UNIVERSITI PUTRA MALAYSIA

ECONOMIC PRODUCTION QUANTITY MODEL BASED ON EXTENDED COST PARAMETERS FOR IMPERFECT PROCESS AND DEFECTIVE ITEMS

MOHAMMAD REZA SHAHRAKI

ECONOMIC PRODUCTION QUANTITY MODEL BASED ON EXTENDED COST PARAMETERS FOR IMPERFECT PROCESS AND DEFECTIVE ITEMS

By

MOHAMMAD REZA SHAHRAKI

Thesis submitted to the School of Graduate Studies, Universiti Putra Malaysia, In Fulfillment of the Requirements for the Degree of Doctor of Philosophy

August 2011

Abstract of thesis presented to the senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

ECONOMIC PRODUCTION QUANTITY MODEL BASED ON EXTENDED COST PARAMETERS FOR IMPERFECT PROCESS AND DEFECTIVE ITEMS

By

MOHAMMAD REZA SHAHRAKI

August 2011

Chairman : Prof. Napsiah Ismail, PhD

Faculty : Engineering

The inventory includes the elements to construct the products that finally will appear as completed goods. The main purpose for the inventory management is effectively utilizing inventories in the manufacturing system to meet customer requirements and bring about the minimum total cost. The classic Economic Production Quantity (EPQ) model is a mathematical model, which determines the lot sizing in a production process so that minimizes the total inventory holding cost and set up cost. The classic EPQ model is assumed that the product quality is always perfect; therefore, the quality cost is not considered as an issue to influence the production lot size.

This research aims to extend the existing body of knowledge on the imperfect-quality inventory problem by developing a new inventory model that relaxes some of the previous common assumptions of the EPQ models. The main objective is to minimize the total cost of inventory and quality in a manufacturing system with a

single product, and a batch production process. The proposed EPQ model identifies the costs that exist because of poor quality and their effects on the optimal lot size and total cost. The sensitivity analysis is employed to show changes in the optimal production lot size and total cost from variations in the various parameters of the proposed EPQ model. The statistical hypothesis tests demonstrated that the total cost of the proposed EPQ model significantly less than previous EPQ models. The results indicated that the production rate, demand rate, holding cost of returned items, scrap rate, defective rate, warranty cost, lost sale cost, lost sale cost, and holding cost of scrap items have extensive effect on the total cost of manufacturing system.

Abstrak tesis dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

EKONOMI PRODUKSI KUANTITI MODEL BERDASARKAN KOS KUALITI PROSES TAK SEMPURNA DAN ITEM CACAT

Oleh

MOHAMMAD REZA SHAHRAKI

Ogos 2011

Pengerusi : Prof. Napsiah bt. Ismail, PhD

Fakulti : Kejuruteran

Inventori merangkumi elemen-elemen untuk membina produk yang akhirnya akan menjadi barangan lengkap. Tujuan utama pengurusan inventori ialah untuk menggunakan inventori secara efektif dalam sistem pembuatan demi memenuhi tuntutan pelanggan dengan jumlah kos yang minimum. Model klasik Kuantiti Pengeluaran Ekonomi atau *Economic Production Quantity* (EPQ) adalah sebuah model matematik yang menentukan pensaizan lot dalam proses pengeluaran agar dapat meminimumkan jumlah kos pegangan inventori dan kos penubuhan. Model EPQ klasik ini mengandaikan bahawa kualiti produk adalah sentiasa sempurna; oleh sebab itu, kos kualiti tidak dianggap sebagai satu isu untuk mempengaruhi saiz lot pengeluaran.

Kajian ini bertujuan untuk memperluaskan bidang pengetahuan yang sedia ada tentang masalah ketidaksempurnaan kualiti inventori dengan membangunkan satu model inventori baru yang merehatkan beberapa andaian umum terdahulu dalam

model-model EPQ. Objektif utamanya ialah untuk meminimumkan jumlah kos inventori dan kualiti dalam sistem pembuatan dengan produk tunggal, dan sebuah proses pengeluaran berkelompok. Model EPQ yang dicadangkan mengenalpasti kos-kos yang wujud disebabkan oleh kualiti yang rendah dan kesannya terhadap saiz lot optimum serta jumlah kos. Analisis sensitiviti telah dijalankan untuk menunjukkan perubahan yang berlaku dalam saiz lot pengeluaran yang optimum dan jumlah kos daripada variasi dalam pelbagai parameter bagi model EPQ yang telah dicadangkan. Ujian hipotesis statistik menunjukkan bahawa jumlah kos bagi model EPQ yang dicadangkan adalah secara signifikannya kurang daripada model-model EPQ yang terdahulu. Keputusan kajian pula menunjukkan bahawa kadar pengeluaran, kadar permintaan, kos pegangan barangan yang dikembalikan, kadar kerosakan, kos penalti, kos pemulihan, peratusan pesanan yang dibatalkan, dan kos pegangan barangan tidak terpakai mempunyai kesan ekstensif pada jumlah kos bagi sistem pembuatan.

ACKNOWLEDGEMENTS

Praise is to “Allah” the cherisher, and the sustainer of the world for giving me strengths, health and determination to complete this thesis.

My grateful appreciation is extended to a wonderful, outstanding and distinguished professor who has encouraged, helped, supported and enlightened me. Prof. Dr. Datin Napsiah bt. Ismail, the chairperson of my supervisory committee, to whom I owe an extreme debt of gratitude, offered constant help beyond the call of duty.

Special thanks and admiration are due also to the other members of my supervisory committee, Prof. Dr. Shamsudin b. sulaiman and Prof. Dr. Megat Mohamad Hamdan b. Megat Ahmad for their help and advanced insights into the study.

Finally, I would like to express my sincere gratitude and appreciation to my father for their help and encouragement, to my wife, Jamileh, who offered constant support and love during the years I spent doing this research, and to my children, Reza and Kosar, who at age seven and two do not fully understand what inventory and quality are but who have tried to be patient when I retreated to my study to write the thesis.

DEDICATION

Dedicate to my wife, Jamileh and my children, Reza and Kosar for their love and support.

I certify that a thesis Examination committee has met on 26 May 2011 to conduct the final examination of Mohammad Reza Shahraki on his thesis entitled "Economic Production Quantity Model Based on Extended Cost Parameters For Imperfect Process and Defective Items" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the University Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Doctor of Philosophy.

Members of the Thesis Examination Committee were as follows:

Mohd Sapuan b. Salit, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Norzima bt. Zulkifli, PhD
Senior Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Tang Sai Hong, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Bermawi P. Iskandar, PhD
Professor
Faculty of Engineering
Institute Technology of Bandung
(External Examiner)

SHAMSUDDIN SULAIMAN, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

APPROVAL

This thesis submitted to the senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory committee were as follows:

Napsiah Ismail, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Shamsuddin Sulaiman, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Megat Mohamad Hamdan b Megat Ahmad, PhD
Professor
Faculty of Engineering
Universiti Pertahanan National Malaysia
(Member)

HASANAH MOHD GHAZALI, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledge. I also declare that it has not been previously and is not submitted for any other degree at Universiti Putra Malaysia or other institutions.

_____

MOHAMMAD REZA SHAHRAKI

Date: 26 April 2011

TABLE OF CONTENTS