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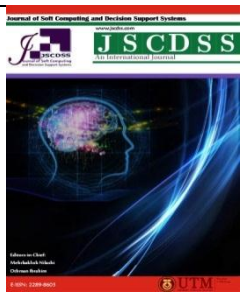

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Trade-off Analysis for Multi-Objective Aggregate Production Planning

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Abstract

Aggregate production planning (APP) determines the best way to meet forecast demand in the intermediate future, often from 3 to 18 months ahead, by adjusting regular and overtime production rates, inventory level, labor levels, subcontracting and backorder rates, and other controllable variables. However, the majority of APP models have cost-related objectives, whereas non-cost objectives are often sought by managers. In this study, authors try to minimize total costs and maximize customer service simultaneously. It is shown there is a trade-off between these objectives. Authors propose a linear model for aggregate production planning problem. Then, the two- phase method solution, which takes both objectives into consideration, is used as an alternative objective. By solving the model, it was found that minimizing one objective results in an average loss of about 20% in the other objective. The two- phase method solution, on the other hand, results in a loss of 8% from the furthest objective and 7% from the closest objective.

Keywords: Aggregate production planning, Customer service, Trade-off, Two-phase method

1. Introduction

Aggregate production planning (APP) determines the best way to meet forecast demand in the intermediate future, often from 3 to 18 months ahead, by adjusting regular and overtime production rates, inventory level, labor levels, subcontracting and backorder rates, and other controllable variables (Mortezaei et al., 2013). APP aims to identify production, inventory and work force levels to meet fluctuating demand requirements over an intermediate-range planning horizon Generally, APP takes either one or mix of several pure strategies in giving a respond to fluctuating market demand: 1- adjusting production rate 2- adjusting workforce or subcontracting 3- maintaining a constant production level with inventory Saad (1990) categorizes all models for solving APP problems into six categories 1- linear programming 2- linear decision rule 3- transportation method 4-management coefficient rule 5- search decision rule 6- simulation. In this section, we review some pervious researches Fung et al. (2003) investigated a fuzzy multiple products APP problem in their research. Only one objective function (minimizing the total cost) is considered in their fuzzy multi-product APP model and he defined the demands and the capacities as triangular fuzzy numbers. The problem is transformed into a crisp parametric programming problem with using the membership functions of the fuzzy parameters. The resultant crisp problem is solved by utilizing parametric programming and the proposed interactive method. They employed threshold level to state the decision maker's satisfaction level with the usage of production capacity which should not be less than threshold level. Techawiboonwong and Yenradee (2003) developed a linear model for multi-product APP that enabled workers to be transferred among production lines. Their model had only one objective function or minimizing total cost. In reality, when a worker performs any task for a long time, they get used to the task. Then, if that worker is transferred to operate a different task, their skill with the new task would likely be lower than that with the old task. This also impacts productivity. A feasible way to evaluate the extent to which productivity falls is to evaluate training cost and cost due to the loss of production. Therefore, they add to their model cost of transferring workers as a cost parameter. They compared two situations: 1) the worker cannot transfer among production lines, and 2) the worker can transfer between lines. The results of APP model showed that the total cost increases about 5% when the workers did not transfer among production lines; however, the goals and model inputs in these APP models were assumed to be crisp. Recently, Jamalnia and Feili (2013), Li et al. (2013), Ning et al. (2013), Mortezaei and Zulkifli (2013, 2014), Mortezaei et al. (2014) and Iris and Cevikcan (2014) studied on aggregate production planning. However, the majority of APP models have cost-related objectives, whereas non-cost objectives are often sought by managers. This paper aims to consider total costs and customer service as performance measures and authors tries to find out trade-off between them.