Chapter 7
Coordination and Cooperation in Green Industry 4.0 Manufacturer–Retailer Supply Chains

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ABSTRACT

Worsening environmental conditions make it increasingly important to produce eco-friendly products. Consumers are aware of this, so they are increasing demand for green products. This study considers a two-level supply chain, comprising just one manufacturer and one retailer, applying Industry 4.0 technologies, and supplying a market that prioritizes green products. Each lot of the manufacturer's single product is shipped to the retailer in several batches of unequal sizes. The batch sizes are determined by an arithmetic progression. The manufacturer's Industry 4.0 investment level influences their cost and greenness level. Demand for the product is influenced not only by the retail price, but also by the level of investment in Industry 4.0 and consequently the product's greenness. The authors construct both a non-coordinated decentralized model and a coordinated model under a cost sharing contract, as well as a centralized model. The analysis illustrates that the supply chain's sustainability in both economic and environmental sustainability terms is increased by coordination.

1. INTRODUCTION

Historically, organizations' focus has been on effective decision-making in a single facility. In such approaches, the organization's various functions - assembly, storage, distribution, etc. - are usually split up according to function and location, with large inventories serving as buffers. This allows complex decisions to be simplified by treating each component independently. On the other hand, the consequences of ignoring dependencies between component, can be costly, and the globalization of markets makes this increasingly apparent. Consequently, a general movement is taking place in which decision-making processes which were previously decoupled are becoming more coordinated, and firms are progressively

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integrating the way they design and control their component parts so as to supply their customers with goods at low cost and services at high levels (Thomas and Griffin, 1996).

In supply chain management, various approaches and practices enable effective integration of suppliers and manufacturers with distributors and customers. In this way, individual firms and the complete supply chain can improve their long-term performance, as they form a cohesive whole (Chopra and Meindl, 2007; Lenny Koh et al., 2007). This integrated approach to network-wide inventory palling and control is known as supply chain inventory management. It involves the co-operation of organizations throughout the network, from the originator to the end user. For companies to be successful, it is vital that the transfer of materials between companies to ultimately to the customer should be effectively managed. From the perspective of transferring physical goods, supply chain integration enables competition based on speed and flexibility. Essential inventory levels can simultaneously be held in the chain, but moving between points in the chain, rather than being held stationary (Power, 2005). Many researchers, such as Goyal (1977), Banerjee (1986), Goyal (1988), Hill (1999), Braglia and Zavanella (2003), Ben-Daya et al. (2008), Glock (2012), Wangsa and Wee (2018), Taghipour et al. (2020), Çömez-Dolgan et al. (2021), and Ambroszkiewicz and Bylka (2023) have considered this field to be key to supply chain theory.

A significant amount of research has been published on cooperative inventory modeling, based on equal distribution of decision-making between the key supply chain participants, i.e., vendor and buyer. However, in current market studies, increasing attention is being paid to an approach allowing the two players to have different levels of power. This kind of model is solved through the Stackelberg game strategy, employing a leader-follower policy. In this approach, one decision-maker takes the leading position and is referred to as the leader; this player takes the first decision, which then sets constraints for the follower, whose decisions then become constraints in turn. Intense competition in the business world makes coordination among supply chain members essential for survival. Numerous works by various researchers (Ghosh and Shah, 2015; Ren et al., 2016; Bai et al., 2017; Gao et al., 2018; Hou et al., 2022) have sought appropriate schemes for coordinating supply chain participants for the maximum possible profit. Zhou and Zhou (2013) devised a model assuming vendor-managed inventory and the Stackelberg approach. Li and Liu (2015) outlined three different coordination schemes, namely cost-sharing contract, wholesale-price contract and two-part-tariff contract as part of a two-echelon supply chain model. Huang et al. (2018) obtained pricing and inventory decisions for deteriorating products under both decentralized and centralized supply chains. In addition, they proposed a revenue sharing and cooperative investment contract to coordinate the supply chain. Tliche et al. (2020) examined a two-level supply chain with a single manufacturer and single retailer, in which a downstream demand inference approach is employed to coordinate the supply chain. Hou et al. (2022) prepared a comparative analysis of wholesale-price and revenue-sharing contracts in their supply chain model. Other studies include those by Taghipour and Frayret (2010), Taghipour (2014), Tliche et al. (2019), and Vosooghidizaji et al. (2022).

Environmental problems are a current concern because rapidly depleting resources, pollution, climate change and loss of biological diversity are disturbing the earth's ecological balance. Constant worsening of these ecological problems is leading governments, companies, communities and individuals to take precautionary measures on environmental concerns (Walker et al., 2008; Yildiz Çankaya and Sezen, 2019). This makes green supply chain management essential to balance environmental issues and economic performance. The sustainable development processes involved in green supply chain management include green product design and green packaging, while sustainability must also be built into manufacturing processes and delivery, as well as remanufacturing and waste management, and integrated into the supply chain. Globally, various companies have taken on eco-friendly business strategies to reduce

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Hamid Ech-Cheikh, Saâd Lissane Elhaq, Ahmed Rachidand Abdessamad Douraid (2014). *International Journal of Applied Logistics (pp. 12-31).*
www.irma-international.org/article/simulating-demand-uncertainty-and-inventory-control-variability-of-multi-echelon-distribution-supply-chain/121750