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Collaboration in Truck Appointment System in Container Terminals

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Abstract

Due to the continual increase of the global containerized trade, many container terminals face the problem of high demands that their current resource capacity cannot afford. The consequences of such situation are not only the long queues of trucks at the entrance gates and storage yards but also the large turnaround times of trucks. In response, Truck Appointment Systems (TAS) were introduced to schedule truck arrivals in order to alleviate the terminal rush hours, however, the mandatory appointments developed by TASs have a negative impact on the operations as well as resources of the trucking companies. In recent literature, this issue was considered by introducing collaborative TAS in which the trucking companies as well as the container terminals collaborate to set the truck appointments. This work elaborates on the difference between traditional and collaborative TAS and demonstrates how collaborative TAS can improve the performance of the container terminal and reduce the cost of the trucking companies.

According to the International Maritime Organization, about 90% of products and raw materials are transported by vessels. Due to this rapid growth in container transportation, container terminals are considered as the most essential nodes in the containerized cargo supply chain. As a result, strategic and operational planning of container terminal operations is witnessing a considerable interest in both practice and academia. The global containerized trade is steadily growing every year as shown in figure 1.

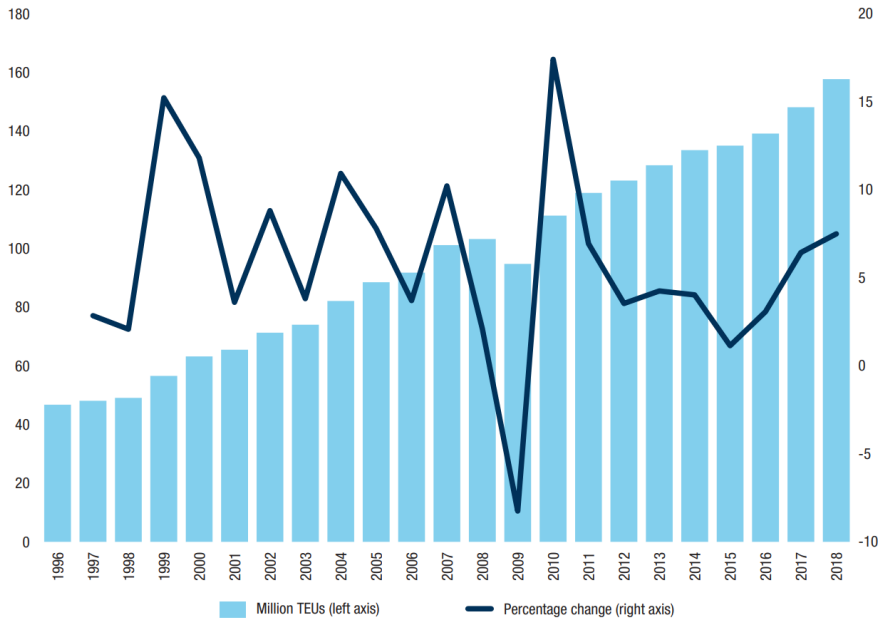


Figure 1: Growth of global containerized trade between 1996 and 2018 [1].

Container terminals in Denmark have witnessed an increasing demand on its service. In general Denmark has around 159 seaports, four of these seaports are container ports as can be seen in figure 2. Figure 3 shows the throughput of containers and RORO units in major container terminals in Denmark. As can be noted from figure 3, the containerized trade increased by an average of 4.2% annually between 2009 and 2018.

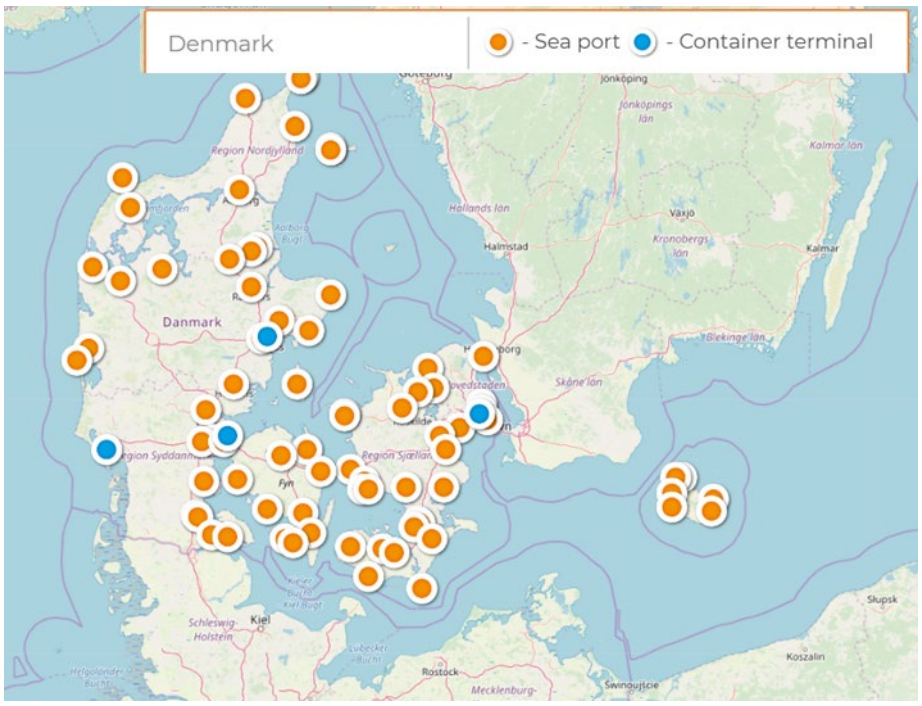


Figure 2: Locations and types of Danish ports [2].

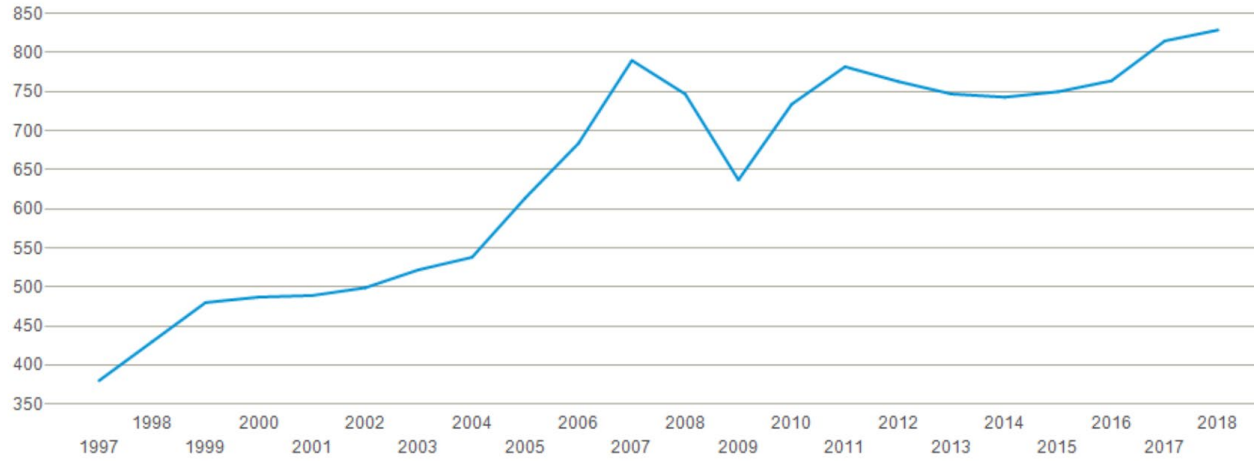


Figure 3: Throughput of containers and ro-ro units in major Danish ports, (vertical axis represents number of containers handled in 1000 TEU) [3].

Figure 4 shows the typical layout of the container terminal, which comprises three major areas, namely, the seaside area (berths and quay canes area), the yard area (yard blocks) and the landside (truck gates and train area). The internal transportation among the three areas is indicated by dashed lines. This work focuses on the operations at the landside area where the gate of the container terminal is located. Gate operations are an essential part of the container terminal where the terminal receives inbound containers from customers while outbound containers are picked-up from the terminal to be delivered to customers. These containers are temporarily stored at the yard blocks before loading/unloading them to/from the vessels. The most common way to transport containers between the terminal and the hinterland is using trucks operated by specialized trucking companies.

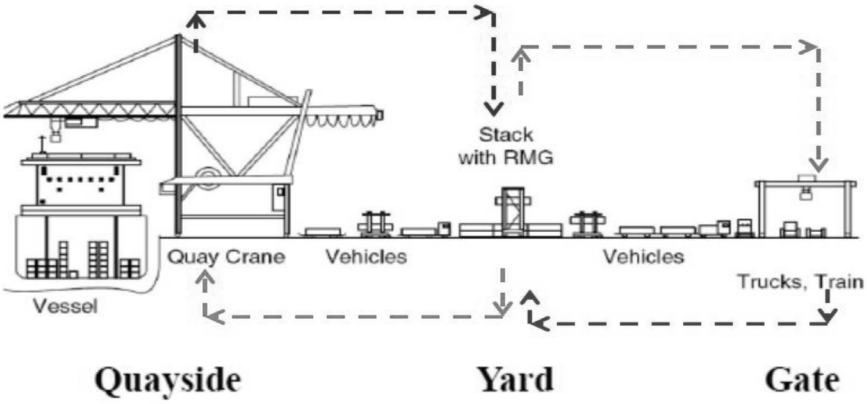


Figure 4: Typical layout of a container terminal [4].

Figure 5 shows the traditional TASs which can be classified into “optional” and “mandatory” TASs. The *optional* TAS allows trucking companies to send their trucks to the terminal at their preferred times, while in the *mandatory* TASs, the container terminal determines mandatory appointments for the trucks of trucking companies. Both types have some advantages and disadvantages for each party. The optional TAS may increase the convenience of the trucking companies but it may lead to severe congestion at the terminal gates if majority of trucks arrived around the same time periods. On the opposite, the mandatory TAS enables the terminal to control the arrival of the trucks and avoid high level of truck congestion at the gates, but it dissatisfies the trucking companies when these mandatory appointments result in long waiting times and low operating efficiencies of their trucks.

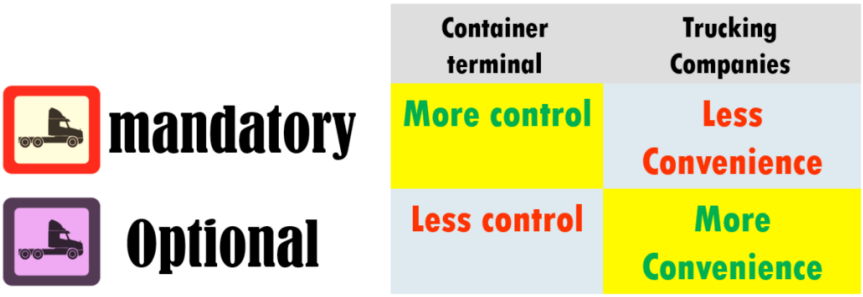
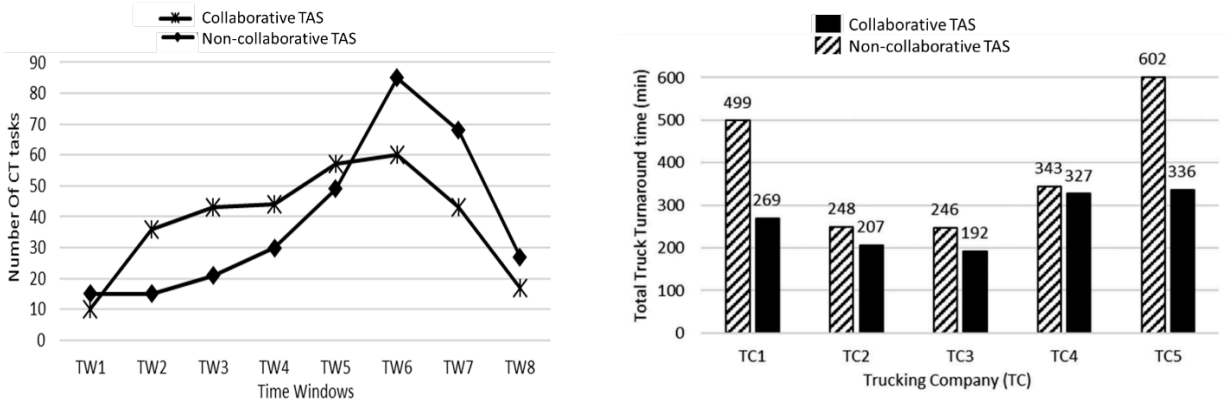


Figure 5: Traditional types of TASs [5].

The collaborative TAS presents a well-balanced tradeoff between the mandatory and optional TASs. It allows both, the container terminal and the trucking companies to collaborate in order to develop the truck appointments together such that the planning needs of both parties are not totally ignored but satisfied to the best possible extent. Figure 6 illustrates an example of how collaborative TAS may result in balancing the workload inside the terminal (Figure 6a), and how the total truck turnaround time of the different trucking companies is reduced at the same time (Figure 6b). The figure is based on case study presented by Azab el al. (2019).



(a) (b)

Figure 6. Impact of using the collaborative TAS on Terminal load (a), and truck turnaround time (b) [6].

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