



1 Proactive route planning offers opportunities for reducing both travel time and waiting times as well as fuel consumption | donvictori0 - stock.adobe.com

2 Ship performance can be controlled and improved proactively | Denys - stock.adobe.com

## GREEN SHIPPING

### WEATHER ROUTING TO ENHANCE SAFETY AND EFFICIENCY OF SHIPPING

#### Initial Situation

Shipping transports 90% of global goods while consuming 276 mega tonnes of fuel annually. This leads to an emission of 940 mega tonnes of CO<sub>2</sub> and a contribution to 2.5 % of global Greenhouse Gas emissions annually. One approach to reduce these emissions is the application of adaptive weather routing solutions developed at Fraunhofer CML.

#### Voyage Optimization

Voyage optimization incorporates various tools and guidances to ensure cost effective, low-emission and safe travelling of any vessel on any voyage. Utilizing weather forecasts of all time frames, both long-term strategic routing and short-term harsh weather safety assessment build the foundation which can be extended and customized according to

#### Key Benefits

CML's weather routing solutions offer the possibility to

- /// improve safety for the vessel, crew, cargo and the environment;
- /// enhance efficiency by minimizing time and fuel during voyages; and
- /// improve communication between vessel and shore.

#### Key Issue

Pre-calculated routes are constantly adapted to weather conditions along the track by means of optimization algorithms and long-term weather forecasts. From the tightly scheduled fast RoRo ferry in regular service through the slow steaming container vessel on a deep sea voyage to an innovative ship concept, there is always a need for customized voyage optimization.

#### Fraunhofer Center for Maritime Logistics and Services CML

Nautical Solutions & Data Science  
Am Schwarzenberg-Campus 4  
21073 Hamburg  
Germany

Prof. Dr.-Ing. Carlos Jahn

Tina Hensel, M.Sc.  
Phone +49 40 42878 6082  
tina.hensel@cml.fraunhofer.de

[www.cml.fraunhofer.de](http://www.cml.fraunhofer.de)



**Approach**

A customized voyage optimization project consists of four consecutive steps:

1. Specify optimization requirements
2. Adapt framework
3. Implement and test functionalities
4. Assess effects and potentials

At all times Fraunhofer CML maintains close contact with the customer to develop a voyage optimization which provides a real client benefit.

**Optimization Requirements**

Together with the customer, Fraunhofer CML answers the key questions to develop a tailor-made solution for voyage optimization. We elaborate customer requirements regarding the main objective, ship, routing and other constraints as well as the degree of onboard integration, strategic decision support and operational guidance.

**Objectives**

The system developed by CML is capable to achieve complex objectives with highly sophisticated optimization goals:

- /// constant speed or power;
- /// specified time of arrival; and
- /// fuel and cost savings.

**Framework Adaption**

In line with user requirements CML derives necessary functionalities and interfaces. Whether the special characteristics of the ship, the route or the operators' preferences require special attention, new functionalities can be added according to customer's demands.

**Implementation, Testing & Training**

Focus is on the implementation based on state-of-the-art optimization algorithms, the test and documentation of all functionalities. In-house simulation environment allows to test the modules extensively. A subsequent on-site testing at the customer's premises will allow to verify the usability. The integral part of the hand-over to the customer is an easy-to-understand documentation and an expedient training, delivered online or at the client's offices, whichever is more suitable.

**Assessments**

CML offers further scientifically based research on the applicability, effects and potentials of voyage optimization for vessels and fleets. Pre-voyage optimizations and ex-post voyage analysis allow to assess vessels' economic feasibility, to improve future vessel designs and provide decision support.

**KEY BENEFITS OF WEATHER ROUTING AND PERFORMANCE OPTIMIZATION**

- /// Time and Cost Savings
- /// Improved Safety
- /// Increased Operational Efficiency
- /// Quick Implementation
- /// Straightforward Visualization
- /// Reporting in a nutshell
- /// Individual Solutions
- /// Up-to-date scientific foundation

**Performance Management**

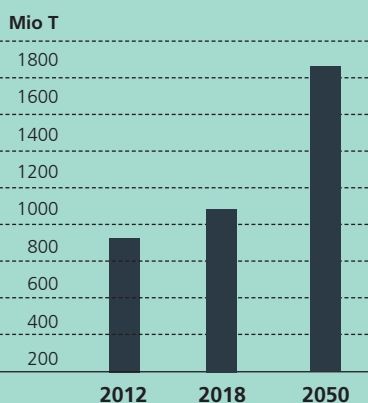
Performance management enables a comparison between the optimized and actual performance of a voyage forming the basis for fuel and emission reductions on the way to Green Shipping. CML's performance assessments offer the possibility to

- /// benchmark ship performances in relation to others or a comparative fleet;
- /// identify measures to achieve savings in fuel consumptions and emissions;
- /// demonstrate transparency to customers, stakeholders and administration using standardized reporting schemes;
- /// receive ETA and speed confidences.

Using adaptive dashboards customers gain quick overviews of their fleet deployment and performance as well as operational profiles depicting critical parameters at-a-glance.

1 Illustration of strategic weather routing for performance optimization, Fraunhofer CML

**CONTRIBUTION OF SHIPPING TO GREENHOUSE GAS EMISSIONS\***



\*International Maritime Organization (2020) Fourth IMO Greenhouse Gas Study, 2020.