



Arab Academy

for Science , Technology and Maritime Transport



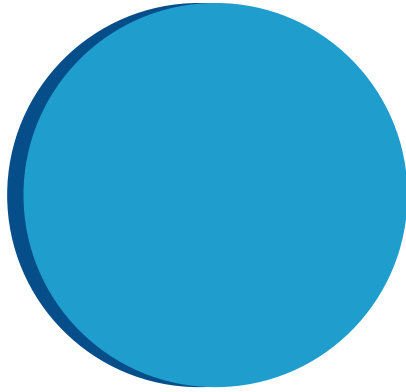
The International Maritime Transport
and Logistics Conference

“MARLOG 13”

Towards _____
**Smart Green Blue
Infrastructure**

3-5 March 2024 - Alexandria, Egypt





Managing the Complexity of Empty Container Movements through Repositioning Strategies and Routing Practices under Uncertain Demand and Supply.

Prof. Dr. Tomaz Kramberger

Dr. Alaa Abdelshafie





Containerization in Maritime Transport

Over the past decades, container transportation management has become an important part of the global maritime industry. Due to an ever-increasing movement of containers across the globe in line with the economic boom, the trade imbalance and issues related to empty containers have become inevitable.

The accumulation of empty containers in specific ports not only causes a waste of money but also increases the environmental footprint. Accordingly, the urgent need for empty container management has been gaining more attention than ever before, as the shipping companies recognized that more revenues are always derived from a good repositioning strategy



Container Movement Cycle

It is recognized that there are no problems when the container is filled with goods, as benefits and profits are pumped.

On the contrary, empty containers cause losses to shipping lines if they are not appropriately managed.

according to
topics



Empty container movements

The main reason for the emergence of empty containers in some major areas is the global trade imbalance.

56% of a container's life is wasted and stacked at depots, either in order to obtain a future demand or wait to be placed in shortage areas.

Subsequently, once the container is empty, a repositioning strategy is required, and other transport routes should be found.

2.5 million TEUs are being stored empty worldwide, waiting to be used.

according to
topics





Empty container movements

Thus, most shipping companies have a tendency to focus on the problem of empty container movements by performing a successful repositioning strategy as the container is a significant asset whose utilization level is connected with profit. Moreover, it needs the same expenditure, effort, and time spent managing the loaded containers.

according to
topics



The Role of Shipping Line in Empty Container Movement Cycle



The top 10 container shipping lines have the most significant percentage of container ownership, with a 90% market share. Hence, they take the whole responsibility for handling the container movements.

Shipping companies suffer from high repositioning costs, which can amount to up to 27% of container handling costs.

As a result, their decisions should be carefully managed to arrange the storage and movements of empties to ensure that containers are available in the right location, time, type and size where an efficient and effective repositioning strategy has an economic and environmental impact along the container transport chain.

Challenges of Empty container movements

Within increasing maritime trade, shipping lines are facing many challenges while addressing the empty container problem:-

- The demand for **empty containers, especially with a short notice**, is considered a significant obstacle as it depends on the market conditions and travel time.
- The technological challenge in terms of **sharing operational information** worldwide and breaching confidentiality.
- The **lack of coordination** between the intra-regional and inter-regional, where each regional office handle decisions related to trips between locations differently according to the geographic area.

Approaches for Empty container movements

Since empty container problem will never be eliminated completely, researchers continued to develop and improve the allocation performance through applying various approaches.

The **first** perspective focuses on the organizational solutions performed by shipping companies to reduce the movements of empties, such as container leasing, container substitution, and carriers' collaboration.

The **second** one explains how technological innovations and the new designs of containers, such as the foldable concept, can support the problem of empty containers.

The modelling technique is the **third** perspective that studies the different methods for managing the repositioning of empty containers.

Approaches for Empty Container Management

Technological Innovation

Foldable container

Connectainer Twortv Six in one Holland Cargoshell Staxxon

Modelling Methods

Simulation

Optimization

Heuristics

Continues programming

Mixed-integer programming

Stochastics and deterministic models

Network Flow Models

Network Design Models

Sub-Problem Models

Organizational Perspective

Internally

Externally

Leasing

Substitution

Intra-channel

Inter-channel

Depot direct

Street turn

Horizontal Integration



Actual Practices of Repositioning Strategies by CMA-CGM

CMA- CGM is a leading French worldwide shipping group in the world. It has raised concerns about the increasing costs of managing empty container and have called for intervention.

CMA CGM is making different efforts to overcome current hardships by applying more efficient strategies for reducing empty container movements and simultaneously pursuing more economies of scale to accelerate their profit.

according to
topics



Direct Repositioning

- The basic strategy for repositioning empty containers where the port with a large number of containers - over its commercial needs - can specify some empties to the other ports with a shortage in containers.
- This strategy can occur between ports under the umbrella of the same regional office, such as the Gulf Area. Additionally, the empty containers which are not required for regional imbalances should therefore be shipped globally from the dominant import markets, such as Europe to the dominant export markets, such as Asia.

Local Repositioning (CAPOTAGE)

- It is the same concept as the direct repositioning strategy, but it can only take place between two ports inside the same country from surplus port to deficit port.
- The CAPOTAGE strategy can be evident through cooperation among different ports in one country.

According to
topics



Non-operated Reefer-Container (NOR)

- It is a two-face repositioning strategy in CMA-CGM. It depends on loading the referred containers with clean dry cargo at lower freight.
- It is used for the exploitation of reefer containers in places where there is no reefer cargo. In this regard, the final destination of the NOR strategy should be in high demand for empty reefer containers.

according to
topics





Maintenance and Repairing Charges

- It can be considered a repositioning strategy where CMA-CGM has a contract with repairing terminals in China to maintain the damaged containers at a special rate.
- The company sends the empty damaged container to China for repair purposes. At the same time, it takes advantage of the contract location, where China is the largest exporter in the world. In this way, CMA-CGM guarantees its profit from refilling the container immediately after repairing it.

according to
topics





Experiments resembling real-life obstacles

Despite all these efforts made by CMA CGM, there are still many problems and challenges facing the company during the management of empty containers leading to delays, additional handling and rising costs of thousands of dollars.

The following challenges are among the issues that make it difficult for shipping lines to enjoy the full advantage of containerization.

according to
topics



Traditional practices:

Traditional administrative practices can negatively impact the empty container's supply chain.

The variations in repositioning procedures across local agencies, which relies strongly on knowledge and gut feeling.

The differentiation of implementing unified practices in all agencies can cause a low accuracy of empty container forecasts in some areas without others.

What makes the situation worse is the centralization of decision-making as the equipment team in shipping lines always need the HO approval regarding the empty container reallocation.

according to
topics



Lack of harmonization

The conflict among the different departments in the same company can be considered another challenge. It is always noted in the sales and commercial departments as they often focus on obtaining more customers without considering the empties distribution. This leads to the possibility of applying the repositioning strategy more than once.

according to
topics



Operational limitation:

some operational limitations include location, timing mismatch, container type and ownership mismatch affecting the empty containers management. Repositioning decisions can be made worse when empty containers arrive at the depot without a valid notification from the shipping line. Consequently, insufficient depot capacity for handling empty container packages can cause more unnecessary movements among inland depots and accordingly, costs increase.

according to
topics



Poor performance:

The unsatisfactory performance of some ports and terminals may influence the effectiveness of the shipping line repositioning strategy. It represents a significant risk that can often be the primary source of shipment delays, supply chain disruptions, additional costs, and reduced competitiveness, resulting in a lack of predictability and reliability

according to
topics





Customer requirements and behaviour:

One factor that contributes significantly to aggravating the problem is that the available empty containers in the depot do not always match what the customers are looking for. They could need different container types (reefers, open-top or high-cube containers) or specific container conditions (cargo-worthy, food-grade, or newly built units). Late bookings is a challenge as well, because instead of sending empties by train or barge, they must go by truck to catch the ship, for no extra revenue

according to
topics



Simulation-Optimization Model

By focusing on Mathematical modelling, a study had been conducted by using simulation-based optimization model to compare and compute the results between two different repositioning strategies in terms of profit, turnover days and utilization rate:

- The first strategy is random approach which allocates empty containers to customers randomly.
- The second strategy is optimized approach that uses the Simulated Annealing and Netlogo platform to allocate empty containers to customers appropriately.

according to
topics



Findings

- The study uses ten different ports in various countries around the Middle East and Asia showing their shipping routes that bound each of these ports.
- The demand, supply and associated costs between selected ports during the simulation had been used as well.
- The results can be concluded as follow:

according to
topics





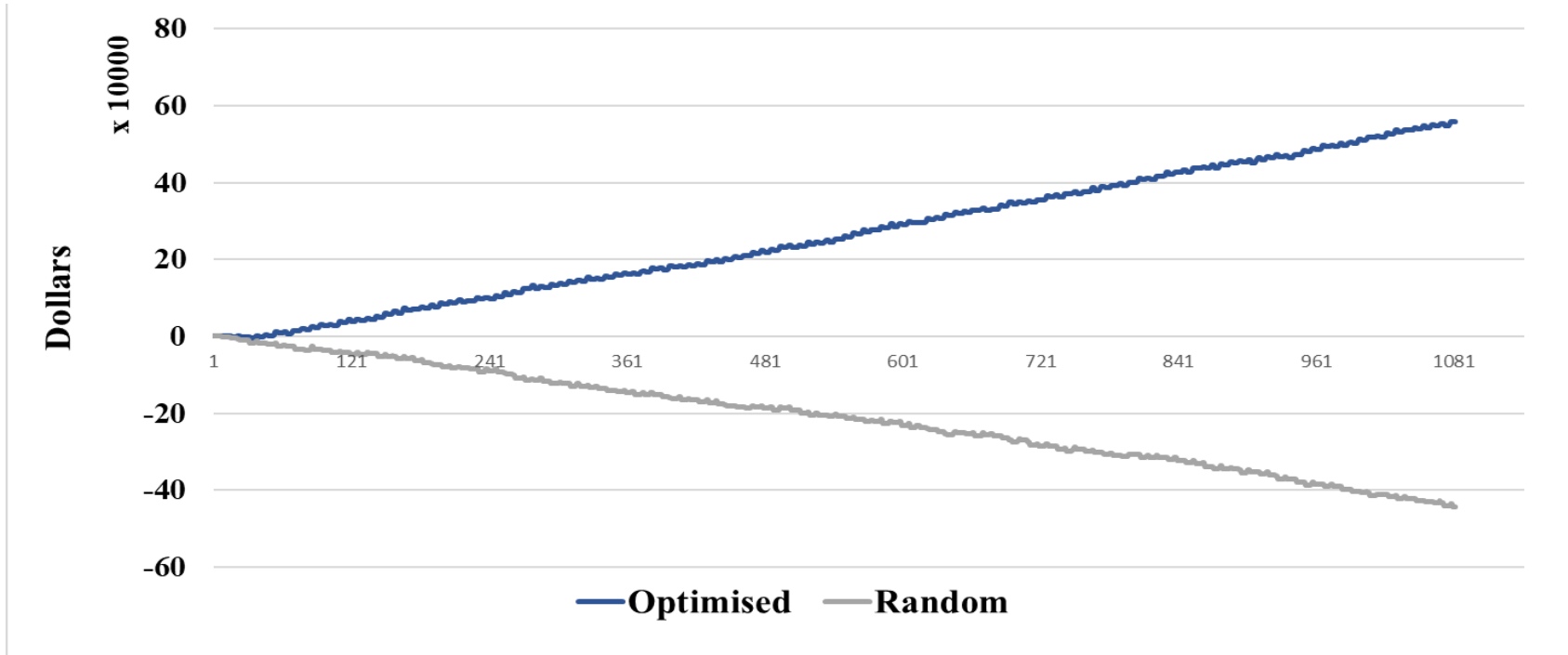
Shipping line company profit

As shown in the next slide, this result can trace the effect of applying an optimized strategy on the company profit. It is related to the main objective of any shipping line to gain more revenue and achieve significant improvement in terms of costs, which is the key success factor for any company.

By comparing the random and optimized repositioning scenarios, the results show that the profit level of the random repositioning scenario rise to positive for a short period before turning to negative in the rest period. Additionally, the profits of the optimized repositioning scenario increased continuously during the simulated period.



Shipping line company profit





Empty container turnover

The next graph show measure the number of days that have passed since the empty container was ordered until it reached the final destination. By comparing the empty container turnover days under the optimized and random repositioning scenarios, the results showed that the average turnover days under an optimized repositioning scenario was around 25 days, while it is around 20 days under the random scenario.

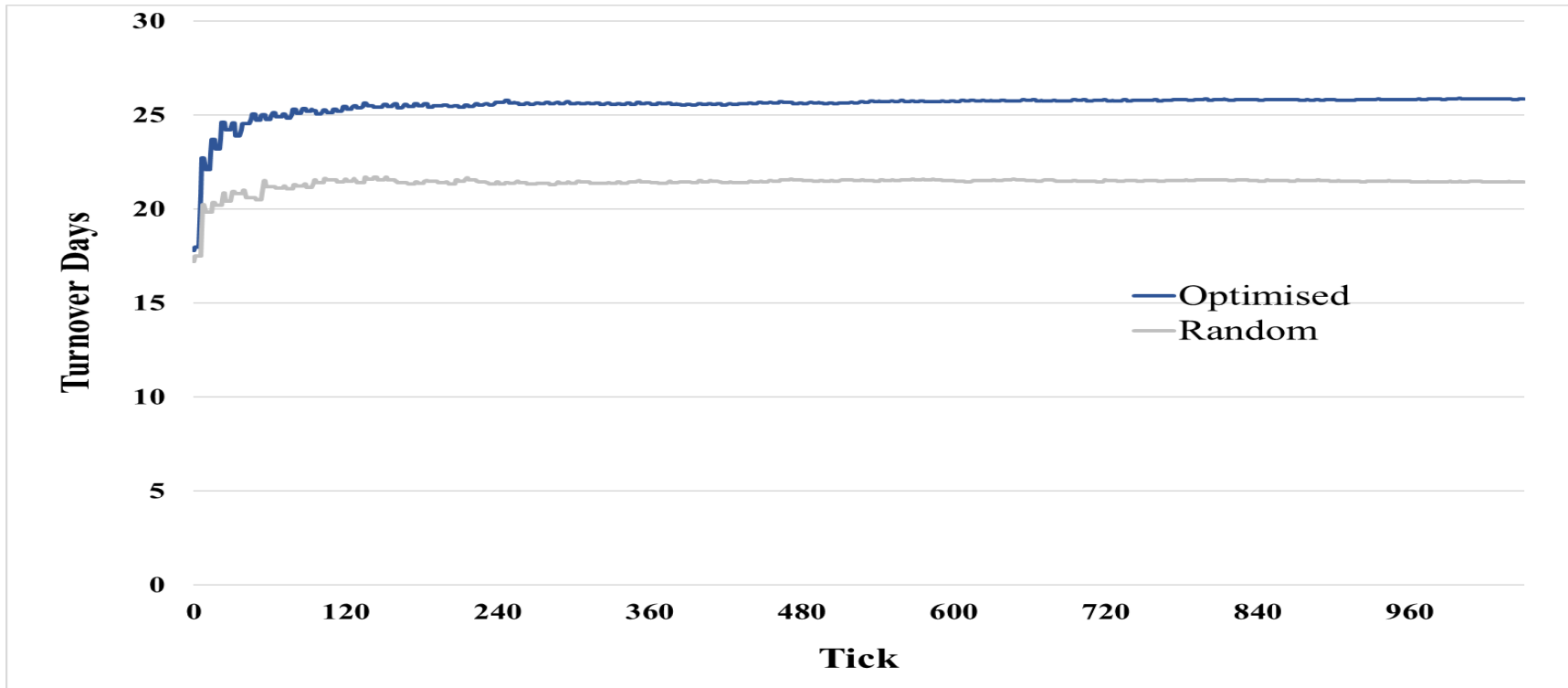
The results show that the number of turnover days in the optimized strategy is five days greater than that of the random strategy due to the careful selection of ports.

according to
topics





Empty container turnover



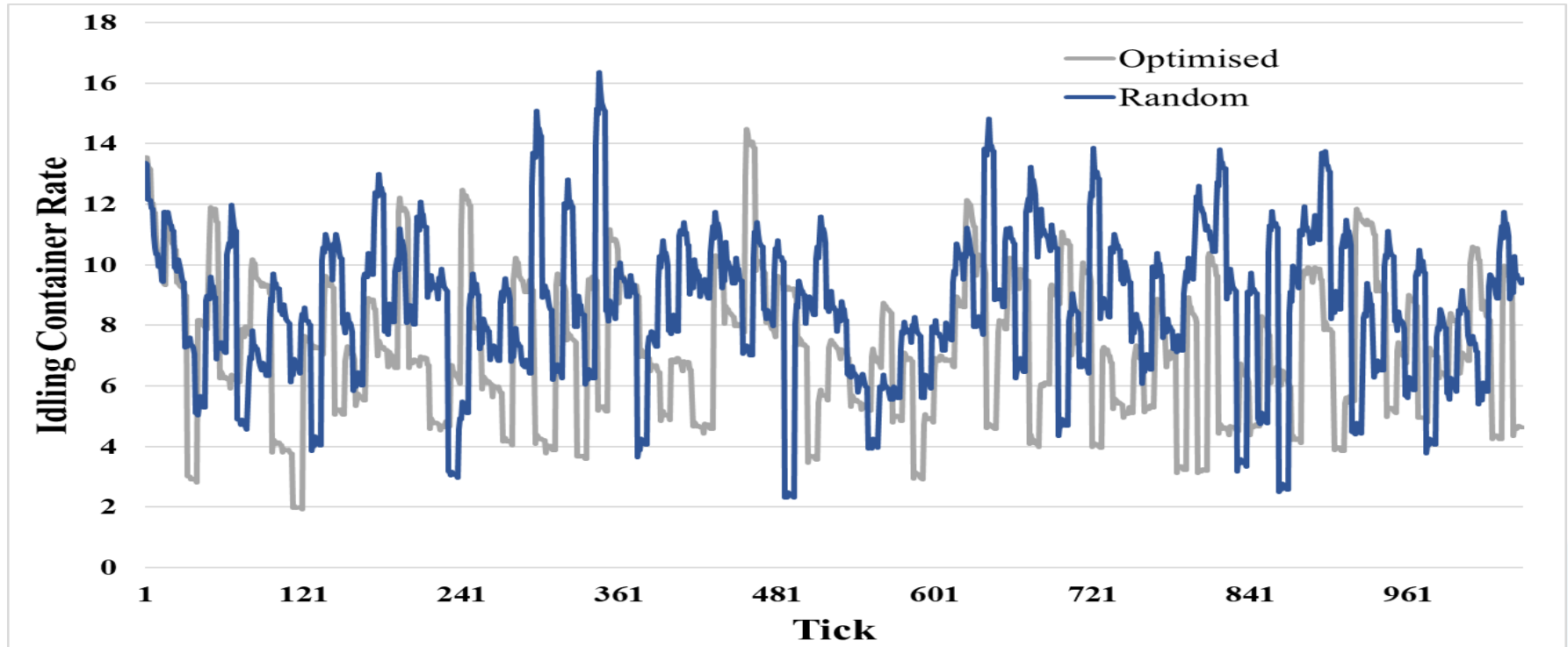
Empty container usage rate

The results illustrate the number of times the container has been used during its lifespan. The empty containers in the random scenarios need to wait for more time in the depot until a vessel arrives. This represents a non-revenue generating part involving additional costs such as storage costs.

In comparison, the average idling rates of empties in optimized scenarios are less than the random ones where containers are shipped quickly to profitable customers. Although the results of empty containers' idle rate in the simulation model are not sharply different between both scenarios, the slightest difference causes a significant change due to the storage cost continuing to rise. Hence, improving container utilization could achieve potential cost savings and save the container's lifespan.



Empty container usage rate



Conclusion

With the existence of a simulation optimization model in empty container management cycle, the repositioning process can be more reliable, faster and easier.

Experimental results of the model show that the optimization simulation approach is applicable in practice. Three main hypotheses have been proved and accepted:

- First, the repositioning strategy significantly impacts the profit
- Second, the increasing turnover of the empty container is more significant when applying an optimized repositioning strategy
- Third, the optimized strategy leads to the maximum improvement of container utilization through its life span.





Arab Academy

for Science , Technology and Maritime Transport



The International Maritime Transport
and Logistics Conference

“MARLOG 13”

Thank You

