ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 6 , June 2016

Literature Review on Optimization of Batch Sizes

AVANISHKUMAR YADAV, Dr. ARUN KUMAR, NIYATI RAUT, SHREEYESH KUTTY

Dept. of Mechanical Engg, Viva Institute of Technology, Maharashtra, India
Principal, Viva Institute of Technology, Maharashtra, India
Dept. of Mechanical Engg, Viva Institute of Technology, Maharashtra, India
Dept. of Mechanical Engg, Viva Institute of Technology, Maharashtra, India

ABSTRACT: Formulating a suitable inventory model is one of the major concerns for an industry. Small lots and low inventories are the results of frequent setups and bigger batch sizes save production time by having fewer setups but they increase inventory value. If there is a bigger product mix in a production environment more hindrances are created because of lack of optimization. Hence we see that finding optimum batch sizes is a problem of many manufacturers in a High mix, Low volume production environment. Also we have to consider the reliability of any process in the research activities. When the values of some factors are almost unreal, fuzzy models of inventory management plays an important role.

This paper discovers possible parameters of existing models of inventory control. Also try to create review of existing literature, concentrating on descriptions of the characteristics and types of developed inventory control models.

KEYWORDS: inventory management, models under uncertainty, EOQ, EPQ.

I . INTRODUCTION

One of the most vital concerns and difficult tasks in front of a production manager is how to manage the inventory. Inventory management is a science primarily about specifying the shape and percentage of stocked goods. It is required at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials.

The scope of inventory management concerns the fine lines between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods, and demand forecasting. Balancing these competing requirements leads to optimal inventory levels, which is an ongoing process as the business needs shift and react to the wider environment.

Inventory management involves a retailer seeking to acquire and maintain a proper merchandise assortment while ordering, shipping, handling, and related costs are kept in check. It also involves systems and processes that identify inventory requirements, set targets, provide replenishment techniques, report actual and projected inventory status and handle all functions related to the tracking and management of material. This would include the monitoring of material moved into and out of stockroom locations and the reconciling of the inventory balances. It also may include ABC analysis, lot tracking, cycle counting support, etc. Management of the inventories, with the primary objective of determining/controlling stock levels within the physical distribution system, functions to balance the need for product availability against the need for minimizing stock holding and handling costs.

In this paper, the objective is to explore different models of inventory control over uncertainty.

A case study may be defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 6 , June 2016

fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis. Although some fields have tried to distinguish sharply between these two approaches, they are in reality two variants of case study designs. A case study can also include or even be limited to quantitative evidence and as a related but important note, the case study strategy should not be confused with qualitative research

II. INVENTORY MANAGEMENT

Typically, in a manufacturing environment, parts are manufactured in:

How large should an inventory replenishment order be?

When should an inventory replenishment order be placed?

The objectives of inventory management often reduce the problem if it is more profitable to do quickly but more expensive or slower but cheaper. Such a strategy will be optimal inventory control, which minimizes the sum of milestones costs associated with the production, storage and inventory shortage per unit of time or for a specific (including infinite) amount of time.

Management models differ in the nature of the available information on the properties of the simulated system. When the value of the model parameters is well-defined, nature of the corresponding mathematical model is deterministic. If the parameters of the system are random values with a known probability, distribution models are stochastic (probabilistic). If all of the model parameters do not change over time, it is called static, otherwise – dynamic. Static models are used when receiving a one-time decision about the level of reserves for a certain period, and dynamic – in the case of sequential decision-making about stock levels or to adjust earlier decisions, taking into account the changes taking place. When static patterns of change in system parameters cannot be installed, it is necessary to solve the problem of inventory management in the face of uncertainty.

In models of inventory management, the following characteristics are taken into account:

Single versus multiple items. This dimension considers whether a single item can be used in isolation for calculations, or whether multiple interdependent products should be taken into account, as a result of collective budget or space constraints, coordinated control or substitutability between items.

Time duration. In some inventory management situations, the selling season for products is short, and excess stock at the end of the season cannot be used to satisfy the demand of the next season. In such cases, a single period model is required. When multiple periods need to be considered, a common approach is to use a rolling horizon implementation approach. Here, decisions consider only a relatively small number of future periods and are made at the start of each period. The decisions are then implemented in the current period, and the problem resolved at the start of the subsequent period.

Number of stocking points. Sometimes, it is appropriate to treat a single stocking point in isolation. In many real world cases, inventories of the same item are kept at more than one location. In multi-echelon situations, the orders generated by one location (e.g., a branch warehouse) become part or all of the demand at another location (e.g., a central warehouse).

In addition, one can have horizontal multiplicity, that is, several locations at the same echelon level (e.g., several branch warehouses) with the possibility of transhipments and redistributions.

The nature of product. The product type dimension identifies and considers certain product characteristics. For instance, a product may be perishable, consumable, repairable or recoverable. Deterioration of an item in the storage period is a natural process. Therefore, it cannot be ignored in inventory policy. It may be different in different storage places due to the difference in the environment.

Nature of demand. There are a number of possible choices in modelling the demand process.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 6 , June 2016

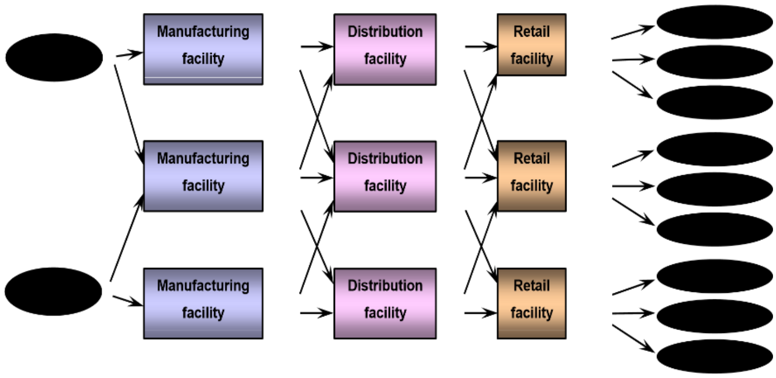
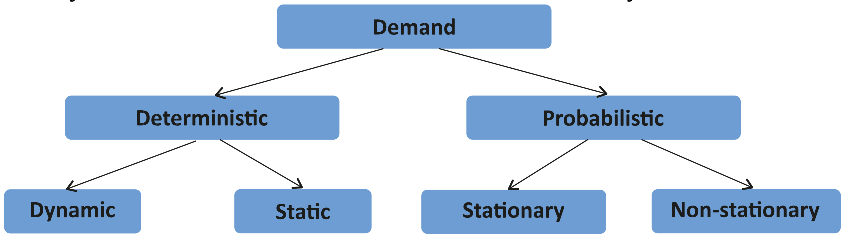


Figure 1: Supply Chain Network

Types of demand could be classified as it is shown in Figure 1. Deterministic demand is exactly known, unlike the probabilistic demand. It can be of two types. One of them is static, which does not have any variation. The amount of demand known or can be computed with certainty. Second type is dynamic, which may vary. This type of demand varies with time, but the way in which the demand varies is known with certainty.



Source:Silver(2008)

Figure 2: Types of demand classification

Stationary distribution with known parameters. This type of demands follows a probability distribution that is known or estimated from historical data. Commonly used distributions include normal, gamma, Poisson.

Non-stationary probabilistic demand. This type of demand behaves like a random walk that evolves over time, with regular changes in its direction and rate of growth or decline.

On the basis of the demand sources, demands are divided into independent and dependent. Independent demand is the demand that consists of the individual consumer's demands, each of them feeling the need independently of the other. Dependent demand occurs when a manufacturer uses a number of components for the manufacture of finished goods, and the demand for each component is associated with other and depends on the production plan of manufacturing.

Nature of supply process. The nature of the supply process refers to any restrictions or constraints that have been imposed on the inbound processes of the supply chain. Minimum or maximum order size or replenishment lead times are examples of typical factors considered in this dimension. Silver (2008) identifies three possible forms of lead-time. The first form is where the lead-time of each replenishment is known; the second is where replenishments arrive after a random time; and the final form is where seasonal factors may affect the time it takes for an order to be fulfilled. A supplier usually has limited capacity; therefore, order size restrictions are taken into account in this dissertation. In addition, lead-time is assumed to be a constant and known value.

Penalty and deficit. Any warehouse is established in order to prevent a shortage of a certain type of products handled by the system. Lack of stock at the right time leads to losses associated with downtime, unevenness of production, etc. These losses will be called a penalty for the deficit.

Any model is an abstraction of reality. The more number of dimensions to be taken into account in the model, the greater the model will meet the requirements of the real environment.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 6 , June 2016

It is a challenging task to obtain realistic input values for the mathematical inventory model parameters. Wang, et al. (2015) propose a modified Wagner-Whitin method that uses a forward focused algorithm to make lot-sizing decisions under chaotic demand. Classical algorithms create each successive point using deterministic computation. The algorithm works by repeatedly modifying a population of candidate solutions. At each iteration, the algorithm selects individuals from the current population and uses them as parents to create the next strategy. These costs are represented by fixed setup costs and variable inventory holding costs respectively. This representation of cost, although common, fails to capture the nature of the batching problem. In reality, there is often no real setup cost with respect to cash flows being affected.

A.Economic order quantity

For the fixed order size inventory models, the economic order quantity (EOQ) model is most well-known. The basic EOQ model is a formula for determining the optimal order size that minimizes the sum of carrying costs and ordering costs. The model is derived under a set of restrictive assumptions, as follows:

Demand is known with certainty and is constant over time.

No shortages are allowed.

Lead time of orders is constant.

The order quantity is received all at once.

The EOQ model was presented originally by Ford W. Harris, in a paper published in 1913 in Factory, The Magazine of Management (Harris, 1913). Many researches were made on the base of this model. However, the coefficients of the model may be fuzzy. One of the first who applied fuzzy theory was K. S. Park, who proposed a single product inventory model with fuzzy parameters on the base of the Harrison model (Park, 1987). Chen and Wang (1996), Roy and Maiti (1997), Yao et al. (2000) and Chang (2004) have extended the well-known EOQ inventory model to fuzzy versions.

Economic production quantity models

Economic Production Quantity model (EPQ) determines the quantity a company or retailer should order to minimize the total inventory costs by balancing the inventory holding cost and average fixed ordering cost. The EPQ model was developed by E.W. Taft in 1918 This method is an extension of the EOQ model. The classical economic production quantity model (EPQ) has been widely used. Numerous research efforts have been undertaken to extend the basic EPQ model by releasing various assumptions or adding new so that the model conforms more closely to real-world situations. Recently, re-work activities have attracted considerable attention because of the reduction of the natural resources and the rise in the cost of raw material. Modified Economic Production Quantity models with different schemes of fuzzy input parameters have been proposed by Lee and Yao (1998). The authors fuzzify characteristics, such as demand quantity and the production quantity per day. In the real situation, both of them have little disturbances every day. Chang (1999) considers the production inventory model in which the product quantity is a fuzzy number. Also, based on the numerical example, he compared fuzzy and crisp approaches for solving this problem. Lin and Yao (2000) treat the optimal solution for the fuzzy case of economic production for production inventory model. Hsieh (2002) introduced two fuzzy production inventory models with fuzzy parameters for crisp production quantity, or for fuzzy production quantity. The fuzzy total production inventory costs of these models under the fuzzy arithmetical operations of Function Principle were proposed. The authors found optimal solutions of these models by using Graded Mean Integration Representation method for de-fuzzifing fuzzy total production inventory cost and by using Extension of the Lagrangean method for solving inequality constrain problem. Lee and Yao fuzzified the demand quantity and production quantity per day in their model (Lee, 1998).

B.Joint economic lot sizing models

Lin (2000), made first attempt by, extending the existing model of Dolan by applying fuzzy mathematical programming to solve the joint economic lot size problem with multiple price breaks.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 6 , June 2016

Das, Roy and Maiti introduced defective items into the JELS model. In crisp defective rate, triangular fuzzy defective rate and statistic fuzzy defective rate the signed distance procedure is applied to estimate the joint total expected cost in a fuzzy sense. Yang presented a model to find the optimal strategy for integrated vendor-buyer inventory model with fuzzy annual demand and fuzzy adjustable production rate.

C. Exact Methods and Heuristics

Wang, X., Tang et. al.(2014), formulate a multi-level capacitated optimization model that works properly under Manufacturing Resource Planning (MRP II.) Heuristics try to find a near optimal answer in a short time. Exact methods use mathematical methods to guarantee that their solutions are optimal. They can be efficient for problems with small or medium size but they require large amount of time for problems with larger size. The objective is to minimize a total cost that includes production setup costs, linear inventory costs, and linear transportation costs over a finite planning horizon. Dynamic demand of multiple products needs to be satisfied for each period of time. In addition, production, inventory and transportation capacities are considered explicitly in the model. The author proposes a modified Lagrangian approach to solve the large-size integer-programming problem obtained. Although the author has spent effort explaining the Lagrangian relaxation approach proposed, no computational study is included to show the practicability of the approach.
Lower bounds are obtained by applying the Lagrangean relaxation method. By solving the linear relaxation dual of a new problem formulation, Kirca proposed an efficient way to obtain tight lower bounds. The same idea was exploited also by Robinson and Gao to obtain the lower bounds, but instead of solving the linear relaxation to optimality, the authors use a heuristic dual ascent method to solve the “condensed dual” of the relaxed problem. Different kind of heuristic methods were also proposed to solve the problem. However, all these procedures fail to solve problems with practical dimensions due to high memory and extensive computational effort requirements.

D.Models with Varying Duration

In the single-period model and the multi-period model concept, main distinguishing factor is that the multi-period model may involve stock leftovers from previous periods, which makes the optimal choice of order quantities more complicated. In formulating multi-period lot sizing models Fuzzy logic is useful. Inventory and production decisions are interdependent and temporal in nature in real world applications.

III. CONCLUSION

In the past years, the efficiency of inventory management has become an area of major concern in business. New inventory models for managing the inventory levels are now available.Frequent setups can lead to small lots and low inventories. In contrast, bigger batch sizes save production time by having fewer setups but they increase inventory value. Lack of optimisation causes more hindrances when there is a bigger product mix in a production environment. Each model, based on some assumptions, has its benefits and disadvantages, but still, many authors continue to design inventory control models using such approach as fuzzy logic. The lot-sizing problems address the issue of determining the production lot-sizes of various items appearing in consecutive production stages over a given finite planning horizon. The most common dimensions to be considered as variables are demand, the cost of acquisition.

REFERENCES

[1]Chang, S.C. (1999). Fuzzy Production Inventory for Fuzzy Product Quantity with Triangular Fuzzy Number. *Fuzzy Sets and Systems*, 107(1): 37–57.

[2]Chen, S.H., and Wang, C.C. (1996). Backorder Fuzzy Inventory Model under Functional Principle. *Inf. Sci.*, 95: 71-79.

[3]Das, K., Roy, T.K., and Maiti, M. (2004). Buyer-Seller Fuzzy Inventory Model for a Deteriorating Item with Discount. *Int J Syst Sci*, 35(8): 457–466.

[4]Harris, F.W. (1913). How Many Parts to Make at Once, Factory. *The Magazine of Management*, 10(2): 135-136, 152.

[5]Ishii, H., and Konno, T. (1998). A Stochastic Inventory Problem with Fuzzy Shortage Cost. *European Journal of Operational Research*, 106(1): 90–94.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 3, Issue 6 , June 2016

[6]Jaber, M.Y. (2009). *Inventory Management: Non-classical View*. Boca Raton: CRC Press, p. 228.
[7]Kacprzyk, J., and Staniewski, P. (1982). Long Term Inventory Policy-Making through Fuzzy Decision Making. *Fuzzy Set Syst,* 8: 117–132.
[8]Lee, Y.Y., Kramer, B.A., and Hwang, C.L. (1991). A Comparative Study of Three Lot-Sizing Methods for the Case of Fuzzy Demand. *Int J Oper Prod Manag,* 11(7): 72–80.
[9]Lin, D.C., and Yao, J.S. (2000). Fuzzy Economic Production for Production Inventory. *Fuzzy Sets and Systems,* 111(3): 465–495.
[10]Liu, B. (1999). Fuzzy Criterion Models for Inventory Systems with Partial Backorders. *Ann Oper Res,* 87: 117–126.
[11]Mula, J., Poler, R., Garcia-Sabater, J.P., and Lario, F.C. (2006). Models for Production Planning under Uncertainty: A Review. *Int. J. Production Economics,* 103(1): 271-285.
[12]Ouyang, L.Y., Wu, K.S., and Ho, C.H. (2006). Analysis of Optimal Vendor–Buyer Integrated Inventory Policy Involving Defective Items. *Int J Adv Manuf Tech,* 29(11/12): 1232–1245.
[13]Sommer, G. (1981). Fuzzy Inventory Scheduling. In G. Lasker (ed.), *Applied Systems and Cybernetics, Vol. VI* (3052–3060). New York: Pergamon Press.
[14]Taft, E.W. (1918). The Most Economical Production Lot. *Iron Age*, 101: 1410-1412.
[15]Wagner, H.M. (1980). Research Portfolio for Inventory Management and Production Planning Systems. *Operation Research,* 28(3): 445–475.
[16]Wang, X., Tang, W., and Zhao, R. (2014). Fuzzy Economic Order Quantity Inventory Models without Backordering. *Tsinghua Sci Tech,* 12(1): 91–96.
[17]Yao, J.S., Chang, S.C., and Su, J.S. (2000). Fuzzy Inventory without Backorder for Fuzzy Order Quantity and Fuzzy Total Demand Quantity. *Comput. Oper. Res*., 27: 935-962.