

An Inventory Model with the inclusion of Eco-Conscious Production Cost parameters

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ABSTRACT: Products and People are mutually consistent. The taste of customers determines the product's destiny and also it lays way for transformation of product's nature, presently this makeover has created great welcome for Environment friendly products at global markets. Naturally these products have close association with the inventory sustained at all levels by the manufacturing sectors and the production processes. The quality of these eco-products highly depends on the production processes employed by the manufactures. The quality yield of conventional production process is not fruitful to meet the current eco needs at large scale. Therefore, switching of conventional to eco – conscious production process has become mandatory these days for producing quality eco-products. This eco-conscious production process is a system of several embodiments which incorporates certain costs for efficient functioning. It is indeed a great challenging task for manufacturing sectors to determine the optimal quantity to be produced with the incorporation of eco-conscious production costs parameters. The main aim of this article is to formulate an inventory model with the inclusion of the associated costs of eco production practice. In this paper a new expression is given for eco-conscious production process. This article also emphasizes the need and states the outcomes of this model.

KEYWORDS: Inventory, Eco-Conscious, optimization, eco-products, costs

I. INTRODUCTION

In recent years, the industrial sectors are circumscribed by several exigent factors such as environmental regulations, buyer buoyancy, quality products and eco-technologies. The fostering forces which urges eco-conscious production process into operation are stringent laws concerning to eco-sustainability. With regard to societal context, the social responsibility of these industries is to promote economic viability, which is the tendency of enabling the users to purchase new product at low cost, produced out of eco-consciousness. All the industries devise quite a few strategies for contending its opponents, for a long run of production process, inventory is kept at all echelons. Besides competitive state of affairs, computational phases are also essential for which inventory modelling enters the production picture. The prime intent of these models is to uncover the optimal order quantity.

The history of Inventory Models runs back to 1913(Harris.,1913). The pioneers of these models are Harris and Taft(Taft.,1918) who framed economic order quantity model and economic production quantity model (EPQM) respectively. In our study, we take Taft's model into account. The EPQM was subjected to a number of modifications suiting the needs of the production sectors. Production models considering shortages (Feittu., price discount(Yong.et.al.,2012), imperfection (Ali Yassine.et.al.,2012), inflation (Kou.,2006), advertisement (Sheng.et.al .,2011), back orders(Biswajit.,2013) were framed by the researchers. On other hand, the facets of remanufacturing, waste disposal (Maurice.et.al.,2011) were also integrated with the production models. Models reflecting on reliable, flexible machinery were also structured. Remanufacturing models insist about rework of defective items and expulsion of waste whereas other models present the profit maximization ways. Though all these models support the industrial sectors in inventory management with the enclosure of specific constraints these models

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do not explicate the eco-social responsibility of these sectors. The eco accountability of any industries is to install eco-conscious production process to produce quality green products and the social conscientiousness of these sectors is resource management and waste lessening. To confront these eco-social liabilities into production process an ingenious model has to be made with the incorporation of costs parameters of eco-conscious production process.

The article is composed of five segments, where segment 2 briefs about eco-conscious production process; segment 3 contains the model development, section 4 corroborates and lists the outcomes of the model and section 5 makes inference of the research work.

II. RELATED WORK

Eco- Conscious Production Processes (ECPPP)

Characteristics of ECPP

Many researchers have defined ECPP in several ways, but in this paper, a new expression is given for it, ECPP = f(production system, human intervention, atmospheric organization). It can be stated as an eco – revolutionary process emerged out of human intervention with the ultimate goal of organizing the systems of atmosphere. The unique characteristics of ECPP which make it distinct from the conventional process are

- (i) Environmental sustainable technologies
- (ii) Quality green products
- (iii) Acquisition of customer consistency
- (iv) Reaching the level of brandedness,
- (v) Control of waste and pollutant generation

Components of ECPP

Eco-Conscious production processes is not a single phenomenon but an aggregate of many constituents such as proficient equipments, energy efficient technologies, eco-product design, bio inputs, zero-emission.

Proficient Equipments

This is a vital component of ECPP. In these days product production takes place at rapid rate to satisfy the demands of the customer. For continuous manufacture the equipments employed must be capable for withstanding the repeated activities. To avoid shortages and the loss of customer's trust installation of potential mechanism is highly essential for the execution of the production phases in sequence.

Energy Efficient Technologies

Energy of all forms is needed in each production stage. The utilization of varied technology for energy consumption such as biomass technology, green energy stratagem and so on is applied in ECPP for minimizing pollutant emission. This component plays an imperative role in the fulfilment of social responsibility of the industrial sectors.

Eco-Product Design

ECPP gets accelerated at time of post production itself. Designing products desirable to the environment is the core module. The flexibility of product usage depends on product design; therefore building the frame work of the product by the experts in compliance to the customer's expectation will enhance the product promulgation.

Bio Inputs

ECPP is extremely cautious about the inputs which steps into the production process. The materials must be bio-friendly, reworkable, repairable, and reusable so that it results in outcome of less waste. Bio inputs are the one which are feasible to the surrounding.

Zero Emission

This is the prime highlight of ECPP. This process ensures very little harmful impact to the environment. This component emphasizes the diminishing of the rate of emission and expulsion of waste.

These are the elements of ECPP which makes this process superior to the conventional production process.

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III. MODEL DEVELOPMENT

Assumptions

1. The demand rate is continuous and constant which is lesser than the production rate.
2. Lead time is fixed.
3. ECPP is employed and the implications are expressed in terms of costs parameters.

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
E _i	costs of proficient equipments i (i= 1,..n)
E	$\sum E_i$
S _{Ei}	Initialization costs of proficient equipments i
S	$\sum S_i$
F _j	Associated costs of Energy efficient technologies j (j = 1,..n)
F	$\sum F_j$
G	Costs of product design
B _k	Costs of input material k (k = 1,..n)
B	$\sum B_k$
W _c	Costs of employed mechanism for mitigating wastes of type c (c= solid, liquid, gaseous)
W	$\sum W_c$

The EPQ cost per unit of time

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

The ECPP associated costs per unit of time is

$$ECPP(Q) = E + S+F+G+W+B/ T, \text{ where } T = Q/D$$

The total cost per unit of time

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

$$= \frac{AD}{Q} + \frac{hQ(1-x)}{2} + \frac{(W+F+S+G+B+E)D}{Q}$$

$$\frac{\partial \Psi(Q)}{\partial Q} = \frac{\partial}{\partial Q} \left[\frac{AD}{Q} + \frac{hQ(1-x)}{2} + \frac{(W+F+S+G+B+E)D}{Q} \right]$$

$$= -\frac{AD}{Q^2} + \frac{h(1-x)}{2} - \frac{(E + S+F+G+W+B)D}{Q^2}$$

$$\text{The optimal quantity is } Q = \sqrt{\frac{2D[E + S+F+G+W+B]}{h(1-x)}}$$

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IV. OUTCOMES OF THE MODEL

This model is extremely beneficial to the industrial sectors in making decisions with regard to environmental and social aspects. The absorption of eco process into the usual production system has brought the significance of promoting eco products in to light. In the inventory ideology, this deterministic model can also be extended to probabilistic, fuzzy and stochastic models based on the practical necessities. This model will indeed provide a comprehensive outlook of green generation.

To validate the model, the inventory system with the following data is taken into account.

$P = 1000$ units/ time, $D = 900$ units/ time, $h = \$ 1.5$, $A = \$ 100$, the manufacturing firm uses ECPP with its related costs as, $E = \$200$, $S = \$100$, $F = \$250$, $G = \$180$, $W = \$270$, $B = \$500$. The optimal quantity to be produced is 4243 units

V. CONCLUSION

This paper presents a workable inventory model reflecting the eco-social needs of the society. This model has great reach as it suits the planning executives in decision draft. The deterministic nature of the model lays the foundation for further development. The corroboration of the model with numerical example justifies the likelihood of the model.

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