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SIMULATION MODELING METHODS FOR ANALYSIS AND VALIDATION OF MID-TERM PRODUCTION PLAN OPERATIONS IN SHIPYARD

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ABSTRACT

Production plans in the shipbuilding industry are divided into long-term, mid-term, and short-term production plans. The long-term production plan serves as the foundational blueprint, the mid-term production plan is the detailed production roadmap, and the short-term production plan focuses on execution. The mid-term production plan is crucial as it encompasses all shipbuilding processes and acts as the monthly operational plan for production departments. An accurate mid-term production plan is essential for maintaining competitiveness in shipbuilding production management. In this study, we developed a mid-term production plan simulation model that considers constraints such as operational rules, workload capacity, and various task precedence relationships. By using this simulation, companies can save costs and time during schedule validation and improve productivity by developing a more effective mid-term production plan.

1 INTRODUCTION

In the shipbuilding industry, constructing a ship involves numerous components and complex processes, making effective management of these processes critical. The core of competitiveness in shipbuilding production management lies in scheduling and executing accurate production plans tailored to specific conditions. However, production plans often fail to reflect the detailed constraints of actual facilities, leading to low accuracy and frequent revisions. Therefore, a simulation modeling methodology is needed that dynamically incorporates on-site constraints, such as process delays and workload, without disrupting the mid-term production plan data structures. This study proposes a product-centric simulation modeling methodology that considers various constraints and the current conditions of the production site, facilitating pre-analysis of production planning in shipyards. Through the proposed method and framework, mid-term production plans are validated and predicted using simulation models built with manufacturing data.

2 NETWORK CONNECTION AND PROCESSING METHOD BETWEEN MID-TERM TASKS

Based on mid-term production plan information from shipyards, we present a method for processing mid-term production plan data in a simulation model that reflects the production flow of blocks. To achieve this, we developed an algorithm that processes mid-term production plan data both before and during simulation execution. In the pre-simulation stage, the algorithm uses task precedence relationship information from the mid-term production plan to create task group data that reflects the logistics flow. It then generates and stores the information needed to connect precedence relationships between task groups. During the simulation execution stage, the algorithm uses the task and task group information created in the pre-simulation stage to conduct a simulation that accurately reflects the logistics flow.

3 MID-TERM PRODUCTION PLAN INTEGRATED PRODUCTION OPERATION SIMULATION SYSTEM FRAMEWORK

In this study, shipyard production operations were analyzed using an integrated yard simulation model built with manufacturing resource data. A base model was established, reflecting the various production constraints within the shipyard simulation model. To improve simulation consistency, we developed simulation logic that incorporates the shipyard's diverse process constraints, and the model was configured to manage and display log data for the visualization and reporting of results. Additionally, an architecture was developed to enable integration with existing legacy systems, such as block location tracking systems. Figure 1 shows the integration of the mid-term production plan into the framework of the production operation simulation system.

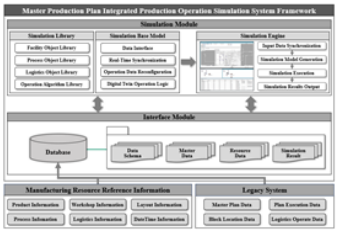

Figure 1: Mid-term production plan integrated in the production operation simulation system framework.

4 MID-TERM PRODUCTION PLAN INTEGRATED PRODUCTION OPERATION SIMULATION MODEL

As shown in Figure 2, The simulation model is linked to the mid-term production plan, which is designed to process based on block information, collecting and outputting process histories for each block during the simulation. The simulation model can be executed based on preprocessed data from the mid-term schedule plan and can output productivity indicators such as workload by shop, block quantity, and block area.

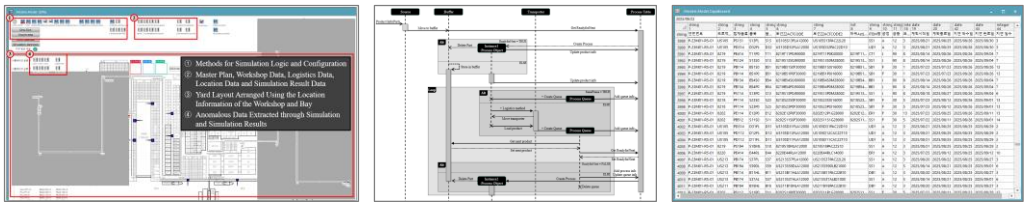

Figure 2: Simulation model (left), simulation process flow diagram (mid), simulation result (right).

5 CONCLUSION

In this study, we developed a simulation model for mid-term production plans that considers constraints such as operational rules and shop capacity, and incorporates various task precedence relationships. The proposed simulation method validates mid-term production plans based on data and production constraints, and is expected to support decision-making related to the planning and modification of mid-term production plans.