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A simple three level supply chain with defective items

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Abstract

This paper investigates the coordination of a simple three level supply chain. Each level consists of a single player and the vendor manufactures a single product ordered by the buyer. This single product may be made of a number of parts from the supplier. The players in the upstream are believed to be providing some defective items for which they are penalized once their percentage of defectives goes beyond a set value. A mathematical model is developed for this scenario and a solution procedure is outlined. Numerical examples are presented to compare the results of the model with and without a penalty for the defective items.

Key words: Defective items; Supply chain; Coordination; Penalty

1 Introduction

A supply chain is a network of facilities that perform the functions of procurement of materials, transformation of these materials into intermediate and finished products and distribution of these finished products [3]. Economic order quantity model has been the corner stone in the arena of research in supply chain management. This model can be summarized as determining an order quantity that makes a balance or trade-off between the ordering costs and the holding costs. Regardless of such a wide acceptance, this basic model has several weaknesses. One of the idealistic assumptions in this model is that all the items received from the suppliers are of a perfect quality. This assumption initiated a wide spectrum of research for many in the industry and academics.

[9] derived an optimal production cycle for the systems producing defective items and showed it to be shorter than that of the classical EMQ model. They also considered the case where the deterioration process is dynamic in its nature, i.e., the proportion of defective items is not constant. [8] described a system that begins each production run in control and as each unit is produced, the system tends to go out of control with a fixed probability. Once the system goes out of control, all subsequent units are defective. He used this model to study the optimal setup-investment in relation to reducing the probability of the process going out of control. His work has been extended by many researchers to deal with modelling the quality improvement. For example, [5] reformulated their model to adjust the process within a production cycle to restore it to an ''in-control'' state.

Recently, the model of [10] has been receiving considerable attention. They assumed that: (i) Each EOQ lot contains a certain percentage of defective items. This percentage is a continuous random variable with known probability density function; (ii) a 100% percent inspection of the lot is conducted; (iii) demand occurs parallel

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