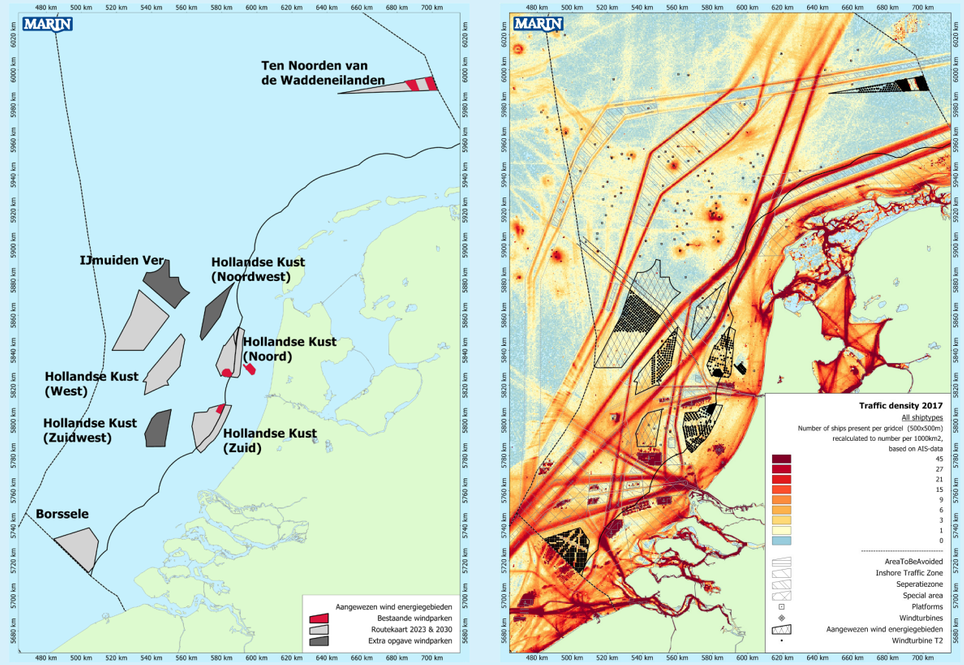

Left: scheduled wind farms on the North Sea. Right: Traffic intensity (2017)

Assessing the impact of offshore wind farms in the North Sea

MARIN is assisting the Dutch government with policy making issues concerning the development of offshore wind farms. Currently we are examining all the scheduled wind farms up until 2030 and their impact on the layout of the North Sea and on the safety of shipping.

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One of the big challenges for governments today is the implementation of the Paris Climate Agreement. The central aim of this agreement is to strengthen the global response to the threat of climate change by reducing CO2 emissions in order to keep a global temperature rise this century to well below 2 degrees Celsius.

It is MARIN's mission to contribute to this challenge and to a sustainable use of the sea and in line with this, we are preforming research for offshore wind turbines, floating islands and farming at sea. However, all these solutions require space and compete with the traditional use of the sea for fishing and maritime transport. Therefore, it is necessary to balance the various interests, and the safety of shipping is one of the main topics.

The number of planned wind farms means that the space for shipping will be reduced and that new traffic flows will be introduced due to the extra vessels working at the wind farms. Due to increased risks related to fishing inside the wind farms, it is likely that the fishing activities will shift and take place outside the wind farm areas more close to the main traffic routes. Furthermore, a new accident type is introduced: a collision with a wind turbine.

The present study focuses on two main questions: What is the effect of large-scale wind farming on the safety of shipping in the North Sea and what are the most effective measures to mitigate these risks? To answer these questions we will deploy the Formal Safety Assessment (FSA) method. On behalf of the Rijkswaterstaat (responsible for water management in the Netherlands), MARIN in collaboration with Royal HaskoningDHV, successfully applied this methodology for the new North Sea route structure in 2016 (see MARIN Report 118). A schematic presentation of this method is given below.

For this study we will use a combination of a quantitative and qualitative risk assessment.

Quantitative Risk Assessment For the quantitative risk assessment we are using our Safety Assessment Models for Shipping and Offshore in the North Sea (SAMSON) model.

The following types of accidents are computed with the SAMSON program:

- Collision between ships (head-on, overtaking and crossing)
- Collision of a ship with a ship at anchor (ramming and drifting)
- Stranding / grounding of a ship
- Contact with objects such as offshore installations, buoys and wind turbines (ramming and drifting)

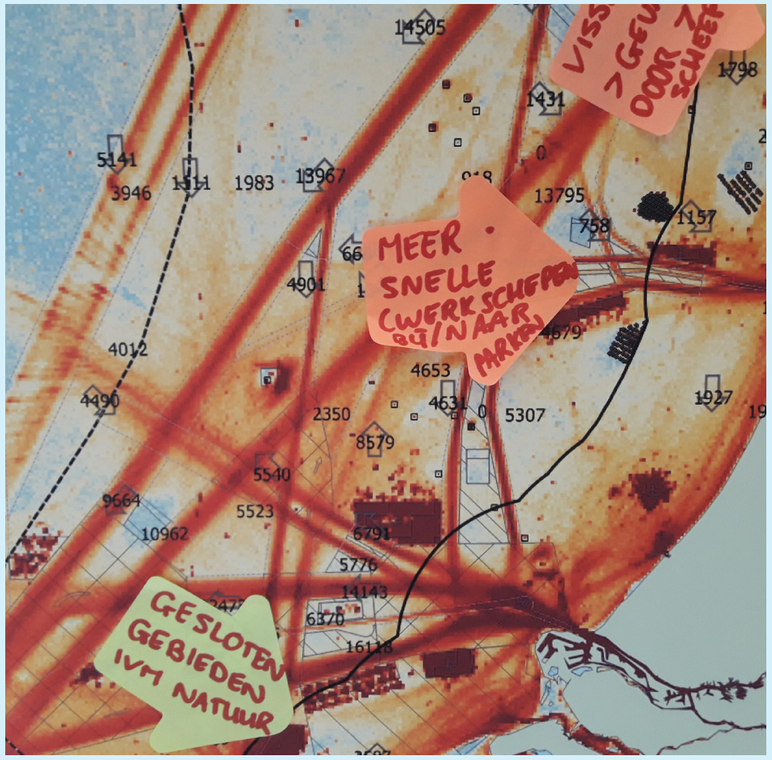
One of the most important input variables is the description of the traffic database. We are using the AIS data of 2017 as a starting point for this study but in the future the traffic lanes, traffic intensity and ship sizes will change. On the basis of the AIS data we developed a traffic database for 2017. Erasmus University Rotterdam executed a study regarding the future of shipping on the North Sea and this provided data about the increase in traffic intensity and the expected change in ship sizes. These data were then used to develop the traffic database for 2030. An example of the traffic database is shown below.

With the SAMSON model various scenarios were studied and calculations were made for different years, but also for different solutions with respect to allowing shipping inside the wind farms.

Qualitative risk assessment: expert sessions The qualitative risk assessment was carried out by holding two expert sessions for the users of the Dutch part of the North Sea. One session focused on risk identification and evaluation and the second on risk mitigating measures. A result of these brainstorm sessions is shown.

In the analysis three categories of consequences were distinguished, e.g. risk to human life, the environment and economic consequences. The proposed measures were then implemented in the risk model. In this way it is possible to compare the expert judgement with risk figures, which in turn, provides a reality check. Alongside this, the costs for various mitigating measures were also computed. In the end it is possible to weight effectiveness in terms of safety versus costs.

This study certainly gives insight into the effect of future wind farms on the North Sea and their impact on the safety of shipping. It will now be the basis for policymakers to take the final decision on how best to maintain the safety of shipping in the future.



Brainstorming during the expert sessions, identifying possible risks