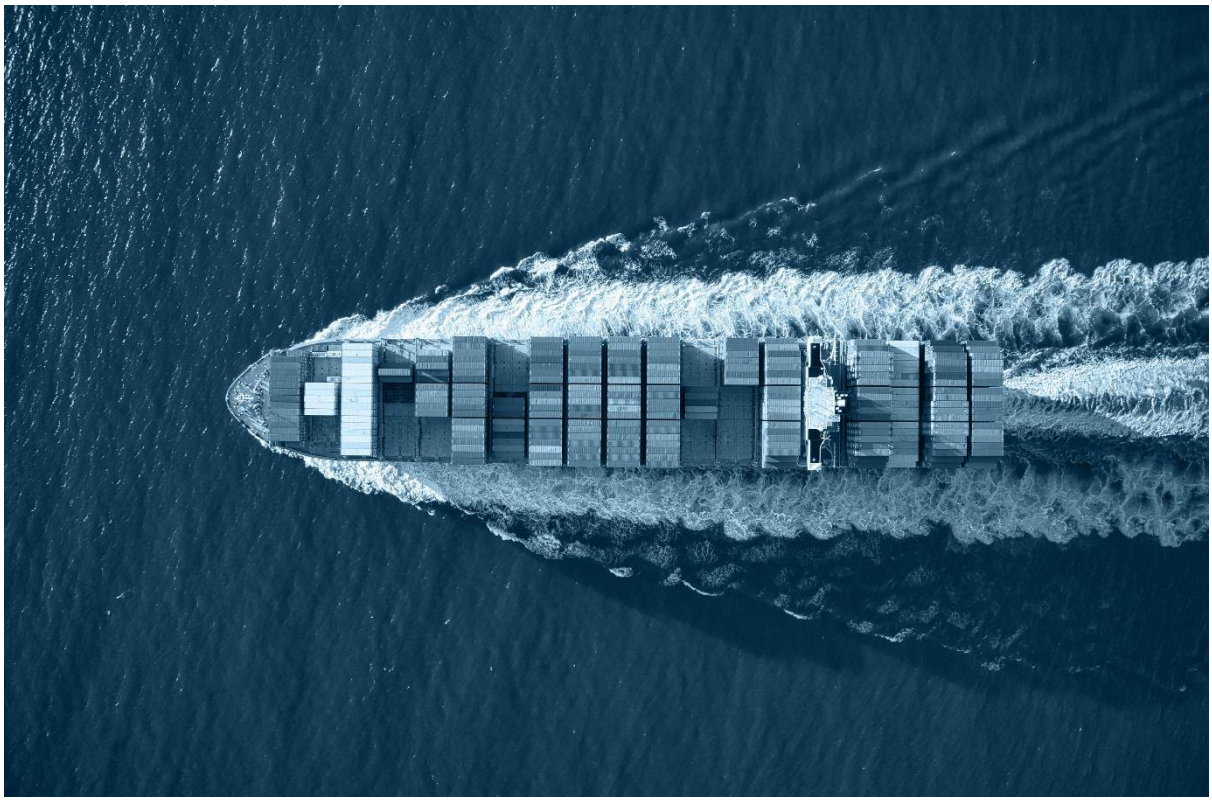
ADMO Deliverable 1.1. - Report on Use Cases and KPIs



Introduction

Digitalization in maritime operations uses technologies like sensors, AI, and automation to improve efficiency, safety, and environmental impact, opening up new business opportunities. However, achieving stable, high-speed connectivity, crucial for global maritime operations, is a challenge due to harsh and remote operating conditions.

The ADMO project addresses this by enhancing maritime connectivity using 5G-Advanced networks. It targets use cases such as remote monitoring and operations, automated vessel operation, and smart fairway services, supporting the maritime industry's digital transformation.

Use Cases

The ADMO project focuses on several key use cases for digitalization in maritime operations:

1. **Remote Monitoring**: This involves the use of sensors and communication networks to monitor ship systems and environmental conditions remotely. It can help in proactive maintenance and decision-making.
2. **Remote Operations (remote control)**: This extends beyond monitoring to include other ship operations that can be controlled remotely, for example navigating the ship.
3. **Automated Vessel Operation**: This involves the use of advanced automation and artificial intelligence technologies to enable ships to operate with minimal human intervention. There are several levels of automation, ranging from automation of some functionalities to assist the human to fully autonomous operation of the vessel.
4. **Remote Pilotage**: This refers to the remote assistance and/or control of a ship's navigation, often from a shore-based center. It can enhance safety and efficiency, especially in complex or hazardous navigational situations.
5. **Smart Fairway Services**: This includes the use of digital technologies to enhance navigation safety and efficiency in fairways, such as real-time traffic information, dynamic routing, and automated reporting.

Remote Monitoring involves the use of various technologies to collect data from the ship and transmit it to a remote location for analysis. It requires reliable and low-latency data communication between the ship and the monitoring center. The data collected can include information about the ship's position, speed, course, and other relevant factors. This use case is crucial for maintaining the health of machinery, using predictive diagnostics, and communicating critical information inside and outside the ship.

Remote Operations (remote control) refers to the ability to control certain aspects of the ship's operations from a remote location. Like remote monitoring, it requires reliable and low-latency data communication between the ship and the operations center. However, in addition to simply collecting and analyzing data, remote operations involve making decisions and sending control commands back to the ship.

Automated Vessel Operation involves the use of autonomous systems on the ship itself to carry out operations without the need for human intervention. These systems rely on the same environmental detection techniques as remote monitoring and operations, but they also need data transmission and remote updatability for sensors. Autonomous ships are able to avoid collisions by sensing the environment and making independent decisions.

The similarities among these three use cases include the need for reliable and low-latency data communication, the use of data from the ship for decision-making, and the goal of improving the safety and efficiency of maritime operations. The differences lie in the level of control and decision-making involved. Remote monitoring is primarily about data collection and analysis, remote operations involve control from a distance, and automated vessel operation involves decision-making on the ship itself.

Remote pilotage is a concept that allows pilots to guide ships remotely. This cloud-based service creates a “safe tube”, a dynamic route for the ship considering various factors. Remote pilotage doesn’t cover port maneuvering or apply to inland waterways. While not yet practiced globally, AI and machine learning may facilitate its future implementation. Remote pilotage will not be ready to be trialed during ADMO project timeline, but we will aid in the development of the systems through connectivity and quality of service measurements.

Smart Fairway services aim to enhance services for autonomous maritime traffic and other emerging uses of territorial sea. These services involve the creation of a dynamic route for the ship that takes into account the waterway characteristics, the weather conditions, and the other traffic. The dynamic route is created using data from the ship and other sources. The MaDaMe project, which stands for Maritime Data Methods for Safe Shipping, will study and pilot these Smart Fairway services. It is coordinated by Turku University of Applied Sciences. The project aims to support national authorities responsible for maritime traffic management in developing common, cyber-secure, digital transport infrastructure services in the Baltic Sea Region. For connectivity, the MaDaMe project will utilize VDES (VHF Data Exchange System), an extension to AIS (Automatic Identification System), adding two-way data channels over VHF. This system allows for more secure and efficient data exchange, which is crucial for the successful implementation of Smart Fairway services. ADMO will support MaDaMe by studying how mobile networks could be used to transmit smart fairway services.

Key Performance Indicators (KPIs)

The performance of the communication network service in supporting these use cases can be evaluated using several KPIs:

1. **Bitrate**: The data transfer rate, which should be sufficient to support the data needs of the use cases.
2. **Latency**: The delay in data transmission, which should be minimized to support real-time operations.
3. **Coverage**: The geographical area covered by the communication network, which should ideally encompass all operational areas of the ship.
4. **Scalability**: The ability of the network to handle increasing numbers of users without degradation of service.

Use Case	Key Performance Indicators (KPIs)	Suggested Values	
Remote Monitoring	Bitrate, Latency, Coverage, Scalability	To be determined based on specific monitoring needs. Bitrate depends on the needed video streams and their quality.	
Remote Pilotage	Bitrate, Latency, Coverage, Scalability	High bitrate and low latency for real-time control, wide coverage. Several usage scenarios need to be defined for different network conditions and this needs to communicated to the remote operator. End-to-End latency should be less than one second.	
Remote Operations	Bitrate, Latency, Coverage, Scalability	High bitrate for data-intensive operations, low latency for real-time control. Several usage scenarios need to be defined for different network conditions and this needs to communicated to the remote operator. End-to-End latency should be less than one second.	
Automated Vessel Operation	Bitrate, Latency, Coverage, Scalability	High reliability and low latency for safety-critical operations. If the vessel is not monitored remotely, there is no need to transfer vast amount of sensor data.	
Smart Fairway Services	Bitrate, Latency, Coverage, Scalability	Wide coverage for extensive fairway areas, high scalability for multiple users.	
Wireless on-ship sensors (e.g. engine room)	Bitrate, Latency, Availability	High availability needed for critical sensors, bitrate, latency depending on application	
On-ship infotainment	Bitrate, Coverage, Scalability	High bitrate and scalability needed to provide on-sip infotainment service	

Concluding Remarks

The digitalization of maritime operations presents significant opportunities for enhancing efficiency, safety, and sustainability. However, it also poses challenges in terms of connectivity requirements. The ADMO project aims to address these challenges by developing a roadmap for the deployment of 5G-Advanced networks in the maritime environment.

The use cases and KPIs identified in this report provide a foundation for this work, helping to ensure that the solutions developed are tailored to the specific needs of the maritime industry. The ultimate goal is to enable seamless data flows, supporting the digital transformation of maritime operations.

ADMO project trials focus mainly on remote monitoring, remote operations and automated vessel operation use cases. Deliverable 4.1 introduces the available infrastructure and the planned trials. Based on the trial results, ADMO project will give suggestions for numerical KPI values.