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A fuzzy goal programming approach with priority for channel allocation problem in steel industry

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Abstract

A model is presented to address a steel supplier's channel allocation problem that includes decisions of channel mix and capacity allocation for each distribution channel. The problem has been formulated as a fuzzy mixed integer multiple goal programming problem that includes business competitive advantages such as maximizing net profits, minimizing the rate of end user claims, and minimizing the rate of late lading, and is subject to constraints regarding manufacturing capacity, customer's demand, channel capacity, channel quota flexibility, budget limitations, and so on. Realistic data from Taiwan's largest steel company is implemented for the effectiveness of the model. The proposed model can also be applied to the allocation problem in other industries with preemptive priority and desired achievement level in a fuzzy environment.

Keywords: Channel allocation problem; Fuzzy goal programming; Fuzzy sets; Preemptive priority

1. Introduction

Many firms distribute their products through multiple distribution channels including indirect and direct channels. In an indirect channel, the distribution function is shared by a supplier and one or more of intermediaries. However, in a direct channel, products move from producers to end users without intermediaries. There are various reasons for firms to adopt multiple channel strategy. For example, advances in information and manufacturing technology have encouraged multiple channels. Besides, launching multiple channels can be an effective way of sales expansion to reach customers in different market segments. However, multiple channels may raise many challenges in distribution strategies, and one of them is the allocation of products among multiple channels. An economic assessment model can help firms determine the most appropriate allocation strategy for multiple channels.

In this paper, we considered the largest steel maker in Taiwan selling steel coils through multiple distribution channels to end users. A typical steel maker has a component of the business that is engineered to order, i.e. the specifications of products are defined at the time a customer places an order. Since, these products are highly customized, they are generally shipped directly to the customers by the producer. Most of the steel producers do have some "standard" products also, and these products can be sold through intermediaries or directly to end customers. In general, major "standard" sales, accounted for 15% of the sales, are generated through steel maker directly, while other sales are carried out by intermediaries, accounted for 75% of the sales, such as steel stockholders

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(including mill owned businesses and independents providing full stockholding services) and independents, accounted for only 10% of the sale, who provide simply trader services. Further, in recent years, the steel market in Taiwan is in favor of the seller side due to the shortage of steel supply; therefore, steel makers can have dominant power in determining the allocation of steel products among multiple channels for their own economic benefits after considering past cooperation and future long-term relationship.

Fig. 1 is a schematic graph showing the channel structure between the steel supplier and customers of steel coils. In direct channels, customers can source their products from the steel maker directly via direct sales call, mail order, or on-line channels. While in indirect channels, steel stockholders play a bulk breaking role within the steel supply chains. They order in large quantity from the main producers with long lead time, and then break the bulk and sell to customers in small quantities with short lead times according to the customer's requirements (McAdam & Brown, 2001; Potter, Mason, Naim, & Lalwani, 2004). The other type of indirect channel member is the independent middlemen, such as selling agents, brokers, commission merchants, and manufacturer's sales branches or offices, who actively involved in the negotiator functions of buying and selling while acting on behalf of their clients. They are usually compensated in the form of commission on sales and purchases (Rosenbloom, 2003).

Since, it requires heavy capital investment and time-consuming expansion, steel makers plan the allocation of products among distribution channels at the beginning of the year to make sure the facilities can operate at full capacity, and can also adjust the allocation plan when the demand or supply change accidentally. The allocation of capacity among multiple channels or customers is also common in other industries, such as chemistry industry, gasoline industry, etc., where capacity expansion is costly and time-consuming, and where channel power is producer-oriented due to under production in that industry. For channel members, the allocated capacity is where their sales can be generated from. Therefore, channel members compete for the limited capacity. However, for steel makers, the allocated capacity is where their profits are created, and when market demands exceed their supply, they would

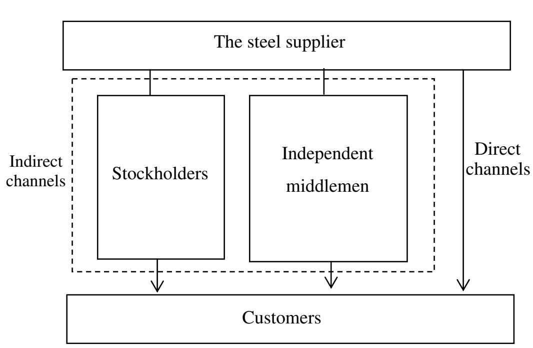

Fig. 1. A schematic representation of the steel distribution channels.

need an allocation plan among channel members to achieve their goals. Usually, profit is just one of the considerations, since other goals like customers' past sales histories and credits, rate of late lading, loyalty, future potential, etc., could also affect decisions on the allocation plan.

In reality, channel allocation problem for steel makers is a complex problem due to some goals of the company should be considered altogether and several constraints must be met, and it can, therefore, be modeled as a multi-objective decision-making problem. To consider more than one objective at the same time, we could expect to have trade-offs among those objectives. One of the methods to tackle multi-objective optimization problem is through fuzzy modeling of goals programming to make use of fuzzy characteristics in defining achievement levels of each goals to satisfy their priorities and achievement levels required in the problem. For the constraints, some of them are related to the producers and some are to the customers. In this paper, we propose a model that enables us to develop an optimal distribution policy among multiple channels that can satisfy the maximization of net profit, minimization of rate of customer claims, and minimization of the rate of late lading, and consider constraints regarding manufacturing capacity, customer's demand, channel capacity, channel quota flexibility, channel rating, budget limitation, etc.

2. Literature review

Rosenbloom (2003) defines market channel strategy as the broad principles by which a firm expects to accomplish its distribution objectives for the target markets. These principles include profits and customer services, company policies, etc. To achieve distribution objectives, a steel supplier should determine the allocation of products and capacity among multiple channels to maximize the profit and customer services while meet company policies and physical constraints. There have been some literatures considering decisions of channel mix and allocation problems in past. Most of the research tended to focus on issues relating to optimizing the manufacturer's allocation of resources among a set of alternative distribution channels. Corstjens and Doyle (1979) presented a geometric programming model to solve the channel selection problem which referred to the manufacturer's selection of channels to serve designated end markets. Rangan (1987) constructed a mathematical model to optimize profits over several channel alternatives. The model considered a number of basic distribution tasks and specified the optimum channel structure in terms of length, intensity, and levels of support for channel members. Moorthy (1988) developed a mathematical model to decide channel structure with respect to using intermediaries versus developing own channel. Rangan and Jaikumar (1991) constructed an optimal buying arrangement of intermediaries to minimize customer's procurement costs and maximize manufacturer's profits simultaneously.