



Case Study

# Balancing Operational Risk and Environmental Performance

# The Business & The Challenge

Our client requested an updated analysis of transportation options between the port of Shanghai in China and the port of Barcelona in Spain, a critical trade lane impacted by ongoing geopolitical instability in the Red Sea region.

## The strategic dilemma

Routes transiting the Suez Canal offer shorter transit times and, in some cases, better emissions performance. However, regional security concerns create operational risks that may outweigh efficiency advantages.

Outdated emissions measurement tools cannot help with this decision because they:

- Provide only historical averages, not current route-specific data
- Cannot account for real-time geopolitical routing changes
- Don't reveal the emissions cost of risk mitigation strategies
- Fail to compare carrier-specific performance on alternate routes

## The client's requirement:

“Comprehensive visibility into carrier options, routing choices, emissions profiles, and operational complexity for this specific trade lane, aiming to enable an informed decision that balances efficiency, risk, and environmental responsibility.”



# How VesselBot Approached the Problem

Using VesselBot's Supply Chain Sustainability Platform and its progressive real-time Digital Twin technology and AIS tracking, we analyzed the most optimal schedule for each available carrier on the Shanghai-Barcelona route.

Our analysis incorporated:

**Operational complexity:**  
Port calls and transshipment requirements

**Transit duration:**  
Total voyage time including all stops

**Emissions performance:**  
Actual vessel-specific emissions based on utilization, speed, and route efficiency

**Geopolitical considerations:**  
Real-time assessment of routing risk factors

We also evaluated air freight alternatives to provide complete modal visibility.

# Understanding Route Complexity: Shanghai to Barcelona

## The Geopolitical Routing Challenge

The Red Sea crisis situation created two fundamentally different operational approaches:

### The Suez Canal Route:

- Significantly shorter distance and duration
- Direct Mediterranean access
- Potential for better emissions performance
- Exposure to regional security risks

### The Cape of Good Hope Route:

- Extended voyage duration (circumnavigating Africa)
- Avoids geopolitical risk zones
- Longer distance typically increases emissions
- Greater operational predictability

## Why this matters:

VesselBot's platform delivers unparalleled real-time visibility into routing decisions and their emissions impact. As carriers adjust routes in response to geopolitical events, our Digital Twin technology dynamically visualizes these changes, quantifying both environmental and operational consequences. This live, data-driven insight provides a depth of understanding that static historical averages simply cannot deliver.

# Strategic Analysis: Ocean Freight Options

Our Supply Chain Sustainability platform identified three distinct carrier services, each with different routing strategies and operational profiles:

	Duration	Port Calls	Transshipments	Utilisation Factor (average)	Emissions	Analysis
Option 1: <b>Carrier A</b>	35 days	4	3	77%	100 kg CO <sub>2</sub> e per ton of cargo	This service prioritizes operational security and efficiency over speed. The extended voyage around Africa results in high transit times but lowers geopolitical routing risk and emissions.
Option 2: <b>Carrier B</b>	40 days	4	3	59%	131 kg CO <sub>2</sub> e per ton of cargo	The least efficient option in terms of duration, coupled with an increase of 31% in emissions compared to Option 1.
Option 3: <b>Carrier C</b>	34 days	9	3	76%	176 kg CO <sub>2</sub> e per ton of cargo	The least emissions-efficient ocean option, with 76% increased emissions compared to Option 1. However, even by a small margin, it is the fastest alternative.

## Ocean Freight Option Comparison

Emissions per ton of cargo

Emissions vs the lowest alternative

Carrier A	100 kg CO <sub>2</sub> e	Baseline
Carrier B	131 kg CO <sub>2</sub> e	+31%
Carrier C	176 kg CO <sub>2</sub> e	+76%

### Key Finding:

The fastest schedule is just **3% faster** than the baseline scenario,  
yet it results in **76% more emissions**



# Alternative Analysis: Air Freight

We also identified and analyzed a typical chain of air schedules that connect Shanghai with Barcelona. There are no direct freight services between the two airports, and usually the transportation takes place on three or four different legs. The following table quantifies the environmental footprint of five different types of air freight alongside a common air route between Shanghai and Barcelona.

## Well-to-Wake Emissions (kg) per Ton of Cargo Transported

From	To	B747-8F	B747-400F	B747-200F	A300-600F	A310-300F
Shanghai	Istanbul	8,450	10,395	11,878	-	-
Istanbul	Charles de Gaulle	2,413	2,968	-	3,044	3,097
Charles de Gaulle	Barcelona	1,763	1,262	2,253	1,680	1,710

**Modal Comparison: Ocean vs Air**

	Transit Time	Emissions per Ton
Ocean - Carrier A: Most Efficient	~35 days	100 kg CO <sub>2</sub> e
Ocean - Carrier C: Fastest	~34 days	176 kg CO <sub>2</sub> e
Air - B747-8F & B747-400F*	~3 days	12,125 kg CO <sub>2</sub> e

**Key Finding:**

Ocean transport generates approximately  
**99% less emissions** than air transport.

\*Air transport combination: Cargo is transported with a B747-8F from Shanghai to Istanbul and from Istanbul to Charles de Gaulle, and with a B747-400F from Charles de Gaulle to Barcelona



# Client Decision & Strategic Rationale

## Client's Choice: Carrier A

Despite Carrier A having:  
→ 35 days transit time  
→ 3 transshipments

The client prioritized operational predictability and emissions efficiency over speed.

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### Decision Rationale:

“Due to the geopolitical unrest in the Middle East and its impact on shipping safety in the Red Sea, we will continue with Carrier A’s services. We will reassess this decision by the end of 2025, pending developments in the region, before booking our next contract with our freight forwarder.”

The client also evaluated the air freight options presented and acknowledged: “The time-saving benefits are substantial; however, the environmental cost is considerable. We will therefore reserve air transport for cargo that truly requires expedited delivery.”



## VesselBot's Supply Chain Sustainability Platform delivered:

Comprehensive carrier comparison across different routing strategies and modes of transport

Precise emissions quantification for each route and carrier combination

Transparent trade-off analysis enabling risk-informed decision-making



Every shipment in your network is an opportunity. An opportunity to reduce emissions. An opportunity to cut costs. An opportunity you're likely missing. Let's fix that.

[Schedule a meeting](#) with VesselBot and let our team quantify your optimization potential.

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