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Vendor managed inventory system considering deteriorating items and probabilistic demand for a three-layer supply chain

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Abstract

This paper proposes a Vendor Managed Inventory model for a three-layer supply chain comprised of multiple suppliers, manufacturers, and retailers. During the production and storage of products, rates of defective and deteriorated products are generated, respectively. The imperfect quality and deteriorating items are removed from the lot size. The decision variables include the replenishment cycles and production rates of finished products, order times, and raw materials production rates. It is assumed that deteriorating rates are constant, and the demand rates of retailers are probabilistic. A joint optimization model is developed to maximize the benefit function of the supply chain. Cost of order, deterioration, holding, screening, production, disposal, fixed, labor, purchasing, and others. A collaborative approach is considered among the chain members where the manufacturers lead the inventory policies to avoid risks associated with deterioration items. Moreover, the Taylor series expansion approximates the exponential terms, and a solution procedure is proposed to find the optimal solutions. A case study of the Dairy Industry for highly perishable products is provided to apply the VMI model and perform a sensitivity analysis. This collaboration scheme is developed according to confidentiality policies to share information related to sales forecast, operational cost, storage strategies, quality conditions, and increased product rotation to reduce deterioration. The results show greater participation of the retailers and manufacturers in the benefits of the chain, which is consistent with the VMI policy. Finally, the conclusion, managerial implications, and future research are presented. © 2023 Elsevier Ltd

Index Keywords

Deterioration, Inventory control, Sales, Sensitivity analysis; Defective products, Deteriorating items, Inventory modeling, Probabilistic demand, Probabilistics, Product-rate, Production rates, Three-layer, Vendor managed Inventory, Vendor-Managed Inventory systems; Supply chains

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