Proceedings of the International Conference on Industrial Engineering and Operations Management
Pilsen, Czech Republic, July 23-26, 2019

Assessing Due Date Fulfillment for Lumber Manufacturing Production Orders

Francisco P. Vergara
Wood Engineering Department, Faculty of engineering
The University of Bio-Bio
Collao Avenue 1202, Casilla 5-C, Concepción, CHILE
fvergara@ubiobio.cl

Abstract

Lumber production planning can be classified as a general lot sizing and scheduling problem, which has been addressed with MIP formulations and myopic methods. These models allow backlogs, inventory, and sequence dependent set-ups based on due date of orders, but they do not analyze the effect on costs. The research conducted in this field until now focused on fulfillment of demand for lumber in a certain period without questioning the manufacturing cost of this policy. My research determines the opportunity cost of a multi-period LP approach in comparison with order-processing sequences. I conducted a study to determine the cost of scheduling sequences to process production orders. First, I built a multi-period MIP model (PL) where demands must be satisfied in a certain period of the planning horizon, without explicit orders and due dates. A relaxed version of the PL model allowing backlogs without penalties was also built. Second, I added a production sequence to test how sequences to process orders affected their due dates and called this model planning-scheduling (PS). The periods of the formulation were dropped and an "earliness" constraint that forced orders to be processed without violating their due dates was added. Earliest due date (E), longest processing time (L), and shortest processing time (S) heuristics sequences were used to sort orders which were then fed to the DSS. A relaxed version of this PS model allowing overdue orders (i.e., relaxing the earliness constraint) without penalization was also built. The PL model and its relaxed version PL^r were solved with five sizes of demand, and the PS model and its relaxed PS^r version were solved with five sizes of orders. The demand and sum of the orders were equivalent in volume, and order due dates occurred in the corresponding periods. The PL approach was the cheapest, although with a small cost gap in comparison to the PS with an E sequence. However, when relaxing overdue orders, this last approach was as efficient as PL, with lower backlogged volumes (high fulfillment of order due dates). Thus, the PS with an E sequence is proposed as the best approach to plan lumber production orders in sawmilling operations. Although the percentage differences in costs of the planning and scheduling approaches PSA-scenarios were not dramatic, the economic effect of the PS with an E sequence could be significant given the operational scale of this type of facility. Moreover, the PS with an E sequence showed the ability to reduce the backlog ratio close to zero, when the corresponding PL backlog ratio was 14%. I did not apply any penalties for backlogs because of the subjective nature of these costs; however, when shortages occurred the demand was lost or backlogged with substantial costs. Therefore, if I adopt my planning approach using a conservative backlog cost, sawmill which produces 300,000 m^3 or 125,000 mbf per year would reduce backlogged orders by 42 thousand m^3 (i.e., 14% backlog reduction). If the holding lumber cost is 2 US$/$m^3$, annual savings would be $336,000.

Keywords
Lumber, planning, scheduling, backlogs, orders

Biography / Biographies

Vergara Francisco is an Assistant Professor in the Wood Processing Department, Engineering Faculty, and Director of Innovation and Tech. Transfer Office in Vice-rectory of Research and Postgraduate studies at the University of Bio-Bio, Concepcion, Chile. He earned B.S. in Forest Industries Engineering, a Diploma in International Forest Management from Uppsala University, Uppsala, Sweden; a Masters in Industrial Engineering from University of Bio-Bio, Concepcion, Chile, and a PhD in Forestry from the University of British Columbia, Vancouver, Canada. He has worked as production manager for Colcura Forest Industries subsidiary of Shell forest business area in Latin America; and he has worked as a production chief for Sawmills Cholguan subsidiary of Arauco forest Company. He has published journal and conference papers. Dr. Vergara has completed research projects with CORFO (a Chilean government corporation in charge of improving the competitiveness and the productive diversification of the country by encouraging investment, innovation, and entrepreneurship), Sawmills Arauco subsidiary of Arauco forest company. His research interest are: forest products manufacturing and economics, production planning, supply chain management, simulation, optimization, value stream mapping, agile and lean manufacturing with focus on the forest to lumber supply chain.