Proceedings of the 2019 Winter Simulation Conference
N. Mustafee, K.-H.G. Bae, S. Lazarova-Molnar, M. Rabe, C. Szabo, P. Haas, and Y-J. Son, eds.

STUDY ON THE OPERATION EFFICIENCY OF STEEL STOCK YARD USING DES SIMULATION

Jong Hun Woo
Jong Gye Shin
Huiqiang Shen
SuHeon Ju

Department of Naval Architecture
and Ocean Engineering
Seoul National University
1 Gwanak-ro, Gwanak-gu
Seoul, 08826, REPUBLIC OF KOREA

Sang Hun Kim
Jong-Ho Nam

Department of Naval Architecture and Ocean
Systems Engineering
Korea Maritime & Ocean University
727 Taejong-ro, Yeongdo-gu
Busan, 49112, REPUBLIC OF KOREA

ABSTRACT

The steel stock yard for storing the purchased steel plates is the first step of shipbuilding and a space where sorting is performed to supply proper steel pates to the cutting process at the right time. However, due to the nature of shipyard where multiple vessels are constructed simultaneously, there are many steel plates of various types. Hence, it is difficult to supply all steel plates from one steelwork. Therefore, the deviation of the duration of plate procurement increases in the process of supplying steel plates from multiple steelworks, and the changes in production plans resulting from this affects the duration for which the steel plates stay in the stock yard. To address this problem, shipyards are researching on efficient management of steel plates in a limited space. In this study, a steel stock yard simulation model was constructed using discrete event simulation (DES). Before starting actual work with this model, the optimal solution for the input steel plates was searched by analyzing the selection result of the stock yard by the predefined logic for stock, arrangement, and sorting work for the steel plates. Through this process, the steel plate delivery plan can be established in more detail, and a method of efficiently managing steel plates in the steel stock yard is proposed.

1 RESEARCH OBJECTIVES

The main objective of this study is to build a simulation model using the commercial DES software AnyLogic that can help field workers determine the sequence of tasks by allowing them to select steel plates to be moved according to a predefined logic, choose a stock yard to which the steel plates must be moved, and to check the results in advance through simulations before working at the field for steel stocking, rearrangement, and sorting work. In addition, indices are defined and displayed for information related to the crane work status changes that can be obtained through simulation and the simulation results. This study also determines the basis for selecting the most appropriate case for the input data by analyzing costs required for performing the tasks through the Time-Driven Activity-Based Costing (TDABC) analysis and examines how economically a steel stock yard can be operated in terms of company's profit. Finally, based on the simulation results obtained through the most appropriate case, the information about the stored location in the bay where the steel plates are stocked and the number of transfers for each steel plate is additionally provided to the steel plate delivery plan.

2 MODELING AND SIMULATION

A steel stock yard simulation model was constructed based on the defined agent structure and simulation parameters. When user clicks on the Basic Configuration and Detailed Settings texts at top of the screen, the corresponding screen appears. On the Basic Configuration screen, user can choose a method of selecting a stock yard during the steel plate delivery and sorting tasks in the steel stock yard. Furthermore, user can set the priority of tasks among the steel plate delivery, sorting, and release tasks. In addition, the sorting task start date can be defined and the criteria for classifying stock yard and load determination can be set. On the Detail Settings screen, the capacity of the equipment deployed in the steel stock yard and the number of stock areas in the stock yard can be changed so that the simulation users can perform simulations for various situations where the capacity and layout of the steel stock yard are changed.

3 RESULT ANALYSIS OF STEEL STOCK YARD SIMULATION

Simulations were performed for 40 cases in total. For the daily average number of released steel plates, all the steel plates for release were released during the period, and every case showed the same number of released steel plates because the number of steel plates to be released was identical. The daily average number and weight of moved steel plates showed the same trend of change as that of the crane movement distance. Hence, to determine the operation efficiency of the steel stock yard, the crane movement distance index was analyzed in detail. These two indices were checked as indicator for the performance of the steel stock yard in each case. When the applied logic was different and the sorting start date was identical, the average stock quantity of the main stock yard was similar because the number of steel plates moved to the sorting stock yard and the time of movement were the same. In the opposite case, that is, when the applied logic was identical and the sorting start date was different, the number of steel plates moved to the sorting stock yard increased as the sorting work started earlier, which decreased the stock quantity of the main stock yard. Finally, cost analysis was performed for 16 work types in total in the steel stock yard by using the cost equation for CASE25, CASE30, CASE35, and CASE40. Following table outlines the cost analysis results.

Table 1: Simulation result.

steel stock yard	**CASE25(Project number / Project number)**		**CASE30(Block number / Project number)**		**CASE35(Project number / Block number)**		**CASE40(Block number / Block number)**	
	Unit cost	**Number of occurrences**	**Unit cost**	**Number of occurrences**	**Unit cost**	**Number of occurrences**	**Unit cost**	**Number of occurrences**
1 Bay sorting	4,985	939	5,219	939	5,213	948	5,213	948
2 Bay sorting	5,070	1420	5,443	1,420	5,480	1,705	5,480	1,705
3 Bay sorting	5,019	1738	5,171	1,739	5,118	1,784	5,120	1,786
4 Bay sorting	4,037	0	2,650	0	2,650	0	2,650	0
1 Bay release	5,856	466	6,283	466	6,283	466	6,283	466
2 Bay release	6,056	640	6,653	640	6,653	640	6,653	640
3 Bay release	5,907	644	6,377	644	6,377	644	6,377	644
4 Bay release	4,040	0	2,650	0	2,650	0	2,650	0
	Total	**122,501,106**	**Total**	**120,075,037**	**Total**	**126,091,148**	**Total**	**123,986,075**

ACKNOWLEGEMENT

This work was partly supported by National IT Industry Promotion Agency(NIPA) grant funded by the Korea government(MSIP) (S0604-17-1001, Prediction based smart SCM framework for offshore industry and S1106-16-1020, Production strategy and execution simulation technology development for the optimization of offshore plant production cost)