Effects of imperfect products on lot sizing with work in process inventory

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ABSTRACT

The economic production quantity (EPQ) is one of the most widely known inventory control models that can be regarded as the generalized form of the Economic Order Quantity. However, the model is built on an unrealistic assumption that all the produced items need to be of perfect quality. Also, the introduction of work in process, WIP, as part of the inventory has been of lesser concern in developing inventory models. This paper attempts to develop the economic production quantity considering work in process inventory and manufacturing imperfect products that may be either reworkable or non-reworkable. The non-reworkable imperfect products are sold at a reduced price. This paper introduces a new model for this problem.

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1. Introduction

The main focus of inventory control consists in optimizing order quantity or lot-sizing considering capacities and limitations in an attempt either to minimize total costs associated with the inventory control system including ordering costs and holding costs or to maximize the benefits associated with the system. The EOQ model has been widely employed along these lines in inventory control systems to determine order quantity or purchase quantity. Introducing the assumption that production takes place at a constant rate, the model has been extended to Economic Production Quantity (EPQ), which has found applications in lot-sizing for manufacturing systems. One of the impractical assumptions of the EOQ and EPQ models is that all of units are of perfect quality. In practice, most manufacturing processes are not defect free and result in items that require rework [1]. Gopalan and Kannan [2] wrote: "All over the world, industries are concentrating in making quality an inherent in their products. In spite of these efforts, rework is becoming an unavoidable factor in many production systems. For example, glass manufacturing, food processing, etc.".

Among the earliest models that link the EOQ/EPQ model and product quality are those of Porteus [3] and Rosenblatt and Lee [4]. Porteus [3] studied the relationship between process quality improvement and set-up cost reduction. He showed that annual costs could be reduced when investments were simultaneously made in both process quality improvement and set-up cost reduction. Rosenblatt and Lee [4] investigated the effect of imperfect products on the EPQ model and concluded that introducing the effect of imperfect items in the EOQ model would reduce the lot size. In their work in the following year, they introduced inspection into the model based on the assumption that manufactured products might deviate from quality limits (Lee and Rosenblatt [5]). Schwaller [6] addressed the economic batch quantity problem when in detecting a given portion of defective items both fixed and variable costs are considered. Salameh and Jaber [7] developed an EOQ model based on the assumption that some of items in the arriving batch may not be of the required quality. However, they made an error in their final formulation later corrected by Cardenas-Barron [8]. In their paper, Salameh and Jaber [7] did not declare what point in the cycle would be appropriate for selling the imperfect products. Papachristos and Konstantaras [9]

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