MAERSK

Transport Management System for Fixed Fleet Planning and Optimization

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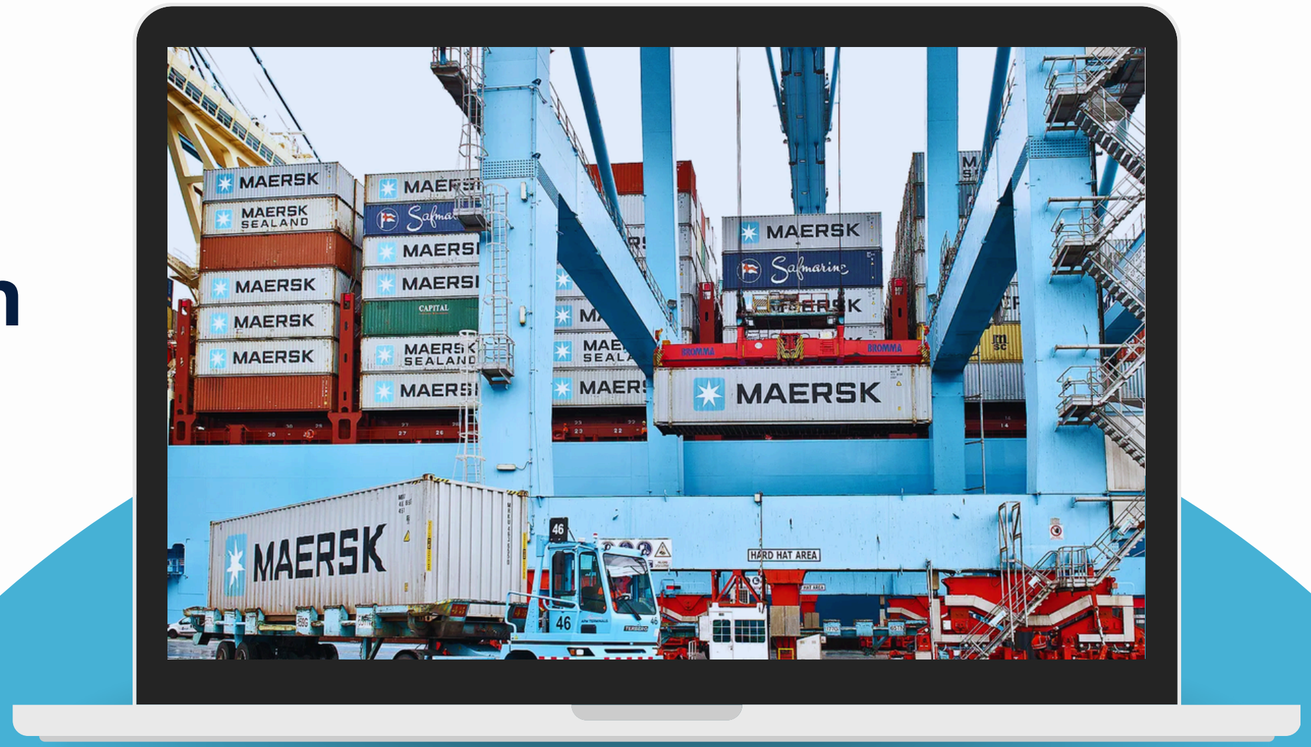


Project Background and Business Problem:

1. **Operational Context:** Inland container movements require daily allocation of thousands of shipments across a hybrid fleet comprising fixed (leased) trucks and third-party logistics (3PL) providers.

2. **Current Planning Challenge:** Truck assignment decisions are largely manual, lacking cost optimization logic or fleet prioritization frameworks.

3. **Identified Inefficiencies:**
   - Underutilisation of fixed fleet assets despite lower operational costs.
   - Over-reliance on costly third-party trucking vendors.
   - No structured alignment between demand and fleet resources.

4. **Strategic Implication:** Without optimisation, freight operations incur higher transportation costs, limited scalability, and inefficient use of available assets.

Objective & Scope

Objective:

- Develop an optimization model minimizing transportation cost while maximizing fixed truck utilization.

Scope:

- Focused on containerized road-based shipments (Export, Import, Transit).
- 7-day tactical planning horizon; extendable to rolling schedules.
- Constraints modeled: fleet capacity, container load logic, exclusive trip assignment.
- Out of Scope: rail shipments, loose cargo, real-time dynamic routing.

Data Description and Cleaning Process:

Initial Dataset:

- 33,794 shipment-level records sourced from internal TMS systems.
- Attributes included shipment ID, movement date, origin-destination pairs, container type, equipment size, transport mode, a truck assignment.

Cleaning Steps:

- Removed incomplete, duplicate, and rail-based records.
- Coded fleet type: fixed vs. third-party.
- Applied container size-to-truck equivalency (e.g., 2×20ft = 1 truck).
- Mapped geo-coordinates for spatial analysis.

Final Model-Ready Dataset:

- 22,899 valid shipment records.
- 1,397 unique origin-destination arcs.
- Directionally segmented into Export, Import, and Transit shipments.

Exploratory Data Insights

01 High-density corridors: Top 12 locations account for 33.4% of all trips

02 Fleet imbalance: Significant reliance on 3PL even where fixed trucks were available

03 Trip types: One-way movements dominate, underscoring the need for return-planning logic

04 Route consolidation potential: Repetitive O-D pairs suggest opportunities for fixed-fleet clustering

Methodology Overview

- Manual Dispatch: No systematic logic, leading to under-utilized fixed trucks and over-reliance on spot-market capacity.
- Data Inconsistencies: Duplicate or incomplete records, mixed transport modes, and unstandardized fleet labels.
- Lack of Business-Rule Encoding: No formal way to enforce daily capacity limits, container-to-truck conversions, or exclusive assignment of fixed vs. 3PL assets.

Step 01

Descriptive analysis: Quantify volume, spatial patterns, and equipment usage

Step 02

Data structuring: Build trip-level matrix with date, arc, and TE demand; merge geocoordinates

Step 03

Constraint logic: Define realistic rules for capacity, exclusivity, and load conversion

Step 04

Optimisation framing: Mixed-Integer Linear Program (MILP) to minimize cost under operational constraints

Framing the Problem: Cost-Minimizing Truck Allocation Model

Objective

- Minimize total transportation cost while maximizing use of fixed fleet.

Decision Variables

- Assign each order to a fixed or a 3PL truck.

Constraints Modeled

- Fixed fleet availability
- Demand must be fully served
- Transit trips must be preserved
- Driving limits/hours

Optimization Goal: Minimize Total_Cost = ∑ (fixed_cost × distance × x_f) + ∑ (spot_cost × distance × x_s)

Making It Work: Model Implementation at Scale

Data Inputs

- 12 months of shipment data from Turkey
- Fixed fleet inventory
- Delivery dates

Solver and Approach

Mixed Integer Linear Programming using Gurobi

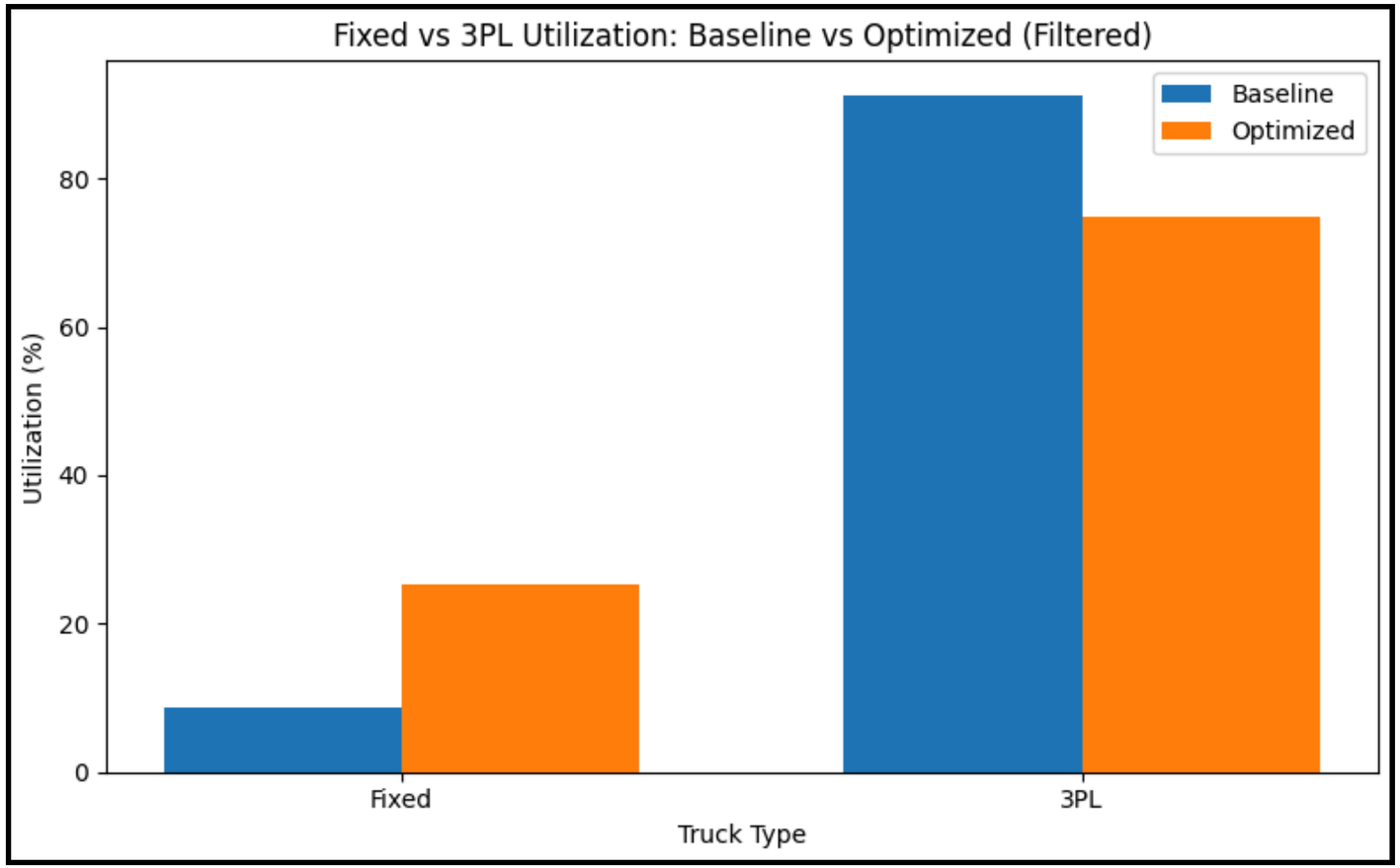
- Encoded truck reuse over multiple days
- Built-in depot return logic
- Transit trip preservation enforced

Key Assumption Cards

- 3PL Cost = 1.15 x fixed
- Max 8 hrs of drive time per day
- Fixed fleet of 18 trucks

The model converts real-world constraints into truck plans that reduce cost and improve asset utilization.

Smarter Planning, Lower Costs: Baseline vs Optimized Model



Metric	Baseline	Optimized
Fixed Truck Moves	10%	**22%**
3PL Truck Moves	90%	**78%**
Cost	$4,207,163	**$2,257,717**

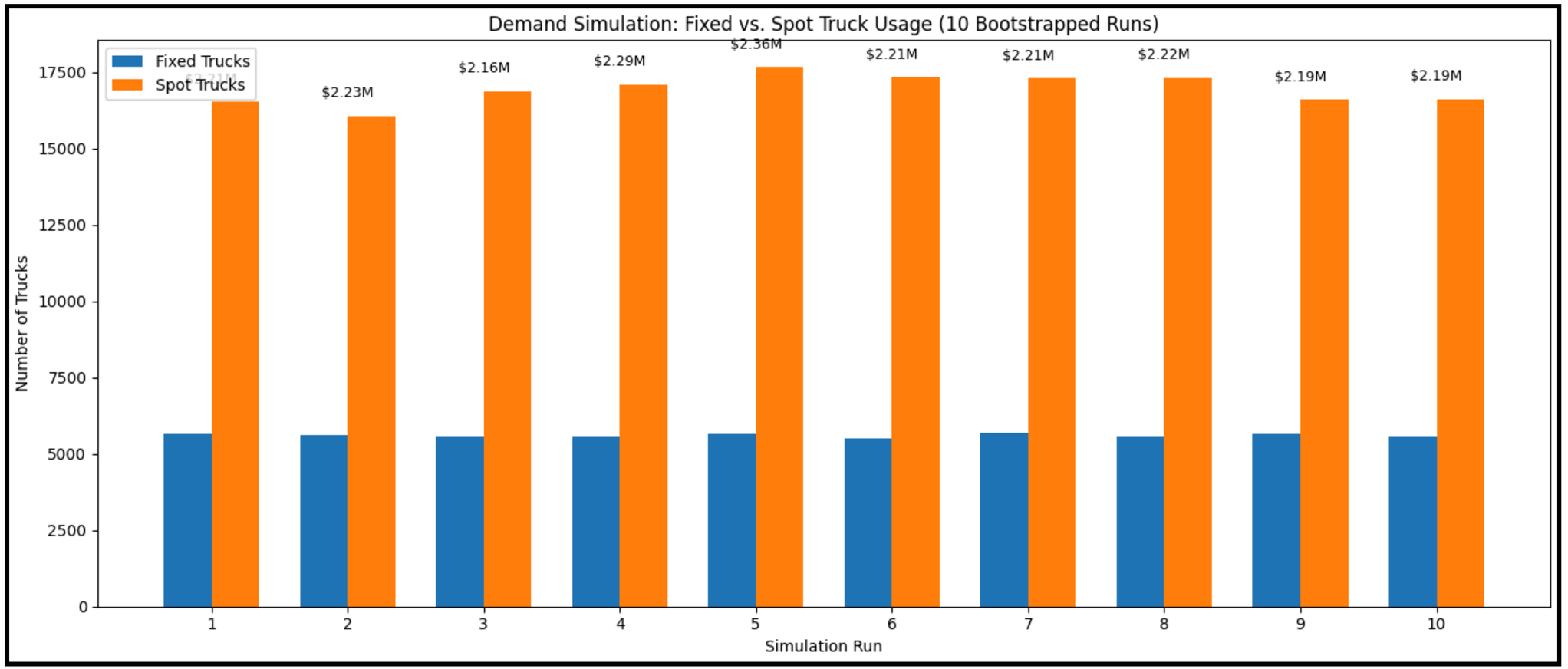
- 46% reduction in cost
- Eliminating reliance on third-party trucking
- 4x increase in fixed-truck utilization

Binding Constraints Reveal Bottlenecks and Priorities

	Corridor	Container_Type	Date	Shadow_Price
0	TR_OP_00000033 → TR_CU_00009904	20DRY86	2024-03-13	2384.344464
2	TR_OP_00000033 → TR_CU_00009904	20DRY86	2024-04-20	2238.719333
1	TR_OP_00000033 → TR_CU_00009904	20DRY86	2024-02-02	2238.719333
3	TR_OP_00000071 → TR_CU_00006373	40REEF96	2024-06-06	2073.975644
4	TR_CU_00005324 → TR_OP_00000025	20DRY86	2024-04-26	1893.967765
5	TR_OP_00000063 → TR_CU_00010978	40DRY96	2024-04-18	1850.353118
6	TR_OP_00000031 → TR_CU_00010046	40DRY96	2024-08-28	1651.530644
7	TR_OP_00000031 → TR_CU_00010046	20DRY86	2024-07-05	1647.143030
8	TR_OP_00000031 → TR_CU_00010046	40DRY96	2024-10-15	1647.075681
9	TR_OP_00000031 → TR_CU_00010046	20DRY86	2024-11-12	1646.915985

A $2,300 shadow price means unmet demand on this corridor is extremely costly — a strategic target for investment.

Robust Even When Demand Shifts: Simulation Insights



Across 10 demand scenarios, the model held performance within a ~7% cost band, maintaining 25–26% fixed fleet usage.

Business Impact: Realizing Cost Savings and Operational Efficiency Efficiency

Our optimization model delivers transformative results across Maersk's transport operations.

46%

Cost Reduction

Total transportation costs slashed through fixed fleet optimization

$2.3K

Per-Trip Savings

Smart reallocation on high-cost corridors yields immediate returns

4x

Fleet Utilization

Dramatic increase in fixed fleet efficiency reduces 3PL dependency

100%

Scalability

Framework deployable across new geographies with minimal adjustme

Beyond immediate savings, our model provides a strategic decision-making framework for quantifying cost-benefit of fleet investments.

Conclusion and Next Steps

Conclusion

- Model delivered 46% cost reduction with optimal fixed fleet usage
- Performance maintained across varying demand scenarios
- $1.34M projected annual savings validates enterprise approach
- Framework establishes data-driven fleet investment decisions

Action Plan

- Integrate outputs with TMS and SAP systems
- Launch pilots in India and Thailand regions
- Implement weekly automated truck plans with real-time data
- Provide operations team training on constraint tuning

We're excited to drive Maersk's next phase of operational excellence. Thank you for your partnership!

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THANK YOU!

ANY QUESTIONS?