Port Multimodal Inland mode of transportation predictor & prescriptor

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Abstract

The steady increase referred to the goods moved by containers in the different ports of Europe, as well as all around the world, the volume of TEU's has augmented 20% in the last 10 years, has implied an increase of the inland transportation that has posed economic, social and environmental challenges to ports, and their hinterland. To tackle this issue, one of the innovative tools that the European Commission's project, COREALIS, is developing, is the Cargo Flow Optimizer (CFO) tool, that uses the data available from the key port stakeholders (Port Authority, Terminal Operators, inland transportation operators, etc.) to create a predictive and prescriptive model in order to improve multimodality. The proposed tool, aims to improve the port operations while at the same time it reduces the current negative impacts in the surrounding area.

Keywords:

MULTIMODALITY, LOGISTICS, PREDICTION

1. Introduction

Ports are essential for the European economy; 74% of goods exported or imported to the EU are transported via its seaports. At the same time, the challenges they face are only getting greater: Volumes of cargo increase while they also arrive in a shrinking number of vessels: Post-Panamax vessels have a capacity of more than 18.000 containers. Port operators need to comply with increasingly stricter environmental regulations and societal views for sustainability.

A sustainable land-use strategy in and around the port and a strategic transition to new, service-based, management models that improve capacity and efficiency are paramount. They are key enablers for ports that want to keep pace with the ocean carriers needs and establish themselves as trans-shipment hubs with a 'societal license to operate'; for ports whose land strategy, hinterland accessibility and operations are underpinned by circular economy principles.

In this sense, the European Union (EU) is putting significant effort in order to improve and optimize the efficiency of the European ports. To achieve this goal, a number of European projects have been funded within the Ports of the Future program, with COREALIS being one of them.

COREALIS proposes a strategic, innovative framework, focused on disruptive technologies, including IoT, data analytics, next generation traffic management and 5G, for modern ports to handle future

capacity, traffic, efficiency and environmental challenges.
Through COREALIS, the port will minimize its environmental footprint to the city as well as decrease disturbance to local population through a reduction in the congestion around the port.
To tackle these challenges, one of the innovative tools that the COREALIS project will develop is the cargo flow optimizer (CFO) tool that develop a model based on data available from the key Port stakeholders (Port Authority, Terminal Operators, Inland Transportation Operators, etc.) that allows to predict and prescript different solutions related to the port operations as well as to the multimodal transport.

2. Main issues related to port multimodality operations

It is already known that one of the basic problems related to the ports and their inland connectivity is referred to the trucks, as the most common inland mode of transport, and the different issues that arise with that mode all along the port and its surroundings.
Nowadays, the most commonly used mode of transportation is road transportation. Several reasons make this mode the best fitted for all the carriers:

- Road transportation allows a much wider schedule flexibility due to its main dependence to the driver and its almost full independence to any other issue (shared transportation, rigid timetables, etc.)
- Road transportation allows to move the cargo independently of the number of containers required by the shipper
- Finally, road transportation does not depend on any prioritizing rule that any other transportation mode can apply – the most common case is the one related to rail transportation where passengers are normally prioritized in front of goods

Although for carriers road transportation is often the best solution, this option has different problems that make this solution one to be, at least, mitigated and adjusted to the real needs of all the stakeholders:

- The port detects that a high number of heavy vehicles in the roads of the installation, implies a reduction of the productivity and an increase of congestion and the appearance of a bottleneck
- The terminal and specifically its internal operations, due to the bottleneck that arises with the congestion, can be affected implying a relocation in-real-time of the containers and a reduction of the productivity
- Finally, in the surroundings of the ports different issues related to road inland transportation appear: traffic congestion, atmospheric and acoustic contamination, increase of accident rate, visual impact, etc. These side effects are increased due to, normally, next to the port is located an urban area and, implying that the negative effect of the different impacts affect economically, socially and environmentally to the mentioned urban area.

In fact, one of the key reasons not to use other inland transportation modes is related to the lack of information of these alternatives as well as the option to access, as customers, to these options independently of the total volume to be transported.

3. Scope of study

To analyze the issue, we decided to work with the Port of Antwerp. This port is located next to the most populated city of Belgium (and the 2nd metropolitan area behind Brussels) and was in 2017 the 2nd container port of Europe behind Rotterdam (and the number 17 in all the world in 2014) with almost 9 Million TEU per year.

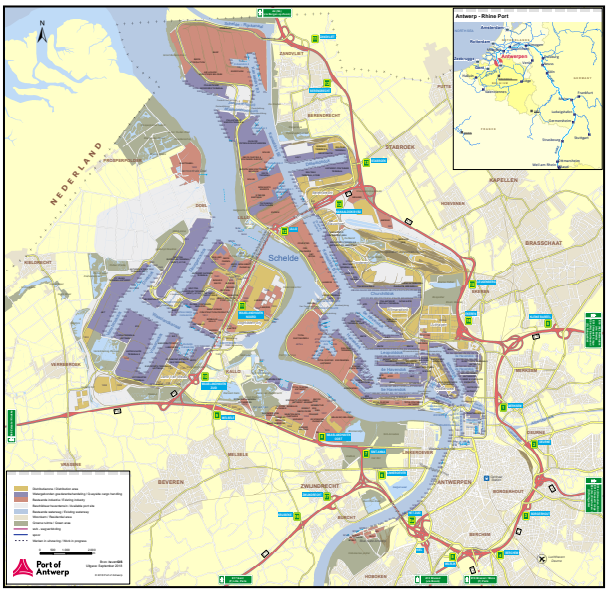

Figure 1: Port of Antwerp

The selection of the port of Antwerp (PoA) was motivated for many reasons:

- PoA is one the biggest ports in Europe and it is strategically located about 88 kilometers from the North Sea at the upper end of the tidal estuary of the river Scheldt
- The city of Antwerp, with more than half a million inhabitants is next to the port
- The roads that are going from and to the port are saturated with trucks involving Antwerp as the most traffic saturated urban area in Belgium and one of the most congested in all Europe
- The location of the Port allows not only to use rail and road mode but also barges to transport the goods inland

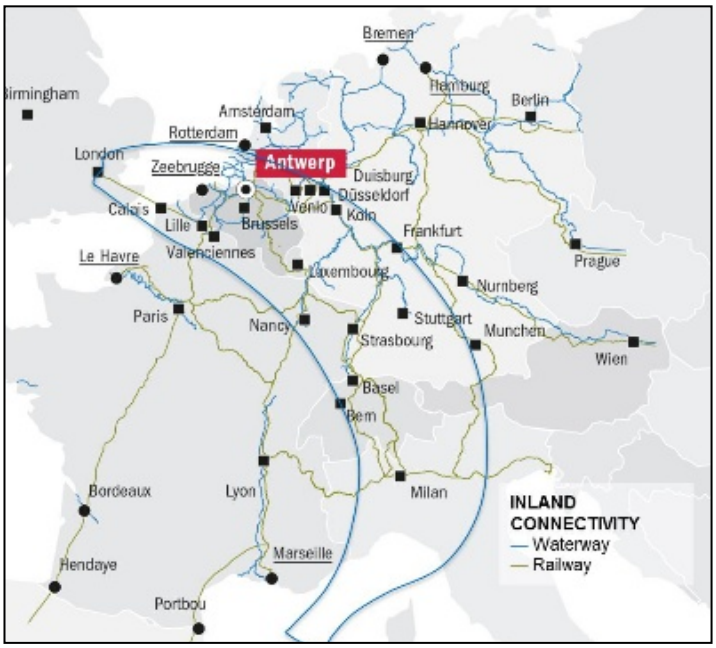

Figure 2: Antwerp inland connectivity

4. Methodology

In order to improve the different issues that arise related to the port, the terminal and the urban area, our main goal has been to define a solution that allows to obtain an improved multimodal split of the containers that arrive at the terminal and are needed to be sent to final destination.

The idea is to promote data sharing between the different key stakeholders in order to obtain the data required to create a tool to be able to develop a predictive and prescriptive model based on real and historical data, that allows the different stakeholders to choose the best option to optimize the supply chain.

To achieve the goal, we are developing the CFO, a tool that allows to improve the internal organization of the terminals as well as gives to the carrier different alternatives in order to decide the best choice related to inland mode of transportation. The CFO in focused on the following goals:

a) To improve organization of containers placed on port's terminal

Development a prediction model based on real data (both historical and real time) provided by the different key stakeholders in order to obtain in advance the terminal occupancy as well as the inland mode of transportation expected to be used.

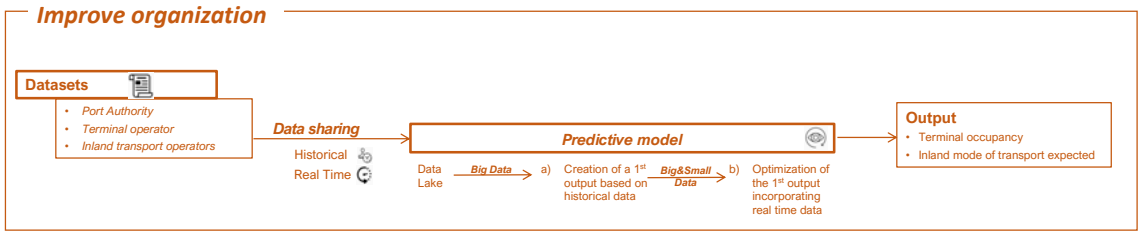

Figure 3: *Improve organization of containers* model

To improve the organization of containers, data sharing will be the base to create a two-phases predictive model where first a prediction based on historical data is made and – in real-time and constantly updated – a second prediction optimizes the final output adjusting the initial results obtained.

b) To predict the best available inland transportation to achieve final destination

Analyse the inland requirements of the container as well as the inland transportation connections in order to predict the best existing available mode of transport

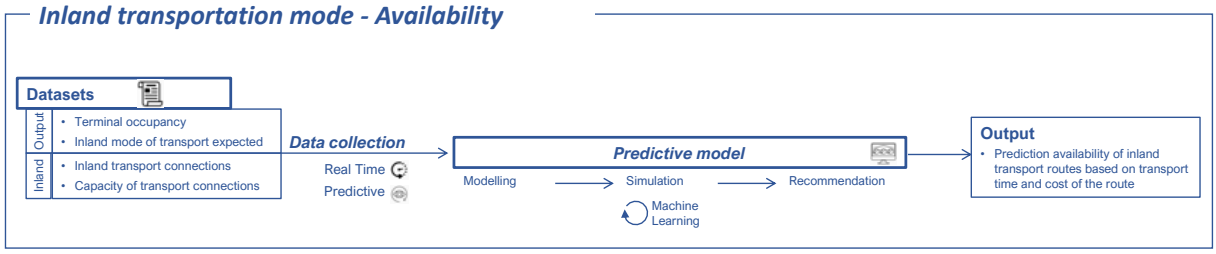

Figure 4: *Inland transportation mode-Availability* model

To predict the availability of inland transportation mode, a two-step scheme is created. First of all, a modelling of the different options is created. Following, a simulation based on the demand expected allows to recommend the best option based on the availability of the different existing modes of transport.

c) To propose new shared services related to inland transportation

Analyse the different destinations related to containers in order to propose the creation of on-demand inland routes in order to optimize this inland transportation

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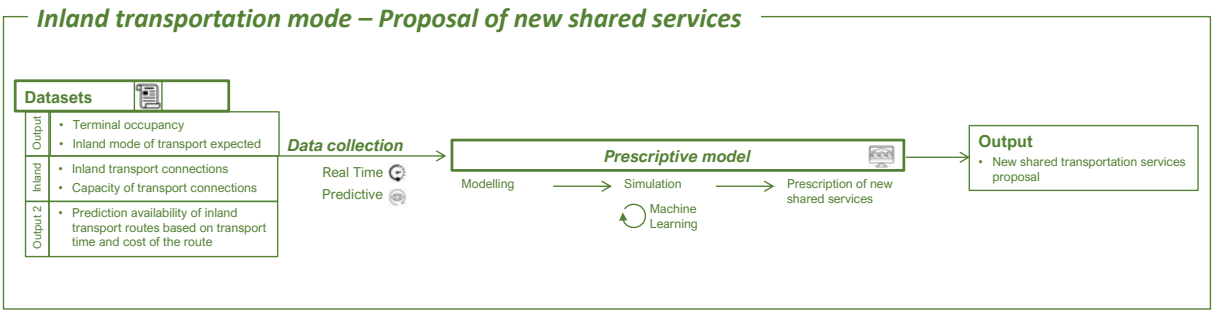

Figure 5: *Inland transportation mode-New Shared services* model

To prescript new shared services, a two-step scheme similar to the previous goal described is developed. First, a modelling of the different options is created. Following, a simulation based on the demand expected allows to propose new shared services combining different modes of transport.

5. Next steps and conclusions

The project began in May 2018 and it is expected to be finalized in April 2021.

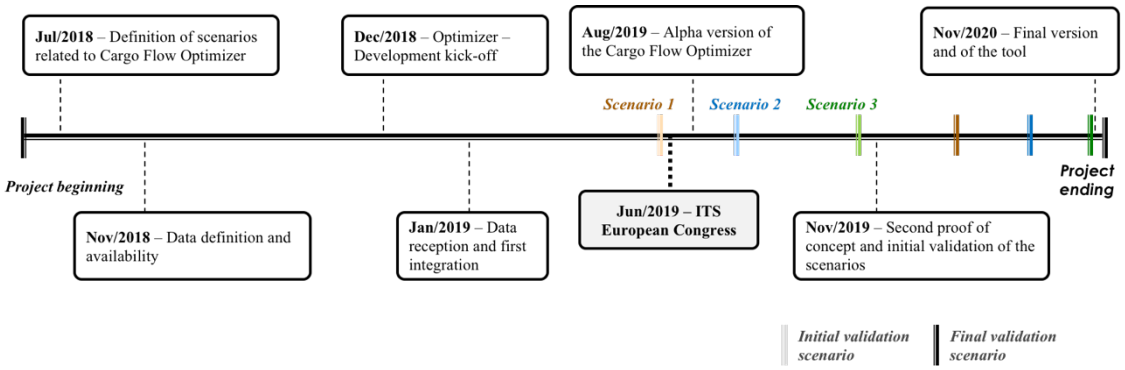

Figure 6: Cargo Flow Optimizer Plan

Currently, the different scenarios as well as the data required to develop the CFO have been defined and we are just receiving the data in order to develop a first version of the CFO to be submitted in August 2019.

Acknowledgement

This work is a part of the COREALIS project. COREALIS has received funding from the European Union's Horizon 2020 research & innovation programme under grant agreement no 768994. Content reflects only the authors' view and European Commission is not responsible for any use that may be made of the information it contains.

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