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NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

THE LOGISTIC SYSTEM CONCEPT
AND FOREIGN MILITARY SALES,
U.S. NAVY - ROYAL NORWEGIAN NAVY

by

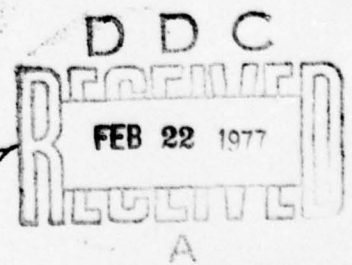
Karsten Haukeli

December 1976

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It is concluded that there is a good fit between the existing FMS organization and the theoretical logistical model. Areas of special concern are identified to be order processing, communications, transportation and training of individuals in the customer's FMS organization.

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The Logistic System Concept
and Foreign Military Sales,
U.S. Navy - Royal Norwegian Navy

by

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Graduate from the Norwegian Naval Academy, 1969

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

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ABSTRACT

A conceptual framework for a logistic system is developed. The functional activities within the logistic system, their relationship to each other, and how they should be managed is described.

The existing organization for Foreign Military Sales (FMS) in the Royal Norwegian Navy and the U.S. Navy is identified, including an example of a typical FMS transaction.

An evaluation of the FMS system is made, partly based on the conceptual model of a logistic system developed earlier. The evaluation is also based on gathered information and the author's personal experience with FMS.

It is concluded that there is a good fit between the existing FMS organization and the theoretical logistical model. Areas of special concern are identified to be order processing, communications, transportation and training of individuals in the customer's FMS organization.

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I. INTRODUCTION

The logistic system concept and the technology of logistics have made remarkable progress and also gained substantial attention among business executives during the last two decades. Also, the systems approach in looking at logistics has been recognized within industry and throughout the business world. Logistics is now considered to be a productive functional area that can be managed to increase the profitability of a company.

Traditionally, in their effort to reduce cost and improve profit, businessmen concentrated their effort on the manufacturing part of the enterprise. Production techniques were constantly improved; however, the efforts to reduce costs within the field of production have in many companies reached a point where relatively little can be gained. Consequently, business managers now turn their attention to the non-manufacturing operations of their business in their cost reducing efforts. Those operations will include functions such as procurement, transportation, warehousing, inventory control and materials handling, all of which are considered integral parts of logistics.

Also in non-profit oriented organizations like the Royal Norwegian Navy (RNON), the logistics function has become a major part of the activity, both in terms of scale and importance. A well organized and properly managed logistic system is essential for the operational units in order to carry out their functions.

The systems approach in looking at logistics involved designing it and managing it as a whole, rather than as a series of discrete, independent functions. If their interdependence and interrelationships are not recognized, sub-optimization will often occur with a resulting reduced efficiency and overall results for the organization.

One way to avoid the above and to improve the way of thinking and the organizational performance would be to inform and educate the members of the organization about existing theories and ideas within the field. The logistics part of this thesis is intended to be one tool to achieve this.

Foreign Military Sales (FMS) have become a growing function within the Naval Material Command, RNON. Since the Fleet Construction Program of 1960, which was in part funded by the United States, Grant Aid given under the Military Assistance Program, has been substituted by FMS.

In order to make an efficient use of the FMS option in providing logistic support for the RNON, an overall knowledge and basic understanding of FMS' historical development, its organization and procedures are important. It is the impression of the author, that the field of FMS is too little studied and inadequately understood within the RNON. To include some discussion of it in this thesis might serve as a means to increase the general interest and stimulate further studies into the various aspects of FMS.

The U.S. Navy's and the RNON's FMS organizations, and the functions they perform can readily be compared to and placed within the framework of a logistic system. Even if the FMS-system seems to function satisfactorily, it might be useful to make an evaluation of it with a view to theories suggested by a theoretical framework. Weaknesses with the system might in this way be discovered or one can get a confirmation that theory and practice are matching each other.

II. THESIS INTENT

The purpose of this thesis will be to provide a source of general information about the logistic system concept and show how this can be related to Foreign Military Sales from the U.S. Navy to the Royal Norwegian Navy. It is also the purpose to identify problem areas within the FMS-organization or areas within which improvements might seem possible.

The evaluation of the FMS-system will be based on the theoretical concept of a logistic system presented in Chapter III. It will also be based on findings made during research and study of the existing FMS-system and on the author's personal experience as a customer of the system.

The development of the logistic system concept in Chapter III was made within the context of an industrial firm. Military organizations like the U.S. Navy and the RNON will have different goals and objectives than those found in a private company. Special requirements and priorities will put different demands on a military logistic system than what will be the case in private industry. Consequently, the theoretical framework as presented in the following chapter cannot be adopted without critical evaluation and necessary

modification in order to meet the military requirements. Realizing this limitation, comparisons between the FMS-system and the Logistic System Concept will only be made when applicable.

It should be pointed out that it is not the intention or the purpose of this thesis to find causes of problems that might exist or suggest solutions. It is however the hope that some of the problem areas identified will be made subjects for further studies in order to find causes and propose solutions.

The thesis will be constructed as follows:

Based on a survey of current literature, a conceptual framework for a logistic system will be developed.

Next, the current organization for FMS within the U.S. Navy and the Royal Norwegian Navy, the existing routines and procedures will be described. An example of the flow of a typical FMS case will be included.

Finally, an evaluation of the existing FMS system will be made and problem areas identified. No ranking of problems in terms of severity will be attempted.

Potential readers of this thesis are assumed to include members of the RNON organization.

III. THE LOGISTIC SYSTEM CONCEPT

A. INTRODUCTION TO LOGISTICS

Logistics can be defined as the physical movement of goods from source of supply to final sale to customer and the associated handling and holding of such goods at various intermediate storage points. (2, p. 4) Logistics would include such functions as purchasing, inventory control, warehouse operations, materials handling and transportation.

For the purpose of classification, logistics can be divided into two main subsets of activities, physical supply, and physical distribution. Physical supply, often also called materials management, includes the movement and storage of raw materials and/or semi-finished products from source of supply to the point of manufacturing. (3, pp. 4-5) Physical distribution on the other hand, includes all activities involved in movement and storage of finished goods from the end of the production line to the customer. (7, p. 28) Refer to Figure 1 for a pictorial presentation of this classification. Figure 1 also shows the activities normally considered included in each subset of logistics.

It should be noted that the movement of materials from the supplier to his customer is physical supply from the

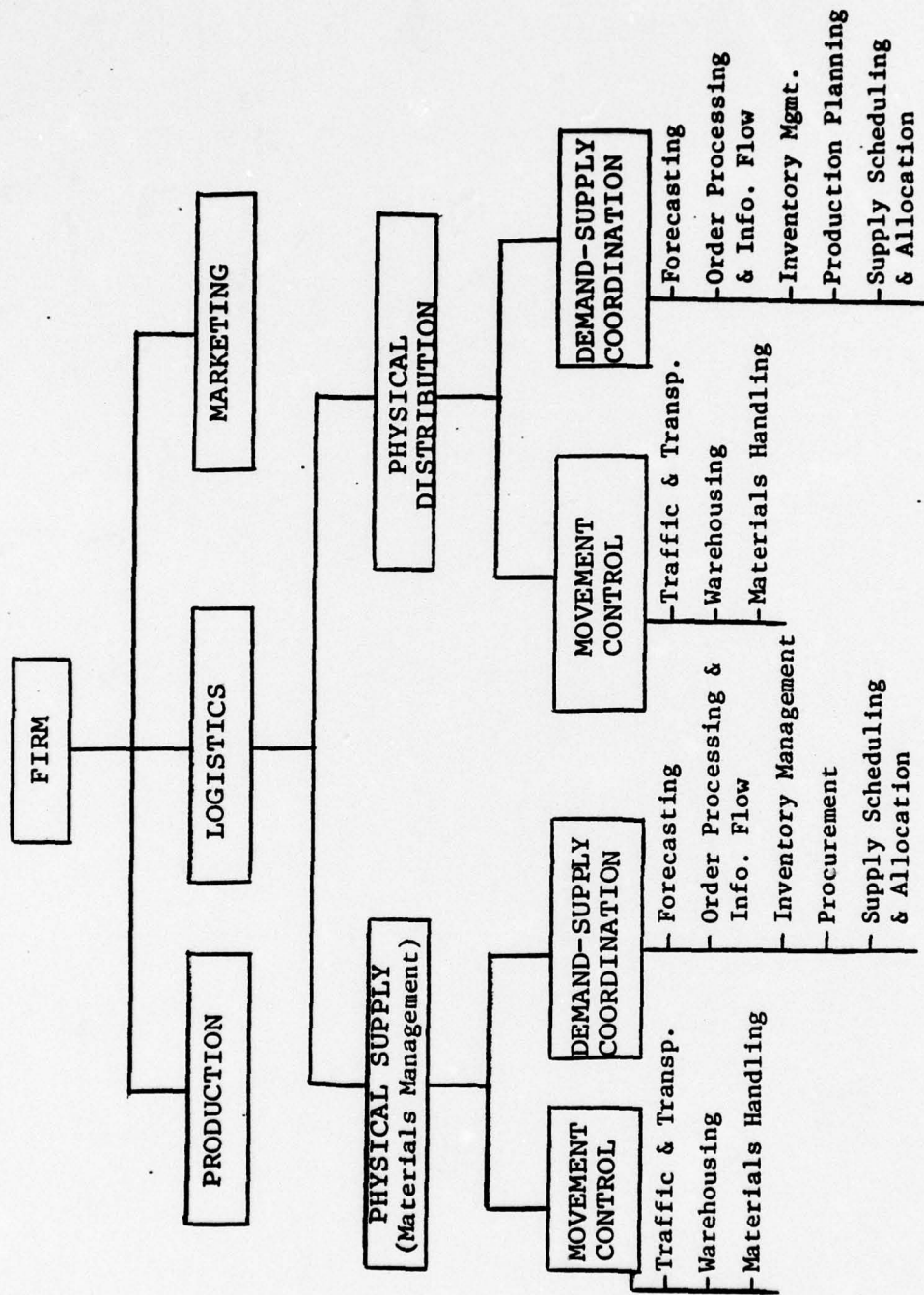


Figure III-1. Breakdown of the Logistics Activities. (7, p. 27)

customer's point of view, but physical distribution for the supplier. Consequently, both physical supply and physical distribution is accomplished by the performance of a common set of activities dealing with demand and supply coordination and movement control.

B. LOGISTICS AND UTILITY CREATION

Utility can be defined as addition of economic value to a product. Different kinds of activities performed in a company create different kinds of utilities in the company's product. These different kinds of utilities and their creation may be classified as shown in Figure III-2.

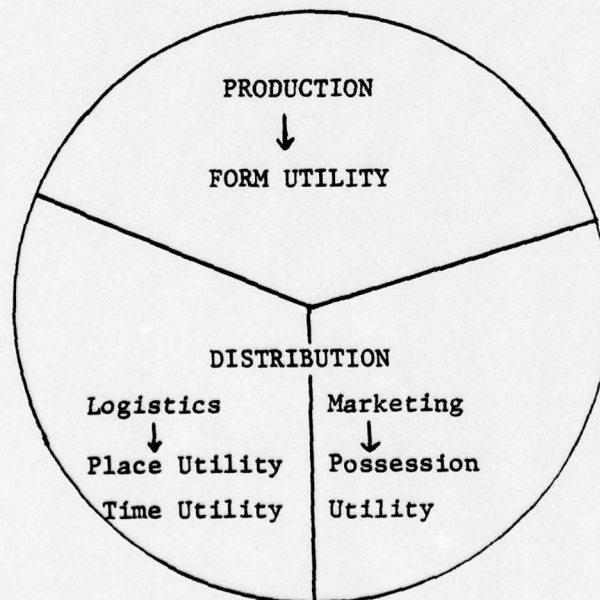


Figure III-2. Fundamental Utility Creation. (3, p. 25)

Form utility is created in the production department by the design and general physical appearance given to the product. The creation of possession utility is mainly being done by the marketing side of the firm. Through contact with the market, promotional efforts increase the desire or call latent desire to mind in the customer, to possess a good or benefit from a service. (7, p. 11) Logistics create time and place utilities in goods and services. Place utility is created primarily by transportation, time utility primarily by inventory maintenance, and the strategic location of goods and services. To some extent, transportation may also play a role in time utility creation by quicker movement of some goods to a point of demand. An example would be the use of air transportation as a substitute for warehousing.

C. LOGISTICS - THE CONCEPTUAL FRAMEWORK

The existing literature within the field of logistics differ to a great extent in the way of looking at a logistic system and how to approach it for the purpose of study and presentation.

One approach would be to consider the logistic system to be composed of two basic elements, namely fixed points and a transportation network. The fixed points may vary in

number from two to several thousand, depending on the size and nature of the business. These fixed points are connected by a transportation network, in which the goods are moving, in contrast to the fixed points where it is stopped. The functional activities being performed at the fixed points include for instance storage, management and inventory control of finished goods, raw materials or spare parts. Activities performed in the transportation network will include for instance the intraplant transportation of raw material, semi-finished or finished goods or line haul transportation. (10, p. 62)

Another interesting way of explaining a logistic system is to look at its parts as being either determiners, components, or integrators. Determiners are thought of as elements outside the system which must be accepted and dealt with in order to operate the system. These elements will include suppliers, customers and carriers. To call elements like the above determiners is appropriate, because to a great extent they determine what a logistic system can accomplish. By their very nature, being more or less outside the control of the logistic manager, the logistic system often has to adjust to them. This would especially be the case when dealing with customers.

Components are the physical elements of which a logistic system is built and include buildings, people, machines and departments which have been arranged according to a design. The components are essentially the firms own creation. They can be controlled, rearranged and redesigned for the purpose of improved efficiency of the company.

Integrators are the intangible factors which tie the components of a logistic system together. They are essentially the management activities and techniques which monitor the system and make it work. Integrators, like the components of the system, are controllable by the firm.

In operating an efficient logistical flow, the logistician must be willing to take responsibility for the performance and actions by all components involved in spite of the limited authority and control he has over many of them. It is also important to be aware of the fact that a logistic system has a strong tendency to cohere, that is, a change in any part of the system causes a change in, or has an influence on, the entire system. Thus, an action by a supplier, a customer or a carrier could affect the entire logistic operation. This implies that the logistician's task has to be a dynamic one, which must be continually performed to keep the system working smoothly. (10, pp. 63-64)

D. THE ACTIVITIES OF A LOGISTIC SYSTEM

No universal agreement has yet been reached upon which elements to include in a theoretical presentation of a logistic system. It is also doubtful whether agreement ever will be reached because it will vary, all depending on the circumstances and the kind of business within which the logistic system is set up to function. For the purpose of this presentation, a typical manufacturing organization will be used as a framework. Figure III-3 shows one possible way of viewing the logistic flow in such a firm. As can be seen from the figure, basically two sorts of goods are involved in the total logistic chain; raw materials flowing into the production area and finished products flowing out. The following is a short description of the individual activities/ functions to be found in such an organization.

1. Production Scheduling and Control. Production scheduling requires decision as to when goods should be produced and in what quantity. This will mean that logistics will have to inform production when certain types of goods will have to be produced and the quantity necessary, based upon sales forecasts and inventory levels of the various products. The corresponding need for raw materials must also be kept track of and requisitions issued to purchasing.

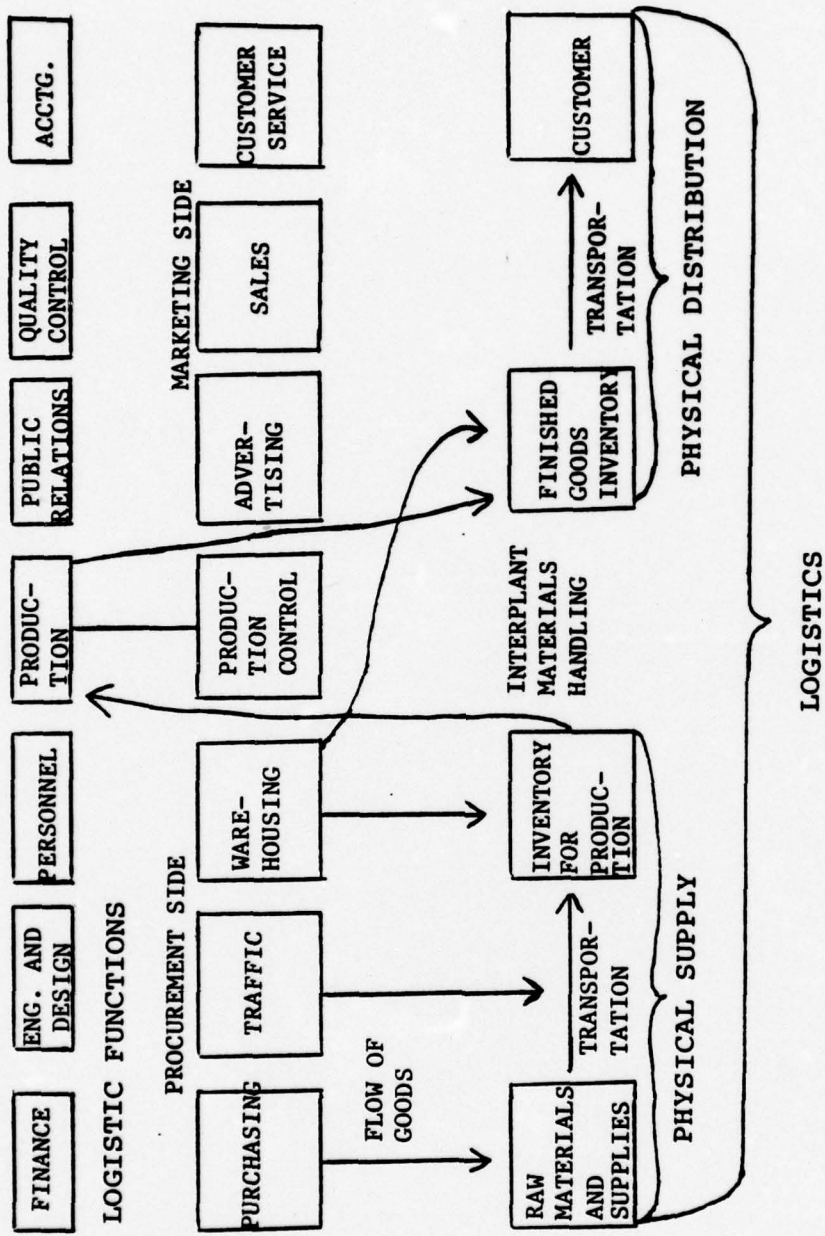


Figure III-3. Logistics Flow in a Manufacturing Organization. (10, p. 69)

2. Purchasing. The reason why one would include purchasing in logistics is the relationship that exists between transportation and the amount and geographic location of raw materials and parts which are purchased for the production need of the company. The way purchasing is performed has an important impact on both transportation and inventory costs. In addition, the purchased raw materials are of a vital importance in supporting the manufacturing capability of the company.

3. Traffic. This department determines methods for movement and provides transportation for purchased parts and raw materials. It also arranges for release and transportation of finished products to the customers.

4. Storage. This function is closely related to transportation and is often divided into: a) Inventory Management, and b) Warehousing. There is a relationship between the selected mean of transportation and the level of inventory required in one or more warehouses. It is important for the logistic manager to realize the trade-off that can be made between the mean of transportation used, and the number of warehouses and level of inventory stored therein. Total costs may be reduced by increasing transportation costs for the purpose of reducing costs in inventory and warehousing.

If this cost reduction is greater than increased transportation cost, total costs will be reduced.

5. Materials Handling. Materials handling is important to the efficient operation of a warehouse. It involves the movement of goods into the warehouse and their placement therein, the movement of finished goods from storage or order picking area and eventually out of the warehouse to be loaded for transportation to the customer.

6. Industrial Packing. The type of transportation selected has an important impact on packing requirements. Trade-offs should be considered between packing and means of transportation. Because of the close relationship between packing and transportation, it may be argued that packing should be part of the logistician's responsibility.

7. Sales Forecasting. Based on inputs from the market research division, the logistic manager may often have to do forecasting for inventory purposes. Sales forecasts received from marketing are not always suitable for logistic purposes and may need recasting. Recasting may also have to be made to find out specific geographic requirements. The logistician must therefore know the various forecasting techniques available.

8. Order Processing. Order processing includes those activities involved in filling a customer's order. If we

look at logistics in a time perspective, one of the important factors is the time elapsed between the customer's purchase decision being made and the delivery of the goods. The time used on the communication surrounding the routines established to process an order is often significant compared to the time used for the actual transportation of the goods. The firm can make a trade-off between the established system for order processing and the means of transportation selected. By making order processing a part of logistics, possible improvements can easily be examined. These improvements may require additional expenses, but allow the firm to reduce transportation costs by not having to use a premium means of transportation.

Which of the elements listed above to include in a given logistic system and make their function the responsibility of the logistic manager, will depend on the characteristics and environment of the firm in question. No matter what kind of logistic organization a company may establish, an important task will be to make all the elements work together as a whole, without any department trying to suboptimize its own position. By placing all activities listed above under the management of one capable executive, the logistic function can be optimized without adversely affecting other departments, for instance production. If, in addition, the

logistic system is staffed with skilled people, the logistic manager will be in a position to make the system respond to the company's goals and objectives.

E. THE ORDER AND REPLENISHMENT CYCLES

Before starting to discuss the management of some of the major areas within the logistic system, it will be useful to include an overview of the order and replenishment cycle.

The total order cycle represents the elapsed time from an order being placed to the merchandise receipt and includes communication, order processing and transportation.

A logistic system also represents one or more replenishment cycles, depending on the number of levels at which inventories are held. The order and replenishment cycles are interdependent; that is, the time elapsed in the order cycle depends on whether the replenishment cycle is activated or not. In Figure III-4, a typical two-stage distribution system is shown. (A two-stage system implies the existence of one order cycle and one replenishment cycle).

1. The Order Cycle

(1)* The order cycle starts at the customer with the identification of need for an item. The time involved

*Refer to numbers in Figure III-4.

for this identification will vary, depending on the nature of the customer's inventory control system. The system may be manual or computerized, be updated on a real time, daily or maybe weekly basis. Consequently, the time lapse between the occurrence and identification of a need for an item may vary a great deal among different organizations, ranging from a few seconds to a week or more.

(2) The next step involves accumulation of orders to meet economic order size requirements. (See section on inventory, its control and maintenance.) The delay involved may add up to a week or more to the order cycle time.

(3) Order communication between customer and supplier may be achieved by a number of different means, like a supplier's salesman, direct mail, telephone or some other electronic method. There exist examples where the time required to transmit an order from a customer to his supplier represented 75% of the total order cycle time.

(7, p. 240) In an effort to reduce this time, more emphasis should be placed on communication and order processing.

(4) When an order is received at the supply point, a series of steps might be required, such as credit or credit limit check for the customer, inventory records updating, inquiry into the updated records or any other information processing ability necessary. As shown in Figure III-4,

these functions can be either centralized or decentralized. Decentralization will in most cases save some time required for communication.

(5) If the items ordered are not in stock at the supply point, the following options may be available to the supplier.

(a) Split the shipment by delivering what is available and back order the rest.

(b) Hold the entire order until replenishment action is completed.

(c) Order the items from other supply points, if available.

(d) Purchase the out-of-stock items from other sources.

(e) Cancel the order for items not in stock.

Whenever stock replenishment is necessary, the time required may vary considerably, ranging from a few days in the case of transfer from another supply point up to several months in cases where production for replenishment must be scheduled weeks in advance.

(6) The order picking and packing may be carried out in a number of ways, with varying degrees of automation. The picking and packing time is influenced by:

(a) degree of automation;

(b) complexity of orders;

(c) size and complexity of distribution facilities from which orders are filled. The picking and packing operations normally consume small amounts of the total order cycle time. (7, p. 242)

(7) Transportation time varies in length with:

(a) the size of shipment;

(b) mode of transportation;

(c) the transportation distance.

(8) The order receipt is carried out by the customer, and the time consumed for this purpose is normally short. However, if the volume of receipts are great compared to normal workload, a delay in the order cycle may result.

2. The Replenishment Cycle

Step number 5, above, stock replenishment, is a primary determinant of the order cycle time. Whether a replenishment in connection with a given order should be required or not is theoretically within the control of the supplier. Simply by keeping a sufficiently large stock at the supply point, delays caused by replenishment actions can be eliminated. However, this might turn out to be a costly approach, caused by high inventory holding costs.

(A)* Often, items for replenishment are shipped in car-load or truckload quantities, requiring items to be accumulated to meet minimum quantity requirements, with resulting time lags in the replenishment cycle.

(B) Order placement and communication are often automated for replenishment purposes and the time lag for this function is reduced to a minimum. However, updating of inventory, depending on the method used, may produce a certain delay in the cycle.

(C-G) The time involved in these steps are mainly dependent on the established routines and may vary a great deal. If the procurement or production process has to be brought into the cycle, considerable time-lag may result. Normally, only the replenishment time will be affected; however, in a stock out situation it will have a direct effect on the order cycle time.

(H) Determinants for the time involved in receiving are mainly labor, equipment and facility capacity.

The time lag caused by various stages in the order and replenishment cycles will vary, with a resulting variation and uncertainty about the total order cycle time. In Figure III-5, the typical probability distribution for the time

*Refer to letters used in Figure III-4.

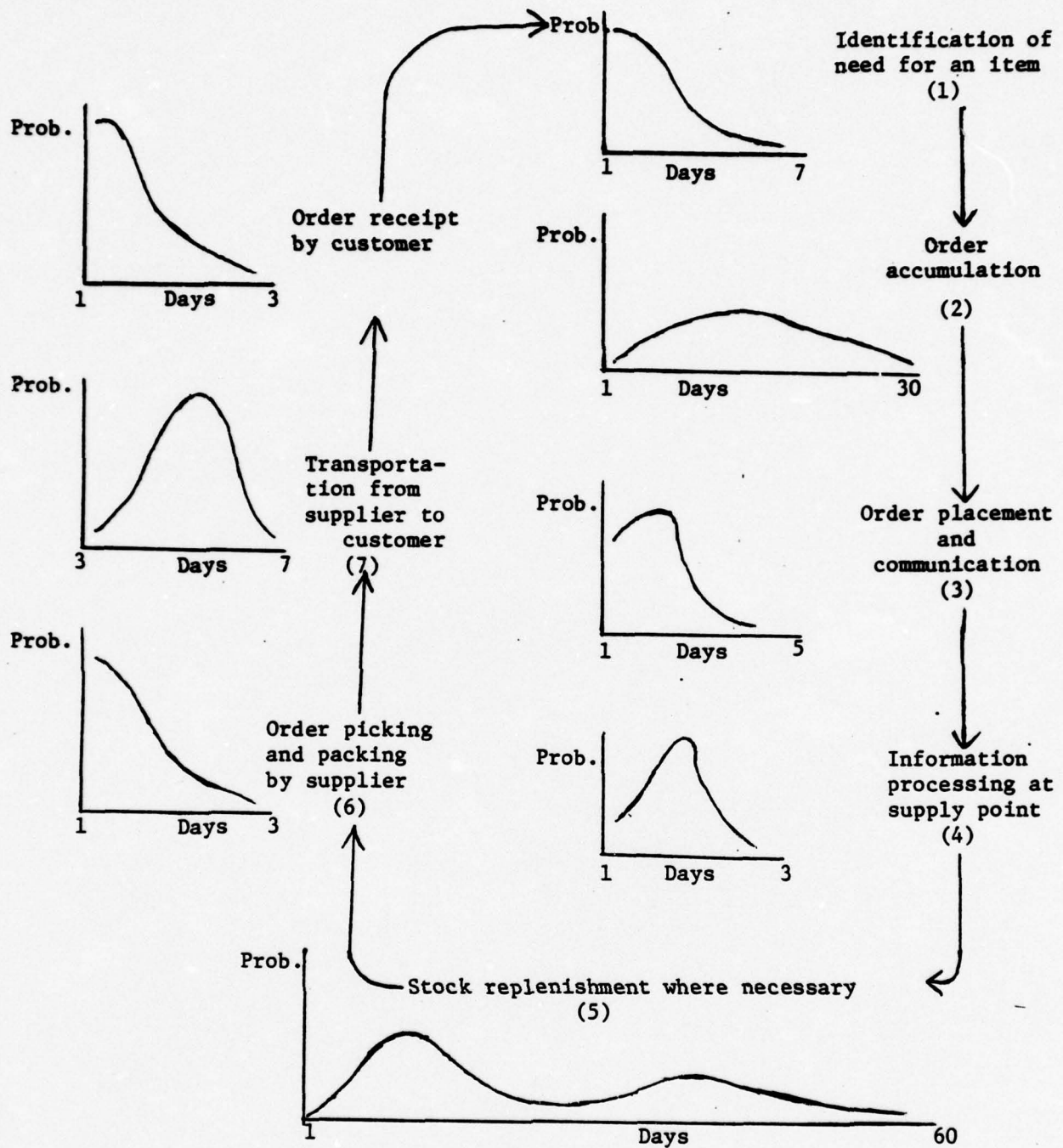


Figure III-5. Frequency Distributions of Times Required to Complete the Stages in a Typical Order Cycle. (7, p. 246)

required to complete each stage of the order cycle is given. The number of days listed on the horizontal axes is based on general experience about each stage (7, p. 244), and the distributions are shown to give an idea of what they normally look like. As can be seen from the figure, the time involved in each stage can vary greatly and the most likely time can be read from each graph.

When an order for an item is placed, stock on hand must be sufficient to cover customer's demand during the order cycle time. The longer this time, the larger stock on hand is required when placing the order. In addition, there are also uncertainties about the actual demand for an item over a given period in the future, a fact which adds to the already existing problem caused by uncertain lead time for an item.

To be protected against these uncertainties, safety stocks are held. Safety stocks, of course, add to the inventory holding costs and are obtained by setting the reorder point at a higher level than would have been required under certain demand and cycle time. This topic will be further discussed in connection with inventory control and management.

F. MANAGING THE LOGISTIC ACTIVITIES

Under the above heading, the following areas, considered to be of major importance to an efficient operation of a logistic system, will be covered; namely, materials handling and packaging, inventory and inventory control, warehousing and transportation.

1. Material Handling and Packaging

A major factor contributing to the internal efficiency of a warehouse operation is the set of activities generally called material handling. Another important factor contributing to this efficiency is packaging.

a. Materials Handling

Materials handling can be performed either by means of mechanical equipment or by manual methods. It can be defined as short distance movement of goods or material usually taking place within a building such as a plant or a warehouse, or between a building and a transportation agency. In a modern logistic system, this short distance movement is most often performed by means of highly specialized equipment, designed to do the work rapidly and efficiently.

One of the basic features of an efficient materials handling system is that it provides for the usable capacity of the warehouse facility being as close to the theoretical maximum capacity as possible, for instance, by

use of handling equipment that allows utilization of practically the entire height of warehouse building or narrow down-the-aisle space to the maximum extent possible without causing inefficient movement in the facility.

Another indication of a well-designed and efficient materials handling system is that the number of times the same unit of commodity has to be handled is cut down to a minimum. When working to improve the logistic service of a firm, the materials handling activity should be given a close look. It plays an important role in getting goods to customers in time, in the right quantity and condition. Also, when it comes to serving the company's own plant, materials handling is an important function. It is therefore important that the logistic manager is constantly looking at his materials handling system, to make sure that it will respond quickly and efficiently to customers' orders and the requirements of a production schedule.

b. Packaging

Packaging, like materials handling, is of great importance to the logistic manager. The size, shape and type of packaging affect material handling, warehouse operation and transportation of goods to the customer. Packaging is important for effective damage protection and must be designed to provide adequate protection to the product when

being stored or handled in the warehouse and during transportation. A package might drop from a conveyor or a truck, be hit by a forklift or simply be exposed to "normal" rough handling. Goods arriving to a customer in a damaged condition are likely to have a negative effect on future sales.

Packaging also provides information about what is inside the package and thus helps to identify the product. It is important from the logistic manager's point of view that goods be identified properly so that they can be located easily and correctly, assuring that the right product for an order is provided. Information about how the product should be handled, transported and stored can also be printed on the package. In general, providing the required information correctly and easily to people who are going to deal with the goods is an important role of packaging.

The packaging technology has advanced at a rapid rate in recent years. An example of this new technology is the use of newly developed packaging materials and utilization of the new technology within printing.

Even though packaging technology has advanced in recent years, packaging still represents a considerable cost. For manufacturers of consumer goods, packaging costs represented 18.6% of gross sales in 1967, a decrease from 27.9% in 1954. (7, p. 372)

In managing the packaging and packaging design, it is important to have a good understanding of the number of cost trade-offs and cross-functional relationships that exist. The wide variety of considerations that must be taken into account make packaging a complex area of management.

Figure III-6 gives a condensed presentation of some of the important considerations to take into account when designing product packaging. The importance of each of these in a given situation will vary with such matters as the characteristics of a product, the market to which it is sold and the channels of distribution through which it is passed, as well as the cost and performance of various packaging alternatives. For the sake of completeness, the considerations listed include those also given by departments other than logistic.

2. Inventory, Its Control and Maintenance

a. Inventory - General Discussion

The inventory carried by a production company can be classified into two basic kinds, physical supply and physical distribution inventory. The first category of inventory will basically be raw materials and the second finished products.

(1) Raw Materials. Any given organization may have a variety of reasons for carrying inventories of raw

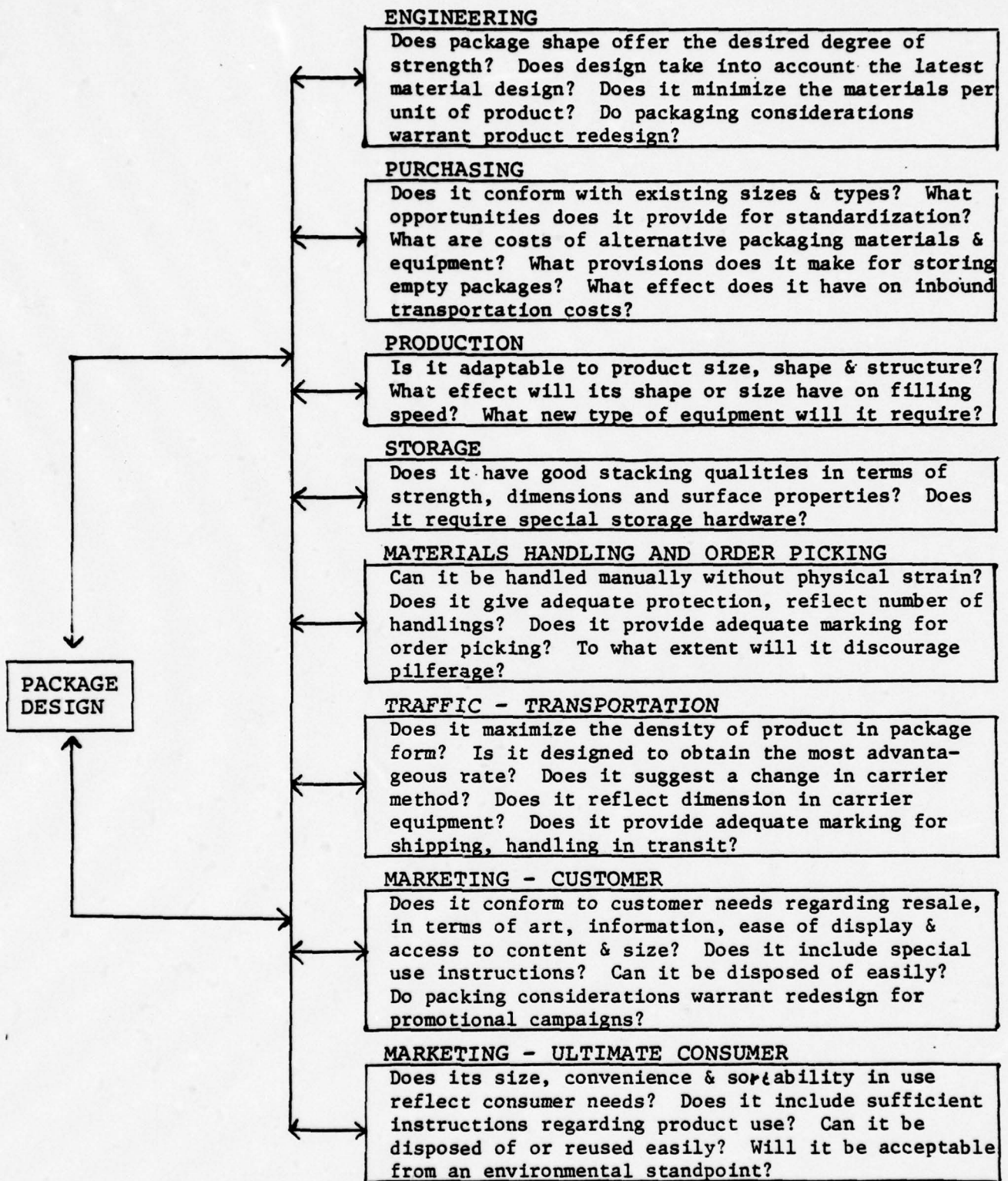


Figure III-6. A Sampling of Important Considerations in Product Package Design

materials. However, basic to most companies' decisions regarding the holding of inventory, will be assumed or proven cost savings related to the established policy.

One reason for a company to keep a stock of raw materials is the economies achieved by purchasing in large quantities. Suppliers often give quantity discounts for orders above certain quantities. Further, transportation costs may also be reduced. These costs usually represent a significant portion of the final cost of raw materials. A reduction in transportation rate, even a small one, can be of great importance, because the overall volume of raw materials transported, and the importance of transportation cost for final price of raw materials.

Also bearing in mind that warehousing costs for raw materials are relatively low, they can even often be stored out in the open; total materials costs can be reduced through large volume movement, the reason being that inventory and warehousing costs may not increase as much as the reduction in transportation costs. Whenever the savings from buying in large quantities are greater than the added cost from holding the excess inventory, overall company economy will benefit from such action

Another reason for carrying physical supply inventory would be to prevent a production line shutdown

caused by a delay in filling orders for raw materials. The safety stock level of raw materials will vary depending on the probability of events which might delay delivery, the overall volume of raw materials utilized and the cost of closing down and starting up production. The trade-off to be made in this case would be between the costs of holding a given safety stock and the costs related to a stock out.

Raw materials of seasonal supply are often accumulated in inventory to obtain a balanced production. Agricultural products of various kinds may serve as an example. The trade-off would be between added costs of holding inventory and the lower costs of a balanced production.

Physical supply inventory is sometimes held for speculative reasons. The desire to speculate may be based on a fear for future price increase or a discontinuance of supply.

A final reason to be included is the desire to maintain supply sources which are needed during the peak demand season for the company's products, but not really required during periods of low demand. To maintain these sources and keep them operating on a regular basis, certain

quantities of raw materials are purchased also during the off season and put into the warehouse.

Whatever the reasons for holding physical supply inventory might be, there are certain economies or cost reductions involved, which the companies must be trading off against the increased warehousing and inventory costs.

(2) Finished Products. The first reason to be mentioned why companies carry physical distribution inventory is transportation economies achieved by shipping in larger quantities. Only by accumulating the production output in inventory over a period of time, can quantities large enough for economic shipments be obtained. As long as these cost savings caused by large shipments are greater than the added inventory holding costs, the firm will be better off by shipping in large quantities.

A second reason why a firm may want to accumulate finished goods inventory is production economies. Unit cost of production can be reduced by producing in relatively long production runs, without stopping or changing to another of the company's products. However, such big production runs will often mean production in excess of and in advance of demand. As a result, the goods produced will have to be carried in inventory until depleted by demand

over time. Lower production costs will be traded off against increased costs by holding the excess productions in inventory.

Companies having a seasonal demand for their products may not find it efficient to have production capacity to meet the peak seasonal demand. The best policy might be to produce on a regular basis throughout the year in a somewhat smaller plant than otherwise would be needed. Production taking place during the low demand season would have to be inventoried for later sale during the high sale season. The economies obtained by having a balanced production and a stable work force must be traded off against the added inventory holding costs.

Physical distribution inventory is also held to improve customer service and reduce the probability of costs because of lost sales. The trade-off would be between these reduced costs and the inventory costs.

It should be noted that the various reasons mentioned above for carrying physical supply and physical distribution inventory may occur in a given firm in any combination.

b. Inventory Control and Maintenance

Two fundamental questions that must be answered in the context of inventory control and management are when

should an order be placed for an item and in what quantity should it be ordered. As a framework for discussing this, a simple system like the one shown in Figure III-7 below will be used.

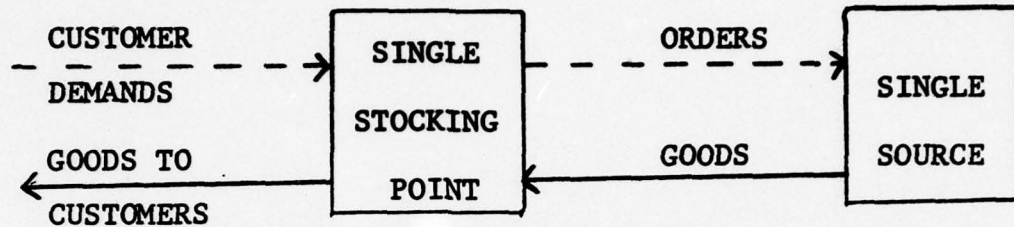


Figure III-7. A Basic Inventory System.

Customer orders are received at a stocking point and at appropriate times orders are placed with the supplier. The way such an inventory system is operated in terms of order quantities and order points is often referred to as "the system's operating doctrine." Costs of performing various functions within the system are major factors in determining what the doctrine in a given system will be. The costs to consider are only those that vary with a change in the operating doctrine.

There are basically four categories of costs that may be of importance in determining order points and order quantities. These are: (1) the costs associated with procuring the unit stocked, (2) the costs of carrying the item in inventory, (3) the costs associated with demand

occurring when the system is out of stock, (4) the costs of operating the data gathering and control procedures for the inventory system. Each of those four types of costs will be discussed briefly in the following.

(1) Order Costs. These are costs that are incurred as a result of placing an order for an item. They are considered to be fixed, regardless of order size, but may vary considerably from one inventory system to another. In a situation where production of an item is not involved in connection with an order, the order cost would typically be composed of costs for the following types of operations: (1) review of the inventory level, (2) preparing and processing the purchase request, (3) selection of supplier, (4) preparing and processing the purchase order, (5) preparing and processing receiving reports, (6) inspecting the goods received, (7) posting the receipts on stock records, (8) preparing and processing payments.

When an order for goods necessitates a production line to be set up, the following costs will have to be added: (1) review the stock of raw materials, (2) preparing and processing work orders and materials requisitions, (3) removing excess materials from production line, (4) assembling the new materials required for the

different production run, (5) repositioning and instructing labor, (6) expected delay before smooth operation begins.

As mentioned earlier, order costs are considered fixed regardless of order size. As the order size increases, the number of orders per unit of time will decrease, and so will total order costs for the same time interval.

(2) Inventory Carrying Costs. These costs include all the costs necessary to hold a given quantity of goods available in inventory. They include costs of insurance, taxes, warehouse rental, and breakage and pilferage at the storage site. Inventory carrying costs also include costs of operation such as heat, lights, night watchman, etc., and costs caused by depreciation and obsolescence, an example being fresh fruits and vegetables, which will depreciate in value or become obsolete when stored. The final component of inventory carrying costs to be included is classified as opportunity costs. These costs represent a significant part of total carrying costs and are incurred by having capital tied up in inventory rather than having it invested elsewhere. Opportunity costs will be equal to the highest rate of return which the system could obtain from alternative investment. By having funds invested in

inventory, this rate of return is foregone, and hence represents a cost of carrying inventory.

Although it might be simplifying assumptions for parts of the cost components mentioned above, for the purpose of deciding on an operating doctrine, inventory carrying costs are considered to be varying proportionally to the value of the goods kept in inventory, and are normally calculated as a percentage per dollar invested.

(3) Stockout Costs. These are the costs of not having an item available when it is needed. If this item is some raw material needed for production, a stockout would mean shutting down a production line or some part of a productuin process. The opportunity loss from such a shutdown may be considerable and should be compared to the costs of holding sufficient inventory.

In a physical dis...ation environment, the result of a stockout can either be a back order or a lost sale. Back order costs are difficult to measure, since they may include such things as loss of customer's goodwill; he may in the future take his business elsewhere. Other costs which are easier to measure but less significant would include all the extra costs incurred by using a special established back order procedure.

Also, when the stockout results in a lost sale, a number of different costs are involved. In addition to a loss of profit caused by the lost sale, the most important component here will probably be costs related to lost goodwill. The customer may temporarily or permanently take his business elsewhere and may even discourage potential customers by telling them about the unsatisfactory service. In addition, costs will also include any special procedure used to inform a customer that his demand cannot be met.

(4) Costs of Operating the Information Processing System. In order to use any operating doctrine, an inventory system must gather all the information required. The costs may include costs of having a computer continuously to update the inventory records, the costs of having physical inventory counts, or the costs of making demand predictions.

The task of performing inventory control and management will differ depending on the kind of organization and inventory system used. For the purpose of presentation, it is useful to consider two basic types of situations in which to operate an inventory system, namely, inventory management under certainty and under uncertainty.

c. Inventory Management Under Certainty

Determining an inventory operating doctrine under conditions of certainty is a relatively simple task. Certainty implies that one know exactly the amounts of products that will be demanded each time period, exactly the required time to schedule and accomplish new production and exactly the time required to replenish the inventory of some purchased product. Stockout costs will not have to be worried about, because stockouts will simply not occur.

In determining the quantity to order of an item, there are two major costs to be considered and traded off against each other. These are the costs of placing an order and the costs of carrying inventory. If we increase the order size, the average inventory on hand will also increase. Assuming a constant rate of demand, average inventory on hand is computed by dividing order quantity, Q , by two ($\frac{Q}{2}$). Reference Figure III-8. The result will be higher inventory carrying costs. On the other hand, the more we order each time, the fewer orders we will have to make in order to procure a given quantity of commodity. This relationship implies that the costs of carrying and ordering inventory vary inversely. This is shown graphically in Figure III-9. We can see that the optimal number of orders

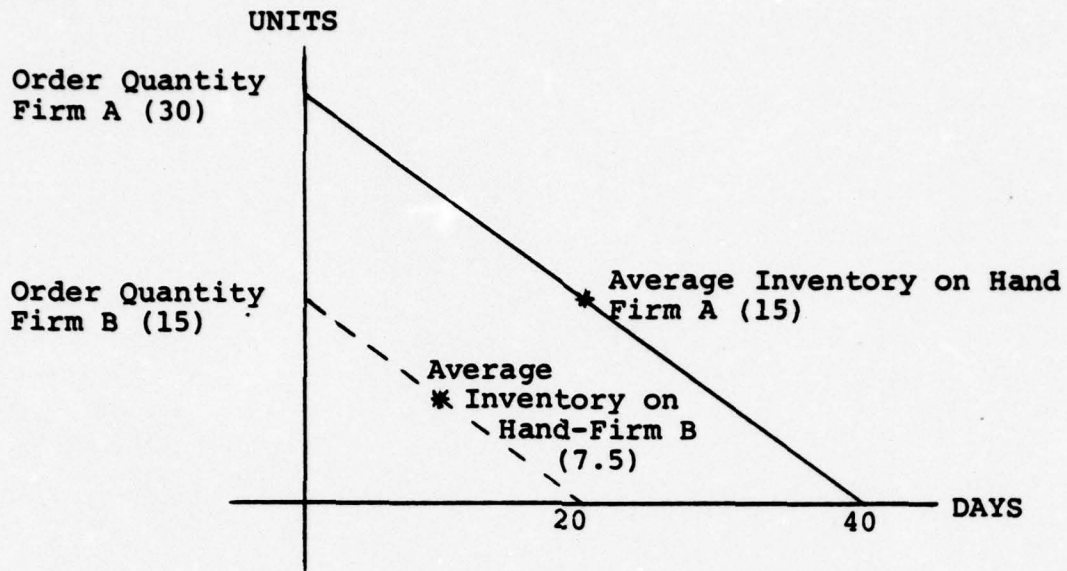


Figure III-8. The Effect of Order Quantity on Average Inventory on Hand Assuming a Constant Demand Rate.

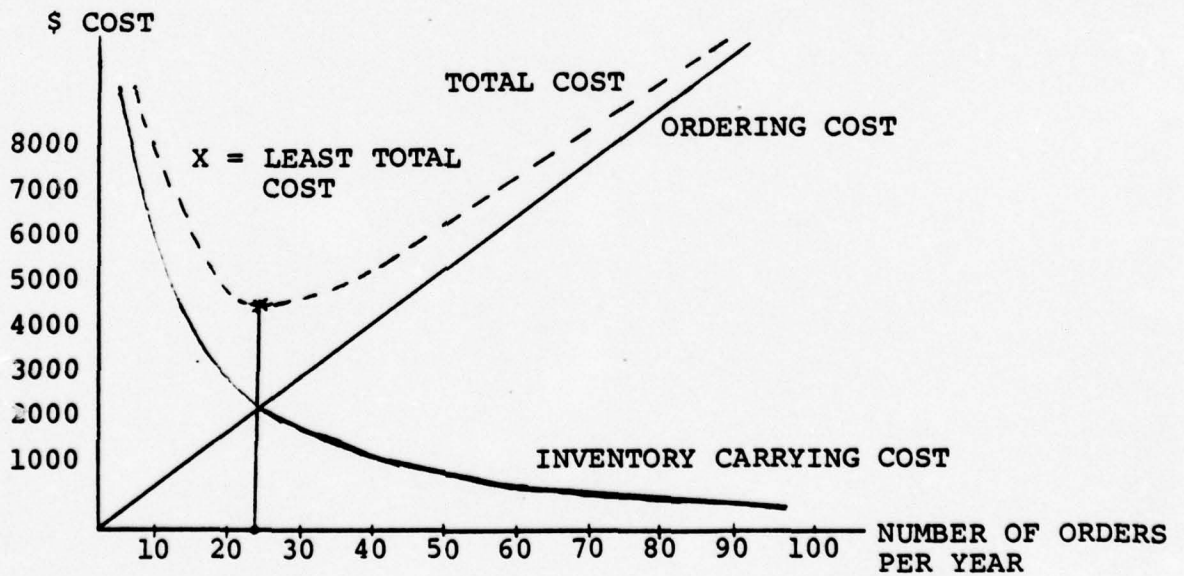


Figure III-9. Inventory Ordering Cost, Carrying Cost and Total Cost for Various Operating Doctrines.

will be about 24. We can also see when the number of orders per year increase, holding cost goes down and ordering cost increases.

The total costs of operating an inventory system like the one described can be expressed by the following formula:

$$c = \frac{Qvr}{2} + \frac{AS}{Q} \quad \text{where:}$$

C = total inventory management costs;

Q = the quantity ordered;

v = average cost or value per unit of the product;

r = annual inventory carrying charge as a per cent of product value;

A = ordering or set up cost;

S = the annual demand or usage of the product.

In the formula, the term $\frac{Qvr}{2}$ is simply a way of stating annual inventory carrying cost. $\frac{Q}{2}$ is average inventory level, $\frac{Qv}{2}$ represents the value of this average level and multiplied by the rate r, we get annual carrying cost. The term $\frac{AS}{Q}$ is an expression for annual ordering cost. $\frac{S}{Q}$ represents total number of orders a year, and multiplied by A, the cost to place each order, we get total yearly order cost.

By setting C equal to a minimum value (zero), take the first derivative of the cost equation with respect to Q and then solving for Q we obtain:

$$Q^* = \sqrt{\frac{2AS}{rv}}$$

(Q* means the optimum value of Q.)

The above formula is referred to as the Economic Order Quantity formula (EOQ). The assumptions made when using the formula include no economy of scale, known demand and order cycle time, constant commodity price and no inventory in transit. While the conditions stated never prevail completely in practical life, there are situations where the model is very useful. It also serves as an excellent starting point for developing more refined models.

Once the economic order quantity is calculated, the order point is easy to find. This will simply be the minimum amount needed in stock for sales during the order cycle time. We order the shipment to arrive in stock sometime after the last unit in stock has been sold but before customer demand occurs for the next unit.

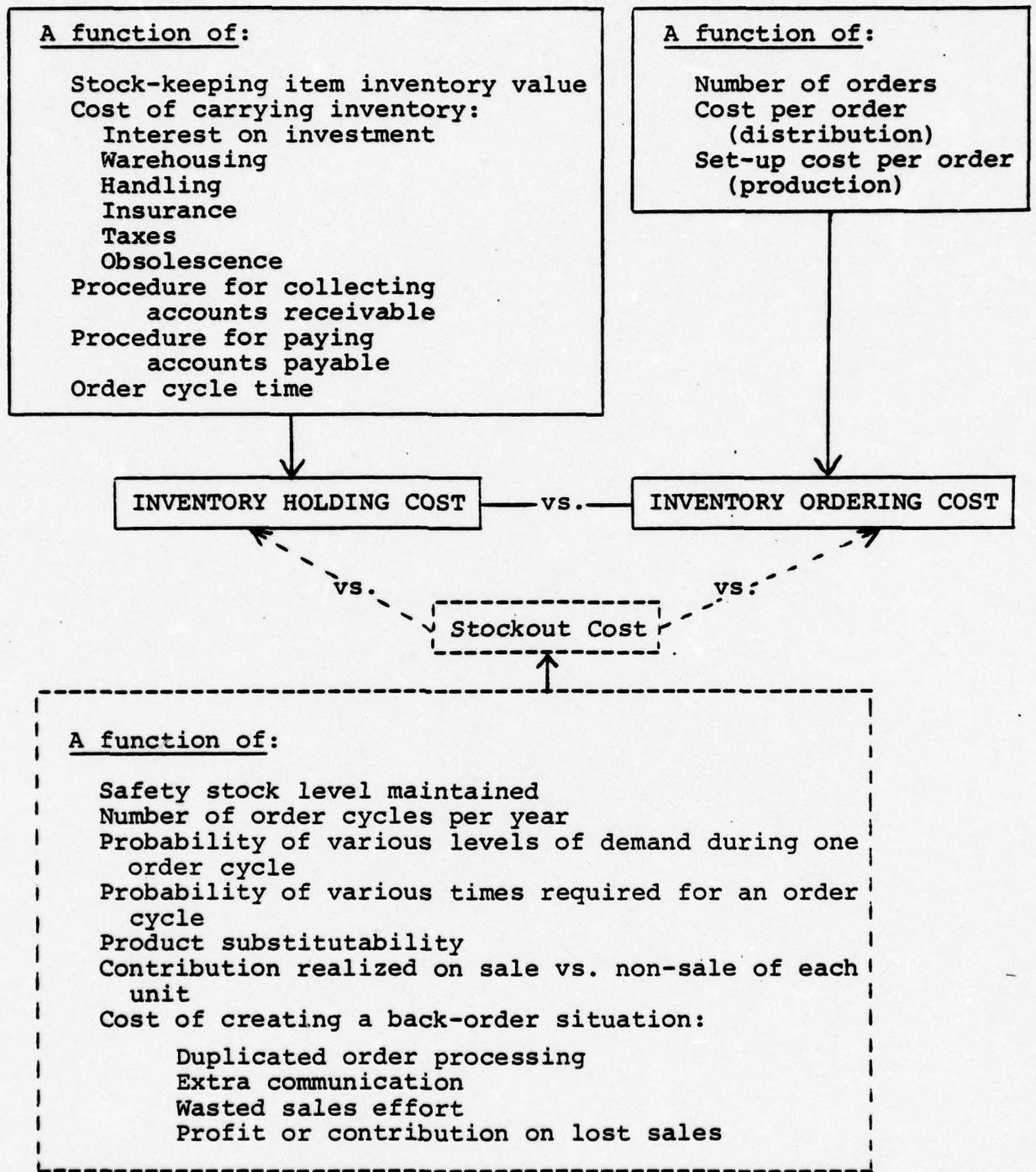
d. Inventory Management Under Uncertainty

The situation described in the previous section where certainty prevailed, will not be the normal operating circumstances for most organizations. Typically, we will

not know what the demand for a product will be since customers purchase products somewhat sporadically. The usage rate of many items will vary, depending on a variety of real or presumed needs, etc.

In addition, there are factors that can cause variations in the time required for the order and replenishment cycles. For instance, the transportation transit time may vary, so also the time it takes to process an order and transmit it to the supplier. If an item has to be produced before delivery can take place, variations in production time adds to demand uncertainty during the order cycle. This uncertainty opens up the possibilities for stockouts and stockout costs will have to be introduced into the inventory model. The cost trade-off will now be the inventory holding and ordering costs vs. stockout costs. These costs, their causes and trade-offs are presented in Figure III-10.

All we know in this uncertain environment is the probability distribution of the demand during the order cycle, not the actual demand. When we decide on an order point, there will be some probability that a stockout will occur, with resulting expected costs. Figure III-11 illustrates how inventory now will behave. An order of size Q is placed whenever the inventory reaches a level R . Because demand during lead time is uncertain, stockout sometimes occurs.



(Solid lines indicate certainty; broken lines indicate uncertainty.)

Figure III-10. Trade-offs Typically Represented in Inventory Control Theory. (7, p. 313)

The expected costs of a stockout is affected both by the order point (R) and the order quantity (Q). A change in Q affects the annual frequency of reaching the order point and thus the frequency of being exposed to possible stockout conditions. A change in R affects the likelihood of stockouts and the number of times the order point will be encountered.

As in what was the case under certainty, the objective is to minimize the total costs incurred during a given time period.

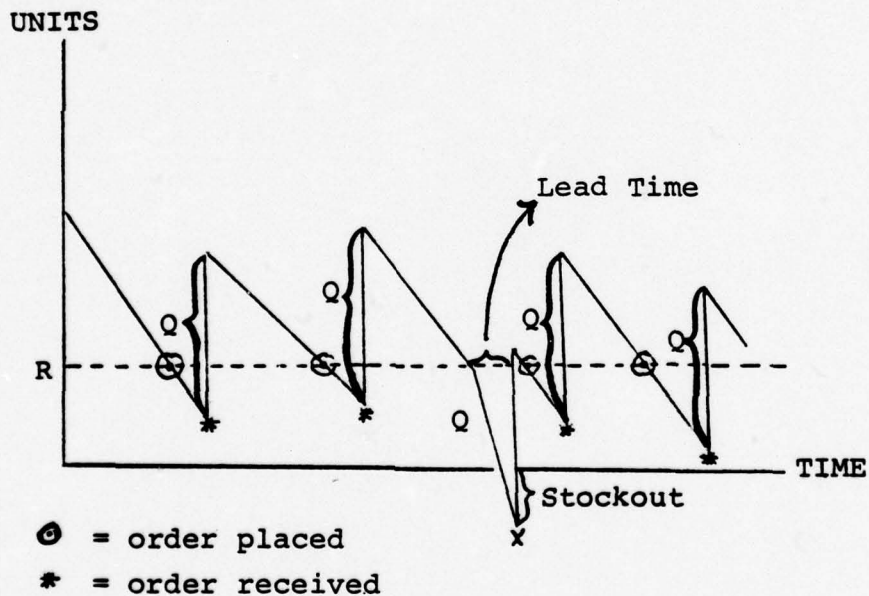


Figure III-11. Illustration of Inventory Pattern Under Uncertainty.

However, there are now three cost categories to consider instead of two.

A = the cost of placing an order.

v_r = cost of carrying one unit in inventory for one year.

$E(s)$ = expected cost of being out of stock one unit.

Other symbols to be used in the following will include:

\bar{M} = average number of units demanded during the lead time;

M = number of units of demand over the lead time;

σ_M = standard deviation of demand during the lead time;

S = annual demand or usage of the product;

Q = the quantity ordered;

$F(R)$ = probability that demand during the order cycle will be \leq current value of R ;

R = order point.

The optimum order size (Q) and the optimum order point (R) will in general be a function of the three costs mentioned above plus the average number of units demanded during lead time (\bar{M}) and the variability or standard deviation of demand during lead time (σ_M).

(1) Optimum Order Quantity. This calculation can be based on the EOQ model used under certainty. The only modification to be done to the model is to add the expected stockout costs, essentially as another element of ordering costs. The expected stockout penalties can be expressed as the number of orders $\frac{S}{Q}$ multiplied by expected

stockout costs $E(s)$. Ordering cost will be like before $(\frac{S}{Q} \cdot A)$. Combined into one expression, we get $\frac{S}{Q} [A + E(s)]$.

The calculation of inventory carrying cost will basically be as before, namely $rv \frac{Q}{2}$. However, an additional amount of inventory, called safety stock, is now carried. This could be thought of as a quantity being held in excess of the estimate of average demand or usage during the order cycle, which is \bar{M} . In other words, R is purposely set greater than \bar{M} in order to compensate for uncertainty in the number of units demanded (M) for any given cycle. The safety stock thus can be expressed as $(R - \bar{M})$ and the total cost formula will be:

$$C = \frac{S}{Q} [A + E(s)] + rv \left[\frac{Q}{2} + (R - \bar{M}) \right]$$

The order point R is assumed constant and independent of the order quantity (Q). Consequently, the expected demand less than the order point $E(M < R)$ will also be a constant. Setting the above equation equal to a minimum cost of $C = 0$, taking the first derivative of the cost equation with respect to Q and then solving for Q , we obtain the following economic order quantity formula:

$$Q^* = \sqrt{\frac{2s [A + E(s)]}{rv}}$$

Once this optimum value of Q has been found, it is used in the calculation of the optimal order point.

(2) The Optimal Order Point. The underlying principle for calculation of order point is that a firm will continue to add units to its order point (and hence to its average inventory) until the expected annual costs of adding a unit to R equals the expected annual costs of not doing so. The annual incremental costs of adding a unit to R is vr . The expected annual incremental costs of not adding the additional unit to R will equal the probability that the additional unit or more will be demanded during the order cycle multiplied by unit stockout costs $E(s)$, all multiplied by the number of inventory cycles per year $\left(\frac{S}{Q}\right)$. The expression will be: incremental costs = P [next unit or more demanded] $\cdot E(s) \cdot \left[\frac{S}{Q}\right]$.

If we define $F(R)$ to be the probability that demand (M) during the order cycle will be less than or equal to the current value of R, then the probability that the next unit or more will be demanded (a stockout occurring) is $1-F(R)$. The cost relationship between adding or not adding an additional unit to R is graphed in Figure III-12. As R is increased, the probability that the last unit added or more will be demanded falls. At the point R, where the two cost lines are crossing, the incremental cost of adding

a unit to R becomes greater than the incremental cost of not doing so, and we will stop adding units to R. At this point the two costs are equal:

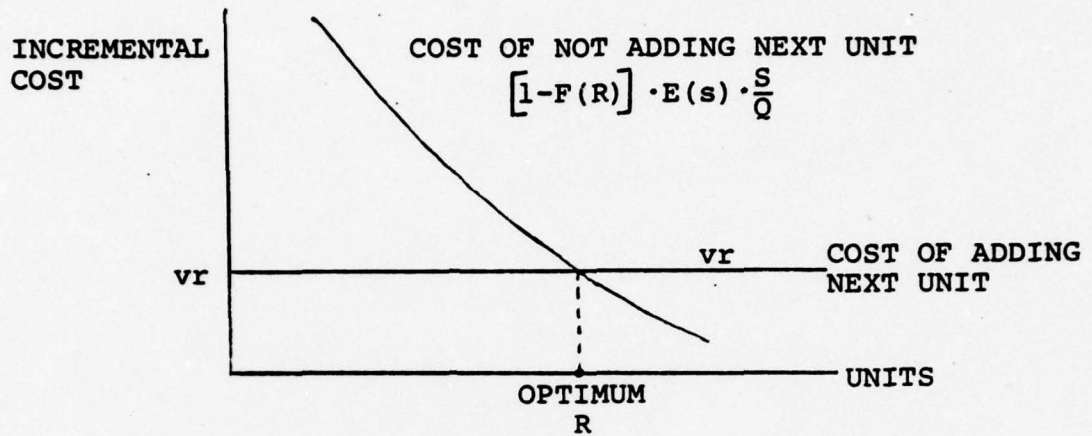


Figure III-12. Relationship Incremental Inventory Holding Cost/Stockout Cost.

$$(a) \quad vr = [1-F(R)] \cdot E(s) \cdot \left(\frac{S}{Q}\right) \quad \text{and}$$

$$(b) \quad [1-F(R)] = \frac{vrQ}{E(s)S} \quad \text{and}$$

$$(c) \quad F[R] = 1 - \frac{vrQ}{E(s)S}.$$

The above equation (c) can be used to find the optimum value of R as follows:

1. Compute Q from the square root formula in the EOQ section above.
2. Compute the right-hand side of formula (c) above.

This will be our desired probability that the demand

during the order cycle being less than or equal to R.

3. By assuming that the demand (M) during the order cycle is normally distributed, a normal distribution table can be used to find the value of R for which the computed probability applies. Refer to Figure III-13 for a graphical explanation of this point.

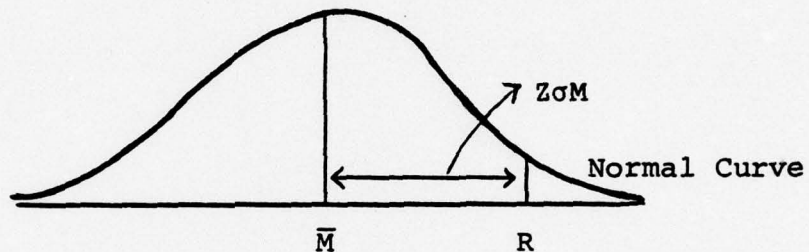


Figure III-13. Illustration of the Use of Normal Distribution to Find the Value of R. (1, p. 189)

The idea is to find a value for R so that there are $1 - \frac{vrQ}{E(s)S}$ probability that M being equal to or less than R. Z is the number of standard deviations we have to go from the mean sale (\bar{M}), before the desired probability $F(R)$ is reached. The formula for R, the optimal order point will then be:

$$R = \bar{M} + Z \sigma_M.$$

The assumption of normal demand distribution during the order cycle is not critical for the calculations. Any other

distribution could be used instead. (1, pp. 186-190)

Appendix C gives an example of how to compute the optimum order quantity and optimum order point, inventory management under uncertainty.

3. Warehousing

Warehousing is a functional activity which involves the storage and transshipment of goods, normally without any change in the form of the goods. (7, p. 59)

a. Classifications

There are a number of different classifications which can be used in order to describe a warehouse.

(1) Physical Functions. If a warehouse is used primarily for the storing of raw materials and finished goods, it is normally called a storage warehouse. Although there are a variety of reasons why a firm may want to hold goods in storage, the primary use of a storage warehouse occurs in relation to, and usually in advance of various production processes. A storage warehouse may be located at any point within the logistic system, but will normally have a strong locational relationship to a production facility.

A distribution warehouse contains goods on the move. The basic functions performed in such a warehouse are receiving, transferring, selection and shipping of goods. One characteristic of a distribution warehouse is the rapid

turnover of inventory, requiring more flexibility and higher speed materials handling equipment than would a storage warehouse.

A warehouse may also serve as a combined distribution and storage warehouse. Such a warehouse will normally have two separate parts, one for distribution and one for storage. Each part will be designed and equipped to serve the special requirements for the two functions.

(2) Commodities Handled. This classification is used for the purpose of describing the many different warehouses in existence, designed to handle and store special kinds of commodities. Examples might be warehouses for frozen or chilled products and storage facilities for specialized bulk-like grain, oil or wine.

(3) Ownership. Warehouses may be classified according to whether they are owned by the user, leased by the user or are public warehouses. Owned or leased warehouses can be classified as private facilities. These are in contrast to the public ones operated to provide storage space to the public on an as needed basis.

A further step would be to classify leased and public warehouses into rented facilities; the rest would be what are called owned warehouse facilities.

Rented warehouses do not require any capital investment by the using firm while an owned warehouse might require substantial investments. In a leased private warehouse the using company rents all or a portion of a structure for a given period. A company utilizing a public warehouse pays only for space utilized on a day-to-day basis. The basic considerations involved when choosing between the three basic ownership possibilities is shown in Figure III-14.

When deciding whether to use a private or a public warehouse, it should be noted that a private warehouse requires a relatively high and stable volume of throughput to make the operation economical. This is particularly true in the case of private, owned warehouses, mainly because of the fixed costs associated with them.

(4) Legal Status. Examples of warehouses possessing special legal status are bonded warehouses and field warehouses. In a bonded warehouse goods can be stored without taxes or duties being paid until removal for sale or other disposition. The advantage of this is that the owner of the goods does not have to tie up his capital in paid taxes and duties. A field warehouse implies an arrangement in which goods are stored under the actual supervision of a designated public warehouseman. A "warehouse receipt"

is issued for such goods and the receipt can be used by the owner to obtain credit or loans.

A warehouse may also have no particular legal status other than as an integral part of a business operation.

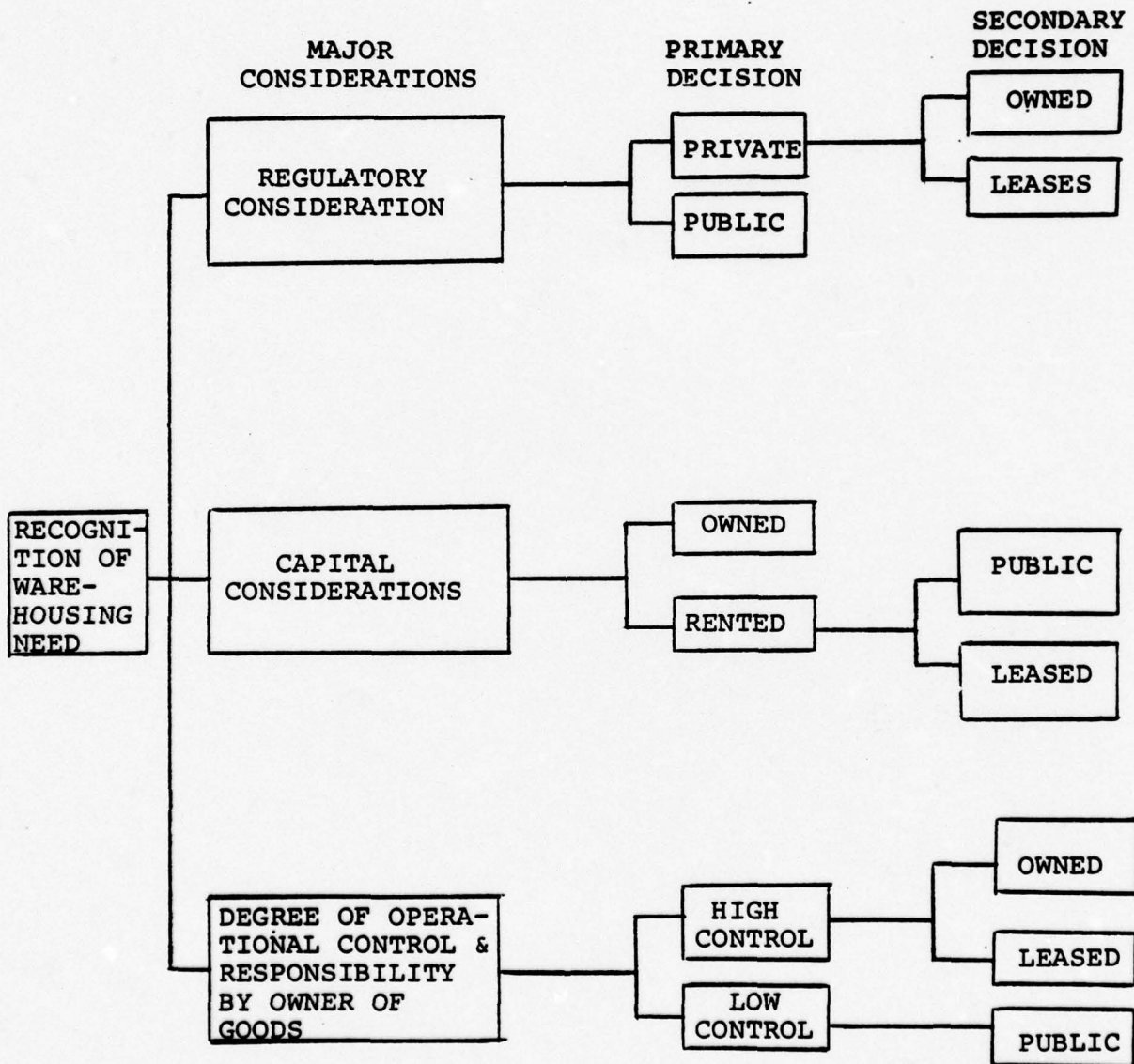


Figure III-14. Major Considerations in Evaluating Warehouse Ownership Alternatives. (7, p. 62)

(5) Place in the Logistics System. As a final classification, warehouses may be classified according to their place in the logistic system. Examples would be facilities for handling raw materials, receiving and transporting finished goods coming off an assembly line or a warehouse located at some point between the company's plant and its customers for the purpose of storage and transshipment of finished goods.

b. Warehouse Operation and Management

The operation of warehouses and carrying costs of the inventories stored in them account for an amount equivalent to more than 10 per cent of the gross national product and, in many firms, a greater proportion of the total cost of goods sold. Further, in many firms, the warehousing function comprises the major portion of the operation over which logistics management has control. (7, p. 603)

(1) Private or Public Warehousing. Basically, a business firm has three alternatives in regard to warehousing. It can use public, own, or lease private facilities. As mentioned before, own and lease facilities are normally called private warehousing.

Private warehouses are likely to provide more flexibility in design to meet the specific needs of the owner. These needs can, for instance, be special

temperature requirements, extreme size and shape products requiring special handling equipment, or need for other special installations not normally provided by a public warehouse.

The operation of a private warehouse can provide the using firm greater control of the operation to insure that warehousing is conducted efficiently. A private warehouse operation will, to a reasonable degree, guarantee a given service rate over a period of time.

Another advantage of private warehousing is the possibility to house a local sales or field purchasing organization in the warehouse building. One should note, however, that such a combined use of the warehouse facility might create supervisory and organizational problems which affect any savings achieved by the arrangement.

The use of owned or leased warehousing space in contrast to public warehousing may be necessitated by the desire to provide warehousing facilities near a company's manufacturing plant. Most storage space immediately adjacent to the production line is either owned or leased by the operating firm.

In general, the average cost to handle a unit through a private warehouse is less when the product moves through in constant, high volume. Some firms, in an

attempt to increase volume, have over-extended market territories served by the warehouse. The result of this often is that greater transportation cost per unit is incurred than the savings in warehousing costs traded for it.

Public warehousing requires no investment in facilities. Operating problems assumed by a public warehouseman also free executive talents in the firm for other activities.

The per unit cost for public warehouse service is probably less than private or leased facilities when the volume of operation is low, or the level of operation fluctuates greatly from time to time. (7, p. 608) Further, the cost per unit handled is a known factor when public warehousing is used. This facilitates budgeting and general planning by the user.

Maybe one of the greatest advantages in the use of public warehousing facilities is the great flexibility allowed in inventory location. A firm utilizing public warehousing can shift the location of its inventories to reflect changes in the transportation rate structures which make existing warehouse locations comparatively uneconomical.

Finally, because it is available on a short-term basis, public warehousing is used to test marketing

activities, where the need for warehousing support is uncertain and perhaps temporary.

(2) Facility Layout. Facility layout is a major determinant of the cost and service levels which can be obtained from a warehouse. (7, p. 623) It is important to plan the layout carefully because once a layout is chosen and the facility built, any change will be costly and require time to accomplish.

In laying out the receiving, storage order selection, and shipping areas within a warehouse, it is important to consider the following:

First, to the extent possible, materials should move in one general direction through the warehouse. Second, provision should be made, where possible or necessary, to circumvent one or more stages in the warehousing process. It should, for instance, be possible to move stock directly from incoming transportation vehicles to the order-selection area.

Third, the cross-hauling of freight within areas of the warehouse should be avoided. One should consider the efficiencies to be gained by the use of one-way corridors and other devices to route internal traffic in such a manner as to eliminate crossing traffic.

Finally to be mentioned, the greatest amount of stock possible should be located closest to its point of greatest need.

The goals listed above require complex analysis to be accomplished. It often becomes so complex that the goals are rarely reached in its entirety. (7, p. 624)

(3) Warehouse Operations. Problems of warehouse operations cover the whole range of those associated with line management. According to recent research, labor relations and costs control are considered among the most important problems to be dealt with. (7, p. 634)

A way to control cost is the development of routines and procedures to measure performance of warehouse operations. Among measures used are: (a) tons of commodities moved in and out per time period; (b) the number of orders picked per time period, and (c) labor disputes and work stoppages per period of time.

All of the above measures would be meaningless unless compared to some factor which will yield a ratio indicative of efficiency. Normally, the factor used is manpower on hand.

Any process as subject to repetitive activities as warehousing is likely a candidate for extensive automation. There are examples of warehouses in operation

controlled almost entirely by machine. Electronic routing equipment can be used to place the incoming freight into storage and move it from storage to order-selection areas. Human labor may be used only to assign stock to storage points, prepare information for computer processing and pack assembled shipments for loading.

Although automated warehouses are gaining a great deal of attention, their use is not yet widespread. Arguments in favor of them are that they provide faster service to customers, allow for inventory reduction due to less order lead time, provide excess material handling capacity without the need for rapid increase in work force, and relieve the warehousing operation of some labor problems through the reduced work force needed to handle goods.

Arguments against automated warehouses include frequent malfunctions in the system, fluctuations in demand, causing machines to be idle, and rather than alleviating labor-management problems, automation may merely worsen it. Automation also imposes a loss of flexibility in warehouse locations, because almost all automated facilities are operated on a private basis.

Given a decision has been made to go for an automated operation, proper planning in the use of the

automatic equipment is of vital importance. Where it can be used, automation seems to offer substantial operating economies. (7, p. 636)

Whether automated or not, effective warehousing operation appears to be dependent on the nature of the planning and management of the operation. Further, warehousing decisions are important aspects in the design of an effective logistic system.

4. Transportation

Transportation is a vital part of the logistic system. It represents the link between a firm's raw material sources, its plants, warehouses and customers. Transportation creates time and place utility in goods by physically moving it to the place desired, at the time desired. Knowledge of transportation systems is important to the efficient and economical operation of the logistic function in a firm.

There are five basic modes of transportation: rail, motor (highway), water, air and pipeline. The structure of the transportation industry is based on these five modes plus a number of variations and subgroups derived from their legal form, auxiliary users and various combinations of the modes. Figure III-15 gives an illustration of the classification of relationships.

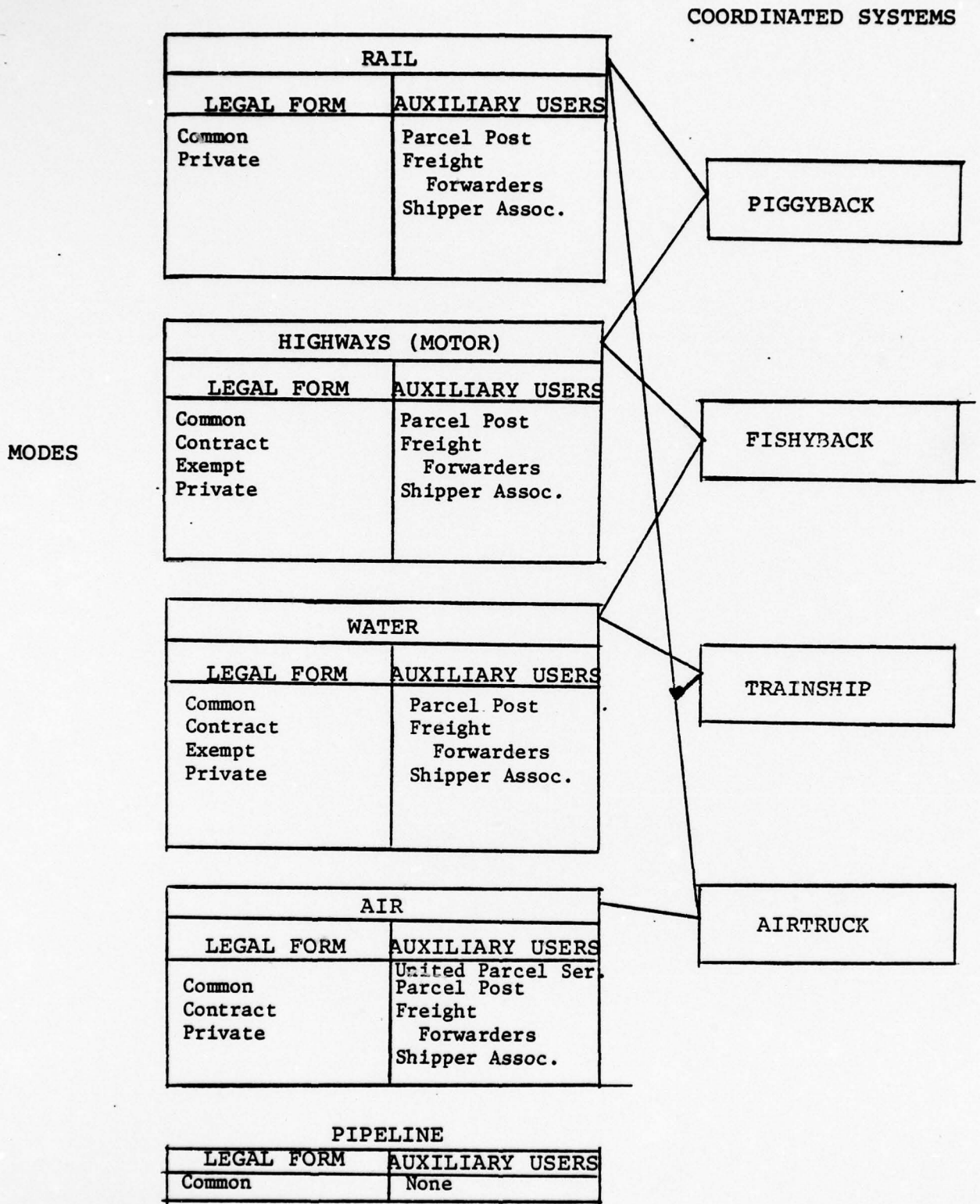


Figure III-15. The Relationship of Modes, Legal Forms, Auxiliary Users and Principal Coordinated Systems of Transportation. (7, p. 94)

a. Explanation of Some Terms

The term legal form refers to the manner in which a transportation operation is regarded for regulatory purposes.

Common Carrier: This is a for-hire carrier who offers services to the general public. The common carriers are the most highly regulated of all the legal types of carriers. They must accept shipments from anyone who decides to use their services, charge the same standard rate to all customers and maintain a regularly scheduled service. Because of this high degree of regulation, common carriers are limited in coping with specialized transportation needs of a customer.

Contract Carrier: The contract carrier is a for-hire carrier. This operation is not set up to serve the general public, but rather service a limited number of shippers under specific contractual arrangements. A contract carrier has considerable flexibility in coping with the needs and requirements of individual shippers, and they are also subject to fewer government regulations than the common carriers. Contract carriers rates may vary widely, depending on the special circumstances involved. No regular schedules have to be maintained and a personalized service can be offered to the shippers.

Exempt Carriers: The exempt carrier is a for-hire carrier, not regulated with respect to economic matters. The laws of the market place determine the rates, services and the supply of such carriers. The status of the exempt carrier is gained by the type of commodity hauled or by the nature of the operation. The primary commodities carried by these carriers are agricultural products, newspapers, livestock, or fish.

Private Carriers: Companies using their own transportation system to move their goods and make their own deliveries are private carriers. The private carriers are usually regulated for safety only by local and state governments. A crucial aspect of the legal distinction of a private carrier is that the transportation function must not be the primary business of the controlling firm. Private carriage may be economical where there is a high usage rate of the transportation equipment or when highly specialized transportation service is required.

Auxiliary Users: Auxiliary users are defined as transport agencies which purchase a major portion of their transportation needs from other carriers via one or more of the basic modes. They generally own limited amounts of long-distance transportation equipment of their own concentrating

their operation on the collection of freight at origin and dispersion of freight at destination.

Coordinated Transportation Systems: This refers to the use of two or more carriers of different modes in the through movement of the shipment, maintaining regularly scheduled operations. Refer to Figure III-15 for various combinations.

b. Transportation Mode and Carrier Selection

The carrier selection decision is a specialized purchasing process whereby a firm selects a carrier to provide necessary links between the fixed points in the logistic system. First, a mode of transport (rail, motor, air, water, pipeline) is selected, and second, a particular carrier from within the selected mode must be chosen. In this process, business must analyze each transportation system in terms of efficiency in a specific situation. The factors to consider include: (1) transit time and reliability, (2) transportation cost, (3) commodity movement capability and availability, (4) frequency of service, and (5) security.

(1) Transit Time and Reliability. Transit time is the total time that elapses from the time the consignor makes the goods available for dispatch until the carrier delivers the same goods to the consignee. Reliability

refers to the consistency of the transit time provided by a carrier or other promised performance. Transit time and reliability affect the costs of operating other elements of the logistic system, i.e., inventory costs. Lower transit time results in lower inventory requirements, while less dependability will mean a need for higher inventory levels or costs of stockouts.

(2) Transportation Cost. The user of transportation services must carefully analyze the cost of each system. One will normally choose the service that meets the specific needs at the lowest rate. However, attention is also very much focused upon the cost trade-off existing between the services provided by a carrier and the costs of operating the other elements of the logistic system.

(3) Commodity Movement Capability and Availability. Capability and accessibility of a particular carrier determine whether he can physically perform the transportation service desired. Capability refers to the ability of a carrier to provide the equipment and facilities required for the movement of a particular commodity. Accessibility refers to the ability of a carrier to physically approach the facilities where the commodity to be transported is located or the place of destination.

(4) Frequency of Service. This refers to how often during a given period the carrier's service is offered. This might be the most important consideration, especially for producers of commodities which cannot be stored but will have to be brought to the consumers without any delay.

(5) Security. Security is concerned with the arrival of the goods in the same condition in which they were handed over to the carrier. The continued use of a carrier that provides unsafe transportation in terms of damaged goods will have an adverse effect on customers' selections and consequently an adverse effect on sales. In addition, costs are incurred in the process of preparing and documenting claims against the carrier.

The relative importance of the selection criteria mentioned above will vary, depending on the nature of the firm, its commodities and on the operating policy of the firm.

c. Traffic Analysis

Before any decisions can be made with regard to transportation mode and carrier selection, a comprehensive analysis of transportation and related costs has to be made. A number of costs in addition to published rates and accessorial charges must be considered in analyzing transportation cost by any method.

Transportation transit time can result in two types of costs, those resulting from product deterioration or obsolescence, and in-transit inventory carrying charges. The first type of cost is applicable to individual products and can be determined only in relation to a specific product. The second cost applies to all products. As transit time increases, the importance of inventory-in-transit carrying costs also increases.

Loading and unloading costs also have to be considered. A lower quoted rate may well become a higher cost of transportation between two points when those costs are added. Various modes of transportation require different types of fixed facilities for loading and unloading. A rail car, for instance, requires more extensive fixed facilities than a truck-trailer.

Some carriers also offer more loading assistance than others, sometimes with and sometimes without additional charge. Typically, loading and unloading costs are charged to warehousing operations. When those costs are not separated from warehousing costs, the modes of transportation are not charged with the full costs which should be assigned to them.

The term "dunnage" refers to the bracing and other protection devices used in the packing of products

into transportation vehicles or warehouse areas. The amount of packaging or dunnage provided by the various carriers should be taken into account when calculating costs of transportation.

The failure to obtain consistently a standard transit time between two points can have at least three adverse effects on logistic systems: (1) maintenance of excess safety stocks at delivery points, (2) lost sales, and (3) excess manpower costs. Whenever those costs are chargeable to transportation service inconsistency, they should be taken into account in traffic analysis.

Reference is made to the discussion of safety stock in the section of inventory control. It is a fact that safety stocks are required as much for protection against inconsistency in order cycle time as they are a protection against inconsistency in customer demand. When a regular transit time is offered, one of the variables of inventory planning is eliminated.

When transportation service reaches a level of inconsistency which safety stocks have not anticipated, the results at the delivery point are lost sales, back-order costs, fill-in transportation and customer dissatisfaction.

Excess manpower costs can result by having men waiting to unload a shipment expected in at a certain time.

Having a crew waiting for a delayed truck is costly and creates confusion in unloading and loading operations because the normal warehouse schedule then may have to be broken apart and shifted around.

In general, it is important to consider the true transportation costs as opposed to the out-of-pocket costs of various transportation rates and services. Emphasis should also be placed on coordination with carrier organization to find lower total cost solutions to logistic problems rather than only lower rates. Finally, it should be noted the importance for the traffic department, through the firm's logistics organization, to communicate and coordinate its activities thoroughly with other functions in the firm.

G. CONCLUSION

The objective of this chapter has been to give a general description of a business logistic system and discuss some of the more important elements of its structure. It is very important for the logistic manager to view the individual functional elements of logistics as a system with important interrelationships and interdependencies. Unless this can be achieved, the individual elements of the logistic system may tend to suboptimize its function causing increased costs and reduced profit for the company as a

whole. The logistic manager has to assume the important role of an integrator, making the elements of the logistic system work as a real system, to the benefit of the company and its customers.

IV. ROYAL NORWEGIAN NAVY/U.S. NAVY - EXISTING
ORGANIZATION FOR FOREIGN MILITARY SALES

A. INTRODUCTION

The purpose of this chapter is to describe the present organization for Foreign Military Sales (FMS) in the Royal Norwegian Navy (RNON) and in the United States Navy (U.S. Navy). Also included will be some general information about FMS, its historical development, legal foundation and the existing policy. For an understanding of terms used in the following, reference is made to the glossary in Appendix A. In addition, a few terms are considered vital to this chapter and their definitions are included in the following.

1. Definitions

a. Security Assistance (SA)

SA includes those activities carried out under the authority of the Foreign Assistance Act of 1961 and the Foreign Military Sales Act of 1968. SA includes but is not limited to:

(1) Military Assistance Program (MAP). MAP is an annual program for which the United States Government (U.S. Government) receives no dollar reimbursement for defense material furnished to eligible foreign countries.

(2) Foreign Military Sales (FMS). FMS is a sales transaction with an eligible foreign country for which the U.S. Government receives dollar reimbursement. Sales may be for cash, Department of Defense (DOD) credit or U.S. Government guarantees.

b. International Logistics (IL)

This is defined to be similar to Security Assistance. However, some manuals define it to be the logistic portion of Security Assistance. For the purpose of this presentation, IL is synonymous with SA.

c. Military Export Sales

All sales of defense articles and defense services made from U.S. sources to foreign governments, foreign private firms and international organizations, whether made by DOD or by U.S. industry directly to a foreign buyer. Such sales fall into two major categories, Foreign Military Sales (see definition above) and Commercial Sales.

(1) Commercial Sale. Sale made by U.S. industry directly to a foreign buyer not administered by the DOD and not involving credit under the provisions of the FMS Act.

B. THE HISTORY OF SECURITY ASSISTANCE

The United States first became involved in Security Assistance in 1776 when France furnished troops, ships,

advisors, and loans totaling \$6.4 million to assist in the defeat of Great Britain at Yorktown.

Tracing the historical development further, George Washington, the first President of the United States, cautioned against "entangling alliances" in his farewell address in 1797. Isolationism became an established American foreign policy. However, the American victory over Spain in 1898 pushed the United States into world power status and the effect was an increasing involvement in world affairs.

The United States' security assistance to Allied countries in World War I consisted mainly of men and money. Approximately \$7 billion was loaned to these countries during the war and much of it was never repaid.

After World War I, the United States returned to their pre-war isolationistic posture and rapidly demobilized its armed forces. Little concern was shown towards the possibility of another involvement in war and future aid to allies. However, as war clouds gathered in Europe and Asia during the 1930's, the U.S. again became involved in developing foreign policy to aid Allied countries.

Little by little, the Congress permitted Presidential action to assist Allied countries in defending themselves. In March, 1941, Congress authorized the Lend-Lease Program

which enabled the President to authorize the manufacture of defense articles "for any foreign government whose defense he considered vital to the defense of the United States, and to sell, transfer, exchange, lend, lease or otherwise dispose of to any such government."

The Lend-Lease Program was in effect to August, 1945. In all, about \$50 billion of lend-lease assistance was provided, of which \$8 billion was returned in reverse lend-lease, and \$2.5 billion was returned after the war.

In the years immediately following World War II, it soon became apparent that Western Europe was on the edge of economic collapse. The United States accepted the challenge of aiding these countries both economically and militarily. In early 1948, Congress passed legislation and the European Recovery Plan (ERP), commonly known as the Marshall Plan, became operative. This plan was highly successful and within a few years the Western European countries were at economic levels higher than their pre-war levels.

In addition to the Marshall Plan, the United States also became involved in furnishing aid to Greece and Turkey. Aid to these two countries had formerly been given by the British government; however, the bad economic conditions at home made that aid come to an end in March 1947.

Britain informed the U.S. of this decision and another legislation, the National Security Act of 1947, also called the "Truman Doctrine," was passed. This act permitted the United States to assume responsibilities formerly shouldered by the British, and is generally accepted as the United States' initial commitment to the principle of collective security. The act is also recognized as the origin of the later and presently existing Security Assistance Program.

With the Truman Doctrine as its basis, the United States initiated a series of legislative actions which gave authority for the U.S. Government to provide security assistance to the free countries of the world.

The formation of the North Atlantic Treaty Organization (NATO) in 1949 was a response to the threat of Russian military force and influence. Rearmament of the NATO countries became of prime importance and the Mutual Defense Assistance Act of 1949 was passed to provide this authority.

The Mutual Security Act of 1951 combined and brought under one policy all the United States-administered Security Assistance Programs. The act also established the organizational structure necessary to administer the programs and served as a basis for security assistance programs until replaced by the Foreign Assistance Act (FAA) of 1961.

In the FAA, the Congress restated its belief that the security of the United States is strengthened by assuring the security of other free countries. The act gave authority to the President of the United States to give assistance to eligible countries by lease, exchange or any other means, including loans, grants and sales.

The Foreign Military Sales Act of 1968 separated sales from the FAA of 1961. The act of 1968 authorized the DOD to engage in the sale of defense articles or defense services to many international organizations and a number of foreign nations.

As the economies of an ever-increasing number of the countries, benefiting from SA programs, improved, the policy of the United States has been to change from MAP to FMS. Thus, the FMS programs instituted by the FMS Act of 1968 were, and still are, the means of supplementing, augmenting, and eventually replacing the Military Assistance Programs.

C. INTRODUCTION TO FOREIGN MILITARY SALES

1. Policies

As mentioned earlier, the FMS Act of 1968 (Public Law 90-629) separated FMS from the FAA of 1961. It also placed into one single act legislation to authorize sales of defense articles and services by the U.S. Government to

friendly foreign countries and international organizations. It was enacted as a result of concern expressed by the Congress regarding arms sales policies and should give a clear definition of FMS purposes and provide for close Presidential and Congressional controls.

The FMS Act authorizes U.S. Government sales to those countries who have sufficient wealth to equip and maintain their own forces at adequate strength, or assume a larger share of the cost, without imposing an unreasonable burden on their economies.

It is the intent of Congress that sales be approved only when they are consistent with the foreign policy interests and the security objectives of the United States. Further, the sale should also be consistent with the extent and character of the military requirements and the economic and financial capabilities of recipient countries.

The policy also is that sales shall not be approved when they have the effect of arming military dictators who are denying the growth of fundamental rights or social progress for their people.

Reference is now made to the definitions of Military Export Sales, FMS and Commercial Sales. Under FMS, the DOD purchases equipment from U.S. firms, takes title to the equipment and then sells to the foreign buyer. This

intermediate transaction does not take place in Commercial Sales.

It is DOD policy that Commercial Sales shall normally be made whenever practicable. However, commercial sales shall not be made in the following cases: (a) security classification of the equipment, (b) Government Furnished Equipment (GFM) is included in the end product, (c) commercial credit terms cannot be arranged, and (d) the U.S. contractor has a strong desire not to deal with the foreign government directly.

Although commercial sale is the preferred method, it is relatively little used. One reason for this is the fact that most weapon systems and sub-systems are classified and/or contain GFM. The result is that between two-thirds and three-fourths of all military export sales are FMS transactions.

Finally, it is interesting to note the trend of decreasing military export sales to developed and industrialized nations, and increasing sales to less developed nations. This trend reflects both the greater reliance in the industrialized countries on their own production capabilities, and an improvement in the economies of developing countries which enables them to pay for a growing share of their defense needs.

2. Types of Foreign Military Sales

Foreign Military Sales encompass different sales methods, each tailored to meet the requirements of the country concerned. The methods are ranging from one time sales to continuing support programs. The contractual sales agreement between the U.S. Government and the eligible foreign country is referred to as a CASE, and documented by a Letter of Offer and Acceptance (DD Form 1513). The specific sales methods to be mentioned are:

a. Standard Foreign Military Sales Cases.

Standard FMS are sales of defense articles and services to eligible foreign governments and international organizations through other than Cooperative Logistic Support Arrangements (discussed under b. below). They are normally for major end items or systems and their concurrent repair parts and also follow-on repair parts. If an item is not available from stock and must be procured, the customer country will have to wait through the normal procurement lead time to get the item.

(1) Blanket Open End (BOE) Case. A common form of the Standard FMS case is the BOE case. This is a case established for an estimated dollar value, covering anticipated repair parts requirements for a fixed period of time,

normally a fiscal year. This permits the customer to submit requisitions when he desires without a Letter of Offer and Acceptance being prepared each time.

The purchaser normally expects to wait the procurement lead time before receiving the item, but if stocks are available in excess of the operating stock level of the service, it may be provided off the shelf.

The main advantage of the BOE procedure is the faster supply afforded by not having to complete the formal Letter of Offer and Acceptance each time a repair part is needed.

b. Cooperative Logistics Support Arrangements

This is an arrangement which provides logistic support to a foreign government through its participation in the U.S. Department of Defense logistic system, with reimbursement to the United States for the support provided. Two main forms of Cooperative Logistic Support will be discussed in the following:

(1) Supply Support Arrangements (SSA). The key features of the SSA are the provisions for continued supply support as opposed to the one-time nature of a standard FMS. It permits allied countries to become a "partner" in the U.S. Navy's logistics system and thereby can realize the advantages of long-term support, the U.S. logistic experience,

repair parts available when required, cost reduction due to large procurement orders and fewer special procurement and administrative actions.

Stocks procured for the customer are administratively reserved for his use. It receives the same in-storage maintenance and quality control as U.S. stocks. An SSA is established through bilateral agreements and executed through Foreign Military Sales Orders (FMSO). The bilateral agreement is an agreement between the U.S. Department of Defense and the Defense Ministry of a foreign government. It stipulates the particular terms and conditions under which the supply support and services will be provided. It further describes the support to be rendered, procedures for implementing FMSO's, requisitioning, priorities, financing, obsolescence, excesses and termination.

Following negotiations leading to an agreement on the terms and conditions under which the support will be provided, the SSA is executed through FMSO, prepared by a Government Agency, and accepted by the participating country.

The Foreign Military Sales Order No. 1 represents the customer's investment in the U.S. supply system. It is also called a Stock Level Case and consists of an Offer and Acceptance (DD Form 1513) covering estimated

dollar value and total initial agreed upon list of items, and quantities to be stocked and maintained. The Offer and Acceptance also covers the estimated annual storage costs for the material.

The Foreign Military Sales Order No. 2, also called the requisitioning case, encompasses an Offer and Acceptance covering the participating country's estimated withdrawals of material from the supply system for an agreed upon period of time, normally one year. The case is undefined as to items and quantities, only reflecting in dollars the estimated consumption for the period.

After the development of sufficient demand history, and at least annually, FMSO No. 1 will be revised to include those items required, based on the customer's usage experience.

The FMSO No. 2 will be closed at the end of each year, at which time a new consumption sales order will be established, based on demand history and planned operations.

(2) Maintenance Support and Services Arrangements. These arrangements represent a close parallel to SSA, however, only one FMSO is used to provide for these services. The FMSO details the type and extent of support and services to be provided. Normally, the maintenance

services are limited to depot level maintenance of major end items of equipment which are common to U.S. forces and the allied country participating in the agreement. One major advantage of Maintenance Support and Services Agreements is the common use of a single facility employed in overhaul of similar items.

The costs incurred in providing support through these arrangements are based on the principle that charges will not exceed those applicable to the United States Forces for corresponding support and services.

D. FMS ROUTINES AND PROCEDURES FOR THE U.S. AND ROYAL NORWEGIAN NAVIES

In an effort to describe the existing system for FMS within the U.S. Navy and the Royal Norwegian Navy (RNON), a good way to start would be to identify the various organizational units typically involved in an average foreign military sales case.

In Figure IV-1, organizations within U.S. Navy are identified and Figure IV-2 shows organizations involved on the Norwegian side. To which extent the various organizations shown on the two figures are involved in any given case will vary, depending on factors like type of material, dollar value of the sale, and who the customer is.

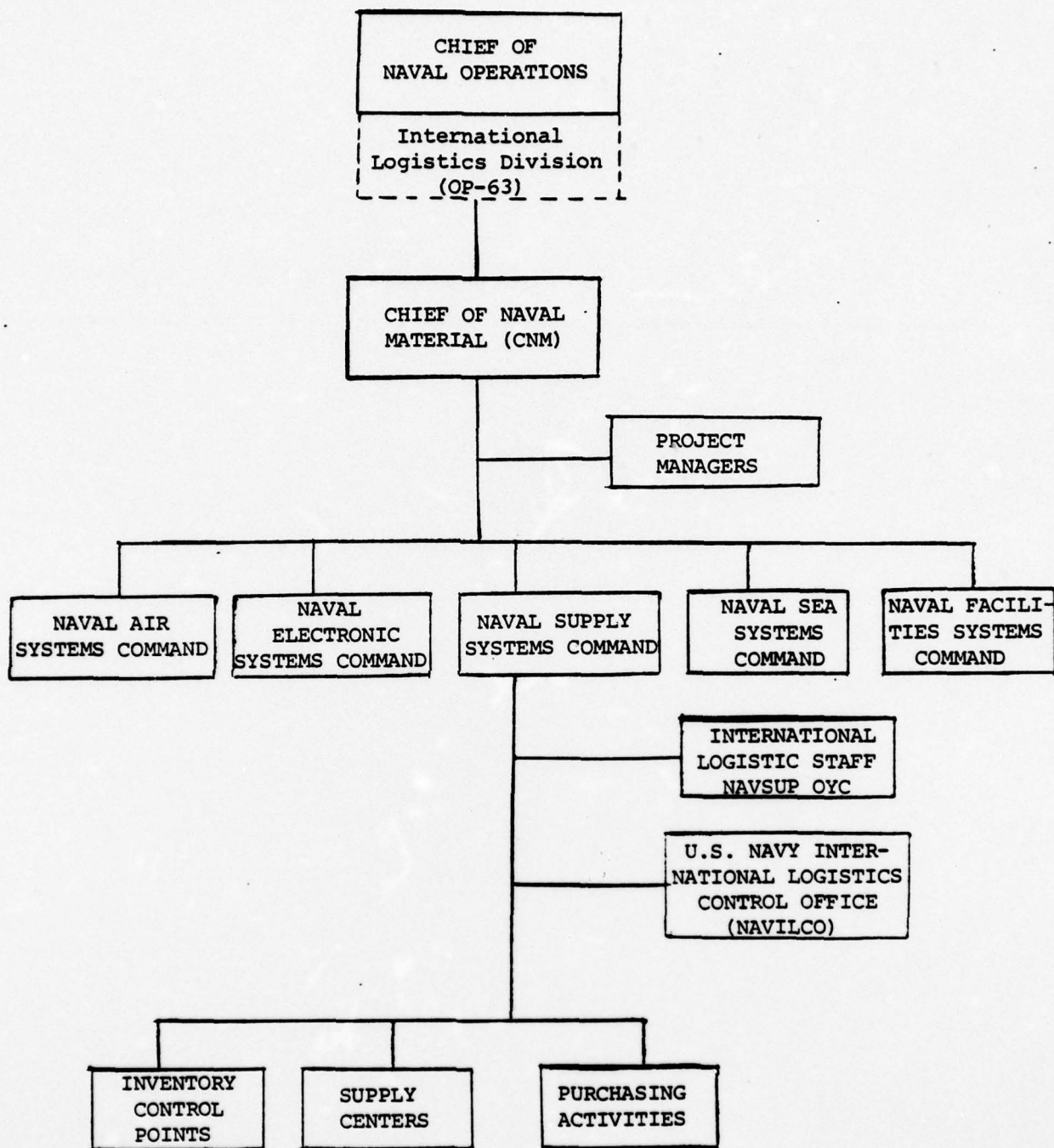


Figure IV-1. Organizations Normally Involved in a Typical FMS Case, U.S. Navy.

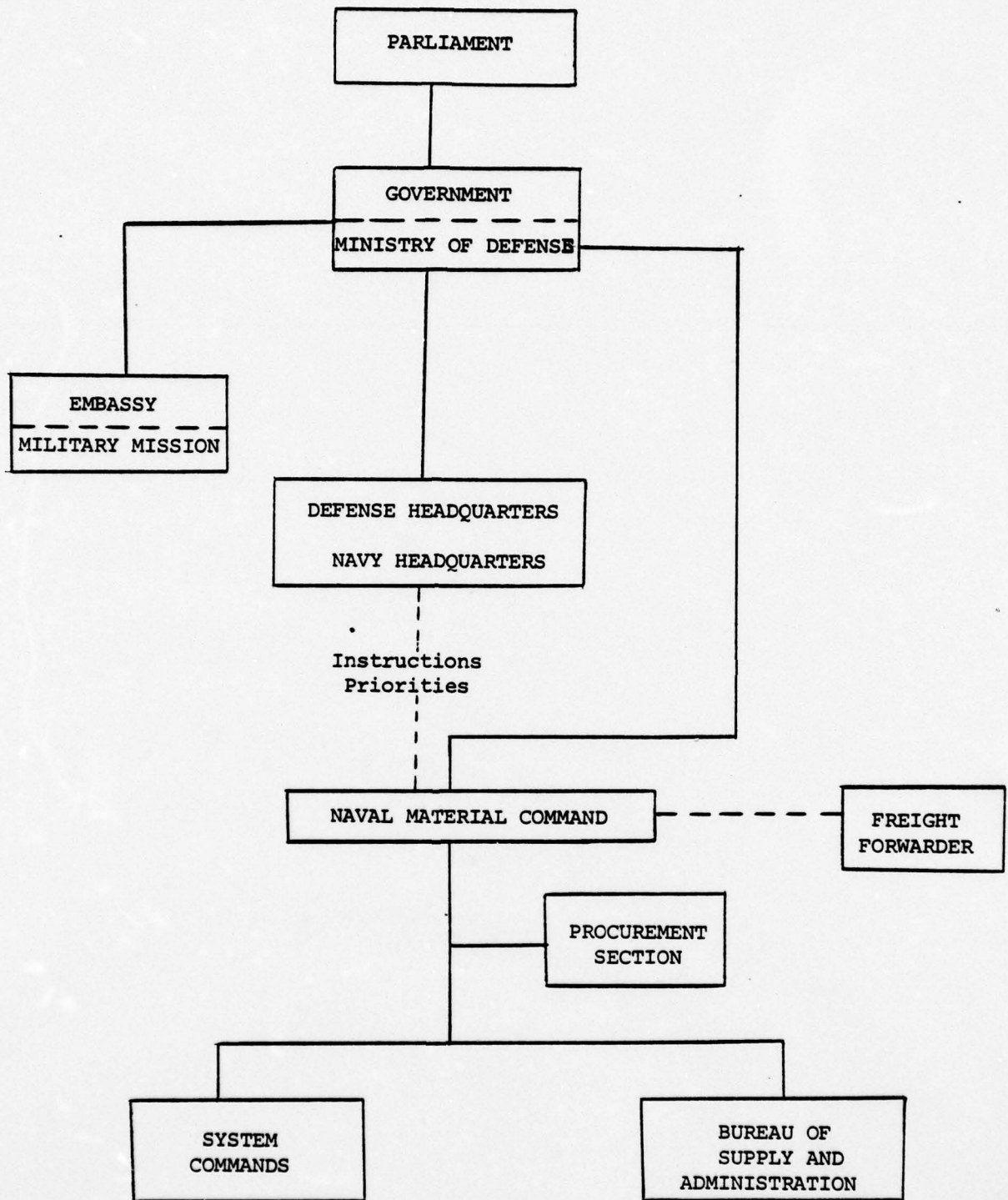


Figure IV-2. Organizations Possibly Involved in FMS - Norway.

1. Security Assistance - The Role of the Various Organizations, U.S. Navy

In carrying out its various responsibilities under the SA programs, the U.S. Navy employes basically the same resources, supply organizations and management policies as used in the acquisition and supply in U.S. programs. In the following, therefore, a general introduction to the various organizational units of the U.S. Navy Supply System will be given. (Ref. Figure IV-3.)

a. Secretary of the Navy

The Secretary of the Navy, under the direction, authority, and control of the Secretary of Defense, is responsible for the policies and control of both Navy and the Marine Corps. By statute, the Department of the Navy is separately organized under the Secretary of the Navy. It is composed of an executive part; the Headquarters of the United States Marine Corps; the operating forces; all the shore activities, headquarters, bases, installations, activities and functions under the control and supervision of the Secretary of the Navy.

The Secretary of the Navy is assisted by a number of civilian and military executive assistants. One of those, the Assistant Secretary of the Navy (Installations and Logistics) is responsible for the department-wide

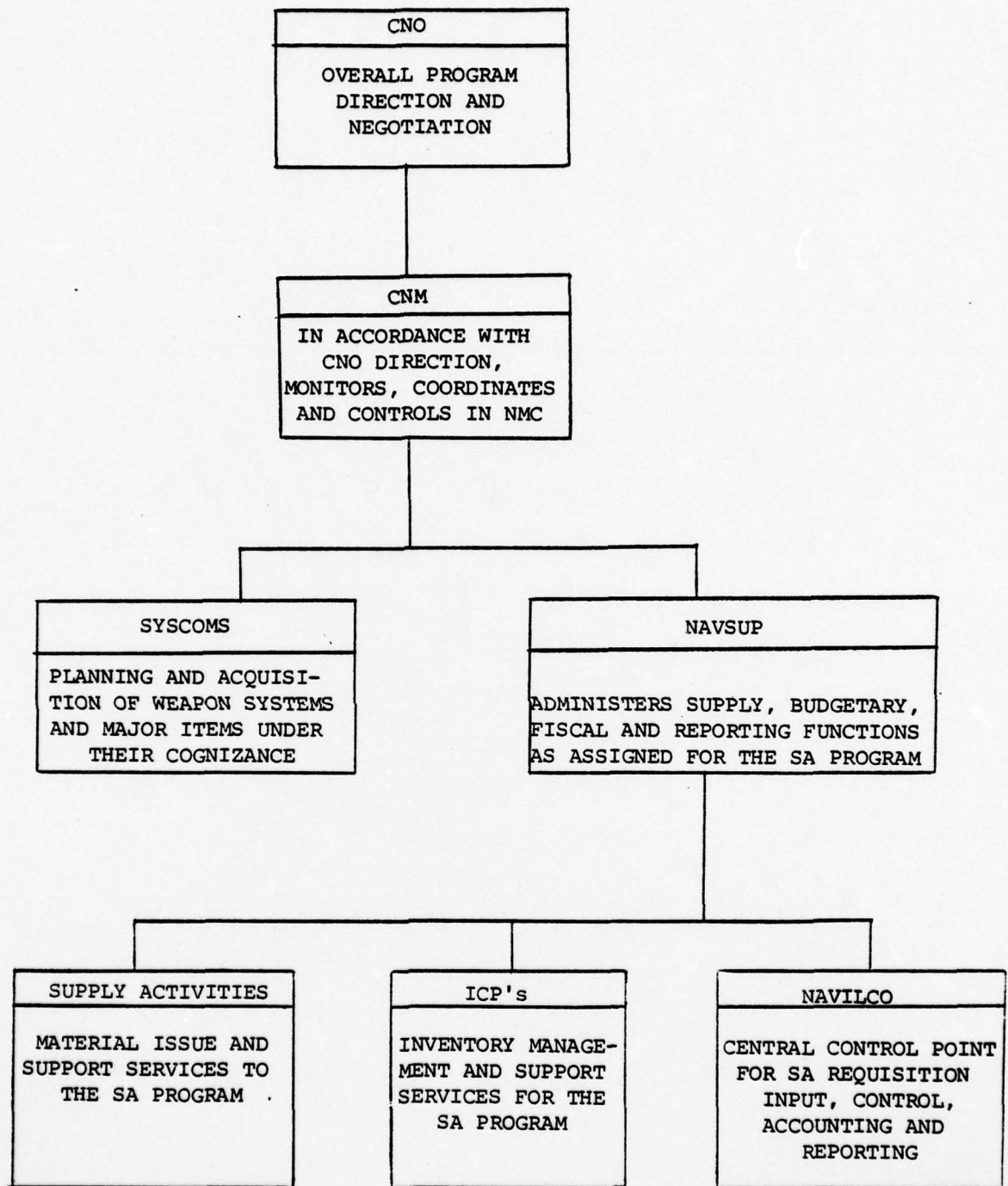


Figure IV-3. U. S. Navy Security Assistance Program Organization and General Function.

policy supervision of all matters related to production, procurement, supply and distribution of material.

b. The Chief of Naval Operations

The Chief of Naval Operations (CNO) is the senior military officer in the Department of the Navy. He is the principal Naval advisor to the President and to the Secretary of the Navy, and he is a member of the Joint Chiefs of Staff (JCS).

The CNO is responsible for planning and determining the material support needs of the operating forces of the Navy, including weapon or weapon systems, materials, supplies, facilities, maintenance, and supporting services. His responsibilities also include determination of the military performance requirements and the determination of priorities between various projects.

As a member of the JCS, the CNO participates in development of JCS recommendations and positions pertaining to security assistance and provides naval technical advice to the DOD, Unified Commands and MAAG's.

Another important function is the negotiating of FMS cases for major weapon systems and their support on a service-to-service or government-to-government basis. In addition, the office of the CNO plays a role in direct commercial sales of items which are on the Munitions List.

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The Munitions List enumerates articles which, by law, are defined as arms, ammunition and implements of war. Any commercial firm that wishes to sell an item on the Munitions List to a foreign country must obtain an Export License from the State Department. Applications for Export Licenses are received at the Office of Munition Control (OMC) (State Department). Navy cases are sent by OMC to the Office of the Chief of Naval Operations, with a request to comment on the proposed exports. A coordinated Navy position is then forwarded to OASD/ISA for the formulation of a coordinated DOD position before return to OMC.

Munition Control is closely related to FMS, in that the same releasability factors are applicable. Further, in cases where foreign governments are advised, through FMS channels, to consult the manufacturer for items not available from the Navy, these requests become Munition Control Cases.

The Office of the Chief of Naval Operations (OPNAV) has additional Security Assistance responsibilities like providing price and availability data as requested by, for instance, OASD/ISA or the customer country directly. Further, to procure and deliver to recipients material and services included in approved SA programs and to sell military equipment and services to eligible nations and international organizations (FMS), OPNAV should also make an

effort to integrate procurement of FMS material with service procurement programs in accordance with OASD/I&L policy.

Virtually all of CNO's responsibilities regarding Security Assistance are performed by the International Logistic Division (OP-63) of the CNO staff and further down by the CNM's organization. OP-63 is the highest level office in the Navy with a primary function of administering FMS, and is therefore the focal point for coordinating intra-service and interdepartment FMS-associated matters. The office is also responsible for training efforts related to foreign sales.

c. The Chief of Naval Material and the Systems
Commands

The Chief of Naval Material (CNM) under the Chief of Naval Operations (CNO), commands all activities of the Naval Material Command. The Command includes the Headquarters, Naval Material Command and five principal subordinate commands, known as the systems commands; separately organized project management offices, and the shore (field) activities which are part of the Naval Material Command. The field activities include industrial activities, research and development centers, and laboratories.

The five Systems Commands have been assigned responsibility for different kinds of material. The Naval

Air Systems Command (NAVAIR) is responsible for aircrafts and airborne weapon systems and other aviation related equipment.

The Naval Electronic Systems Command (NAVELEX) is responsible for shore-based electronic systems and certain common use airborne and shipboard electronic equipment.

The Naval Facilities Engineering Command (NAVFAG) is responsible for the administration of the Navy Military Construction Program, facilities planning and facility maintenance.

The Naval Sea Systems Command (NAVSEA) is responsible for whole ships and crafts, and for shipboard components such as propulsion, power generating, sonar, search radar, and auxiliary equipment. A common name for the above mentioned systems commands is "Hardware Commands."

The Naval Supply Systems Command (NAVSUP) is responsible for supply management policies and methods, administration of the Navy Supply Systems, publication and printing, the Navy Stock Fund, the Field Procurement System and material functions related to materials handling equipment, food service and special clothing.

NAVSUP has cognizance of the procurement of materials and services throughout the Navy for which no other procuring activity, office or command is delegated

procurement authority. Of the four million items in the DOD supply system, about 1.7 million are used by the Navy. Forty-five per cent of these items are managed and controlled by NAVSUP through its directly managed inventory control points, namely the Aviation Supply Office in Philadelphia and Ships Parts Control Center in Mechanicsburg. (4, p. 4-3) The remaining items are managed by the Defense Supply Agency or the General Services Administration, except for some 22,000 major items which are managed by other Navy commands and offices.

It is the policy of the Navy that all material used by the Navy will be considered as items of supply to be managed by one of the inventory control points; unless the material is assigned to another integrated material manager.

The material managed by the Inventory Control Points are stocked by a Supply Center, which also stocks material managed by the Defense Supply Agency and General Services Administration. In addition to this, the Supply Centers also stock a number of locally managed items.

Material stocked by the Supply Centers is issued to the mobile logistic support forces and also directly to the operating forces. In addition, support is also provided to activities like the air stations, ordnance

stations, shipyards, training stations and smaller shore activities.

The basic responsibility for providing this supply to meet total user needs for most of the Navy supply items rests in the inventory control points. They determine the quantity and range of items to be carried at specific locations; position those inventories at the major stock points, and determine in collaboration with the hardware systems commands the individual support missions that these stock points will carry out.

NAVSUP is responsible for the supply, budgeting and the fiscal and statistical functions in support of assigned Security Assistance (SA) programs. Within NAVSUP, the International Logistic Staff carries out the command responsibilities for the International Logistics Programs. This is done by exercising executive authority over the Navy International Logistics Control Office (NAVILCO), located in Bayonne, New Jersey.

d. U. S. Navy International Logistics Control Office

NAVILCO is the focal point within the U.S. Navy for requisitioning control, financial accounting and reporting control for all Navy SA programs. The various tasks performed by NAVILCO all pertain to monitoring the progress of customer demands through the U.S. government supply

system, from initial input of the requisition to delivery, final settlement of accounts and reporting.

(1) Requisition Control. NAVILCO's sales mission starts with the receipt of the signed Letter of Offer and Acceptance, the DD Form 1513, which implements the case or total order.

NAVILCO's main task is the control of these cases until each item is shipped, billed, paid for and, finally, reported as a completed transaction.

Requisition control, which is NAVILCO's first mission element, begins as soon as the customer's requisition is placed on the computer in NAVILCO and processed into the supply system. This system keeps NAVILCO informed of the status of all requisitions. This status information is passed on by NAVILCO to the customer country. The first status is sent when the requisition is introduced into the supply system and later whenever status feedback is received during the life of the requisition. If shipment status is not received within specific time frames, the computer automatically follows up on the source of supply.

(2) Financial Control. A basic element of FMS is the method of financing. The type of assistance assigned to each case identifies the methods and term of financing and constitutes the basis for the collection of funds from the customer.

The most commonly authorized Types of Assistance (TA) are TA-3 (Cash With Order): customer is required to submit complete payment upon submission of an order; TA-4 (Dependable Undertaking): customer is required to have funds on deposit prior to delivery of material and performance of services; TA-5 (120 Day Payment): customer is permitted 120 days from date of shipment to effect payment.

To provide each customer with a complete financial status of his program, NAVILCO maintains a separate account for each country. The receipt of a signed DD Form 1513 from the customer signals the establishment of a new allocation within that country's account. With the exception of Cash With Order cases, the customer is normally not required to deposit any funds in order for his country's account authorization to be increased. However, NAVILCO must insure that funds are obtained from the customer prior to expenditure of any fund.

On a quarterly basis, NAVILCO provides the customer with statement of account for each case. This statement reflects the cumulative cash requirement for each case, the collections received to date and the funds required for the subsequent quarter.

Upon receipt of delivery and financial data at NAVILCO, the customer is provided with an Interim

Statement advising him of how his money was applied against open cases.

All collections received by NAVILCO are deposited to a Trust Fund Receipt Account with a subhead for each country. U.S. Navy Appropriations and private contractors are reimbursed from this account for stock issues and procurements.

A customer collection or payment is the result of a billing or request for scheduled payment made by NAVILCO. Such billings and requests are generated based on the requisition, the constructive proof of delivery and matched financial charges from the supply system.

After completion of delivery and financial transactions, a Final Statement is prepared summarizing all costs. Surplus funds are transferred to the customer's Holding Account or refunded when a Holding Account has not been authorized. The purpose of a Holding Account is to establish a fund where debit/credit actions can be easily and quickly processed to expedite case closure.

(3) Reporting Control. NAVILCO is responsible for preparation of all reports pertaining to the management and operations of the U.S. Navy's Security Assistance programs. These reports are used by NAVILCO, the customer

and higher authority such as NAVSUP, CNO, CNM, the DOD, Congress and the Executive Branch.

The Quarterly Requisition Report reflects current status of all requisitions in process of being filled by the supply system. Another report is the Quarterly Summary Report which contains material and supply status of all cases.

Finally to be mentioned is the DOD 1100 FMS Reporting System which has been implemented by all services. Under this reporting system, all sales transactions are reported at detailed generic levels or case record levels from negotiating stages through case closure. A master file is maintained by the Defense Security Assistance Agency. This master file is updated periodically with supply and financial information reported by NAVILCO.

(4) Country Program Management. The Country Program Manager (CPM) can be considered as the Customer Country's Representative within the U.S. Supply System, and is a focal point for all actions concerning a specific country. Briefly, the CPM shall:

- (a) oversee entire country program with all NAVILCO operating components;
- (b) be responsible for complete monitoring of case/program line to closure;
- (c) be the one individual responsible to the command on all aspects of a country logistics package.

2. The Typical FMS Case; An Example

Before trying to identify and make an outline of a typical Foreign Military Sales Case, it should be realized that two cases rarely are alike, neither in the manner in which they originate, nor in the fashion in which they are implemented. Each sale is different and the route it takes through the system is varied as the number of sales.

Standard Foreign Military Sales cases are the most frequently used type of FMS in the Norwegian Navy. The Blanket Open End (BOE) case method is used for direct requisitioning of spares and repair parts and other items authorized for the Direct Requisitioning Procedure (DRP). This procedure is well defined and documented, and few problems are encountered. Costs, as well as lead time are not unreasonable, particularly when the ordered material can be delivered directly from U.S. stock. If, on the other hand, an item has to be procured, a substantial increase in lead time is experienced.

For the purpose of the following example, a Standard FMS Case will be studied, and typical routine for such a case will be identified. As mentioned above, no two sales are alike and what is described in the following is what might be a typical route. The procurement of a 65-foot patrol boat will be used; however, any major weapon system

would have served the same purpose. For a pictorial presentation of the flow, reference is made to Figure IV-4 at the end of this Chapter.

a. Perception of Need - Norway

It is assumed that officials in Norway have perceived a need to update the current fleet of patrol boats. Such a need would probably originate at Defense Headquarters/Navy Headquarters level (ref. Figure IV-2).

Information has been obtained that a 65-foot patrol boat, which might meet the requirements of the RNON, is in existence in the United States. This information might have come to the attention of Norwegian officials in a number of different ways. Examples might be Norwegian diplomacy/military mission in the United States, magazines, newspapers, radio and television, both in Norway and the United States.

b. Transmission of a Request for Price and Availability

Given that a need is perceived in Norway for a 65-foot patrol boat and the U.S. Navy is identified as a possible source, a request must be sent to the U.S. government. Such a request may be sent via diplomatic channels to the U.S. State Department or direct to the service involved.

All potential FMS customer countries are classified as either "A" or "B" countries. The classification is

made by the State Department and represents two different country categories for purchase of defense articles. "A" designated countries may go directly with their requests to the service concerned while the "B" countries must forward their requests to the State Department for its considerations before it goes to the service.

Norway is an "A" country and in the case of the 65-foot patrol boat, the request would be sent by the Naval Material Command in Norway to the Norwegian Military Mission in Washington for direct submission to the Chief of Naval Operations, International Logistic Division (OP-63). The request will ask if the United States is willing to sell the patrol boat, how much it will cost and how long a period of time it will take to make delivery.

c. Price and Availability Information

Before going ahead to a lower echelon in the Navy's Supply System to obtain the information requested by Norway, there are certain clearances the Military Department/CNO might have to get from the Department of Defense. Within DOD, the organizations that would be involved in the considerations are Assistant Secretary of Defense, International Security Affairs (ASD/ISA), and Defense Security Assistance Agency (DSAA). The ultimate purpose of any such

clearance would be to reach a decision whether Norway should be authorized to buy the weapon system requested.

Assuming this to be the case, CNO would forward the request to Naval Sea Systems Command, who would be the hardware command responsible for inventory management for the 65-foot patrol boat. The request from CNO to NAVSEA can be given in the form of a telephone call, a message or a formal letter. It would state that the Royal Norwegian Navy is a potential buyer of one 65-foot patrol boat, please provide price and availability information. CNM would be informed of this action. For identification purposes, CNO will already have assigned a case number to the transaction. This would be a three letter group, for instance, SAA.

At NAVSEA, the procurement and technical specialists for patrol boats will provide their best price estimate and lead time information. However, a ship requires components, equipment, systems and spare parts which would be under the responsibility of other systems commands or inventory control point. It is required for each of those inventory managers to participate in developing price and availability for the 65-foot patrol boat.

Thus, NAVSEA will coordinate the requirements for all of the components and equipment that will be built into the boat. As Project Manager, NAVSEA is responsible

for the entire logistic support plan for the patrol boat and must coordinate with the commands concerned and bring them into the act. These might be NAVELEX, NAVSUP and the Inventory Control Point (ICP). (The Navy Ships Part Control Center (SPCC), Mechanicsburg.)

When all the required information is gathered and coordinated in NAVSEA, they will go back to CNO with the information, saying, for instance, that the 65-foot patrol boat can be delivered for \$500,000, a two-year support package covering all three levels of maintenance can be delivered for \$25,000 and the procurement lead time will be 36 months. As a guide in estimating procurement lead time, a minimum of seven months shall be included to cover time required for administrative purposes. This time is added onto the time required for manufacturing plus an additional two months (12, p. 3-6).

The above information is what NAVSEA recommends the Letter of Offer and Acceptance (DD Form 1513) to Norway to include.

d. Letter of Offer and Acceptance

Based on information received from NAVSEA, the Office of the Chief of Naval Operations (OPNAV) will convert the data into a formal offer on a DD 1513 for submission to

the Norwegian Military Mission (MMW), Washington, D. C.
(An example of the DD 1513 is provided in Appendix D.)

The DD 1513 will contain one line for the main equipment, in this case a 65-foot patrol boat, and one line for the Logistic Support Package. It will also include other costs, in addition to the equipment cost, like administrative charges and accessorial charges (packing, crating, and handling). The appropriate financial arrangement is indicated, in the case of the patrol boat, is assumed Dependable Undertaking. Finally, the form will indicate a date beyond which the offer is no longer valid, usually 90 days from date of offer.

Having received the DD 1513, the Norwegian Military Mission, Washington, D. C. (MMW), will send a copy to Naval Material Command in Bergen, Norway, asking for a decision whether to accept the offer or not. Before acceptance can be made, clarifications and negotiations might be necessary. Assuming that the Norwegian Navy, with the approval of DOD, finds the DD Form 1513 to be in accordance with the stated requirements, a telex message is sent to MMW, authorizing the Military Attache to accept the offer and sign the DD 1513 on behalf of the Chief of Naval Material Command, Norway.

e. Case Implementation

The accepted DD 1513 is now sent from MMW back to OPNAV. The document has become an official contract between the two governments and is forwarded by OPNAV to Naval Material Command (NAVMAT) for implementation as an FMS case.

NAVMAT reviews the DD 1513 for conformance to FMS policy. To identify each line on the document, a Record Serial Number (RSN) code is assigned to each of them. The RSN code also identifies the Designated Implementing Activity (DIA). Whenever an FMS case includes a major item with supporting spares and repair parts, the DIA responsible for the end item will also be in charge and responsible for the support line.

In the case of the 65-foot patrol boat item, the DD 1513 will wholly be assigned to NAVSEA for program management. After having made an input to the DOD 1100 Reporting System, NAVMAT will forward a copy of the signed Letter of Offer and Acceptance to NAVSEA, which will be responsible for providing the end item and also the related support package. Another copy will be sent to NAVILCO, which will be the official record keeper in the program. NAVILCO will provide requisition control, financial control and reporting control.

NAVILCO will not go ahead and establish the various case records. A number of different FMS computer files are used, the purpose of them all being to provide adequate control and monitoring of the program. To implement the case, NAVILCO processes standard FMS MILSTRIP (Military Standard Requisitioning and Issue Procedure) requisitions, one for each line on the DD 1513, and enter each requisition into its computer system. The requisition will then be sent to NAVSEA under a letter of transmittal.

In addition to providing the initial requisitions, which in fact triggers NAVSEA's work on the case, NAVILCO will also provide the necessary funding authorization. This is normally included in the letter of transmittal, giving NAVSEA FMS Trust Fund direct citation authority.

A Trust Fund receipt account is established to record receipts of funds from Norway. Assuming Dependable Undertaking, request for funds will be sent to Naval Material Command in Norway by NAVILCO about 90 days in advance of expected or committed payments to contractors and the U.S. Navy supply system. This is done to make sure sufficient funds are available at the time of payment.

A Trust Fund expenditure account is also established to record expenditures related to carrying out the program. Periodically, funds will be transferred to this

account, and as payments to contractors/refunds to the U.S. supply system become due, the account will be charged for the amounts that are being paid.

(1) NAVSEA Action. NAVSEA will now have a requisition for a 65-foot patrol boat, one requisition for spares and support items to be delivered with the boat and a funding authorization. (It should be noted that the requisition for the support package is undefined. It will be the responsibility of NAVSEA to break down this undefined line into a number of defined items, adding up to a total cost of \$25,000).

On receipt of the above-mentioned documents from NAVILCO, NAVSEA will go ahead and contract for the building of the 65-foot patrol boat according to specifications. Contracting will be done in accordance with contracting procedures normally used in the U.S. Navy.

Concerning the support package, the first task will be to define the individual items to be included. This will be a task for the Navy Ships Part Control Center (SPCC) in Mechanicsburg, who is the Inventory Control Point (ICP) for ship construction. The SPCC will cooperate in the provisioning task with the contractor selected to build the 65-foot patrol boat.

When all items to be included have been decided on and specified in a listing, NAVSEA will send this information to NAVILCO who will convert it into FMS MILSTRIP requisitions. The requisition data will be entered into the NAVILCO computer system, and the dollar balance on the original line requisition will be reduced to zero. The requisitions will be forwarded to NAVSEA by NAVILCO within ten days after receipt of the specified listing of items. Copies of the requisitions are furnished to Naval Material Command, Bergen.

NAVSEA will now ensure that the spare parts/repair parts requisitions are processed without any delay. They will select the method by which the items will be furnished, either by direct delivery from procurement or through the U.S. Navy Supply System. In both cases, NAVSEA will pass the line item requisitions on to the ICP with a copy of the letter of transferral to NAVILCO, who will also be provided MILSTRIP status.

At work now are NAVILCO, controlling the requisitioning, financing and reporting; NAVSEA with its engineers and contracting specialists contracting for the 65-foot patrol boat; and the Inventory Control Point (SPCC) with the task of providing the initial support package.

If the support package is provided through the supply system, requisitions are processed into the system with a reimbursable fund code on it. This means that the supplying activity, for instance, a Naval Supply Center, sends a bill to NAVILCO, who will make a refund from the Trust Fund expense account.

If the ICP signs a contract with a private contractor for delivery of the support package, the same contracting procedure will be followed as used for the end item.

Throughout the program, NAVILCO is provided status information which is passed on to the Naval Material Command in Bergen.

(2) Shipment and Delivery. In general, FMS material is shipped to a Freight Forwarder who is selected by the customer country, and their relationship is governed by a contract. On receipt of FMS material from the various U.S. sources, he will arrange for the shipment and forward it to the customer country.

NAVSUP Publication 437 and Military Standards provide rules for packing, packaging and marking of the shipment. Important information to include on the package and all shipping documents are FMS case number, and FMS requisition number. The NAVSUP publication also contains instructions

on shipment from DOD stock, including instructions on consolidation of shipment.

The majority of FMS are FOB origin. This implies that title to the material passes to the customer country at the initial point of shipment or origin, and the freight is ultimately paid by the customer. (12, p. 3-20) Normally, a commercial collect bill of lading is used. This would imply that, for instance, a trucker picks up the freight at the supply center for transportation to the freight forwarder. The freight forwarder pays the trucker and bills the customer country for the total cost of transportation.

In deciding on a mode of transportation, guidance is primarily provided by the priority put on the individual requisition. Both a private contractor, a U.S. stock point and the country's freight forwarder will be guided by these priorities. Priorities can be assigned, ranging from 1 through 15. Priority 3, for example, would automatically imply air transportation (ref. 5).

Another guidance in deciding mode of transportation would be the physical size and weight of the item(s) to be shipped and the limitations the various modes represent in this respect.

Cost considerations would also be an input to the decision making process. Costs would have to be traded off against the urgency of need for the equipment. For instance, sending extremely bulky and heavy items as air freight might turn out to be more expensive than the customer country would be willing to accept. In such cases, the customer country will normally be consulted before a decision is made.

The above considerations would all be made in the case of the 65-foot patrol boat and the related support items and spare parts. The boat would probably be picked up at the source and sailed to Norway, and the support items and spare parts would most likely be shipped by sea.

f. Material Receipts - Routines in Norway

The in-country address for FMS shipments to RNON will be Naval Material Command, Bergen. The Command has a special Receiving Group under the supervision of the Department of Supply and Administration. The Receiving Group is responsible for receiving all classes of material, and performs quantity control and preliminary quality inspection of all goods received.

The Procurement Section will keep the Receiving Group informed of all shipments expected in, and also provide copies of all contracts and purchase orders. In this

way, the Receiving Group knows what to look for and can compare the receipts against the contracts.

Upon receipt of material for the 65-foot patrol boat, the Receiving Group will make out receiving reports with copies to the Systems Command responsible for the contract, to the Procurement Section and to the Bureau of Supply and Administration.

In the case of the 65-foot patrol boat, the systems command responsible will be the Bureau of Ships. However, other systems commands will be involved in connection with weapons and other systems on board. Thus, final quality control and inspection will be made by the various systems commands according to their responsibilities for different kinds of equipment.

After completed receiving control and inspection, any discrepancies will be brought to the attention of the U.S. Navy Supply System by the use of a Report of Item Discrepancy. A sample of the form is provided in Appendix E. There exist detailed procedures for the use of this report. Time involved to settle claims will vary, depending on the type of discrepancy; however, considerable delay in case closure is often experienced.

Assuming all material received in connection with case SAA is accepted by the Naval Material Command, the

material is distributed to the various warehouses. The Bureau of Supply and Administration will bring their files up to date in order to keep track of the material and keep it available for issue. The Procurement Section will use their copy of the receiving reports as documentation for financial accounting purposes.

g. Case Closure

When all equipment, training and services contracted for are delivered and accepted by the RNON, and all payments and reimbursements have been made, the case is ready for closure. This is done by NAVILCO issuing a Final Statement of Account, showing total costs and total payments received on the case. Any differences between the two amounts can be settled by transferring funds to or taking funds out of the Holding Account, given sufficient funds are available.

Norway has now received the 65-foot patrol boat with a two-year support package. A question that might be raised is, what are the strengths and weaknesses with the system used to accomplish the delivery, and how does it function compared to the theoretical system presented in Chapter III?

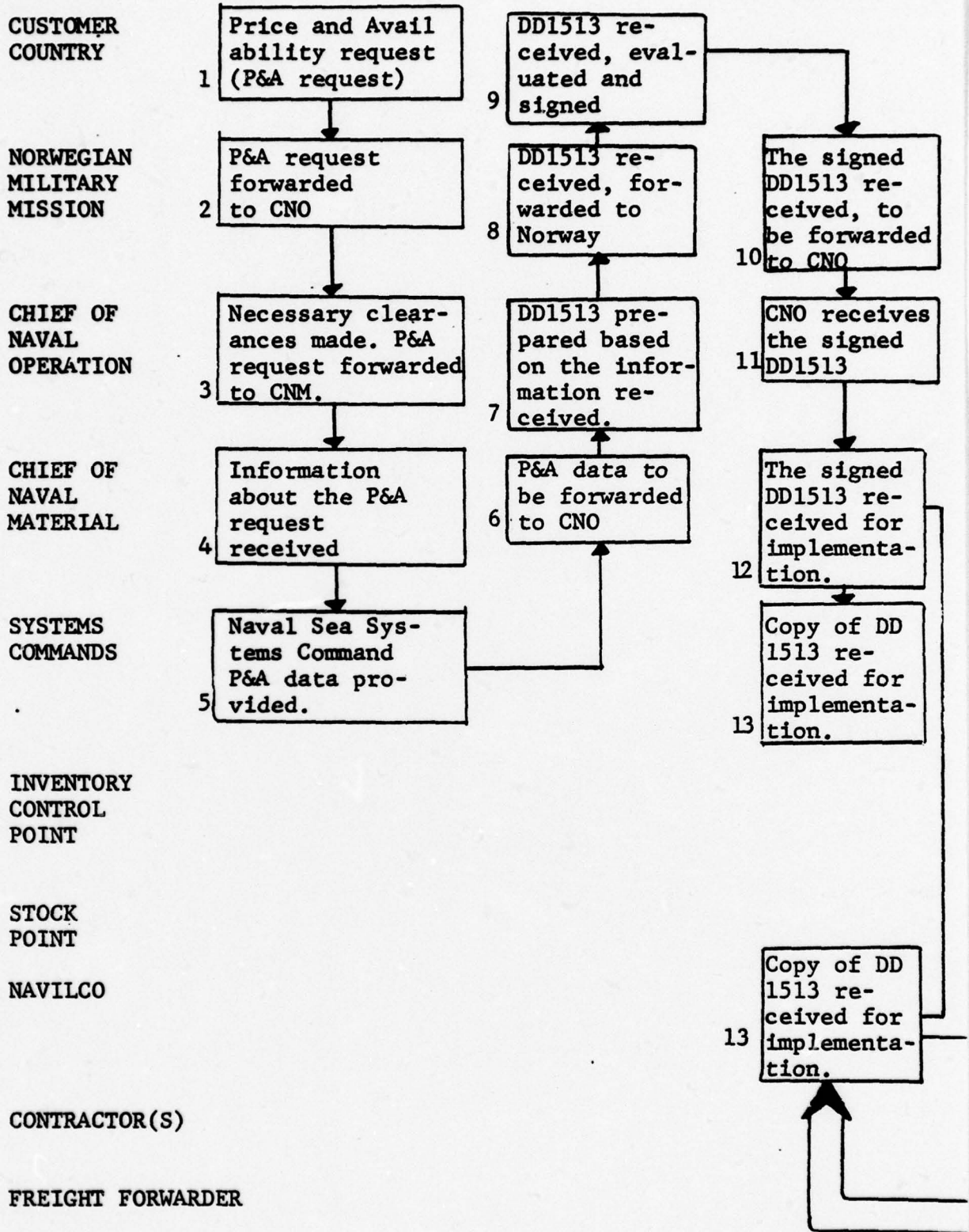


Figure IV-4. Typical Flow of a Standard FMS Case (page 1)

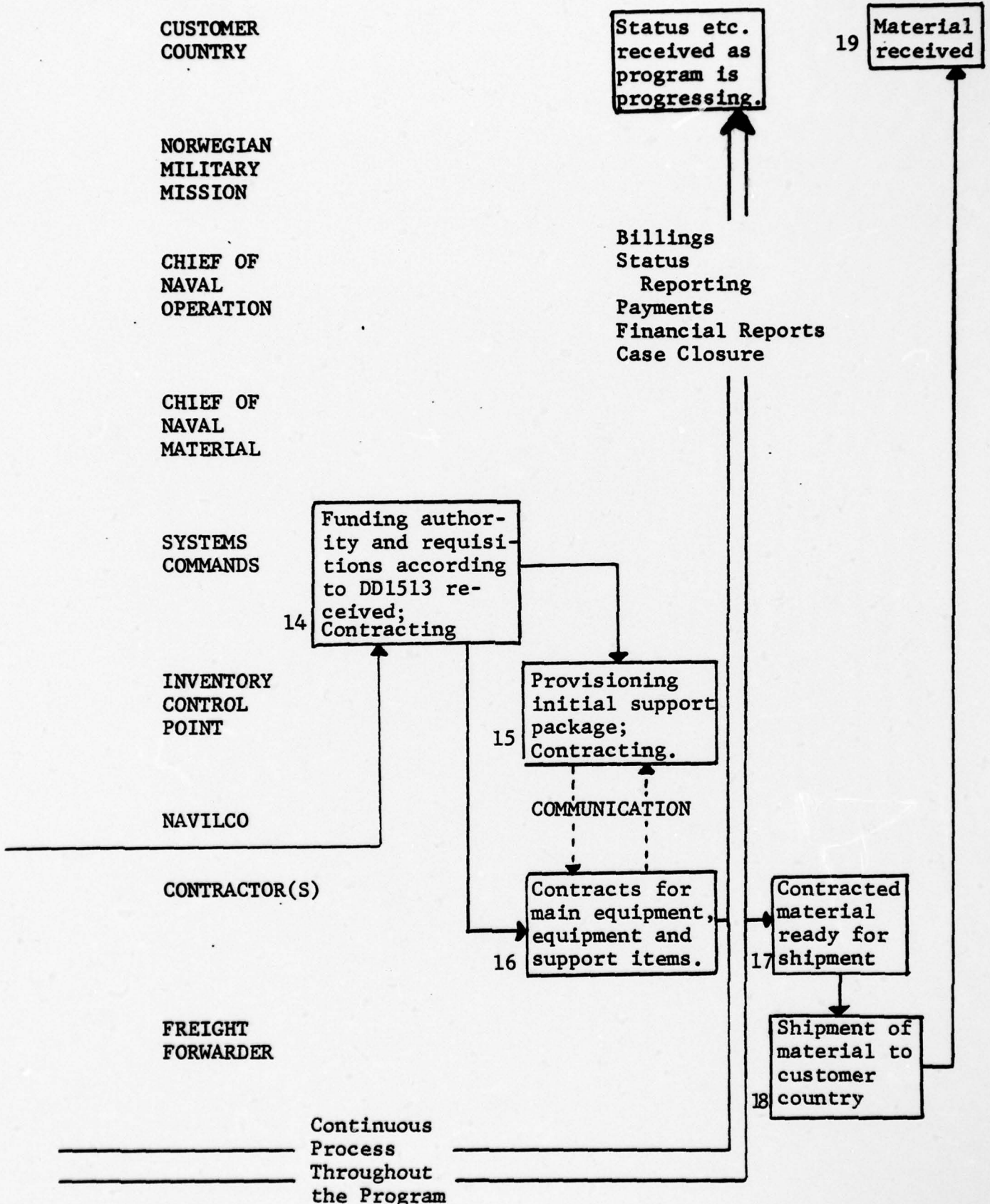


Figure IV-4. Typical Flow of a Standard FMS Case (page 2)

V. EVALUATION

Reference is made to Chapter III, where a framework for a logistic system was presented. With a view to that logistic concept, an evaluation of the FMS system as described in Chapter IV will be made. The purpose will be to identify existing problems and point out areas within which improvements seem possible. It is outside the scope of the thesis to find causes of the problems and to suggest their solutions.

Basically, the present system for FMS is constructed as suggested by the logistic model of Chapter III, with the same basic functions being performed. There is a flow of information between the customer country and the U.S. Navy Supply System, and a flow internally in each of the two organizations. There is also a flow of material from producer to consumer which requires warehousing, materials handling and packaging, inventory control and transportation. In connection with replenishment of inventory or direct deliveries from contractors to a customer, procurements are made, and demand forecasting is an important part of inventory control.

Each major area of FMS logistics will be discussed relative to identifying possible ways for improvement in terms of lead time and cost savings for the customer country.

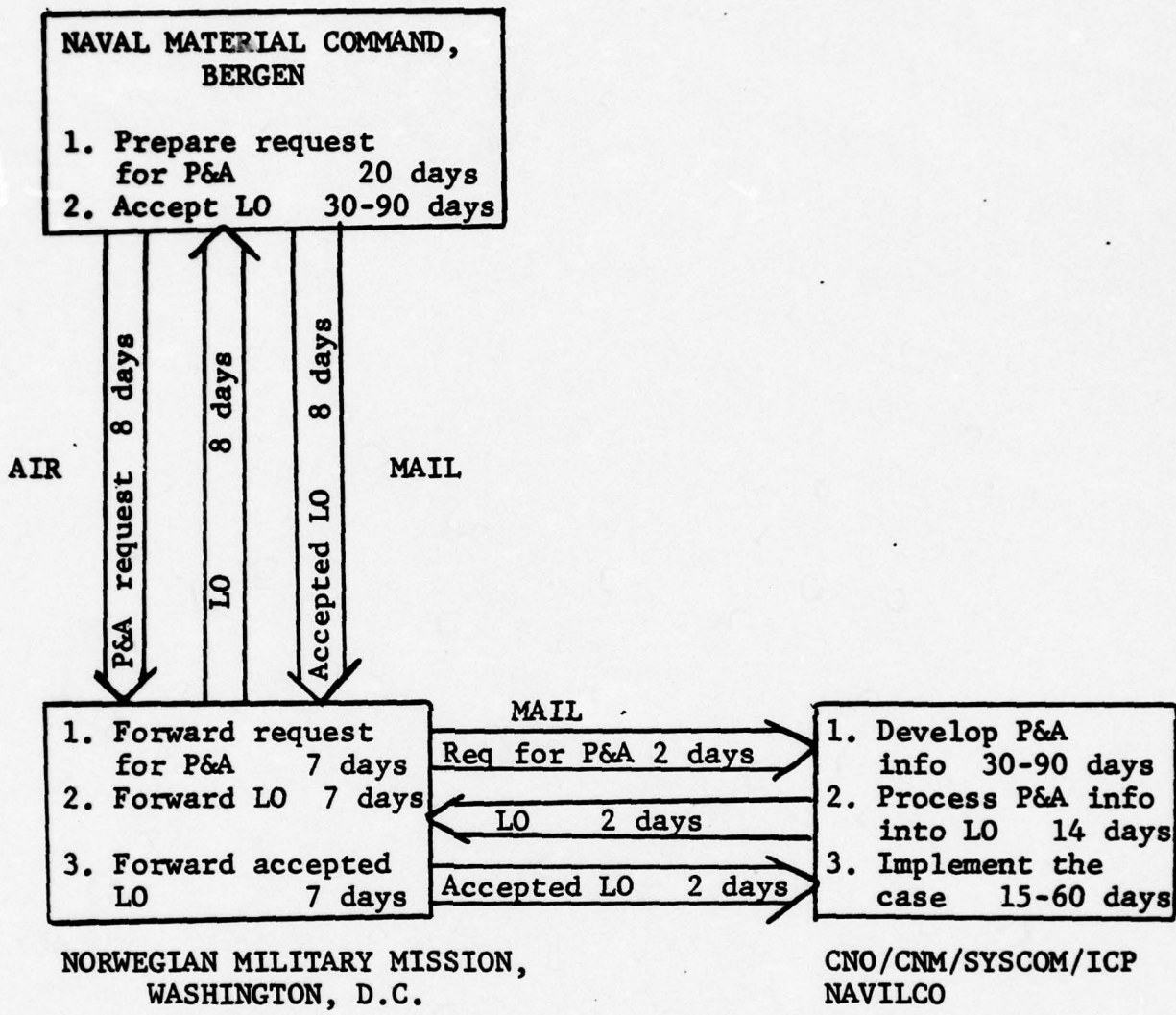
A. COMMUNICATION AND ORDER PROCESSING - FLOW OF DOCUMENTS

As mentioned in Chapter III, the time required for communication and order processing often represents a major part of the total order cycle time. This seems to be the case also for FMS, and a major effort should be concentrated within this area to achieve time savings.

As mentioned in Chapter IV, a minimum of seven months shall be added on to the estimated procurement lead time of a major weapon system to include time required for administrative purposes.

Also data provided in Figure V-1 support the belief that communication and order processing time represent a significant part of total lead time for an item. It should be noted that the time frames presented are estimates believed to represent the average number of days required within each organization to carry out their designated tasks in connection with a sale. By adding the number of days in Figure V-1, a minimum of 160 days should be expected and a maximum of 235. In addition, time required for contracting and production will have to be taken into account.

To which extent communication and order processing time represent a major or minor part of total order lead time, depends entirely on whether the item can be delivered directly from U.S. Navy stock or separate procurement is required.



LO = Letter of Offer
 P&A = Price and Availability

Figure V-1. Communication and Order Processing Time. Estimates for a Standard FMS Case. (Reference 17)

The procurement lead time is often significant, reducing the relative importance of order processing and communication time. When deliveries are made directly from U.S. Navy stock, this relative importance is increasing.

At the Naval Material Command in Bergen, communication is mainly by phone, internal mail service or by meetings held when required. For high priority items, the process is accelerated by having documents hand-carried through the system.

Requisitions prepared according to the Direct Requisition Procedure (DRP) for placement against a Blanket Open End Case are sent by air mail directly to NAVILCO. The transit time for such time will normally be one week. Upon receipt of a requisition from RNON in NAVILCO (DD Form 1348), all information contained in the form have to be keypunched for processing purposes. A requisition transmitted to NAVILCO for instance by message, is processed identically as a letter.

To save time required for mail in transit, alternatives to the present system of requisitioning (DD Form 1348) should be considered. A trade-off should be made between the time savings achieved and the added costs of using a superior means of communication, for example telex.

One additional thing to be mentioned in connection with DRP is that requisitions are often consolidated at Naval

Material Command in Bergen before submission to NAVILCO. Such consolidation serves no purpose seen from NAVILCO's point of view and should be avoided, at least whenever time is critical. (Reference 5)

For all other FMS cases than DRP, the Norwegian Military Mission in Washington serves as a link between the Naval Material Command, Bergen and the U.S. Navy's Supply System. All requests for Price and Availability, and all subsequent communication between RNON and the U.S. Navy are being done with MMW as a linking point. Since MMW's role in FMS is limited to that of a mail receiving and distribution center,¹ a study should be made in order to analyze MMW's contribution to the FMS process. An alternative method is to allow direct communication between CNO/CNM/NAVILCO and Naval Material Command in Bergen. It is, however, realized the importance of having an organization like MMW which can be brought into the process whenever "face to face" communication is required to solve problems that might arise.

Communication between Norway and MMW are done mainly by means of airmail, telex or telephone. FMS inquiries from Norway received in MMW are forwarded to the CNO or CNM, both organizations located in Washington, D.C. Mail is the primary means of communication.

¹Information provided by proprietary correspondence between the author and MMW.

Within the U.S. Navy Supply System, documents are forwarded by mail and communication related to the FMS processing are to a great extent performed by means of computer communication, the efficiency of which is considered to be very good. (Reference 5)

B. PROCUREMENT AND CONTRACTING

Procurement or contracting as a part of FMS is being done either in connection with replenishment of items carried in the U.S. Navy Inventory System or in response to an FMS case for material either not carried or not eligible for release direct from U.S. stock.

The same procurement organization, techniques and regulations are used for FMS procurements as normally used for U.S. Navy procurements. Based on information in current literature, efforts are made to improve Federal Procurement. Recent establishment of an office for coordination and improvement of all Federal Procurement Policy can serve as an example.

The use of commercial sales would be an alternative to involving the U.S. Navy Procurement Organization in the process of obtaining material, that is procurement being made by the RNON direct from a U.S. company. (This would of course imply elimination of the entire FMS procedure).

As mentioned in Chapter IV, the DOD policy is that commercial sales shall be made whenever practicable. Although some exceptions exist to this general policy, one should expect the trend to be a move away from FMS towards commercial sales. Available statistics, however, indicate that this has not been the case. The trend has rather been a move in the direction of FMS, with a decreasing use of the commercial sales option.

When looking at the extensive system and routines that are established to take care of FMS, one should expect that time and money could be saved by having the customer buying major items not available from U.S. stock directly from a U.S. contractor. A support for this approach would be the fact that DOD services within the field of quality assurance and price and cost analysis could be made available whenever considered necessary and requested by RNON.

One problem would be for the customer country to know in advance whether an item is available from U.S. stock or not and if available, to know where the commercial sources are. Despite this problem, commercial sales as an alternative to FMS is an interesting thought well worth further study.

C. WAREHOUSING, MATERIALS HANDLING AND PACKAGING

The U.S. Navy warehousing operations and materials handling systems seem to be very much in line with the latest developments within the field. (Reference 18)

The great majority of U.S. Navy operated warehouses are either owned or leased by the government. The use, for instance, of a public warehouse would be considered impractical, given the special nature of a military organization and its operations.

The means of materials handling used and the physical layout of a warehouse varies from stock point to stock point; however, the general impression is that an efficient operation is achieved by utilizing various kinds of mechanical handling equipment combined with well designed and properly planned facilities. Even fully automated materials handling systems are installed at some of the larger units, like the Naval Supply Center, Oakland. The experience has been good and system processing requirements have been satisfied. (Reference 18)

FMS items are often sent over long distances so packaging and marking become important elements to ensure safe and timely arrival of material. Inadequate packaging and marking of shipments can cause substantial increases in lead time for reasons to be mentioned in the following.

In addition to problems created during transit of material, inadequate marking causes serious problems at Naval Material Command in Bergen. If a shipment cannot be identified and matched to a contract, the material will not be transferred to a warehouse and made available for issue, until proper identification and matching has taken place. Sometimes, this will add weeks and even months to the order cycle.

Arrival of goods in damaged condition is often caused by inadequate packaging. In most instances, this will more than double the lead time for the item(s) in question. This is because of the time involved in filling out a Report of Item Discrepancy (ROID) and have it processed through the system. After a decision on the ROID has been reached, a replacement item will have to be provided and shipped.

Whether problems caused by inadequate packaging and marking are of significant importance or not has not been determined. Data, measuring frequency of occurrence, should be gathered at Naval Material Command in Bergen in order to find this out. Included in the study should also be the frequency of incorrect items received, which will have a similar negative effect on supply efficiency as for instance receipt of a damaged item. A distinction should be made

between shipments received from a U.S. Navy stock point and shipments made direct from a U.S. contractor in order to determine any significant variance in frequency.

Based on the findings of such a preliminary study, a decision could be made whether the problem warrants further and more detailed studies.

D. INVENTORY CONTROL AND MANAGEMENT

The quality of these functions becomes of particular importance in the case of Supply Support Arrangement (SSA), under which a customer country becomes a direct customer of and participant in the U.S. Navy supply system, with delivery of support items directly from stock. The U.S. Navy's Inventory Control and Management programs are also important to any other FMS arrangement, in which deliveries of material are made directly from U.S. Navy stock. This will often be the case in connection with a Blanket Open End Case, which RNON uses to a large extent.

The U.S. Navy Supply organization has an advanced system for inventory control and management. By the aid of computer programs, a base for management information and control is provided. Computers are also used as an aid in decision making regarding Economic Order Quantities, Safety Stock Levels, Reorder Points and Operating Levels of Inventories.

All of these are familiar concepts from the Inventory Systems theory. It should, however, be realized that even though apparently outstanding models are used, the end result will not be of higher quality than the quality of the various inputs used. Demand forecasting for instance is a complex area of major importance to the performance of the supply organization.

The U.S. Navy Supply System has a number of standard inventory models currently in use. They are basically classified into the fixed level inventory models and the variable level models. Under a fixed level inventory system, all inventory line items or groups of line items are treated alike. Operating level, safety level and lead time level are fixed in months of stock across line items. The variable level models consider specific item characteristics in determining the appropriate operating level, lead time level and safety level for individual line items.

The model currently in use in a number of Navy Stock Points is the Variable Operating and Safety Level (VOSL) Model. The model will allocate the minimum investment to overall operating level, consistent with the number of replenishment actions which the activity in question can reasonably process per period. (6, p. 4-20)

In summary, it can be stated, that the inventory models currently in use, and the techniques employed for inventory control and management are consistent with the current ideas within the field. Updating and improvements are being made on a continuous basis.

Material availability is an inventory performance measurement commonly used within the field of inventory management in the U.S. Navy. A net material availability² of 85% is a minimum goal recommended and frequently used. (6, p. 5-74)

As an example, net material availability for Naval Supply Center Oakland (NSCO) is provided in the table below:

FY	Navy ICP Managed Items	NSCO Managed Items	DSA Managed Items	Overall
1970	89%	88%	84%	86%
1971	87	94	84	86
1972	83	94	82	83
1973	81	94	78	79
1974	84	94	82	83
1975	84	88	80	81
1976 (July-Feb)	88	88	83	84
1976 (August)	89.2	93.2	83.9	85.2

Table V-1. Net Material Availability, Naval Supply Center, Oakland (13, pp. 14-15)

It can be seen from the table that the overall result is very close to the goal of 85%. This good result might be

²Net Material Availability is defined to be the number of requisitions for stocked or carried items filled by the stock point, divided by the total number of requisitions for carried items received at the stock point.

used as an argument in favor of going into Supply Support Arrangements (SSA), whenever a lasting support need for a given weapon system can be identified. As mentioned in Chapter IV, under an SSA, the customer country becomes a direct customer of the U.S. Navy Supply System with priorities on an equal term with the operational units of the U.S. Navy.

E. TRANSPORTATION

The main decision criteria in choosing the mode of transportation for FMS material are as stated in Chapter IV, the priority assigned to a requisition, and the physical shape, size and weight of the item. For instance, high priority assigned to a requisition might dictate another mode of transportation than normal private business practice otherwise would suggest. The cost of using a primary means of transportation would in such a case have to be traded off against the benefits gained by receiving urgent needed material days or weeks sooner than what else would have been the case.

The major modes of transportation available for FMS shipments to Norway are ship and air, combined with modes like rail or highway. The decision regarding mode of transportation is normally made by authorities at the U.S. Navy

stock point or by a private contractor, all depending on who makes the delivery. The material will be shipped to the assigned Freight Forwarder, who again will select mode of transportation from his facilities to Naval Material Command in Bergen. The Freight Forwarder's selection of transportational mode will be guided by the same criteria as mentioned above, namely the priority of the requisition and weight and size of the item. It should be recalled that the relationship between the Freight Forwarder and the RNON is guided by a contract.

It should be discussed whether and to what extent the customer country should be involved in selecting the mode of transportation. One possibility might be for the customer to specify a desired mode of transportation upon requisitioning. Although such an approach might seem like a good way to go, making a sound judgment that far ahead of actual shipment will be difficult. The ideal point in time for a customer to make such a decision would be when the item is ready for shipment from the Freight Forwarder's plant. Although it might seem impractical to establish such a procedure, the possibilities should be looked into. A system might for instance be developed, to enable the Naval Material Command in Bergen, in a simple way, to specify air transportation, whenever an item on FMS order becomes of urgent need.

A special problem area of FMS transportation is shipment of explosives. Transportation and handling of such material are subject to strict regulations and sometimes has to wait for shipment possibilities for months. It should be checked into whether it would be advantageous with a more extensive use of military transportation for this special kind of material.

F. THE USER'S KNOWLEDGE OF THE FMS SYSTEM

Although not included as a part of the Logistic System Concept, the above point is considered to be of vital importance to the efficient use of the FMS system, and will be discussed shortly in the following.

On the Norwegian side in FMS, there are basically two organizations involved, namely the Naval Material Command in Bergen and the Norwegian Military Mission in Washington, D. C.

The personnel involved in FMS at Naval Material Command, Bergen, have a basic knowledge about the FMS system. However, the personal opinion of the author is that the knowledge is inadequate to achieve maximum efficiency in the use of FMS. This is not meant to be a critique of the individuals involved, who all do an excellent job given the level of formal training received.

If any at all should be criticized in this respect, the supplier rather than the customer would qualify, the reason being the following.

The DOD/U.S. Navy organization for FMS is complex. In spite of this fact, there exists no single publication to which the customer can refer in order to get information about the FMS organization, and the functions and responsibilities of each element. Theoretically, the customer is confronted with some 240 manuals, directives, regulations and booklets, all of which relate in some way to the Security Assistance Program (8, p. 51). It should readily be seen the problem that exists in determining which of those publications are significant to the FMS program and the customer's special circumstances.

Given this lack of a single publication serving as a basic reference for the FMS customers, training and development of people in the organization becomes an extremely difficult task. A trial and error approach often becomes the normal way of operations.

The same problem as outlined above for Naval Material Command is also present for personnel in MMW. Although 95% of their workload is related to FMS, a basic knowledge about what is happening within the U.S. Navy supply system is

lacking. Again, an important factor accounting for this is the lack of easily available and comprehensive information.

G. GENERAL

Looking at the pictorial presentation of the typical FMS case in Figure IV-4, it can be seen that the procedures and flows of information and material are extensive and complicated. A general question and basis for further studies would be to which extent simplifications are possible, whether steps and tasks in the process are unnecessary and could be cancelled.

For a person not working in the system, it seems like there are great opportunities for improvements and simplifications. Realizing that most likely reasons exist for doing things a special way or following special procedures, nevertheless, these reasons should be looked at regularly and challenged, because changing conditions over time might warrant simplifications and changes, determined to be beneficial to the FMS system.

Finally, the importance of adequate training on the part of the customer should be emphasized. It is the author's opinion that the FMS programs could be used more efficiently, and better decisions being made if proper, goal oriented training were given to all RNON employees involved in FMS.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY AND CONCLUSIONS

The objective of this thesis has been to provide a comprehensive source of general information relating to the subject areas covered. An objective has also been to make an evaluation of the existing system for FMS within the U.S. Navy/RNON.

A conceptual framework for a logistic system was developed in Chapter III, pointing out the importance of a system approach to the management of the field. Coordination and a total view must be developed in order to achieve an efficient operation.

The existing system for FMS was described in Chapter IV, pointing out the multiplicity of the FMS functions. Various forms for FMS exist, and within each form variations exist. However, for the purpose of this thesis, a model of a typical FMS case was developed.

In the evaluation of FMS, the various fields of logistics identified under the conceptual framework were discussed in the context of FMS.

It can be concluded that logistics is of primary importance, not only within a private company, but also very much

in organizations like the U.S. Navy and the RNON. A well designed and properly managed logistic system is of vital importance for the operational readiness and the performance of operational units.

The existing system for FMS is well matched to the theoretical framework of logistics; however, improvements should be possible, particularly within the following areas:

1. Simplification of the current flow of information and material from the start of a case to its final closure.
2. Transportation.
3. Training and development of the users of the system (customers).

B. RECOMMENDATIONS

It is recommended that a task be given to a group within the U.S. Navy to develop a comprehensive document covering all information required from a customer's point of view in order to make an efficient use of the entire range of available FMS programs. The manual should be made, bearing in mind its intended use, as a source of information when required and as a "textbook" for self-instructional purposes. It should be assumed no previous knowledge on the part of the reader, neither within the field of FMS or the DOD supply organization.

It is also recommended that further and more detailed studies be made within the following areas:

1. Transportation, selection of mode and the customer's involvement.
2. Accuracy in order picking, ensuring the selection of the correct item.
3. Protective packaging and proper marking.
4. Simplification of the existing procedure.

These studies should include researchers from customer countries when found practical and beneficial.

APPENDIX A

GLOSSARY OF SELECTED TERMS AND ABBREVIATIONS - FOREIGN MILITARY SALES

Acceptance, Letter of Offer. U.S. Department of Defense (DD) Form 1513 Offer and Acceptance by which the U.S. Government offers to sell to a foreign government or international organization defense articles and defense services pursuant to the Foreign Military Sales Act, as amended. The DD Form 1513 lists the items and/or services, estimated costs, the terms and conditions of sale, and provides for the foreign government's signature to indicate acceptance.

Acceptance Date. The date which appears on the acceptance portion of DD Form 1513 and indicates the calendar date on which a foreign buyer agrees to accept the items and conditions contained in the FMS offer portion.

Accepted Case. An FMS offer and acceptance for definitized requirements signed by the designated representative of the eligible recipient.

Accessorial Charges. A separate charge for packing, crating, port handling and loading, and transportation (PCH&T) associated with preparation and delivery of material.

Administrative Charges. Charges for expenses associated with the administration of the defense logistic system.

Blanket Order Case. An open-end requisitioning case covering spare parts for a specific weapons system. The FMS case is of specific duration, normally 12 months.

Cancelled Case. An FMS case which was not accepted or funded within prescribed time limitations, or was cancelled by the requesting country or the U.S. government. In the latter case, the U.S. government or purchaser electing to cancel all (or part) of case prior to delivery of defense articles or performance of services shall be responsible for all (or associated) termination costs.

Case. A contractual sales agreement between the U.S. and an eligible foreign country or international organization documented by DD Form 1513. One FMS case designator is assigned for the purpose of identification, accounting, and data processing for each accepted offer (DD Form 1513).

Case Designator. A unique designator assigned by the implementing agency to each Foreign Military Sales case. The designator originates with the offer of a sale, identifies the case through all subsequent transactions, and is generally a three letter designation.

Closed Case. An FMS case on which all materiel has been delivered and/or all services have been performed, all financial transactions, including all collections, have been completed, and the customer has received a final statement of account.

Commercial-Type Items. Any items, including those expended or consumed in use which, in addition to military use, are used and traded in normal civilian enterprise and which are, or can be imported/exported through normal international trade channels.

Commercial Sale. Sale made by U.S. industry directly to a foreign buyer not administered by the DOD and not involving credit under the provisions of the Foreign Military Sales Act.

Commodity Group. A grouping or range of items which possess similar characteristics, have similar applications, or are susceptible to similar supply management methods.

Completed Case. A delivered FMS case for which all collections have been completed, but for which accounting statement has not been furnished the purchaser.

Concurrent Spare Parts (CSP). Spare parts programmed as an initial stockage related to a major item and normally delivered concurrently with the delivery of the major item.

Constructive Delivery. Delivery of materiel to a carrier for transportation to the consignee, or delivery to a U.S. post office for shipment to the consignee. Delivery is evidenced by completed shipping documents or listings of delivery at the U.S. post office. The delivery of materiel to the customer or the customer's designated freight forwarder at point of production, testing or storage at dockside, at staging areas, or at airports constitutes actual delivery.

Cooperative Logistics Sales. Sales pursuant to arrangements wherein continuing support is provided a foreign government through its participation in the U.S. Department of Defense logistics system, with reimbursement to the U.S. for support performed.

Cooperative Logistics Support Arrangement. The arrangement, sometimes called a supply support arrangement, under which logistic support is provided to a foreign government through its participation in the U.S. Department of Defense logistic system with reimbursement to the U.S. for support performed.

Delivered Case (Same as Completed Case). An FMS case on which all materiel has been delivered and all services have been performed. The case is not closed until final billing action and funds are recieved.

Delivery. (a) Constructive or actual delivery (as defined above); (b) the performance of services for the customer or requisitioner; (c) accessorial services, when they are normally recorded in the billing and collection cycle immediately following performance.

Delivery Commitment Date. The date negotiated in the DD Form 1513 for complete delivery of the total quantity of the line item.

Delivery Forecast. Estimated date of delivery of the total quantity of a line item.

Dependable Undertaking. A firm commitment by the foreign government or international organization to pay the full amount of a contract for new production or for the performance of defense services which will assure the U.S. against any loss on such contract and to make funds available in such amounts and at such times as may be required by the contract, or for any damages and costs that may accrue from the cancellation of such contract, provided that in the judgment of DOD there is sufficient likelihood that the foreign government or international organization will have the economic resources to fulfill the commitment.

Down Payment. Money transferred to the credit of the Treasurer of the United States or other authorized officer at the time of acceptance of DD Form 1513 as partial payment for defense articles or services contracted for by an eligible foreign country.

DSAA. Defense Security Assistance Agency.

Eligible Recipient (FMS). Any friendly foreign country or international organization determined by the President to be eligible to purchase defense articles and defense services, unless otherwise ineligible due to statutory restrictions.

End Item. Assembled whole system or equipment, ready for its intended use, (1) for which only ammunition, fuel or other energy sources are required to place them in an operating state and (2) consisting of components and parts with or without accessories or attachments, e.g., rifles, tanks, aircraft, ships, etc.

Expendable Supplies and Material. Supplies which are consumed in use, such as ammunition, paint, fuel, cleaning and preserving materials, surgical dressings, drugs, medicines, etc., or which lose their identity such as spare parts, etc. Sometimes referred to as "consumable supplies and material."

Extended Offer. A new FMS offer for which a reply from the buyer has not been received within the time limit specified on the letter of offer which is still in effect pending clarification of its status.

Financing, Type of. The method by which the U.S. Government is authorized to sell defense articles and services under the Foreign Military Sales Act (e.g., cash in advance, dependable undertaking, credit).

Foreign Military Sales (FMS). Include cash sales from stocks of the DOD; procurement for cash sales by the DOD; DOD credit sales, and DOD guarantees covering the private financing of credit sales of defense articles and defense services.

Foreign Military Sales Order No. 1 (FMSO No. 1). Provides for pipeline capitalization of a cooperative logistics support arrangement, which consists of stocks "on hand" and replenishment of stocks "on order" in which the participating country buys equity in the U.S. supply system for support of a specific weapons system. Even though stocks are not moved to a foreign country, deliver (equity) does in effect take place when the country pays for the case.

Foreign Military Sales Order No. 2 (FMSO No. 2). Provides for replenishment of withdrawals of consumption-type items (repair parts, primarily) from the DOD Supply System to include charges for accessorial costs and a systems service charge.

Foreign Military Sales Order No. 3 (FMSO No. 3). Provides for storage costs and the modification of material within the U.S. pipeline under a cooperative logistics support arrangement. Charges are billed quarterly for actual costs incurred.

Implementation Date. The date when supply action on an FMS case is initiated or directed by the implementing agency.

Implementing Agency. The Military Department responsible for the execution of FMS Programs.

Military Export Sales. All sales of defense articles and defense services made from U.S. sources to foreign governments, foreign private firms and international organizations, whether made by DOD or by U.S. industry directly to a foreign buyer. Such sales fall into two major categories, Foreign Military Sales and Commercial Sales.

MILSTRIP. Military Standard Requisitioning and Issue Procedure.

Offer Date. The date which appears on the offer portion of DD 1513 and which indicates the date on which an FMS offer is made to a foreign buyer.

Open Sales Case. An FMS case is designated open as long as any portion of the transaction is incomplete, i.e., delivery of materiel, performance of services, financial transactions, or rendering of the final statement of accounts.

Open Sales Offer. An FMS offer made to a foreign buyer which is pending acceptance.

Progress Payments. Those payments made to contractors or DOD industrial fund activities as work progresses under a contract, on the basis of cost incurred or percentage of completion, or of a particular stage of completion, accomplished prior to actual delivery and acceptance of contract items.

APPENDIX B

ORGANIZATION AND RESPONSIBILITIES FOR SECURITY ASSISTANCE PROGRAMS - UNITED STATES

A. THE PRESIDENT AND HIS EXECUTIVE OFFICE

The President has authority to make Executive Agreements with other nations. This authority has been extended to include the various Security Assistance Agreements like Military Assistance Grant Aid and Foreign Military Sales.

A foreign country may not be provided any defense article or service until the President finds that the assistance will "strengthen the security of the United States and promote world peace." When it is determined that this is the case, qualifying countries may be furnished articles on a grant aid or military sales basis without further Presidential action.

The Congress holds the President responsible as the ultimate coordinating authority for development, implementation and execution of the Security Assistance Programs (SA Programs). However, the President has delegated to the Secretary of Defense those SA functions not particularly reserved to the President. The Secretary of State maintains responsibility for coordination of military, economic and technical aid programs.

Typical areas of decision which must be considered in the process of program development are:

1. countries or regions to receive assistance,
2. magnitude of aid within limits set by law,
3. type of equipment, material or supplies to be provided, and
4. type of financing to be employed such as grant aid, long term payment or direct sale.

In planning for the defense of the nation and matters relating to security assistance, the President has executive offices for advice and assistance. Mentioned in this connection should be the National Security Council, which is the highest advisory body to the President with respect to the integration of domestic, foreign and military policies relating to the national security. The Council is composed of the President, the Vice President, the Secretary of State, the Secretary of Defense and others.

B. THE LEGISLATIVE BRANCH

While the Executive Branch is responsible for the development, implementation and coordination for Security Assistance Programs, the Congressional role is to provide legislative authorizations and appropriations for the programs. In fulfilling this role, Congressional Committees conduct

hearings and investigate program implementation with the goal to improve and enhance the operations at all levels.

The Constitution of the United States provides the Congress with the legislative powers. In the area of Security Assistance, Congressional interest and influence are exerted in a variety of ways.

1. Development, consideration and action on legislation to establish or amend basic Security Assistance Acts.
2. Ratification of treaties.
3. Enactment of appropriation acts.
4. By means of a Continuing Resolution Authority, permit the incurrance of obligations in order to carry on essential SA programs until appropriation action is completed.

In an amendment to the FMS Act, the Congress has given themselves an important tool to control FMS. The act prescribes that the Congress must be provided advance notice of FMS Letter of Offer and Acceptance valued at \$25 million or more. Such a letter shall not be issued to the customer if Congress, within 20 calendar days after receiving such notification, adopts a concurrent resolution stating that it objects to the proposed sale.

The General Accounting Office (GAO), which is an agency of the Legislative Branch, should also be included. It

conducts periodic audits of the various agencies associated with Security Assistance, to determine financial responsibility, insure that use of property and personnel are for authorized programs only and that programs are conducted in an efficient manner. The results of its audits are covered in reports which are available to the head of the agency involved, the Office of Management and Budget, and the Congress.

C. DEPARTMENT OF STATE

Under the direction of the President, the Secretary of State is responsible for the continuous supervision and general direction of Security Assistance Programs, including the determination of whether a country shall receive SA or not, the value thereof, and the coordination of such programs to insure that the foreign policy of the United States is best served thereby. The functions have been delegated to the Under Secretary of State for Security Assistance, who has an extensive organization established to fulfill his responsibilities.

Within the foreign country, coordination between foreign policy administration and military activities is accomplished by a "country team." This is an informal in-country grouping of the heads of U.S. Government agencies represented in a

particular country. The Chief of the Diplomatic Mission, normally an Ambassador, is responsible for overall direction of the country team and for coordination of all U.S. programs. The Department of Defense is represented in the country team by the head of a Military Assistance Advisory Group (MAAG). The traditional and primary functions of such a group are summarized as follows:

1. Represent the Department of Defense with the host government on security assistance matters.
2. Develop military assistance plans in coordination with other members of the country team and submit plans and programs to the Unified Command.
3. Make recommendations on security assistance to the commander of the Unified Command, and observe and report on end use of the equipment.
4. Provide advice, technical assistance and special program liaison to the host country.
5. Arrange for receipt and transfer of security assistance material and services to the host country.

D. THE GENERAL SERVICES ADMINISTRATION (GSA)

The role of the GSA in support of DOD Security Assistance Programs is primarily performed by Federal Supply Service (FSS). The major missions of FSS are procurement of personal property and non-personal services for federal

agencies, storing and distributing supplies and regulating the supply functions performed by other agencies. These logistic functions are in support of both civil agencies and DOD activities.

The GSA is not authorized by law to support foreign nations directly, therefore GSA's role in SA programs is that of a major supplier of material for those agencies, both civil and military, which are engaged in various SA programs.

E. DEPARTMENT OF DEFENSE (DOD)

The Secretary of Defense is the principal assistant to the President in all matters of national security. By law and Presidential delegation, he is responsible for the military aspects of Security Assistance. Within guidelines of foreign policy laid down by the Secretary of State and fiscal policy laid down by the Secretary of the Treasury, the responsibilities of the Secretary of Defense include the following:

1. Determination of military equipment requirements.
2. Procurement of military equipment consistent with the programs of the military departments.
3. Supervision of equipment use by recipient country.
4. Supervision of training of foreign military personnel.

5. Movement and delivery of military equipment.

6. Establishment of priorities in procurement, delivery, and allocation of military equipment.

Among those officers within the Department of Defense directly involved in planning, organizing, coordinating and controlling the DOD Security Assistance effort, the following will be briefly discussed: (Reference also figure, Appendix B-1.)

1. Assistant Secretary of Defense (International Security Affairs (ASD/ISA)).
2. Defense Security Assistance Agency (DSAA).
3. Defense Security Assistance Council (DSAC).
4. Assistant Secretary of Defense (Installation and Logistics (ASD/I&L)).
5. Assistant Secretary of Defense (Comptroller).
6. Joint Chiefs of Staff (JCS).
7. Defense Supply Agency (DSA).
8. Unified Commands.
9. Department of the Navy.

1. Assistant Secretary of Defense, International Security Affairs

The ASD/ISA is the principal point of contact and the policy spokesman for DOD Security Assistance Programs. In short, the ASD/ISA coordinates DOD activities related

to security assistance affairs, formulates guidance for preparation of security assistance plans and programs, and represents DOD in all matters concerning security assistance policy and guidance. The above functions are performed for the ASD/ISA by the Deputy Assistant Secretary of Defense for Security Assistance (DASD/SA).

2. Defense Security Assistance Agency

The DSAA directs, administers, and supervises the implementation of approved Security Assistance Programs, established within the policy guidelines provided by ASD/ISA. The DSAA conducts logistics and sales negotiations with foreign countries and maintains liaison with, and assists the U.S. industry in export of military material and services.

The Military Assistance and Sales Manual is published by DSAA. The manual sets forth responsibilities, policies, and procedures governing the administration of Security Assistance within the DOD. The DSAA maintains the data base for Security Assistance Programs and is headed by a director who is also designated the DASD/SA.

3. Defense Security Assistance Council

The DSAC is composed of the ASD/ISA (President), the Director DSAA (Secretary), and representatives from Joint Chiefs of Staff, ASD/I&L, and such other representation

as the chairman may desire. Their basic function is to coordinate within DOD all security assistance policies, plans, and programs, and to advise the Secretary of Defense on Security Assistance.

4. Assistant Secretary of Defense (Installation and Logistics)

The ASD/I&L is the Staff Assistant to the Secretary of Defense on all supply and logistics matters affecting the DOD. His responsibilities extend to the international logistic support of friendly foreign forces as well as support of United States forces. These responsibilities include inventory control, storage and movement of defense material, supplies, tools and equipment. The office develops policy in the logistics area, monitors logistic planning and programming, and performs surveillance of the effectiveness of logistic systems and general performance.

The nature and variety of International Logistics Programs require a close working relationship between the offices of the ASD/ISA, DSAA and ASD/I&L. The ASD/ISA establishes the design and extent of the programs and ASD/I&L provides the logistic policies, means and procedures for carrying them out. ASD/I&L provides technical advice and related logistical guidance to the DSAA, and maintains also regular contact with the military departments as the sources

of technical and supply data. ASD/I&L serves as an important link between DOD developments in SA programs and execution of these programs by the logistics elements of the military departments.

5. Assistant Secretary of Defense (Comptroller)

He supervises and directs the preparation of the DOD budget estimates and is the principal advisor to the Secretary of Defense in budgeting and fiscal matters.

In Security Assistance activities, the ASD Comptroller works in close conjunction with ASD/I&L and DSAA. The areas of primary importance will include pricing policies and the development of terms and conditions to be employed in the transfer and reimbursement of material and services provided through Security Assistance Programs.

6. Joint Chiefs of Staff

As the principal military advisor to the Secretary of Defense and the President, the JCS have a direct interest and influence in Security Assistance. They are charged with the responsibility for continuous review that Security Assistance resources are employed most effectively in promoting the strategic concepts of the United States. The functions of the Joint Staff include assistance in the development and coordination of policies, directives and supporting

documents relative to Security Assistance; further, the planning, conduct and implementation of procedural arrangements.

7. The Defense Supply Agency

The DSA is under the direction, authority, and control of the Secretary of Defense. The agency is responsible for providing material support to the military departments, other DOD components, federal civil agencies, foreign governments and others as authorized.

The role of DSA in Security Assistance Programs is to support the military departments by supplying the items assigned to DSA for integrated management. In executing this support responsibility, DSA coordinates with ASD(I&L) and ASD(ISA). It provides representation to various task groups and assists in the resolution of international logistics problems. Coordination is maintained with the military departments to assure responsive support, that timely supply and shipment status is provided and that, at the request of military departments, periodic reconciliation of open programs is effected.

The DSA operates six supply centers located throughout the United States. These centers are responsible for material management of assigned categories of material and receives requisitions submitted by the International Logistic

Centers: At the Defense Supply Centers a decision is made whether the item is to be furnished from DSA stocks or by procurement action.

8. Unified Commands

A unified command is composed of two or more service component commands. The commander of a unified command is responsible for the coordination of all United States military functions in the designated area. It operates under the strategic and operational direction of the Joint Chiefs of Staff and has important responsibilities within the field of Security Assistance.

There are at present three unified commands, the European, the Pacific, and the Southern Command. The commanders of these unified commands and under their direction, the Military Assistance Advisory Groups in their respective areas, prepare plans and programs representing the initiation of many of the Security Assistance-Grant Aid Programs. Also within FMS, the unified commands have responsibilities, for instance, determining the desirability of specific FMS programs.

9. Department of the Navy

In matters of Security Assistance, the Department of the Navy, as other military departments, participates in the development, negotiation, and execution of agreements with

foreign governments. In addition, they also provide the means and act of execution of the SA programs. Representatives from the services work directly with representatives from ASD(I&L) and ASD(ISA) in developing plans, programs and policies for Security Assistance. In essence, the military departments serve to supplement the efforts of offices of the Assistant Secretaries of Defense, the Joint Chiefs of Staff, and the unified commands. Each military department and DSA act as the responsible source of technical data regarding price, source, availability, and lead time of items of material which are the logistics responsibility of that department or agency.

Subsequent to the act of program preparation and approval, the military departments perform as the prime executors of the Security Assistance programs. Each service is responsible for the necessary organization and the assignment of functions and responsibilities to insure attainment of the Security Assistance program objectives.

Figure Appendix B-1 shows the interrelationship of the DOD offices to other departments and agencies involved in Security Assistance.

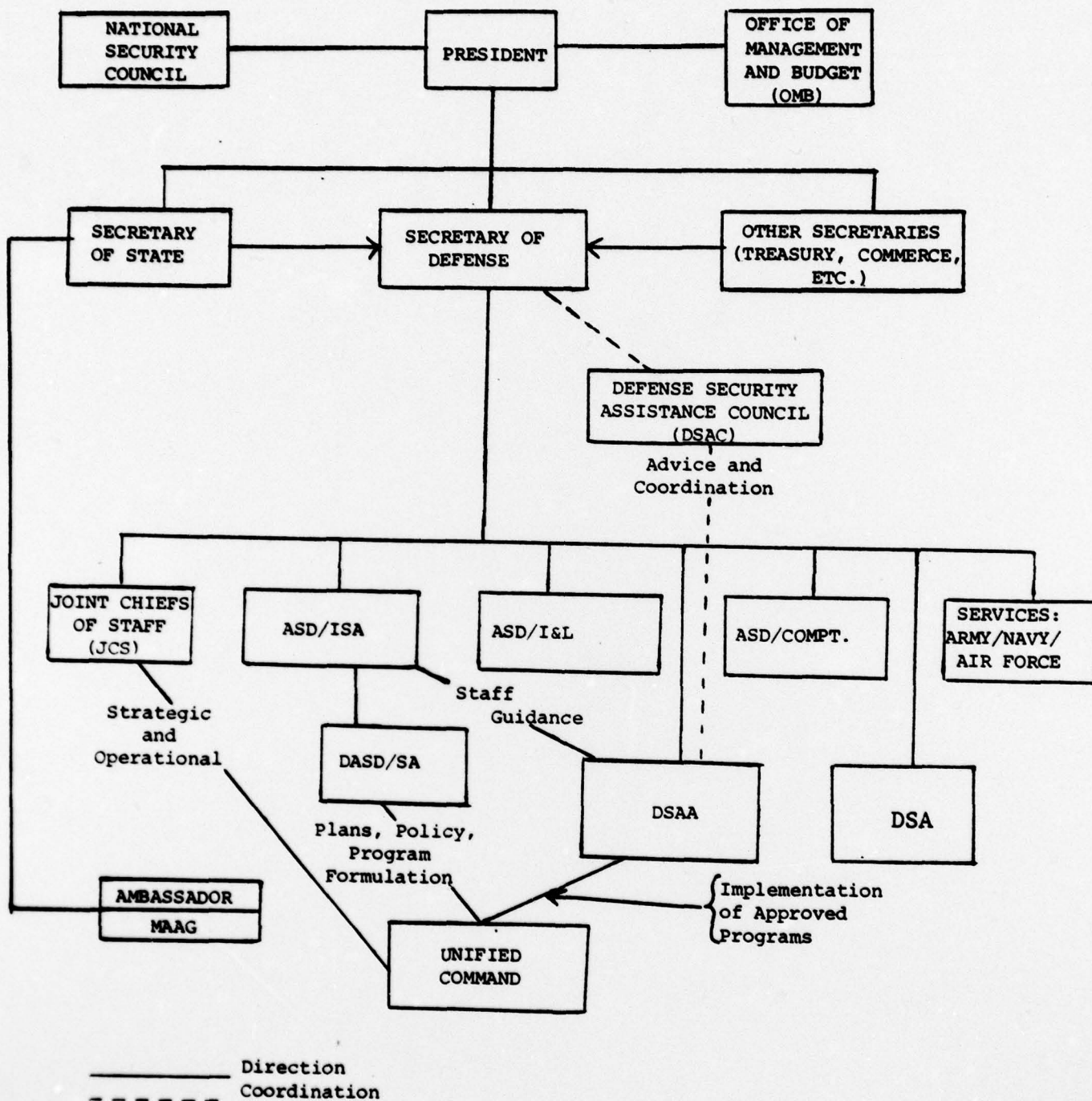


FIGURE APPENDIX B-1: ORGANIZATION FOR SECURITY ASSISTANCE

APPENDIX C

EXAMPLE OF HOW TO COMPUTE OPTIMUM ORDER SIZE AND ORDER POINT, INVENTORY MANAGEMENT UNDER UNCERTAINTY

Reference is made to the text for interpretation of the symbols used in this example. The following information is assumed given:

$$S = 1.800 \text{ units per year}$$

$$A = \$10$$

$$v_r = \$.60$$

$$E(s) = \$5.00$$

$$\bar{M} = 100 \text{ units}$$

$$\sigma_M = 30 \text{ units (normal distribution).}$$

Using the equation from the text to compute the optimum order quantity (Q^*), one obtains:

$$Q^* = \sqrt{\frac{2 \cdot 1800(10 + 5)}{.60}} = \underline{\underline{300 \text{ units.}}}$$

Then, using the procedure described in the text to find the optimum order point (R),

$$F(R) = 1 - \frac{.60 \times 300}{5.00 \times 1800} = 0.98.$$

Referring to a table of cumulative probabilities for the standard normal distribution (Appendix D), one can

find that $z = 2.06$ standard deviations

R will then be:

$$R = 100 + 2.06 \times 30 = 161.80 \text{ or } \underline{\underline{162 \text{ units}}}.$$

With an order point of 162 units, this organization will not run out of stock approximately 98 per cent of the time during the ordering period. Bear in mind that the mean demand during this period is 100 units.

APPENDIX D

UNITED STATES DEPARTMENT OF DEFENSE OFFER AND ACCEPTANCE		PURCHASER (Name and Address) (Include ZIP Code)				
PURCHASER'S REFERENCE	CASE DESIGNATOR					
OFFER						
The Government of the United States hereby offers to sell to the above purchaser the defense article(s) and defense service(s) listed below, subject to the terms contained herein and conditions cited on the reverse.						
This offer expires _____ 19____		AUTHORIZED U. S. REPRESENTATIVE _____			DATE _____	
U. S. DEPARTMENT OF _____						
ITEM OR REF. NO.	ITEM DESCRIPTION <i>(Including stock number)</i>	QUANTITY	UNIT OF ISSUE	ESTIMATED		AVAILABILITY AND REMARKS
				UNIT COST	TOTAL COST	
ESTIMATED TOTAL MATERIEL COST				\$		
ESTIMATED PACKING, CRATING, HANDLING COSTS						
ESTIMATED ADMINISTRATIVE, SYSTEM SERVICE CHARGE						
OTHER ESTIMATED COSTS <i>(Specify)</i>						
ESTIMATED TOTAL COSTS				\$		
TERMS						
ACCEPTANCE						
I am a duly authorized representative of the Government of _____				OFFER/RELEASE CODE: _____		
and upon behalf of said _____				FREIGHT FORWARDER CODE: _____		
Government, accept this offer under the terms and conditions contained				MARK FOR CODE: _____		
herein, this _____ day of _____ 19____				POINT OF DELIVERY: <i>(For Passage of Title)</i> _____		
PRINTED NAME AND TITLE _____				SIGNATURE _____		

DD FORM 1513
1 MAR 65

82441

PAGE _____ OF _____ PAGES

APPENDIX E

REPORT OF ITEM DISCREPANCY (ROID)				1. DATE OF PREPARATION		2. REPORT NUMBER		
3. TO (Name and address, include ZIP code)				4. FROM (Name and address, include ZIP Code)				
5. SHIPPER'S NAME				5A. DATE OF INVOICE		5B. INVOICE NUMBER		
6. SHIPMENT NUMBER		7. GBL MANIFEST, WAYBILL, TON, ETC.		8. CONTRACT/DOCUMENT NUMBER				
9. PSM/PART NUMBER AND NOMENCLATURE		10. UNIT OF ISSUE	11. QUANTITY SHIPPED/ BILLED	12. QUANTITY RECEIVED	13. DISCREPANCY			14. ACTION CODE
					QUANTITY (a)	UNIT PRICE (b)	TOTAL COST (c)	
15. REMARKS (Continue on separate sheet of paper if necessary)								

DISCREPANCY CODES

CONDITION
 C1—Material received which is defective or in condition other than that indicated on release/receipt document.

DOCUMENTATION
 D1—Supply documentation not received
 D2—Supply documentation illegible or mutilated
 D3—Supply documentation incorrect, improper or without authority (Only when receipt cannot be properly processed)

MISDIRECTED
 M1—Material addressed to wrong activity

OVERAGE/ DUPLICATE SHIPMENTS
 O1—Quantity received in excess of quantity on receipt document
 O2—Quantity received in excess of quantity requested (Other than unit of issue pack)
 O3—Quantity received duplicates shipment

SHORTAGE
 S1—Quantity received less than quantity on receipt document
 S2—Quantity received less than quantity requested (Other than unit of issue pack)
 S3—Non-receipt of parcel post shipments

ITEM TECHNICAL DATA MARKINGS (i.e., Name Plates, Log Books, Operating Handbooks, Special Instructions, etc.)
 T1—Missing
 T2—Illegible or mutilated
 T3—Precautionary operational markings missing
 T4—Inspection data missing or incomplete
 T5—Serviceability operating data missing or incomplete
 T6—Warranty data missing

WRONG ITEM (Identify requested item as a separate entry in Item 9 above)
 W1—Incorrect item received
 W2—Unacceptable substitute

OTHER DISCREPANCIES
 Z1—See remarks

ACTION CODES

1A—Disposition instructions requested (See reverse)
 1B—Material being retained (See remarks)
 1C—Supporting supply documentation requested
 1D—Material still required expedite shipment
 1E—Local purchase material to be returned at supplier's expense unless disposition instructions to the contrary are received within 15 days (See reverse)
 1F—Replacement shipment requested
 1Z—Other action requested (See remarks)

16. TYPED OR PRINTED NAME AND TITLE OF PREPARING OFFICIAL		16A. SIGNATURE	
17. FUNDING AND ACCOUNTING DATA			
18. BUYER'S NUMBER		19. SIGNATURE OF APPROVING OFFICIAL	19A. DATE
20. DISTRIBUTION OF COPIES			

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 FPMR—101-26.307 366-101

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