Microsoft

Effective Replenishment Parameters

By Jon Schreibfeder

Microsoft Dynamics

EIM

Effective Inventory Management, Inc.

This report is the fourth in a series of white papers designed to help forward-thinking distributors increase efficiency, customer service, and profitability with smart inventory management strategies based on tried and proven methods and best practices.

Many distributors rely on their computer software to help them decide when to replenish the inventory of stock products and how much of each product to reorder. They are relying on the system to alleviate customer service problems and improve profitability. Unfortunately we've found that management and even buyers often do not understand the actual definition and purpose of each of the application's parameters. As a result, the system is often set up incorrectly or misused, and the distributor does not receive all of the possible value from this very expensive tool.

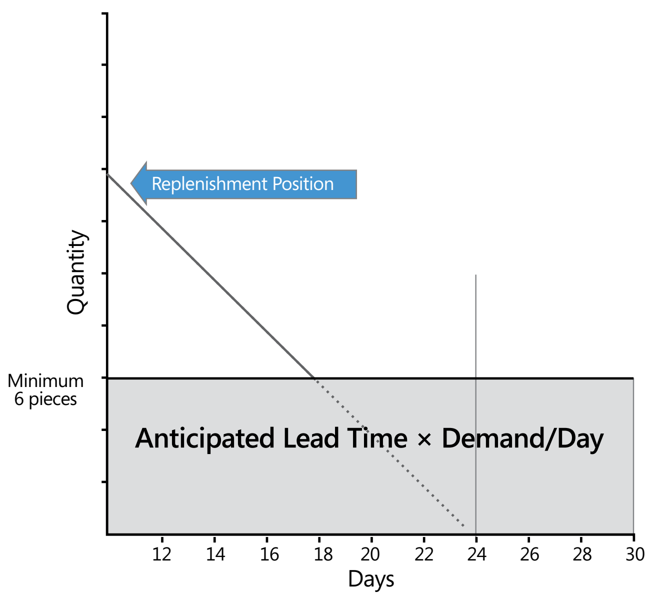
In this document we discuss some common replenishment parameters found in distribution application software packages. Please keep in mind that though the actual name of a specific parameter may be different in your system, the concepts are probably very similar or even identical. Be sure that all of your employees who are responsible for replenishing products understand these concepts. With this knowledge they will be able to maximize their productivity and help your organization achieve the goal of effective inventory management.

Please note that the parameters discussed in this document are designed to replenish stock items with recurring usage. That is, products that are sold on a regular basis. "Target stock levels" of items with sporadic usage are discussed in the Improving the Accuracy of Forecasts white paper as part of this series.

When to Order a Product

The Minimum Quantity

If you reorder a product at the right time, you will avoid stockouts and disappointed customers. For example, suppose you sell one piece of an item every day and the lead time for the product is six days. If you always reorder the product when there are six pieces left on the shelf, you will consistently receive the replenishment shipment on the day you are selling the last piece in stock:



Six pieces represents the minimum quantity. If you reorder the product when the available quantity is less than six pieces, you will probably run out of stock. Note that in determining the minimum stock level, it is critical that the forecasted demand per day, as well as the anticipated lead time, are as accurate as possible. We explore developing accurate estimates of future usage in *Improving the Accuracy of Forecasts*, another white paper in this series.

The Anticipated Lead Time

The anticipated lead time is the sum of four factors:

- The time it takes you to place an order
- The time it takes the vendor to process your order and ship the material
- The time it takes for the material to travel from the vendor to your warehouse
- The time it takes you to receive, unpack, and prepare the stock receipt for sale or use

A common method of calculating the "average" lead time is to average the lead times associated with several previous stock receipts of a product. We have found three major problems with this technique:

- Half of the actual lead times will be less than the average, increasing the possibility of a stockout of the product.
- If the anticipated lead time dramatically changes, it will take a while for the average to "catch up" to the new actual lead time for the item.
- The calculated average may not take into account all four elements of the lead time. For example, the lead time may be recorded before a shipment is inspected and the material is available for sale or use.

We suggest that anticipated lead times be manually maintained by a buyer and set to *the longest normally anticipated lead time for a product*. If actual lead times for an item range from one to two weeks, set the lead time equal to 14 days. If actual lead times for a product range from two to four weeks, set the anticipated lead time equal to 28 days. While this method may slightly increase your overall inventory investment it will greatly reduce annoying instances of stockouts of critical products.

The Replenishment Position

Notice in the diagram on page 1 that the stock level is referred to as the "replenishment position." Is the replenishment position the actual quantity on the shelf? Maybe, maybe not. The replenishment position is equal to:

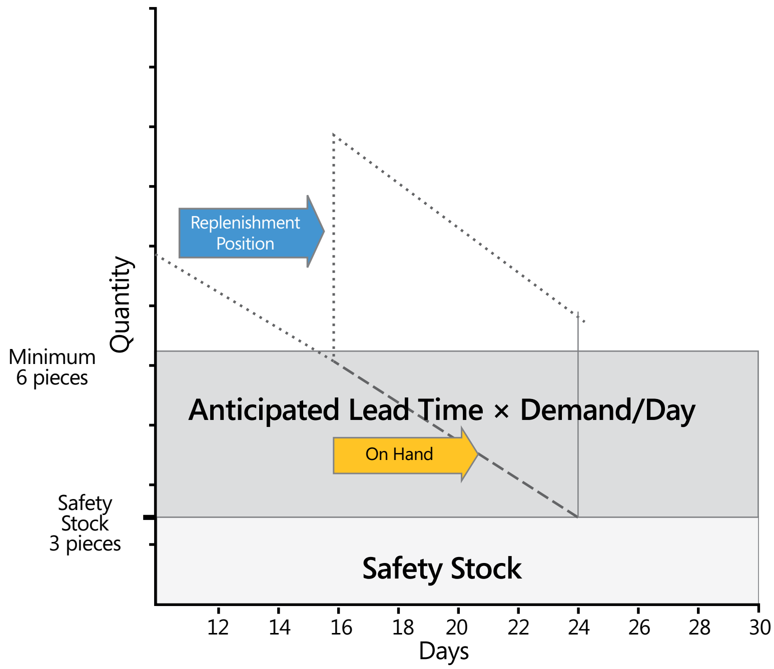
On-hand qty – Qty committed on current outgoing orders + Qty on current replenishment orders

If a customer is on his way to your warehouse to pick up two pieces, they should be committed to that customer. We want to subtract that quantity from the on-hand quantity in determining when to reorder the product. After all, what would happen if someone called and ordered six pieces to be picked up in six days? Would we want to wait to reorder the product until the customer order was picked up and there were none left on the shelf? Of course not. To maintain a high level of customer service it is important to know when the "available quantity" (on-hand quantity – committed quantity) reaches or falls below the minimum quantity.

But what if we order more of the product today? Because it takes six days to receive a replenishment shipment, the available quantity will still be below the minimum quantity tomorrow. Do we want to order more of the product? Probably not. If a replenishment shipment is already on order, we don't need to order more. This is why the *quantity on current replenishment orders* is added to the *on-hand quantity* to equal the replenishment position.

Safety Stock

The minimum quantity is equal to the anticipated demand during the lead time. But will we always sell one piece per day? Will the lead time occasionally exceed the longest normally anticipated lead time? Many distributors want to maintain some reserve inventory to avoid stockouts in case of unusually large demand or unanticipated supplier shipment delays during the lead time. This insurance inventory is known as safety stock:



Notice that the safety stock of three pieces increases the minimum from six to nine pieces, and that the reserve inventory of three pieces will only be used if more than six pieces are sold during the time it takes to replenish the inventory of the item.

There are several ways distribution systems determine safety stock quantities. These include:

- A percentage of the anticipated demand during the lead time
- A specific quantity or a certain number of days' supply
- A multiple of the average difference between the demand forecast (prediction of what you will sell or use) and actual usage during the last several months. *If your system uses this method be sure it only considers instances where actual usage exceeded the forecast. If the forecast exceeded usage you don't need safety stock. You already have too much of the item.*

Some items require more safety stock, such as critical items and those that consistently have a high forecast error. Other products require less safety stock. These include products with very predictable demand and those that will not result in dissatisfied customers if they happen to be out of stock. Like any type of insurance, safety stock is an expense, not an investment. Whatever method you use to determine safety stock quantities, be sure you only keep enough safety stock to maintain your desired level of customer service.

Target Orders and Review Cycles

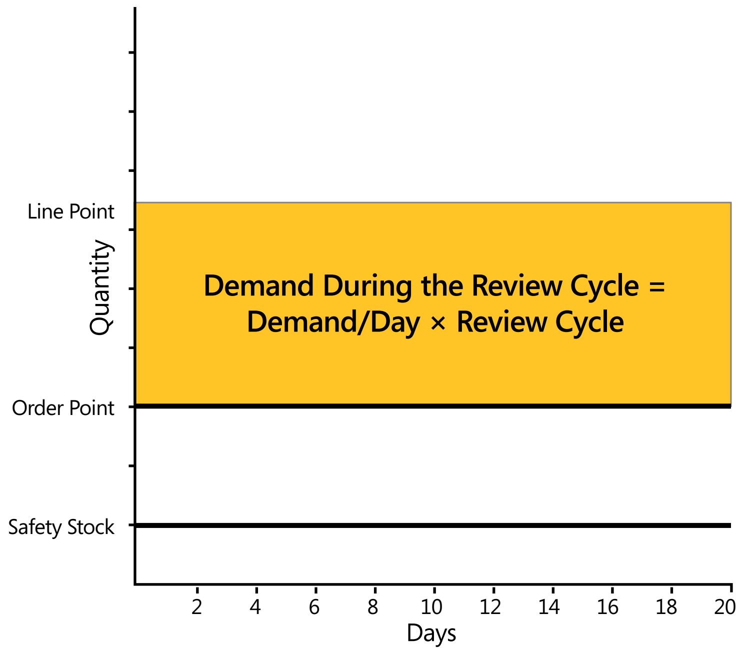
If you reorder a product when its replenishment position reaches or falls below the minimum quantity you will avoid most stockouts. Often a distributor has to place an order of a certain size to get the terms or discounts necessary to competitively sell the vendor's products. This "target order" requirement can be expressed as:

- A minimum number of pieces
- A minimum monetary amount
- A minimum weight or weight range
- A minimum cubic volume or cubic volume range

The average amount of time necessary to sell, transfer, or otherwise use enough of the vendor's products to meet the target order requirement is called the review cycle or order cycle. What if the replenishment position of one item in a vendor line falls below its minimum quantity but there is not enough need in that line to meet the target order requirement? Do you wait until there is enough need to meet the target requirement, causing a stockout of that one item? Do you produce a vendor purchase order, making up the difference necessary to meet the target requirement with products you *think* you might need in the future?

The Order Point and Line Point

Whenever you are faced with a vendor target order requirement, you need two minimum quantities to ensure that products are reordered at the right time. The first minimum is equal to anticipated demand during the lead time, plus safety stock. This minimum quantity (discussed above) is called the order point. The second minimum is the line point, a quantity equal to the order point plus anticipated demand of the product during the review cycle:



To understand how the two minimum parameters work, let's look at an example:

It takes a week to sell, transfer, or otherwise use enough of ABC Industries' products to meet the target order requirement. That is, the vendor line's review cycle is seven days. If we place a target order with ABC Industries today, February 1, we will place the next target order seven days from now on February 8. To protect customer service we do not want the replenishment position of an item in the vendor line to fall below its order point without being reordered. Therefore we want to place on the February 1 order any item whose replenishment position is below its order point, or will probably fall below its order point before we can place the next target order on February 8. These are the items whose replenishment position is below the line point (the yellow area of the graph above).

In practice, the replenishment position of one item falling below its order point should prompt a buyer to review a vendor line and issue a purchase order. That purchase order should include any item in the vendor line whose replenishment position is below its line point.

How Much of a Product to Order

If you reorder a product at the right time, you will protect customer service. The amount you order helps determine your company's profitability. The objective of most distributors is to buy every item at the lowest total cost per unit. The total cost is the sum of three elements:

- Cost of the material—This amount includes freight and any other charges that are related to a specific shipment.
- Cost of reordering an item—This is the cost of issuing, receiving, and paying for a line item on a vendor purchase order.
- Cost of carrying inventory—This is the cost of maintaining inventory in your warehouse before it is sold, transferred, or otherwise used.

Cost of Reordering

The cost of reordering inventory (also known as the "R" cost) includes:

- Deciding what products need to be replenished
- Issuing the purchase order
- Expediting the purchase order (if necessary)
- Processing the receiving paperwork for the shipment
- Approving the vendor's invoice for payment
- Processing the vendor's payment

The cost of reordering is calculated by dividing the total annual cost of purchasing stock line items by the number of purchase order line items for stock products issued in the past year:

$$\frac{\textbf{Annual cost of issuing purchase order line items}}{\textbf{Purchase order line items issued in the past year}}$$

Typical R costs range from $5 to $6 per purchase order line item. Your Microsoft dealer can provide you with a questionnaire we've developed that will assist you in calculating your organization's cost of reordering. Note that the cost of reordering is not calculated for a whole purchase order or each piece purchased. The R cost is expressed *per purchase order line item*. The theory is that it probably takes the same amount of time and effort to purchase a product regardless of whether you buy 10, 50, or 1,000 pieces. But if we graph the R cost per piece, you see that the cost per piece drops rapidly as the quantity purchased increases:

If the cost of reordering is $5 per line item and we buy one piece, that one piece has to "absorb" the entire $5 R cost. But if five pieces are ordered, each piece only has to absorb $1 of the $5 R cost.

The Carrying Cost

The cost of carrying inventory (or "K" cost) includes all of the costs you incur by stocking material in your warehouse:

- Moving material from the receiving dock to the proper bin location and shifting it to other warehouse locations as necessary
- Insurance and possible taxes on the inventory
- Rent and utilities for the portion of your warehouse used to store material
- Physical inventory and cycle counting
- The risk of inventory shrinkage and obsolescence
- Opportunity cost of the money invested in inventory (That is, how much could you make if the money tied up in inventory was invested in a relatively safe, income-producing investment. Or, if you finance your inventory purchases, the amount of interest that you pay the bank.)

The annual amount of these costs is accumulated and divided by the average inventory investment. The K cost is expressed as a percentage. Think of it as the cost of maintaining a dollar's worth of inventory in your warehouse for an entire year. Typical K cost values currently range between 15–23 percent. Your Microsoft dealer can provide you with a questionnaire developed by EIM that will help you calculate your company's specific inventory carrying cost.

Unfortunately, while the R cost decreases as the quantity ordered of a product increases, the K cost behaves in the opposite fashion:

If we buy 500 pieces of an item, part of that shipment will remain in our warehouse longer than if we bought 20 pieces. As long as any part of that purchased quantity remains in our warehouse, it absorbs the elements of the K cost (listed above) like a sponge. If we add the cost of the material to our graph, we can plot the total cost curve:

Notice that the total cost is at its lowest at point "A" and that we can draw a straight line from point "A" through the intersection of the K cost and R cost curves. This is the economic order quantity (EOQ).

The Economic Order Quantity (EOQ)

You do not have to develop graphs to determine the EOQ for every stocked product. The “best buy” quantity can be derived from a formula. In fact, Microsoft distribution software products utilize one of two versions of the EOQ equation:

One version is based on forecasted demand per business day:

$$\sqrt{\frac{\textbf{2} \times \textbf{[Number of work days in the past 12 months]} \times \textbf{[Reordering cost]} \times \textbf{[Demand/day]}}{\textbf{[Annual carrying cost percentage]} \times \textbf{[Replacement cost per unit]}}}$$

The other version is based on forecasted demand per month:

$$\sqrt{\frac{\textbf{24} \times \textbf{Reordering cost} \times \textbf{Monthly demand}}{\textbf{Annual carrying cost percentage} \times \textbf{Replacement unit cost}}}$$

Which version you utilize is not as important as understanding how to interpret the results of the EOQ equation. The EOQ will suggest you order smaller quantities of items with a large number of dollars flowing through inventory and larger quantities of products with few dollars moving through your warehouse. Let’s look at two examples:

- **Forecast demand = 25 pieces per month**
- **Unit cost = $10.00**
- **R cost = $5.00**
- **K cost = 20%**

$$\sqrt{\frac{24 \times \$5.00 \times 25}{.20 \times \$10.00}}$$

$$\sqrt{\frac{3000}{2.0}}$$

$$\sqrt{1,500}$$

EOQ = 38.7 (rounded to 39 pieces)

Based on a monthly forecast of 25 pieces (25 × $10 = $250 flowing through inventory per month) an EOQ of 39 pieces represents a 46-day supply. We calculate a day’s supply of inventory by dividing the EOQ by the monthly forecast divided by 30:

EOQ ÷ (Monthly Forecast ÷ 30)

If we raise the unit cost to $50 per piece, the EOQ is reduced to 17 pieces or a 20-day supply (25 pieces × $50 = $1,250 flowing through inventory per month):

$$\sqrt{\frac{24 \times \$5.00 \times 25}{.20 \times \$50.00}}$$

$$\sqrt{\frac{3000}{10}}$$

$$\sqrt{300}$$

EOQ = 17.3 (rounded to 17 pieces)

Buying to Minimize Total Inventory Cost

If accurate parameters are entered into the EOQ formula, it will suggest the quantity that produces the lowest "total cost" of inventory per piece; this will maximize your profitability. However in today's economy we see many companies emphasizing "cash flow management" over profitability. That is, they are willing to sacrifice some profit dollars in order to invest smaller amounts in inventory.

If you find yourself in this situation, closely examine the EOQ quantities calculated by your computer system in terms of the day's supply of inventory. Compare the results to the value of the product sold or used during the order cycle for each supplier. For example, you may receive shipments from the primary vendor for this line every 10 days. If you include this item on each order, you can order a ten-day supply (10 days × 1.5/Day = 15 pieces). Compare the value of the EOQ and order cycle replenishment quantities for our first example (the monthly forecast of 25 pieces is divided by 30 days to result in the demand per day):

EOQ value = 39 pieces × $10 per piece = $390

Order cycle qty value = 10 days × (25 ÷ 30 days) × $10 = $83.33

This lower 10-day reorder quantity of this product results in buying $306.67 ($390 – $83.33) less inventory. Note that the order cycle reorder quantity does not affect either anticipated lead time usage or safety stock quantity. These are elements of the minimum or "order point" quantity, which will ensure that you reorder the product at the "right" time in order to avoid a stockout. Replacing the EOQ with the order cycle quantity for many items can substantially reduce the amount of money you have to invest in inventory.

Though you will not be buying to achieve the lowest total cost for each piece of the product and maximize your profitability, buying just enough to last during the order cycle will reduce necessary cash outlays and increase your inventory turnover (that is, your opportunities to earn a profit from every dollar of your average inventory investment). This may be just the remedy for a company having cash flow challenges. And because the elements of the minimum or "order point" are not affected, "order cycle" replenishment should not have a detrimental effect on customer service!

Time is a precious commodity. If the parameters in an advanced distribution system are set correctly, a good distribution system can automatically perform routine replenishment decisions and bring unusual situations to the attention of buyers, management, and salespeople. But this ideal situation requires that your employees have the knowledge to exploit your system's capabilities. A necessary step in this process is to understand how reordering parameters are calculated, so that they can be fine-tuned to meet the exact requirements of every replenishment situation.

About the Author

Jon Schreibfeder

Jon Schreibfeder is president of Effective Inventory Management, Inc., a firm dedicated to helping manufacturers, distributors, and large retailers get the most out of their investment in stock inventory. For over 20 years, Jon has helped over two thousand firms improve their productivity and profitability through better inventory management. Jon has designed several inventory management computer systems and has also served as a distribution industry "troubleshooter" for two major computer companies. He is the author of numerous articles and a series of books on effective inventory management, including the recently published *Achieving Effective Inventory Management (5th edition)* and the *National Association of Wholesale Distributors' Guess Right – Best Practices in Demand Forecasting for Distributors*.

A featured speaker at seminars and conventions throughout North America, Latin America, Europe, Asia, and the Pacific Rim, Jon has been awarded the title "Subject Matter Expert" in inventory management by the American Productivity and Quality Center. He is an advisor and guest lecturer in the Industrial Distribution Program at Purdue University.

About Microsoft Dynamics

Microsoft Dynamics® is a line of integrated, adaptable business management solutions that enables you and your people to make business decisions with greater confidence. Microsoft Dynamics works like familiar Microsoft software, such as Microsoft® Office, which means less of a learning curve for your people, so they can get up and running quickly and focus on what's most important. Built to work with Microsoft technologies, it works easily with the systems your company already has implemented. By automating and streamlining financial, customer relationship, and supply chain processes, Microsoft Dynamics brings together people, processes, and technologies, helping increase the productivity and effectiveness of your business and helping you drive business success. Visit www.microsoft.com/dynamics to learn more.

Worldwide (1) (701) 281-6500
United States and Canada, toll free, (888) 477-7989
www.microsoft.com/dynamics