COREALIS Final Conference

PORTMOD

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Agenda

PORTMOD – A Planning and Simulation Tool for Container Terminal Operations
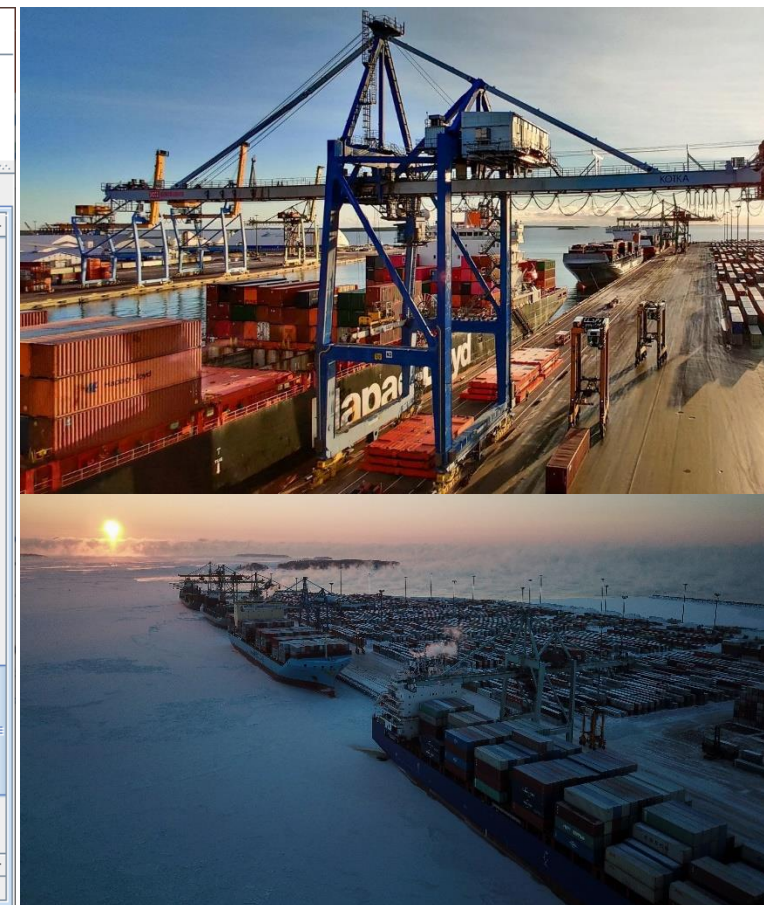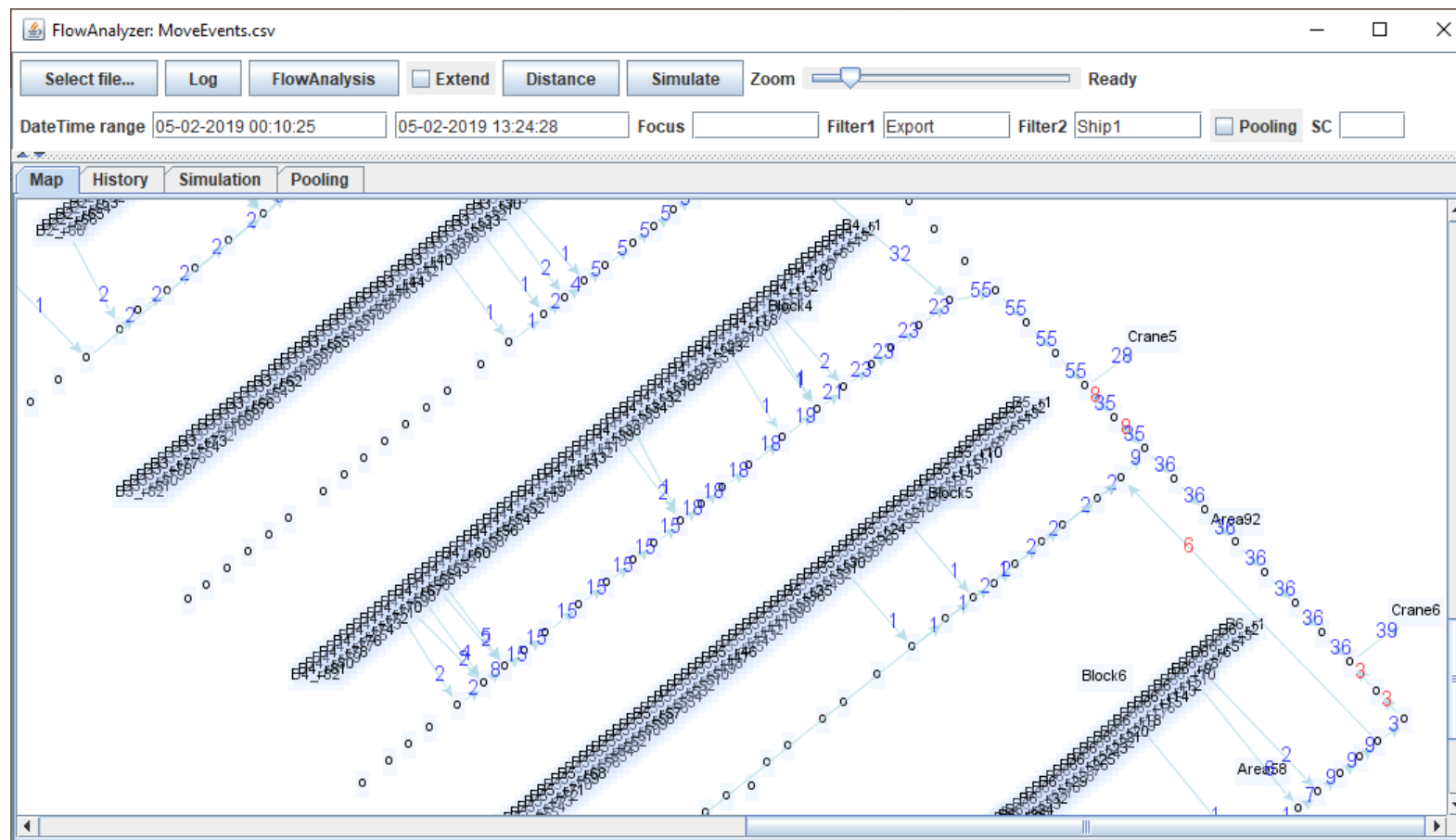
Introduction

- PORTMOD is a standalone Java program

- Input: CSV, e.g. from a Terminal Operating System (TOS)

- Capabilities:

  a) Identify inefficiencies and bottlenecks in container flows

  b) Identify inefficiencies in straddle carrier and crane operation

  c) Estimate the benefit of machine pooling during ship loading and unloading operations

- Testing: Kotka Container Terminal (KCT) operated by Steveco.

- For more information see https://www.corealis.eu/ (click on PORTMOD hexagon)

Training Seminar of COREALIS HaminaKotka Living Lab: Increasing efficiency step by step

COREALIS HaminaKotka Demo/Training Webinar
PORTMOD - A Planning and Simulation Tool for Container Terminal Operations
Toni Lastusilta, VTT Technical Research Centre of Finland Ltd
October 21st, 2020

https://www.youtube.com/watch?v=w2TVBU9rBJg&t=2237s

PORTMOD Introduction

Illustration of container movements from Crane 2.

Container Moves
During September 2020

Import Containers

Placement	Amount	Share (%)
Good	8 180	55,5 %
Mediocre	5 977	40,5 %
Poor	590	4,0 %

Export Containers

Placement	Amount	Share (%)
Good	6 511	46,4 %
Mediocre	1 209	8,6 %
Poor	6 301	44,9 %

- Conclusion: We may improve the situation by asymmetrically increase the efficiency of moving containers by using a Terminal Tractor (TT) [2] connected to a Multi Trailer System (MTS)

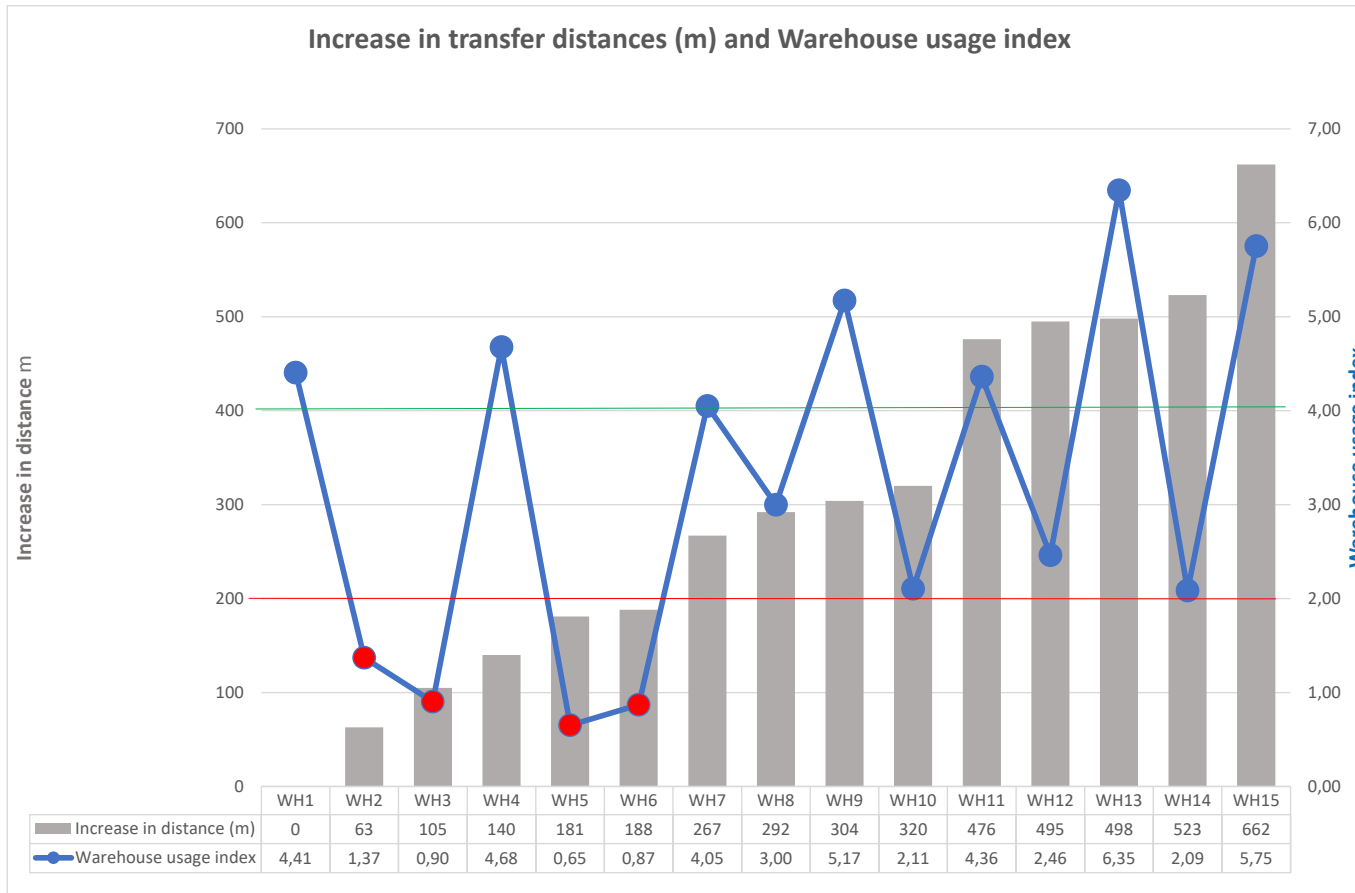Rough estimation on roundtrip times and average daily drive time

	Roundtrip time(min)	Average daily drive time (h)
Depot2-->N6	7,2	5,1
Depot-->N6	6,5	4,5
Depot2-->N3	4,0	2,8
Depot-->N3	3,3	2,3

Multi Trailer System Double Stack Trailers

Increase in transfer distances (m) and Warehouse usage index

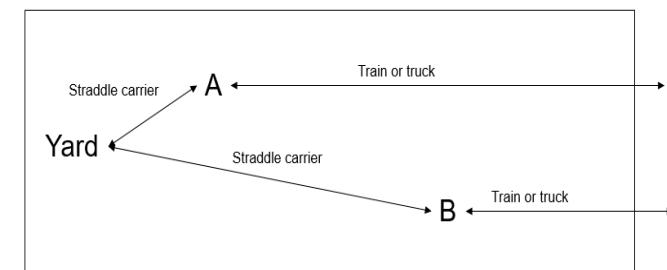|	WH1	WH2	WH3	WH4	WH5	WH6	WH7	WH8	WH9	WH10	WH11	WH12	WH13	WH14	WH15
Increase in distance (m)	0	63	105	140	181	188	267	292	304	320	476	495	498	523	662
Warehouse usage index	4,41	1,37	0,90	4,68	0,65	0,87	4,05	3,00	5,17	2,11	4,36	2,46	6,35	2,09	5,75

Some containers are stuffed at warehouses (WHs).

Observation
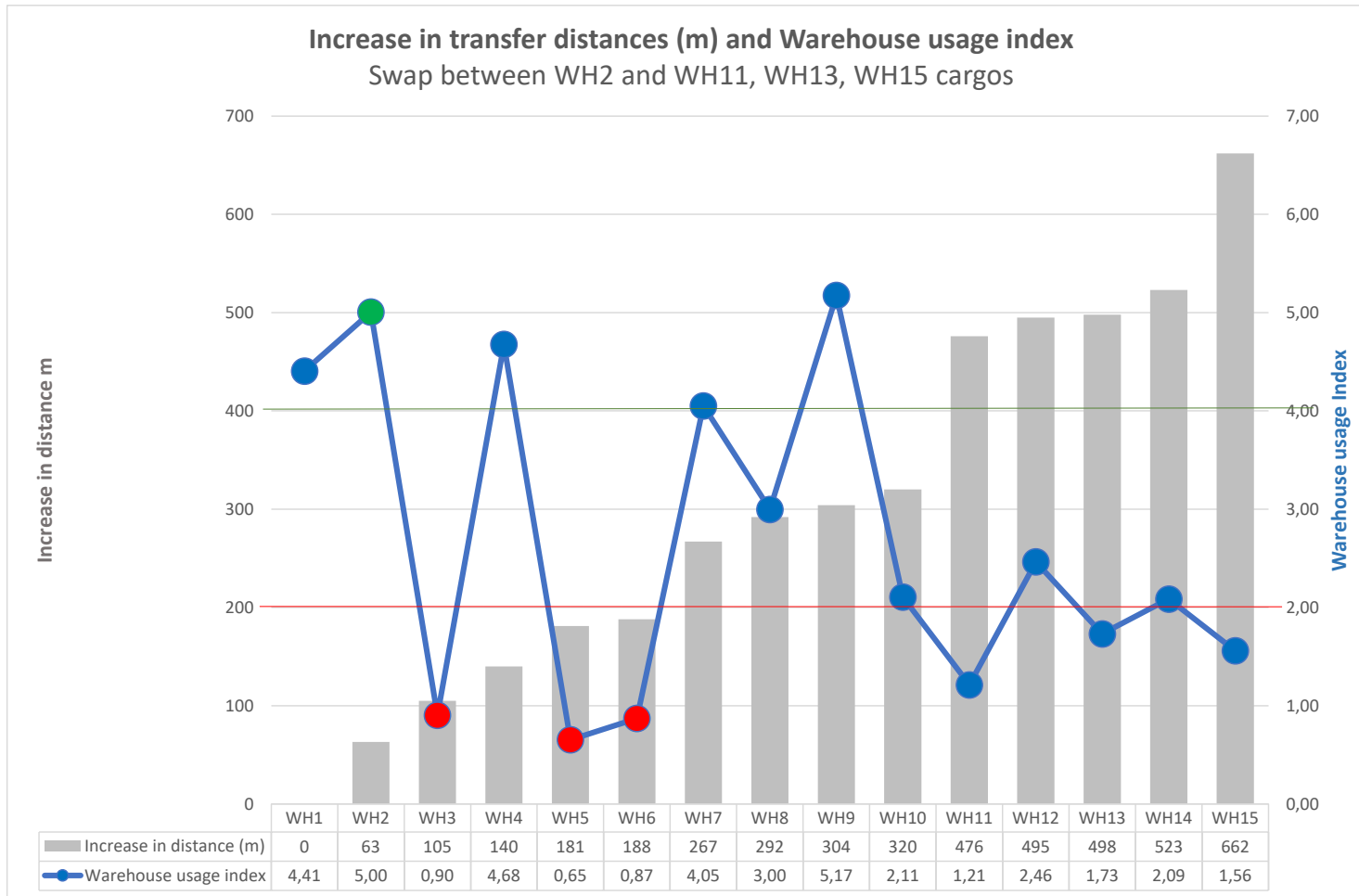Some WHs that are located close to the container yard have a low throughput of export containers, see red dotes.

Terminal area with warehouse A and B

Fictional illustration of the issue

Increase in transfer distances (m) and Warehouse usage index
Swap between WH2 and WH11, WH13, WH15 cargos

	WH1	WH2	WH3	WH4	WH5	WH6	WH7	WH8	WH9	WH10	WH11	WH12	WH13	WH14	WH15
Increase in distance (m)	0	63	105	140	181	188	267	292	304	320	476	495	498	523	662
Warehouse usage index	4,41	5,00	0,90	4,68	0,65	0,87	4,05	3,00	5,17	2,11	1,21	2,46	1,73	2,09	1,56

Conclusion:
A good rearrangement will reduce Straddle Carrier driving distances.

For example, swapping container activities between large WH2 and smaller WH11, WH13 and WH15 would have reduced driving distance by 1550 km and saved 74 hours in Straddle Carrier time during September 2020.
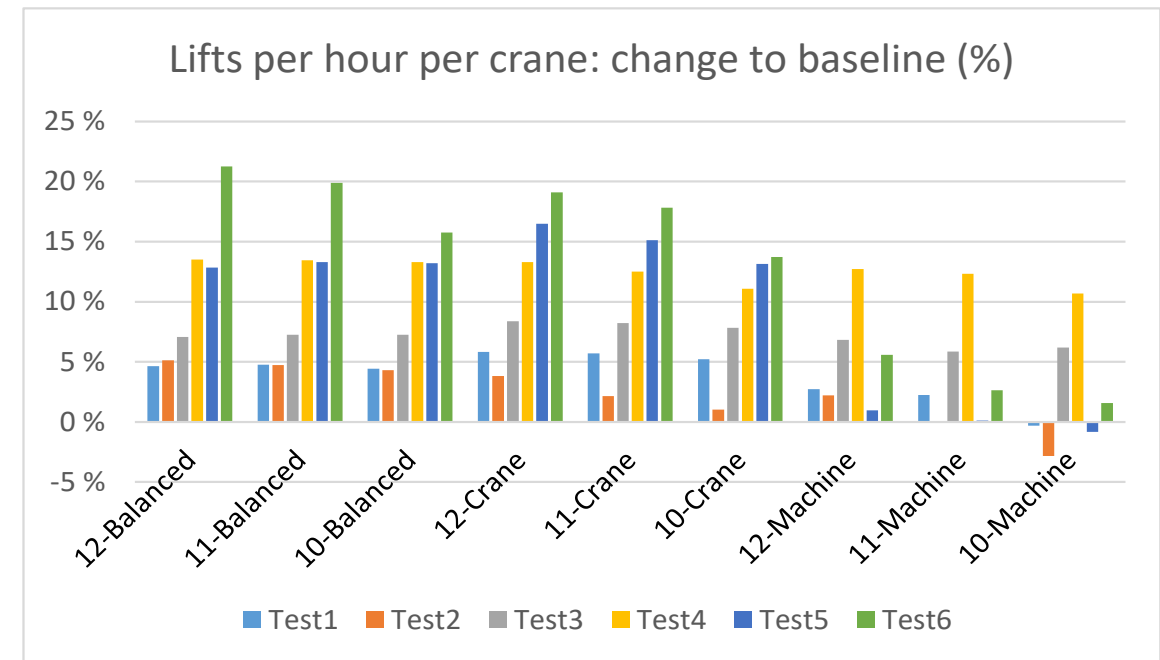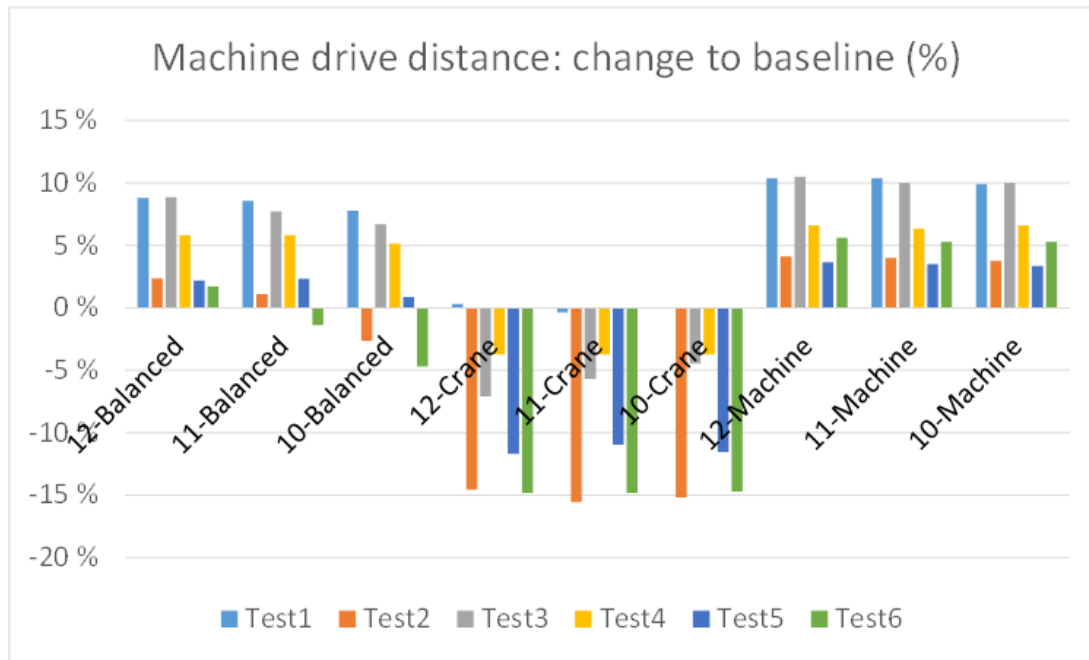
- The currently used baseline strategy (dedicated Straddle Carriers for each crane) is compared against a pooling strategy that was tuned towards 3 different objectives:

  - Minimize both crane idle time and machine driving distance in a balanced way. (**Balanced**)

  - Minimize crane idle time. (**Crane**)

  - Minimize machine-driving distance. (**Machine**)

- 6 simulation tests, each on 8 hour shifts when using 4 STS cranes

Machine drive distance: change to baseline (%)

Lifts per hour per crane: change to baseline (%)

- Summarized comparison of 6 tests: baseline vs. machine pooling with 10 machines that minimizes driving distance.

		Baseline	Pooling with 10 machines	Improvement	Improvement(%)
Statistics					
	Number of containers	4645	4645		
	Share of containers loaded to ship (%)	55 %	55 %		
Crane KPI:s					
	Crane operating time (min)	11282	11024	258	2 %
	Lifts/hours/crane (value)	24,7	25,3	0,6	2 %
	Productivity: productive time / operation time (%)	89 %	91 %		2 %
Machine KPI:s					
	Machine operating time(min)	32264	27952	4312	13 %
	Machine travelling distance (km)	4784	4468	316	7 %
	Productivity: productive time / operation time (%)	57 %	62 %		6 %
	Driving distance per container move (km)	1,030	0,962	0,068	7 %

Conclusion: Simulation showed that by only changing the job dispatching strategy to a simple centrally distributed one; significant savings for the scenario of using 4 STS gantry cranes can be obtained.

Summary

PORTMOD – A Planning and Simulation Tool for Container Terminal Operations

1	Introduction
2	Result 1: Distance analyses for containers
3	Result 2: Warehouse usage analysis
4	Result 3: Benefit analyses of machine pooling

User feedback from Steveco

"The information from different voyages, cranes or other areas at the container yard can now be obtained with simple searches."

"The container movements can be visualized on a container yard layout map which makes it easier to digest the information.
This helps the operational planning and control processes."

"The PORTMOD simulating software has also been used to confirm the straddle carrier pooling advantages as well as the what-if analysis for analysing the optimal number of straddle carriers to serve the STS-cranes."

Steveco has included PORTMOD as one of the reporting tools for Kotka Container Terminal!

THANK YOU FOR YOUR ATTENTION

VTT   **STEVECO**

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