Summary

The size and amount of inland shipping vessels on the waterways in the Netherlands will increase in the future. This will partly be the result of the growing throughput of the Port of Rotterdam to the hinterland and vice versa. In the inland shipping waterway network locks are the most important bottlenecks, which results in waiting times at the locks. Without intervention the expectations are that the waiting times will increase to unacceptable levels. This research will focus on the implementation of the concept of intelligent waterways on the inland waterway network in order to optimize the flow of inland shipping vessels and reduce waiting times at locks. This may not lead to an increase of the voyage costs for ship owners and should result also in a reduction of the emissions. The composed requirements are transformed to a simulation model specification, which is used for the model design. From there the design is implemented into Lazarus, using the simulation package TOMAS. The model is used to perform experiments of which the results must contribute in answering the research question.

The concept of intelligent waterways is implemented by a system with knowledge. For example a waterway segment knows the position of each ship in its domain and a lock complex knows the start times of the cycles. This information is accessible to a global controller, which uses the information to optimize the flow of vessels according to a defined objective. The results of the optimization are communicated back to the ships and locks. In response ships will for example adapt their velocities and locks their cycle scheme.

Several simulation experiments have shown that intelligent waterways with a global controller which uses an optimization algorithm, contribute to the reduction of waiting times at locks. Actually the waiting times are completely eliminated in the proposed experiments while simultaneously the total voyage costs and the emissions are reduced. However, the optimization algorithm induces an increase in the total travel time of the vessels.

It can be concluded that the implementation of the proposed intelligent waterways result in an optimized flow of inland shipping vessels through a lock. In the performed simulations the results of the suggested optimization algorithms were equal, despite of the huge difference in computational speed. However, due to some assumptions, further research is desired. It should focus on the performance of the optimization algorithms when simulation parameters and assumptions are changed.