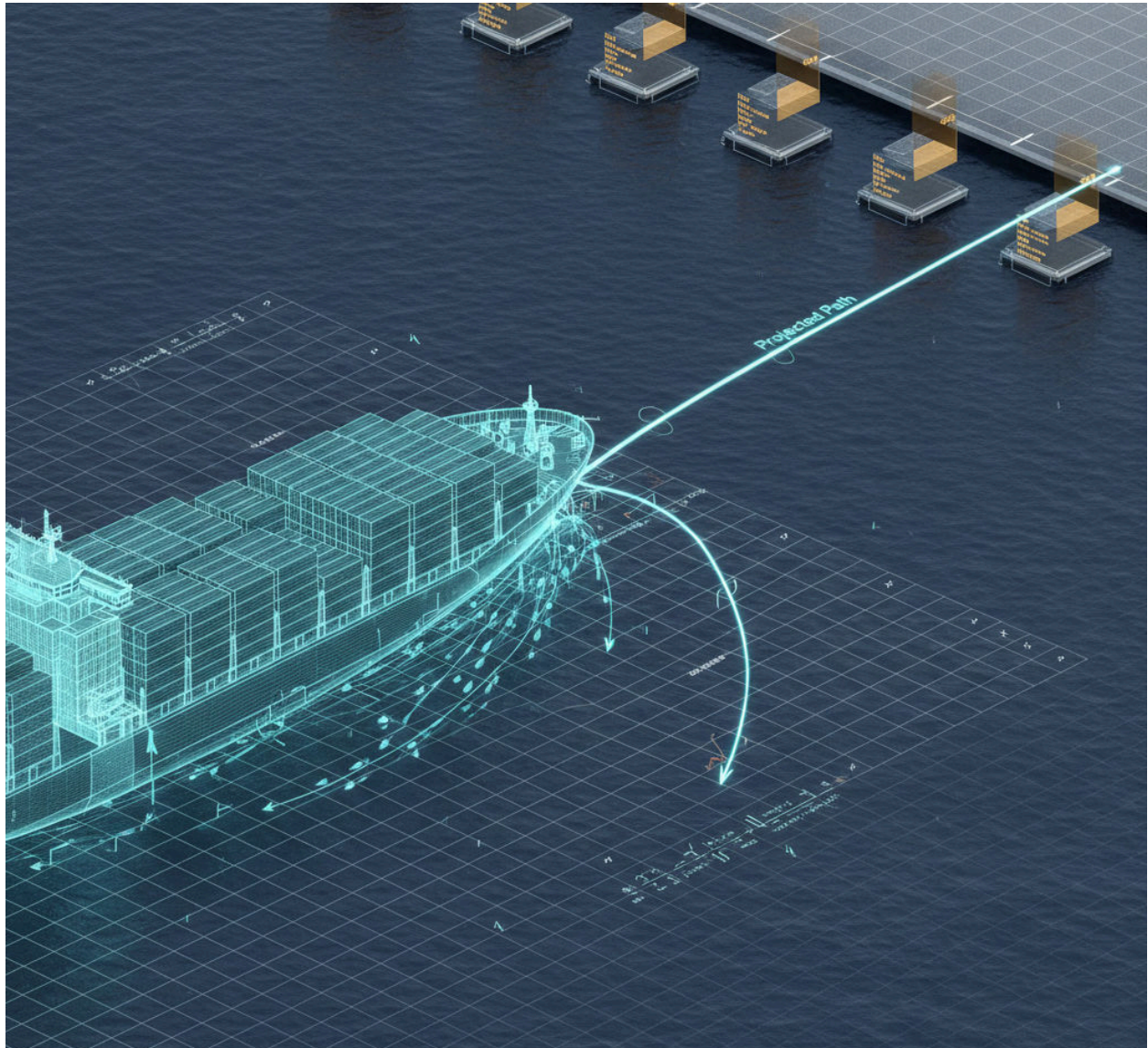


Use Case Playbook: The Physics of Arrival

Sector: Global Logistics & Maritime Supply Chain

Theme: Physics-Grounded Reasoning Over Time



The Problem: The "ETA Illusion"

Global supply chains run on Estimated Time of Arrival (ETA). Every decision—from dock labor scheduling to inventory stocking—relies on knowing exactly when a ship will arrive.

Currently, most logistics platforms calculate ETA using Historical Statistics.

- *How long did this route take on average last year?*
- *What is the average speed of this vessel class?*

The Failure Mode:

Statistics work until reality intervenes. A statistical model doesn't know that a specific storm front increases hull drag by 14%, or that a specific port crane breakdown creates a nonlinear queuing delay. It treats these as "outliers."

- Result: ETAs drift by days. Inventory stockouts occur. Fuel is wasted speeding up to meet impossible windows.

The Blackspire Solution: Physics-Based Reasoning

We do not predict arrival based on "averages." We simulate the journey based on physics.

Blackspire creates a Computational Twin of the vessel and its environment that respects the laws of nature.

1. Modeling the Vessel (The Entity):

Instead of a data point, the ship is modeled as a physical object. We account for:

- Hydrodynamics: Current hull fouling and drag coefficients.
- Propulsion: Engine efficiency curves and fuel consumption rates.

2. Modeling the Environment (The Context):

We ingest weather and oceanographic data, but we don't just "read" it—we calculate its physical impact.

- Force Calculation: How does *this* wave height at *this* angle affect the speed of *this* specific hull?
- Thermodynamics: How does ambient temperature impact engine performance?

3. Modeling the System (The Constraint):

We apply Queuing Theory to the destination port.

- We don't just look at "port traffic." We model the berth availability as a constrained resource, calculating the ripple effect of one delayed ship on the entire queue.

The "What If" Capability

Because the model understands physics, it allows operators to ask causal questions that statistical AI cannot answer:

- *"If we slow down by 2 knots now to save fuel, will we miss the tide window at the destination port?"*
- *"If we push the engine to 95% to beat the storm, what is the probability of a mechanical failure based on current wear?"*

The Outcome

- Precision: ETA accuracy improves from "within days" to "within hours."
- Fuel Savings: Vessels can "slow steam" confidently, knowing exactly how much buffer they have, reducing fuel costs by 5-15%.
- Resilience: When a disruption happens, the system re-calculates the optimal physical path instantly, rather than waiting for human analysis.

The Takeaway

Don't predict the date. Calculate the journey.

Trusting a statistical average to navigate a physical ocean is a risk you no longer need to take.