MEET TODAY'S CHALLENGES

The United Nations says that the decade from 2011 to 2020 was the warmest on record, with the surface global temperature almost 1°C (2°F) above the 20th-century average.[1] Even this seemingly tiny increase can have grave consequences. According to the US-based National Resources Defense Council,

> *human influences are the number one cause of global warming, especially the carbon pollution we cause by burning fossil fuels ... The carbon dioxide, methane, soot, and other pollutants we release into the atmosphere act like a blanket ... altering the earth's climate system, including its land, atmosphere, oceans, and ice, in far-reaching ways*[2].

The European Parliament estimates that global shipping activity creates 2% to 3% of total global greenhouse gas (GHG) emissions.[3] To begin to lower the industry's impact, the International Maritime Organization (IMO) established its 2030/2050 targets. By 2030, IMO wants shipping to reduce carbon emissions by 40% from 2008 and, by 2050, to cut at least 50% of the shipping industry's total GHG emissions.

How can we get there? Reaching the IMO's ambitious goals will require collaboration and coordination across all aspects of design and operation. Meeting these targets in the short-term, given the current fleet's age, is about operations. The vessel's designer can help the operator better understand how to reduce GHG emissions — is the vessel running at designed speed, her most efficient? Are the engines optimized for this fuel grade and operating environment? Is the power consumption by onboard systems as

expected, or can something be tuned? This connection between as-designed and as-operated is often called a digital twin, which we'll explore below.

Longer-term, however, design choices become more critical. Over a vessel's 30-year working life, selecting the correct engine and fuel will help meet targets given a proposed operating profile. So will effective on-board energy management, innovative propulsion concepts, new and lighter materials, among many other techniques.

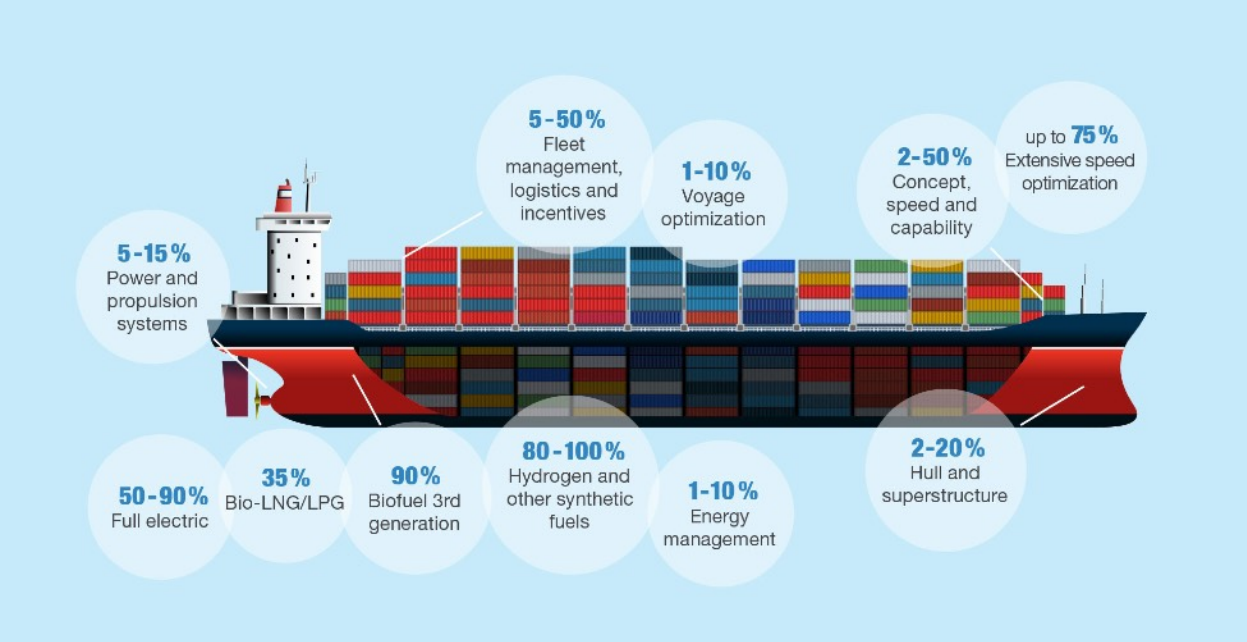


Image courtesy of IMO

The best long-term solution is to replace older, less efficient, and more polluting vessels with new designs that incorporate modern concepts for clean fuels, lighter materials, and more advanced operations solutions. Those ships will be at sea for many years after today's fleet is retired.

UNDERSTAND DESIGN CHOICES

Designing these advanced vessels involves trade-offs between speed and fuel efficiency, cargo capacity and operating cost, among many other choices. It's easiest to examine these trade-offs in an integrated environment that captures and manages requirements, concepts, supplier information, and more to facilitate intelligent design exploration. There, the structural team can work with colleagues from propulsion, electrical systems, and other relevant disciplines to get greater insight into the factors affecting the vessel's

performance — and whether the design is getting closer to or further away from target objectives, including GHG emissions.

Innovative thinking is required to meet today's challenges, leading to new hull designs and propulsion concepts. Testing these ideas with model scale prototypes is not the most efficient way to know if they meet objectives; advanced simulation is faster, more accurate, and can test many more operating scenarios. Techniques such as computational fluid dynamics (often referred to as digital towing tanks) require hull form, propulsion, and weather characteristics — and can, with enough compute power, estimate many factors of a vessel's performance within a few hours. This simulation enables naval architects to test out many concepts, arriving at the design case's best solution.

Note that design exploration doesn't have to be physics-based. It can also include many other attributes such as cost (does the lifetime cost of this piece of equipment outweigh given its benefits?), schedule (will this design change negatively affect the delivery date?), and other factors. By examining a concept from many different angles, designers can make trade-offs with full knowledge of their impact.

FIND OPERATING ADVANTAGE

Vessel operators typically have fewer options since they can only work with what's available right now or via a refit they can financially justify. In this case, a digital twin can be an essential component. A digital twin is typically a combination of the as-designed or digital model (hopefully, as-built, since that's never 100% the same as as-designed) and real-time data from the operating asset. The naval architect or yard typically has access to the digital model, while the operator can access data from the vessel.

By combining the two and using analytics to sync operations and equipment models, for example, the operator can determine which equipment needs maintenance urgently, soon or not at all — helping optimize performance and control cost. Digging deeper into that same data can give clues to tuning the equipment for optimal operations, minimize fuel use, and otherwise improve efficiency, requiring lower energy use overall.

The digital twins and advanced design scenarios essential to meeting GHG targets can best be addressed with a platform technology that gathers, maintains, and serves out the data necessary to solve the specific problem at hand.

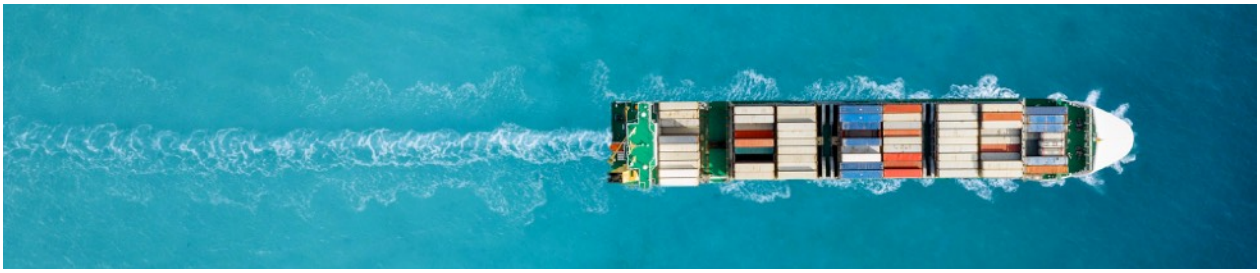
These platforms manage and grant access to data; manage processes and people; improve traceability and collaboration; and create a closed-loop configuration, requirement, change, and verification system. And, when extended into operations, improve both the useful life of the asset and its operations.

GET READY FOR 2030

The IMO's 2030/2050 targets, reducing carbon emissions by 40% by 2030 and cut 50% of the industry's total GHG emissions by 2050, are ambitious. You may be a naval architect trying to find the perfect compromise between hull speed and fuel use or a designer working to reduce the vessel's weight via innovative materials. If you're an operator, you want to understand your options given the IMO's mandate. In all cases, a technology framework that manages, distributes, and controls information about the design is key to understanding the problem and discovering solutions.

This type of advanced digitalization will transform how we design, build and operate–and reduce our dependence on environmentally unfriendly fuels.

TRANSFORM HOW YOU WORK, ENABLED BY DIGITALIZATION



Schnitger Corporation created this brief at the request of Siemens Digital Industries Software, Inc. For more information or to comment, please visit www.schnitgercorp.com

[1] https://www.ncdc.noaa.gov/sotc/global/202013

[2] https://www.nrdc.org/stories/are-effects-global-warming-really-bad

[3] https://www.europarl.europa.eu/news/en/press-room/20200910IPR86825/parliament-says-shipping-industry-must-contribute-to-climate-neutrality