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# Remote Pilotage: The Profession of Maritime Pilot in a Changing Landscape

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## ABSTRACT

Maritime pilots are the key actors of a public service established by coastal States to facilitate maritime trade, protect the safety of life at sea, and ensure the integrity of the coastal marine environment. Once transferred onboard the ship, the pilot coordinates with the bridge team as an adviser whose local knowledge, expertise and independent judgement are officially recognized by the national authority. Since the time when merchant ships and pilot boats were propelled by wind and used sails, ships evolved and became more sophisticated, but the mission of the pilot remained the same: to help the bridge team to safely and swiftly move the vessel into and out of the port. Pilots operate in dangerous work contexts all year round, night and day, in all sea and weather conditions, onboard various types of ships. A new concept of 'remote maritime pilotage' has appeared and may change the working conditions of a profession whose existence dates to the beginnings of maritime trade. In remote maritime pilotage, the pilot assists the bridge team from the shore. The pilot is no longer transferred onboard the ship and has therefore no more physical contact with the ship's bridge. While technology development is underway for remote pilotage, this study outlines the changes expected in the way maritime pilots perform their mission and to what extent this new concept may solve some of the challenges faced by the profession.

**Keywords:** Remote, Pilotage, Maritime, Pilot

## INTRODUCTION

The United Nations Convention on the Law of the Sea, which regulates both the right of innocent passage of ships through the territorial sea (Article 17) and the right of the coastal State to adopt laws and regulations for the safety of navigation, the regulation of maritime traffic and the protection of the marine environment (Article 21), is the legal instrument of reference regarding the enforcement of maritime pilotage by coastal/port States in port approaches and within internal waters (ports, canals, rivers). Exemptions exist for experienced ship masters, who can be granted a Pilotage Exemption Certificate (PEC) after an examination. Either designated as the 'local guide', or 'advisor', or 'assistant', or 'expert' (local geography, local communications, local rules and procedures) to the captain, depending on the national laws and practices, the pilot conducts the ship (which remains under the master's command) into and out of ports, thereby contributing to the safety of navigation. "The rule that the pilot is only a helper and a counsellor, while

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the master continues to command, was considered by Rodière to be common to all nations" (Comité Maritime International, 2025).

Maritime pilot is an occupation which is difficult to get into. Candidates need to undergo training in a maritime academy, and to serve at sea for several years (usually 4-5 years) as licensed navigating officers. They should also complete a Bridge Resource Management (BRM) course. After being selected to become pilots (physical ability is one of the selection criteria), they serve as apprentice pilots. At the end of their training program, if they satisfy all the requirements, they take a license examination to become limited-license pilots (limit on ships under a defined length). After working for a certain number of years, they are appointed as full pilots (British Columbia Coast Pilots, 2025; Maryland Department of Labor, 2025).

Maritime pilot is a stressful profession exposed to occupational risks (Main & Chambers, 2015). The most dangerous moment in their mission is when they climb (unsecured) onboard the ship, by the means of a ladder made of rope and wood, in between two ships moving independently from each other. Statistically, greater risks are observed when the pilots transition from the top of the pilot ladder to the ship deck (Marine Accident Investigation Branch, 2023). Every year globally, two pilots lose their life in performing their duties (Clayton, 2023; Marine Accident Investigation Branch, 2026).

The International Maritime Pilots' Association (IMPA) launched in November 2024 the International Study on Remote Pilotage. The first phase consists of an analysis of the concept of remote pilotage as a socio-technical system, with an emphasis on the human factors; the second phase is an assessment of the current state of technology. So far, the technological options submitted are not advanced enough to permit trials. On the one hand, remote pilotage eliminates the occupational safety risks associated with pilot transfer. On the other hand, it reconfigures the relationship built between the pilot, the master and the crew, which is the cornerstone of the profession of maritime pilot.

The pilotage of ships from a place which is not the ship's bridge is not completely new (Brooks, Coltman & Yang, 2016). There are cases in which remote pilotage is authorized, particularly in case of adverse weather. In Portugal, Decree-Law No. 48/2002 of March 2 on maritime pilotage, Annex I, Article 4 relating to Remote Pilotage reads:

> Whenever weather or sea conditions do not safely allow the pilot to embark within the established limits, the service may be provided by remote assisted piloting if it is accepted by the vessel's master and provided that the safety requirements defined in the port regulations are met.

In France, the Gironde estuary is covered by a radar surveillance system. The equipment available to the Gironde pilot station allows pilots to remotely carry out their mission of providing navigational assistance to vessels in accordance with the local regulations. Remote pilotage is executed exclusively by a maritime pilot, and only in good weather (Gironde Pilots, 2025).

In the UK, there was a case in which remote pilotage was conducted from a launch (Marine Accident Investigation Branch, 1998). The COVID-19

pandemic also provided justification for remote pilotage (Dolan, 2020). They remain marginal cases. The maritime pilotage service is still carried out today as it has been since the days of sailing ships, that is, by transferring the pilot onto the ship.

In many industries, for example the mining industry, automation and digitalization have disrupted traditional operational models. What can be anticipated in the case of maritime pilotage? This study summarizes the changes expected in the way maritime pilots perform their mission and to what extent this new concept may solve some of the challenges faced by the profession.

## MARITIME PILOTAGE IN A CHANGING CONTEXT

To analyse the prospect of remote pilotage in regard to the safe operation of ships, ten marine accident investigators (referred to hereafter as Investigators A, B, C, D, E, F, G, H, I, J) from eight countries (Denmark, France, Japan, the Netherlands, Portugal, Singapore, Sweden, the United States) were interviewed and asked the following question: "Based on your experience as an accident investigator, what do you think of remote pilotage?".

To draw a parallel with the mining sector and look at the way remote operators conduct surface mining assets, two automation experts (referred to hereafter as Automation Expert A and Automation Expert B), from Australia and the United States, were interviewed and asked the following questions:

- What changes in the stakeholders' roles are introduced by remote operations?
- What essential information should be communicated before remote operations start?
- How is the reduced sensory input compensated during remote operations?
- What are the procedures in case of an emergency (such as a communication breakdown)?

Investigator D highlighted that advancements in Dynamic Positioning (DP) systems and the extension of their use beyond the offshore industry, with DP systems now fitted onboard cruise ships, yachts, and research vessels, may impact pilotage.

### Dynamic Positioning (DP)

A dynamically positioned vessel "automatically maintains its position and/or heading (fixed location, relative location or predetermined track) by means of thruster force" (International Maritime Organization, 2017). DP systems were first introduced in the offshore industry to keep vessels stable in a position or maintain them at a certain distance from floating assets to prevent "loss of life, severe pollution, major damage and economic loss" (International Marine Contractors Association, 2016). DP vessels were typically found as support bases to diving and remotely operated vehicle (ROV) operations; performing high-precision tasks in the close vicinity of oil rigs (supply vessels); and carrying oil from the offshore field to port (shuttle

tankers). With the development of DP technologies, there are presently three DP classes of vessels (DP1, DP2 and DP3), depending on the level of their redundancies. The collection of multiple data through sensors (wind, current, water depth, etc.), the adaptation of the predicted steering to changing conditions (e.g. wind gust), and the use of thrusters result in a really accurate control and manoeuvrability of the ship.

When asked about the changes associated with the transition towards automation, Automation Expert A cited three pillars: people, processes and technology. He also emphasized that the success of the transition relies on bringing people along for the journey. Indeed, people monitor/operate technology, with the support of rethought processes. And the technology should be designed to adapt to the work to be done.

### New Technologies Create New Working Environments

Automated data acquisition is based on sensors, instrumentation and connectivity. In the mining industry, Automation Expert A explained that sensing technologies for collision avoidance (vehicle-to-human, vehicle-to-vehicle, vehicle-to-hazard) exist. To the objection formulated by Investigator C, who stressed that remote pilotage would involve a reduction of sensory input for the pilot, Automation Expert A answered that smell is the sole sensory input that cannot be replaced by machines today. In automated surface mining, trucks and excavators are no longer operated from inside the cabin. Instead, skilled operators control them remotely, in a safer work environment, away from noise, dust and potential hazards. Advanced, real-time technologies allow visibility and control, giving the operator the feeling that he/she 'is there'. The use of Artificial Intelligence increases support to the remote operator in various ways, such as anomaly detection to alert on unsafe conditions, the identification of areas of interaction between different pieces of equipment, and the reduction of fuel consumption with efficient routing. In addition, simulation can help validate decisions before taking action. One operator can oversee multiple assets at once. In case of an emergency, such as a technical breakdown, solutions are in place with, for instance, a back-up remote operation station. It can also be an automatic stop of the asset if the remote operator stops responding (Automation Expert B). Teleoperation goes along with upskilling. For the remote maritime pilot, the integration of the data provided by new sensing technologies into the sets of data generated by the traditional navigation systems - mainly radar and Electronic Chart Display and Information Systems (ECDIS), in addition to the coordination with third parties (tugboats, linesmen) and the reporting procedures (Vessel Traffic Service - VTS), will require additional training. There will be a need to manage and check the reliability of newly generated data, for example in drone-assisted pilotage (DanPilot, 2025).

### Redefining Roles and Responsibilities

Automation creates roles that can be performed from a separate location. It also requires the involvement of new processes and actors, such as data analysts and technology specialists. The distribution of roles during pilotage

will need to be redefined when this service is provided from the shore. How is BRM running at a distance? Will the remote pilot still be able to give orders directly to the helmsman? How are mutual checks performed remotely? How do several remote pilotage operations coordinate in high traffic areas? "The meaning of remote pilotage is unclear. In the aviation sector, Air Traffic Controllers issue instructions (clearances) to flight crew remotely during all phases of flight that cannot be deviated from, unless the aircraft is in an emergency. In theory, this mode of operation can be replicated in the marine sector. However, there are constraints and limitations to implementing this model. The dynamic situation for all ships and pilots, when departing the port, would be challenging for remote pilotage. A remote pilot may not be able to see, in real time, a developing situation that may need immediate instructions to the bridge team member. A remote pilot would also not have the benefit of the feedback loop from bridge lookouts who can call out concerns directly to the pilot in order to take corrective actions in a timely manner. In addition, the remote pilot would not know each ship's limitations and maneuverability" (Investigator A). For every berth and every type of ship, the pilot will have a different approach; this is why the master/pilot exchange is so important for good pilotage. Planes are much more standardized than ships are. Also, unlike the aviation sector, the regulation of maritime traffic very often is fragmented across several competent authorities. This lack of interoperability and information sharing hampers innovation and true maritime traffic management (Brooks et al., 2016). The International Maritime Organization (IMO) fosters a more important role played by VTS centers whose systems are gaining increased connectivity with 'allied services', such as pilotage (International Maritime Organization, 2022). The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) is working in the same direction designing future VTS digital communication exchanges, including shared sensor data (IALA, 2024).

## DISCUSSION

To put into practice the concept of remote pilotage, there is a need for a strong change management process from the traditional pilotage service. It should be founded on a rationale, not simply the sake of putting the technology into practice. Remote operations in the mining industry are justified by both safety reasons and productivity reasons. Investigator C saw in remote pilotage more the satisfaction of economic interests than a real concern for the occupational safety of maritime pilots. The concept of remote pilotage may nevertheless solve some of the challenges faced by the profession. "There is a shortage of pilots in Japan, and although they are highly skilled, a considerable number of them are elderly. It may serve as one of the measures to address the issues that have become apparent, including accidents involving falls from pilot ladders and situations in which pilots are compelled to cease their professional duties due to physical limitations" (Investigator H). The psychologically and physically demanding nature of the work, together with the associated occupational health and safety risks (Main & Chambers, 2015), may also explain the difficulties in recruiting women. Remote pilotage may help create a more inclusive profession, with female pilots being more represented among the global

community of maritime pilots. Navigating ships based solely on screens will necessarily provide a different feeling for the pilots (Investigator G). It may also generate technostress. In the mining industry, with the benefit of user experience hindsight, non-essential displays have been removed to reduce the operator's cognitive workload (Automation Expert B). The sharing of mental models between the remote pilot and the bridge team, which is crucial for maintaining and updating situational awareness (Grøneng, 2023), will have to be done indirectly and by other means. Considering that pilots meet people from all over the world, from different cultures, it necessarily impacts communication. Remote pilots might feel deprived of their know-how, lack variety in their job, and find pilotage from the shore boring. From the vessels' perspective, remote pilotage might be more stressful for ship masters who will not have physically an 'extra help' on the bridge, while many preparations for the next call in port need to be done. The pilot must be the one who ultimately decides whether the remote pilotage operation is possible or preferable (for his/her own safety), depending on the type of ship, the weather conditions, tidal restrictions, and the added responsibilities to an already heavy workload (Investigator F). Investigator J reported that remote pilotage is under consideration by an internal working group on emerging technologies, whose scope extends to all modes of transport.

## CONCLUSION

Digital and automated technologies are about to change the profession of maritime pilot, just as they changed the profession of miner. As soon as technological innovations will allow the remote pilot to obtain real-time information from the ship bridge, and other areas, and that effective and secure communication mechanisms can be established to allow the remote pilot to support the bridge team, trials in real conditions will be able to take place. But technological aspects are not the only ones to consider. Greater connectivity and integration of data with the other stakeholders involved in maritime traffic management, such as VTS centres and port authorities, will be the key enablers of this transition. Significant change management by the community of maritime pilots, who will need to add a new skillset to their expertise, become more 'digitally literate' and adopt a new work environment, is a requisite. Furthermore, remote pilotage may help address an aging demographic of pilots and create a more inclusive work environment, providing opportunities for women. Finally, the prospect of another change for maritime pilots is looming on the horizon with the progressive entry into service of Maritime Autonomous Surface Ships (MASS).

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