Abstract

With systems and processes becoming complex, their seamless functioning—be a factory, a service utility, or a public infrastructure—has become vital to sustain an enterprise's growth and prosperity in the long run. To this end, the research works on modelling and analysis of cargo vessel scheduling in seaports are appraised and reported in the thesis. From the review of existing research works, the problem dimensions, factor combinations, and uncertainties are determined. The critical findings from the modelling approaches are used to propose a research methodology by which the objectives of the research work are accomplished. To proceed with developing a dynamic cargo vessel schedule, a simple representation of the job-shop equivalent of vessel schedule is given. Analysis of the model is performed in exact method and heuristics by incorporating the empirical and real-time data on cargo vessel handling from a riverine tidal port in east India. It is found that while all the three methods are successful in reaching the defined scheduling objective, the heuristic solution provides better result compared to the exact ways. The limitations of the simple scheduling model are further addressed by adding quantity, processing time, and completion time bounds. As the proposed model, despite giving an initial value of turnaround time, is unsuccessful in reaching the optimality, an alternative multiple server Markovian queuing model is proposed and solved by Discrete Event System Simulation (DESS). Ship arrival and service probability distributions, determined from analysis of collected data, are added in the simulation model. The result revealed significant decrease in mean turnaround time. The processes involved in shipping are grouped in terms of their value addition. However, as the simulation output does not consider the effects of tidal variations and time window of operation, a third mathematical model is developed considering the tidal effect, water level constraints, precedence, and time window of operations. The tidal data obtained for the year 2018 is used to forecast the high tide level in the following year. The model is subsequently initialized and solved by relaxing the hard constraints. Also, a few instances of the permutation schedules are also given to envisage the wide variety of feasible sequencing options available.

Keywords: Ship Scheduling, Mixed Integer Linear Programming, Shifting Bottleneck Heuristics, Multiple Server Queue, Discrete Event System Simulation, Tidal Analysis, Permutation Schedules