Sustainable at the core

by Esa Henttinen, *Executive Vice President, NAPA Safety Solutions*

The pursuit of sustainable shipping requires decisive action on two fronts. Ashore, shipyards are challenged to design the more efficient ships of tomorrow, while at sea, crews must ensure each vessel navigating today is operated safely and sustainably. On both fronts, it begins by understanding the data that makes each vessel unique – its 'digital DNA' – and making the most of these insights, from design to operations.

Modern ships are made of data just as much as steel. Well before its physical structure is welded together in a shipyard, a vessel exists digitally in the 3D models used to design it – what we call its digital DNA. As no two ships are exactly the same, this digital DNA is key to understanding a vessel's unique design, containing a wealth of information on its technical characteristics, propulsion systems, and any additional technology on board.

Importantly, these digital models are not fixed in time, and their role doesn't end once a vessel leaves the shipyard. A ship's digital twin evolves just like its physical counterpart, incorporating data on its operations, maintenance, and the sea conditions it has experienced to truly reflect its current state. This dynamic understanding of a vessel throughout its lifetime helps us predict its performance in a variety of conditions, which is crucial to making the best possible operational decisions to maximise efficiency while ensuring safety.

The capacity to understand each vessel thoroughly is an ace card for shipping as the sector faces the challenge of a generation: improving sustainability, both immediately and in the long term. On the one hand, already sailing ships need to reduce their emissions right now to meet the International Maritime Organization's (IMO) Energy Efficiency Existing Ship Index (EEXI) and Carbon Intensity Indicator (CII) requirements that are about to enter into force. On the other, the industry also needs to develop ambitious new designs, using them as efficiently as possible to meet the 2030 and 2050 decarbonisation goals.

In other words, we need a fundamental transformation of global fleets and of the way we operate them. This must begin at the granular level, and insights from digital DNA can help with three key aspects.

Tailored voyages

Firstly, the dynamic, vessel-specific insights provided by digital models represent an exciting opportunity to take weather routing to the next level. By using the ship's unique digital twin, we can estimate how fast and at what fuel consumption rate it can sail for a number of potential voyages – taking into account its design characteristics and details of its current condition, such as hull fouling and engine wear, for example.

Combining these vessel-specific insights with weather forecasts detailing wind, waves, swell and currents, as well as information on safe routes, our NAPA Voyage Optimization solution can simulate hundreds of possible routes and predict their impact on estimated time of arrival, fuel consumption and emissions. From this, our algorithms can calculate optimal routes and speed profiles that will meet operational needs and desired arrival times, giving captains and operators better visibility of all possible options and enabling them to minimise their emissions for every voyage.

This is already making a tangible difference. NAPA Voyage Optimization cuts fuel consumption and emissions by an average of 5-15%, which has a substantial impact on fuel costs today, while also helping shipowners 'future-proof' their fleets for the crucial years ahead. Indeed, these emissions reductions can make the difference between compliance and non-compliance with CII regulations – or in other words, between keeping a vessel trading or seeing it become a 'stranded asset' prematurely.

Looking further ahead, the capacity to optimise operations for each vessel's unique characteristics will be even more valuable. It will enable operators to make the most of the unique combination of technologies on board by tailoring their routes to maximise the benefits of wind propulsion systems, among others.

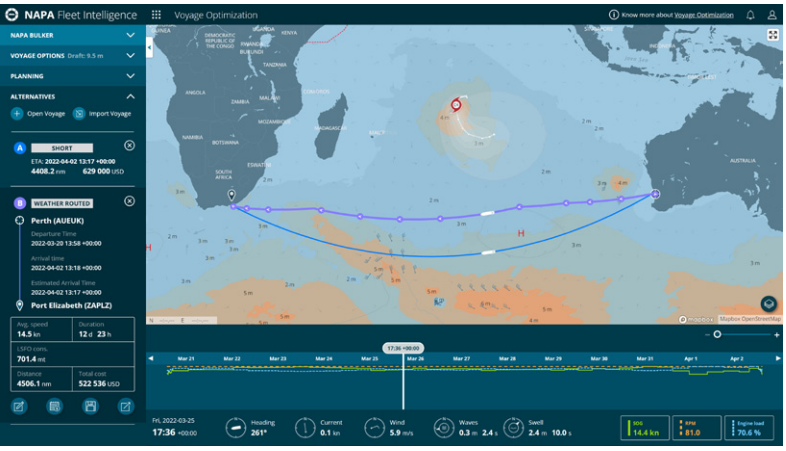
Safety as a prerequisite

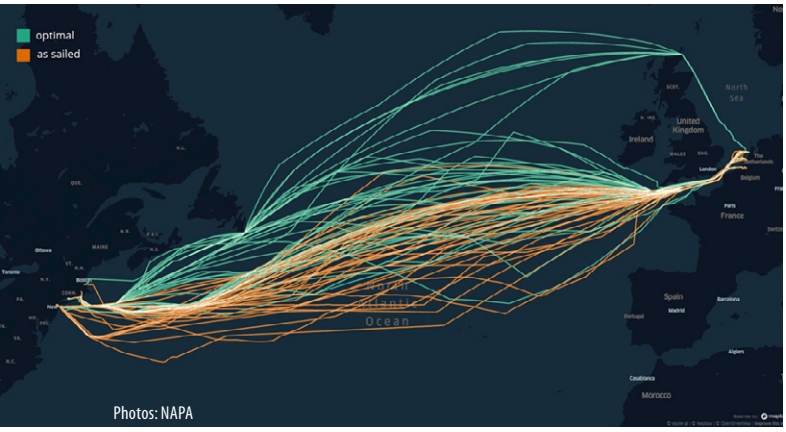
The second key contribution of digital models is to provide vital insights to ensure the safety of global fleets throughout this period of rapid innovation. As the worldwide fleet integrates a variety of new fuels and technologies, both as retrofits and on newbuilds, safety must be a prerequisite. Ship-specific digital models also play a critical role here, giving a real-time picture of a vessel's vulnerability and the risks it faces at any given moment in a voyage.

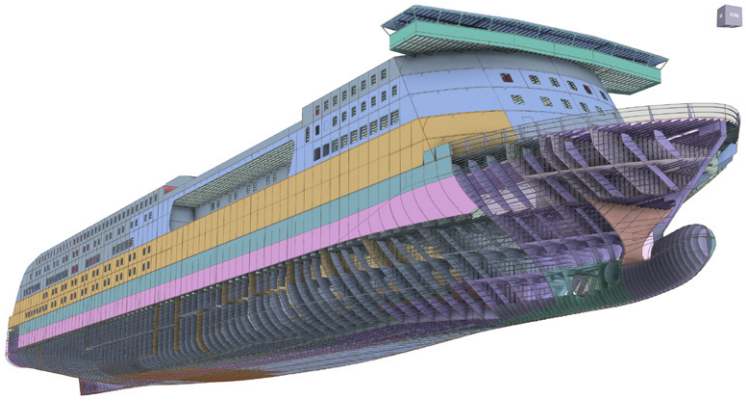
Our NAPA Stability solution achieves this by combining a ship's digital DNA with the wealth of data continuously generated by the vessel's systems. Thanks to the latest advances in connectivity, several variables that may affect a ship's stability, from deadweight changes (cargo, bunkers, ballast) and loading conditions to the number of water-tight doors left open on the vessel, can be monitored constantly. This information is fed into a cloud-based system, alongside external data such as location from the automatic identification system, weather and precise maps that help build the most accurate picture possible. As a result, a wide range of calculations related to hydrostatics, intact stability, damage stability, and longitudinal strength can be made in real-time.

Crucially, this means that risk levels can be assessed constantly by the crew and shoreside teams alike, creating a more proactive approach to safety where any potential issues can be flagged and addressed before they ever become a serious problem. Moreover, if an emergency does happen on board, the shared situational awareness between ship officers, onshore teams, and emergency services will facilitate an immediate and efficient intervention.

As a ship's safety can never be compromised, green and safety technology







Photos: NAPA

must work together to pave the way for zero-carbon shipping. For instance, data from NAPA's loading computer can also support environmental reporting requirements, such as the EU Monitoring, Reporting and Verification and the IMO Data Collection System, which require loading and cargo information. Moving forward, data-powered models will help ensure that innovative vessels remain safe at all times by enabling decision-making, implementation and execution of new green technologies that ensure a vessel's sustainable operations without ever compromising on safety.

Using today's experience to improve future designs

Last but not least, a deeper understanding of vessels' digital DNA supports shipping's sustainability transition by empowering shipyards to create the more efficient vessels needed to bring the industry to net zero.

Today, 3D models already support naval engineers and architects as they develop innovative designs by facilitating class approvals and enabling all stakeholders to work on a single 'source of truth.' A comprehensive 3D model enables fast design changes and reliable analyses across the domain: from hydrostatics, stability, ship weight estimation and hydrodynamics to steel structures and Finite Element (FE) analysis.

Quick design iterations and comprehensive analyses are particularly important for innovative designs, enabling engineers to make the right choices early and understand the impact of new features on the integrity, stability, and efficiency of the global structure. It is also key to creating flexible designs, such as vessels ready to be converted to new fuels, that the industry demands in this period of uncertainty.

Moreover, the current digital era provides a goldmine of insights that will help optimise the future fleet. Real-life voyage data links theory and practice, providing shipyards with the unparalleled ability to analyse their vessels once deployed at sea – and further refine and iterate their designs to improve efficiency even more.

Additionally, historical data from thousands of real-life voyages at sea can be analysed to give a statistical picture of the weather conditions a ship is likely to encounter on specific routes, which helps inform decisions on required engine power for newbuilds that will navigate the same trade lanes. In other words, data from operations at sea helps fine-tune ships' digital DNA from the very start to make future vessels more sustainable and adapted to the routes and conditions they will encounter.

A tangible effect of the intangible

While the impacts of climate change are increasingly visible, one of the most powerful and efficient tools to reduce emissions from shipping – data – is intangible.

By deploying this tool through concerted and widespread action at the granular level, in the world's shipyards and on the tens of thousands of vessels navigating at sea, the industry can take its first tangible steps to surmount the monumental challenge of decarbonisation. ■

In its over 30 years of operation, the Helsinki-headquartered NAPA has become a global leader in developing and scaling software, services and data analysis for a safer, smarter, and more sustainable maritime industry. To date, NAPA has 420 user organisations for its design solutions, nearly 3,000 installations onboard vessels, and a growing number of subscribers for its cloud-based fleet services. Make your way to **www.napa.fi** to see more.