Summary

This report describes the design and modeling of a simulation of a Rail Service Center. The goal of this simulation is to improve the unloading process and cooperation between the cranes, independent of the number of cranes and/or tracks. This generic simulation model can thus be used for every Rail Service Center.

The simulation simulates the arrival and unloading process of the Rail Service Center, the loading and the distribution of containers inside the Rail Service Center is not simulated. At the time the trains are empty, the trains leave the simulation model.

Elements in this simulation model are: Train Generator, Track, Train, Container and Crane. The Train Generator generates the arrival of trains according to a specific stochastic process. If the track is empty, the train decides to enter the shunting yard, where after the cranes start to unload the containers on the train. This can be a very simple process, a crane driver can for example simply pick the nearest container on the train to unload. The performance of a Rail Service Center is determined by looking at a few parameters, these are:

- Average and maximum waiting time for the trains
- Average and maximum loading time for the trains
- Track and crane occupancy

A Rail Service Center can be improved by improving a few aspects. The most obvious is the improvement of the unloading algorithm of the cranes. Furthermore, trains can choose a free track more intelligent. Finally, if there are trains waiting to be unloaded and a track releases, it could be more efficient to have a look which of the waiting trains is the best train to enter that free track. In total five algorithms are created to improve the terminal performance, these are:

- Smart dividing containers – divide all containers on the shunting yard by amount of estimated unload time
- Smart track allocation – Send a train to the nearest track towards the unloading track
- Smart waiting train to track allocation – Find the most suitable train in the shunting yard queue for the available track
- Smart crane movement – Select the "zigzag" container unloading algorithm
- Smart train emptying – Empty a train when it is nearly empty first, before continuing with the unloading algorithm

These algorithms have to be tested against the simple, basic case on a variety of number of tracks and cranes. To be able to test for all these scenarios, the simulation model can be adjusted by using some input variables, these are:

- Terminal lay-out:
  - Number of rail tracks
  - Number of cranes
- Workflow:

- Number and arrival times of trains and the train container compositions
- Travelling speeds of the crane
- Simultaneous trolley and crane travelling
- Container handling time
- Train berthing time

To give an answer to the research question, it is possible to develop an algorithm which is capable to improve the terminal performance. However, this does not account for all algorithms and certainly not for all train arrival frequency scenarios. It turned out that the performance of the algorithms depends heavily on the arrival frequency of trains. The algorithms have more impact on quite busy Rail Service Centers than in case of nearly empty of very crowded shunting yards.

Furthermore, the travelling of the cranes takes related to the container handling only little time. Improving the pick-up & drop-off process of containers has more impact on the terminal performance than improving the crane algorithm.