THE MARINE INDUSTRY IN 2030

FROM SPIRAL TO V-MODEL

Your client changes the design requirements again. A supplier cannot guarantee the delivery of a critical component in time to meet the plan. Something goes wrong in the yard, which puts project outcomes—quality, schedule, and cost, which to you means profit—at risk. Each of these is a common occurrence in design offices around the world and can feel overwhelming. They can be dealt with if the team has access to the information it needs to quickly make decisions and trade-offs and effectively communicate these to all stakeholders.

CHANGE IS THE NEW NORMAL

Whether you are part of the naval or civilian industry sector, cruise or workboat, shipbuilder or supplier, you must respond to our industry's changes. These might be:

- **Moving to new contracting mechanisms, such as fixed price, which requires access to legacy data** and confidence in all aspects of design and build. The US Navy recently announced that it would modify existing ship designs and award fixed-price incentive contracts for the detailed design and construction of a new frigate, instead of the cost-based contract for lead ship construction, as was done in the past.

- **Meeting decarbonization and other environmental mandates with closer collaboration** among all of a design's stakeholders. In January 2020, the International Maritime Organization (IMO) cap on sulfur used for marine fuels came into effect. This

regulation and the target of a 50% carbon emissions reduction by 2050 are expected to change the industry. Meeting these targets for older ships requires operational efficiency and awareness; for new ships, there may be the need to rethink traditional answers.

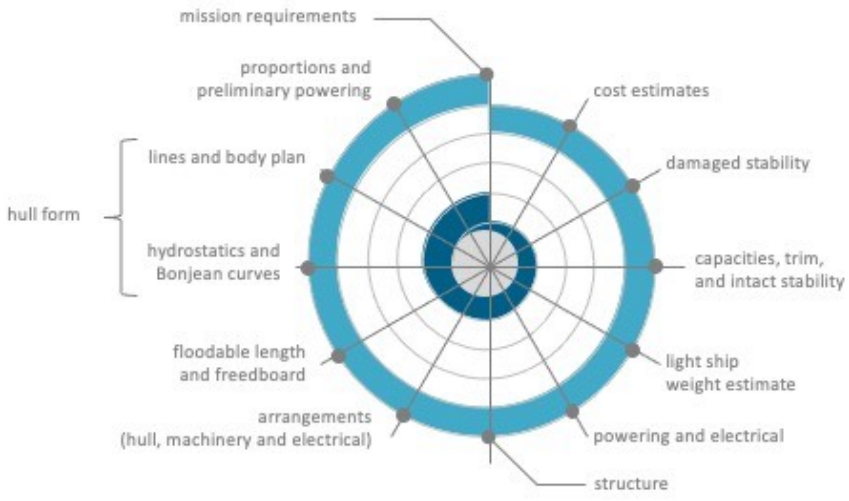
- **Investigating new propulsion concepts,** such as wind or solar power, to assist more traditional engine systems as part of the response to IMO caps. What could that imply for your designs? Your yard?

- **Using innovative materials** to improve sustainability and decrease weight without sacrificing strength. How can you participate in this?

Of course, an uncertain global economic outlook adds extra difficulty to many of the industry's decisions.

NEW PROBLEMS CALL FOR NEW METHODS

These trends are not likely to reverse any time soon. Environmental, safety, regulatory and other external pressures, combined with the competitive need to create ever-better designs, mean that doing things the way we always have is no longer sufficient. For many years, ship design has relied on old processes, layering new technologies on top to improve outcomes. To some extent, that worked: moving from 2D drafting tables to 3D CAD models dramatically increased yard productivity by identifying interferences well in advance of physical construction. But in most design offices, the overall process still follows the Design Spiral identified in the 1950s, which uses a stepwise approach to vessel design, from initial, contract, functional, to detail and production design.



During each phase, the vessel's hull form, stability, propulsion, arrangements, and other requirements

are met. For example, once the initial or concept phase is complete for hull form, the process moves on to preliminary or contract design, and so on. The spiral repeats for each requirement and through each phase.

Before the advent of today's technologies, this made sense. Each design discipline worked on its requirements, refining the concept until costs and plans could be determined. Each also likely used specialist tools, which made them opaque to outsiders – and necessitated laborious data transfer between tool suites.

Today, technology makes it possible to combine many of these requirements and address them in trade-off studies. A designer can simulate a particular hull form and propulsion combination and estimate its initial and annual fuel and maintenance costs—does it meet the owner's criteria? Or is another engine cheaper initially, if that's a key criterion?

The design spiral works but is not the most efficient way to work, given today's tools and owner expectations. Owners want the best design at the lowest cost and on a guaranteed handover date. Meeting those expectations—and dealing with the likelihood of changes during design and build—requires using modern tools that connect disciplines and facilitate quick decision-making while reducing risk.

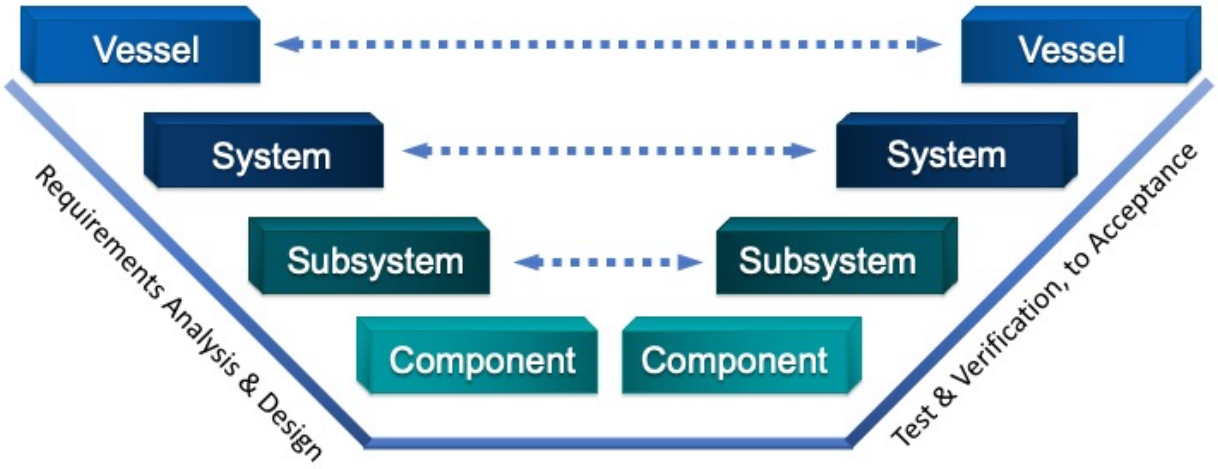
LEVEL UP FOR INNOVATION

Other industries have run into similar challenges as they've seen their products grow in complexity. For example, the automotive industry adopted the V-model, a visual representation of a product creation process that summarizes the main design and validation steps along with deliverables. It describes both the activities to be performed and the results that have to be produced during product development. A simplified V-model is shown on the next page.

The V-model's left leg covers design definition at ever more granular levels, from the overall product to systems, subsystems, and components. These are summed back up on the right leg, verification and validation, testing (digitally or physically) each component, then subsystem, system, and whole. Each discipline has its own V, breaking down the design steps and deliverables into the smallest components, working at that level, and then validating the design in ever more complex steps back to the top level. In a marine context, each discipline (power and propulsion, hull form, arrangements, and so on) has its own V, and all Vs are interconnected to ensure that the complete design meets all

objectives.

The V-model recognizes that decisions made at each point influence the options available for future choices and that the process is iterative and collaborative. It also attempts to address the need to revisit processes, tools, and organizational workflows to increase traceability and synchronization throughout the design phases.



The maritime industry isn't, of course, the same as the automotive. Ships are much more complex and are produced in smaller lot sizes. There may be more national, strategic imperatives guiding the selection of partners and suppliers. Even so, many of the same principles apply:

- designs need to be managed and controlled – for traceability and accountability
- information about each design decision must be shared with those who need it – for validation, collaboration, class society approvals, and many other reasons
- collaboration means co-development across the supply chain, from ideation to operations – to achieve the best possible design and project outcome
- design must increasingly include simulation (physics-based, cost, schedule, operations, and many other types) for early visibility into the impact of all design decisions, and
- where simulation isn't possible, because of a lack of expertise, regulatory requirements

or another limitation, design choices must be physically validated in ways that replicate the vessel's operating environment.

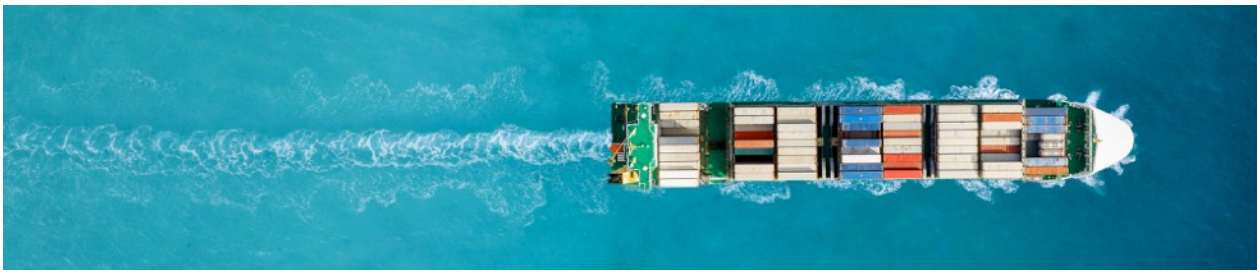
This concept for marine design, using a much more iterative and integrated approach than the typical silos of a spiral, calls for a new generation of practices (as well as the use of modern design and engineering tools). To fully take advantage of this approach, work roles may change, interfaces between disconnected tools may have to be built to streamline the flow of information throughout the design enterprise and its broader project team. And this may mean connecting digital platforms across design, supply chain management, and yard/manufacturing operation.

GET READY FOR 2030

Why would you want to do this? After all, change is often complicated and chaotic. In a simple answer: because there's no alternative. Competition between naval architects, designers, and yards is intense and will not ease. Being more responsive to clients, quickly adapting to their design changes, and new concepts in materials or construction techniques will be a crucial differentiator, as is delivering projects on time, on budget, and at the quality expected. This is only possible with an integrated digital framework that makes it simple for all project participants to collaborate on the best possible design.

Such a framework will also position you well for the advent of smart connected ships, digitally integrated yards, and opens up the prospect of delivering new services to clients, perhaps including digital twins of the physical ship.

TRANSFORM HOW YOU WORK, ENABLED BY DIGITALIZATION



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