MOSWOZ simulator study

Management summary

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SIMWAVE
MARITIME CENTRES OF EXCELLENCE

Colophon

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Background

The North Sea is one of the busiest maritime areas in the world. Besides shipping it is used for energy production as well. The ambition to significantly increase offshore wind energy production in the coming decades to meet climate goals will have major implications for the shipping lanes in the North Sea. The installation of additional offshore wind farms (OWFs) will limit the navigable space for shipping. Moreover, maritime traffic is expected to increase further in the future.

To preserve safety in the North Sea, Rijkswaterstaat (RWS) established the Offshore Wind Energy Shipping Safety Monitoring and Research Programme (MOSWOZ). One of the program's themes focuses on the risks of collisions caused by the installation of OWFs and measures to mitigate those risks.

As part of this program, a simulation study was conducted to examine the effects of future OWFs on the behaviour of ship crews. The study also assessed the efficiency of the following planned risk-reduction measures:

- **Vessel Traffic Monitoring (VTMon)** | This is a coast guard function that monitors maritime traffic in and around OWFs. VTMon operators warn and guide ships in cases of potential danger and provide assistance during incidents.
- **Emergency Response Towing Vessel (ERTV)** | A tugboat deployed to assist ships in distress. If a ship becomes adrift, the ERTV can tow it to safer waters or shore.
- **Deep Sea Pilot** | A deep sea pilot has knowledge of local waterways and guides ships through or around OWFs. Upon the captain's request, the deep sea pilot boards the ship and advises the captain and crew on navigation tasks.

Research Questions

The study aimed to answer the following main research questions:

1. **What is the effect of the wind farms and increasing traffic intensity in the North Sea on the behaviour of ship crews?**
2. **How effective are the mitigating measures?**

These main questions were translated to 56 sub-questions, each addressed individually within the various scenarios.

Approach

The study had an exploratory nature, aiming to gain initial insights into crew behaviour and the effectiveness of the measures. These insights were obtained through the execution of several scenarios in a simulated environment.

Scenario's

A total of 8 simulation scenarios were conducted over 10 days. The scenarios focused on various roles, including:

- Merchant vessel crew
- Tugboat crew
- Yacht sailors
- Deep sea pilot
- ERTV crew
- VTMon operator

The interaction between these roles were studied as well. Events during the scenarios ranged from encountering an approaching fishing vessel to a collision between two ships.

Simulators

Multiple simulators were used:

- A 360° Full Mission Bridge (FMB) simulator for a merchant vessel and the tugboat (Figure 1).
- A 360° offshore FMB simulator for the ERTV (Figure 2).
- A VTMon workstation simulator (Figure 3).
- A part-task bridge simulator for sailing yachts (Figure 4).

In several scenarios multiple simulators were active. For example, in one scenario, the 360° FMB simulator, the 360° offshore FMB simulator, and the VTMon simulator operated simultaneously. A simulator operator controlled the simulations from the control room.

Data Collection

Observers registered participants' behaviour during the simulations, encouraging them to use a think-aloud protocol to gain insights into decision-making processes. Participants also recorded their mental workload (Rating Scale Mental Effort - RSME) and perceived threat levels (Threat Assessment Scale - TAS) every 15 minutes during the scenarios.

Objective metrics, such as Closest Point of Approach (CPA) and Time to Closest Point of Approach (TCPA)[1], were used to estimate situational threat levels. After the simulation, participants filled in a questionnaire about their experiences, followed by a debriefing to collectively evaluate the scenario.

[1] TCPA (Time to Closest Point of Approach) and CPA (Closest Point of Approach) are maritime navigation metrics used to assess collision risks, indicating the time and minimum distance between vessels if they maintain their current courses and speeds.

Figure 1. The 360 degrees FMB bridge used for the merchant vessel and tugboat.

Figure 2. The 360 degrees offshore FMB used for the ERTV.

Figure 3. The VTMon station.

Figure 4. The part-task bridge simulator used by the sailing yacht skippers.

Results, conclusions, and recommendations

Research questions:

1. What is the effect of the wind farms and increasing traffic intensity in the North Sea on the behaviour of ship crews?

The study found no evidence that OWFs inherently have a negative impact on situational awareness. OWFs are viewed as restricted areas, much like other no-go zones. Crews also showed awareness of the presence of cables and pipelines on the seabed.

However, light pollution from OWFs at night makes it more challenging to detect and distinguish vessels or other objects, particularly smaller ones such as yachts. The study recommends researching distinct lighting, that complies with rules and regulations, for OWFs to make them easier to differentiate from surrounding areas. Additionally, raising awareness among yacht sailors about AIS requirements in and around OWF areas is essential.

The increasing maritime traffic intensity in the North Sea is seen as a greater concern. Wind farms increase this issue by reducing navigable space, forcing ships to sail in closer proximity. This may require more intensive and specialised support from VTMon. The recommendation is to assess the specific future requirements for maritime traffic management and translate these into VTMon capacity, competences, and support systems.

Yacht sailors tend to prioritise safety when planning their routes, avoiding large shipping lanes when possible. Passages through OWFs designated for small vessels are often preferred, as long as it does not significantly increase travel time. However, these passages are considered narrow, particularly under certain weather conditions, such as heavy winds requiring frequent tacking. The lack of clarity regarding access restrictions and expected traffic in these passages was also noted. The recommendation is to ensure greater awareness among sailors about the access criteria and usage expectations for these passages.

2. How effective are the risk-reduction measures?

- **VTMon** | VTMon was shown to be highly useful for traffic monitoring and incident management. However, its performance during simulations was hindered by the absence of a back-up operator (Duty Officer), inadequate tools, and incomplete role descriptions and training. The recommendation is to further develop the VTMon role, train future operators, and provide the necessary tools. This should be combined with the earlier recommendation to evaluate future traffic management needs.
- **ERTV** | The deployment of the ERTV proved to be highly effective in incident management. By adopting a proactive approach, they acted swiftly when needed, maintaining efficient communication with VTMon and affected vessels via VHF. However, there is a risk that the ERTV may arrive too late, particularly if adverse weather prevents shortcutting through OWFs. It is recommended to optimise ERTV positioning and define criteria for minimum response times or critical areas requiring shorter response times.
- **Deep Sea Pilot** | The deep sea pilot proved highly valuable during incident handling, not only for the knowledge of the area but also for the communication skills. Currently, deep sea pilots are not mandatory, and financial considerations often lead to their exclusion. The recommendation is to better inform shipowners about the importance of having a deep sea pilot on board when navigating near OWFs.

Finally, the study provided valuable insights into navigation behaviour and safety related to OWFs in the North Sea. However, its exploratory nature requires prudence in generalising the conclusions. Further quantitative research is necessary to substantiate these findings.

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