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DigiMar: ADVANCING MARITIME COMMUNICATION TRAINING THROUGH DIGITAL LEARNING

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Abstract. The *Digital Education for Maritime Communication* (*DigiMar*) project offers open access digital learning tools, based on international standard protocol regulations for maritime routine communication. The DigiMar lifelong learning tools (instructional videos and chatbots) are tailored for students, shore service operators and external users, to enhance maritime communication skills, and improve safety onboard. The development process for our tools integrates technical and pedagogical best practices, focusing on high-quality voice generation, structured training categories and world-wide accessibility. A total of 30 instructional videos—20 for Basic Training and 10 for Advanced Training—have been developed, validated, and made available online. The project includes a structured evaluation process to assess efficiency, user engagement, and long-term impact. Recommendations for future improvements emphasize iterative refinement, broader integration into maritime education, enhanced interactivity, and sustainable industry feedback. By modernizing maritime education and communication training, *DigiMar* fosters an internationally calibrated and accessible approach to learning in the global maritime sector.

Keywords: Maritime Communication; Digital Learning; Instructional Videos; Open-Access Education.

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1. THE *DigiMar* PROJECT

The main objective of the project is to enhance navigational safety, measured through statistically significant differences (gap analysis) in the maritime communication skills of shore service operators and higher education students before and after the implementation of a digital educational pilot study enacted through instructional videos and chatbots, and potentially to contribute to a reduction of human, environmental, societal, and/or economic losses resulting from maritime accidents.

1.1. Goals of the Project

The *DigiMar* project aims to:

- develop open-access digital educational tools relevant for the maritime industry and the broader society;
- develop open-access instructional videos and chatbots that will support continuous and self-directed learning, allow the interaction between the research and educational dimensions, and strengthen the links between education, research, innovation, and practical use;
- promote the lifelong learning dimension of higher education;
- support and develop new forms of interdisciplinary cooperation among higher education teachers from different disciplines involved in the project;
- exploit the potential of digital technologies and develop the digital competencies of the target group users and of higher education teachers;
- use the digital tools for the creation and analysis of language databases, and the creation of maritime communication simulation tasks;
- develop a database that can be utilized for the development of a wider maritime communication library to be used in AI-based speech recognition and communication management solutions;
- be in line with the strategic priorities of the Digital Education Action Plan (2021-2027) in that the project supports high-quality, inclusive, and accessible digital education, and presents digital opportunities for the education and training community, policymakers, academia, and researchers;
- develop, deploy, and evaluate open-access digital educational tools expected to increase the capacity and readiness of the involved institutions to manage an effective shift toward digital education;
- assess improvements in navigational safety as a result of the digital education pilot study;
- provide research-based recommendations for a revision of the standard protocol of communication.

To support all of this, an open-access, research-based digital learning platform has been created. The platform provides instructional videos and chatbots for routine maritime communication, along with a database of simulation-based learning tasks (cf. Borucinsky et. al 2024: 125).

1.1.1. Project Structure

The project consists of five work packages, each further subdivided into several WP activities:

- **WP1:** Project Management
- **WP2:** Maritime Communication Standard- and Data-based Content Development
- **WP3:** Digital Educational Tool Development, Deployment and Evaluation
- **WP4:** Maritime Communication Standard- and Data-based Benchmarking
- **WP5:** Exploitation and Dissemination

In this paper we present the results of WP3.

2. THE EDUCATIONAL TOOL DEVELOPMENT, DEPLOYMENT AND EVALUATION

The *DigiMar* lifelong learning tools (instructional videos and chatbots) are tailored for students, shore service operators and external users, to enhance maritime communication skills, and improve safety onboard. The development process for our tools integrates technical and pedagogical best practices, focusing on high-quality voice generation, structured training categories and world-wide accessibility. A total of 30 instructional videos—20 for Basic Training and 10 for Advanced Training—have been developed, validated, and made available online. The project includes a structured evaluation process to assess efficiency, user engagement, and long-term impact.

2.1. *DigiMar* Videos

The development of instructional videos followed a methodical, multi-phase process aimed at enhancing routine maritime communication skills among students and professionals. This process is anchored in pedagogical rigor, technical precision, and alignment with international maritime communication

Table 1. Categories of training and their features

Basic Training	Advanced Training
Target group: Maritime students Content: Core VTS-related communication procedures Format: Introduction – Demonstration – Conclusion Length: 5–6 minutes Output: 20 open-access videos	Target group: Maritime professionals and VTS personnel Content: Complex scenarios derived from incident reports analyzed in WP2.2 Format and output: Case-based

standards, particularly those set by the IMO and STCW. Through close collaboration between Higher Education Institutions (HEIs) and Maritime Safety Autho-rities (MSAs), the project ensures content relevance, educational quality, and operational applicability.

2.1.1. Framework and Tool Selection

The process began with a comprehensive review of pedagogical and technical guidelines. HEIs evaluated best practices in digital learning and multimedia instruction, focusing on learner engagement, retention, and real-world application. Simultaneously, technical parameters—such as audio-visual quality, accessibility, and platform compatibility—were established to ensure seamless integration into diverse learning environments.

In parallel, a comparative analysis of video production and narration tools (e.g., *Camtasia, Murf, PowerPoint*) led to the selection of PowerPoint for animation and *ElevenLabs* for narration. ElevenLabs was favored for its realistic speech synthesis, ability to render maritime-specific terminology accurately, and support for various accents—key to simulating authentic communication scenarios.

2.1.2. Content Definition and Categorization

Instructional content was defined through collaboration between HEIs and MSAs. Topics were selected based on real-world relevance and adherence to standard communication protocols. Two categories of training were established: Basic Training and Advanced Training, as illustrated in Table 1.

2.1.3. Instructional and Technical Design Principles

The pedagogical approach prioritized clarity, brevity, and structured learning including a standardized format across all videos to ensure consistency, short duration to maintain learner focus and emphasize key objectives, use of clear, accessible language and realistic voiceovers, inclusion of transcripts for accessibility, visual elements and animation used to reinforce key concepts and reduce reliance on dense text, optional interactive elements (e.g., quizzes) to support active learning.

The video development process followed an iterative, collaborative model: HEIs drafted scripts based on approved topics; MSAs conducted content validation. Feedback loops were implemented to revise scripts for clarity, accuracy, and alignment with operational practices.

2.1.4. Testing, Revision, and Dissemination

Videos were pilot-tested with maritime students and shore-based operators to assess clarity, instructional value, and procedural accuracy. MSAs played a key role in evaluating communication protocols and identifying necessary improvements. The feedback informed revisions addressing language clarity, pacing, and visual enhancement.

The final videos were published as open-access resources to support wide dissemination and long-term reuse. This approach promotes professional development, facilitates continuous improvement, and reinforces the project's goal of improving maritime safety through standardized communication training.

2.2. Sample Videos

The 30 videos created within WP3 of the *DigiMar* project feature authentic exchanges between vessels and VTS operators and are applicable to a variety of geographical contexts. The videos do not need to be used in sequence as each presents a self-contained scenario. However, it is recommended to use the videos in sequence as they are designed in such a way to progress from simpler to more complex ones. Figure 1 shows the *DigiMar* website with access to digital tools, among which are the instructional videos.

Table 2 shows the topics covered in the basic level instructional videos, whereas Table 3 shoes topics covered in the advanced level instructional videos.

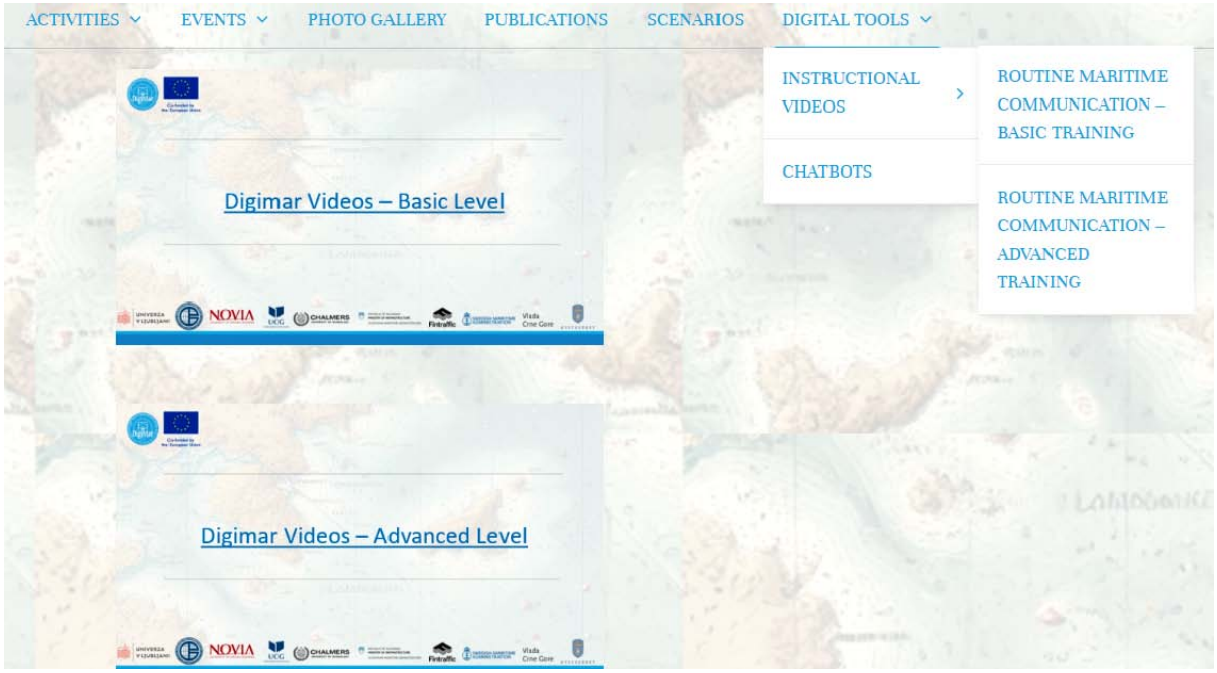


Figure 1. The DigiMar website

Table 2. Topics of routine maritime communication – basic level videos

ROUTINE MARITIME COMMUNICATION – BASIC LEVEL
A – INTRODUCTION
1. Introducing Digimar videos
B – ESTABLISHING THE CONTEXT
2. What is VTS?
3. Defining routine maritime communication
C – VTS PHRASEOLOGY
4. Structuring routine maritime communication
5. Understanding and applying standard VTS phraseology
D – CLARITY OF SPEECH
6. Phonetic alphabet and figures
7. Understanding tenses
8. Using action verbs
9. Message markers – question, answer, request
10. Message markers – information, advice, warning
11. Speed messages
12. Closing the communication loop
13. Negative confirmation
14. Speaking formally and clearly
15. Simple statements and questions
16. Wordiness
E – AMBIGUITY
17. Avoiding ambiguity
18. Avoiding ambiguity caused by modal verbs
19. Using prowords
20. Prowords for avoiding ambiguity

Table 3. Topics of routine maritime communication – advanced level videos

ROUTINE MARITIME COMMUNICATION – ADVANCED LEVEL
INTRODUCTION
Introducing Digimar case study videos
ROUTINE MARITIME COMMUNICATION CASE STUDIES BASED ON ACCIDENT INVESTIGATION REPORTS
1. Collision in a Congested Waterway
2. Near-miss between Incoming and Outgoing Vessels
3. Vessel Grounding Caused by Communication Breakdown
4. Grounding on an Underwater Reef on a Calm Night
5. Collision in Foggy Conditions
ROUTINE MARITIME COMMUNICATION CASE STUDIES BASED ON AUTHENTIC SITUATIONS AND CONTEXTS
6. Traffic Coordination in Complex Meeting Maneuvers
7. Refusing Permission to Drift
8. Traffic Coordination in Complex Overtaking Manoeuvers
9. Tugging Operation

The following section shows a sample transcript from the Advanced level instructional video titled Traffic Coordination in Complex Meeting Maneuvers.

Case Study 6: Traffic Coordination in Complex Meeting Maneuvers

Welcome to Digimar case study videos!

To support learning, the case studies in these videos are based on real-world events with authentic VTS-vessel communication, including mistakes or deviations.

However, content has been modified, adjusted, and simulated for instructional purposes. The names of ships and ports are anonymized.

You will find suggestions for improving communication at the end of this video.

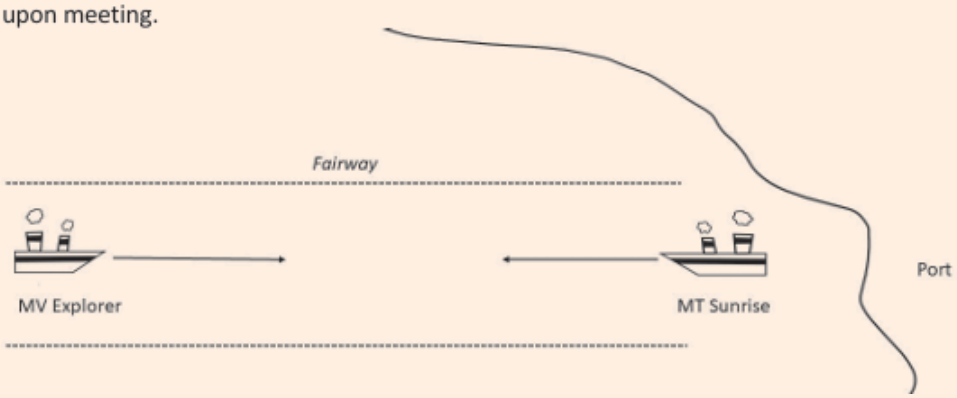
In this case study, two vessels are about to meet and pass each other in a narrow fairway.

Here are some important points to reflect upon before watching this video:

- How is the VTS operator addressing the vessels in the fairway to avoid ambiguity?
- What communication tools are used to comply with routine communication regulations to avoid a collision?
- How is the VTS operator ensuring that all the vessels have understood the advice and will act in a synchronized way to avoid collisions?

In this case study we observe two vessels who are about to meet and pass each other in a narrow fairway.

The vessels who are about to meet are Motor tanker Sunrise, on her way out of the fairway, and Motor Vessel Explorer, a large container vessel, on her way into the fairway. VTS calls the vessels to ask them to agree upon meeting.



Digimar VTS: Sunrise, Digimar VTS, over.

Motor Tanker Sunrise: Digimar VTS, this is Motor Tanker Sunrise.

Digimar VTS: Sunrise, Digimar VTS. Traffic information: You will meet Motor Vessel Explorer, on her way into the fairway, ahead of you. Talk directly to Explorer and arrange meeting.

Motor Tanker Sunrise: I will talk to Explorer, thank you.

Following the VTS advice, Motor Tanker Sunrise calls Motor Vessel Explorer.

Motor Tanker Sunrise: Explorer, this is Sunrise.

Motor Vessel Explorer: Sunrise, this is Explorer.

Motor Tanker Sunrise: Sir, can we pass starboard to starboard?

Motor Vessel Explorer: Naaah, I am port side, so I'm turning to port now.

Motor Tanker Sunrise: Copy that, thank you.

VTS tracks the vessels on their AIS and notices that Motor Vessel Explorer prepares for a port-to-port turn, but Motor Tanker Sunrise had asked for a starboard-to-starboard meeting. VTS calls Motor Vessel Explorer.

Digimar VTS: Explorer, Digimar VTS, over.

Motor Vessel Explorer: Digimar VTS, this is Explorer.

Digimar VTS: Motor Vessel Explorer, Digimar VTS, you are very close to Sunrise. What is your intention?

Motor Vessel Explorer: We will meet port to port Sir.

Digimar VTS: Explorer, Digimar VTS, Advice: call Sunrise and confirm. You have a very short CPA.

Motor Vessel Explorer: Will do, Sir, thank you.

Following the VTS advice, Motor Vessel Explorer calls Motor Tanker Sunrise.

Motor Vessel Explorer: Sunrise, this is Explorer, please come in.

Motor Tanker Sunrise: Explorer, Sunrise.

Motor Vessel Explorer: Sunrise, this is Explorer. I will pass you now on your port side. Please confirm.

Motor Tanker Sunrise: Negative, I am going starboard, Sir.

Motor Vessel Explorer: We must go port to port. I cannot alter course now.

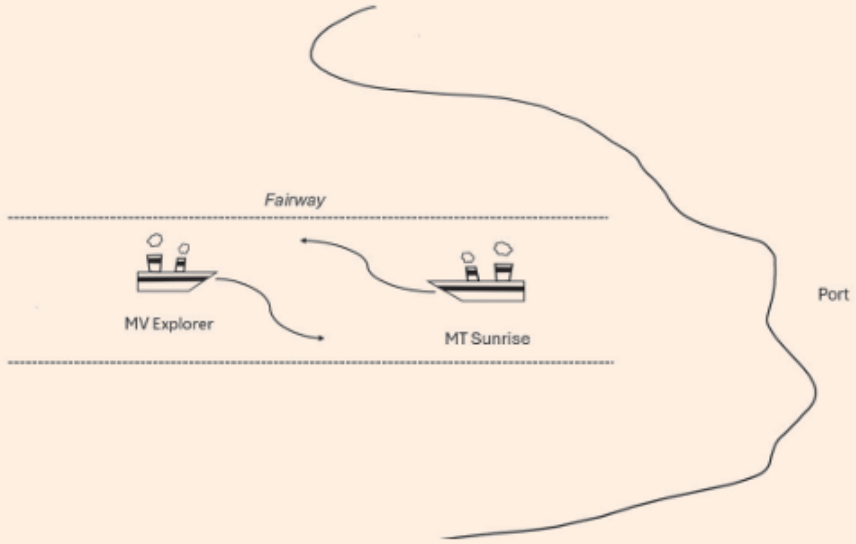
Motor Tanker Sunrise: You want to meet port to port, Sir?

Motor Vessel Explorer: Yes, port to port.

Motor Tanker Sunrise: Received. We will meet port to port. Please stop your engines to give some time.

Motor Vessel Explorer: I stop my engines. Thank you.

By now, VTS can see that Motor Vessel Explorer is almost at a standstill turning to port, and Motor Tanker Sunrise proceeds to port.



The vessels pass safely but at a very close CPA in the fairway and continue to their destinations.

Figure 2. Traffic Coordination in Complex Meeting Maneuvers – video transcript

3. THE EVALUATION PROCESS

The project includes a structured evaluation process to assess efficiency, user engagement, and long-term impact. A structured evaluation framework was established to assess the effectiveness and applicability of the instructional materials. The evaluation comprises both qualitative and quantitative components and is tailored to the two distinct video categories (Basic and Advanced Training). Key metrics include:

- User Satisfaction: A target benchmark of at least 80% satisfaction among learners and practitioners.
- **Engagement and Usability:** Assessment of attentiveness, use of transcripts, and perceived learning value.
- **Instructional Quality:** Evaluation of content clarity, logical structure, and alignment with real-world scenarios.
- **Technical Performance:** Analysis of audiovisual quality, cross-device compatibility, and compliance with maritime communication standards (e.g., IALA, IMO).
- **Learning Outcomes:** Measured by the degree to which the videos improve understanding and practical communication skills.

Separate surveys were used for each video category to ensure relevance and accuracy in feedback. The surveys will be distributed digitally and timed to capture immediate user impressions. HEIs will initiate student evaluations upon video implementation in learning environments, while MSAs and industry stakeholders will provide input following the multiplier event in April.

The evaluation results will inform iterative refinements to the instructional materials. Specific recommendations for sustaining and enhancing the project's impact include:

- **Ongoing Refinement:** Systematic updates based on user feedback and evaluation outcomes.
- **Wider Adoption:** Integration of video content into broader maritime education and VTS training programs.
- **Enhanced Interactivity:** Incorporation of quizzes, simulations, and scenario-based discussions.
- **Sustainability and Accessibility:** Continued hosting on open-access platforms and the addition of multilingual subtitles to broaden reach.

4. CONCLUSION

The development of instructional videos carried out within WP3 of the *DigiMar* project represents a comprehensive effort to modernize maritime communication training. Through careful topic allocation, validated script development, consistent production protocols, and robust evaluation measures, the project delivers high-quality educational tools aligned with professional standards. By ensuring accessibility and continuous improvement, the initiative contributes meaningfully to communication competence and safety in the maritime sector. The project includes a structured evaluation process to assess efficiency, user engagement, and long-term impact. Recommendations for future improvements emphasize iterative refinement, broader integration into maritime education, enhanced interactivity, and sustainable industry feedback. By modernizing maritime education and communication training, *DigiMar* fosters an internationally calibrated and accessible approach to learning in the global maritime sector.

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Project links: https://digimar.si/

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