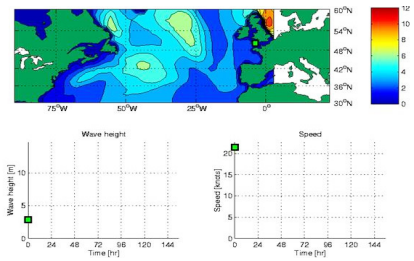
Design for service

When the first sketch of a new vessel is being made, the running costs are being defined as well, and with every additional line that is drawn, they are getting more and more fixed.



If this new vessel is an important new product, it would be of interest to reduce these running costs to a minimum. The best way to do this is to design the vessel for the job it is supposed to do. In this way the overall running costs will be as low as possible and the ship will not only be highly efficient on a condition which seldom occurs. Remember that there are rarely “ideal trial conditions” in service.

To define the operational circumstances for a ship a thorough understanding of the ship’s business targets and related values is required, and an adequate description of day-to-day operations, which are qualities of ship owners, ship managers and traders. The ability to quantify the relevant aspects of ship behaviour in all hydrodynamic-related circumstances is a quality MARIN has acquired in last decade using the experience that was obtained in its more than 75 years of history.

For long, lack of numerical tools to address the relevant aspects of ship behaviour in all relevant circumstances proved major obstacles in a quantitative “design for service”. This is probably one of the reasons why operational aspects find limited recognition in new building specifications and in design optimisations, as they were hard to put some numbers on. One sees that the “design for service” approach then becomes a matter of confidence between the ship owner and the shipyard.

This situation is changing now; the growing understanding of many aspects of ship behaviour, the advantage of robust numerical tools reflecting this insight and the advantage of powerful tools to obtain a detailed picture of the operational performance is moving the focus of the developments towards the core of “shipping business”.

Shipping business
The first confrontation of shipmasters and owners with a detailed picture of day-to-day business seems to show that, despite the intense competition, management of ships is not always a very quantitative business. From a technical perspective, room for improvement is seen if more information is available and used, both in operation and in the development of specifications for a new building project. We regard this situation as a challenging opportunity to improve the shipping industry.

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Hydrodynamics

Fuel costs, on-board revenues related to passenger comfort, reliability and an incident free operation are important aspects of ship operation. The impact of calm water resistance, which determines a major part of the fuel bill, scheduling problems (like weather-induced delays and late departures) and the added resistance from wind and waves are quite accessible nowadays.

In particular the calm water component of the resistance, including the effects of non-optimum trim and draft, can be predicted sufficiently well to account for them in an optimisation for in-service performance. Aspects of seakeeping like passenger mobility and seasickness and (to some extent) lashing problems are fairly accessible with numerical tools, including the performance and drag of roll stabilisation.

Practical design aspects that are much harder to quantify, are the effects of bow flare and stern slamming in waves from forward directions and the risk of excessive behaviour in waves from the stern-quarter. These aspects materialise in the performance in two ways, first through passenger comfort, lashing problems and involuntary speed loss and secondly through the delays that are generated by risk avoiding measures of the master, such as reducing power or changing course.
Obviously, MARIN is investing in the field of hydrodynamics. Notable developments are the developments of techniques for multi-objective optimisation of hull-forms (the FRONTIER and FANTASTIC development), the impact of combined vertical motions, roll and lateral motions on passenger discomfort and work in the area of bow flare slamming.

Operational performance

Detailed wind and wave climatology that are nowadays available from hind casts provide a basis for a detailed simulation of ship behaviour. These “scenario simulations” account for the mutual coherence of wind and waves, the persistence of their severity and direction and the master’s reaction on past, actual and forecasted weather and ship behaviour.

Scenario simulations find rapidly increasing application in design. Following the Queen Mary II performance assessment, which investigated the trade-off between high speed (reliability) and passenger comfort, this technique was used to investigate the relation between service margin and reliability of ferries on particular routes. Other work addressed the feasibility of safe short-sea shipping routes with relatively vulnerable ships, the feasibility of transporting vulnerable cargo, the frequency and risk of parametric rolling, the impact of an advanced ride control system on passenger comfort and the fuel consumption and reliability of a tanker.

Present developments in the simulation tools aim at more detail in the fuel consumption, the complete representation of the engine and propeller characteristics in off-design (over-load) situations and the effects of tidal and global current.