

# Berthing Optimization for Container Terminals

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# Challenges



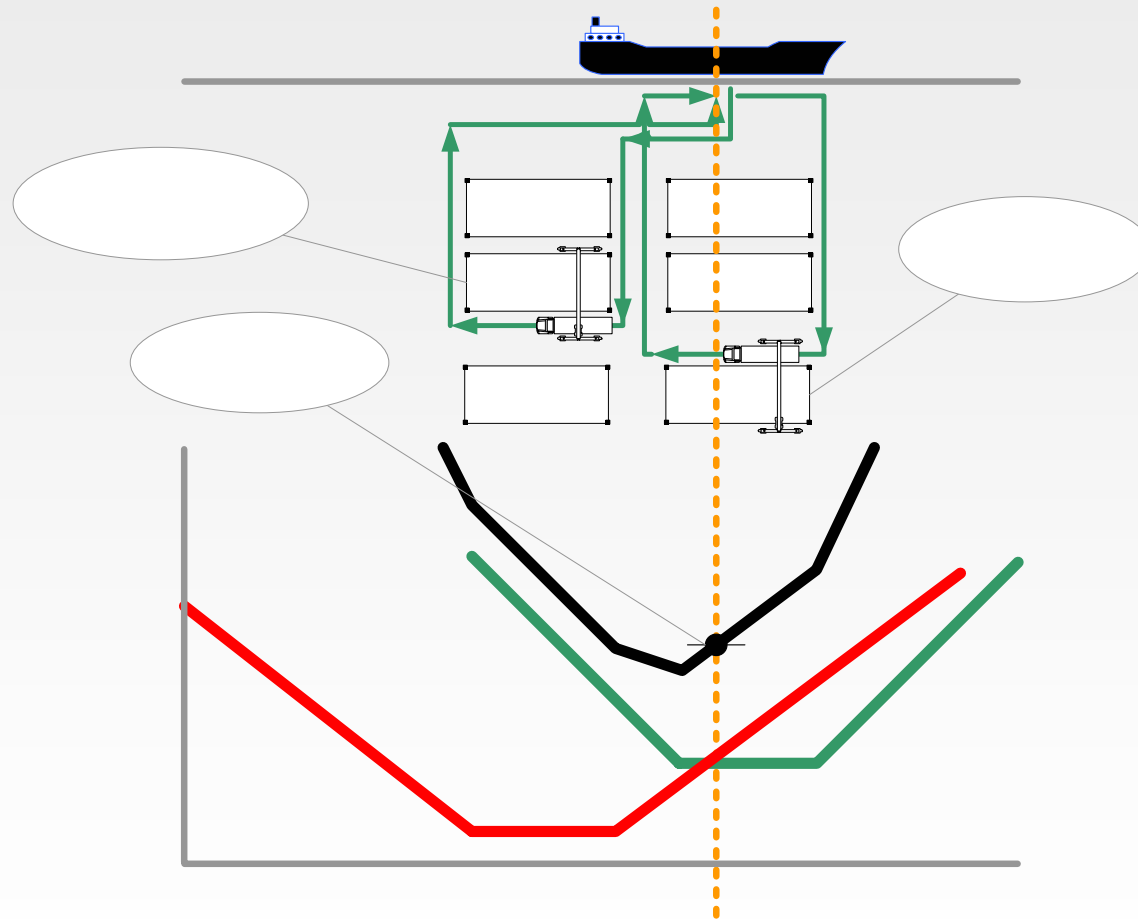
## Addressed problems

- A lot of manual work when doing berth plan. How to satisfy all possible constraints?
- High level of transshipments. How to increase terminal utilization?
- Congestion at container terminal. How to save PM distance, time, and fuel?

## Goals

- Arrange vessels on berth with respect to ETA/ETD
- Minimize total PM mileage by finding optimal vessel berth position
- Visualize berthing scenario to operator

# Solution for one vessel



# Complete model

$$(1) \sum_{i=1}^N \text{Mileage}(CL20_i, CL40_i, DL20_i, DL40_i, BLX_i, BLY_i, BDX_i, BDY_i, P_i) \rightarrow \min$$

$$(2) |P_i - P_j| \geq \frac{L_i + L_j}{2} + S; \quad i = \overline{1, N-1}, j = \overline{i+1, N}; \quad \text{where } V_{i,j} = 1,$$

$$(3) P_i \geq \frac{L_i}{2}, \quad i = \overline{1, N}$$

$$(4) P_i \leq B - \frac{L_i}{2}, \quad i = \overline{1, N}$$

$$(5) V_{i,j} = \begin{cases} 1, & \max(A_i, A_j) < \min(D_i, D_j) \\ 0, & \text{otherwise} \end{cases}$$

- Objective function (1) requires total mileage minimization for all vessels.
- (2) states that two vessels cannot be located closer than allowed distance.
- (3) and (4) limit vessel positions to a berth size.
- Definition (5) shows if vessels with indexes  $i$  and  $j$  intersect in time. If vessels are in port at different times, then inequality (2) is not applied for vessel pair  $i$  and  $j$ .

# Approaches



## Simplex method

- not applicable

## Non-linear optimization

- no general method available
- time and resources consuming
- sensitive to the initial conditions

## Heuristic method

- fast
- flexible

# Algorithm



## Phase I. Finding feasible scenario

- Own heuristic algorithm for solving system of inequalities is applied
- The algorithm considers total moves amount of each vessel to provide good enough solution on this stage
- Near to optimal feasible solution is found

## Phase II. Scenario fine tuning

- Set of heuristic is used to find vessels group which interchange cannot result in not feasible solution
- Interchanges that minimize mileage are done

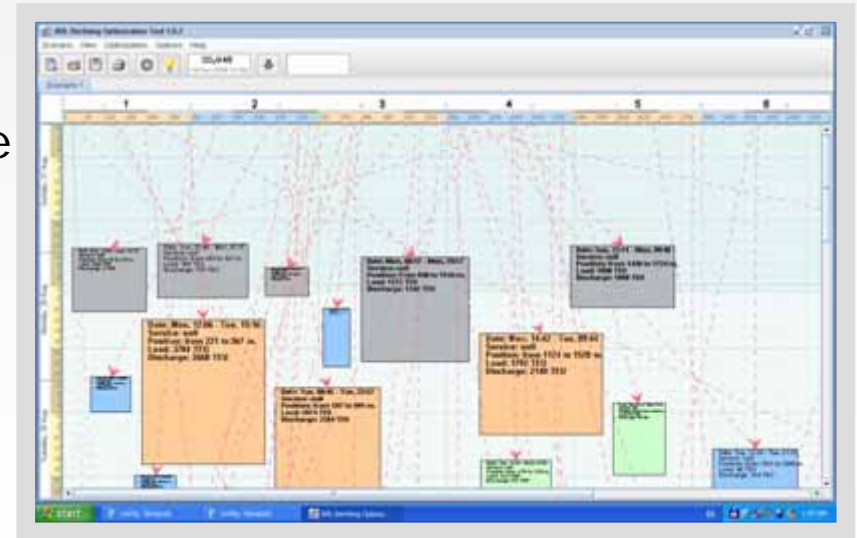
# Solution :: Overview

## Benefits

- Up-to-date live data from TOS or any other source
- Fast computation
- Operator keeps full control on berthing scenario

## Features

- Calculate optimized berth positions for one week schedule
- Manual drag&drop editing
- Support berth unavailable zones
- Allows multiple scenarios
- Display current and ideal mileage/position



# Contacts, Q&A

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