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A REVIEW ON INVENTORY MODEL FOR DEFECTIVE AND DETERIORATING GOODS

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Abstract

Inventory control can be applied for every industrial and non industrial application, but specifically when apply to did you reading and defected item it is very helpful in managing inventory of wastage. Also it helps in recycling and restoring the equipment which is mainly considered as scrap in many industries. Considering environmental aspects, it save the resources and it optimise the use of inventory which reduce the overall cost of production.
This literature review consist of study of various item in industries such as raw material, spare/ repair parts, intermediate goods and finished goods. This re is done for deteorating items and defective item goods under various conditions which allow the marked down policy of company, goods allowed with inflation, goods allowed with preservation technology, goods allowed allowed with three level production setup, inventory model allowed with single vendor and single buyer, inventory model allowed with shortages.
The finding of the research or literature review is that inventory control for deteorating item and re manufacturing items under different condition need to be analysed. Concluding, inventory control model or case study for various condition such as backlogging, inflation, markdown policy, variable demand, multiple production system, preservation technology can be analysed.

Keywords: *EPQ, ELDSP, EMQ, MRP, EOQ, Inventory Control, Remanufacturing Goods*.

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1. Inventory Control

Inventory is coordination and supervision of the supply, storage, distribution, and recording of materials to maintain quantities adequate for current needs without excessive oversupply or loss. The inventory is used to represent the aggregate of those items of tangible assets which are:
Held for sale in ordinary course of the business.
In process of production for such sale.
To be currently consumed in the production of goods or services to be available for sale.
The inventory may be classified into three categories:

Raw material and supplies: It refers to the unfinished items which go in the production process.
Work in Progress: It refers to the semi-finished goods which are not 100% complete but some work has been done on them.
Finished goods: It refers to the goods on which 100% work has been done and which are ready for sale.

1.1 Meaning of Inventory Control

Inventory control means efficient management of capital invested in raw materials and supplies, work-in-progress and finished goods. Inventory control is the activity concerned with the management of inventory situations. The control and maintenance of inventories of physical goods is a problem common to all enterprises in any sector of a given economy. For example, inventories must be maintained in agriculture, industry, retail establishments, etc. The fundamental reason for the organizations to maintain inventories of goods is that it is either physically impossible or economically unsound to have goods arrive in a given system precisely when demands for them occur. Without inventories, customers would have to wait until their orders were filled from a source or were manufactured. In general, customers cannot wait for long periods of time. For this reason, carrying and controlling of inventories is necessary to almost all organizations that supply physical goods to customers.

The need for stocking any item arises because of the imbalance between the supply and demand of that commodity at a particular instant of time. In a typical industry, inventories of the following items become necessary:

1. Raw materials
2. Spare parts (or) repaired parts
3. Intermediate goods which are

a) Manufactured in house
b) Purchased from outside

4. Finished goods

2. Literature Review

Inventory control is the foundation of stock administration and the real fret of all undertakings in any part of a given economy. It has increased massive progression in the present economy and is common among producers, industrialists, agriculturists, specialist organizations, etc. A few researchers have committed their work on developing inventory models to get rules for working inventory framework rapidly. As far back as Harris [35] established the framework for inventory administration by developing an economic order quantity model, researchers have reinforced the literature on inventory models by calibrating certain presumptions to draw nearer to certifiable cases. A meticulous mathematical analysis of a straightforward kind of inventory model was tended by Arrow et al. [1]. From that point forward a lot of research has been completed in breaking down inventory frameworks by creating mathematical models to assist the decision makers associated with supply chains. Over a hundred years, heaps of research articles and books on inventory hypothesis and the management have been developed concentrating on an assortment of practical business circumstances. Full length book dedicated to the mathematical properties of inventory systems is that of Arrow et al. [2]. In 1963, Hadley and Whitin [34] dedicated a full length book on "Analysis of Inventory Systems". In 1996, Naddor [73] authored a book on "Inventory Systems". Along these lines, the works in the area of inventory emerged and gradually developed. A lot of papers and books on inventory theory and management have been published to present numerous models over the past decades that describe a variety of conditions and assumptions. This section shows a concise audit of the related writing on the connection between this theory and the general scientific classification of inventory control look into.

2.1. Inventory model with deteriorating items

A major issue in any business transaction is that control and maintain the inventories of deteriorating items. Goods are deteriorating owing to their values go down with time. The few common examples for deteriorating items are electronic products, fashion clothing, pharmaceuticals, paper-based materials, foods, vegetables, fruits and chemicals. Therefore, in practice, the loss due to deterioration cannot be ignored. The deteriorated items cannot be repaired or replaced. Deterioration occurs due to evaporation, damage, spoilage, dryness, etc., and it reduces the quality and/or quantity of stored items. Numerous studies have been carried out to address the problems of EPQ model for deteriorating items. The inventory problem of deteriorating items was first studied by Whitin [137], in which he proposed the fashion items deteriorating at the end of the storage period. After that Ghare and Schrader [29] were the first to incorporate the idea of deterioration in inventory models. They studied an exponentially decaying inventory model with constant demand. Perumal and Arivarignan [83] presented an inventory model with two rates of production, shortages, and deterioration. Later, Bhowmick and Samanta [7] developed a deteriorating inventory model with two rates of production, shortages, and variable production cycle. Lin et al. [66] provides a mechanism for measuring the influence of two stage deterioration on the supplier's capacity utilization for the joint economic lot sizing problem model. Mashud et al. [67] discussed a non-instantaneous inventory model for two constant deterioration rates under partially backlogged shortages. Vandana et al. [131] discussed an inventory model for non-instantaneous deteriorating items considering quadratic demand rate and shortages under trade credit policy. Inderfuth et al. [46] established an EPQ model with rework process of defective items and deteriorating recoverable items. Pour and Ghobadi [84] presented a two echelon supply chain model for deteriorating items wherein the optimal selling price, production lot size, total cycle time, number of deliveries and delivery lot size are obtained simultaneously. Teng and Chang [124] presented an EPQ model for deteriorating items considering the demand rate depends on the selling price of the products and the stock level. Tiwari et al. [127] studied a manufacturer–retailer gaming problem for deteriorating products when the retailer has limited storage capacity. Tiwari et al. [128] developed a supply chain model for deteriorating items under two-level partial trade credit with price-dependent demand and partial backordering. Shukla et al. [103] presented an economic production quantity model with defective products for deteriorating products. Benkherouf et al. [6] offered an EPQ model for deteriorating, defective items and time-varying demand over planning horizon. Cárdenas-Barrón et al. [12] studied a vendor–buyer system with multiple deliveries and rework to derive the optimal delivery policy and replenishment batch size. In their study, the proposed problem is solved under two different scenarios; the first scenario dealt with the case that only number of shipments must take discrete values and in the second scenario both number of shipments and batch sizes are discrete values. Nobil and Taleizadeh [75] presented a single machine and multi-product inventory model for defective items in which the defective products produced are reworked or they are put on auction as they are. Garg et al. [28] considered a price discounting model for non-instantaneous deteriorating items.

Many researchers assumed that the rate of deterioration as a function of time or a variable and optimized the total cost of the inventory model. Chowdhury et al. [19] presented an optimal inventory replenishment policy for deteriorating items where the rate of deterioration of items is directly proportional to time. Tadikamalla [112] developed an economic order quantity model with Gamma distributed deterioration rates. An EPQ model based on the retailer's stock level was proposed by Kaliraman et al. [52] wherein it is prescribed that the rate of deterioration is Weibull distribution and the production cost consists of raw material cost, labor cost, wear and tear cost and environmental cost. Kumar et al. [62] have developed a general inventory model for deteriorating items with probabilistic deterioration rate and ramp type demand under stock dependent consumption rate. Chung and Wee [21] considered short life-cycle deteriorating items with green product design. Sarkar and Sarkar [96] developed an inventory model for inventory dependent demand and variable deterioration rate. Sarkar et al. [97] developed an inventory model under variable deterioration rates. Mishra [68] formulated a production-inventory model for deteriorating items by considering the price dependent demand while the production depends on the rate of demand.

The researchers have developed the inventory model considering the instantaneous/non-instantaneous deteriorated items in their warehouse inventory model. Sarkar and Saren [98] investigated a warehouse inventory model for variable deterioration rate. Jaggi et al. [48] investigated a replenishment policy for non-instantaneous deteriorating items in two-warehouse facilities under inflationary conditions. Chandra et al. [15] introduced the effect of deterioration on two warehouse inventory model with imperfect items. Pakkala and Achary [77] considered a two-warehouse model for deteriorating items with finite replenishment rate and shortages. Chung et al. [20] analyzed an EPQ model having two warehouses where one of them is rented and another one is owned. Hsieh et al. [41] determined the optimal lot size for a two warehouse system with deterioration and shortages using net present value. Recently, Sarkar [94] discussed inventory models with delay in payments having time varying deterioration rate and stock dependent demand. The EPQ models discussed in this section are used in this research to develop the EPQ models with deteriorating items under various realistic assumptions.

2.2. Inventory model with defective items

Rework is common in Semiconductor, Pharmaceutical, Chemical, Food industries, Textile industries, Paper industries, Glass industries, Metal processing industries and Plastic industries. Barketau [4]; Buscher [8]; Chiu et al. [16]. Ca´rdenas-Barro´n [11] presented rework with single stage of production system. In real life manufacturing system, the manufacturing of defective products is to be anticipated due to process deterioration, setup errors, tools errors or other manageable and/or unmanageable problems (Hinckley [40]). The earliest research that focused on rework and remanufacturing process was done by Schrady [101]. Since then, researches on rework have attracted many researchers. Khouja [57] considered direct rework for economic lot sizing and delivery scheduling problem (ELDSP). The economic production quantity model problem for single item under the assumptions of imperfect production and perfect rework have been broadly carried out in the past decades (For instance, Widyadana and Wee [138]; Shah and Shah [102]; Li et al. [65]; Kundu and Chakrabarti [63]; Jawla and Singh [51]; Khanna et al. [56] and Chiu et al. [17]). Krishnamoorthi and Panayappan [59] pointed out that the "Economic Production Quantity" model, which is commonly used by practitioners in the fields of production and inventory management to assist them in making decision on production lot size, has a common assumption that all units produced are perfect and shortages are not allowed. However, in real life manufacturing process, quality of reworked items is not always perfect. Owing to deterioration of process, imperfect technology, human error, unpredictable issues or numerous other factors (Drury [24]), generation of defective items during rework process is inevitable. In this chapter, system of imperfect production and imperfect rework is carried out to supply 100% high quality products to markets.

Feng and Viswanathan [27] planned arithmetical models for common multi-production and rework setup policies. Sarker et al. [100] compared immediate remanufacturing process and remanufacturing policy in a multiple production runs scheme. Taleizadeh et al. [118] developed an EPQ model with random defective items, production capacity limitation and failure in repair work. Koh et al. [58] 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. [50] 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. Yoo et al. [143] developed an EPQ model with imperfect production quality, imperfect inspection and rework. Wee et al. [136] developed the model by taking random defective rate. Jaber et al. [47] assumed that the percentage of imperfect items per lot reduces according to a learning curve. Mukhopadhyay et al. [72] investigated an economic production quantity model for three types of imperfect items with rework. Disaggregating the shipments of imperfect quality items in single production run and aggregating the shipments of imperfect items over multiple production run are studied in Yassine et al. [142]. Sana et al. [90] introduced an imperfect production process in a volume flexible inventory model. Sarkar et al. [91] developed a stock dependent inventory model in an imperfect production process. Kumar et al. [61] presented Economic Production lot size (EPLS) model with the stochastic demand and shortage partial backlogging rate under imperfect quality items, in which stochastic imperfect production was assumed. Rezaei et al. [87] discussed an economic production quantity and purchasing price for imperfect quality items while inspection shifts from buyer to supplier. Felix. et al. [25] investigated a modified EPQ model with deteriorating manufacturing system and deteriorating product where rework process was started at the end of production setup. Tai [113] proposed an EPQ model for deteriorating/imperfect product with rework which was performed after a production setup. Sarkar et al. [99] assumed rework for single stage production system. Kim and Sarkar [55] recommended an idea of complex multi-arrange with quality improvement and got amount of delivered defective items in intermittent audit stock model for complex multi- stage issue. Hsueh [42] investigated inventory control policies for manufacturing /remanufacturing system by considering different product life cycle phases. Taleizadeh et al. [114] developed production quantity model by considering random defective items, repair failure and service level constraints. Later, Taleizadeh et al. [115] studied production inventory models of two joint systems with and without rework. Sarkar and Sarkar [95] developed an economic manufacturing quantity (EMQ) model for deteriorating items and an exponential demand over a finite time horizon under the effect of inflation and time value of money wherein the improper items are produced which are reworked at a fixed cost to make it as proper items. Pal and Adhikari [81] presented an economic production inventory model for imperfect quality items where rework process is considered as perfect. Chakrabarty et al. [13] developed a production inventory model in which the defective items are refunded from the customer which are reworked and sold to the customers as good items. Taleizadeh et al. [117] considered that the total quantity of defective items can be reworked and scraped items will not be left at the end of the rework period. Singh et al. [104] proposed an economic production model for time dependent demand with rework and multiple production setups where the production depends on the demand. Recently, several related researches are found which are in the direction of this chapter by Teng et al. [125]; Tayyab and Sarkar [123]; Feng et al. [26]; Taleizadeh et al. [120]; Kang et al. [53]; Rabbani and Aliabadi [85]. Moshtagh and Taleizadeh [71] extended a hybrid manufacturing /remanufacturing model by considering short age, rework, and quality-dependent return rate in which quality of used items is considered as a random variable. Salameh and Jaber [89] presented an EPQ model for imperfect items wherein the imperfect items are screened out and sold at lower price. Hence, in our models, we have developed the EPQ models for defective/imperfect items where the defective/imperfect items are classified into serviceable and scrap items .

2.3. Inventory model allowing markdown policy

Markdowns can play an important role in product lifecycle management. Recently, online shopping attracts the customers, such as amazon, flipkart, etc., by providing stock clearance sale with some percentage discount on maximum retail price (MRP) during festival time or end of the season to sell unsold items. Markdown policy is frequently used in retail business, but it can be a competitive advantage in any business where the store needs to move slow-selling merchandise off the shelves as rapidly as possible to reinvest in more-popular items. Markdown pricing can also be used to motivate bargain hunters to make a buying decision. Markdowns are often associated with margin degradation and profit loss. And some companies believe that the cutting prices for their products could negatively impact their brand image. Although inevitable, retailers have historically viewed markdowns as a necessary evil, designed to help to sell old or slow-moving inventory. Retailer sometime uses markdown strategy to reduce their inventory and increase their profit by assuming that demand will increase with price decreases. Hence, inventory model with markdown price and stock-dependent demand is also getting attention of researchers. Namin et al. [74] empirically examined the determinants of a retailer's dynamic pricing policy and investigated consumer response to price changes (markdowns) throughout a fashion product's selling season. Srivastava and Gupta [110] presented deterioration with time and price dependent demand under markdown policy. Wang et al. [134] developed an optimal markdown policy model for perishable food pricing to optimize the food retailer revenue and enable a maximum aggregated consumer utility. You and Hsieh [144] have presented an EOQ model with stock-price dependent demand to maximize profit and to obtain the order quantity and selling price. Garg et al. [28] considered the price discounting for non-instantaneous deteriorating items. The effect of inventory on demand has been analyzed in a variety of practical settings in both the operations management and marketing literature, e.g., Caro and Gallien [10], Collado and Martínez-de-Albéniz [22] and Smith [109]. Based on the models discussed in this section, we conclude that the markdown policy is very essential in the world business. Hence, we have introduced markdown policy for our EPQ model with deteriorating and defective items.

2.4. Inventory model allowing inflation

The term inflation is especially utilized in a financial context, actually intends to blow up or get greater. Be that as it may, the most well-known monetary importance of inflation is: decrease in the time value of money for example financial depreciation. Because of high inflation rate, the impacts of inflation and time estimation of cash are basic in sensible circumstances. The value of money goes down as rate of inflation raises which will ultimately affects long-term investment and the inventory decisions. It has taken place generally due to the conviction that the inflation and the time value of money would not influence the inventory policy to any significant degree. In any case, the greater part of the nations have suffered from large-scale inflation and sharp decline in the purchasing power of money. Accordingly, while deciding the optimal inventory policy, the impacts of inflation and time value of money can't be overlooked. Buzacott [9] first developed the EOQ model taking inflation into account. Palanivel and Uthayakumar [78] presented an EPQ model for deteriorating items with variable production cost, time dependent holding cost and partial backlogging under inflation. Tolgari et al. [129] derived an inventory model for imperfect items under inflationary conditions by considering inspection errors. Yang and Chang [140] developed a two warehouse partial backlogging inventory model for deteriorating items with permissible delay in payment under inflation. An imperfect production process for time varying demand with inflation was developed by Sarkar et al. [92]. An EPQ model with inflation in an imperfect production system under finite time horizon was proposed by Sarkar and Moon [93]. Singh et al. [105] presented a mathematical production inventory model for deteriorating items with time dependent demand rate including the effect of inflation and shortages. Ghoreishi et al. [30] developed an economic order quantity model for non-instantaneous deteriorating items with a selling price and inflation induced demand rate under the effect of inflation and customer returns. Jaggi et al. [49] studied an inventory model for a retailer dealing by deteriorating items under inflationary conditions over a fixed planning horizon. Pérez and Torres [82] proposed a new inventory model to better embrace just-in-time purchasing. In their model, they developed a deterministic single setup multiple-delivery model for deteriorating items by considering the effect of the time value of money. Sundararajan et al. [111] analyzed an economic order quantity inventory model by considering the effect of inflation on a multivariate demand function and inventory control for non-instantaneous deteriorating items. Pal et al. [79] carried out an EPQ inventory model for ramp type demand with Weibull deterioration under inflation and finite planning horizon in crisp and fuzzy environment. With the help of the survey, we have developed an EPQ model considering the inflation.

2.5. Inventory model allowing preservation technology

In today's global world, due to rapid changes in environment, preservation technology becomes very important as well as essential to preserve the items. Also, many products such as fruits, vegetables, high-tech products, pharmaceuticals, and volatile liquids not only deteriorate continuously due to evaporation, obsolescence and spoilage but also have their expiration dates. The deterioration of most physical goods is a natural process that cannot be stopped; however, it can be slowed down with preservation technology investment. Investment in preservation technology is important to sustainable product lifecycle management. A recent empirical study on deteriorating items suggests that the total profit of a store may increase by 33% if it can reduce 20% of its perishable waste (The Profit Experts, [126]). These findings have motivated several researchers and marketers to study the effect of preservation technology investment in reducing deterioration rate.

To the best of author's knowledge, Hsu et al. [45] first derived an inventory policy allowing the retailer to invest in preservation technology when the demand and deterioration rates were both constant. He and Huang [36] studied the effect of investment in preservation technology in a price-dependent demand and constant deterioration rate scenario. Mishra [70] developed an inventory model with controllable deterioration rate under time-dependent demand and time-varying holding cost. Singh and Rathore [106] developed a model with preservation technology investment for constantly deteriorating inventory, permitting shortage under the effect of inflation and trade credit with time-varying demand. Yang et al. [141] examined an optimal dynamic decision making problem under trade credit and preservation technology allocation for a deteriorating item, the demand rate varies simultaneously with time. Singh et al. [107] studied that the retailers invest in preservation technology to reduce the rate of product deterioration. Dhandapani and Uthayakumar [23] presented an EOQ model for fresh fruits with preservation technology investment for variable deterioration rate. Tayal et al. [122] investigated a two echelon supply chain inventory model for deteriorating products with effective investment in preservation technology. Zhang et al. [146] developed the characteristics of investment in preservation technology for deteriorating products. However, the effect of reference price was ignored in these studies. Hence, we have developed EPQ model for defective and deteriorating items by considering preservation technology.

2.6. Inventory model allowing three level production setup

In a production inventory model, the case of change of production is very useful in practical situations. By starting at a low rate of production, a large quantum stock of manufactured item, at the initial stage is avoided, leading to reduction in the holding cost. The variation in production rate provides a way resulting consumer satisfaction and earning potential profit. A continuous production inventory model for deteriorating items with shortages in which three different rates of production was developed by the researchers. Karthikeyan and Viji [54] developed an economic production quantity inventory model for constant deteriorating items in which three different levels of production are considered. Further, this model was developed by Viji and Karthikeyan [133] for Weibull deterioration rate. Sivashankari and Panayappan [108] integrated a cost reduction delivery policy into a production inventory model with defective items in which three different rates of production are considered. Lakshmidevi and Maragatham [64] considered an inventory model with three different rates of production and quadratic demand rate. The shortages are allowed and deterioration rate is time dependent. Three level production inventory models for deteriorative items under the variation in production rate was proposed by Krishnamoorthi and Sivashankari [60]. A mathematical model for multi-product inventory management in a three-tier supply chain consisting of multi-supplier, a manufacturer, and several retailers were developed by Ghourchiany and Bafrouei [31]. Their model determines that different factors such as the optimum ordering of the raw materials and the optimal level of the production items with the optimal order of the products by retailers at each level of the chain. Hence, we concluded that the three level production setup is most imperative and so we introduced the production setup under shortages.

2.7. Inventory model allowing single vendor and single buyer

The single vendor single buyer integrated production inventory problem received a lot of attention in recent years. This renewed interest is motivated by the growing focus on supply chain management. Firms are realizing that a more efficient management of inventories across the entire supply chain through better coordination and more cooperation is in the joint benefit of all parties involved. Such collaboration is facilitated by the advances in information technology providing faster and cheaper communication means. Goyal [32] introduced the idea of integrating a single vendor with a single buyer as component of two entity supply line system. One of the first works dealing with the integrated vendor–buyer problem is due to Banerjee [3]. He assumed that the vendor is manufacturing at a finite rate and considered a lot for lot model where the vendor produces each buyer shipment as a separate batch. Later, many modifications are reported in the literature. For example, the two-level vendor and buyer problem and its related issues can be studied in Goyal [33]; Hill [37, 38]; Valentini and Zavanella [130]; Zanoni and Grubbstrom [145] and Hill and Omar [39]. Benkherouf and Omar [5] presented a method for finding the optimal replenishment run and production plan for a single-vendor single-buyer inventory model. Hsu and Hsu [43] proposed an integrated single-vendor single-buyer production-inventory model for items with imperfect quality and inspection errors. Chiu et al. [18] improved shipment policy for a vendor-buyer system with rework and an improving delivery plan. Omar et al. [76] developed an integrated just-in-time inventory model where the demand rate is linearly decreasing with time, production rate is finite, and delivery time is constant and deterministic. Yang et al. [139] discussed a vendor-buyers integrated inventory model involving quality improvement investment in a supply chain. Taleizadeh et al. [116] presented a model which deals with the problem of the joint determination of selling price, replenishment lot size and the number of shipments for an economic production quantity model with rework of defective items in which multi-shipment policy is used. Hence, we have developed a single vendor single buyer integrated inventory model under multi-production setup and rework.

2.8. Inventory model allowing shortages

One idealistic assumption of the classical EPQ model is that the shortage is not permitted. In practice, due to production of defective items, screening of deteriorated items or other manufacturing issues, shortage is inevitable. Shortages may be backlogged in two ways: completely backlogged (Shortage units are completely fulfilled) and partially backlogged (shortage units are partially fulfilled). In present days, some customers are willing to wait until replenishment if the waiting time will be petite while others are intolerant and go somewhere else. To reflect the phenomenon, Chang and Dye [14] considered an inventory model for partial backlogging shortage where the backlogging rate is the reciprocal of a linear function of the waiting time. Recently, many researchers have focused on the partially/completely backlogging shortages. Roy et al. [88] developed an EPQ model for defective items with partially backlogging shortage. A deterministic inventory model with time-dependent demand and time varying holding cost under partially backlogging shortage was proposed by Mishra et al. [69]. Taleizadeh et al. [119] derived an EPQ inventory model for scrap items, rework, interrupted production process and backordering with the reason of minimizing the expected total inventory cost. Pal et al. [80] presented a model related to the model of Sarkar et al. [99] with a multi-production system for deteriorating items, ramp type demand and effect of inflation when there is a shortage in the stock under the finite time horizon. Taleizadeh et al. [121] developed four new sustainable economic production quantity models that consider different shortage situations. Hsu et al. [44] considered an EPQ model under an imperfect production process with shortages backordered. Wee et al. [135] developed a model for deteriorating items wherein shortage was completely backlogged. A two-warehouse inventory model for deteriorating items with price dependent demand under partial backlogging was discussed by Rastogi et al. [86]. Vandana et al. [132] examined an economic order quantity model for retailers fractional permissible delay in payment allied to order quantity through shortages.

3. FINDING AND GAPS

The inventory research issues explored above plays an accentuation on giving sagacious devices to operational basic leadership and appropriation framework plan under different conditions. The finding of the research or literature review is that inventory control for deteriorating item and remanufacturing items under different condition need to be analysed. Concluding, inventory control model or case study for various conditions such as backlogging, inflation, markdown policy, variable demand, multiple production system, and preservation technology can be analysed. Concluding the review, following goals can be can be done for research:

1. A deterministic inventory model for deteriorating items and determining optimal replenishment run time with remanufacturing policy and complete backlogging.
2. Optimizing an imperfect manufacturing system for deteriorating items with remanufacturing system and complete backlogging under inflation.
3. Determining an optimal replenishment run time and lot size for an imperfect manufacturing system and rework under markdown policy.
4. A production inventory model for single vendor single buyer integrated demand with multiple production setups and remanufacturing system.
5. A manufacturing inventory model for exponentially increasing demand with preservation technology and complete backlogging.

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