INTRODUCTION TO WHOLESALE REQUIREMENTS DETERMINATION

1. Introduction. Inventory management is that phase of logistics which includes requirements determination, distribution, cataloging, acquisition, maintenance, and disposal of materiel. These are the functions of inventory management and item managers are required to know and work with these functions. The function of requirements determination is the nucleus of the item manager's job.

2. Inventory.

a. An inventory, simply defined, is a stock of goods purchased now to be sold in the future. It is an alternative to purchasing goods in the future. The choice between the alternatives of stocking now or purchasing later depends a great deal on costs. The relationship between these costs determines whether an inventory should be carried. The provisioning process determines initially which items are to be stocked. After the item is in the system and demand data is compiled, the requirements determination process determines how large an inventory is maintained.

b. Why do we have inventories in the Army? In a military supply system, the "product" we sell our customers is "response time." Quantities of stock on hand and on order decrease response time; the length of time between when the customer requests an item and when he gets it. To compensate for the time between demand and the receipt of materiel, the Army maintains inventories. What would the Army lose by not maintaining inventories? As discussed above, time is lost. Lost time causes a degradation of readiness. A degradation of readiness lessens the Army's ability to provide for the defense of the country.

3. The Role of the Computer in the Requirements Determination Function. In today's environment, the requirements determination process could not be accomplished without the assistance of a computer. Through the process called programming, we tell the computer how to arrange and manipulate the information we give to it. The computer records and files information and makes requirements determination decisions regarding when to order stock and in what quantities. A prime responsibility of the item manager is to insure that current and correct information is put into the computer. The item manager, using knowledge and judgment, should review the computer's decisions. The manager's responsibility is to provide pertinent additional information to correct or improve on these decisions.

4. Objectives of Requirements Determination. The objectives of requirements determination appear simple when looked at one at a time but become very difficult when considered together. Individually, the objectives are easily accomplished but considered together, the objectives sometimes oppose one another. A look at some of these objectives will illustrate this point.

a. To have stock available when needed.

b. To keep inventory levels within budget limitations.

c. To achieve requisition effectiveness goals.

d. To insure that funds are spent for purposes specified in the budget.

e. To maintain purchasing workload.

f. To utilize available storage space effectively.

g. To maintain accountability of assets.

These objectives serve to measure the adequacy of the requirements determination process.

5. Requirements Determination Process.

a. The necessity to maintain inventories establishes the need for the inventory management function of requirements determination. The questions of what to stock and who shall manage are answered prior to the initiation of the requirements determination process. The requirements determination process examines how many will be needed in a certain period of time. It also determines the time it will take to get the items where they are needed (leadtime).

b. The requirements determination process (see Exhibit 1) encompasses four general areas which will be discussed in detail. These areas are: demand analysis; requirements computation; asset

computation, and requirements determination decisions.

6. Demand Analysis.

a. Collection of Demand Data. To determine the level at which an inventory should be maintained, it is necessary to consider two elements. First, what quantity of an item customers will request (demands) and second, how long it takes to get the requested items in stock. Demands are categorized as recurring or nonrecurring. Recurring demands are demands of a random nature which are expected to occur again. Because of the randomness, their exact value cannot be foreseen but their expected value can be forecast. Nonrecurring demands are demands of a "one-time" nature whose expected value cannot be forecast. Most nonrecurring demands can be quantitatively defined in advance of the date they're required. Examples are initial issues, materiel to support modification work orders, special program requirements, overhaul demands, etc. They are collected and maintained separately for all secondary items. Since requirements levels are based on demand forecasts, the analysis of past demands and the computation of a demand forecast is very important. The methods which have been developed to predict future demand are many and varied. However, they all use past demand rates as a basis for the forecasts. Thus, the collection of accurate demand history becomes very important in the requirements determination process.

b. Demand Analysis and Forecasting. One of the easiest ways to look at and analyze past demands is to graph the data. Once the historical demand data have been graphed, significant trends, upward or downward, should become obvious. After analysis of the graph, different forecasting techniques can be employed which will use past demand data to its best advantage. The demand rate is often based on a moving average of the past 12 or 24 months' recurring demand history.

c. Program Change Factor (PCF).

(1) Initial supplies of secondary items to support a new end item are distributed based on the total number (density) of the end items in the field (in use). Engineering estimates formulated during the development stage are multiplied by planned density to determine the quantities of items required. Once the materiel is in the field and demand experience is accumulated, projection of future demand becomes susceptible to program changes. By "program changes" we mean changes in the density of end items, changes in flying hours for aircraft, changes in troop population, etc. Any increase or decrease in the program will cause changes in the future demand pattern for the supporting secondary items. Therefore, we must establish a factor which is used in conjunction with the historical demand rate to forecast demands. This factor is known as the PCF. The PCF acts to modify the average historical monthly demand to compensate for known program changes in the future. PCF's are determined by dividing the forecasted average end item density during the forecast period by the historical average end item density during the base period. The resulting number, carried to two decimal places, is the PCF. The historical average demand rate is then multiplied by the PCF, producing a forecasted average demand rate. Perhaps at this point it should be clarified what is meant by the "forecast period" and the "base period."

(a) Forecast Period. A planning horizon or a specific time in the future for which we are determining requirements. This period is determined by simply adding the number of months in the acquisition leadtime (AQLT) and the EOQ cycle (EOQCY). For example, an AQLT of 15 months and EOQCY of 3 months equals a forecast period of 18 months.

(b) Base Period. The base period is the historical timeframe which related to a specific number of months in the past. Generally, we are relating to the demands generated during this historical period. It is extremely important that the same base period used to determine the forecast demand rate be used to compute Program Change Factors (PCF's).

(2) The following example will explain the development and the use of a PCF.

(a) An item manager is responsible for the wholesale management of a printed circuit board that is peculiar to one type of radio set. During the base period of 24 months, there was an average of 1,000 radio sets in use in the system. In that same 24-month period, the Average Monthly Demand (AMD) for the printed circuit boards was 160 each. During the next 18 months (forecast period), the forecasted average in-use density of the radio set will increase to 1,250 sets in the field.. How many printed circuit boards will be required each month to

support the radio sets in the future?

$$PCF = \frac{\text{Forecasted average in-use density during the forecast period}}{\text{Historical average in-use density during the base period}}$$

$$PCF = \frac{1{,}250}{1{,}000}$$

$$PCF = 1.25$$

Now remember, the PCF was used to modify the historical demands to compensate for known changes in the future. Thus:

Historical AMD	=	160
PCF	=	x 1.25
Forecasted Demands	=	200

(b) The historical AMD (160) is adjusted by the PCF (1.25) to compute a forecasted average monthly demand (200). It appears logical that if an average of 160 printed circuit boards were needed to support 1,000 radios, more than 160 would be needed to support 1,250 radios. The program change factor modifies historical average demands to reflect future program changes.

d. Nonrecurring Demand Forecast. In addition to forecasting recurring demands in the Army, nonrecurring demands are forecasted and included in the gross demands. Nonrecurring demands are the results of varied one-time known requirements. They include support for:

(1) Rebuild/overhaul.

(2) Set assembly.

(3) Initial issue.

(4) Mobilization/Army prepositioned stocks.

(5) Basic issue items.

It is essential these nonrecurring demands are included in the gross demands. To insure availability, the nonrecurring demands should be identified and forecast at least the acquisition leadtime in advance. If these nonrecurring demands are not accurately forecasted, it is very likely the desired support will not be available.

e. Gross Demand Forecast. Gross demands would be computed by adding recurring and nonrecurring demands. For example:

Forecasted recurring demands	200
Forecasted nonrecurring demands	+10
Gross demands	210

f. Serviceable Returns Forecast. The gross demand rate includes recurring and nonrecurring demands and is reduced by the amount of any serviceable returns. The forecast of serviceable returns is developed on the basis of past serviceable return history.

g. Net Demand Forecast. Net demands are computed by reducing the gross demands by any forecasted serviceable returns. For example:

Forecasted gross demands	210
Forecasted serviceable returns	-10
Net demands	200

7. Requirements Computations.

a. Consumable Item. The “basic” wholesale requirements elements for a consumable item are:

(1) Variable Safety Level (VSL). VSL stock is that quantity of materiel that is required to be on hand to preclude minor interruption of normal replenishment caused by unpredictable fluctuations in demand. Shortages can be quite costly in terms of equipment downtime. The existence of shortages suggests that additional stock should be on hand to cover demand uncertainty during the resupply time. VSL's are established at all echelons of supply as protection against stock depletion that could be caused by fluctuations in demands from customers. VSL's are determined based on probability principles and on analysis of historical data. VSL's, which are used throughout the wholesale system, are based upon the degree of protection desired against stock depletion. The computation of VSL's considers such data and the frequency of demands, the size of the average order, the implied requisitions short cost, and reorder frequencies.

(2) Acquisition Leadtime (AQLT) Requirement.

(a) AQLT is the time interval between the initiation of a procurement and the receipt of a significant quantity of materiel into the wholesale system. It is necessary to establish a requirement which will enable the wholesale system to have assets to issue during the AQLT. The times used to measure AQLT are based on past actual procurements. AQLT is divided into two parts: Administrative Leadtime (ALT) and Production Leadtime (PLT).

(1) ALT is the time elapsing between the initiation of a Procurement Work Directive (PWD) and the award of an order or contract.

(2) PLT is the time interval from the date an order or contract is awarded to the receipt of the first significant delivery. A significant delivery consists of a quantity equal to or greater than one-third of the order quantity.

(b) AQLT is usually measured in months. The computation of an AQLT requirement for a consumable item is quite simple. The AQLT requirement equals the number of months of leadtime (ALT + PLT) multiplied by the forecasted recurring demand. For example:

Given the following information:

AQLT is 15 months where
ALT is 4 months, and
PLT is 11 months
Forecasted recurring demand rate is 200/month

The quantitative value of AQLT requirement is obtained as:

ALT - 4 months x 200/month	=	800 units
PLT - 11 months x 200/month	=	2,200 units
AQLT requirement	=	3,000 units

In other words, we have a requirement for 3,000 units of stock to meet recurring demands during the AQLT.

(3) EOQCY Requirement. The EOQCY requirement is that amount of stock required to satisfy the forecasted demand quantity between procurement actions. It is based on Economic Order Quantity (EOQ) concepts. The EOQ is the reorder quantity that minimizes the variable costs to order, to hold, and the implied shortage cost.

(4) Decision Action Points. During the requirements determination process, action points surface requiring the item manager to make decisions. These decisions will include buy, cutback, excess, repair, etc., actions. However, there are two basic decisions to be made in the requirements determination process. These are: First, when to order; and second, how much to order. These decisions can be made by establishing two specific action points--the Reorder Point (ROP) and the Requirements Objective (RO).

(a) ROP. Due to the leadtime involved in placing and receiving procurements, orders for more stock must be placed before the stock is needed. Assuming constant demand and constant leadtime, stock must be ordered when the system assets are equal to or below the number required during the leadtime. Therefore, a level of requirements is established, called the ROP. When assets are equal to or less than the ROP, an order (procurement work directive) must be

placed. This helps to insure a continuous and uninterrupted flow of materiel into the system.

(b) RO. The RO represents the total of all funded requirements authorized to be on hand and on order. Quantitatively, the RO is the

sum of all the requirements in the ROP plus the EOQCY requirement.

b. Reparable Item.

(1) The management of a secondary reparable item establishes the repair facility as the primary source of supply. For each serviceable asset that is issued to a user, an unserviceable should be returned to the supply system. The unserviceable item can be repaired and returned to an issueable condition. However, the item manager does not always receive an unserviceable item back for each serviceable item issued. The reasons for this are varied. The unserviceable may be lost at the user (or retail) level. There are no unserviceable assets to return for initial issues. Procurement is used as a source of supply only to satisfy those requirements which cannot be satisfied from repair; e.g., washouts, pipeline increases, etc. Three important areas must be discussed in order to determine the quantity of requirements which cannot be satisfied from the restoration of unserviceables (see Exhibit 2). These are: The worldwide unserviceable returns, the recoverable unserviceable return rate, and establishing a net authorized stockage requirement.

(a) To determine how many unserviceable items will be returned, a past average, expressed as a percentage, is computed. An example will clarify this: During the past 24 months (the base period), the average monthly demand has been 160 each. During this same time, an average of 120 unserviceables per month were returned to the wholesale supply system. The unserviceable return rate has, therefore, been 120/160 or 75 percent. During the forecast period, the item manager computes a forecasted worldwide demand of 200 units. Assume the unserviceable return rate in the forecasted period will be as in the past. The item manager can then compute the forecasted monthly unserviceable returns. By multiplying the 75 percent return rate times the future issues of 200, the forecasted worldwide unserviceable returns of 150 per month (200 x .75 = 150) is computed.

(b) To determine the recoverable unserviceable returns, it is assumed that all unserviceable assets returned cannot be repaired. Unserviceable returns to the wholesale supply system that are uneconomical to repair will be "washed out" and sent to disposal. Losses due to washout are expressed as a rate or percentage based on past unserviceable return history. This rate is called the nonrecoverable unserviceable return rate. For example, in the past, the worldwide unserviceable returns average 120 per month and the number repaired averaged 84. To compute the recoverable unserviceable return rate, divide the average number of returns repaired by the past unserviceable returns.

$$\frac{84}{120} = .7 = 70\%$$

The item manager is concerned with unserviceable assets that can be repaired and applied against future requirements. Therefore, it is necessary to "net" unserviceable returns before they can be applied against requirements. To net the unserviceable returns, the following formula applies: Worldwide unserviceable returns x recoverable returns rate = recoverable unserviceable returns. For example:

Worldwide unserviceable returns	150
Recoverable unserviceable return rate	x .70
Recoverable unserviceable returns	105

(c) Earlier, it was stated that demand which cannot be satisfied by the restoration of unserviceable are called "net demands." Since a reparable item should replenish itself through the repair cycle, the procurement of these items would be reduced. It was determined in the computation of recoverable unserviceable returns that 105 assets will become serviceable at the end of the repair cycle. Therefore, new procurements can be reduced by this monthly amount. For example:

Gross worldwide demand requirement	200
Recoverable unserviceable returns	- 105
Net authorized stockage requirement	95

This net figure will be used to compute the AQLT and the EOQCY requirements.

(2) The same "basic" recurring requirement elements which apply to a consumable item apply also to a reparable item, but because of the difference in management techniques, the computation of the quantitative value of some of these elements is somewhat different.

(a) Repair Safety Level. The amount of stock to be on hand to guard against a due out occurring due to fluctuation to repair lead-times and gross demands. This level will only appear on reparable items in the Medium/High Dollar Value path. There is no override capability for the item managers. It will not affect the Requirements Objective directly, but has replaced the use of "Procurement Safety Level" in the computation of the Repair Action Point (RAP). The Repair Safety Level will use the same LAMBDA value used in the Procurement Safety Level computation. This is due to the fact that the cost of a backorder is the same whether it is filled through repair or procurement. In addition to the LAMBDA value, the Repair Safety Level utilizes the following elements in its calculation: repair lead-time, gross demands, and overhaul price.

(b) AQLT. For a reparable item, the only portion which must be considered as a requirement is the net authorized stockage requirement. In other words, the forecasted demands for each month of AQLT is reduced by the recoverable unserviceable returns. Those demands which cannot be satisfied by the restoration of unserviceables are called the net authorized stockage requirement. The AQLT requirement equals the sum of the net authorized stockage requirement for the number of AQLT months.

(c) EOQCY. The computation of the EOQCY is basically the same as for a consumable item. The difference is due to the effect of unserviceable returns from the field on net forecasted demands.

(3) In addition to the "basic" recurring requirement elements discussed above, there is another recurring requirement element that applies only to a reparable item. This element is the Repair Cycle Requirement (RCR). The purpose of the RCR is to compensate for the leadtime involved in restoring unserviceable items to a serviceable condition. As mentioned earlier, the gross worldwide demand requirement for reparable items is reduced by the recoverable unserviceable returns rate. Since there is time involved in repairing unserviceables, a compensation is made for this by computing a RCR. Simply stated, the RCR is a "repair pipeline." To insure a continuous flow of restored unserviceables to reduce future demand, this repair pipeline, called the RCR, is established. Quantitatively, the RCR represents the number of assets required in the system during the time the unserviceable assets are being repaired. The repair cycle is the average time between unserviceable returns being entered on the wholesale records until these assets are repaired. The total repair cycle is divided into two elements involving time:

(a) Repair Administrative Time. The average time required to process the repair directive (paperwork) is the repair administrative time. This primarily transfers the responsibility of the items from the item manager to the repair facility.

(b) Repair Leadtime. The average time required to restore the unserviceable item to a serviceable condition is the repair leadtime. It begins from the date of induction in the repair facility and ends when the item has been inspected and reclassified as serviceable. The time it takes to return the serviceable item to the depot for storage is usually included in the repair leadtime. The RCR is equal to the total number of economically reparable unserviceables that are expected to be repaired during the repair cycle time. The RCR is computed by summing the recoverable unserviceable returns for the number of months in the repair cycle time.

c. Other Requirements (Nonrecurring). In addition to the basic recurring requirements elements previously discussed (RSL, AQLT, EOQCY, and RCR), there are nonrecurring requirements also. Normally, these are additive type requirements and reflected as separate requirement elements as necessary. The quantitative value of each is, of course, included in the ROP and the RO. The nonrecurring requirements are:

(1) War Reserve Materiel Requirement, Protectable (Army Prepositioned Stocks). This is a quantity of stock which plans dictate will be on hand prior to hostilities, usually at or near the point of planned use or issue. Specific funding is provided for procurement of this materiel. These requirements are scrutinized under a selection criteria to insure that only essential items are acquired. The quantity to stock is limited to what will be required for the

duration of the approved support period or until production exceeds combat consumption.

(2) Due-Outs (Back Order). A firm requirement for materiel which cannot be issued due to an insufficient stock condition. Due-outs can be shown as a requirement or as a negative asset.

8. Asset Computation. An effective inventory system must know at all times where the assets are and the number of assets on hand. The system must also keep track of when items are due in. Any requirements determination process is concerned with two general categories of assets. They are: Assets on hand and assets due in. Both categories must be accounted for when applying assets against requirements. Secondary items are divided into two basic groupings -- consumable and reparable. The different type assets applicable to both the types of secondary items will be discussed.

a. Consumable Item Assets.

(1) Serviceable On Hand. For purposes of this lesson, it is assumed that all serviceable on hand stock is condition code A (issueable without qualification).

(2) Serviceable Due In. These are assets which are not physically on hand but due into the system.

(a) Committed Due In. These are assets for which an order has been placed (initiated), but a procurement contract has not yet been let.

(b) Obligated Due In (On Contract). These are assets for which a contract has been awarded.

(c) Returns. Assets being returned, i.e., field, contractor.

b. Reparable Item Assets.

(1) Serviceable on hand (same as consumable).

(2) Serviceable Due In. This element is the same as a consumable except there is “due in from repair action.” The due in from repair reflects assets in “M” condition (in repair).

(3) Unserviceable On Hand. Unserviceable on hand assets are generated from the customer’s return of unserviceable items. Since these items have the potential of being repaired and returned to a serviceable condition, they are included in system assets.

(a) Assets that are determined to be economically reparable will be placed in condition code F (economically reparable).

(b) Assets uneconomical to repair are normally placed in condition code H and require disposal.

9. Requirements Determination Decisions. There are three basic requirement action points. The procurement ROP and RO apply to both consumable and reparables. The repair action point applies only to reparables.

a. The procurement ROP answers the question of when to order. It will identify the leadtime ahead of which an order must be placed to insure an uninterrupted supply. Naturally, because of the AQLT, the order must be placed before the stock is needed. When total assets drop to or below the number of items that will be required during the leadtime, then the system has reached the ROP. It is time to order!

b. The repair action point is very similar to the procurement ROP. For a reparable item, when assets applicable to repair review are equal to or below the repair action point, repair should be initiated.

c. The RO is an expression of the total funded requirement authorized to have on hand and on order. When assets reach or go below the ROP, a determination of how many to buy can be made by subtracting the total applicable assets from the RO.

10. Wholesale Inventory Model. Exhibit 3 is a simple model of a wholesale inventory management system. Note that there are only three requirements elements (VSL, AQLT, and EOQCY) in this model; also, the ROP and the RO are shown.

a. The model starts with the full RO quantity on hand (which is unrealistic but a good place to start the model). As time passes the assets are drawn down until month 3 when the ROP is reached. At that time, an order (O_1) is placed. This brings the total system assets back up to the RO (assets equal 700 on hand and 300 on order). As the model continues through time, the on hand assets are further drawn down. At month 6, the system ROP is again reached as the total

assets at that time equal 700 (400 on hand and 300 on order). The second order (O_2) is placed for 300, which brings the system back up to the RO (1,000). We now have two orders outstanding (O_1 and O_2). Continuing in time, on hand assets are drawn down until month 9 when on hand assets reach the variable safety level. At the same time, the first order is received (R), which brings the on hand assets up to 400. The total assets are now 400 on hand and 300 on order (O_2). Since 700 is the quantitative value of the ROP, another order must be placed (O_3). This again brings the system up to the RO of 1,000. This drawdown of assets and placing orders continues throughout time.

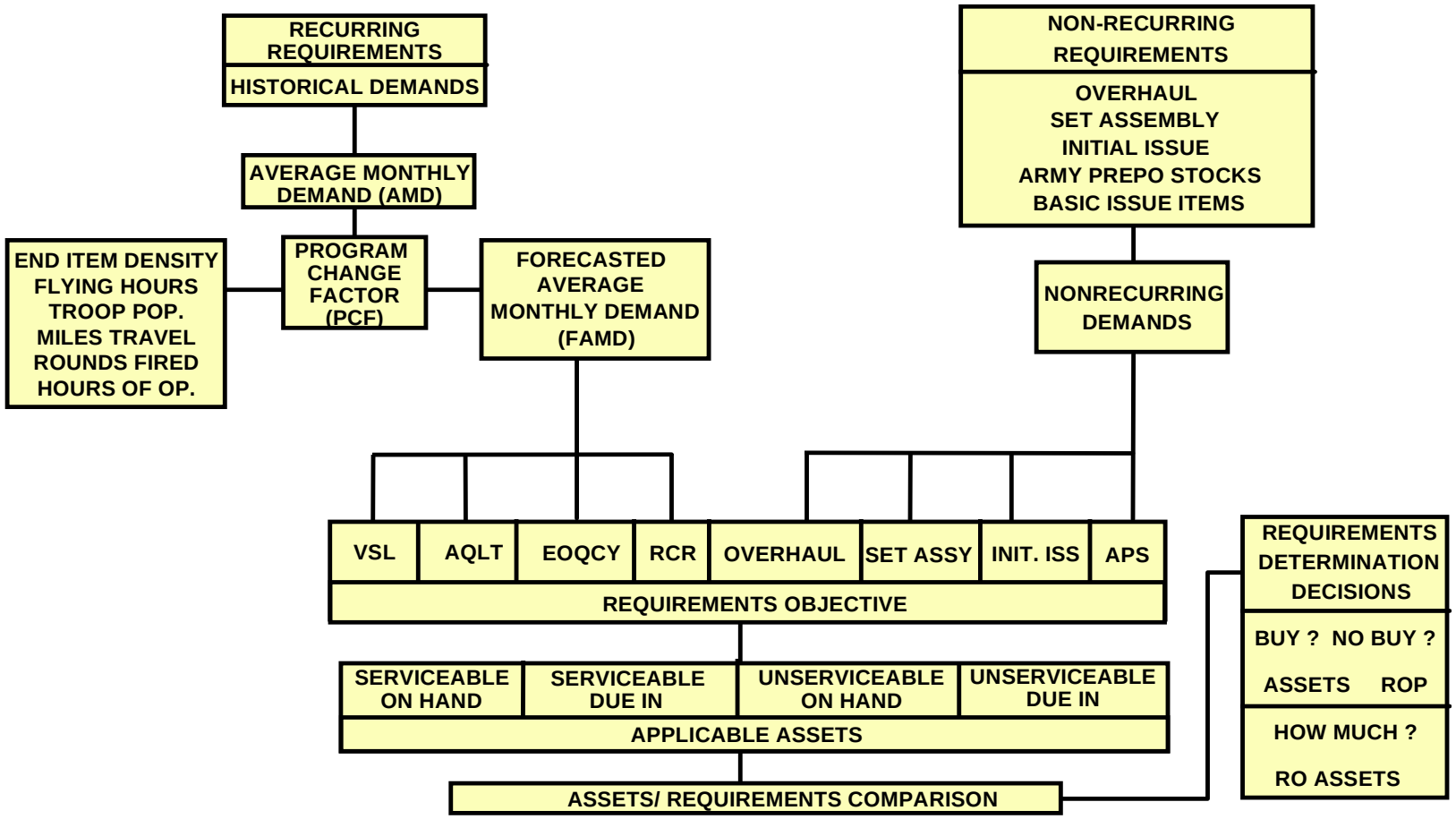
b. Thus, we can see from this simple model how, in theory, an inventory system works. Total assets (on hand plus on order) are compared against the system ROP. If total assets are equal to or less than the ROP, an order is placed in a quantity equal to the difference between the total assets and the RO. At the end of the acquisition leadtime, the orders are received and increase the on hand assets while decreasing the assets on order.

11. Summary.

a. This lesson discusses wholesale requirements and assets and the application of assets against the requirements action points. The action points include the procurement ROP, repair action point, and the RO. The basic requirements elements for both a consumable and a reparable item plus the nonrecurring requirements make up the requirements "stack."

b. When the sum of the total assets is equal to or less than the reorder point, the inventory manager places an order. The question of how much to order is answered by comparing the total assets to the RO quantity. The difference is the order quantity.

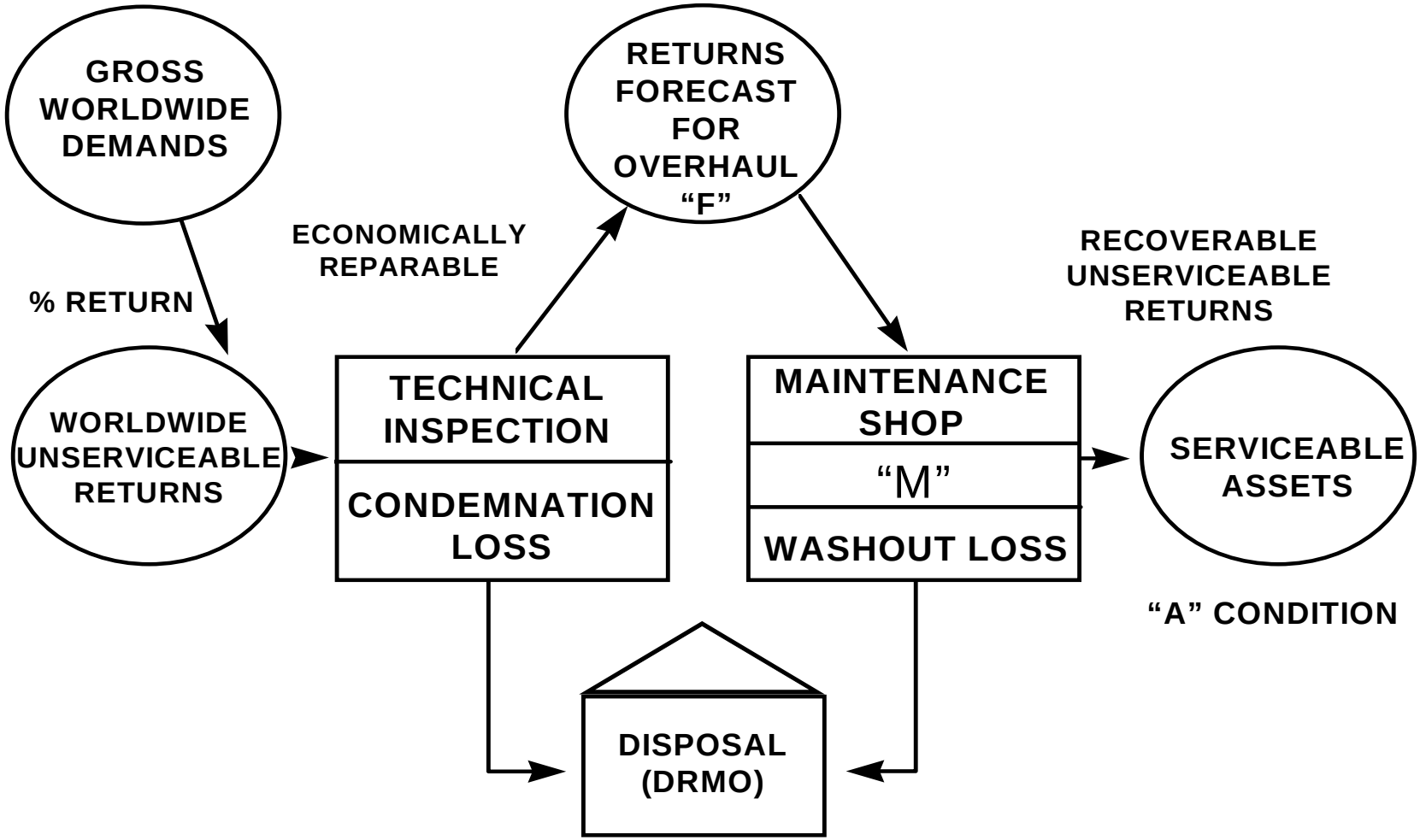
WHOLESALE REQUIREMENTS DETERMINATION PROCESS



L7TAAP1-24.PPT

EXHIBIT 1

THE NETTING OF UNSERVICEABLE RETURNS

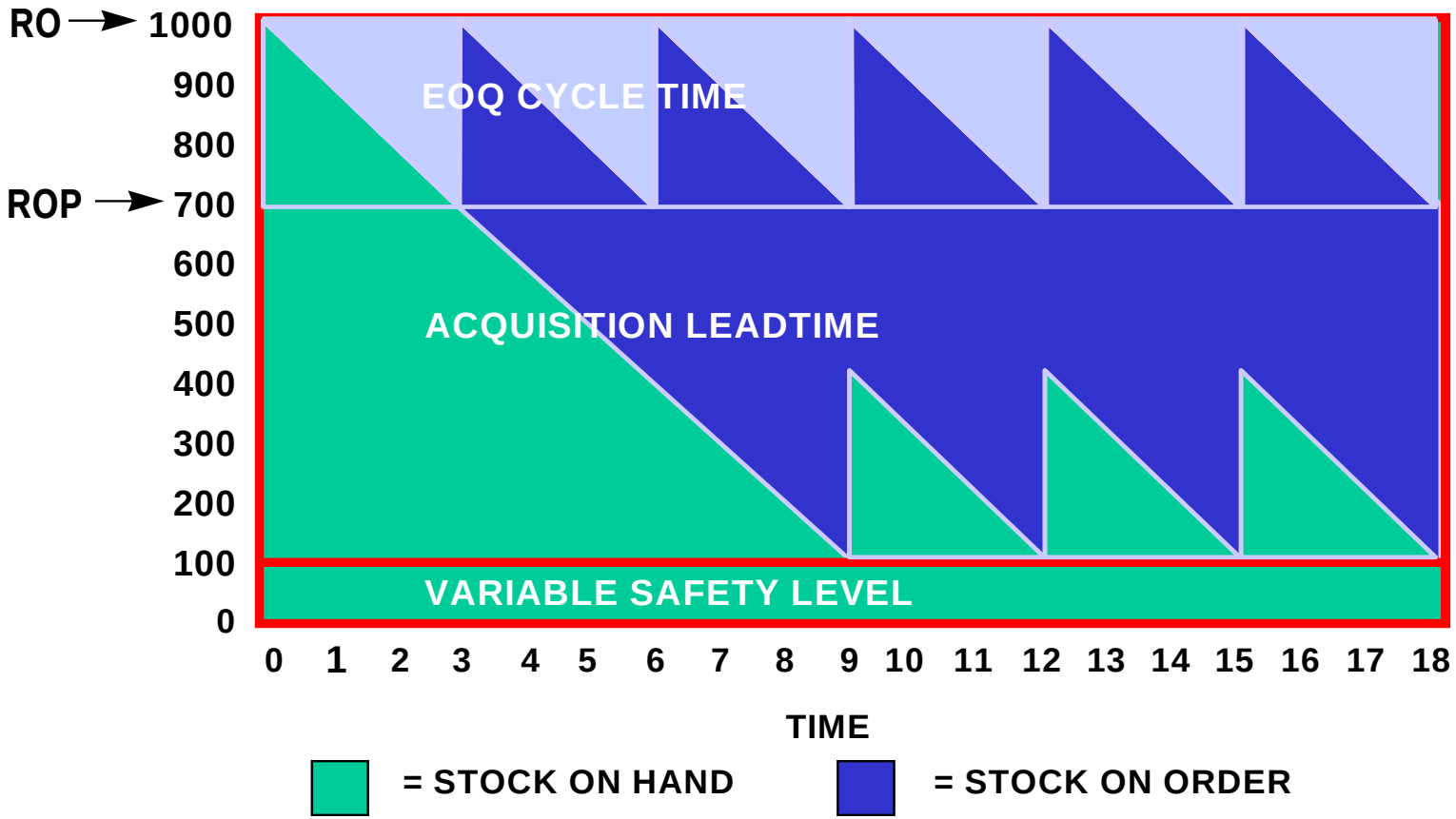


L7TAAP1-16.PPT

EXHIBIT 2

INVENTORY MODEL (WHOLESALE)

AMD = 100
VSL = 1 MONTH
AQLT = 6 MONTHS
EOQ CT = 3 MONTHS



L7TAAP1-23.PPT

EXHIBIT 3