

Optimization of Inventory Model with the incorporation of the associated costs of Product innovation

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Abstract— In these days people are at the back of novelty and innovation which have made them crazy over inventive ideas and its implementation. This fanatical intention of the people has emerged as the drive for the production sectors to opt for Product Innovation (PI), which is a growing and much focused area by the managerial people. PI is not a single entity rather it is the composition of product design, manufacturing techniques, expertise opinion, initialization and profitability assessment. These components of PI are highly significant as it contributes to the development of new products. In recent times the tactics of PI is used as weapon against the competitors in global markets. To make the PI successful the industrial sectors must allot monetary values to it, which have to be incorporated in the total cost of economic production quantity model to determine the optimality. This research work put forth a new realistic inventory model with the inclusion of the concept of PI to reflect the existing situations in the industrial sectors. This paper also scatters light on the different strategies used by the production sectors to capture the attention of the consumers for enhancing the purchasing behaviour.

Keywords— Optimization, Product innovation, Production quantity model

I. INTRODUCTION

This document The origin of inventory model dates back to nearly a century, the pioneer of basic Economic Order Quantity model is Harris in the year 1913 and this model was later extended to economic production quantity model by Taft in the year 1918. Later these two models were modified by several researchers based on the needs of the production management with the incorporation of shortage, complete backlog, partial backlog, discount, price-break, switching, environmental conservation and other associated factors of business management. But in recent days the production sectors have begun to focus much on product innovation, an embodiment of several tactics of innovative product production. PI is not a solitary unit rather it is multi-faceted. The launch of new products in the market and maintaining its sustenance is quite a challenging task as it is an integration of several significant factors such as product design, manufacturing techniques, expertise opinion initialization and profitability assessment. To make PI successful the intervention of these factors are equally important. The core emphasis on PI is rendered by the production sectors as PI is used as a tool for customer attraction and enhancing the purchasing behavior of the customers.

This paper mainly aims in the formulation of new inventory model with the inclusion of the associated costs of product innovation to cater to the needs of production sectors with regard to the context of PI. The earlier formulated inventory models are categorized as deterministic, probabilistic, fuzzy and stochastic inventory models which reflected the business scenario and duly assisted in determining the optimal quantity. But on profound analysis the deterministic inventory models are formulated initially and later it was reformed to other categories of inventory models. Based on this notion, a deterministic economic production quantity inventory model with the incorporation of the costs of PI is framed in this article.

The paper is organized as follows: section 2 consists of the model development; section 3 validates the proposed model and section 4 concludes the paper.

II. MODEL DEVELOPMENT

The following assumptions and notations are used throughout this paper.

2.1 Assumptions

1. Continuous demand rate of items
2. Replenishment of the production levels occur at regular intervals.
3. Production rate is greater than the demand rate to avoid shortages

2.2 Notations

- D demand per unit time
- P production per unit of time
- x D/P
- 1-x the fraction of time the production process spends actually idling
- A fixed ordering cost/ set up cost per production run
- h holding cost per unit per unit of time.
- PD costs of product design
- MT associated costs of manufacturing techniques
- OS cost pertaining to outsources of expertise
- PA costs related to profit assessment

The EPQ cost per unit of time

$$C(Q) = \frac{AD}{Q} + \frac{hQ(1-x)}{2}$$

The product innovation costs per unit of time is

$$PI(Q) = (PD+MT+OS+PA)/T$$

where T = Q/D

The total cost per unit of time

$$\Psi(Q) = C(Q) + PI(Q)$$

$$\frac{AD}{Q} + \frac{hQ(1-x)}{2} + \frac{(PD+MT+OS+PA)D}{Q}$$

$$\frac{\partial \Psi(Q)}{\partial Q} = \frac{\partial}{\partial Q} \left[\frac{AD}{Q} + \frac{hQ(1-x)}{2} + \frac{(PD+MT+OS+PA)D}{Q} \right]$$

$$= -\frac{AD}{Q^2} + \frac{h(1-x)}{2} - \frac{(PD+MT+OS+PA)D}{Q^2}$$

The optimal order quantity is $Q = \sqrt{\frac{2D[A+PD+MT+OS+PA]}{h(1-x)}}$

3 Numerical Example

Consider an inventory system with the following secondary data

A = \$100 / cycle, h = \$5/ unit/ cycle, D = 50,000 units/ year, P = 75,000 units / year, PD = \$50 ,MT = \$100, OS = \$75, CPA = \$ 80. The optimal order quantity is 4954units.

III. CONCLUSIONS

This paper primarily focuses on the aspects of product innovation in the production sectors. The formulated deterministic inventory model mirror the prevailing marketing stratagems implemented for product propagation. This paper also stresses on

the fact that the concept of PI is closely associated with the purchasing behavior of the customers. The formulated inventory model can be extended with the incorporation of several associated factors.

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