AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Design and Production Engineering

Resources planning in Sea Port Terminals

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(Design and Production Engineering)

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Summary of M.Sc. Thesis on

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Maritime transport is the lifeblood of the global economy, moving nearly 90% of global trade volume across oceans and between continents. The sea port is also one of the essential components of the country's economic development. Not long ago, the world tended to develop the transportation process by using containers of specific capacities, which are easy to handle, and can be used to increase the efficiency of the storage space for ships, which were specially designed to transport these containers. It is also possible to use container ports for the temporary storage of containers for the purposes of re-export of goods. Therefore, the design and operation of container ship ports has become a critical objective to achieve the highest possible operational effectiveness of the port's available resources.

Research in this field tended to solve three main problems related to the effectiveness of port operations. The first of these is the loading and unloading berth allocation problem (BAP), the second is the quay crane allocation problem (QCAP) and the third is the quay crane scheduling problem (QCSP). In the meantime, some researchers have been interested in solving these three port problems in an integrated manner. In this context, there is a need to determine the appropriate number of cranes for each vessel according to the length of the vessel, the workload of the vessel, and the number of berth cranes available at the wharf.

Literature review has shown that there is a need for more effort to study the influence of various factors that may influence decisions to use the available port resources effectively.

The aim of this research is to investigate and ascertain the elements that affect the productivity of ports and the degree of mutual influence between them. The research proposes to build a mathematical model to improve the total flow time of many container vessels of different lengths and different workloads, considering the limited availability of quay cranes that can be allocated to each vessel, as well as the maximum number of the total number of quay cranes available in the port. The results that can be obtained from the mathematical model are represented in determining the optimal schedule for docking vessels and the schedule for allocating quay cranes, through the application of linear programming technique. The same study was conducted on the different berth lengths to study the effect of the berth design on the operation efficiency. The study was repeated after generating a random end of vessel service due date for each container vessel in queue. In addition, the study was extended to investigate the effect of the number of vessels (with greater diversity in their lengths) on service and quay cranes schedules.

The interrelationships between the different factors affecting operating efficiency were studied using analysis of variance technique (ANOVA). The results of the study led to the possibility of developing an empirical formula to determine the appropriate total number of quay cranes that can serve a particular seaport considering the berth length, the average length of the vessels, and the average maximum allowable quay cranes that can serve simultaneously each vessel.

The results showed that within the assumed maximum number of berth cranes that can be allocated to each vessel, the use of a larger number of cranes than exceeding the critical number will negatively affect the utilization rate of the cranes. It was also shown that the developed empirical formula can efficiently determine the critical number of quay cranes to be assigned to each vessel with high accuracy without the need to use the linear programming optimization method. This result proves the practical applicability of the proposed empirical model. The results showed that the utilization rate of the berth increases with the increase in the number of quay cranes. It was clear from the experimental results that considering service due dates in optimization, the total flow time was not significantly affected as compared to that with no due dates. This may be true for within the limits of the values that were assumed for the different factors influencing the results of the study.