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Order selection and pricing methods using flexible quantity and fuzzy approach for buyer evaluation

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Abstract

This paper presents the methods for order selection and pricing of manufacturer (supplier) with make-to-order basis when orders exceed production capacity. By quoting the concepts of triangular fuzzy numbers and linguistic variables, a fuzzy approach to evaluating buyers by taking into account both positive and negative criteria is proposed. According to the classified results of buyers, the orders will be produced with priority, declined, or determined by MIP model. The fixed quantity MIP model and flexible quantity MIP model are employed to determine the produced orders along with the production quantity and the reference amount for price reduction. By applying the concept of TOPSIS, the closeness coefficients for satisfaction grades of orders and for ranking values of buyers are used as the adjusting rates in the final pricing MIP model to set segmented price.
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1. Introduction

In recent years, supply chain management and the supplier selection problems have received considerable attention. Chen et al. (2006) concluded that supplier selection problems adhere to a group decision-making under multiple criteria, uncertain and imprecise data, and fuzzy sets theory is adequate to deal with them. They proposed a normalization method involving linear scale transformation to transform the benefit and cost criteria into comparable scales in their fuzzy decision-making approach. The drawback of the method is that the fuzzy ratings must not include zero; otherwise, all normalized fuzzy ratings will yield zero. With respect to buyer and supplier relationships in the supply chain, Shin et al. (2000) studied the supply management orientation and concluded that an improvement in the supply management orientation improves the performance of both suppliers and buyers (a win–win situation for the supply chain). Das and Abdel-Malek (2003) stated that the underlying assumption of a good supply chain is that buyers and suppliers are willing to accommodate the

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uncertainties and variations in each other's business. They introduced supply chain flexibility as the elasticity in the supply contract negotiated between the buyer and supplier. Calosso et al. (2003) presented a negotiation process and three mixed integer programming (MIP) models in a make-to-order (MTO) environment to deal with interfirm negotiation.

Most researches focus on the viewpoint and decision-making of buyers, but Korpela et al. (2002) presented a frame to focus on those of suppliers. They proposed the analytic hierarchy process and MIP for the manufacturer (supplier) to solve production allocation problems that maximize both strategic importance of customers and preferences of customers but minimize customer-related risks. Choi et al. (2004) proposed an order selection agent that employs a job shop scheduling model to deal with the decision problem of selecting a set of optimal orders to maximize profit under limited production capacity. However, the performance of buyers has not been evaluated or taken into account in their method.

With respect to pricing process, Kingsman and Souza (1997) conducted an empirical research and found that most companies use two-phase activity-based costing methods to estimate cost. An initial price is prepared by cost estimation in the first phase and then adjusted with considerations of the company's characteristics, market conditions and economy in the second phase. The final price formula consists of five elements, which include final estimated cost, risk with cost variances, risk with mistakes by the estimators, mark-up on materials and profit margin. In the case of orders which are considered ''very normal''; that is, these orders do not present any significant risk of losses, a pre-specified profit margin for these orders is utilized to set price by some companies. In the accounting literature, some authors, for example, Drury (1992) and Needles et al. (1994) have argued that companies employ a cost-plus method for pricing, where the estimated cost is adjusted according to demand and some market factors. Hinterhuber (2004) proposed a framework using company perspective, customer perspective and competitive perspective to set price. The segmented pricing – by type of customer and distribution channel – is introduced to complement a policy of fixed prices in the research. Shipley and Jobber (2001) suggested the concept of continuous pricing process, that is, the selected elements of the pricing process can be altered by the changes in environment conditions, in marketing strategy and in customer needs.

In this paper, we focus on the viewpoint and decision-making of suppliers. In addition to the production perspective, the customer relationship management (CRM) has also attracted increasing attention from suppliers to analyze information about customer behavior and preference to build close business relationship. Armstrong and Collopy (1996) conducted an empirical research and concluded that companies with a pure competitor-oriented strategy are less profitable and less likely to survive than companies with a strong customer orientation. One of the important facets of CRM is that several studies have shown that not all customers are equally profitable for a company (Storbacka, 2000); and hence, Parvatiyar and Sheth (2001, 2002) pointed out that the company must be selective in tailoring its program and marketing efforts by segmenting and selecting appropriate customers so that a company allocates its resources to those customers it can serve the best in order to create mutual value. According to the customer selectivity idea, we propose a fuzzy approach for evaluating customers (buyers) and use the assessment results to screen orders. By applying the concept of TOPSIS (Hwang and Yoon, 1981), the closeness coefficients of the negative-ideal solution for satisfaction grades of orders and the closeness coefficients of the positive-ideal solution for ranking values of buyers are calculated and used as the adjusting rates in the segmented pricing formula.

This paper is organized as follows. In the next section, we describe the characteristics and considerations of manufacturer for decision-making. In Section 3, we present the framework and methods for evaluating buyers. Section 4 discusses how to select orders and set prices, while an illustrative numerical example is presented in Section 5. The empirical application of the addressed problem is introduced in Section 6. Finally, conclusion is pointed out in Section 7.

2. The characteristics and considerations of manufacturer for decision-making

Possible buyers detect the market demand and then place orders to declare the intention for purchasing the predicted quantity of product. From the standpoint of the manufacturer, the characteristics of the production system include: (i) The product structure belongs to multiple products – low volume type. (ii) It is hard to keep a ready inventory of pre-manufactured or over-manufactured goods, and hence, the supplier's production is a MTO basis. (iii) The demand quantity surpasses the supply quantity, that is, the manufacturer cannot produce