Bulk Terminal Optimization With Simulation

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Bulk Terminal Optimization with Simulation

- Event-based simulation is an essential & useful tool for terminal design and capacity enhancement.

- In this PPT, we will initially demonstrate why & how simulation can assist in identifying and solving the technical and operational bottlenecks at a bulk terminal

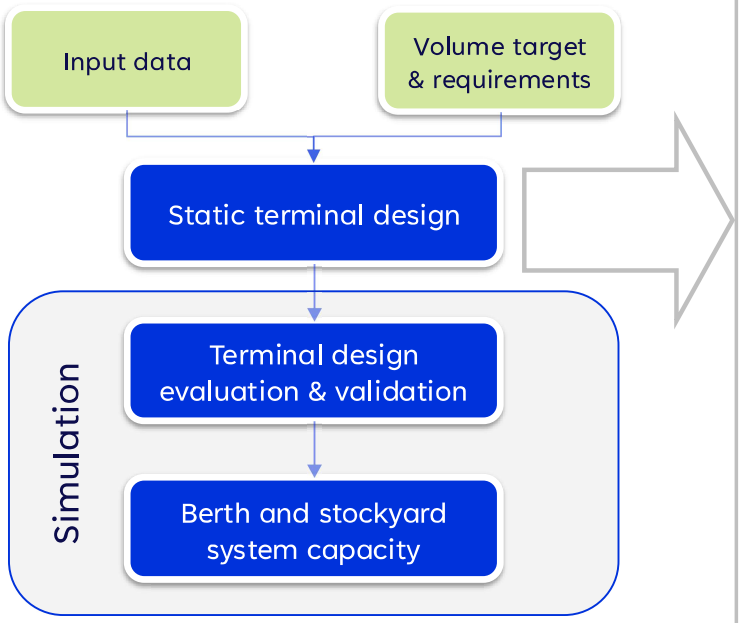
- As a 2nd step, we aim to show how an integrated simulation approach can provide additional benefits by providing a more balanced and optimal outcome.

- Lastly, we give a few main misconceptions, reality & take-aways.

The paper is based on a representative terminal, but the original work was done for a real terminal.

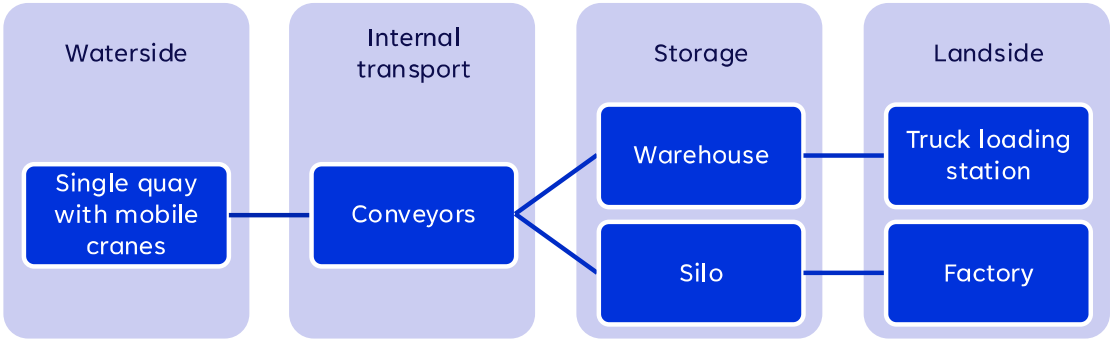
Bulk Terminal -Design and expansion studies

Why & How Simulation can assist

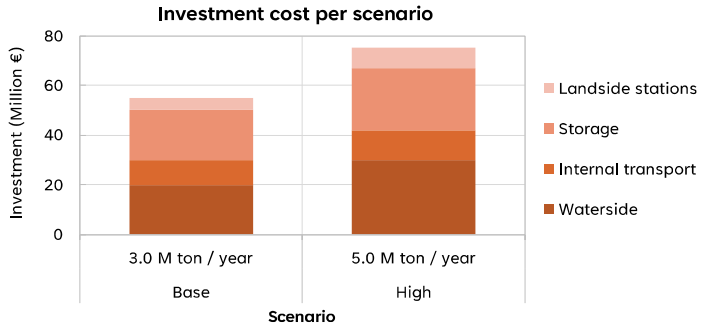


Static terminal design (example)

1. Layout, logistic process, equipment



2. Investment, technical and operational evaluation



Simulation – with examples of input and output parameters

Vessels
Schedule, RTA

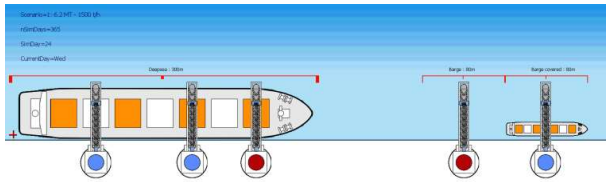
Berth
Length, depth, crane ranges

Equipment
Cranes, productivity, maintenance

Operators
Shifts, breaks

Environment
Tide constraint, weather stoppage

Planning
Service levels, priority of vessels



Berth simulation (dry bulk)

Key simulation steps

- Collating info & data
- Configuring the model
- Validating the model
- Identify bottleneck(s) & establish capacity
- Test improvements Round 1
- Multiple & integrated simulation
- Final recommendation

Vessels
Waiting time, demurrage cost

Berth
Occupancy per berth, realized schedule

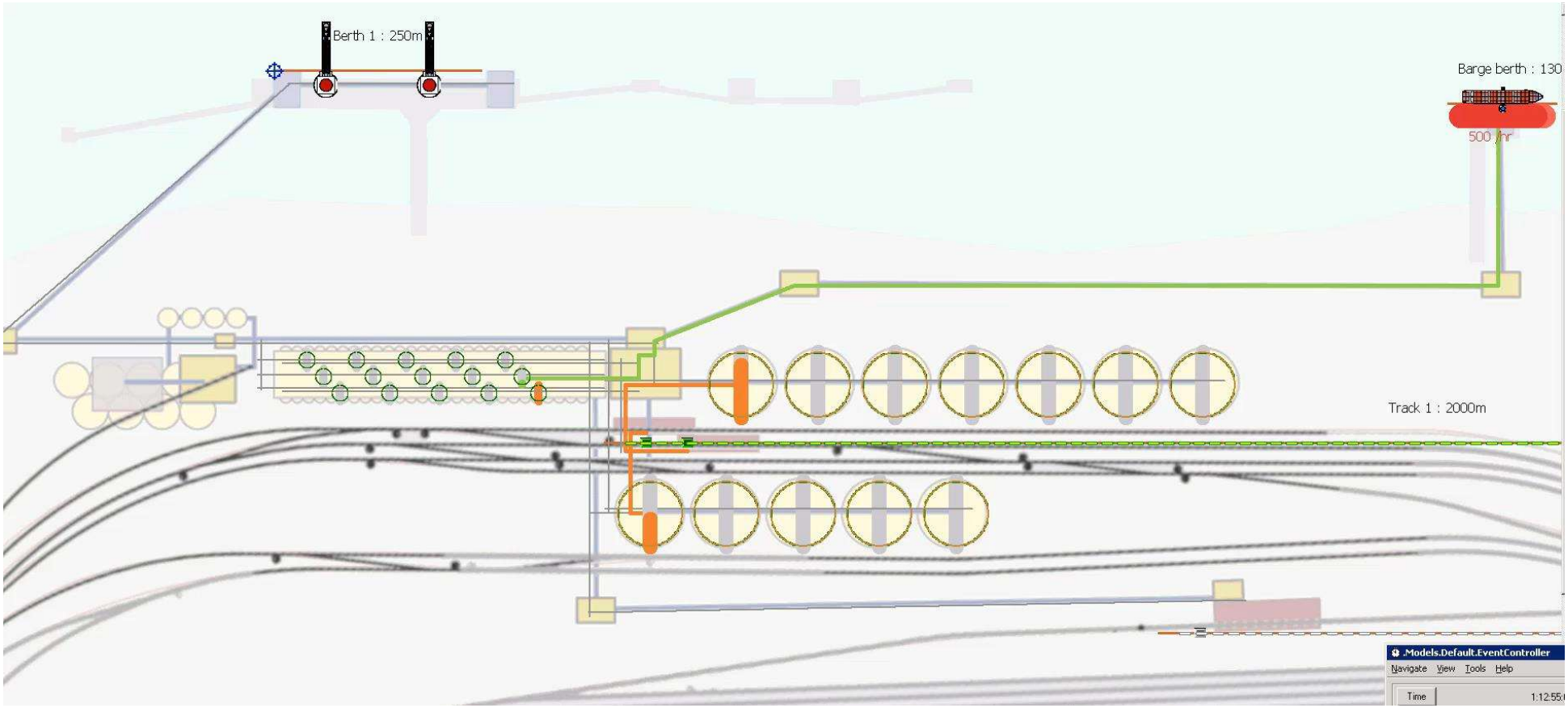
Equipment
Working hours, efficiency

Operators
Working hours

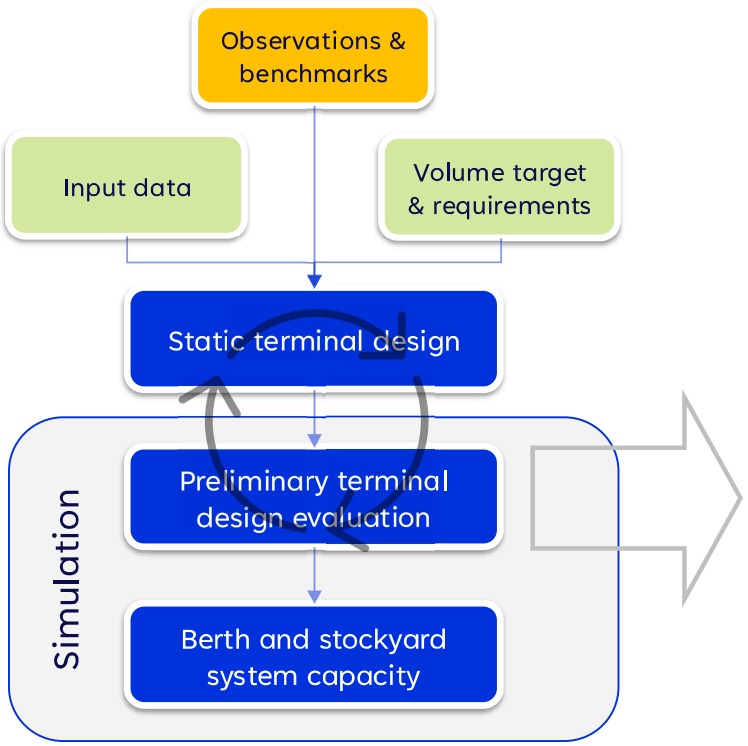
Environment
Energy consumption

Planning
Deployment frequency, workload distribution

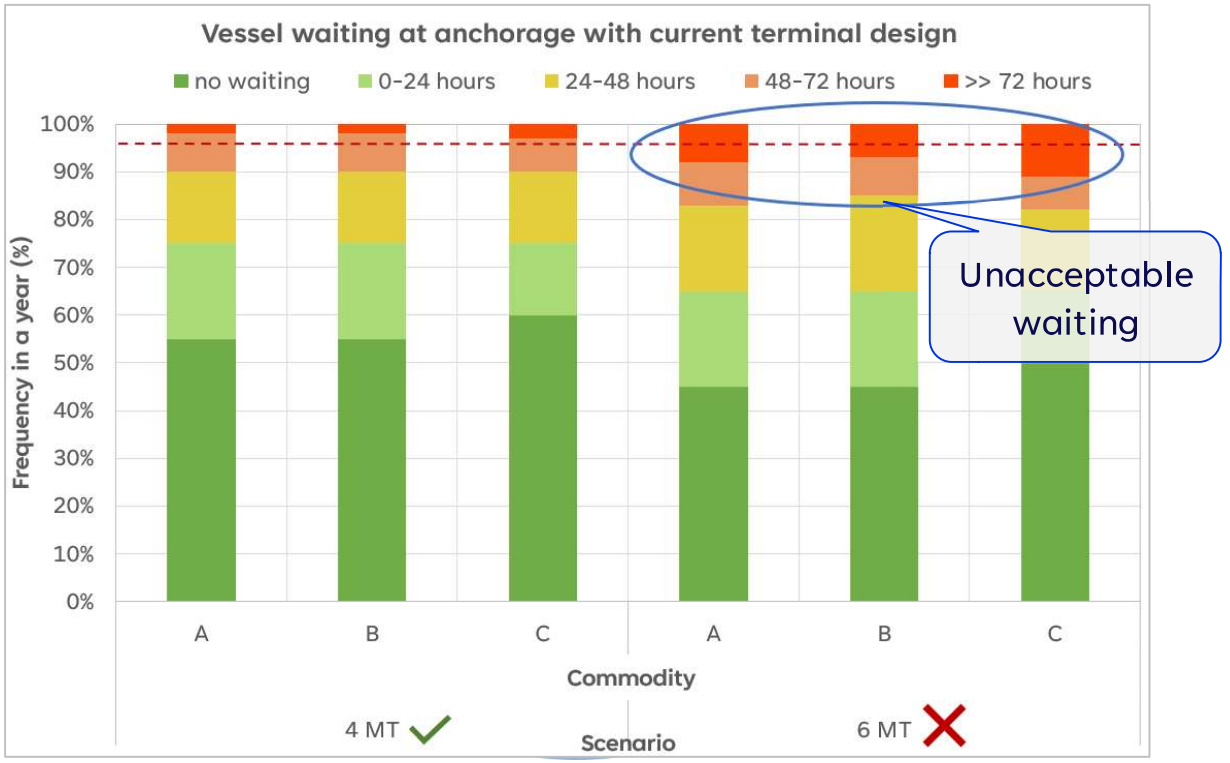
2D simulation model integrates major parts, incl. trucks, storage, conveyors, (un)loaders of a bulk terminal



Case study: Bulk case study a terminal handling 3 commodities Increasing volume 4.0 → 6.0MT



- Dynamic simulation shows that the current terminal design configuration is inadequate for the future volume of 6MT



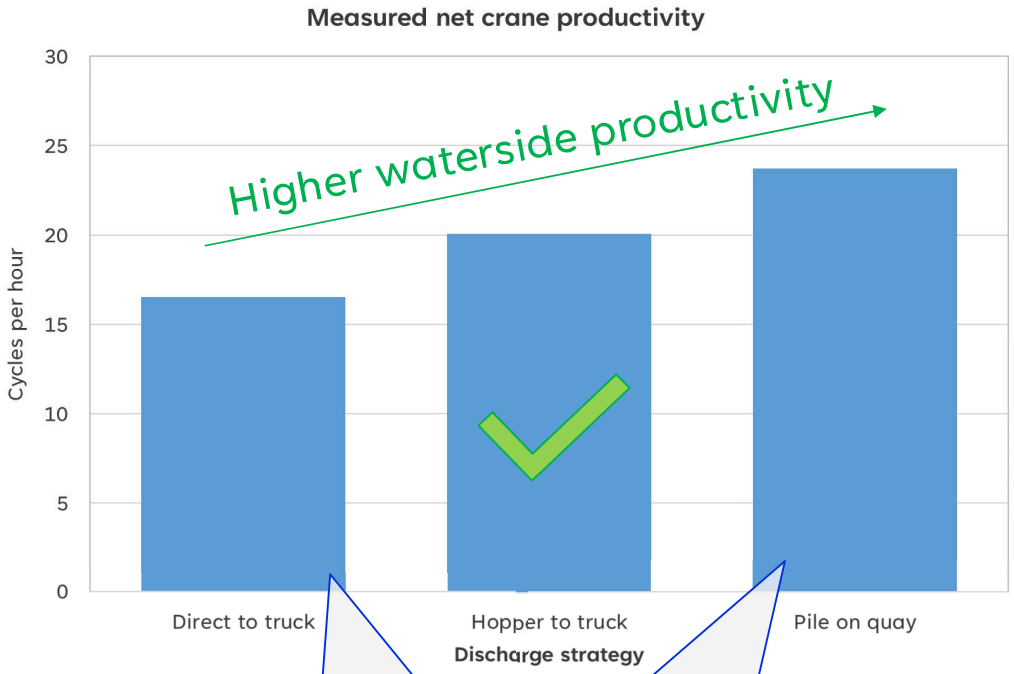
Identifying bottlenecks → to propose solutions for improving productivity

- The terminal operator has been using 3 different discharge methods to deliver materials from crane to storage:
  - Direct loading from crane to truck
  - Loading trucks through hopper
  - Discharge on quay to be picked up later

- "Hopper to truck" is the recommended method → trade-off between productivity and operation cost

- Applying conveyor is an alternative method to increase the waterside productivity:
  - Discontinuous operation → Continuous

Identify bottlenecks (Commodity A & B)

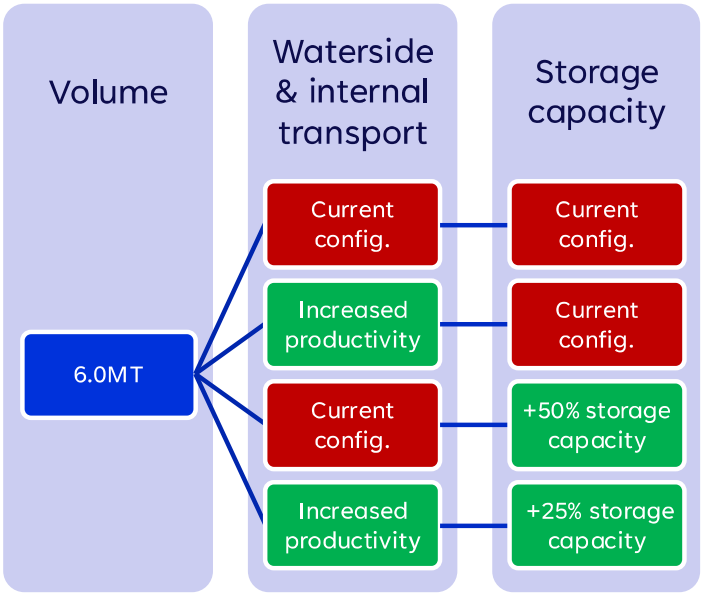


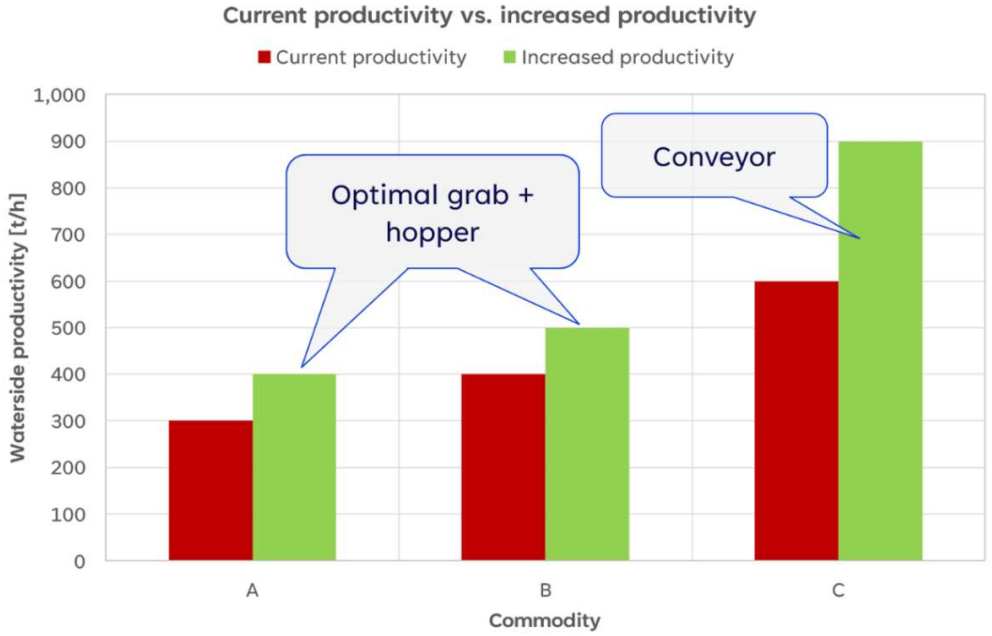
- Delays & congestion
- Low filling rate

- Weather sensitive
- Additional handling cost

Simulation scenarios

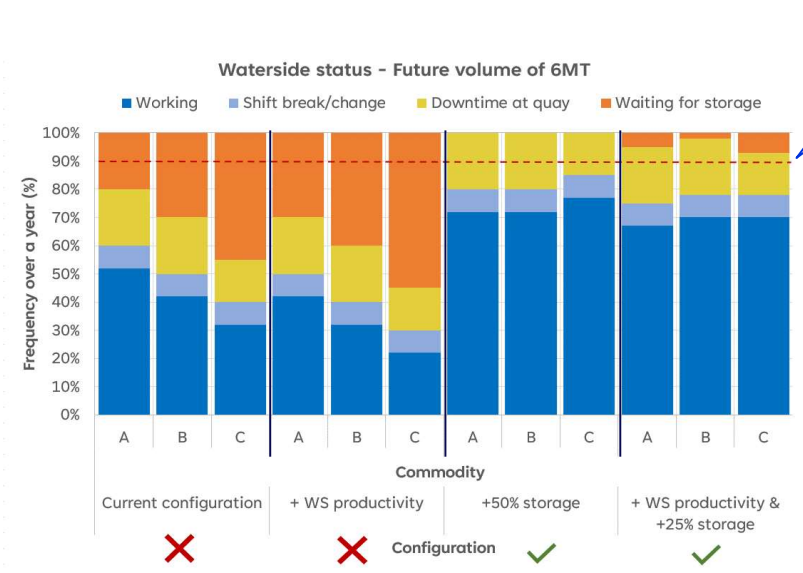
- Waterside productivity of commodities A and B are increased by applying optimal grabs and hoppers, to maximize crane utilization
- For commodity C, conveyor is used rather than trucks, to minimize waiting time of quay cranes.
- In addition, storage capacity needs to increase to accommodate the higher volume throughput:
  - 2 different levels are investigated: +25% an +50% storage capacity



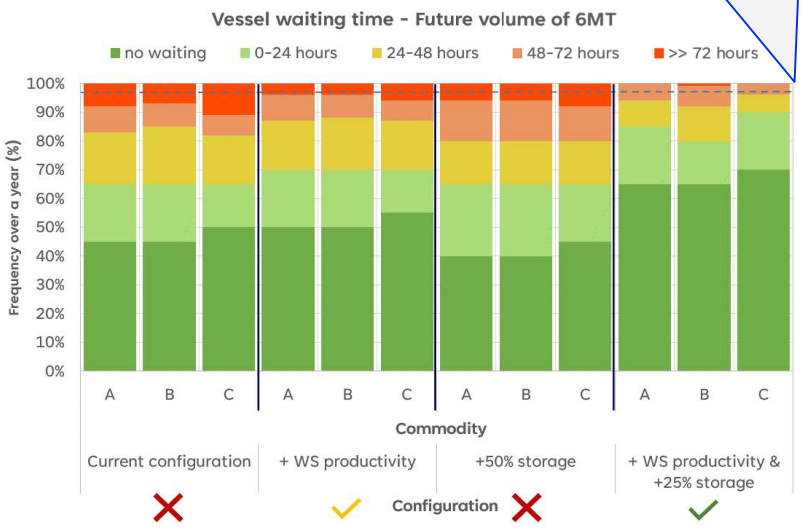


Terminal design evaluation using simulation

Future volume of 6.0MT



Target:
≤10% waiting
for storage



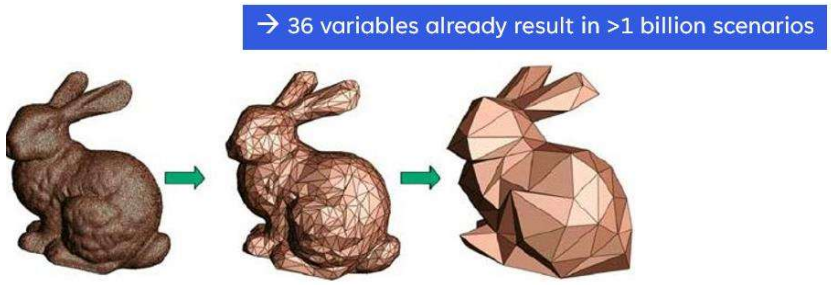
Target:
≤4% waiting
longer than 72hrs

- Although in "+50% storage" scenario, the waterside status is mainly "working", however low productivity results in unacceptable service levels and waiting time for vessels.

- The outcome of "+WS productivity & +25% storage capacity" scenario shows waterside, internal transport, and storage operations are interrelated, affecting the overall terminal operation outcome.
  - Therefore, improvements are best handled in an integrated way to find the best balance & trade-off.

Reality & take away

Misconception/Myth	Reality	Take away- How to address
Data problem has been solved	Data quality is variable to poor	Data & outcome validation #
Port industry is IT minded	Not at all, & long way to go.	IT tools provide excellent value, focus on business value
More complexity is superior	More complexity can give less insight	Reduction is the core of modelling



Reduction is the core of modelling!

This work was based on annual capacity simulation.
Detailed simulation can provide better insights by varying processes, speeds or delays within the simulation model.

Concluding remarks

- The case study highlights how the simulation approach can be used to enhance bulk terminal operation & optimise operation:
  - Identify design and operational bottlenecks.
  - Assess technical and operational measures to enhance productivity.
  - The benefits of an integrated approach

Thank you.

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