

Use of real time sensor data of tugboats to reduce fuel consumption

Joris Lemmens, Olivier Schalm
Antwerp Maritime Academy

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1. GENERAL INFORMATION

A. Description of the practice

The Antwerp Maritime Academy (AMA) will approach tugboat owners with the request to share real-time monitoring data on the operations of a limited number of tugboats. The collected data will include fuel consumption, position, speed, and the sequence of performed activities (i.e., type of activity during an operation). For some activities such as towing a ship it is not possible to save much fuel, but for other activities such as sailing from job-to-job fuel reduction is possible.

This data will be compared to a fuel consumption baseline—the minimum amount of fuel required to perform similar operations in a past reference period. Different kinds of targets can be defined: (1) a static average per activity type from a reference period, (2) a dynamic target that adapts itself to activity type, weather, etc., (3) a total amount of energy for the entire task and it is responsibility of the operator to perform that task with the given amount of energy. On the basis of data provided by tugboat operators, AMA will investigate the fuel consumption pattern and how to assess this using a baseline will be studied by AMA

B. Specific goals

- Gather data from monitoring campaigns performed on board tugboats.
- Define parameters for fuel consumption (e.g., total consumption, average consumption rate in L/h, highest peak consumption during the task, number of peaks and valleys per hour, average hourly consumption). Similar parameters will also be used to assess the simulator experiments
- Identify from the information the activities where fuel consumption can be reduced and how much fuel can be reduced.

C. Direct impact of the practice

- Reduce fuel consumption by visualizing the real-time fuel consumption with a dashboard
- Reduce fuel consumption through awareness raising by publishing monthly reports about consumptions per day, average consumption per activity, and consumption per operator.
- Find a way to ensure that the focus on eco-sailing does not wane over time

D. Place of implementation

Data will be collected from tugboat operators along the River Scheldt and in the Port of Antwerp.

E. Start and end date or duration of the pilot project

The start and end dates will be determined based on data availability.

2. CONTEXT AND DESCRIPTION

A. Description of the practice

By analysing monitoring data, we aim to identify mitigation measures to reduce energy consumption.

B. Driving factor behind the adoption of the green practice

- Cost reduction: Lower fuel consumption results in reduced operational costs.
- Environmental benefits: Reduced fuel usage leads to lower emissions (CO₂, NO_x, particulate matter).
- Improved air quality: Lower emissions improve air quality in the wheelhouse, as fewer pollutants infiltrate through the ventilation system.

c. Stakeholders involved

- AMA will ask companies such as Boluda, Port of Antwerp- Bruges and Antwerp Towing if they are willing to share data for this study.

3. IMPLEMENTATION

A. Description of the adopted practice

- Installation of sensors for real-time fuel consumption monitoring.
- Development of a dashboard for crew members to visualize consumption data.
- Comparison of recorded data with historical benchmark data, providing monthly reports to the crew

B. Technologies used (if applicable)

- Sensors for fuel consumption, speed, and position tracking.
- Data analytics and benchmarking methods.
- Dashboard technology for real-time visualization of fuel consumption.

C. Competencies required

- Technical skills for sensor installation and maintenance.
- Operational knowledge of tugboat activities and energy efficiency.
- Environmental awareness and behavioral adaptation by the crew.

4. COLLECTED DATA

A. Before implementation

- Request consumption baseline before starting monitoring: Gather historical fuel consumption data for similar operations under normal conditions. This will serve as a benchmark to assess improvements. If available, use company-established methods to calculate predicted minimum fuel consumption.

B. After implementation:

- Compare actual fuel consumption with the baseline before the start: Evaluate the effectiveness of real-time monitoring and operational adjustments by comparing recorded fuel consumption with the established baseline. Identify any reductions and analyse contributing factors such as crew awareness, operational changes, or external conditions.

5. ECONOMIC AND ENVIRONMENTAL ANALYSIS

A. Initial investment required

- Sensor installation: Costs for hardware and implementation.
- Data processing and analysis: Expertise needed to correctly interpret data.
- Dashboard development: One-time investment, with potential maintenance costs.
- Crew training: No hardware costs, only training efforts.

B. Key savings or economic impact

- Fuel cost reduction through more efficient usage.
- Lower maintenance costs due to optimized engine operation.
- Potential advantages in compliance with environmental regulations and certification.

C. Contribution to environmental goals

- **Reduced emissions:** Lower CO₂, NO_x, and particulate matter.
- **Cleaner working environment:** Less air pollution in the wheelhouse.

6. CONCLUSIONS

A. Success of the green practices

The results should demonstrate whether the real-time dashboard and crew awareness contribute to fuel savings and emission reductions.

- The analysis of time series aims to provide insights into how fuel consumption can be reduced through behavioral change.
- Success will be measured through efficiency improvements and participant feedback.

B. Lessons learned:

- Challenges faced and solutions found during implementation.
- Training needs and crew awareness strategies.
- Recommendations for future applications and training programs.

C. Next steps

- Expansion of the project to additional vessels and companies.
- Optimization of the dashboard and integration with other vessel systems.
- Further studies on behavioral influence and operational optimization.

7. ANNEXES (TO BE PROVIDED)

- Graphs and tables showing measurement results.
- Photos or diagrams of the implemented technology.
- Experiences and testimonials from crew members.