Optimization of the hinterland in real-world container transportation

Artificial Intelligence for the optimization of real-world port logistics

Stakeholders

DMS LOGISTICS

MINES Saint-Étienne
Une école de l'IMT

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LIMOS

➢ Context and Problem description:

- Intermodal container transportation growth
- Increase in CO2 emissions
- Tremendous delays
- All the supply chain is impacted: Gain losses
- Not much studied in the literature

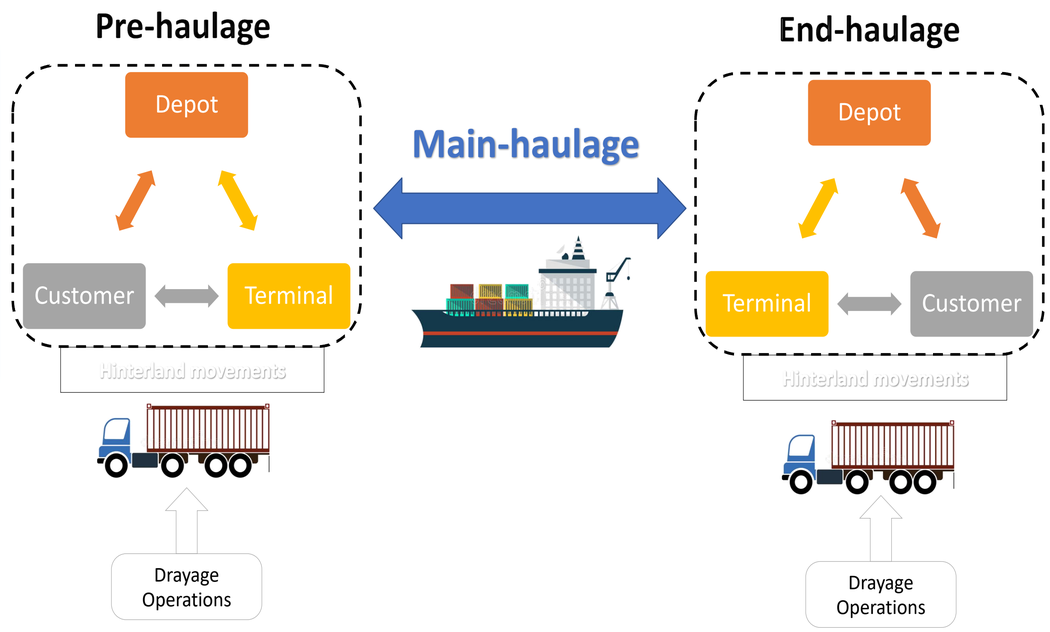

Figure 1: Intermodal transportation phases

➢ PhD thesis under CIFRE with DMS Logistics:

➢ **Goal:** Optimize the hinterland while considering real-world data and constraints, to complete the literature with more practice-oriented models and help DMS Logistics in optimizing the global port logistics chain. More specifically, we address drayage operations which are container movements realized by trucks of transportation companies (DMS Logistics clients).

➢ Specificities of the problem:

Container missions can be (Figure 2):

- **Import requests**: a full import followed by an empty repositioning
- **Export requests**: an empty supply followed by a full export
- **Single requests:** any movement of an empty/full container

Import and export requests are composed of two single ordered requests with a minimal time lag, incurring synchronization for the same container when carried by a different truck (precedence constraint in Figure 3).

➢ The fleet as well as container sizes are **heterogeneous**.

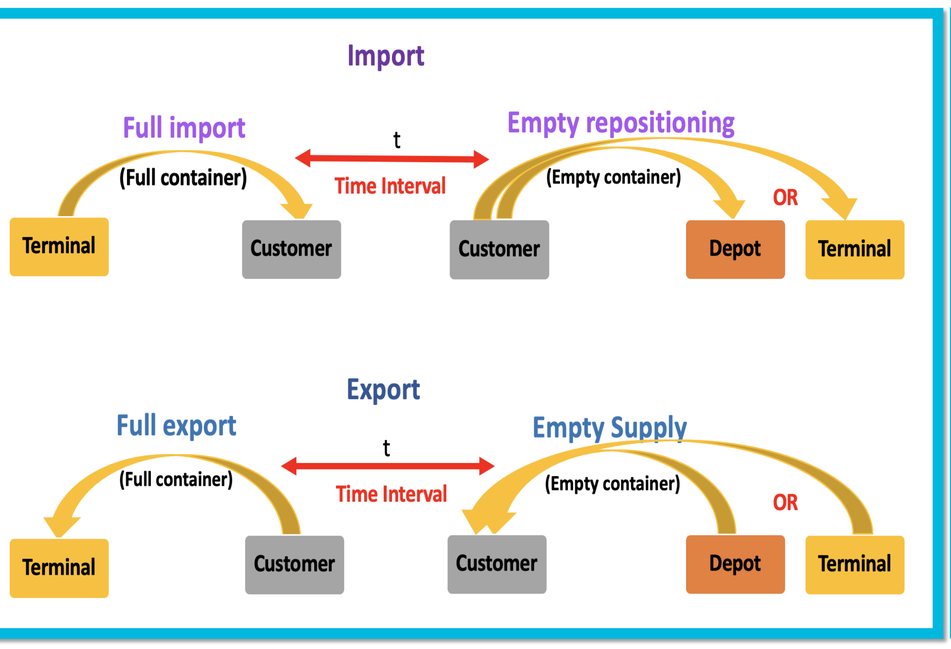

Figure 2: Type of container movements

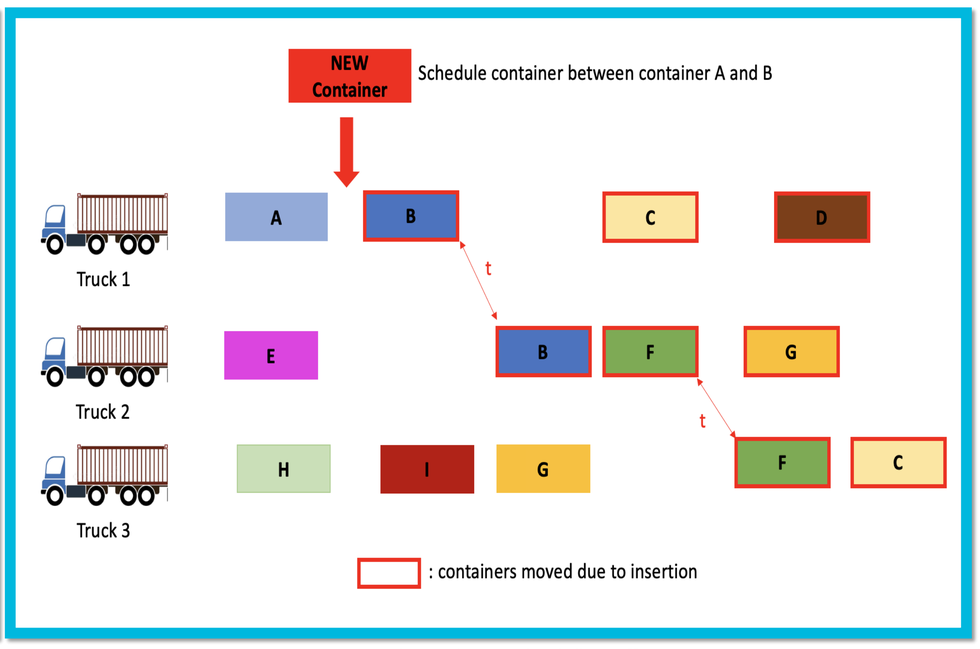

Figure 3: Rescheduling effect

➢ Solution method:

We developed a **generalized** model to provide an **optimal planning** of a fleet of trucks to **serve a set of container missions.**

To solve large instances, we developed a dedicated **Large Neighborhood Search** (LNS) **heuristic**:

- destroy a part of the solution and repair with a **best insertion** procedure
- improve with **local search**
- iterate and control with **simulated annealing**

➢ Conclusion:

- We formulated a real-world drayage problem taking into account requests precedence constraints as well as trucks and containers heterogeneity.
- We developed a dedicated LNS heuristic that served requests in less than a minute.

➢ Perspective:

- Address terminal problems from which predicting the stochastic time of serving containers at terminals using Machine Learning techniques, optimize resources allocation, etc.

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