Operations Research in Ship Management
Maximizing fleet-wide revenue routing at Danaos
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Maximizing fleet-wide revenue at Danaos

The vision
Professional Expertise
Creative Thinking

Utilized by Danaos
Welcomed by Shipping
Used for education from academia
Vision : Continuous Betterment

Mission : ERP to Decision Support and Expert System

Seven years in house implementation

Partially funded from EU Research programs
SEAROUTES - FLAGSHIP - EMAR

To be OR : To be better
Objective was redefined from \textit{cost} to \textit{revenue} 
\textbf{Domain} is expanded from \textit{single vessel} to \textit{fleet} 
\textbf{Time frame} is extended and mission is refined as 

\textit{Fleet-wide revenue routing optimization}
Approach  Entities

Operations Research is Management Of betterment

Voyage intelligent plan: weather routing
Chartering optimum decision making among alternatives
Vessel scheduling and utilization: vessel, cargo, voyage suitability
Idle time minimization: Go and stay concept
Bunkering intelligent plan: quantity, price, place

Fleet-wide long-term planning optimization
Approach  Information required

‘Enterprise Information System today is a must
Formal management systems will be a must tomorrow’

Weather forecasting
Market trends and boundaries
Rules, regulations, constraints, sea distances: external information sources
Vessel particulars, hydrodynamic models, potential clients’ details
Sea keeping data: position, itinerary, speed, consumption, engine performance

Be ready since tomorrow will start today
Was implemented from *Shipping*, evaluated by *shipping*, to be used by *shipping*

welcomed from the industry because of its *open architecture* and *portability*

**Who**

**How**

Behinds the scenes several expert heuristics and in depth OR suggests

**What**

To be OR To be better

Combinatorial of individual optimizing models in one goal programming function
Integration: Total > S [parts]

To be used from all involved users and departments, on board and ashore transparently.

To harmonize theory and practice with both readjustment.

Build-in simulator to prove the concept.

Making the things simple but not simpler.

Data and models are integrated.

Personnel continuity: When Author leaves at least one bug is appeared.
Objectives - Benefits

4,500 up to 6,000 USD Saving (cost + time) per vessel per day

Because of its portability, System is expected to be used from thousands of vessels

Creativity unleash because of Workload reduction

Significant emissions lowering

Customer satisfaction improvement
For given environmental conditions, and a voyage between an origin-destination pair, the least fuel consumption is achieved by minimizing added resistance, adjusting speed, and possible deviations.
For given environmental conditions and a single voyage between an origin-destination pair

The least fuel consumption

Does not necessarily

maximum daily profit

Does not necessarily

maximum daily vessel profit over a time horizon > one voyage

Doing it ....
Allocating the closest vessel to an open employment

Does not necessarily

maximum fleet utilization

Optimizes fleet scheduling to maximize ton-miles capacity utilization
Waiting to fix a vessel to minimize bunkering cost

Does not necessarily

maximum vessel revenue

Doing it Suggesting: Go and stay  How and where
Minimizing bunkering quantities for a given voyage

Does not necessarily

minimum voyage fuel cost

Minimizes consumption instead of bunkering cost as
$[S(quantity \times price) + eventual\ deviation\ cost]$
Wind Diagram
Suggested routes vs. actual routes every 6 hours
Methodology  Proof of concept

![Fuel Consumption Distribution due to various factors](image-url)
<table>
<thead>
<tr>
<th>Variables</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>2580 Nm</td>
</tr>
<tr>
<td>Time en route</td>
<td>292H 00M</td>
</tr>
<tr>
<td>FOC For Propulsion</td>
<td>244 MT</td>
</tr>
<tr>
<td>FOC for weather forces</td>
<td>280 MT</td>
</tr>
<tr>
<td>Total FOC (Fuel Oil Consumption)</td>
<td>524 MT</td>
</tr>
</tbody>
</table>

Fuel cost: 350 $ / Fuel Tone &  
(NTCE: Next Time chartering Equivalent): 66,000$, the expected daily profit is:

- 37,100 $ bunkering cost savings  
- 368,500 $ time cost saving  

Total 405,600 USD
✓ Continuous optimization process

✓ Management of change plan

✓ Standardized integration of interfaces

✓ Adaptation to real-time attributes

✓ Eventually, the ship’s captain needs to define the required passage assisted by the ORISMA suggested routes
Benefits

• Shipping Industry is fragmented and highly competitive

• Market participants have always been seeking to differentiate themselves from the competition and establish a competitive advantage

• Technological Innovation in ship management improves competitiveness

• Danaos developed internally an ERP platform in 1985

• Today, more than 600 shipping companies worldwide use the Danaos ERP integrated software platform
Benefits

• Danaos Corporation is the 3rd largest independent containership owner and operator in the world

• A large part of the success of Danaos is attributed to the utilization of innovative technological advancements

• The Danaos Research Centre is continuously evaluating improvements in line with changing needs of its customers

• ORISMA is the latest addition to the Danaos ERP

• More than 250 vessels are currently being managed with ORISMA support
Tangible Benefits

- The Danaos bottom line profitability has improved by up to 10% with the use of ORISMA

- If this is extrapolated to the 60,000 vessels comprising the world fleet, the potential ORISMA benefits are anticipated to exceed $20 billion

- Optimal Weather Routing has produced fuel consumption savings, particularly important at the current high oil prices

- Revenue has increased through better fleet utilization

- Cost savings have been achieved through the Supply & Purchasing Evaluation module
Intangible Benefits

• The Crewing Module has been a significant aid in organizing and optimizing crew quality assessment and logistics

• Carbon footprint has been improved for every vessel using ORISMA through optimized routing and reduced fuel consumption

• Vessel Charterers have been satisfied with the results, and companies using ORISMA have gained a significant commercial advantage in becoming preferred tonnage providers to the industry
We continue to refine our solution since

“The most beautiful sea hasn’t been crossed yet”

Nazim Hikmet `1935