# Summary

One of the major parts of operational control of a dry bulk terminal is planning the different assignments which have to be done together at the terminal. In this thesis a proposal is presented to control (especially making plannings) a dry bulk terminal with use of simulation.

EMO has the availability of 4 shipunloaders, 3 bargeloaders, 6 silo's, 1 shiploader, 6 stacker/reclaimers, 1 iron ore trainloader and 1 coal trainloader connected by a network of conveyors. The piles are stacked and reclaimed by stacker/reclaimers. There is possibility to reclaim material by shovel loaders. By use of hoppers the material can be added in the conveying system.

Berth allocation, priorities of ships, tide windows, pile planning, assigning shipunloaders and assigning assignments to sources, destinations and tracks are the basic variables to control a dry terminal. With use of a planning for occupation of sources and destinations, assignment requests from clients can be accepted or not. The operational planning consists of the planning and execution of assignments by assigning tracks (connected conveyors). Stock pile management consists of the planning of piles and making space for new piles.

A system for operational control of a terminal is proposed by use of three models with interaction between each other. With different functions and processes for classes conceptual and PDL models are made for the programs.
The primary program, the dynamical planner, reads-in the assignments and simulates them. An object assignmentplanner is used to plan (if necessary) at regular planning times, by disturbances, by new assignments which are added during the actual planning horizon and by speeded up or delayed assignments. Assignments which are ready to start during the actual planning horizon are communicated to a secondary program. The output of the primary program consists of a report of all planned assignments on the screen, there is also the possibility to show assignments in the network on the screen.

To determine the possible tracks between a source and a destination there is made a program called ProductieGroepen. The network is build up with nodes and transport equipment (conveyors and machines) with a bilateral connection. There is started an object track from a "source" transport equipment. For every node out of the actual transport equipment is the track duplicated and after that stopped. The new tracks are started (for the track out of the assigned node) and do again the duplication process until there is no new transport equipment or the destination is reached. After the iterations the tracks which have reached the destinations are communicated to the primary program.

In the secondary (optimization) program the assignments to be planned are read-in. With use of an algorithm the possible plannings are created for every combination of assignment and track. The possible plannings are simulated and after that the assessment of the possible plannings has to be done. The assessment is done by a bottleneck approach. By use of different filters there is one or more possible plannings which are optimal (with respect to the assesment) for this program. The first

possible planning listed is used. The first filter consists of the choice of the minimal assignment end time. This means terminal performance and indirectly, minimizing the number of changes between conveyors. The second filter consists of minimal waiting times, which means minimization of demurrage costs or maximization of dispatch compensation and is related to unloadship assignments. For other assignments, this means a service oriented performance indicator. The last filter is used to choose the planning with the minimal energy consumption of conveying. That means minimization of operational costs indirectly.

The communication between the three programs is done by text files. The primary program starts the other programs when needed and waits till the execution of that specific programs has finished. Then the primary program resumes the processes.

The system should be able to determine start and end times for assignments and determine the tracks that should be used. This is done by use of times of readiness and priorities of assignments are taken into account.

A boundary condition is that the user should be able to choose between a single or a group of the same sources or destinations. Barges can also be loaded by a ship loader. With hoppers the conveying system can be loaded by shovel loaders. Assignments for the EON energy plant should be transported through the silos and it is not allowed to transport CC-coals or iron ore through the silos. For pellets the choice of quay conveyors are important because of spillage. Therefore in some cases a choice is made for a particular quay conveyor or a warning message is given.

The verification and if possible validation of the programs is done by use of the Tomas Trace function. De processes of the programs match with the PDL models.

From the test results can be concluded that the time for calculation dependis on the number of possible plannings, assignments and tracks. A faster processor saves time, but most of time saving can be obtained by renovating the secondary program. The general conclusion of the test is that the choice for a track for an assignment can be done with the dynamic planner, with respect to minimize the obstruction of the execution of assignments by choice of a certain track.