II Summary

Calculations for berth occupancy and waiting times of vessels is mostly done with the help of queueing theory. Many designers today still use this theory to decide on the length of a to be built quay wall. With the use of queueing theory, Unctad found averages for vessel waiting time in a queue. As a designer, some amount of waiting time is acceptable, but it should be kept small. Queueing theory is a simplification of reality and some assumptions made by Unctad could be made more realistic by creating a computer model that can simulate the arrival and departure of vessels. Research of Unctad showed that the service process could be modeled as an Erlang-2 probability distribution. This research assignment will try to support or overthrow this assumption.

It will first be demonstrated that the created computer model has an outcome that is in line with some simple throughput calculations for terminals and time calculations for arriving and departing vessels. Unctad states that the $E_2/E_2/s$ queueing system is a good representation of the arrival and departure process of container vessels at a terminal. To validate the computer model, the model should be adjusted to meet the same input parameters as a queueing model. Samples are taken from the Erlang-2 interarrival time distribution, as well as from the Erlang-2 service time distribution. After some experiments it will be demonstrated that the computer model has the same output as the $E_2/E_2/s$ queueing system.

A number of experiments is carried out and for every experiment the service time distribution is determined. Via the test statistic the distributions are compared with a number of different theoretic probability distributions. The distributions all show a relatively high peak and the range of service time hours per vessels varies between approximately 0 and approximately 82 hours. The theoretic probability distribution that has the smallest test statistic value is the Erlang-10 or Erlang-11 distribution. The results show that there might be a relation between the quay crane reach and the service time distribution. Some extra experiments support this statement, since all service time distributions are similar in these experiments.

This research assignment overthrows the assumption of an Erlang-2 service time distribution made by Unctad. It is more likely that the service time distribution is Erlang-10 or Erlang-11. However, the results from experimenting with this model should be compared to all theoretic probability distributions available, not the most common ones and the Erlang distribution. A nice way to do this is via a program called Easyfit. It is also recommended use the computer model for finding the waiting time of vessels in the queue. A very important output parameter, since a waiting vessel could cost terminals money.