May–June 2024

The Maritime Executive™

INTELLECTUA[illegible]R LEADERS

YAMAN ŞEN

GENERAL MANAGER, YMN TANKERS MED MARINE

The Decarbonization Challenge

The design is the easy part.
***What* to design is the challenge.**

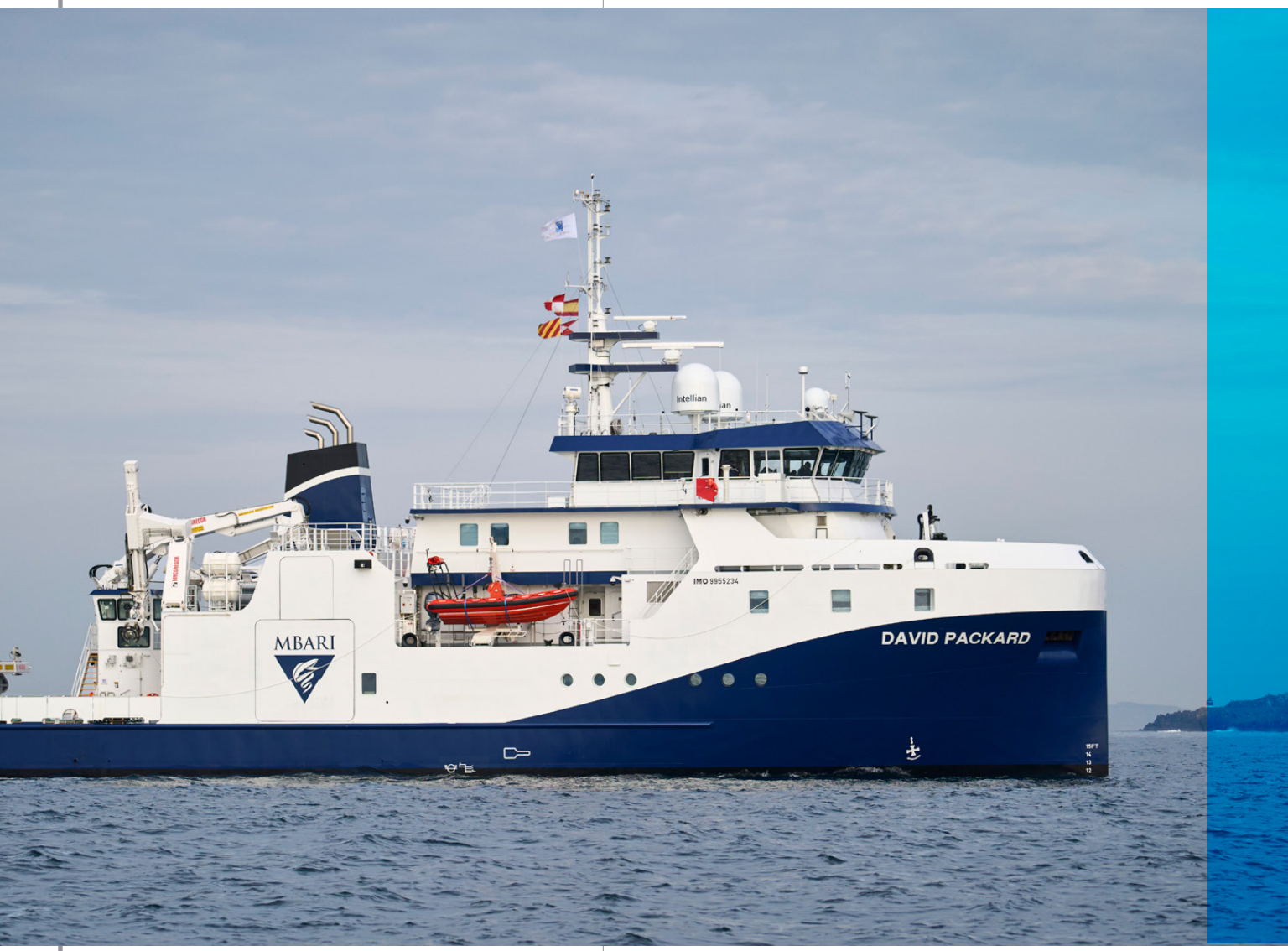
BY **ALLAN JORDAN**

While much of the discussion about the future of shipping is centered on big concepts like increasing efficiency, alternate fuel sources and decarbonization, naval architects say there is no one solution to the emerging challenges.

The field is having to respond as technologies rapidly mature and regulatory requirements remain a moving target as they continue to evolve and react to public sentiment.

"Operators are asking which alternative fuel they should consider or if batteries or hybrid solutions are an option," says Sam Waterhouse, Technical Manager for Naval Architecture at Elliott Bay Design Group. "Our advice is always to start with an analysis of their operation. Every vessel is unique."

A full-service marine engineering and naval architecture firm with a broad



GLOSTEN-DESIGNED *DAVID PACKARD*. PHOTO: FREIRE SHIPYARD.

portfolio ranging from fishing boats, barges and tugs to passenger vessels and ferries, Elliott Bay knows the future of ship design will evolve to accommodate the future variety of fuel options. Ten years ago the future vision was to convert more ships to liquified natural gas (LNG). Now it will require a more holistic and inclusive approach.

"One of the biggest challenges is the impact specialization has had on naval architecture," says Donald MacPherson, Technical Director at HydroComp, a developer of software applications that optimize vessel efficiency, including their propellers. He notes that naval architects want to retain control of the system design in areas such as propeller design, driving significant growth for their focused propeller design tools.

"Successful naval architecture requires a vision of the whole project supported by specific staff providing very focused specialized deliverables," MacPherson adds.

TrueProp Software, a spin-off and now partner company of HydroComp, offers just such a tool for propeller inspections and tuning to maximize performance. "Customers demand more performance and higher efficiencies," states Adam Kaplan, TruProp's Chief Technical Officer. "Fuel and emissions are slowly transforming the way we power (and repower) vessels."

NO ONE SOLUTION

Decarbonization is one of the biggest challenges.

Glosten, a full-service naval architecture and marine engineering consultancy working on innovative

CCRV RENDERING. PHOTO: GLOSTEN.

projects such as the first hydrogen-hybrid coastal-class research vessel and battery-hybrid pilot boats for San Francisco, says naval architecture involves a consulting role requiring a complete understanding of the options for clients. It requires they educate their own teams as well as clients and sometimes the entire industry. Today, projects involve working with clients to figure out what will be best for the individual situation.

Whether it be methanol, ammonia, hydrogen or a synthetic fuel, vessel designs require adaptation to accommodate alternate fuels. Many of the fuels come with a lower energy density and some have health and safety concerns.

"As a sector, we're getting smarter about choosing between alternative fuels and electricity," says Glosten. "Many of our clients are seeking decarbonization, and there isn't currently a one-size-fits-all solution."

Decarbonizing a vessel involves more than simply finding the right energy source and adapting the vessel's structure and systems to accommodate the necessary equipment. The availability of fuel supply or energy sources, the maturity of the technologies and systems that will process it and the infrastructure needed to deliver it are often harder to guarantee than whether or not the solution will work.

"Everything comes back to a good analysis of the operational profile," says Elliott Bay's Waterhouse. The industry is optimistic about batteries but the challenge is for them to become more energy dense.

"Currently, battery designs are limited to roughly two to four hours of operation max before recharging or around 10 to 40 miles depending on the size of the vessels," he adds, saying for the time being batteries will be the solution for ferries and short-sea shipping. Elliott Bay designed a 599-passenger, 15-vehicle, double-ended hybrid-electric ferry for Casco Bay Lines that's due to start service this year on a 30-minute run between Portland and Peaks Island, Maine.

COST CONSIDERATIONS

The transition, however, comes at a cost.

Glosten notes that new fuels, technologies and regulations are cost drivers that are particularly challenging for shipowners and operators "who are trying to balance decarbonization with running a business or marine operation."

Similarly, Elliott Bay's Waterhouse notes, "The cost of vessel construction has increased drastically over the last five years, making it very difficult for operators to finance new construction." He says operators now also face the major challenge of meeting future emissions reduction goals.

As new construction costs mount, Elliott Bay has integrated efficiency and economy as core aspects of its vessel designs. Waterhouse expects there will be a "refo-

cusing on other methods to reduce fuel needs. Options include reducing transit speeds, hull optimization and diversifying the fleet so that smaller vessels are used when there's less cargo to move."

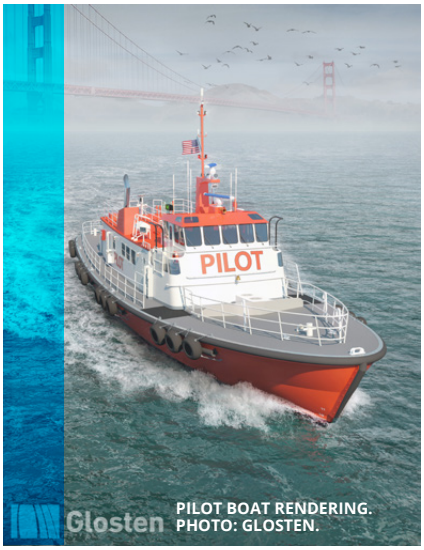
Glosten says inflation in the cost of building new ships may make owners less likely to build new vessels in favor of keeping existing vessels in service longer. This, however, comes with the challenge of keeping older vessels in compliance with new regulations.

Owners are also looking to tools such as TrueProp, which is seeing increased demand as a solution to improving the operations of in-service vessels. Kaplan points out that "Even a perfectly manufactured, high-tolerance propeller may need to be adjusted to dial in the performance for a vessel. This means that propeller inspection and tuning tools are a critical part of vessel post-design delivery."

As shipowners work to respond to the emerging constraints from regulatory agencies, HydroComp's MacPherson says it becomes attractive to look at adding, modifying or replacing components such as propellers, ducts, bulbs, flow-alerting devices or flow-adapted appendages.

"However, from our perspective, everything is a system problem first and a component problem second," he adds. "Isolating design considerations to individual components can omit reaching meaningful solutions." He cites, as an example, that modification to the propeller

As new construction costs mount, Elliott Bay has integrated efficiency and economy as core aspects of its vessel designs. Waterhouse expects there will be a "refocusing on other methods to reduce fuel needs. Options include reducing transit speeds, hull optimization and diversifying the fleet so that smaller vessels are used when there's less cargo to move."



PILOT BOAT RENDERING. PHOTO: GLOSTEN.

to reduce noise can require additional power and fuel consumption, meaning it has to be reviewed from a systems' perspective.

MOVING TARGET

Naval architects are also continuing to learn and refine designs and approaches in response to regulatory challenges.

"The dynamic regulatory environment is a simple fact of naval architecture, but because of the many new fuels and technologies that are emerging, changes are occurring at a faster rate," says Glosten. They note that in the current fluid environment, there can be unintended consequences, such as when previous regulations have come under more scrutiny and are being interpreted differently, making it more difficult to ensure designs work the first time.

"We've spent a lot of time figuring out how our decarb projects are going to be approved," says Tim Leach, a Glosten principal. "It's not a well-worn path. Every novel design must go through the regulatory approval process, and even when you start the conversation early, when the rubber meets the road and people have to sign off, things can change."

Among the examples Glosten highlights are design efforts to develop the world's first hydrogen-hybrid coastal-class research vessel for Scripps Institution of Oceanography. They note that investigatory studies were critical along with the time required to navigate the relatively uncharted regulatory environment around hydrogen use for a research vessel.

Similarly, for the San Francisco Bar Pilots, they recommended a battery-hybrid system that exceeds California's current emissions requirements because they

recognized the likelihood that California's emissions restrictions could become stricter in the future.

"We also try to future-proof our designs, thinking through what could be coming and making decisions knowing certain regulations may become more stringent." Glosten says this is hard for obvious reasons but critical to prevent a vessel design from quickly becoming obsolete.

In a related development, a project to develop the first hydrogen-powered towboat in the U.S., a design developed by Elliott Bay, recently reached a Design Basis Agreement with the U.S. Coast Guard establishing a framework to help speed the review, inspection and eventual certification of the vessel.

In a related development, a project to develop the first hydrogen-powered towboat in the U.S., a design developed by Elliott Bay, recently reached a Design Basis Agreement with the U.S. Coast Guard establishing a framework to help speed the review, inspection and eventual certification of the vessel.

MORE TO COME

The industry appears to be on the edge of a big change that goes beyond how vessels are powered. Many are speculating about how emerging technologies such as artificial intelligence (AI) and the early exploration of autonomous operations will impact future designs.

As with any major shift, there are growing pains, says Glosten. "All we can do is educate ourselves on emerging technologies and regulations, continue honing our design processes and learn as much as we can about our clients and their needs so we can deliver a vessel that will serve them well and be able to adapt to the changing regulatory landscape."

***Mar*Ex**

ALLAN JORDAN is the magazine's Associate Editor.