only positioning system for e-pilotage. However, Tamminen points out that since e-piloting is being developed, it is not yet possible to decide on a location system. One possibility is that position sensors are installed on the fairways.

Tamminen points out that remotely operated operations are already relatively common in military use. The necessary technology for remote control of maritime traffic also exists, but the challenges are costs.

The customer of the pilotage must have a financial reason to participate in e-pilotage. In Finland, the system is designed so that the cost of remote piloting is lower than that of traditional pilotage. Customers contribute to the cost, but so that it can be seen as an investment. According to 2021 thinking the payback period for customers' investments would be 2-3 years.

“It can be challenging to install the equipment needed for e-piloting on ships so that both the pilot and the bridge crew will benefit. The vessel must be productive (large enough) and moderately new to be able to benefit from the investment financially. Regular traffic to Finland may also be a justification for participation in e-pilotage. On the other hand, the equipment to be installed may tie the ship to Finnish traffic”, Tamminen ponders.

It is important for the pilot to have as realistic a picture as possible of the ship's immediate surroundings. Although camera technology has developed, Tamminen thinks the image created by the cameras is challenging. In traditional pilotage, binoculars play a big role – how can you create means of monitoring even up close when working remotely?

Tamminen points out that the entire pilotage process has been highly automated in recent years - the planned e-pilotage can be seen as an inherent extension of this. However, technical progress is not completely hassle-free.

“At least some of the planned e-piloting information goes through cloud services. Cyber security is a big challenge. While technology is constantly evolving, the general uncertainty of information technology can bring challenges. Although the applications used by Finnpilot are constantly updated, their operation can still be uncertain. It must be ensured that there are no such problems in e-pilot applications,” Tamminen notes.

According to him, e-piloting will have a big effect on the pilot's work. During the completion of this thesis, the attitudes of pilots have been somewhat negative – but at the same time e-piloting is not known very well. Indeed, Tamminen emphasizes that he sought to make the thesis objective; not in favour and not against.

More research is needed

According to Tamminen, e-piloting should be clarified further. At least for the masters, but also for the pilot training is worth considering, and creating a training program.

New technology and new technical assistance provide an opportunity for further research. There may be a need to create a separate e-pilotage unit.

Tamminen also needs to find out the technology needed on the bridge.

In his opinion, it is also necessary to consider for whom and what kind of managers the e-pilotage is designed for. The level of expertise of managers varies greatly.

At the end of his thesis, Tamminen considers the planned e-pilotage with his own piloting experience in mind.

By law, the master of a ship may refuse e-pilotage. However, experience shows that in several such cases, the master did not have the right to decide on the use of the tug, but permission had to be sought from the shipping company. According to Tamminen, this may mean that even if the law gives the right to refuse, in fact, this is not entirely clear.

Usually, the pilot uses his native language, for example, when communicating with the tug and the bridge, the crew speaks to each other in their own language. Tamminen suggests that everyone consider the e-piloting discussions to be conducted in English.

According to Tamminen's experience, there are situations in traditional pilotage where the ship's key navigation equipment has not been available as soon as the pilot has entered the bridge due to poor adjustments. Sometimes the pilot has had to adjust the equipment. Tamminen thinks it may be necessary for the pilot to get on to find out the operation and adjustments of the equipment well in advance of e-piloting.

There are also often shortcomings in the ship's controls - which have been known in advance but not reported. It's a bad work culture that you should be able to change. With e-pilotage, the pilot's chance of influencing the ship's navigation is reduced. For this reason, it would be important for the pilot to receive in advance the knowledge of the deficiencies and limitations of the ship.

Photo: ©Finnpilot

Finnpilot:
Pilotage digitalizes step by step

The Sea for Value research project is one of the foundations of remote pilotage. The project, which started in 2020, is also Finnpilot's most important strategic project. Finnpilot acts as a pilotage expert in the program run by DIMECC. In addition to remote pilotage, Sea for Value also creates capabilities for autonomous maritime traffic. It will also develop future fairway services and testing and is supporting the goals of a functioning autonomous marine ecosystem by One Sea by 2025.

Finnpilot's goal is to offer new types of pilotage services in the future using new technologies. The intention is that in early 2022 there will be an agreement on the requirements for safe remote piloting. The first remote pilotage permits would be applied for in around 2025.

Finnpilot's goals are guided by the updated strategy for 2020-2024 in the spring of 2020. According to it, Finnpilot is a pioneer in the utilization of digital maritime services and information. It has a strong position in digital fairway navigation and its definition.

According to Finnpilot's annual report in 2020, the current infrastructure of the sea fairways does not enable remote pilotage. In addition to Finnpilot, the development of technologies and processes requires the work of many actors in the maritime ecosystem.

In addition to the Sea for Value project, Finnpilot is involved in Istlab and MasterSIM projects.

Pilot skills are important

The annual report emphasizes that, in addition to technological developments, remote piloting requires the skills of pilots. Procedures and training for remote pilots are created and tested together with staff. Part of this is the selection of development pilots for remote pilotage in the spring of 2021. Finnpilot aims for better scalability and cost efficiency of pilotage services. For customers it appears, among other things, as an alternative to line piloting. There are challenges in and with digitalization, with the emphasis on cybersecurity, climate change, crew skills and economics uncertainty.

In its annual report, Finnpilot emphasizes the importance of digital competence and networking.

"The process of pilotage services is being digitized step by step. We are talking about the whole as e-pilotage. Not only our strong networks and technology partners, but also our own open-minded development work plays a key role. Finnpilot has digitized the internal part of the pilotage process, and next we are working to digitize pilotage, i.e. we are moving towards remote pilotage," says the annual report.

Development as a highlight

In its annual report for the previous year, 2019, Finnpilot defines one of the highlights of the year as its involvement in developing autonomous shipping with the One Sea ecosystem. The entry into force of the law enabling remote piloting was also significant. The digitalisation of shipping and pilotage was strongly reflected in operations.

The One Sea ecosystem is needed to develop safe remote piloting, said CEO Kari Kosonen in the report.

Customers received the Finnpilot Traffic Info service at the same time as the online service was renewed. The service easily displays schedule information for piloted and non-piloted vessels.

Internally, Finnpilot developed pilotage data management.

Pilotage Director Sanna Sonninen pointed out that emissions minimization in addition to a higher level of automation to improve safety are planned for the ships of the future. Automation is advancing slower than in the dreams a few years back and in smaller steps. Developments are becoming more polarized: at one end, only technology that meets mandatory requirements is used, and at the other end, the pace of change only accelerates.

Fast digitization

In its 2018 annual report, Finnpilot emphasized that safer operations can be achieved through training and through digitalisation.

The rapid development of digitalisation is indicated by the fact that in previous years, the annual reports hardly even mention remote piloting and digitalisation. In the 2016 annual report, digitalisation was mentioned twice; both in CEO Matti Pajula's review: “Finnpilot combines the expertise of maritime professionals and the utilization of digitalisation… Digitalisation will continue with us this year as well. Pilot orders will be built for customers to facilitate the service portal Pilot Online. We are getting more versatile and efficient in pilotage for navigation and ship handling software.”

The following year, 2017, digitization was already mentioned 7 times. At that time, CEO Kari Kosonen's review stated that the digitalisation of shipping would provide better conditions for utilizing Finnpilot's expertise. In accordance with the new strategy, Finnpilot has networked with parties developing new technology solutions. In that year, a procurement decision had been made for a navigation system to be installed on tablet computers.

In 2017, Finnpilot also began to consider e-pilotage: “The implementation of e-pilotage is believed to require a new and broader operating

Photo: ©Finnpilot Pilotage.

model for services provided on Finnish waterways, and therefore the implementation of the experiment requires extensive co-operation between maritime operators". At the time, it was speculated that e-pilotage would be tested in 2020.

Pilotage Director Sanna Sonninen:

Remote piloting requires a change in the entire operating environment

According to Sanna Sonninen, Finnpilot's pilotage director, there is a good understanding of remote pilotage.

Photo: ©Finnpilot Pilotage.

According to Sanna Sonninen, Finnpilot's pilotage director, remote piloting will change the entire shipping and pilotage operating environment. It is not just a question of pilotage, but changes are needed in the fairways, ships and the skills of the crews.

"Currently (spring 2021) a review of the operational boundary conditions for remote piloting is underway. We're starting to have a pretty good understanding of what remote piloting means, but by no means can it be said that it's just that or that. Now we describe the phenomenon and find out the things that still need to be solved", says Sonninen.

When she says "we", she does not mean Finnpilot alone. Numerous projects, research institutes, universities, the legislature, companies, authorities and, of course, pilots are involved in the development of remote pilotage.

There was a lively debate about maritime automation and autonomous vessels in the early 2010s.

The initiator was especially Rolls-Royce, but of course others as well. The first outlines and schedules received a lot of media attention, and the schedules were outlined as well. Some ideas were even unrealistic.

"I especially appreciate the fact that Rolls-Royce started the conversation. Since the IMO, others have also had to wake up to reflection on how shipping is evolving. It has long been clear that even though the technology for autonomous vessels exists, the cost is so huge that expectations for the rapid deployment of commercial applications have been quite unrealistic," says Sonninen.

In the initial discussion, confusion was also brought about by the fact that no one really knew what an autonomous vessel meant. The IMO working group created a framework, but it is still under discussion. "It reflects more on the past than the future. These developments are also reflected in the development of remote pilotage quite perfectly."

Experiments, even successful ones, have been made. Sometimes for big money, and ones that are not reproducible elsewhere.

"The good thing was that the development of shipping started to be discussed. Quite quickly, many actors stated that a fully autonomous ship in terms of technology is not the goal. When crew costs were calculated, it was quickly realized that the costs were not as high as had been talked about. Replacing the security effect of a couple of people with technology and remote control was a much bigger thing than initially thought."

"The discussion was genuine, and it was good that realism was restored and at the same time different actors also cooperated. We began to genuinely see what the industry could offer and what operators needed, how shipping would change. Thanks to One Sea, we started talking about the ecosystem."

Now, the idea of increasing automation and moving in the direction of ship autonomy is rather a service that must operate on the customer's ship, then sail it anywhere.

A new way to navigate

One condition for remote piloting is, of course, the law allowing remote piloting. During the drafting of the law, a change was made to it that the pilot cannot be held liable for technological disruptions. Also, the word experiment was removed from the law.

"We found that remote piloting is a huge thing that no one in the world has done. No state-owned company, Finnpilot, which has only a few people at work in the branch, can solve such a matter. The Sea for Value project (S4V) was then launched, and support was sought from One Sea and the research consortium. Public authorities, industry, research organizations, ports, customers are involved. Now let's find out how fairway navigation will be built in the future, how data sharing will work, how condition and schedule information will flow, what is needed for the ship. The whole is the overall change in the fairway ecosystem – which is a new way to navigate. Pilotage is just one of the services that is changing and that will be made possible by the fairway concept of the future. What is the pathway that changes the operations for all involved," Sonninen ponders.

A funding decision was received for Sea for Value in 2020. It clarifies the remote piloting process, training, technological know-how and legal requirements.

"The project is really big for Finnpilot, and it has progressed well. A big thank you must be made to all partners."

From the beginning of 2022, a demonstration is planned to take place on the Helsinki fairway. In it, the ship is traditionally piloted, but at the same time remote piloting is carried out. "No matter how many experiments

there have been, probably thirty. They will then lead to this demonstration."

Finnpilot can also get help from Istlab. With it and Janne Lahtinen's dissertation, a lot of critical information has been received from pilots in several countries, including the current situation. Among other things, Lahtinen has asked how many of the ships assume that the pilot handles all communication, both to tugs and ports.

Sonninen reminds that in the mind of the average citizen, ships are Sweden and Estonian ferries and Finnlines, which run by line pilotage.

"We have to remember that 90 percent of our customers do not sail under the Finnish flag, and in a large number of ships the master does not steer the ship but delegates the task to the pilot. Understanding this is very important for remote piloting."

Set off with perhaps a limited group service

Sonninen estimates that remote piloting will start in the service of a limited group – maybe in a few years.

"The precondition is that the master of the vessel must have certain, proven skills, and the ship must have the technical ability to connect to data transmission systems and perhaps also the ability to, for example, positioning. The skill of pilotage is the skill of managing the ship's state of motion. If it exists, the master is like a good line pilot. With the know-how, the equipment and the good fairway for remote pilotage, we can get to the point where ships that meet the conditions can receive remote pilotage pretty quickly."

According to Sonninen, Finnpilot sees remote piloting as a competitor in line piloting operations. "If we can provide remote pilotage to frequently visiting ships, we would be returning ships from line pilotage to pilotage."

One part of the prerequisites for remote piloting is the development of a remote-control environment and data transmission.

“The bottom line is that we don't commit to the technology of a single technology provider. It is important for the future of remote piloting that everyone is involved. It is important which interfaces are used on the bridge and in what form the data is sent to the shore. If we can create common standards for these, any equipment manufacturer will be able to make the systems. Development work must not lead to a single market leader,” says Sonninen.

She emphasizes that the development of remote piloting in Finland is not interesting unless it is replicable in other countries. It would already be unreasonable for the master of the ship to have to learn a huge number of remote piloting techniques.

Several projects

Finnpilot is involved in Istlab, S4V and MasterSIM projects.

From Finnpilot's point of view, Finnish projects have progressed well. In addition, Finnpilot develops its own operations in many ways. Part of the development is the selection of developer pilots in May 2021. There were plenty of applications for the position - almost 10 per cent of the pilots were interested. Joakim Kantola, Ville Mattila and Timo Nummi were chosen as developer pilots.

Follow-up projects are already planned for both S4V and Istlab - Traficom and the fairway agency, among others, are visiting discussion on smart fairways road map.

One big thing to find out is the smart fairway on which remote piloting relies: what it is below the surface and what is above the surface.

Another issue commonly related to maritime change is the development of the role of the electronic watchman, the lookout. The goal is to create

“technical eyes” that are able to detect objects in different weather conditions. There are three levels in the outlines: at level one, there would be no one on the bridge - this is not the focus now. At the second level, there would be a human on the bridge most of the time, but on the open seas, reconnaissance could operate by technical arrangements alone. Even the bridge could be positioned so that there is no visibility outside. This would also change the structures of the ships – more cargo space would be available. The third option is for the bridge to have a person on it at all times, and even this option the bridge could be inside the ship. The lookout could do more, but would be on the bridge at all times.

“If ships are taken in this direction, it is necessary to consider how pilotage and the pilot will settle here. The planning is still based on the pilot coming to the ship, but there is no master-type person on the bridge who knows how to steer the ship – how the pilot's job changes.”

One option is that in the future, the pilot will continue to climb on board, carry an independent navigation unit and connect to the equipment on board, and will have electronic visibility – as well as a remote pilot. The remote pilot communicates with his colleague on board and supports in piloting.

The design of ships is also changing

Sonninen points out that the change in pilotage is essentially accompanied by a change in the design of ships. Now we are not aiming for an unmanned ship: automation may proceed in perhaps small but varied steps. The economy defines change: increasing cargo capacity is also part of the development of automation.

Naturally, cyber security is also involved in the projects. Researchers at the University of Jyväskylä are considering data transfer and spatial information. No systems will be built solely on satellite positioning.

The projects consider what if cases: which measure to take if there are problems with the connections, whether they were due to a technical failure or a cyber-attack.

Sonninen reminds that from Finnpilot's point of view, the customer of remote pilotage is the master with a qualified crew on the bridge. “A qualification equivalent to a line pilot's book is not required, but very close to it.”

“In our opinion, remote pilots must have very strong knowledge of the fairway to be piloted, quite traditionally. In addition, separate training for remote piloting is required. Special training is also required from the master of the vessel. There are still many issues to be clarified. What matters is that in the initial stages, things are limited - there is no looking at how the Chinese master would be piloted. It may even be in 2050.”

Sonninen emphasizes that monitoring the development of ships is also important in the development of remote pilotage.

“The near future is very challenging. There is no money flowing on the ships, and when you get the pilot anyway, why would shipowners invest in the ship's technology if there is no economic benefit, even in the form of reduced pilotage prices.”

Technology Manager Tero Vainio:
Basic blocks are in order

According to Tero Vainio, Finnpilot's technology manager, the basic technology of remote piloting is starting to be under control – so well that remote piloting can be tested.

“In individual tests, the technology has been found to work. The demo at the beginning of next year will then see the functionality of the technical details as a whole. At this point, there is a view that the whole works as well.

Of course, after the demo, the details will certainly be filed, and shortcomings will also be found”, Vainio says.

In early 2022, it is planned to test the first remote pilotage of a cargo ship on the Helsinki fairway as part of DIMECC's Sea for Value project.

The demo also looks at whether the idea of remote piloting is basically correct.

Vainio emphasizes that Finnpilot has invested especially in creating a safe remote piloting environment, not just in developing technology.

“We are working to ensure that the same understanding that is on the bridge can be replicated in the technical environment as well. I think we are already strong here.”

Accurate situational picture

In remote piloting, it is important to create the right situational picture - it must be at least as good as when the pilot is on board.

“There are technical solutions to create an accurate situational picture, starting with weather and traffic information. With data, we aim to create the same view as the bridge. It is not similar and not necessarily the same.

According to Technology Manager Tero Vainio, the basic technology of remote piloting is starting to be under control. However, there is still a lot of work to be done. ***Photo: ©Finnpilot Pilotage.***

We assume that the data can make up for the lack of a window."

There is a lot of data involved in creating a situational picture. For example, the condition information must be real-time, exactly from where the vessel is. Traffic information comes from several sources, including research.

There has been a discussion that the way data is presented must be familiar enough and must appear to look right for the pilot to be able to function properly.

"The presentation is at the centre," says Vainio.

Remote piloting also requires a lot of information about the ship: its movement, direction and everything else that happens on the ship. Information important to the control information comes to the remote pilots using the data.

Vainio emphasizes that data transfer is at the centre. Data must be obtained for remote pilots from as many places as real-time as possible. Much research has been done on data transfer.

In remote piloting, the voice connection between the pilot and the ship is also important.

"There has been a lot of discussion about that as well. Whether data is used or is it some traditional method. In any case, the communication

over the voice connection must be clear so that it is not unclear at either end what is the message that is being said. Even the voice connection must be real-time, delay-free and high quality. The data connection offers the conditions for this," Vainio says.

The old ship technology of many ships brings its challenge to remote pilotage. Not all ships receive sufficient information to ensure safe passage. The smart fairway is a prerequisite for building security. Vainio does not dare to assess the future of the smart fairway: as more intelligence comes to ships and marine electronics, the importance of the fairway will diminish – but this will not happen in the next few years.

"Currently, the smart fairway is very important for remote piloting."

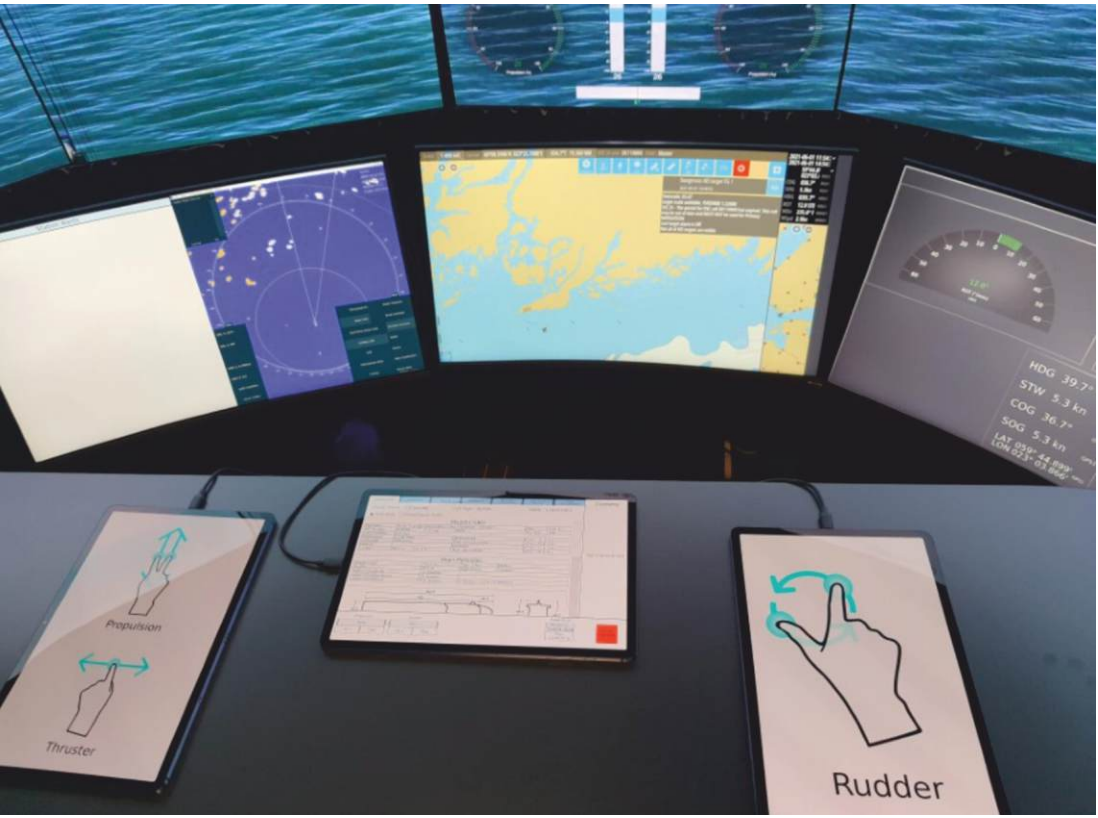
Pilots involved in developing

In Vainio's opinion, the development and evolution of remote pilotage is not only a matter of technology, but also of communication.

"The more things are told, the better. It is clear to me that when the pilot's work is being developed, the pilots must be very closely involved, and preferably so that development proposals come from the operational staff. This will lead to a better and more efficient overall solution."

From the point of view of Finnpilot's technology manager, remote piloting is about data and analytics. They are processed in such a way that the pilot gets the best possible picture of the situation and safety can be increased.

"In the world, someone needs to show how remote piloting will be done and standardize the base. The concept needs to be developed. I think we are taking big leaps."



Remote piloting technology was developed at the e-Pilots development day.
Photo: ©Finnpilot

President of the Finnish Pilot's Association, Antti Rautava, boarding the ship

The Pilot Association emphasizes training

The Pilot Association is concerned that while electronic navigational aids have increased, seafarers' skills have declined. According to the association, ensuring safety requires, among other things, the development of a pilotage system and training.

The association's statement says that the development of smart fairways must be stepped up to enable remote pilotage. At the same time, it improves the conditions for safe navigation for most fairway users.

“The expertise of pilots should be utilized extensively in the design of fairways and harbour basins. This avoids unnecessary additional costs for fairway construction and ensures the safety and usability of the fairways,” says Pilot Association.

According to the Pilotage Association, pilotage is a service – a means of managing the risk of a maritime accident – which ensures a high level of competence and sufficient professionalism on board ships. Coastal states around the world use the pilotage service to protect human lives, the marine environment and property.

“The pilot's job is to ensure that the ship is safely taken to and from port.

The main elements of pilotage are seamless fairway knowledge, local expertise and good ship handling skills. One of the key tasks of pilotage is risk management in the event of disturbances”, the association states.

The Association emphasizes that in the event of failure of navigation systems or equipment, the only way to save a ship from an accident is the

ability to take the necessary corrective action manually and steer the ship safely on the fairway by traditional methods.

"This will not succeed if the bridge does not have the above-mentioned skills, correct spatial information and an understanding of the surrounding sea area and traffic situation. According to reports, error situations in navigation aids and systems have arisen because of user errors, hardware failures and cyber-attacks, which have become a new problem".

Technology requires additional expertise

According to the association, water transport relies too much on navigation aids and technology. This is especially true for recreational boating, but unfortunately the same trend is also reflected in professional sea traffic.

"Navigation technology is evolving, but systems cannot replace human expertise. For the time being, the bridge systems of ships operating on Finnish navigable routes are not able to provide reliable information on the necessary navigation measures. The systems provide the navigator with information that allows them to make the right decisions and actions. Thus, the systems do not guarantee competence, but are a support for navigation. The safe use of new technology requires additional skills, which the officers of piloted ships often lack in the experience of pilots". Piloted vessels use a lot of equipment that is not intended for professional shipping. According to the association, the current competence requirements and their testing do not ensure competence, for example in line pilot examinations, and the training requirements are not up to date in many respects in terms of content.

The association recalls that the aviation safety culture, training, technologies and practices used and their standardization are significantly more advanced than those in maritime affairs.

According to the association, a test performed in a simulator, performed correctly, is a good and safe way to establish sufficient local knowledge related to navigation. The simulator should therefore ensure the ability to navigate the vessel optically and using radar. At the same time, the already mentioned hardware, technology and cyber challenges would be met.

Skills at sea are declining

The Pilotage Association is concerned that the competence of the officers of ships operating on Finnish coastal waterways has deteriorated. This has led to a further emphasis on the role, expertise, and professionalism of pilots. The skills of foreign seafarers can be influenced to some extent through international regulations, but the opportunities to influence the skills of Finnish seafarers' competence development are naturally greater.

“Here, piloting and its development is central, effective and even easy. At the same time, the development of pilotage training serves the development of the training and competence of all Finnish professional seafarers. The new training and competence requirements can be utilized in the development of line piloting training and qualification requirements”, the association states.

It is also concerned about obtaining skilled pilots for all pilot stations - as has been the case in Sweden and many other countries. The education of new pilot students should therefore be more extensive.

Smart fairways need to be improved

The Pilot Union attaches importance to the development of fairways. The projects implemented in the initial phase have mainly focused on improving information under the water surface and monitoring the failure of safety devices, as well as developing the environmental aspects of safety devices.

“It is also necessary to develop a smart fairway that meets the needs of safe and autonomous shipping and supports their development.

The definition and deployment of more reliable positioning and communication technologies is essential, in particular for the implementation of remote piloting or remote control. Utilization of new solutions also requires additions to bridge devices to ensure data transfer. Effective technology solutions can promote safe and efficient maritime transport and enable cost savings for Finnish industry and trade.”

According to the association, maritime operators, and industry familiar with pilotage have understood the complexity of developing remote pilotage.

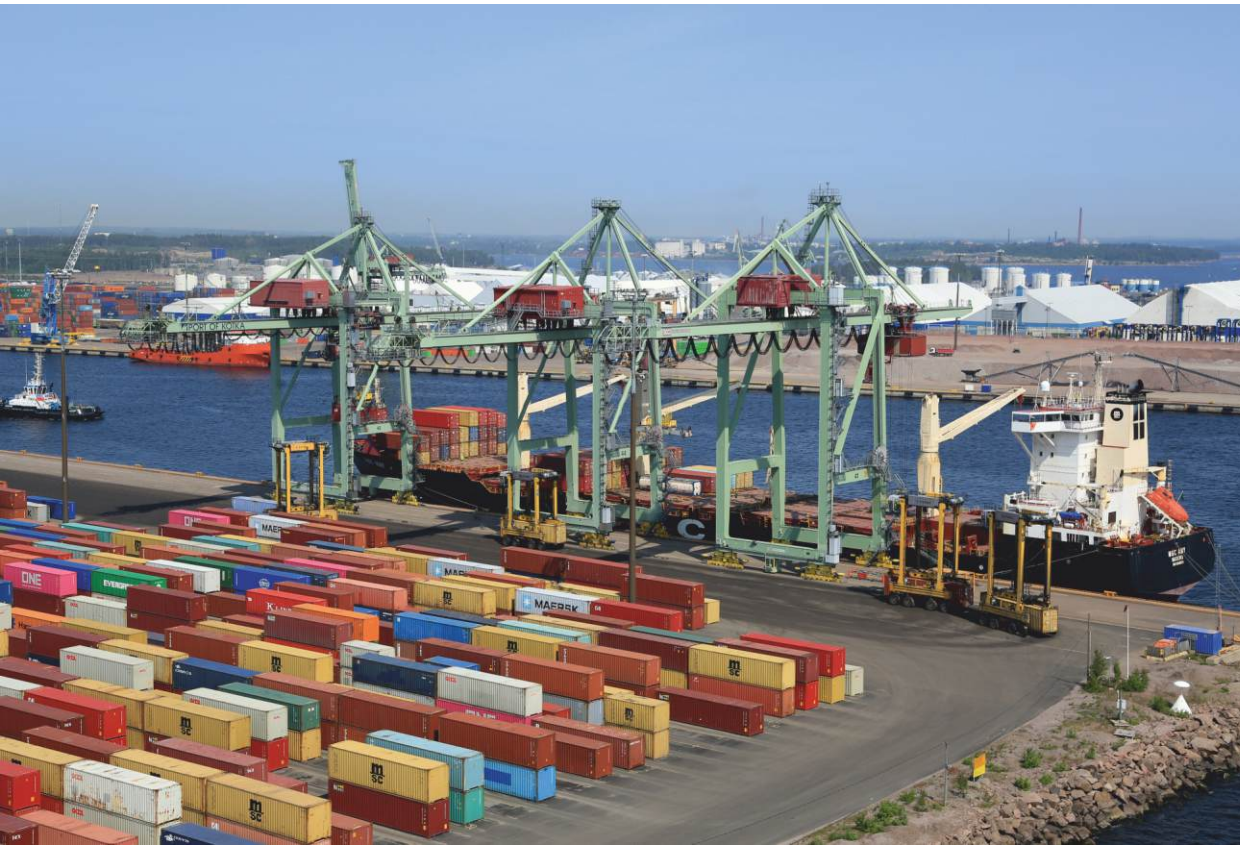
“The pilot's duties include an increasingly holistic role in the safe arrival and departure of a ship from a port. Pilotage is not just about ensuring the safe passage of a ship; it is the exchange of information with different actors in the logistics chain and security organizations. The pilot has been forced to take on the role of master of the ship in steering the ship and cooperating with icebreakers, tugs, ports, agents and ship brokers, as well as the authorities,” the association recalls.

The international development of remote pilotage – including obtaining IMO decisions - may be slow. In Finland, conditions should therefore be created for remote piloting to be one of the risk management measures also in international sea areas near the Finnish coast, especially in the Gulf of Finland. Discussions with Estonia and Russia are therefore necessary.

Help with fairway and port planning

The Pilots 'Association also offers pilots' expertise in the design of fairways and harbour basins. The union recalls that the cost of simulations is estimated at tens of thousands of euros, but fairway projects at

tens of millions. Simulations can be used to ensure that the fairway plan is safe and feasible for navigation. Cooperation between designers and pilots is important.



The operation of ports is being developed e.g. in the international MASSPorts project.
Photo: ©HaminaKotka Satama Oy

Developer pilots Joakim Kantola, Ville Mattila and Timo Nummi participated in the e-Pilots development day in Turku at the beginning of June.

Photo: ©Finnpilot

Developer pilots cautiously curious

In the spring and winter of 2021, Finnpilot selected three developer pilots. Their task is to bring pilotage expertise to remote pilotage projects and at the same time develop into a remote pilotage expert themselves. Exporting information to pilots is also an important part of the task.

The pilots have discussed little about remote piloting so far - but the role of the developer pilot was of interest. Almost every tenth pilot applied for the position. The selection was made and the chosen pilots are Joakim Kantola, Ville Mattila and Timo Nummi. Kantola operates in the Gulf of Bothnia, Mattila in the Archipelago Sea and Nummi at Kotka area.

In May 2021, the role of developer pilots was just taking shape. Here are their views on remote pilotage, its preconditions and ideas for the role of the developer pilot.

Joakim Kantola:
The discussion is still limited

Joakim Kantola believes that in the initial phase, remote piloting would be best suited for a short, straight, and wide fairway.

According to Joakim Kantola, who acts as a pilot in the Bay of Bothnia, the pilots have so far discussed little about remote piloting.

"No one really knows anything concrete about it yet, and maybe the matter has been approached with a bit of humour as well. Perhaps as much has been said about autonomous ships. But the debate is likely to intensify as more information becomes available. At the beginning of May, there was already an article on Finnpilot's intranet."

Kantola is one of the three developer pilots selected in spring 2021. He is curious about the task: it is interesting to see what kind of technology is available, how remote piloting could be implemented. There are many challenges.

Kantola emphasizes the importance of human knowledge as one part of the pilot's work. When a pilot meets a skipper and other crew on a ship, he or she quickly gets a picture of what the crew on the ship is like, whether it is calm or nervous, how the pilotage progresses.

"Sometimes there have been isolated cases that a skipper has been drunk. How do you detect it remotely?"

“Sometimes ships rely on pilots too much, and let the pilot take care of everything. Large ships have large crews and there may be five guys on the bridge. In small ships, the captain is often on the bridge alone, and when the pilot goes aboard and drives the fairway, the skipper goes to the computer and only sees his back. If the skipper is alone, the pilot will replace the mate at the same time. If something happens, the bridge may have quite a bit to do. On small ships, the skipper and mate are driving 6/6 watch, they may be tired. How will remote piloting succeed then,” Kantola ponders.

“But a ship with only one man on the bridge hardly would not be piloted remotely.”

A prerequisite for remote pilotage is that it is at least as safe as current pilotage.

“The first thing that comes to mind is that a ship that now sails without a pilot is suitable for remote piloting. Remote piloting could be a support service for those with a line pilot license. You might want to try this at the beginning. You could start with a short route that is as straight and wide as possible.”

Kantola emphasizes that before the introduction of remote piloting, pilots need training – in addition to the underlying experience and training. You need to know the system, how to perform remote piloting, what tools and information are used. The crew of remotely piloted vessels also need training.

“One can even think of a model where the ship would be piloted remotely near the harbour basin and the harbour pilot would take care of the rest. Perhaps lastly, remote piloting would be suitable for a ship using a tug.”

Sometimes the captain manoeuvres and the pilot instructs. “If the remote pilot is in some booth, how can he see how the skipper is, for example,

preparing for a turn. Delay comes easily and this is a challenge that needs to be addressed. You can see on the bridge if the crew is unsure."

According to Kantola, the technology must be mainly on the fairway and on land. A similar service must be provided for each ship. And ships should also be held accountable: not everything always works on all ships, even if they should be fine. If the technology is on the fairway, one element of uncertainty is left out. Appropriate qualities must be required of ships and crews, and training of crews.

Some company presentations introduce very autonomous ships. Often, even large ships cross a narrow fairway, almost like a river, and everything works out nicely, at least in demos. However, Kantola reminds that if the edges and shores of the fairway are close, the technical implementation is much easier than when there is extensive water, and the obstacles are under water.

Kantola sees the task of a developer pilot also to be to take messages in both directions: to and from pilots.

"I would see the task of assisting experts and evaluating the suitability of different technical solutions for remote piloting. And I am also happy to discuss pilotage issues with colleagues and go through concrete issues and new technology with others. It is good that the pilots have been involved in the development work already at this early stage," says Kantola.

Ville Mattila:
A hybrid model could be good

Turku pilot Ville Mattila was looking forward to becoming a developer pilot.

“Remote piloting is something that pilots must of course be involved in developing. At some level, it will certainly come, and the integration of future technology with maritime skills should also be seen from the perspective of pilots,” says Mattila.

Ville Mattila emphasizes that the professional skills of pilots should be used in the planning of remote pilotage.

There is still a lot of ambiguity and uncertainty in remote piloting. Remote pilotage includes ships, their technology, crew skills, fairways, watercraft and boat traffic, technology, communications, ports, tugs, berth crews, and weather and seafaring. It is also under consideration whether the remote pilot would handle the pilotage alone, whether he would perform his duties from the remote pilotage point, where the remote pilotage begins and where it ends.

“I would see that there could be hybrid remote piloting in the future. The ship would come in with the assistance of remote piloting, for example in archipelago areas, and the pilot would board the ship there and pilot it into the harbour. Safety and pilotage security would also increase if the pilot did not have to board a ship on the high seas in bad weather.”

Mattila thinks that many issues still need to be clarified before remote piloting can be introduced. The whole of pilotage is diverse and consists of many variables – not least the human factor. The technical solutions developed on the engineer's desk alone are not enough. Smooth and reliable communication is paramount. Remote piloting is not suitable for all ships: especially on ships sailing under the flag of convenience, the level of competence of the crew is very varied. Some shipping companies go for more of a money first ideology, rather than having maritime experts making the decisions.

In the port, the pilot's work also essentially involves working with tugs. Mattila thinks that managing it remotely can be challenging. Harbour manoeuvring is one separate element. But in fairway sailing, remote piloting might be the easiest to take advantage of.

“On the technical side, I'm still a little worried. Pilot work is a lot of anticipation. When entering congested fairway areas, the flow of information must be virtually delay-free. Transmitting a visual image to remote pilots in all conditions requires a great deal of bandwidth and very fast connections to replace the human eye.”

However, Mattila believes that a technically advanced vessel that has a qualified crew prepared for remote piloting on a simple fairway section, remote piloting can very well be successful.

In his view, it is essential to ensure that the ship's crew is capable of remote piloting.

Northern European manned ships in line pilotage are perhaps best suited for the early stages of remote pilotage. Different ships also have different capabilities: fast ro-ro, passenger and tankers invest in high-quality equipment. Their shipping companies could be interested in investing in technology, and reduce e.g. retardations brought about by the weather.

Mattila, who works as a pilot in Turku, also reminds of one of the challenges and risk factors of remote pilotage: recreational traffic. The Archipelago Sea can have several hundred pleasure boats in traffic at the same time.

Funding for remote piloting is a big question mark. Many shipowners have such small margins that they hardly have the resources to start investing in new technology.

Mattila reminds that although remote pilotage may now seem like a distant thing and behind many bends and problems, the development of technology can be very fast.

“Pilots have been using iPads as a technical aid for several years. We get exact data for our own devices. Monitoring the information available has become part of the pilot's daily life and at the same time safety has increased. Hardly anyone is terribly opposed to this development. The industry is already used to the fact that one element of the work is technical monitoring and supervision, and we work with them,” says Mattila.

“It is great that for the time being, the common interest of technology, authorities and professionals has been discovered in Finland to create new and build remote piloting together. Many industries and actors put a lot of resources into maritime development,” says Mattila.

Timo Nummi:
Reasonably, not quickly

One of the developer pilots selected in April, Timo Nummi, expects a lot from the new task. He believes remote piloting is going sensibly – he doesn't believe in quick steps.

“It has been rare in shipping to include those working on ships in the development. The lay-out of the bridges is often decided by a design engineer who never has sailed the ship. Radars have been positioned on ships so that you cannot visually see out. It is great that Finnpilot gives pilots the opportunity to be involved in development work. The world is moving forward, and we must be involved in development,” says Nummi.

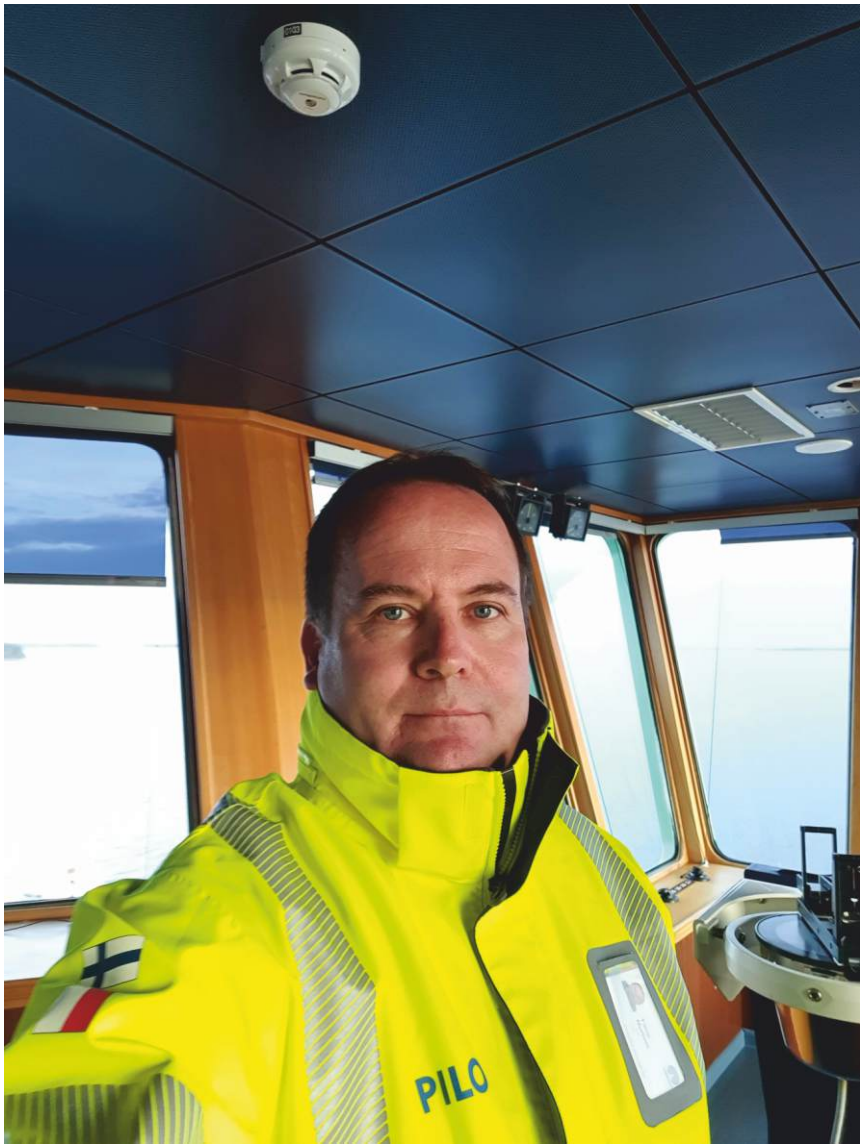
Nummi, who has had a long career in shipping, has seen a major change in technology since the 1990s.

He has always been interested in technology and its development, and that was one reason to apply as a developer pilot. He thinks that pilots in general are still skeptical about remote piloting - the functionality of the technology and the verification systems are questionable for those doing the practical work of the pilot.

Nummi expects the new task to be, on the one hand, to bring information to the pilots and, on the other hand, to bring the pilots' expertise into remote pilotage planning. The developer pilots will continue their pilot work alongside the new task, and information will pass through them at the pilot stations. The job description develops more precisely over time.

Already in the early days of its mission, the developer pilots met with representatives of companies developing technology.

There was a lot of interesting information – partly maybe even about the futurist.



Timo Nummi thinks that effective communication is a big challenge for remote piloting.

More security

Nummi believes that remote pilotage must be at least as safe as the current one before it can be switched on.

“Communication is probably the biggest challenge. Technology in general and backup systems need to go a long way before remote piloting is realistic. Operation must be 100% secure at all times. There is a challenge.”

Nummi estimates that remote piloting could start selectively in terms of ship, weather conditions, fairway and port. Remote piloting requires a lot from the ship, crew and technology; the routes to be chosen must be simple and safe - and there are few of them in Finland.

“A Chinese ship may not be the first pilotage by remote control. The starting point could be to offer remote pilotage to an ocean liner with a Scandinavian crew.”

Nummi estimates that the remote pilot will not manoeuvre the ship to the port or quay in the future either. One possibility is that remote pilotage will be provided from the pilot station in front of the port. In the port, the ship would be controlled by the master or the port pilot, who would also manoeuvre the ship to the quay. A remote pilot could handle communication with tugs.

“I don't think the ship would be driven to the quay completely remotely. Manoeuvring and berthing of a vessel must be done on the bridge.”

“I understand that the plans do not even aim for the remote pilot to pilot the ship to the quay, but the remote pilot aims to navigate the fairway. There must be someone manoeuvring the ship on the bridge.”

Nummi has a long history of line piloting. In practice, maintaining a line pilot book is a major challenge, and Nummi estimates that remote piloting could bring relief; it would facilitate the movement of at least

some ships. Finnpilot could enter the line piloting market through remote pilotage. At present, container ship masters are not very interested in completing a line pilot license PEC (Pilot Exemption Certificates), at least in part due to complex requirements. “Here, remote piloting could be an opportunity to provide the master with an easier way to complete a remote pilotage license when the level of requirements for the drawing test would be easier,” Nummi thinks.

For pilots interested in technology, developing remote piloting is interesting and challenging.

“We are experts and advisors to developers, in collaboration. It is important that important elements of pilotage are included in remote pilotage. We are now looking for a body for remote piloting and our job is to tell the developers about the current pilotage. Important elements of current pilotage must be included in remote pilotage.”

Photo ©Tapio Tuomisto

Working together forward

Finland is one of the world's leading countries in the development of shipping – at least in our opinion.

However, the view has strong grounds. Numerous projects are under way in Finland, including autonomous vessels, digitalisation in shipping, smart fairways and remote pilotage. The projects involve a wide range of actors: universities, research institutes, industrial companies, public authorities, shipping companies, trade unions. The cooperation is assured to be good and confidential.

Here are the views of a few maritime operators.

VTS Finland's Jouni Patrakka emphasizes that the efficiency of the operating model is important in the development of remote pilotage. Duplicate functions should be avoided.

Sinikka Hartonen from Suomen Varustamot ry reminds that combining the expertise and trust of different actors is Finland's strength. We have to go ahead, but realism must be remembered.

Janne Lahtinen, who is writing a dissertation on remote piloting and working at Finnpilot, says that remote piloting could technically be implemented at any time. However, there are no financial incentives.

According to Robert Nyman of the Finnish Engineers' Association, remote piloting and digitalisation are advancing, but the pace is slower than sometimes estimated. However, the direction is clear – autonomy is increasing.

Jouni Patrakka:

Cooperating toward remote piloting

VTS's Jouni Patrakka emphasizes that efficiency must be sought in remote pilotage as well

According to Jouni Patrakka, VTS Finland's business area manager, the model of remote piloting must be applied for through cooperation and experiments.

“Development work must be based on the efficiency and appropriateness of the operational operating model. The basic challenge is the relationship between the remote pilotage service and the current or future VTS service. They should be mutually supportive, not overlapping,” says Patrakka.

Different operating models are available for remote piloting. Patrakka believes that a good and functional model is formed through experiments.

“If the nature of remote piloting remains the same, that is, that the service provided by the pilot is similar to that when the pilot is on board, the situation for us will hardly change from the current one. There is little concern if the exchange of information with the VTS service will remain as it is today. If so, there will be no major change. Agree only, how the information is exchanged, how the communication is handled technically and how sufficient information is obtained from the ship. "

There has also been some discussion of a lightened model.

“Of course, it is not for VTS Finland to comment on whether it makes sense to go for one. But if the pilot mainly provides only information, of the same

type as what VTS offers perhaps a little extra, the service will start to overlap with VTS. It could be ineffective."

If the remote pilotage service were to be extended to all vessels with some lightened model, the role of pilotage should, in Patrakka's view, be reconsidered. He recalls that VTS offers the same service to all vessels.

No duplication

He sees the role of VTS mainly as a producer of information for the remote pilotage service.

"Everything has to start with efficiency. Duplications must be avoided in the scope of the service provided by the state."

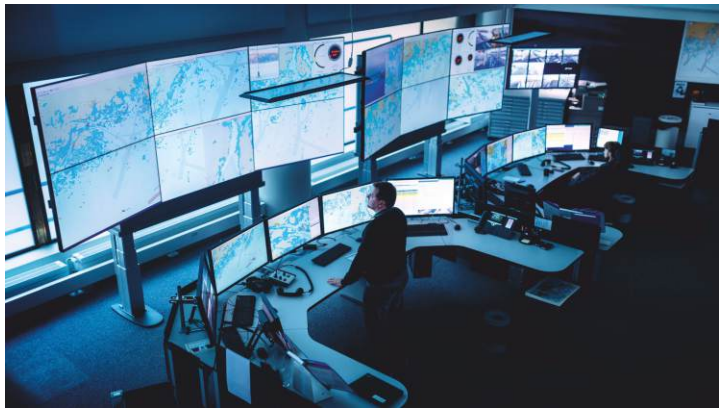
VTS's current sensor system is sufficient for the need for a modern form of VTS service. Whether remote piloting needs different and perhaps more accurate information will only become clear once the actual operating model is in place and approved.

VTS Finland is actively monitoring the progress of the Sea4Value project.

"There is still no discussion on how communication between the ship and the pilot and between the pilot and the VTS will be handled.

Remote piloting must not unilaterally change the dynamics between traffic and land-based activities."

Patrakka emphasizes that the development of remote piloting must be done together, in cooperation. The vessel traffic service is also evolving and changing, also in terms of legislation. Finland differs from most other countries in many ways: our difficult fairways and harsh winter conditions have guided the formation of the current service model, where pilotage is a special assignment company entirely owned by state and the VTS service covers all merchant shipping fairways in Finland. The experiences of other countries cannot be copied as such without careful consideration.



VTS centre's working environment. Photo: ©Fintraffic

"Of course, Finnpilot Pilotage decides how it wants to implement remote piloting. We try to support the implementation of the service. We are prepared to provide information and conceptual services, and why not an operating point as well. We are preparing for remote piloting with different technical scenarios, operational scenarios cannot yet be done," says Patrakka.

In his view, the current roles are clear: the VTS will provide the vessel with information on the traffic encountered, deviations and conditions of the fairways, and, if necessary, organize the traffic and provide a navigation assistance service. VTS does not provide support for steering the vessel; The activity is to inform the ship that they know the position of the ship and understand what should be done. If the role of remote piloting is to act as a remote advisor to a fairway situation, there may be overlaps

"From the ship's point of view, pilotage in its current form is intervening with manoeuvring. At a more general level, we take a position on the movement of the vessel and provide information on the control of the traffic as a whole, as a common situational picture of how the traffic flow works for all vessels."

Janne Lahtinen:

There are no financial incentives

“Remote piloting is progressing all the time, in concrete terms. If you want to put enough incentives to it, then it can be done next week even. After all, a person went to the moon when there were enough incentives for it.

If desired, we can hit the ship so full of technology that it can be controlled - not just monitored – remotely. So far, there are no financial incentives,” says Janne Lehtinen, Finnpilot's project manager. He also works as a maritime lecturer at Satakunta University of Applied Sciences and is writing his dissertation for Aalto University.

Lahtinen is promoting remote piloting as part of the Sea4Value Fairway project. The project will implement a remote piloting experiment in January 2022.

“The demonstration shows what has been learned. Additionally, it shows how the remote piloting process and especially the fairway structure that enables it is being understood. We need some hands-on operation to get us to chew on things. Remote pilotage is approached through a use case.”

According to Lahtinen, it is precisely the fairway structure that has the greatest technical added value generated by digitalisation.

Communication enables remote piloting.

"If we accept that a pilot works at a remote monitoring or pilotage centre, he or she must have situational awareness. It cannot be built in the same way as on the bridge, but it must be adequate."

According to Lahtinen, until now, the development of autonomous traffic has been based on the development of vehicles, such as the car.

"There is nonexistent intelligence in the road structure for cars on highways and in the streets. In motoring and shipping, too, it has been assumed that the infrastructure will not change. If car traffic were to be developed now, it would be unthinkable that the cars would be driving at a speed of 100 kilometres a meter and a half away without basic infrastructure being developed. Even on ships, the first feelings of autonomy were based on similar thinking."

Added value for everyone

"If we are going to develop more autonomous maritime traffic, we need payers for enabling technologies. We need to focus on technical solutions that add value to all fairway users. Not to change the ship, but to change the fairway where the ship is. Creating operational added value for the shipping process. This will improve the overall safety of the fairway structure," says Lahtinen.

He emphasizes that traffic – both at sea and on land – is a joint gaming operation. If technology is used that improves the safety of all, merchant shipping will also receive significant added value.

According to Lahtinen, we will gradually move towards the 2022 remote piloting experiment.

"We are beginning to understand how the demonstration will be carried out, what kind of practical changes are needed, what they are aimed at and what kind of changes are needed in the fairway structure, for example. Now we know the demonstration of the month and the ship, but

much, for example, the weather, is a mystery at this time. The test tells you what happens to that ship, that crew, that pilot, at that time of the year and that time of day, in that weather, on that fairway. We learn that in this context, the test went like this."

Thus, one experiment does not provide answers to almost all the questions of remote piloting.

"The fairways are different. So are the pilots."

Lahtinen estimates that the importance of standards in remote piloting will inevitably increase. For example, in terms of communication, we are going in a more regulated way.

"Perhaps, like air traffic control, it is said that it takes 5 minutes to start a turn. This is very essential in building trust. The pilot on board has a calming effect: he brings know-how and perhaps calms even the tensest crew. At a distance, a relationship of trust must be built somehow differently, but it must be built anyway. Communication is important in that. If you are driving a car to Ruka, the navigator can announce that you will stay on the main road and the next turn will be 50 kilometers. It does not make the announcement because the driver could otherwise steer into a ditch, but because so that the driver would be convinced that the device works. The same goes for remote piloting. A relationship of trust is not between two people, but the relationship of trust between man and the system. The pilot represents the system and certain operational standards ensure that the remotely piloted vessel can trust."

More things stay than change

According to Lahtinen, it is important that communication about projects and their progress works.

"Pilots have fears and suspicions about remote piloting, but also an interest in being involved. The opportunities for development to provide support to pilotage must be reported."

In his view, at least some kind of automation is coming: different ways to monitor the vessel's state of motion and validate the information related to the vessel's position. However, no people will be removed.

“I think there are more things in remote piloting that won't change than things that change.”

“In the future, there will also be a ship that must have a device that transmits information about, for example, the dynamic state of the ship to the shore with the least possible delay. There is a crew and there is a pilot. Building a pilot's situational awareness is different in remote piloting, but the goal is the same: to navigate the vessel on the fairway structure as safely as possible without endangering the vessel, crew, and marine environment. Means of access to the finish line are changing.”

In his dissertation, Lahtinen explains what a pilot needs to know in remote piloting, how information retrieval is built.

In the Istlab project, he has used an eye movement analyser in the simulation to find out where and for how long the pilot looks, what information the pilot has retrieved, what information he or she is viewing, in a piloting situation, for example, while turning is in progress.

“We tried to understand the formation of a situational picture. The weakness was contextuality: the analysis involved only one pilot and only one ship, even though the test was repeated four times.”

Sinikka Hartonen:

Combining expertise develops Finnish shipping

One of Finland's strengths in maritime development is an atmosphere of trust and a common desire to achieve results and create ecosystems. Knowledge sharing will play an important role in the development of future shipping.

Sinikka Hartonen from Finnish Shipowners' Association emphasizes that a holistic view is needed in the utilization of automation.

"The possibilities of technology must be introduced, and we must move forward all the time, but with realistic goals and steps," says Sinikka Hartonen, who is responsible for the environment and technology at Finnish Shipowners' Association.

She points out that digitalisation and automation have long been used in shipping.

"In recent years, technology related to, among other things, various sensors has evolved considerably. In addition, telecommunication connections and data management methods have improved. There are workable solutions at a reasonable price. This will contribute to the wider deployment of new equipment and systems. All of this creates the basis for the industry to gradually take leaps in the use of automation", Hartonen says.

In her opinion, however, utilizing automation requires a holistic or holistic perspective, and a bit of realism in painting visions and scheduling goals. We are now considering what can be done with increasing automation and all the information.

“The priority is not to remove the person from the ship, but how we can support human decision-making and the work of the seafarer with all this, and development will lead to safer, more environmentally efficient and economically viable shipping.”

Better safety

In Hartonen's opinion, a good example of the development is the ongoing work, which is looking for solutions to how the lookout on the bridge can be supported by means of technology. As another example of interesting development paths, she cites the use of knowledge and the utilization of analytics.

Pilotage is one part of maritime safety. Hartonen believes that with the help of various sensors, systems and sufficiently reliable data transmission, traditional pilotage can develop towards remote pilotage.

Hartonen does not believe in large and rapid changes in remote piloting but estimates that it will develop gradually.

“Progress towards remote piloting is likely to be made through various intermediate stages. Already today, pilots have comprehensive information about the vessel being piloted and the prevailing conditions. In the future, the coverage and accuracy of the information will certainly improve even more. This will also improve the possibility of providing pilots with a better picture of the situation and situational awareness”.

Hartonen believes that the development of data transmission connections is key.

The term “connectivity”, which often flashes in speeches and writings, i.e. the networking of different devices and the data transfer between them, is a key factor in e.g. in advancing remote pilotage and ultimately in the transfer of the pilotage operation from ship to shore.”
Vessels of Finnish shipping companies often operate on the fairways under the guidance of the holder of line pilot certificate or pilotage exemption certificate, but pilots are also used. “Since it is a question of maritime safety, Finnish Shipping Companies has an interest in developing pilotage so that the pilotage operation is safer and smoother.”

The shipping companies have not yet thoroughly thought about what remote piloting could mean and offer in concrete terms, but Finnish Shipping Companies considers it important to be involved in remote piloting development projects.

"We want to promote and support everything that is part of maritime safety.”

Synergy must be sought

Hartonen believes that the development of remote pilotage is a natural step in the ongoing change and development of shipping.

“The shipping professions are changing, and maybe so the pilot profession is changing too. It is important to remember that change does not make maritime skills unnecessary. However, it is worth considering what synergies can be achieved in the future. For example, VTS does its own kind of operation and pilots have their own role. What benefits could be gained if these activities were closer to each other in the future - especially at a time when remote piloting is becoming a reality?”

Hartonen estimates that shipping is now going through a transition period.

“We and the world do a lot of good experimentation and great research. The atmosphere is somehow waiting.

Perhaps we are now waiting for the moment for the solutions made possible by digitalisation to begin to be taken seriously and widely used by shipping companies. We are moving towards more seamless ecosystems, in small but sure steps."

There is also a phase of change that there is not yet a unanimous definition of all the terms. Hartonen takes the smart fairway, for example. "It's still looking its shape, what exactly it is, what it can produce. Even now, the pilot on the fairway can sometimes adjust the safety devices according to the conditions, and various sensors or data transmission devices can be connected to the safety devices. But what else can a smart fairway be and what does it bring to the world of virtual security devices - I think there is still something to think about."

Hartonen talks about ship automation rather than autonomy. Autonomy when often creates the image of a ship plowing the sea without seafarers. There are different levels of automation, and it has not yet been clarified how different levels or the scope of use of automation are defined or what all that automation can or wants to do.

One part of the change in shipping is regulation. The IMO is working to modernize legislation to suit changing shipping. Hartonen believes that it is important that regulations keep pace with technological developments, and at least do not constitute an obstacle to safety-enhancing developments.

Hartonen considers the remote piloting experiment, which is taking place at the beginning of 2022, to be an interesting and welcome thing.

"It's really good that experiments are being done on a real merchant ship and a real waterway. If tests were performed only on small test vessels in closed open sea areas, the leap into real world and fairway driving would be too great. A great step forward and an indication of what we in Finland can achieve when there is a desire to develop and combine know-how to achieve results."

Robert Nyman:
Remote piloting would change work tasks

The Finnish Engineers' Association estimates that remote pilotage would reduce or at least change the work tasks of pilot boat operators belonging to the association at sea. On the other hand, occupational safety would improve.

The Association does not believe in very rapid changes. Executive Director Robert Nyman estimates that it will take another 5-10 years to introduce remote pilotage. Autonomous maritime transport requires an even longer period, perhaps 10-20 years. Increasing autonomy and income is still the future.

“It remains to be seen how much will change. The development also requires a lot of changes in international maritime legislation,” Nyman emphasizes.

He estimates that the start of autonomous traffic could only take place on certain types of vessels, mainly container vessels, and on certain types of routes.

The digitalisation of shipping and the increase in automation will significantly change the tasks of engine officers: ship automation will largely replace the work done in the past. Work patterns would change, and more maintenance, for example, would probably be handled in harbours. The union does not believe in significant employment effects, at least in the near future.

“Education will change more toward learning electrical engineering and automation, etc.,” Nyman expects.

The Finnish Engineers' Association is closely monitoring the change in shipping. The association has participated in various working groups and issued opinions on developments.

“Otherwise, the discussions have been quite small. There has not been much discussion about what the future will be for engine officers. Discussions have focused on the development of automation, alternative fuels, and these types of issues. There has not yet been a joint lobbying with other associations in the industry, but in the future, yes,” says Nyman.

Photo ©Luotsiliitto/Matti Elomaa

The book was written by the non-fiction writer, Antti Rinkinen, Master of Social Sciences. His previous books include, among others, the 100 years of the Finnish Pilots' Association **Leettari – 100 years of lobbying** together with Juha Tulimaa. In addition, he has written e.g. the history of Stora Enso's Imatra mills and the history of a South Karelian metal company. His works also include the histories of the two foundations as well as a couple of biographies.

Rinkinen has worked for a long time in the press as a journalist and developer of electronic services. Today, he works as an entrepreneur and non-fiction writer.

Finland's first remote pilotage of a cargo ship will take place at the beginning of 2022. The first remote pilotage permits may be issued in 2025.

Many think that the technology for remote piloting already exists. There is still a lot of work to be done: the pilot's understanding of the bridge must also be available in the technical environment of the remote pilotage centre. The situational picture must be correct, the data transfer must be secure. Communication between the pilot and the crew must work. Remote pilots must have information about the ship's events. The ship and its crew must meet certain requirements. A lot is also required of the fairway.

Prior to remote piloting, there must be assurance that safety will be maintained at least at the current level.

All of these are being developed in numerous projects.

Shipping is evolving and digitalizing. Development has been slower than some believed in the 2010s. The steps may be small, but there are many of them, and they go in the same direction: harnessing technology, reducing emissions, and improving safety.

This book discusses remote piloting and the development of shipping, and talks about development projects, experiments, and studies. In the book, experts – including pilots – share their views on the digitalisation of shipping.

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