Long lifetime design –
Does quality make sound business sense?

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Definition of quality

The answer to the question „Does quality make sound business sense?“ is strongly dependent on the definition of the term *quality*. In everyday life we use the term *quality* for a superior, deficiency-free and long-living product. Sometimes we associate further characteristics like usefulness or user friendliness with the term *quality*. However, we are always aware that quality has its price. Starting from such a pragmatic definition, it is difficult to answer the question whether quality make sound business sense. It is for instance possible to design a vessel for a very long lifetime of e.g. 40 years or more. This entails a significant price increase due to e.g. improved detail design or the choice of better materials. In the end, it will result in an excellent product of high quality according to the common pragmatic definition. However, this implies not that the solution is reasonably from an economical and ecological point of view or in other words: That the solution makes sound business sense. Further aspects have to be considered in this respect. It is for instance important to investigate, whether it will make sense for the customer to sail with a 40 year old design in the future. The experience shows that vessels of such an age are almost always uneconomical in operation and environmentally inacceptable. Thus, long life-time design itself is not a necessarily and unconditionally criteria for sound business sense. Longevity is not more than a characteristic feature of a product which makes only sense if it is beneficial for the customer.
Based on these considerations, it is reasonable to use more formal definition of the term *quality*. According to the ISO 9000 Standard, *quality* is “the degree to which a set of inherent characteristics fulfils requirements”. Following this interpretation, a shipyard produces quality if the respective vessel fulfils the technical specification. However, a separate difficulty is that the requirements laid down in the specification may not fully represent what the customer wants. Thus, the production of quality means

- to define a set of requirements that fully represents what the customer wants,
- to design and produce in compliance with these requirements.

The most suitable view of quality is that it is defined entirely by the needs of the owner. The answer to the question “Does quality make sound business sense?” is based upon the owner’s evaluation.

Different ways to buy a vessel

There are totally different approaches to buy a vessel. In principle, we can distinguish between three types of customers with the basic attitudes described below:

- The owner can buy a vessel off the shelf, i.e. he chooses an existing standard design offered by a shipyard.
- The owner can develop an own concept and define clear requirements. The contract will be awarded to the shipyard on the basis of a detailed specification.
- The owner can approach the shipyard with a specific transportation problem. The design requirements will be developed together with the shipyard.

The first way leads to a standardized ship. The advantages for yard and owner are obvious:

The owner knows what he can expect and he will get a well proven design. It is sometimes even possible to visit and sail on a sister vessel before signing the contract. The price of a standardized ship is slightly lower since the cost for design and engineering are spread over several vessels. In almost complete absence of any design work the delivery time of the vessel can be sometimes earlier, if the schedule is not triggered by the availability of building slots or the lead time for ordering of main components. For the shipyard the most

important advantage is that the price of the construction is exactly known and that is no risk related to the fulfillment of requirements.
However, there are significant disadvantages of standardized ships:

Firstly, the ship is not optimized for the particular transportation problem. Thus, the design may not be entirely suitable for the demands and needs of the customer and consequently, the owner doesn't get quality according to the definition above. Furthermore the involvement of the owner is limited to minor details.
The question whether a standard design is suitable for an owner can only be answered by the owner himself. It should be noted that there are of course transportation problems where the use of standard vessels is reasonable, e.g. for several container routes. However, for more specialized vessels standard designs are not suitable. Freight and passenger ferries are typical examples for such specialized vessels. Ferries are almost always designed for specific routes and are thus tailor-made unique products. There are clearly defined requirements for all characteristics like speed, maneuverability, sea keeping behavior etc. A further aspect could be additional requirements of local authorities with regard to environmental issues (like noise or emissions) or labor conditions (e.g. air changes in the cargo hold). Thus, it will not take long to amortize the additional expenditures for a tailor-made design later in operation.

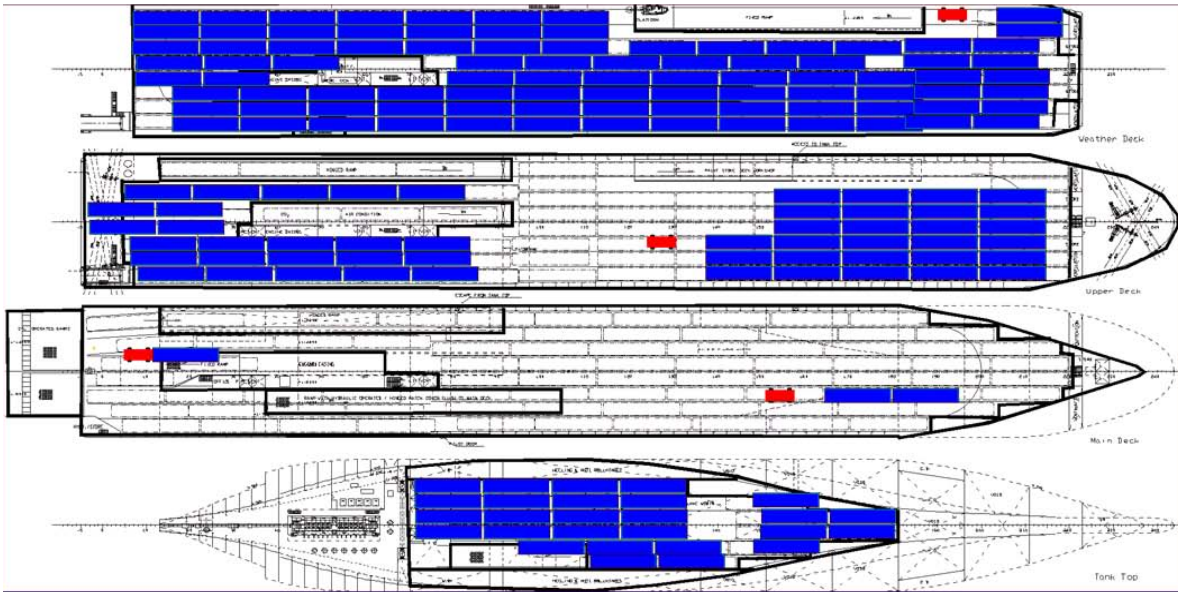
The most promising way

If the owner decides to buy a tailor made design, the second question is whether the specification should be written by the shipping company or should be jointly developed together with the shipyard. First of all it should be noted that the owner knows the business environment better than the shipyard. The customer has the experience in operating ships. In the ferry business, it is most likely that the owner already operate ships on the intended route. Thus, the ship operator can exactly describe what he wants.
On the other hand, the shipyard has the experience in applying a variety of technical solutions on different kinds of ships. On the basis of this knowledge it is sometimes reasonable to investigate alternatives to preferred solutions of the customer. The most important aspect however is that a modern shipyard has appropriate tools to simulate the reality and to find out what might be the best solution.
Thus, the third way usually leads to a most optimized and thus most efficient ship for a specific route. In the following chapter the usefulness of simulation tools shall be demonstrated by three examples.

Examples for design optimization

Example 1: Design optimization considering operational aspects

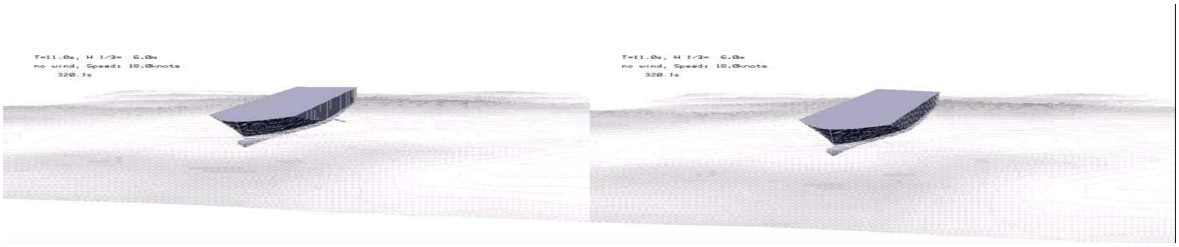
Optimization of loading and unloading is of utmost importance for a freight ferry service. A reduced time period in the harbor means more port calls or -for a ferry service with a fixed time schedule- a reduction of speed at sea and thus a significant save of fuel costs.
The general concept of the vessel should be proposed by the ship owner since the owner has the experience with the particular business and the general procedures. Particularly the owner has a detailed knowledge about the port facilities, the terminal and hinterland capabilities as well as about the skills of the crew and the shore based staff.
However, based on that detailed knowledge the shipyard can simulate all logistic processes. In particular it is possible to investigate different design variants for the future vessel. The picture below shows a screenshot of the loading simulation for a Ro-Ro freight vessel. The aim of that simulation was the optimization of the ramp configuration.



The result of this investigation was that the investment for an additional hoistable ramp pays for itself in a short period of operation.

Example 2: Sea keeping – Reduction of roll motions

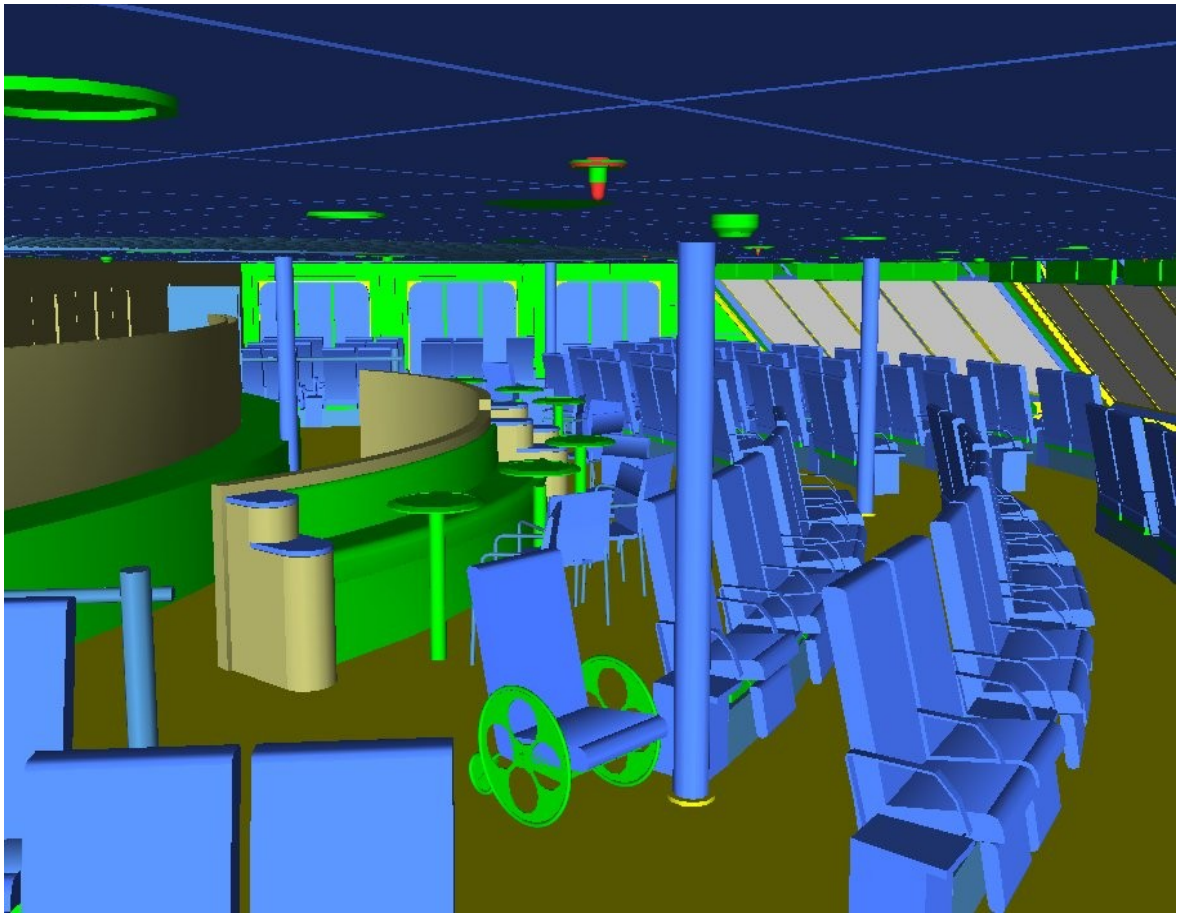
The sea keeping behavior is an important feature of every vessel. For a passenger ferry, the passenger comfort is strongly influenced by the motions in the seaway. For a Freight-Ro-Ro, a detailed sea keeping analysis should answer all relevant question related to cargo lashing and cargo security. In that respect, the reduction of roll motions is of utmost relevance.
Generally the owner has substantial experience with roll damping systems and in most cases a preference for one system (fin stabilizers, flume or interring tanks). Furthermore the ship operator provides requirements for cargo lashing and crew habitability and passenger comfort.
The shipyard too has a sound experience with all passive and active roll damping systems. However, it is more important that the shipyard has the numerical tools to simulate the effect of different systems in order to find the best solution for the intended area of operation.
The picture below shows a screenshot of the sea keeping analysis of a Ro-Ro freight vessel. The aim of this investigation was to compare two design variants - with and without fin stabilizers. The result was that no fin stabilizers were necessary for the intended area of operation. However, for a possible later change of service to a harsher environment (or resale of the vessel) an application of fins could be necessary. Thus, the vessel was delivered without this roll damping device but with a pre-installation for later retrofit.



Example 3: System design with regard to operability and maintainability

Every ship owner has specific expectations with regard to operability and maintainability of the vessel to be designed. These expectations are e.g. related to the accessibility and removableness of aggregates and components. In addition, most ship owner need a specific input for their own maintenance system (e.g. contact data of manufacturer, maintenance intervals or material data for recycling or disposal).

Nowadays, a modern shipyard generates a complete 3D-model of the vessel (steel, equipment, outfitting as well as interior layout). Although the main purpose of this model is to derive all information necessary for the production (drawings, part list etc.), the owner can substantially benefit from this model. A modern shipyard starts with the 3D-model at a very early design stage, normally before signing the contract. On the basis of this model, yard and owner should jointly and continuously optimize the vessel with regard to maintainability and operability. It is e.g. possible, to check whether and how a component can be removed. If this is done in a quite early design stage, the path for removal can be kept free of obstacles (like pipes or cables) in the later design process.
In the end, the 3D-model of the engine room can be used by the owner for crew training in virtual reality.
Just as important as the maintainability is the operability of a system. In principle, the same rule as for the maintainability applies: The 3D-model should be available as early as possible to enable an effective optimization when this is still possible. The reason for starting the optimization quite early is obvious: By the end of the detailed design, changes are at least very expensive or sometimes even not possible any more. Even a small change of an arrangement can result in substantial redesign caused by the complex mutual dependency of all systems. This redesign entails cost for design hours as well as for change orders for material and components.
The picture below shows a screenshot of the operability analysis related to the question whether the interior design fits the needs of handicapped people confined to a wheelchair.



Summary and Conclusion

We consider a ship to be efficient if it is profitable, environmentally compatible and if it complies with the safety, health and environment policy of the owner. To realize this, a shipyard should

– understand the owner’s business,
– be well familiar with the legal requirements,
– analyze possible hazards and

– study the safety, health and environment policy of the owner.

Jointly together with the owner the shipyard should

– define quality measures,
– establish a detailed evaluation schema for all technical decisions,
– develop and compare technical solutions with aid of modern software tools and
– find solutions on a sound rational basis rather than on a subjective opinion.

Based on such a detailed analysis, shipyard and owner will jointly establish a set of requirements that fully represents what the owner wants. The shipyard will later design and produce in compliance with these requirements and deliver a tailor-made vessel for the customer. This approach leads to quality and increases the ships efficiency.

Thus, quality makes sound business sense!

After graduating as a naval architect in 1992, Broder Hinrichsen was assistant lecturer at the Technical University of Hamburg. His research focused on nonlinear structural mechanics and fatigue analyses. With a doctor's degree in engineering he continued his professional career as the deputy head of the department "Strength, Vibrations and Acoustics" at Germanischer Lloyd. In 2002 he joined Flensburger Schiffbaugesellschaft and is currently Executive Vice President for Design, Engineering and Development.