

# WELL BOAT OPTIMISATION BASED ON REAL OPERATIONAL DATA

In well boat design, efficiency, fish welfare and operational flexibility all start below the waterline. Our design methodology combines operational analysis, digital vessel modelling, hydrodynamic optimisation and energy system simulation to develop vessels optimised for real operating conditions.

At HAV Design, well boats are developed based on a fundamental principle: Vessels should be optimised for their actual operating conditions rather than for a theoretical ideal scenario.

To support this approach, operational data, hydrodynamic analyses and energy system simulations are combined in a digital vessel model. This enables us to evaluate how design choices influence performance, energy consumption and operational capability in real-world operations.

## OPERATIONAL ANALYSIS AS THE STARTING POINT

A well boat rarely operates under ideal and constant conditions. It sails at different speeds, with varying drafts, in changing weather conditions, and often in confined waters around fish farms and through narrow straits.

For this reason, we always begin with a thorough operational analysis. The objective is to understand how existing vessels are used, as well as potential market developments that may influence future designs.

Key aspects include:

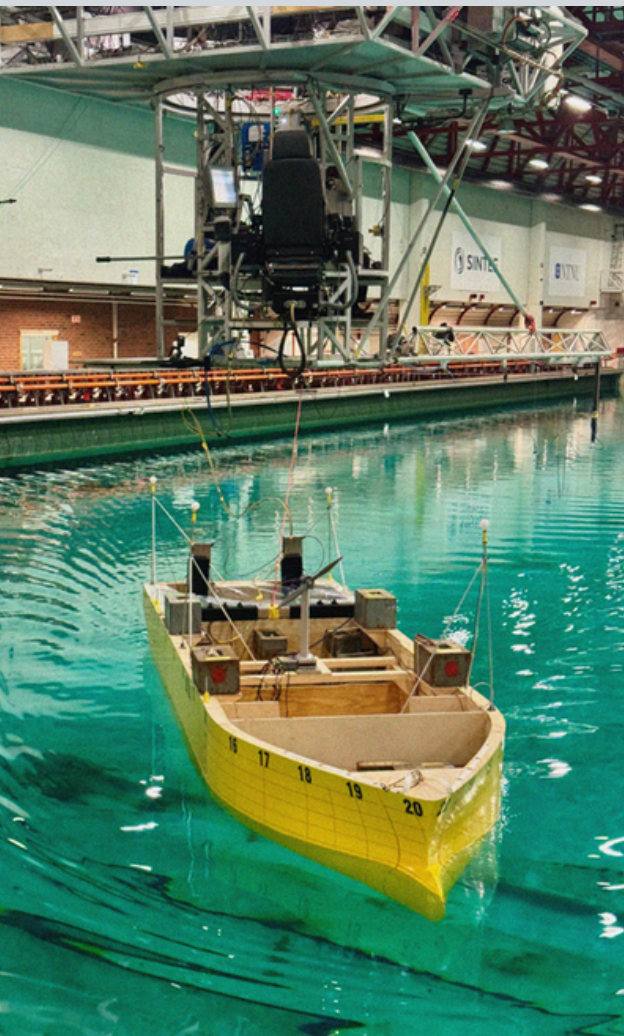
- The speeds most frequently used in operation
- Time spent at different locations
- Variations in draft during operation
- Dominant routes and weather conditions
- The annual distribution of energy consumption



The analysis may be based on operational data from the shipowner, AIS data collected over several years, weather statistics, and onboard logged data from vessels in service.

Only when we understand how the vessel is actually operated we begin the optimisation process.

“When we understand the vessel’s real operational profile, we can optimise for what truly matters: energy efficiency, operational flexibility and safe operation,” says Kjetil Myren, Senior Designer Seafood at HAV Design.



## OUR DESIGN METHODOLOGY

The development follows a structured process:

- 1 **Operational analysis**  
Analysis of the vessel’s actual operations based on operational data, AIS data and weather statistics.
- 2 **Digital vessel model**  
Operational profile, environmental forces, hydrodynamics and energy systems are integrated in a digital vessel configurator.
- 3 **Hull optimisation**  
CAD and CFD analyses are used to generate and evaluate a large number of hull variants.
- 4 **System analysis**  
The interaction between hull, propulsion and energy systems is analysed across the operational profile.
- 5 **Verification**  
Model tests and full-scale measurements are used to validate the calculations.

## DIGITAL VESSEL MODELLING

To enable this approach, we combine operational data, hydrodynamic analyses and energy system simulations in a digital vessel model.

Using a digital vessel configurator, different design options can be simulated by varying logged wind, current and wave conditions together with different loading conditions, propulsion arrangements and energy system configurations.

The configurator integrates several types of data in a single simulation:

- Operational profile and route
- Weather and sea conditions
- Hydrodynamic models of the hull
- Propulsion solution and energy system

This type of simulation makes it possible to calculate power and energy requirements based on how the vessel is actually operated — not only at a single design speed.

By varying routes, operational patterns, propulsion configurations and system efficiencies, we can analyse how different design choices affect energy consumption, performance and operational economy. This provides a far more realistic decision basis in the early design phase.

## HULL FORM OPTIMISATION

Once the operational profile has been established, advanced CAD and CFD tools are used to generate and analyse a large number of hull variants within defined constraints.

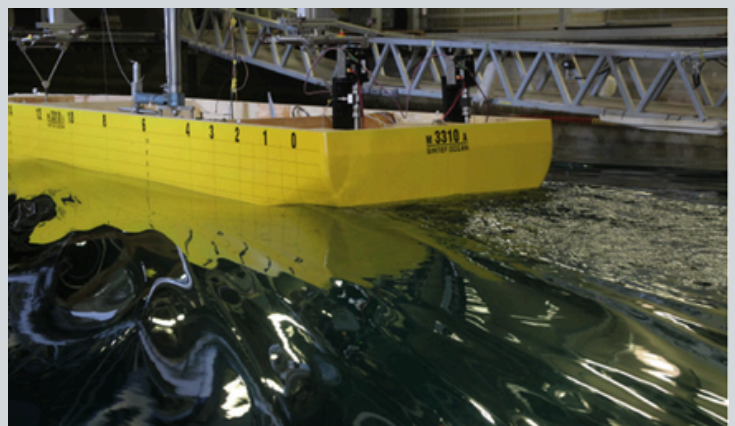
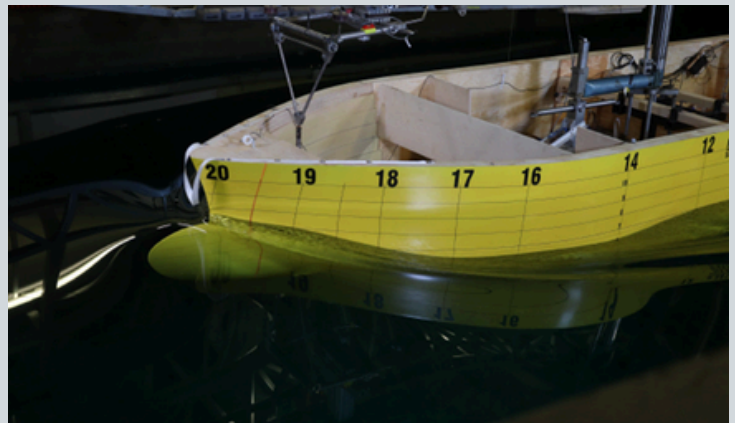
These constraints ensure that key requirements are maintained:

- volume and tank capacity
- stability
- propulsion solution
- operational requirements

Within this design space, optimisation focuses on factors such as:

- hull resistance
- power demand at different speeds
- interaction between hull and propulsion

Many optimise for a single design speed. We optimise for the vessel's actual operational profile.



## BALANCING SAFETY AND EFFICIENCY

Well boats place specific demands on manoeuvrability and robustness. They operate close to fish farms, often in challenging current and wind conditions. Design solutions that improve safety and manoeuvrability may at the same time influence energy consumption.

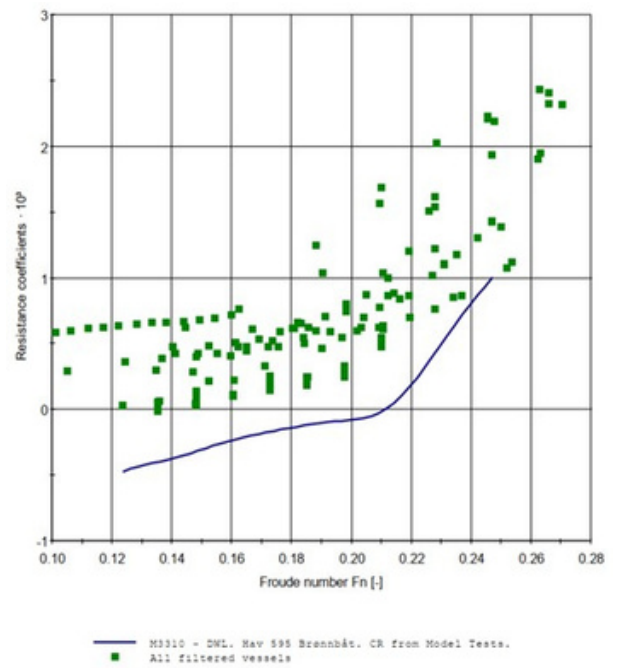


In the HAV 595 design, developed for North Salmon Service, a twin-skeg configuration with two azimuth thrusters has been selected. Such design choices may increase resistance, but they also provide improved operational safety and vessel control.

This illustrates a key principle of our methodology: optimisation is about balancing the overall system, not improving a single parameter in isolation.

An important objective is to develop efficient hull lines. This is assessed, among other methods, through analyses of residual resistance — the component of resistance that reflects the quality of the hull form itself.

For HAV 595, the results were highly favourable. The diagram below presents the residual resistance coefficient of HAV 595 (blue curve) compared with similar vessels in SINTEF Ocean's model test database (green dots).



For HAV 595, model-scale manoeuvring tests were also conducted, making it one of the few wellboats for which such tests have been performed. In addition to traditional manoeuvring tests, such as turning circle and zigzag tests, unique tests were carried out to assess the energy consumption associated with course corrections.



## BRIDGING MODEL TESTS AND FULL-SCALE OPERATION

Digital analyses are powerful tools, but validation and verification are equally important.

In some projects, model tests are carried out to validate the calculations. When the vessel is delivered, full-scale trials such as speed trials and manoeuvring tests are conducted. The results are then compared with the virtual predictions and used for verification.

Data from testing and vessel operation are actively used to improve the next design. In this way, we continuously build an increasingly precise and evidence-based model database.

## INTEGRATED ENERGY SYSTEM ANALYSIS

Using the vessel configurator, we can simulate how different energy configurations — such as hybrid solutions, batteries, or alternative fuels — affect the vessel's energy demand across its entire operational profile.

This enables analysis of:

- Propulsion solutions and overall efficiency
- Energy losses throughout the entire energy chain
- The impact of different operational strategies
- Total cost of ownership (TCO)
- Cost per tonne of emission reduction

The solution that results in the lowest overall energy demand — regardless of energy carrier — is often the most sustainable option.

## HAV 595 – METHODOLOGY IN PRACTICE

HAV 595 has been developed for live fish transport with large tank capacity and high operational flexibility. The vessel incorporates, among other features, a hybrid energy solution and is designed with a strong focus on biosecurity, fish welfare, energy efficiency, and cost-efficient operation.



The design is based on analyses of operations, hydrodynamics, and energy consumption combined in a digital model representing the vessel's actual operation.

However, more important than the individual solutions is the methodology behind achieving an effective overall design. We combine operational data, hydrodynamic analyses, energy system simulations, and verification through model and full-scale testing.

The result is vessel designs that not only perform in theory — but in real operation.