The impact of a B-to-B container transferium on the sojourn time of inland container vessels

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Management summary

**Inland container shipping**  The container transport business has been under stress since the global financial crisis of 2008. Because of the low profit margins, the competition between ports has become even more important. Staying ahead of the competition is crucial for a port. The large container ports in North-Western Europe compete through hinterland connections rather than on their connectivity on the sea side; The performance of the connection between the port and its hinterland is key in the attractiveness of the port for shipping companies.

The Port of Rotterdam has set goals for the future of its hinterland connection, mainly by improving the connection by inland shipping. The Masterplan for the Maasvlakte focuses not only on facilitating the growth of inland shipping but also on the modality shift from road to inland waterway.

![Figure 1: Inland shipping in the Port of Rotterdam](image)

**Problem situation**  The current situation is visualized in Figure 1. Inland vessels have a sojourn time of 24-36 hours of which half is spent waiting to be serviced. This problem is not unique to the Port of Rotterdam. The cause of the long sojourn time in Rotterdam lies in the coordination between inland shipping and terminals, specifically their willingness to work together. Both parties want to keep business information as private as possible for competition purposes.
One of the causes of long sojourn times is the lack of cargo exchange between inland vessels. 20 to 50% of the calls in the port by inland vessels are small call-sizes. Inland vessels must call on average at 6 terminals, upon which each terminal visit requires sailing time and waiting time, irrespective of the call-size. Waiting times at terminals are usually around an hour, but do sometimes increase to up to a day. This inefficient problem exists within logistical processes in ports for decades and no real solution has been implemented. Some terminals have begun with introducing a minimum call-size at their berths to counteract the small calls, the effects on the transport chain are not clear.

The call-size can be increased by bundling small call-sizes of inland vessels by means of an transferium. Diverse types of transferium can be found in literature but few focus upon the use of inland vessels in the bundling process. The effects that a transferium has on the container transport chain depends on the configuration of the interaction between inland vessels and transferium.

This prompts the main research question of this report:

- *What are the effects of a barge-to-barge transferium on the hinterland connection performance of inland container shipping, in the Port of Rotterdam?*

The effects of the transferium on the transport chain are investigated at three aggregation levels; Strategic, Tactical and Operational. The strategic level is concerned with overall performance, the tactical level with the specific terminals and the operational level with the interaction between transferium and inland vessel.

To get a different view on inland shipping in Rotterdam, other than from literature, a round-trip was made by the author on a 'groot Rijnschip' with a capacity of 210 TEU. 30 hours sailing and talking with the crew proved valuable in understanding the challenges that the port is facing in the coming years, especially from an operational perspective.

A conceptual simulation model of the situation in the Port of Rotterdam was made, where inland vessels are the main component to transfer containers between hinterland and destination terminals in the port. This conceptual model has been implemented in a simulation model in Anylogic: an agent and java based software program to model discrete events. The assessment is done by means of a simulation model where the input and output variables of the interaction between a transferium and inland vessels are varied.

**Transferium scenario**  The hypothetical transferium is located on the edge of the Rotterdam port area, near the Waalhaven. The transferium has no physical parameters other than transshipment speed. The interaction between transferium and inland vessels is visually presented in Figure 2.
Three variables are distinguished within the simulation study:

- An input variable; the minimum call-size by which the transferium should not be used
- An output variable; the minimum number of terminal calls. Small call-size can only be dropped off at the transferium when the number of terminal calls does not go below the minimum number of terminal calls.
- Transferium stack size; which elaborates on the physical layout of the transferium.

**Strategic aggregation level conclusions** For cases where only small call-sizes are bundled, the transferium increases the performance of the inland shipping in the PoR. The container travel times and sojourn time of inland vessels are reduced. At a higher call-size minimum, the transferium gets congested and the transport chain efficiency reduces by increasing the container travel time.

**Tactical aggregation level conclusions** The effects on a tactical aggregation level differentiate between terminals, inland vessels and containers. Waiting times of inland vessels at medium terminals are reduced when the minimum call-size increases. Containers benefit at medium and large terminals and inland vessels at medium terminals. The individual terminals experience no negative changes, except when the transferium is congested in which case the throughput decreases.

**Operational aggregation level conclusions** The explored minimum terminal call as an output for the transferium scenario negates the negative effects that occur at higher minimum call-sizes, but does not improve the transport chain. A limited stack size mimics a smaller transferium and shows potential, but more selective input of containers should be considered. In general, more research is needed to identify other ways to use the variables surrounding to improve the interaction with the transferium.

**General conclusion** The introduction of a transferium into the transport chain in Rotterdam is an improvement to the hinterland performance of inland container shipping. The sojourn time of inland vessels is reduced in all variations, the container travel time is improved at
terminals with long waiting times and the waiting times at terminals without large sea going vessels are improved.

The configuration of the interaction between inland vessel and transferium is key to the implementation success. However, the tested variables in this research are only a select base from a wide array of candidate variables, and a more sophisticated interaction with transferium is required to examine the benefits for each individual actor. Overall the effects are positive but require a more detailed model to fully understand the implications that come with a transferium for inland vessels.