

II. Summary

This report contains information about a simulation of the EMO port in Rotterdam. The port handles bulk material. It loads and unloads bulk from ships, trains and trucks and is able to process (wash, sort, mix etc.) the bulk material as well. The simulation written for this report is dedicated to unloading bulk from ships.

The program is written in the computer programming language Delphi and makes use of Tomas, a modeling and simulation tool for Delphi developed by the Delft University of Technology. The program uses several input files for information about the ships the port needs to handle, the crane used to do it, the dock of the port and the water level in the dock. It outputs data to one general output file as well as a dedicated output file based on the performed task.

This report is based on the eight tasks the program is able to fulfill. Several conclusions can be drawn from the data obtained by running these eight tasks:

1. The scheduled crane occupancy should be kept below 95% at all cost, but a safety margin of 5 or 10% is advisable.
2. The port should not increase the depth of the dock that is now less than 23 meters, unless the percentage of VLBC increases drastically (above 25%).
3. Increasing the capacity results in a decrease in average ship waiting time.
4. The average ore capacity at the port is 2000 ton/h per crane. This number is appropriate.
5. The average coal capacity at the port is 1250 ton/h per crane. This is sufficient now, but will not be able to handle growth without an increase in average ship waiting time.
6. The average ship time increases slightly until the dock occupancy reaches 75%. Beyond 75% the graph grows radically.
7. If the capacities of the small cranes would be increase to the current capacity of the large cranes, the average ship waiting time would drop from 124 hours until 56 to 68 hours.
8. It is advisable to keep the annual throughput below 33 Mton. Beyond this number, the average ship waiting time will increase at a faster pace.
9. Adding a fifth crane makes the unloading terminal handle bulk material faster and makes it possible to handle 40 Mton annual with the same easy 33 Mton is handled with 4 cranes.
10. There is no significant difference in average ship waiting time when FIFO (First In First Out) or SSF (Small Ships First) is used. The choice between the unloading methods FIFO or SSF should be based on other characteristics like economics, safety etc.

Further research should be done on the influence of more restrictions on crane. In the real world, cranes cannot pass each other. Also, it is possible to restrict the cranes from reaching the whole length of the dock. Doing this would resemble the real situation at EMO even more. The conclusions mentioned above will not be different, but more situations can be simulated when this is integrated.