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ASSESSING THE HINTERLAND OF MARITIME PORTS IN THE EUROPEAN NORTHERN RANGE

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ABSTRACT

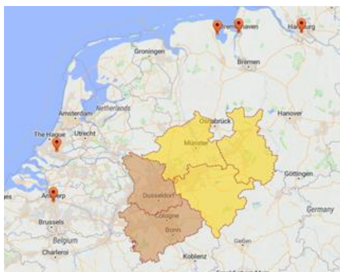
The hinterland region in the state of North Rhine-Westphalia (NRW) in Germany is in close proximity to several ports (e.g., Rotterdam, Antwerp, Hamburg, Wilhelmshaven) allowing for inter port competition through hinterland connectivity. To assess the impact of additional hinterland connections a simulation model has been built, mapping the hinterland connectivity to the respective ports. While calibration of the model can and should be further improved, the impact of changes in the hinterland connectivity can be experimentally evaluated by adding or modifying the connectivity. The model can serve as a first estimate of new potential connections on a managerial level, giving hints for further qualitative investigations of their impact.

1 INTRODUCTION

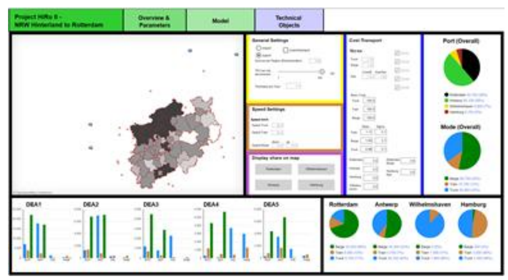
As the hinterland is either point of departure or arrival for containers shipped via a respective port it plays a significant role in assuring port success. Usually ports have a distinctive hinterland, shaped by geography and infrastructure, cultural and administrative barriers or grown relationships between the actors in the transport chain (De Langen 2004). Aside from the on-site capacity and operations of a port, inter-port competition is highly driven by hinterland connectivity. With its proximity to multiple ports, NRW allows for such competition (Zondag et al. 2010). As shown in Figure 1(a), NRW is divided in market shares. For the western part Rotterdam and Antwerp have a market share of ~90%, with barge and rail transport taking up almost 2/3 of it. The eastern part of NRW usually ships via Hamburg, Bremen or Wilhelmshaven with a market share of these ports of ~69%, with truck transport accounting for 2/3 of it (ISL Bremen 2017). Therefore, to assess potential changes in port and mode choice, adding intermodal train services in the eastern part of NRW is interesting, as this region utilizes truck transport heavily. Additionally intermodal connectivity makes the proximity area around a terminal more attractive for a shift to intermodal transport (Frémont and Franc 2010), potentially amplifying the modal shift.

2 APPROACH FOR BUILDING THE SIMULATION MODEL

The simulation model aims to recreate the intermodal connectivity to all relevant ports of the northern range from NRW. The relevant intermodal terminals, frequencies, distances, and modes are obtained through the port information systems of the respective ports. The call position, meaning the sequence of port visits for a vessel, provides an advantage for the ports of Rotterdam and Antwerp as their call position for deep-sea container liners is better for export and import by a certain amount of days. Once the simulation framework has been established, each region in NRW is creating randomized containers within its area with either an export or import destination. The frequency of container creation is based on NUTS2 level data from ISL Bremen, which has been adjusted for the gross regional product (GRP) to enable simulation on a NUTS3 level. For an assessment of each container, a routing through all mode/terminal/port combinations is done. After arriving at the final destination, a utility score is calculated depending on the time used for transport, the cost of the different transport modes on a distance basis, potential transshipments and a time function that considers the value of the transported goods. The best transport option is then counted towards the statistics. As the actual amount of containers cannot feasibly be simulated, a multiplier can be set making each created container equivalent to a certain multiplied amount. Frequencies of intermodal connections were stretched out randomized over the course of a week. The model was programmed in AnyLogic 7.5 University Researcher. We chose an agent-based approach to allow for a per container assessment and keep the model easily extendable. Figure 1(b) shows the user interface with several statistics regarding the market and mode shares for different ports and regions.



(a) NRW and major ports in proximity



(b) Screenshot of simulation model

Figure 1: Market area and screenshot of the simulation model.

3 POTENTIAL ASSESSMENT OF ADDITIONAL HINTERLAND CONNECTIONS

To assess the impact of additional or modified frequencies of intermodal connections, the model first needs to be calibrated. The calibration aims for a close approximation of the real port market and mode shares of the different regions. The costs of the different transport modes were used as a manipulator. A single-digit percentage in deviation for region/mode/port combinations was achieved after calibration. This precision is close enough for a first estimate, but should be improved further to allow for more precise assessments. After calibration, additional hinterland connections can be added to the model and their impact on the market and mode shares of the different ports can be estimated.

4 RESULTS / LESSONS LEARNED / MANAGERIAL INSIGHTS

The simulation model allows for an experimental assessment of the NRW hinterland and its container volumes running through a terminal/mode/port combination. As managerial insight, the model serves as a first estimate. Further validation by qualitative studies (e.g. interviews with respective actors in the transport chain) should be conducted. Further calibration and extensions to the model, e.g. capacity restrictions, should be incorporated.

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