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Consignment Inventory Model with Variable

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Abstract

This paper describes an optimal methodology for consignment inventory based supply chain with variable controllable lead times comprising a two-level supply chain involving one vendor and multi buyers. It evaluates joint total expected cost of vendor and buyer, simultaneously optimize quantitative decision variables and illustrates the significance of production to demand ratio. Numerical examples are presented to illustrate the benefit of the proposed model and the effects of changes on the cost and parameters are studied.

Keywords: consignment inventory; supply chain; joint total expected cost; controallable lead time; crashing cost; production to demand ratio.

1. Introduction

In today's globalization, liberalization, the big challenge to enterprises is to meet the customer needs in the way of service and acceptable costs. To fulfil, entrepreneurs are looking to do business for ways to optimize the network by means of customer mode integration and cooperation of network business models. The new demand pointed towards manufacturing, which in turn pointed towards their suppliers and this formed a chain reaction. Eventually in this aspect inventory is one of the most widely discussed area to improve efficiency. In this environment, Supply Chain (SC) has become an effective business tool to reduce echelon inventory cost. Supply chain is the process of planning, implementing, and controlling the activities as efficiently as possible. From the manufacturing perspective, supply chain spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption. Along the supply chain echelons, inventory plays a key role. Since the inventories can cost approximately between 8 to 20 percentage of product value, hence an effective controlling of inventory is critical and most essential. Houlihan [1] is credited for coining the term Supply Chain

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(SC) with insight concepts and a strong case for viewing it as a strategy for global business decisions. Many definitions of SC have been mentioned in the literature and in practice, although the underlying philosophy is the same. Simchi-Levi et al. [2] defined Supply Chain is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouse and stores, so that merchandise is produced and distributed at the right quantities, to the right location and at the right time in order to minimize system wise cost, while satisfying service level requirements. Nevertheless, most quantitative analysis on supply chain issues is dominated by the framework of multi-echelon serial systems or distribution systems where a relationship between a single vendor and multi buyers is considered.

In supply chain inventory control strategy one of the effective industrial approach that is quickly gaining is Consignment Inventory (CI). The most radical application of CI approach leads to suppression of vendor inventory, as this party will use the buyer warehouse to stock his finished products. Some of the terms are incorporated into CI inventory programs in which payment for supplier inventory is not released until goods have been sold at the customer location. The author has been worked on this issue by providing quantitative studies and showing approaches to enabling optimized solutions to manage inventories using consignment stock policies. Consignment inventory with single vendor – multi buyer model is viewed as a classification of divergent SC with end to multi ends case. The fundamentals of CI is explained in Braglia and Zavanella [3], Valentini and Zavanella [4], Simone and GrubbstrÖm [5], Srinivas and Rao [6-9].

This paper is structured in four sections: section II describes the Consignment inventory strategy with controllable lead time, section III illustrative examples, IV conclusions.

2. Consignment invenoty with controllable lead time

Consignment inventory strategy has been classified into four models such as; Basic Consignment Inventory model, CI with delay deliveries, CI with information sharing and with delay deliveries, and CI with controllable lead time. In this paper the last model ie., consignment inventory with controllable lead time (CI-LT) model is discussed and the significance of production to demand ratio is also discussed. In this model, the buyer will negotiate with vendor closely to reduce lead time as much as possible down to a point where it is acceptable to the vendor with his stable production and delivery schedule. The inventory is reviewed continuously and shortages are allowed with fully backordered. It should be noted that the delivery lead time is null, however the batch is to be produced, so that there exists a system lead time other than zero. By adding an additional cost, the lead time can be controlled. Thus, the lead time is reduced one at a time starting from first independent component because it having minimum unit crashing cost per unit time, and then the second independent component, and so on. When lead time is reduced, its corresponding handling cost for that time is also reduced, but the crashing cost is added to total cost of buyer. The length of lead time which ensures the order transit arrival even though lead time is crashed and shortages if any are permitted. Since lead time is a decision variable in this model, the extra costs incurred by the vendor will be fully transferred to the buyer if shortened lead time is requested can be viewed as an investment.

Nomenclature

h_v	vendor stock holding cost/unit/unit time
h_b	buyer stock holding cost/unit/unit time
A_v	batch set-up cost (vendor)
A_b	order emission cost (buyer)
p	vendor production rate (continuous)
D	demand rate units/unit time seen by the buyer (continuous)
T_C	average total costs of the system / time
σ	standard deviation of demand / unit time
π	unit back order cost for the buyer
Li	length of the lead-time for the buyer
C_L	lead-time crashing cost per cycle