

## **Abstract**

Materials such as coal or iron ore are transported over the world in bulk carriers. These bulk carriers are unloaded in so called bulk import terminals. A common practice at these terminals is to unload the vessels with grab unloaders. The capacity of these grab unloaders determines the unloading time of the bulk carriers. The grabs on the unloaders are subject to wear, from the abrasive properties of the bulk material, but also from the shocks in the wires during hoisting. Due to this wear, a grab can break during unloading, resulting in delays for the bulk carrier. To obtain practical data on grab handling, the situation at the Europees Massagoed en Overslagbedrijf (EMO) is analysed. EMO has data from four unloaders on four berths, but it is possible to split the terminal in two sections with two unloaders on two berths. A calculation sheet is developed for two unloaders on two berths to calculate the delays per subfunction during unloading and the total delay per vessel. In order to find a better storage solution for the grabs and spare grabs and reduce the delays during unloading, five concepts for grab handling are proposed:

- Randomly store grabs on the quay, without taking spare grabs to the vessel
- Grab storage on the back supports of the unloader
- Shielded grab storage between two berths
- Shielded grab storage at the midships of every berth
- Central grab storage with a grab mover

The grab handling times for these concepts are evaluated using the same calculation sheet as the present situation at EMO. In order to choose the best concept, not only delays but other criteria such as the number of grabs, storage capacity between the supports of the unloader, safe working regulations and cost are weighted as well in a multi criteria analysis. In 2013, the situation at EMO has changed to five unloaders. Now it can occur that three unloaders work on one vessel. Therefore the calculation sheet for the best two concepts is adapted for the third unloader on one vessel. The same multi criteria analysis is performed for the new situation. In both the cases of two and three unloaders on one vessel, the delays due to grab handling during unloading can be reduced. The shielded grab storage at the midships of every berth proves to be the best concept.