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An economic production quantity model for deteriorating items with multiple production setups and rework

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ABSTRACT

Rework is one of the main issues in reverse logistic and green supply chain, since it can reduce production cost and environmental problem. Many researchers focus on developing rework model, but few of them developed model for deteriorating items. In this paper, we develop an economic production quantity (EPQ) model for deteriorating items with rework. In one cycle, production facility can produce items in m production setups and one rework setup, $(m, 1)$ policy. An example and sensitivity analysis is shown to illustrate the model. The results show that the deteriorating rate affects the optimal cost per unit time, but the effect is not significant. The parameters that significantly affect the optimal total cost per unit time are the serviceable holding cost, the production setup cost and the demand rate.

1. Introduction

One competitive advantage in global competition market is producing high quality products. In order to produce high quality products, defective products eliminated through 100% screening. For an economic reason and environmental concerns, defective products are reworked to become serviceable items. Rework process is also one important issue in reverse logistics where used products are reworked to reduce waste and environment problems.

The earliest research that focused on rework and remanufacturing process was done by Schrady (1967). Since then, researches on rework have attracted many researchers. Khouja (2000) considered direct rework for economic lot sizing and delivery scheduling problem (ELDSP). Koh et al. (2002) developed production inventory models where supplier can fill the demand in two alternatives: either orders new products externally or recovers defective products through rework. Jamal et al. (2004) evaluated two rework policies. In the first policy, defective items are reworked in the same cycle; and in the second policy, rework is completed after N cycles. Cárdenas-Barrón (2009a) extended the model of Jamal et al. (2004) by developing an EPQ model for single product, imperfect quality, the same cycle rework and planned backorders. Chiu et al. (2004) developed an imperfect rework process EPQ model with repairable and scrap items. A model for two-stage manufacturing system with production and rework processes was developed by Buscher and Lindner (2007). Chiu et al. (2007a) developed an EPQ model with repairable defective items, scrap and stochastic machine breakdown. An EPQ model with rework process subject to backlogging and a service level constraint was developed by Chiu et al. (2007b) and Chiu (2007). Yoo et al., (2009) developed an EPQ model with imperfect production quality, imperfect inspection and rework. Similar research has been conducted by Jaber et al. (2009). They developed inventory models using the concept of entropy cost for perfect and imperfect quality items. Taleizadeh et al. (2010) developed production quantity model by considering random defective items, repair failure and service level constraints. Later, Taleizadeh et al. (2011) studied production inventory models of two joint systems with and without rework. Khan et al. (2011) review some research of EOQ model which incorporate imperfect items. Chung and Wee (2011) considered short life-cycle deteriorating product remanufacturing in a green supply chain inventory control system. Yassine et al. (2012) analyzed shipment of imperfect quality items during a single production runs and over multiple production runs. Wee and Widyadana in press developed a single-vendor single-buyer inventory model with discrete delivery order, random machine unavailability and lost sales.

Some researches on rework also focus on production policy to minimize production and inventory costs. Dobos and Richter (2004) developed a production and recycling inventory model with n number of recycling lots and m number of production lots. Teunter (2004) developed EPQ models with rework in two

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