Int. J. Production Economics ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Behavioral analysis and adaptation of a negotiation based, quantitative planning approach for hybrid organizations

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ARTICLE INFO

Article history:
Received 1 October 2012
Accepted 3 January 2014

Keywords:
Pull-to-center effect
Risk-averse behavior
Multi-location newsvendor model
Contracting
Hybrid organization
Assembly chain
Multi-echelon chain

ABSTRACT

During the last decades organizational flexibility of enterprises has increased to suit the requirements of dynamic and complex markets. The emergence of hybrid organizations as combinations of hierarchical and heterarchical elements comes along with this development. Hybrid organizations consist of centralized and decentralized units which interact with each other. A popular example is the franchising organization of a retailer, where many franchisees act as members of the organization and entrepreneurs at once. Despite the large amount of papers discussing hybrid organizations, our hybrid planning approach in Dobhan and Oberlaender (2013) for a multi-location newsvendor situation is one of only a few approaches which fit hybrid organizations. The hybrid approach results in an optimal production quantity if the decision makers behave risk-neutrally and rationally. However, empirical studies reveal systematic deviations of decision maker's behavior from risk-neutrality and rationality. In this paper, we therefore analyze the results of our hybrid planning approach for empirically observed decision maker's behavior.

1. Introduction

Increasing product complexity and dynamic markets, as well as geographically dispersed customers and factories, require flexible decentralized organizations. Even though such decentralized organizations reduce the headquarters' influence, the alignment of decentralized sites to global company goals is necessary for efficiency improvements. Therefore, a central instance (headquarters or central planning department) has to determine the basic conditions of decentralized planning processes. The coordination of (quasi-) autonomous decentralized sites is based on negotiations considering these conditions. Even though a few planning approaches have been presented (Kouvelis and Gutierrez, 1997) for this situation, those models have not yet been analyzed for the case where decision makers do not act according to the relevant assumptions, such as risk-neutral rational behavior. The results of some laboratory experiments reveal deviations between model assumptions and human behavior for some models (Schweitzer and Cachon, 2000). The deviations might be caused by incomplete information or personal characteristics of the negotiators, such as risk preferences. The experimental results show that decision makers prefer risk-averse decisions concerning gains and risk-seeking decisions concerning losses (Holt and Laury, 2002, 2004; Payne et al., 1980). Furthermore it has been proved for newsvendor situations that decision makers order a quantity between the mean demand and the theoretically optimal quantity (pull-to-center effect; Benzion et al., 2008; Bolton and Katok, 2008; Rudi and Drake, 2008). Both risk aversion and pull-to-center effect have to be considered for the development and sensitivity analysis of mathematical newsvendor models.

Therefore, the aim of this paper is to investigate a hybrid planning approach in multi-location newsvendor situations (Dobhan and Oberlaender, 2013) with special focus on behavioral aspects. The adaptation is based on a detailed sensitivity analysis of the hybrid planning approach considering the empirically observed behavior of decision makers.

We therefore

- introduce an adaptation of the hybrid approach for risk-averse behavior,
- examine how the planners' behavior, which differs from general model assumptions such as risk-neutrality and rationality, influences the planning results, and
- analyze the results of the hybrid approach for two different behavioral patterns.

After a brief literature review about multi-location newsvendor models, risk attitudes of decision makers and the pull-to-center effect, we introduce the basic hybrid risk-neutral newsvendor

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http://dx.doi.org/10.1016/j.ijpe.2014.01.003

model of Dobhan and Oberlaender (2013). Thereafter, we present a risk-averse adaptation of the basic model and analyze the influence of risk-averse behavior and the pull-to-center effect on the planning results.

2. Literature review

Multi-location networks can be categorized by their interaction type: according to Spengler's definition, vertical interaction addresses the interaction between production sites on different levels of the value chain, whereas horizontal interaction refers to different sites on one level of the value chain (Spengler, 1950; Durham, 2000, 207; Lazzarini et al., 2001, pp. 7–8).

Vertical interaction is mainly considered in multi-echelon models. These models refer to networks with different levels of the value chain. Clark and Scarf (1960) introduce multi-echelon models for situations with a fully-informed central instance, while Federgruen and Zipkin (1984) analyze these models for supply chains within organizations. The multi-echelon approaches of Gerchak and Zhang (1992), Eynan and Rosenblatt (1995), and Moon and Choi (1997) are developed for multi-echelon networks consisting of more than one production site within an organization. In contrast to these models, Lee and Whang (1999) eliminate the central instance in their multi-echelon approach and discuss decentralized coordination schemes with special focus on inventories and stock-outs. Neither of these suits the requirements of hybrid organizations. For those organizations we refer to our approach in Dobhan and Oberlaender (2013). This hybrid approach considers the influence of a centralized instance on a mainly decentralized negotiation based planning process in a multi-echelon supply chain.

Horizontal interaction occurs, for example, in assembly chains where the last value stage resembles an assembly site. The parts for the assembly sites are delivered by more than one supply site (Jiang and Wang, 2010). Centralized order policies for this supply chain structure are introduced by Schmidt and Nahmias (1985) and Gurnani et al. (2000). Gerchak and Wang (2004), Zhang (2006), and Jiang and Wang (2010) present decentralized order policies for assembly chains. A hybrid approach consisting of decentralized negotiations and central interventions for a newsvendor order policy was developed by Dobhan and Oberlaender (2013). Another supply chain structure with vertical interaction constitutes a multi-retailer supply chain with more than one retailer and one supply site (e.g. Eppen, 1979, Kouvelis and Gutierrez (1997), Khouja (1999), Rudi et al. (2001), Hartman and Dror, 2005; Agrawal and Smith, 2009). The only hybrid approach for multi-retailer supply chains was developed by Kouvelis and Gutierrez (1997). As we focus our paper on hybrid approaches and our hybrid approach refers to two different supply chain structures, we do not consider the approach of Kouvelis and Gutierrez (1997) for multi-retailer networks.

The literature review about the supply chain structure and the delegation of planning in multi-location newsvendor models reveals that research has focused on decentralized and centralized approaches so far. Hybrid organizations with centralized and decentralized elements have been obviously neglected (Egelhoff and Frese, 2009). To close this research gap we examine the hybrid approach of Dobhan and Oberlaender (2013), which considers two supply chain structures compared to the one of Kouvelis and Gutierrez (1997).

All supply chain models we referred to are developed for theoretic decision makers which behave in perfect accordance with the assumptions of theoretic planning approaches. However, empirical studies show that the perfect decision maker does not exist in reality. Especially two behavioral deviations from perfect behavior have been empirically identified for newsvendor decisions: deviations resulting from the individual risk attitude and those caused by the pull-to-center effect.

Harrison et al. (2009) show in their lottery experiment that the risk attitude of purchasers is essential for purchasing decisions. The experiment was conducted with 52 purchasing managers from Germany, Austria and Switzerland. If lottery-payoffs fall below a focal point, purchasers behavior is risk-averse; above this point the managers behavior is risk-seeking. Payne et al. (1980) define the border between losses and gains as this reference point. This finding has been confirmed by the experimental results of Corbett and Fransoo (2007). Holt and Laury (2002, 2004), Kachelmeier and Shebata (1992) and Smith and Walker (1993) have found that risk aversion increases along the experimental payment. They have further detected risk aversion even in low-payment environments.

All these findings indicate the significant influence of decision makers' risk attitude on the order and purchasing policies as well as on economic decision in general. It has become obvious that the assumption of risk-neutrality, which many theoretic models rely on, is not valid for many decisions in practice.

In addition to the risk attitude, the pull-to-center effect appears in newsvendor situations. Pull-to-center effect means that purchasers order a quantity between the mean of demand and the optimal order quantity. This effect was first identified in the laboratory experiment of Schweitzer and Cachon (2000). Benzion et al. (2008), Bolton and Katok (2008), and Rudi and Drake (2008) confirmed the results of Schweitzer and Cachon (2000). Bolton et al. (2010) compared in their laboratory experiment the behavior of students with the behavior of professionals. They found the pull-to-center effect in both groups. Gavirneni and Isen (2010) and Ho et al. (2010) identified the following reasons for the pull-to-center effect:

- the sequence of identification of the overage and the underage risk,
- a lack of information processing,
- different valuations of the overage and the underage risks,
- learning effects, and
- individual decision processes.

Schultz et al. (2007) examine the risk attitude in newsvendor situations. However, they could not confirm that decision makers behavior is risk-averse for gains and risk-seeking for losses. Instead of the risk attitude, the researchers identified the pull-to-center effect.

To sum up, we can make the following conclusions:

- many newsvendor multi-location supply chain models for decentralized and centralized organizations have been presented;
- nearly all of them are developed for risk-neutral decision makers;
- experimental studies show that professionals, and students do not behave risk-neutrally and rationally; instead, the pull-to-center effect as well as risk-averse and risk-seeking behavior have occured.

These findings reveal the lack of research regarding planning approaches for hybrid organizations consisting of centralized and decentralized elements. Furthermore, the influence of empirically identified behavior of the decision makers (risk attitude, pull-to-center effect) on those models should be taken into consideration. Accordingly, the following paragraph introduces the basic newsvendor model and the hybrid planning approach of Dobhan and Oberlaender (2013). Moreover, we adapt and analyze this model for risk-averse behavior and examine the influence of the pull-to-center effect on the model.

Please cite this article as: Oberlaender, M., Dobhan, A., Behavioral analysis and adaptation of a negotiation based, quantitative planning approach for hybrid organizations. International Journal of Production Economics (2014), http://dx.doi.org/10.1016/j.ijpe.2014.01.003