CHAPTER 2

LITERATURE SURVEY

2.1 Definition of Inventory

Inventory is the stock of any item or resource used in a company. An inventory system is the set of policies and controls monitoring levels of inventory and determining what levels should be maintained, when stock should be replenished, and how large orders should be. Manufacturing inventory refers to items that contribute to or become part of a company's product output. Manufacturing inventory is typically classified into raw materials, finished products, component parts, suppliers, and work in process. In services, inventory generally refers to the tangible goods to be sold and the supplies necessary to administer the service.

2.2 Purposes of Inventory

1. *To maintain independent of operations.* A supply of materials at a work center allows that center flexibility in operations. For example, there are costs for making each new production setup. This inventory allows management to reduce the number of setups.

2. *To meet variation in product demand.* The demand for the products may be possible to produce the product to exactly meet the demand if it is known precisely. However, demand is not completely known and a safety stock must be maintained to absorb variation.

3. *To allow flexibility in production scheduling.* A stock of inventory relieves the pressure on the production system to get the goods out. This causes longer lead times allowing production planning for smoother flow and lower-cost operation through lot-size production.

4. *To provide a safeguard for variation in raw material delivery time.* When material is ordered from a vendor, delays can occur for several reasons such as a normal variation in shipping time, a lost order, or a shortage of material at the vendor's plant causing backlogs.

5. *To take advantage of economic purchase-order size.* There are costs to place an order: labor, phone calls, typing postage, and so on. So the larger the size of each order, the fewer the number of orders that need be written.

2.3 Inventory Costs

There are three principle costs of operating inventory systems including ordering, holding (or carrying), and shortage costs.

Ordering costs

Ordering costs are these costs that increase with the number of orders placed. These costs refer to the managerial and clerical costs to prepare the purchase or production order. In the case of manufacturing costs, ordering costs will include as follows:

- Order preparation
- Stock picking
- Setup
- Inspection
- Put away
- Order close-out

For ordering costs for purchased items, they include the costs of some or all of the following:

- Preparation of purchase requisition
- Preparation of purchase order
- Mail
- Expediting, including telephone and telegraph
- Transportation
- Receiving
- Inspection
- Put away
- Updating inventory records
- Paying invoice

Holding costs

Holding (or carrying) costs are these costs that increase with size of the inventory. These costs include

- Storage facilities
- Handling
- Taxes
- Insurance
- Deterioration
- Obsolescence
- Shrinkage
- Interest on capital

Shortage costs

When the stock of an item is depleted, an order for that item must either wait until the stock is replenished or be canceled.

2.4 Independent Versus Dependent Demand

Inventory management is important to understand the difference between dependent and independent demand. The reason is that entire inventory systems are predicted on whether demand is derived from an end item or is related to the item itself.

In dependent demand, the demands for various items are unrelated to each other. Examples include demand for finished goods and for service parts. The demand usually must also be forecast. Inventory models used in managing independent demand items generally determine how many units need to be ordered, and how many extra units should be carried to provide a specified service level (percentage of independent demand) that the company would like to satisfy immediately from stock on hand.

Dependent demand for an item is demand, which is related to or derived from demand for other items. The need for anyone item usually is derived from the demand for its parent. The demands are determined from the production schedules for these higher level items and therefore are calculated rather than calculated.

Example of independent and dependent demand of automobile company is shown. Assume an automobile company plans on producing 500 cars per day, then it will need 2,000 wheels and tires (plus spares). The number of wheels and tires needed is dependent on the production levels and is not derived separately. On the other hand, the demand for cars is independent. It comes from many sources external to the automobile firm and is not a part of other products: it is unrelated to the demand for other products.

Construction materials are independent demand items. They are finished goods. Demand for an item is not demand which is related to or derived from demand for its parent or a higher level item. So inventory models that would be used involve economic order quantity or order levels, order points, and safety stocks.

2.5 Inventory Systems

There are two general types of inventory systems: fixed-order quantity models (the Economic Order Quantity (EOQ), Q model) and fixed-time period models (Periodic review system, fixed-order interval system, P model). The basic distinction is that fixed-order quantity models are "event triggered" and fixed-time period models are "time triggered." Figure 2.1 shows two fundamentally different approaches called independent demand and dependent demand systems.

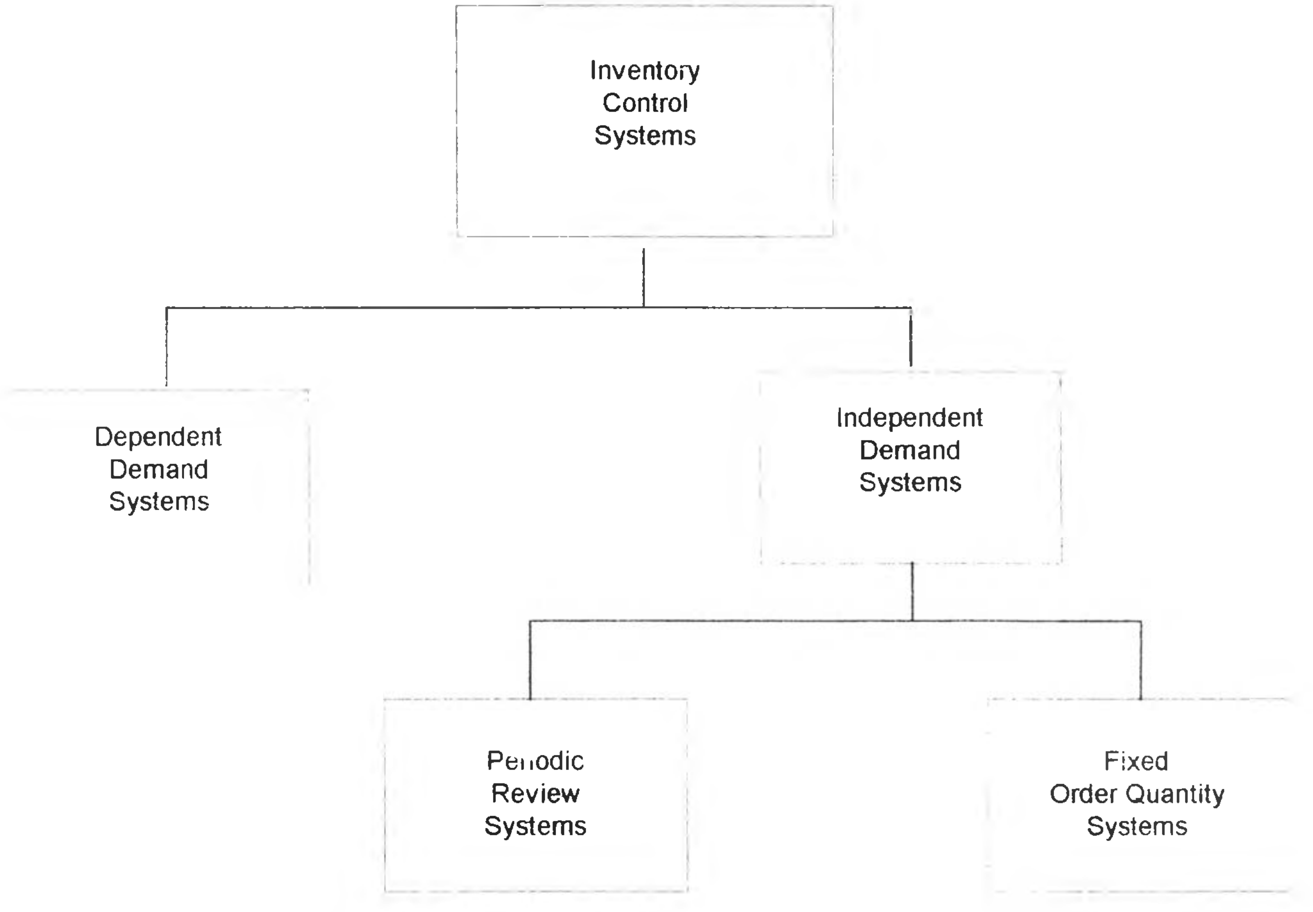

Figure 2.1: A classification of inventory control systems.

Fixed-Order Quantity System

A fixed-order quantity model initiates an order when the event of reaching a *specified point, s*, at which an order will be placed and the size of that *order, q*. The order point, s, is always a specified number of units. An order of size q is placed when the inventory available (currently in stock and on order) reaches the point s. The purpose of the EOQ formula is to determine the order quantity that will minimize the sum of ordering and holding costs per unit time. Figure 2.2 and the discussion about deriving the optimal order quantity are based on the following characteristics of the model. These assumptions are unrealistic, but they represent a starting point and they are important to understand these assumptions.

1. Demand is deterministic and uniform throughout the period.
2. No shortages are allowed.
3. Order size is a constant in continuous units.
4. Lead time (time from ordering to receipt) is constant.
5. Price per unit of product is constant.
6. Inventory holding cost is based on average inventory.
7. Ordering or setup costs are constant.
8. All demands for the product will be satisfied (No back order are allowed).

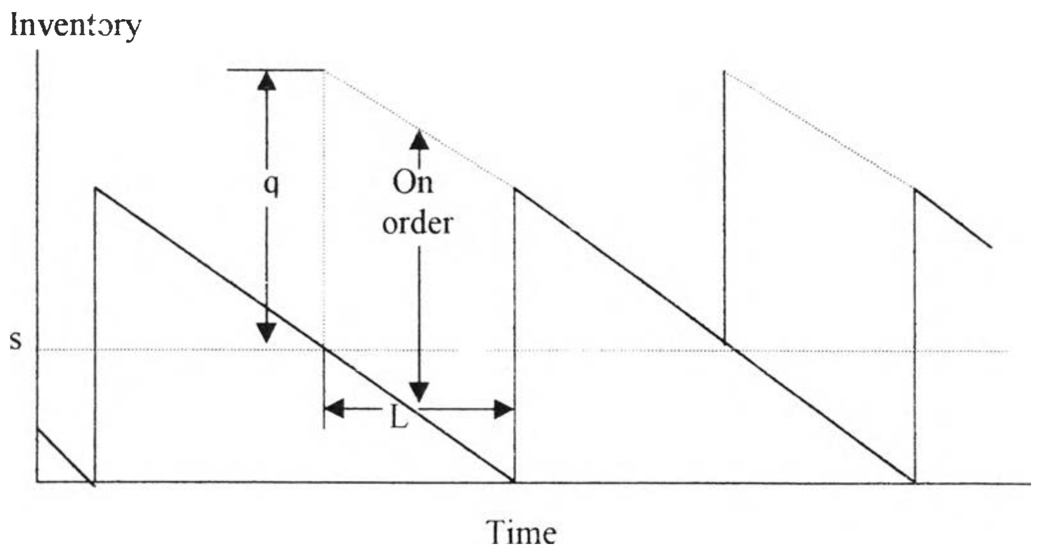

Figure 2.2: Basic Fixed-Order Quantity Model.

Figure 2.2 shows that when the inventory position drops to point s, an order quantity (q) is placed. This order is received at the end of time period L, which does not vary in this model.

Establishing Safety Stock Levels

The previous model assumed that demand was constant and known. In general, demand is not constant but varies from day to day Safety Stock must be maintained to provided some level of protection against stockouts. Safety stock can be defined as the amount of inventory carried in addition to the expected demand.

Fixed-Order Quantity Model with Specified Service Level

A fixed-order quantity system monitors the inventory level and places a new order when stock reaches some level, s. The danger of stockout in this model happens only during the lead time between the time an order is placed and the time it is received. In figure 2.3, an order is placed when the inventory position drops to the reorder point, s.

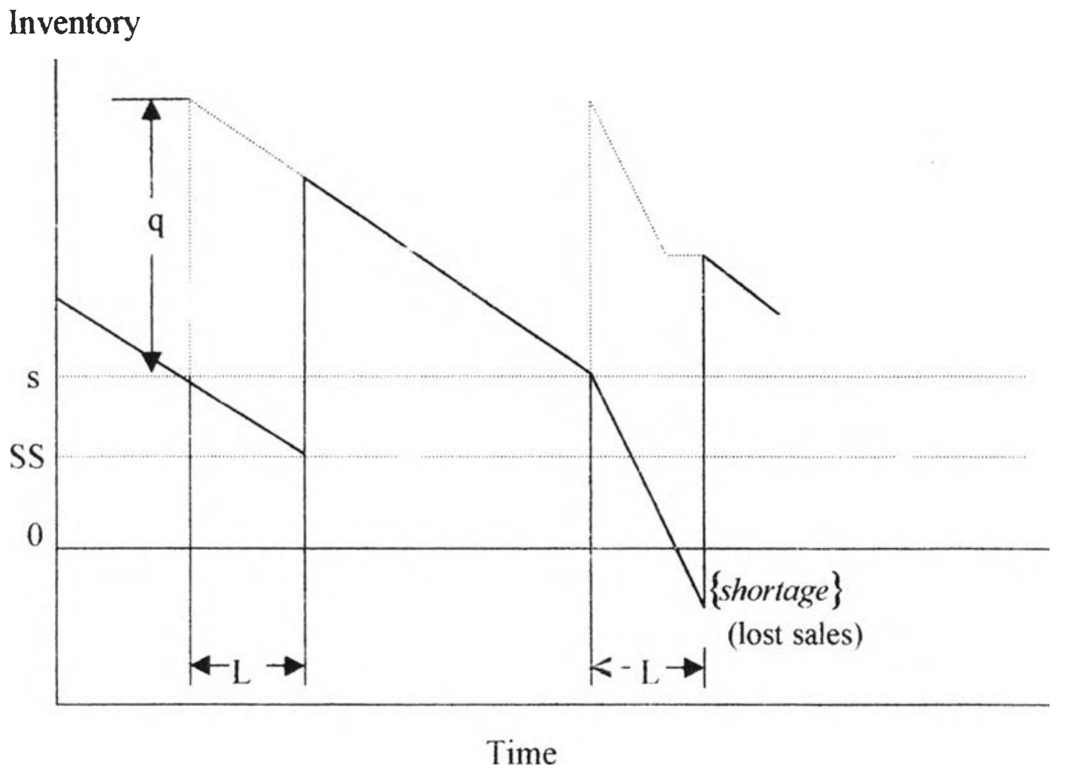

Figure 2.3: Fixed-Order Quantity Model with probabilistic demand.

Fixed-Time Period System

The fixed-time period model is limited to placing orders at the end of a predetermined time period. The size of the order is not fixed, but it is calculated to equal

$$q = S - y$$

where S = the order level (also called the order-up-to-level, target inventory level, or maximum inventory level) and y = the current inventory position. Figure 2.4 shows how the system operates. According to Smith S. B. (1989, p.139), this system is simple to operate and is appropriate for items with a stable demand and low ordering costs. It also has an advantage if a number of items are being ordered from one vendor or a number of items with the same setup are to be produced. It means it is grouping orders. The disadvantage is that following a period with a very low demand a small order will be generated, which may be uneconomical if the ordering cost is taken into account.

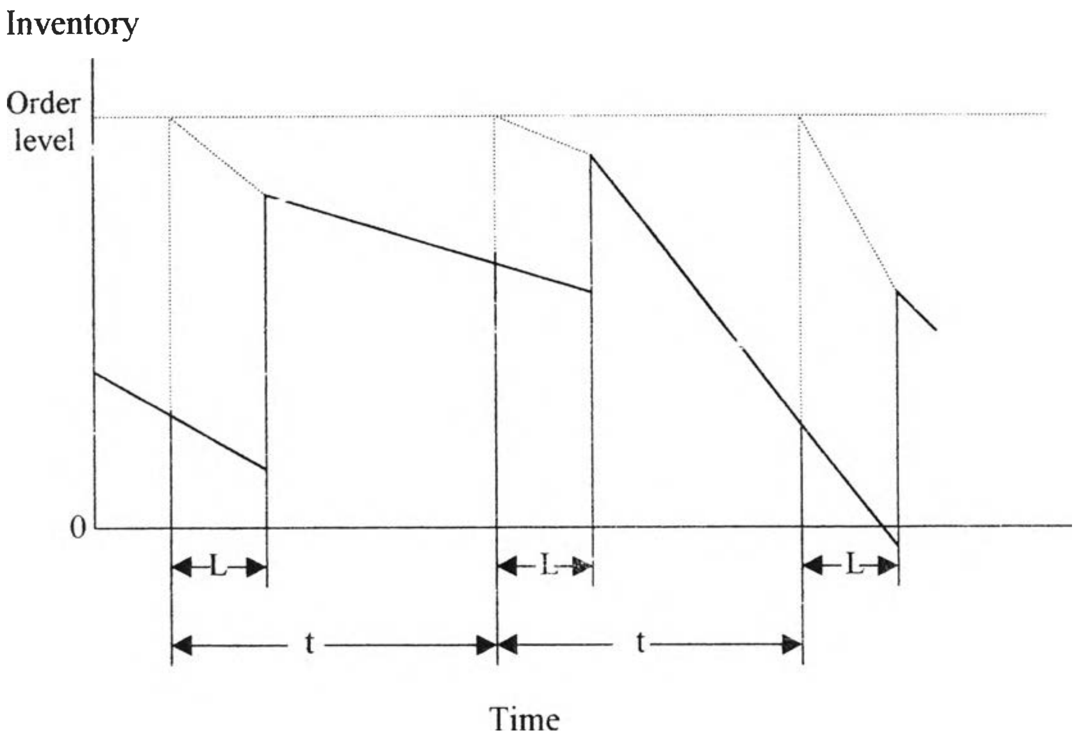

Figure 2.4: Fixed-Time Period System.

The Optional Replenishment System

Another system under the optional replenishment system is called the s, S system. A review is made every w units of time. If the inventory position is less than or equal to the order point, s, an order is placed for a quantity that will bring the inventory position up to the order level, S. Figure 2.5 shows the operation of the system. According to Smith S. B. (1989, p.142), This system is generally superior to the fixed-time period system because it avoids uneconomically small orders.

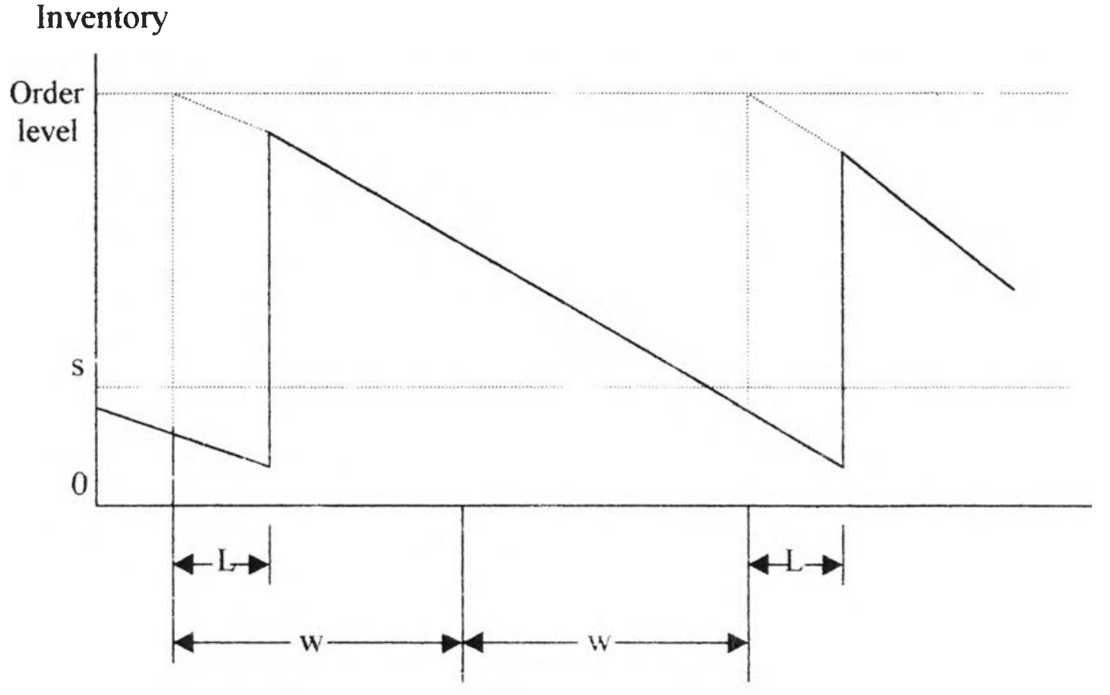

Figure 2.5: Optional Replenishment System.

Can-Order System

According to Smith S. B. (1989, p.148). The can-order system is designed to do an efficient job of grouping orders. With random demand, some items may reach their order points earlier leading to necessitating their immediate reorders. At the same time, some other items that are close to but not yet at their reorder points would have to be made as to include on the order. Under this system each item is assigned an order point (s), an order level (S), and a *can-order point* (c) that is above an order point and below an order level.
This policy is to

(1) Place an order each time any item falls to its order point.

(2) Include on the order every item that is at or below its can-order point.

(3) Order enough of each item to bring its inventory position up to its order level (target stock level).

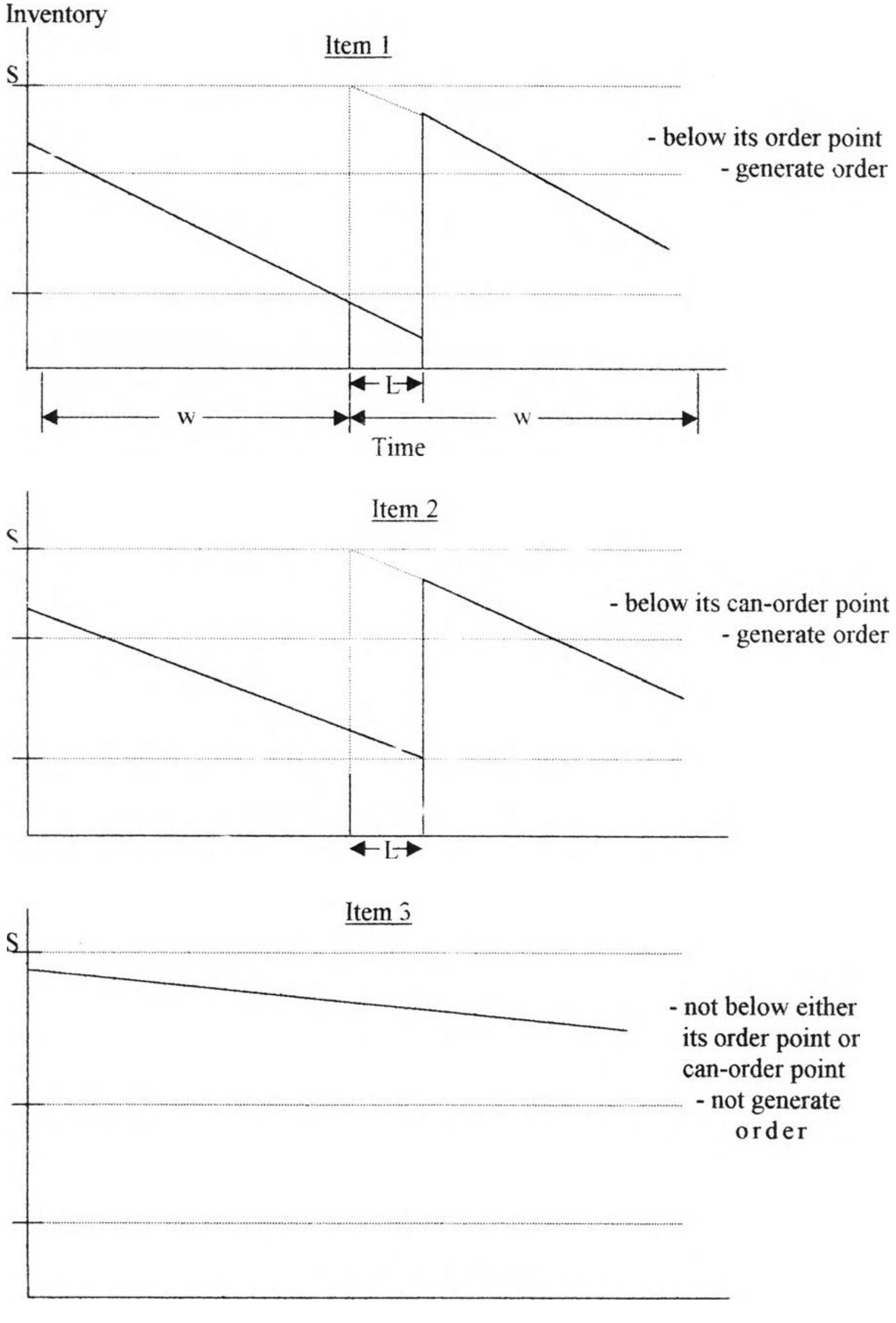

Figure 2.6. Can-Order System.

There are a number of possible inventory control systems. According to Silver E. A. and Peterson R. (1985, p.256), the physical operations of the four most common ones are described as follows;

1. **Order-Point, Order-Quantity (s, Q) system**

   This system involves continuous review. A fixed quantity Q is ordered whenever the inventory position drops to the reorder point s or lower. This system is called a two-bin system.

2. **Order-Point, Order-Up-to-Level (s, S) system**

   This system involves continuous review and a replenishment is made whenever the inventory position drops to the order point s or lower. In contrast to the (s, Q) system, a variable replenishment quantity can be used, enough being ordered to raise the inventory position to the order-up-to-level S. If all demand transactions are unit-sized, the (s, Q) and (s, S) systems are the same because the replenishment requisition will always be made when the inventory position is exactly at s; that is, in this case, S = s + Q. The replenishment quantity in the (s, S) system becomes variable as soon as the transactions can be larger than unit size. The (s, S) system is frequently referred to as a min-max system because the inventory position, is always between a minimum value of s and a maximum value of S.

3. **Periodic-Review, Order-Up-to-Level (R, S) system**

   This system is known as a replenishment cycle system. It is used in companies not utilizing computer control. The control procedure is that every R units of time enough is ordered to raise the inventory position to the level S.

4. **(R, s, S) system**

   This is a combination of (s, S) and (R, S) systems. The inventory position is checked at every R units of time. If it is at or below the reorder points, a replenishment quantity is ordered enough to raise it to S. If the position is above s, nothing is done until at least the next review instant.

2.6 Theses, Journals, and Books Related Literature

In addition, other theses, journals, books involved in this study are described below.

Vetchasart D. (1997)

Vetchasart did the thesis about inventory control by using a case study of the Telephone Organisation of Thailand (TOT). She stated that inventory management is crucial part of any organisation. Better profitable and healthy organisations come from better inventory management. Due to facing of an unsatisfactory inventory management of TOT, it needed to improve the efficiency of inventory management. For inventory control processes, she mentioned that it starts with data collection, the outgoing-inventory quantities and the incoming-inventory quantities of the inventory. The historical data were analyzed by using the time-series method. At the same time, costs were calculated in order to find the optimum inventory level. After all of the processes were operated, TOT could save cost about 133.5 million baht or 68.19%.

Rasree J. (1996)

Rasree studied the problems of production planning and inventory management of a polyethylene pipe factory and proposed the solutions to improve the production planning and inventory management. A polyethylene pipe factory is a plastic industrial that is important for the developing countries and the essential usage of home and public utilities. He mentioned that the factory did not have inventory management system and it led to higher stocks of materials and finished product of polyethylene pipes. Inventory management would provide the effective management of product stock control. He chose ABC analysis to help in convenient controlling inventory because the factory has several types of materials and products. The quantity and sales are categorised as A items, B items, and C items. Fixed order size, fixed time period, and two-bin system are also considered to calculate economic order quantity, target stock level, reorder point, and safety stock. Comparing inventory costs, the total costs after proposing an inventory control system were lower than the before proposing an inventory control system.

Prechachaisurat K. (1995)

Prechachaisurat stated that inventory is important asset. Management wants keeping inventory in low level so it makes lower holding costs. Likewise, if inventory level is much lower, it can lead to be slow down of production, delay of distribution, and loss customer as well. He developed a software for a computer aided instruction system on computer based production management for controlling inventory. The topics include inventory management, characteristics of inventory, considerations in selecting inventory control techniques, inventory control techniques, inventory models, and information about inventory control software.

Sripetchdarnon S. (1992)

His thesis proposed that the study and modeling of the vehicle routing for product shipment from a central depot to several customers by utilising more than a truck. The company, which manufactures and distributes detergent and products group used in bathroom, is used as a case study of this thesis. The shipment workflow of company is classified into four steps: (1) sales visit & order taken, (2) order processing (credit check and inventory check), (3) distribution warehouse (prepare loading and physical shipment), (4) trucker's station (up-country). To prepare loading of distribution warehouse step, it has to deal with routing of distribution for each truck and providing products matching with size of truck. Distributed products are divided into Bangkok and metropolitan areas and suburban (up-country) areas The model of the distribution requirement is constructed by using the CLARE-WRIGHT heuristic on microcomputer. At the same time, the shipment simulation was created on microcomputer to test the model. As a result, the tested results from the model are more satisfactory than the current shipment.

Tunsirijareankun O. (1990)

Her thesis proposed the finding a better clustering of garbage pick-up area and a better sequence of collection waste from the garbage pick-up point. This study used BangKhean district as a case study. The objective was to design a route minimizing the total travel distance and satisfying all capacity of vehicle and amount of trip constraints. A heuristic approach was introduced to solve the problem. There were three steps of solving the problem.

(1) A travelling of salesman problem to routing a giant tour was used

(2) A solid waste collection area was distributed.

(3) An optimal route of vehicles was designed.

The results indicated that the scheduling and routing of vehicle by the heuristic approach increase efficiency of system.

Soontravanich C. (1986)

His thesis studied the production problem of kraft paper factory and recommended the steps for solving a production and inventory-planning problem. Manufactured products of this factory have various kinds and purposes. Essential data had not been properly recorded and production plan was not drawn. In this study, it was suggested that manufactured products in greater demand must be identified and volumes forecast, then production planning executed by using multi item inventory control technique. The economic order quantity was recommended, which may reduce cost by 70 per cent. The electronic spread sheet software package was used to improve and increase output efficiently and help for planning and preparing report as well.

MD. Al-amin (1989)

His thesis developed and implemented a distribution system from one origin to many customers with minimum total transportation and inventory cost, while satisfying capacity constraints and meeting customer requirements. The different oil products (food or non-food) as packed carton or tin product with the minimum total cost per carton per month by the optimal truck type for each customer for a set of different kinds of truck are considered in this study. The models were developed for two different distribution patterns: direct and peddling. For direct shipping, the optimal shipment is given by a solution of a nonlinear program with considering the truck with considering the truck capacity constraint. For peddling, the optimal shipment size is a full truck with considering a side constraint. The peddling cost also depends on the region size (number of customers in each region) Finally, a schedule was provided for the set of trucks per month with the optimal shipment size for each customer or covered by the company.

Manothirawat R. (1980)
His thesis studied the transportation system of a kraft paper company by using heuristic approach. The system includes the transportation of roll paper from the plant to customers in Bangkok and waste paper from the company's baling stations in Bangkok back to the plant. Two types of vehicle are used; 6-wheel trucks and 10-wheel trucks. A heuristic algorithm was developed to search for the optimal loading pattern on each truck by using a set of rules which is closely parallel to real world situations. In addition, the model was tested for its sensitivity as well.

Chase R. B. et al. (1998)
They stated that inventory is the stock of any item or resource used in an organisation. An inventory system is the set of policies and controls monitoring levels of inventory and determining what levels should be maintained, when stock should be replenished, how large orders should be. Raw materials, finished products, component parts, supplies, and work in process are typically classified as manufacturing inventory. In service, inventory refers to the tangible goods to be sold and the supplies necessary to administer the service. In inventory management, it is important to understand the difference between dependent and independent demand because inventory systems are predicted on whether demand is derived from an end item or is related to the item itself. In dependent demand, the need for any one item is a direct result of the need for some other item. In independent demand, the demands for several items are unrelated to each other. For example, an automobile company plans on producing 500 cars per day so it will need 2,000 wheels and tires (plus spares). The number of wheels and tires needed is dependent on the production levels, but the demand for cars is independent. It is unrelated to the demand for other products and is not a part of other products.
Generally, there are two types of inventory systems: fixed-order quantity models and fixed-time period models. Fixed-order quantity models are "event triggered and fixed-time period models are "time triggered". When the event of reaching a specified reorder level occurs, a fixed-order quantity model starts an order while the fixed-time period model is limited to placing orders at the end of a predetermined time period. At the same time, they mentioned the differences of two systems that tend to influence the choice of these two systems. The differences are as follows:

- "The fixed-time period model has a larger average inventory because it must also protect against stockout during review the review period, T; the fixed-quantity model has no review period."
- "The fixed-order quantity model favors more expensive items because average inventory is lower."
- "The fixed-order quantity model is more appropriate for important items such as critical repair parts because there is closer monitoring and therefore quicker response to potential stockout."
- "The fixed-order quantity model requires more time to maintain because every addition or withdrawal is logged."

Stock J. R. and Lambert R. M. (1993)

They stated that inventory is large and costly investment. Better management of corporate inventories can improve cash flow and return on investment. The five purposes of holding inventory are (1) to enable the firm to achieve economies of scale; (2) to balance supply and demand; (3) to enable specialization in manufacturing; (4) to provide protection from uncertainties in demand and order cycle; and (5) to act as a buffer between critical interfaces within the channel of distribution. In inventory management, it can increase the ability to control and predict the reaction of inventory investment to changes in management policy. Total cost integration should be the goal of inventory planning. Management must define how much inventory to order and when to place the order to achieve least total cost, given the required customer service objectives. The ordering policy can be determined by minimizing the total of inventory carrying costs and ordering costs using the economic order quantity model (EOQ). It will be ordered whenever demand drops the inventory level to the reorder point. On the other hand, a fixed order interval model compares current inventory with forecast demand and places an order for the necessary quantity at a regular specified time. The interval between orders is fixed. This method facilitates combining orders for various items in a vendor's line. To improve inventory management, ABC analysis can be used as a technique to try to separate the important from the unimportant. An analysis divides inventory into three grouping by value: A items accounted for 5 percent of items and contributed 70 percent of sales, B items accounted for 10 percent of items and added an additional 20 percent of sales, while C items accounted for the 65 percent of the items remaining and contributed only 10 percent of sales. The last 20 percent of the items had no sales whatever during the past year. The first step in ABC analysis is to rank products by sales, or preferably by contribution to corporate profitability if data are available. The next step is to check for difference between high-volume and low-volume items that may suggest how certain items should be managed. In addition, ABC analysis is also a method to decide which items should be considered for centralized warehousing.

Water C. D. J. (1992)

He stated that inventory control is needed in every organisation. If stocks are not controlled appropriately, the costs can become excessive and reduce-an organisation's ability to compete. A real factor in an organisation's long-term survival is efficient inventory control. There are basically two approaches to inventory control:

- Independent demand systems using quantitative models to related forecast demand, order size and costs.
- Dependent demand systems using production plans directly to calculate stock requirements.

The basic questions to answer and the most important of these are:

- What items should be stocked?
- When should an order be placed?
- How much should be ordered?

He also mentioned that one quantitative model for controlling inventories is economic order quantity (EOQ) found to minimize total costs. Calculation of the economic order quantity answers the question "how much should be ordered? And reorder level calculation answers the related question "when should orders be placed?". When an order is placed, the stock on hand must cover demand until the order arrives. Both demand and lead time is constant and/or variable. For periodic review systems, two questions are considered as follows:

- How long should the interval between orders be?
- What should the target stock level be?

Moreover, he mentioned advantages of each system as shown below. The choice of the most appropriate system must be a management decision. It is not possible to say that one is always superior to the other.

Periodic Review System

- The stock level is only checked at specified intervals and does not have to be monitored continuously.
- It is useful for cheap items with high demand.
- It is the ease of combining orders for several items into a single order.

Fixed Order Quantity System

- It requires the stock to be checked continuously so that a message is given when stock falls to the reorder level.
- Orders of constant size are easier to regulate than variable ones.
- The system can cater for specific characteristics of each item.
- It gives lower stocks (the safety stock has to cover uncertainty in lead time rather than lead time plus the order interval time in periodic review system.)

In addition, a practical way of implementing the reorder level is a "two-bin system". Items are used from bin A and bin B provides an amount large enough to ensure that the stock can be replenished. Stock is used from bin B until the order arrives, at which point B is again filled with the reorder level and all extra units are put into A. This is similar concept of fixed order quantity system.

Smith S. B. (1989)

He stated that forecasts of demands for a company's products are fundamental inputs to a wide rage of decisions in production and inventory planning and control. Forecasting methods can be classified as qualitative and quantitative methods. Quantitative methods can be divided into intrinsic and extrinsic. Qualitative methods rely on human judgment and experience. Quantitative methods are procedures that employ mathematical models and past data to project the future. For intrinsic methods, they use only data on past demand for forecasting project future demand. Exponential smoothing is usually used intrinsic method in production and inventory control and suited to making large numbers of short-term, item-demand forecasts. Extrinsic methods use external factors that are related to demand for the item, possibly in a causal relationship.

Inventories serve an important function to the overall success of the firm. They also serve to protect against uncertainties such as fluctuations in demand and price changes. The principle costs in controlling inventories are ordering, carrying inventory, and shortages, which may involve lost sales or back orders. In deciding on a suitable method of control, it depends on whether the item is subject to independent or dependent demand. Independent demand items must be forecast while dependent demand items have lumpy, discrete demands, which can be calculated. There are two basic models for controlling inventory: order point-order quantity with continuous review and fixed interval order system. For fixed interval order system, it is simple to operate and is suitable for items with a stable demand and low ordering costs. The disadvantage compared to a continuous review system is a larger safety stock must be carried to provide the same level of customer service.

Tony Arnold J. R. (1998)

He stated that an order is placed when the quantity on hand falls to a predetermined level called order point in the order point system. Using the periodic review system, the quantity on hand of a particular item is determined at specified, fixed-time interval, and an order is placed. In addition, the periodic review system is useful for the following:

- "Where there are many small issues from inventory, and posting transaction to inventory records are very expensive. Supermarkets and retailers are in this category."
- "Where ordering costs are small. This occurs when many different items ordered from one source. A regional distribution center may order most or all of its stock from a center warehouse."
- "Where many items are ordered together to make up a production run or fill a truckload. A good example of this is a regional distribution center that orders a truckload once week from a central warehouse."

Buffa E. S. (1969)

He stated that the term "heuristic" originally meant aiding in or guiding discovery. It refers to a set of rules or guides to decision that is not necessarily optimal. It also is applied consistently, are efficient, and avoid a lot of complicated problem solving. In addition, he mentioned that heuristic methods in operations management have been applied in several problem areas such as assembly line balancing, facilities layout, job shop scheduling, warehouse location, inventory control, and the scheduling of large-scale one-time projects.

Jayaraman R. (1981)

This study considers on the implementation of a coordinated replenishment inventory control model to a department store. This model is appropriate for cases where there are a variety of suppliers and a large number of items supplied. Items are grouped into families and established a coordinated policy. This study uses an (S, c, s) policy which is a practical procedure for selecting the order-up-to levels, can-order points, and must-order points of a coordinated control system. Computer program was written for a coordinated replenishment policy as well as an independent control policy. Finally, cost comparisons with the independent control strategy indicate that substantial savings (averaging 18.95%) are possible through coordination.

Ratanamethanon C. (1991)

This study deals with the implementation of coordinated replenishment inventory control model to raw materials of a consumer product manufacturing company. The study uses a coordinated replenishment with periodic review for selecting the order quantity, order interval in combination with safety stock consideration. Deterministic demand is assumed. Raw material groups are classified by ABC analysis and supplier. Different policies are applied to each material group. Finally, cost comparisons of the coordinated model with the independent and the current system indicate that significant savings are possible through coordination.

Ying-Lin H. (1989)

This study deals with the optimization of inventory control policy and machine utilization for a hub wheel manufacturing cell. The related problem are how to analyze the machine utilization in the operation process and to determine the (s, S) control policies of the raw material inventory and of finished part inventory. In the phase of raw material inventory, the model was formulated by combining with EOQ, reorder point (s) and under the uncertain supplier lead time. In the phase of the finished part inventory, the probability formulation is to decide the optimal control level (L = S – s). A simulation approach for latter two cases is used to revise the reorder point of the raw material inventory and the L control level of the finished part inventory.

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Kunraksa C. (1998)

This study considers on inventory system for spare part management at cement plant. The study starts by categorizing these items into general and insurance items. ABC analysis is used for classifying the general items. Order point-order level or (s, S) policy is applied for the A items. The others that are used for scheduled maintenance should be managed by the material requirement planning (MRP) technique. For the items that used (s,S) policy, the study proposes new approach determining the optimal order quantity (Q) and the safety factor (k) simultaneously and then calculating the ordering point (s) and order level (S) respectively. So this study can save at least 77 million baht in spare part inventory costs. For the insurance items, the study applies the "Finite Queue M/M/S/K model" to determine their suitable stock level. A sensitivity analysis is also performed on the ratio of the average lead time to the mean failure free operating time to observe its influence on the stock level.

Sukhapanth J. (1994)

The objective of this study is to study the problem and to provide recommendations on the control of inventory supply of EGAT's office. Emphasis is placed on the application of the inventory supply model so that the total inventory cost could be minimized. The study found that from 345 sample size of inventory, when being prioritized by ABC analysis, 57 were in A type, 72 were in B type and 216 were in C type. With the use of EOQ model together with fixed order size system and fixed order interval system, the set up inventory cost could be reduced to about 52.34% or 3,836,019.70 baht per year.

Silver E. A. (1974)

This research deals with a control system for coordinated inventory replenishment. There are frequent occasions where the coordination of replenishment orders for selected groups of items can lead to significant savings in the costs of replenishment. This study is concerned with a practical procedure for selecting the order-up-to-levels can-order points and must-order points of a practical coordinated control system Demand is Poisson and a fixed non-zero replenishment lead time is assumed. Finally, cost comparisons with the best independent control strategy indicate that substantial savings (average 18% over some 104 examples) are possible through coordination.

Schaack J. P. and Silver E. A. (1972)

This research considers an inventory situation where the control procedure is dependent in nature. An item is allowed to be included in a replenishment triggered at that moment by the necessity of ordering another item. The research develops procedure for selecting the control variables (order-up-to-levels, can-order points and must-order points) of an (S, c, s) system. The procedure us a combination of mathematical optimization and simulation. The cost savings over a usual independent inventory system are shown.