

Enhancing Vessel Performance with Dynamic Recalculations

Executive Summary

This White Paper explores the significance of dynamic recalculations in achieving optimal voyage outcomes. By leveraging advanced machine learning and automated analytics, Danelec provides real-time solutions that consider a variety of factors including weather conditions, market changes, and vessel-specific data. This approach ensures that shipping businesses can make informed decisions to maximize profitability and efficiency.

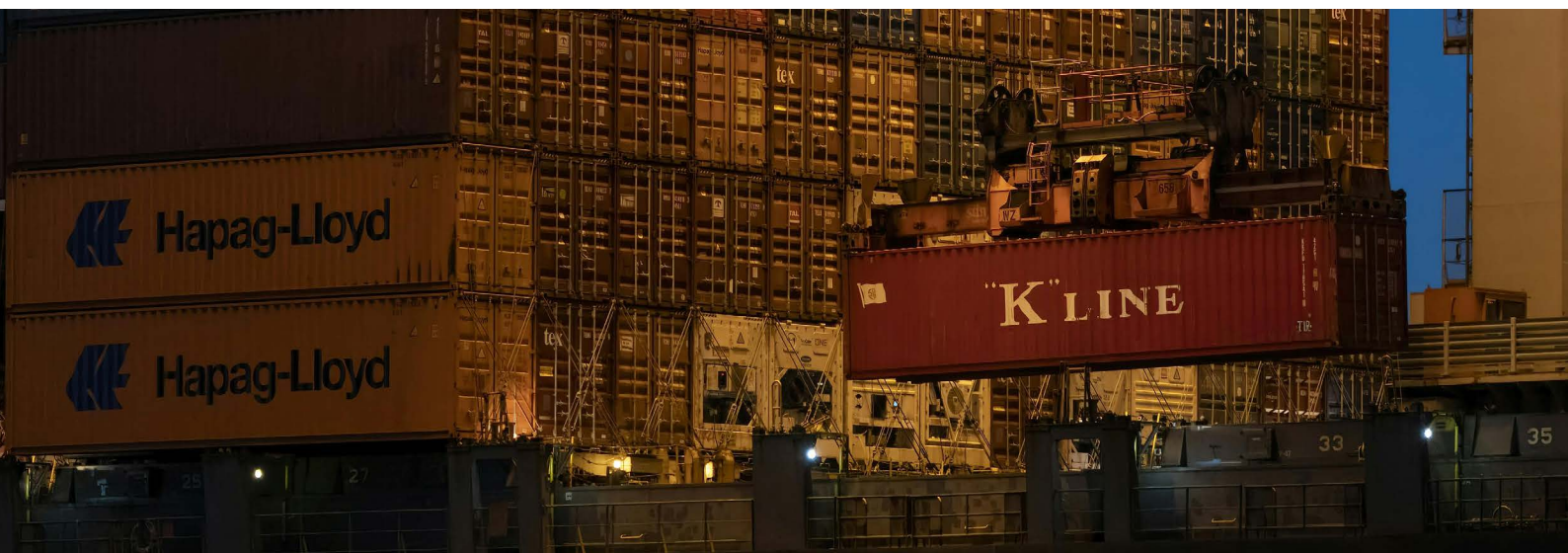


Challenging Traditional Methods of Optimizing Voyage Outcomes

Voyage optimization is not a new concept. As long as vessels have been sailing under engine power, owners and charterers have been weighing the relative value of fuel and time. Is it worth speeding up to arrive sooner? Should a vessel slow down and target a later arrival? How can we assure just-in-time arrival without assuming too much risk? In pursuit of operational excellence, shipping businesses have begun to embrace technology and advanced analytics solutions to make more informed vessel operating decisions and confidently answer these questions.

The advent of machine learning allows shipping businesses to consider more factors to run those calculations in mere seconds, and to generate answers faster with greater accuracy than ever before. In addition to fuel consumption and arrival time, optimizations can and should consider demurrage and laycans, while linking to changes in both the freight and fuel markets. They should also recalculate constantly, so that decision-makers can respond rapidly to any change in weather, business, or market conditions. This paper will discuss the significance of dynamic recalculations in a voyage optimization and how it differs from existing methodologies. It will also discuss how Danelec develops software that delivers voyage optimizations based on variable inputs, driving significant profit uplift for shipping businesses.

Danelec Voyage Insights is a leading-edge solution for achieving optimal voyage outcomes given its flexibility and automated analytics. Optimizations can include Charter Party speeds, forward-looking weather forecasts, demurrage payments and market predictions for both the forward freight rate and fuel costs in the destination port or region. And while for some shipping businesses this is a novel idea—and for others it may seem unattainable given the limitations of current technology—the reality is it is a readily accessible source of competitive advantage today.



Conventional Route Optimization Tools Don't Take Voyage Nuances into Account

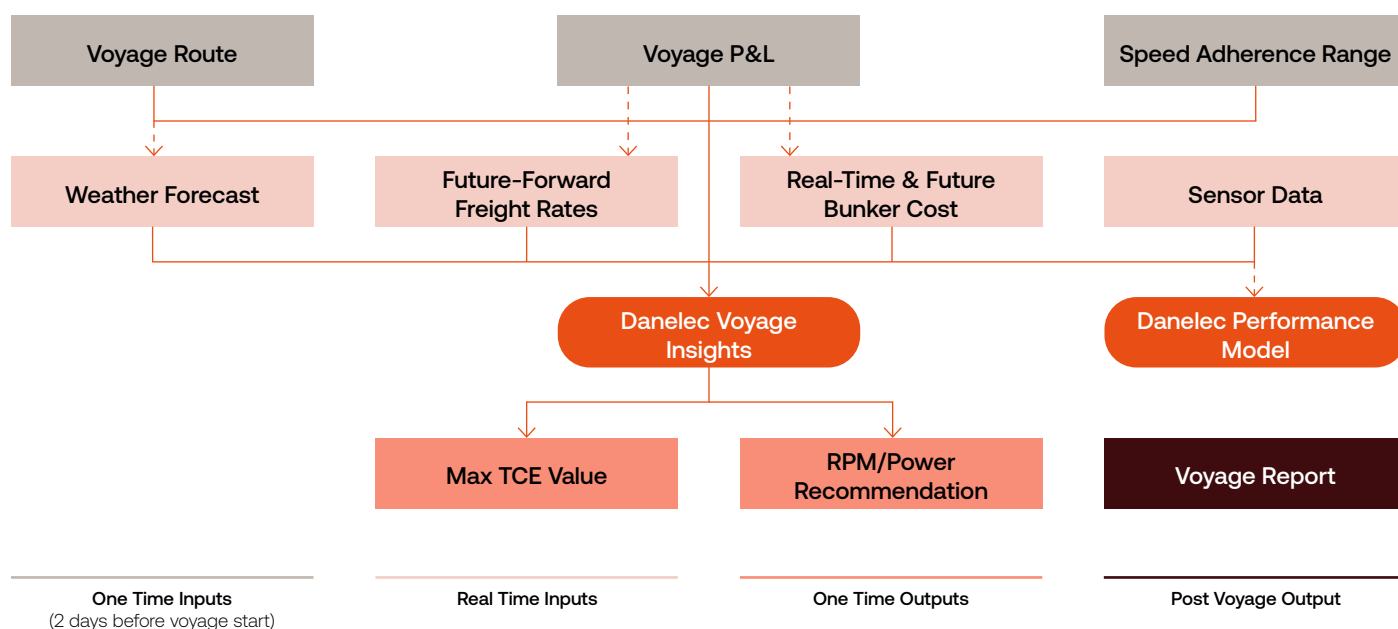
In most cases voyages are planned by the master working with the commercial operations team, and then the weather routing partner assists with route-planning. These groups usually use generalized speed-and-consumption assumptions as inputs, while they are most interested in outcomes that avoid mistakes such as routing into bad weather or missing laycans. This approach is not designed to look for the upside that may be available on a voyage, which limits the ability to achieve that upside—and it doesn't adapt dynamically as the voyage unfolds. It's good to plan voyages before they happen, but as Mike Tyson once said, "Everyone has a plan until they get punched in the mouth." Weather conditions evolve, engines act up and markets change; to properly optimize voyages for an entire fleet, the system has to be nuanced enough to consider all possible passage plans and operating considerations.

This starts with an accurate, real-time and predictive understanding of vessel speed and consumption performance. High frequency sensor data, noon-reported data, vessel condition and environmental information are all critical factors that inform Danelec's machine learning algorithms used to depict a vessel's performance. Artificial intelligence and automation are also at the foundation of what makes it possible to take into account dynamic voyage variables and make sense of them. Using Danelec's machine learning models, the Platform is capable of predicting a vessel's performance over the course of a voyage with a high degree of accuracy. This allows users to understand exactly how a change in RPM or Power will impact speed, fuel consumption, and arrival time. Precise predictions that take into account real life voyage scenarios and objectives allow operations teams to weigh options more completely and find the outcome that meets the constraints for the voyage, generating the highest possible return.

Of course, machine learning alone provides limited value without voyage context or interaction with the people responsible for those outcomes. Attaining an "optimal TCE" becomes irrelevant if a vessel cannot arrive in time to tender arrival. A slower voyage ends up costing money if it arrives outside the laycan. Danelec runs voyage optimizations with some of the most sophisticated technology in the industry, but it is the stakeholders inside the business acting on this information who ultimately drive business results. The value of the software solution lies in its ability to combine machine learning predictions with the variables that affect a voyage, weighing competing priorities and easily delivering insights that users can act on to drive clear ROI for their business.

Voyage Optimization Flowchart

Danelec Voyage Insights' dynamic inputs are paramount to extract highly accurate voyage recommendations that successfully enhance voyage outcomes across different vessel segments and sizes (see chart below).



Weather-Based Recalculations Are Important but Are Merely Table Stakes

Weather is one of the most important variables in a voyage optimization. Danelec's models take into account all meteorological and oceanographic conditions (wind, wave, and current) that a vessel is expected to experience along a route and predict the impact they will have on the fuel consumption and speed of the vessel. As an interoperable and open solution, Danelec is able to pull in routes from any file, format, or source. The Danelec Platform integrates directly with weather-routing providers' API to ingest initial routes pre-voyage and to update routes mid-voyage.

The Danelec Client Success Team also works in partnership with clients to enter waypoints directly into our Voyage Planning tool, which can be used for current voyages or saved for future ones. However, a weather-based approach is only a part of the puzzle. To get the right answer, Danelec takes the weather optimization that weather routing companies provide and adds a highly accurate machine-learning performance model and dynamic inputs such as expected future contract rate and demurrage that meaningfully impact resulting voyage profit.

Automated Recalculations of Voyage Operating Recommendations to Account for Forward Freight and Fuel Rates Are Essential

In order to fully analyze the best speed for a given voyage, Danelec considers the complete commercial picture and the goals of the commercial team. There are a few examples of how this can work in practice, which we have laid out below.

Maximizing TCE in a Healthy Market

TCE is king in the tanker market. Our clients that operate tankers track voyage profitability very closely and are interested in driving that specific metric as high as possible. In early 2020, rates were relatively high (and occasionally very high), which created an opportunity to squeeze higher TCE rates out of voyages with small changes in speed. High daily revenue potential and low fuel costs create an opportunity to increase TCE exponentially, particularly if sailing days are reduced.

$$\text{TCE} = (\text{Revenue} - \text{Costs}) / \text{Days}$$

On a recent Suezmax voyage from West Africa to Indonesia, the owner had the good fortune of having an astronomical day rate, which meant that any time saved would have a positive impact on TCE. The Operations team felt that 12.5 knots was the maximum possible speed for that vessel at that time given the weather conditions, but Danelec worked with them to find opportunities to speed up and helped determine that even in cases where increased speed would noticeably impact consumption, the value of reducing time outweighed those costs. As a result, the operator was able to increase speed to 13.5 knots, shave 2.2 days off the voyage, and increase the TCE by \$7k (Exhibit 1).

On a separate voyage, an Aframax traveling from the U.S. Gulf to Argentina was planning to pursue an average speed over ground of 11.6 knots (Exhibit 2). Danelec helped identify the opportunity to increase the speed while maintaining roughly the same amount of consumption over the course of the voyage leg and ultimately shaved 1.6 days off the leg, resulting in an uplift of TCE profit of 10%.

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Optimizing for Market Rate

For other clients, particularly in Dry Bulk, it is more important to consider the expected value of the next contract and the expected price of fuel at the destination port than it is to consider the TCE or the cost of the fuel that has already been purchased. These clients believe that by the time the voyage has started, their options for affecting the economics are limited and the most important optimization they can do is maximization of their returns on the upcoming voyage. In practice, bulk operators have to balance several considerations which may seem like moving targets. When away on passage waiting to secure the next contract, do you reach the load port without a secured fixture and a weaker negotiating position? Do you reposition more optimally and reroute your vessel towards a different load port?

This future-oriented approach carries a bit more risk in the event that markets change dramatically, but it creates the possibility for the fleet to respond to quickly changing markets and to put vessels in position to seize commercial opportunities as soon as they emerge. In one example, a vessel was traveling from Skagen to Santos with no initial ETA sensitivity in a down market. Danelec Voyage Insights initially recommended 50% Maximum Continuous Rating (MCR) to conserve fuel, but over the course of the voyage, the future freight rose by 36% and Danelec increased the recommendation in step with the market in order to capture the expected future contract. As the market rose, so did the amount of fuel cost that could be traded for time in the optimal configuration.

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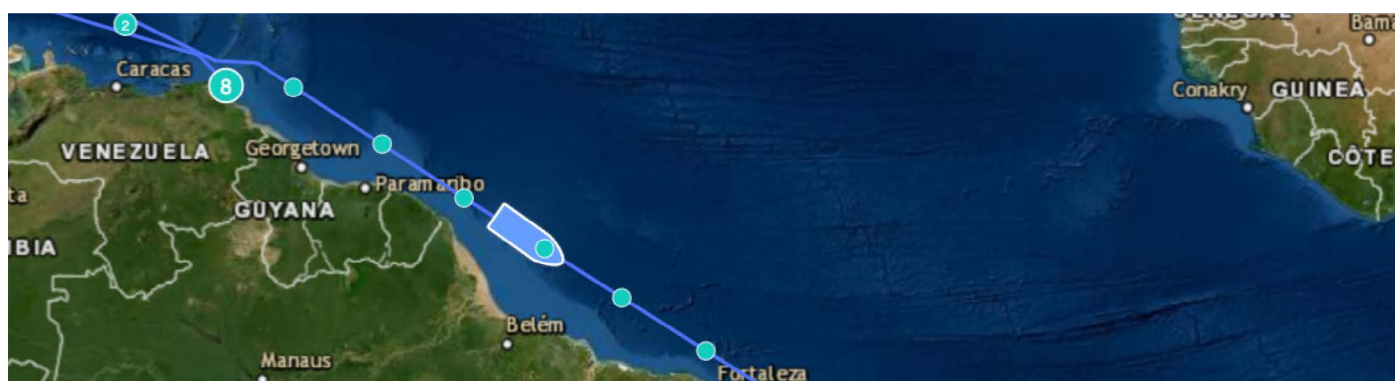
Exhibit 1



West Africa to Indonesia	Avg SOG	Daily Fuel Cons	Duration (Days)	TCE
Modeled Voyage	12.5	36.7	28.2	\$137k
Actual Voyage	13.5	48.2	26.0	\$144k
Difference			-2.2 (7%)	+7k (5%)

Operations team expected bad weather and a low average SOG. The high charter rate increased the value of time, creating a possibility to increase TCE by reducing days—despite higher fuel consumption.

Exhibit 2



US Gulf to Argentina	Avg SOG	Daily Fuel Cons	Duration (Days)	TCE
Modeled Voyage	11.5	21.7	23.5	\$22k
Actual Voyage	12.3	21.2	21.9	\$24.5k
Difference			-1.6 (7%)	+2.5k (10%)

Operations plan would have resulted in a low SOG. Danelec was able to obtain a much higher SOG for about the same consumption which increased TCE by about 10%.

Balancing the Power of Machine Learning and Automation with the Human Element

Ultimately, Danelec Voyage Insights achieves desired outcomes for shipping businesses by balancing the machine learning-based vessel performance understanding with qualitative context and voyage variables as they change from one minute to the next. Leveraging the combined power of our data science methodologies coupled with our commitment to understanding each shipping business's unique objectives, Danelec surfaces smart alerts and voyage recommendations that allow users to monitor and optimize for just-in-time arrival, fuel consumption, or time-charter equivalent (TCE) profitability in real-time. Danelec's clients have seen a 10% uplift in voyage profits from Voyage Optimizations conducted on a range of vessel types.

The dynamic variables that go into a fully optimized voyage are important to identify and break down. It is not as easy as optimizing a simple equation of revenue minus costs divided by voyage days for maximum TCE profit. There is a growing consensus in the industry that achieving operational excellence to outcompete in today's market is predicated on the usage of modern technologies. Supporting decision-makers with a tool that dynamically automates the calculation of all the complex levers impacting a shipping business's bottom line enables teams to always take the profit-maximizing action on a voyage.

For information on how Danelec can support your business and optimize your voyages, please contact us at sales@danelec.com.