Principles of Replenishment

The White Paper

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A research paper designed to stimulate a "Best Practices" approach in using Epicor Prophet 21® (P21) Software for inventory management and replenishment.

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FOREWORD

Replenishment is defined as "*the deliberate process of ordering inventory using efficient practices that optimize Service Level and Inventory Turnover*."

The purpose of this paper is to develop a comprehensive orientation toward replenishment schemes using replenishment theory, available software tools, and experience in execution. The paper is written from the context of designing similar systems within the Epicor P21® environment. This is a living document, not unlike academic research, where collective criticism, amendment, and further testing lead to an ever-increasing body of knowledge, as opposed to a written and non-dynamic policy.

Note what is not in this document—namely that this document does not consider purchasing and quality as part of a total replenishment scheme. Purchasing and quality involve supplier evaluation, supplier appointment, negotiation of terms and conditions, and other matters. This paper attempts to define replenishment best practices among parts where there is an established supplier, and in most cases, established costs.

This paper is written from G.L. Huyett's perspective, a manufacturer and importer of non-threaded fasteners. Nearly all of G.L. Huyett's sales are to other distributors. Most distributors buy randomly, normally absent of scheduled release orders. No standard packs or sale quantities are used. G.L. Huyett is on version 12.11.1283 of Epicor P21®.

Important Acknowledgements
Some of this work was developed from the textbook, Introduction to Materials Management, Fifth Edition, written by J.R. Tony Arnold and Stephen N. Chapman, published by Pearson Education, Inc., copyright 2004. The tables on page 11 of the White Paper were copied from page 291 of the book. This book is used by the APICS organization, now known as the Association for Operations Management, as part of its certification program known as, "*Certified in Production and Inventory Management*" (CPIM). The book is sold on Amazon and is a recommended reference manual for purchasing decision makers.

The book, Achieving Effective Inventory Management, Fifth Edition, written by Jon Schreibfeder, and published by Effective Inventory Management, Inc., copyright 2010 was used as a reference. Mr. Schreibfeder was a consultant to the Epicor Corporation in developing software tools that support effective replenishment strategies in Version 12.11.1283.

EXECUTIVE SUMMARY

Inventory is a substantial investment in an industrial business and requires management. **Structural Inventory** is caused by faulty or non-responsive system processes. Inefficiencies in replenishment systems cause **Transaction Created Inventory**; the subject of this paper.

Inventory management is affected by I**nventory Costs** which include Item Cost, Soft Costs, Carrying Costs, Storage Costs, and Risk Costs. There are **transaction costs** associated with ordering, packaging, and stockouts that are embedded in inventory cost. **Transportation costs** can be affected by replenishment design in that they are usually borne at a purchase order level. There is also a non-inventory **system management cost** to manage the variables in replenishment systems.

Inventory can be controlled using **ABC Class Codes**. Such codes can stipulate Service Level and other managerial objectives for groups of parts with common management denominators. **Service Level** is affected by both supply and demand conditions. Independent ordering systems, which decouple supply and demand, can also create inefficiencies in replenishment. ABC Class Codes are derived from **Inventory Ranking**, which is a process of grouping parts into common denominator groups. In addition to Service Level, **Turnover** (i.e. inventory turns) is another key performance indicator that measures a replenishment system's effectiveness. There are a variety of statistical concepts and standards that can provide an analyst a means to rank inventory.

The **five primary steps** in replenishment are **Recognition, Evaluation, Buying, Configuring, and Order Execution**. **RFQ** (Request For Quote) is a wasteful process as part of a normal replenishment scheme. There are four primary **independent ordering systems** – **MIN/MAX**; Order Point/Order Quantity (**OP/OQ**); Up To (also known as **Period Order Quantity**); and Economic Order Quantity (**EOQ**). MIN/MAX and OP/OQ use static variables for replenishment that require attention and management. Up To and EOQ use dynamic variables that change with business conditions. The **Order Point** is calculated the same in both processes. EOQ uses a formula to calculate **Order Quantity** that considers the intersection of **Order Costs**, with **Carrying Costs**. EOQ is considered the superior method.

Epicor P21® has a variety of tools and some limitations, but largely supports all four replenishment methods. **Conversion, Cost Pages, Carrier ID Codes, Terms Codes** and Purchase Target Value (**PTV**) are useful tools to automate Purchase Order Entry and configuration.

Setting up an effective replenishment system involves using these tools to develop inventory ranking and to apply replenishment methods to the proper Class Code strategy. The actual design process is completed at the Supplier level first, and then at the Item level, using Class Codes developed in the Inventory Ranking process. A system of continuous improvement known as **"yield management"**, following implementation, will ensure that Service Level is optimized and inventory is minimized.

CHAPTER 1

INVENTORY FUNDAMENTALS

Inventory Fundamentals

Inventory generally accounts for 20-60% of total assets for a manufacturing company; and as much as 80% for a distribution company. As inventory is used, its value is converted to cash, which improves cash flow and return on investment. There is a cost to carry inventory in the form of warehouses, pallet racks, buildings, and other devices, on top of the lost opportunity cost of investing cash in inventory as opposed to an alternative asset. Thus an effective means of replenishment can have a profound impact on a company's cash flow, profits, and balance sheet.

The primary purpose of inventory is to decouple supply and demand. While on face value that sounds like an admirable condition, in that demand management and supply management can be segregated into more manageable increments, in reality the decoupling process introduces inefficiency and costs. Today's orientation to lean methodology moves the orientation to a demand-pull reference, as opposed to a "warehouse and wait to sell" approach.

In a demand pull system, production (and inventory) is driven by demand, with demand filled as realized, and production lots aligned with consumption. This is the premise of integrated supply, also known as vendor managed inventory (VMI). For demand pull systems to be effective, changes in demand and supply must be continuously monitored, and the variables that effect replenishment must be easily modified in a timely manner. Ease of use and ease of change are operating parameters that would affect replenishment system design.

There are several types of inventory and for an effective replenishment system to be introduced, it is important to understand them.

> **Anticipation Inventory** is inventory built in anticipation of future sales. It is well known that Wal-Mart maintains several semi-loads of portable generators that are shipped on short notice to stores in regions affected by ice, wind, or hurricanes. Demand and pricing utility increase exponentially during such storms, and thus availability of stock on short notice is profitable and builds customer loyalty.
>
> **Fluctuation Inventory**, also known as Safety Stock, is inventory held to cover random changes in demand or supply. It is the impression of this writer that Safety Stock is calculated using emotion as opposed to science in many operations.
>
> **Lot-Size Inventory** is inventory that is purchased in excess of demand requirements, but which allows the manufacturer to produce in economic production lots, or which yields discounts. Often, lot-size inventory is too high because the purchasing manager does not fully recognize or understand carrying costs. Having said that, sometimes lot-size inventory is too low because of an over-emphasis on turnover.

A special part bought in units of 1,000 for $1.00 each, ($1,000 lot) might be better bought from an alternative supplier oriented to higher production runs in increments of 5,000 at $.19 each ($950.00 lot). While the lot cost arithmetic of this example is obvious, some operations that focus on turnover would ignore or perhaps not consider the larger lot size because it exceeds annual usage by a wide margin.

Transportation Inventory exists because of delays and the time elapsed for shipping goods from the supplier to the customer. This time includes customs clearance and inspection time at receipt.

Processing Time Inventory is embedded in safety stock, and is often a hidden and non-recognized cost. It is inventory held during replenishment, which for some operations can extend to days and even weeks.

Hedge Inventory is inventory held in anticipation of future inflation and increasing prices. It allows the user to have a predictable future cost.

Hoard Inventory is inventory bought in advance of a price increase.

The objectives of inventory management are to balance customer service requirements and benefits in increasing gross margins from buying larger lot sizes; against carrying costs and the adverse impact on working capital. In addition, larger lot sizes and receipts can reduce cost of goods sold from lower invoice prices, or operating costs because of the fixed procurement cost of a given receipt can be amortized over more parts.

Most efforts to reduce inventory focus on transaction management such as adjusting reorder point quantity or making general mandates for reducing on-hand stock. While these techniques are important, managing business processes can have an even greater impact. We refer to process-oriented inventory as **Structurally Created Inventory**, as opposed to **Transaction Created Inventory**. Structural inventory is created by the structure of an organization. Slow processing speed, muted recognition of changes in supply or demand, and tepid responsiveness are some of the hallmarks of structural inventory. Centralized verses decentralized purchasing departments will affect this.

To reduce structural inventory, consider the following:

- **Improve demand forecasting**. Such action reduces risk and therefore safety stock.
- **Reduce the demand planning horizon** by reducing manufacturing lead time. Your sales team can tell you what they will sell next month with a much greater degree of accuracy than what they will sell six months from now.
- **Compress transportation and processing time**. In many operations, there are 2-4 weeks of structural inventory because business processes and transportation are not timely managed or have not been compressed.

- **Stimulate an enterprise-wide software development culture**. The advantage of enterprise software (known as "ERP" or "Enterprise Resource Planning") is that information is visible to all in the organization in real time. "Real time" means that there is no time lag from one person or department being able to see the actions of another. A sales order entered is visible to the order picker as soon as it is saved and scanned. Unfortunately there is a tendency to abdicate software ownership to an IT/IS department. If the user community accepts ownership in the system, then predictably the tools and information in the system will be far more visible and effective, and the users can use such tools to eliminate structural inventory. One of the reasons that Craigslist and eBay are such efficient markets for attic junk is because the users maintain the system. If eBay had to snap pictures of that antique rocking chair and field bids for the item, the market would be less efficient.
- **Reduce handoffs**. Structural inventory often builds when "silos" of information or queues develop in an organization, where one party is waiting on another. These silos can be torn down when business processes are integrated. For example, having Receiving directly handle receiving exceptions with suppliers is normally more efficient and can eliminate structural inventory sitting in Receiving as opposed to the Receiving Manager handing off such exceptions to Purchasing. The Receiving Manager now has ownership not only of the process, but of the inventory sitting in Quarantine awaiting disposition.

Transaction created inventory is created by inefficiencies in the replenishment schemes of an organization. Excess safety stock, overstated lead times, incorrect suppliers, or non-economic lot sizes are examples of transaction created inventory. Reduction of transaction created inventory is the primary subject of this paper.

CHAPTER 2

COSTS

Inventory Costs

Inventory management is affected largely by inventory cost. Whereas anyone can understand **Invoice Cost**, also known as **Item Cost**, there are other hidden costs of inventory.

Landed Cost is invoice cost, plus the cost of procurement. Procurement costs, also known as "soft costs", include freight, duties, brokerage fees, insurance, and other direct procurement costs.

Carrying Cost is the cost of owning inventory. It includes **Cost of Capital**, which is a lost opportunity cost. If your money is not invested in inventory, it could instead be invested in financial assets bearing interest or dividends, or in other fixed assets. Cost of Capital is the estimated lost cost of not having the opportunity to earn invested funds in these other assets.

Storage Cost includes warehouse space, rent, real estate taxes, pallet rack, fork trucks, utilities, insurance, and other costs associated with storing goods.

Risk Costs are losses of inventory value due to damage (corrosion); pilferage ("*We cannot find the parts*."); and deterioration (shelf life). **Obsolescence** ("*We don't use that anymore. It was designed out of the assembly*.") is among the least recognized and most profound risk cost.

While there is great debate as to what carrying costs total, in an industrial business such as fasteners, with most items possessing minimal risk cost, **a conventional value assigned to carrying cost would be 25-40% of value, annualized**. Customer-specific inventory with unique features or made-to-print would have a much greater carrying cost due to risk of obsolescence. Rubber parts such as o-rings or other perishable product would likewise have a higher carrying cost.

Important Definitions

There are many uses of certain terms and definitions in commerce. To ensure that there is consistency in usage, here are some important technical definitions and concepts as they relate to cost.

- **Price** is the value that a customer pays for goods or services. It is the value at which parts are sold.
- **Cost** is the value at which goods or services are purchased.
- **Price List** is a table set up in P21 such that items are sold at the prices listed in the table at the qualifying sell quantities. Price Lists may also be referred to as *Pricing Pages (in P21 Sales Pricing Pages)*.
- **Cost Lists**, also known as *Cost Pages (in P21 Purchase Pricing Pages*), are tables set up in P21 that notate the cost for an item from a supplier based on the qualifying buy quantity. They are often based on either a Supplier Price List or an RFQ (Request for Quote).

- **Standard Cost** is the automatic purchase order and invoice cost assigned to an item in P21 which is pulled into a purchase order at purchase order entry and based on a typical buy quantity using ordinary demand. Standard Costs automate purchase order execution. *(G.L. Huyett's practice is to have Standard Cost equal to the Primary Supplier's Cost. In P21, Purchase Order Cost is auto-generated from one of the following fields dependent on settings: Supplier List Price; Supplier Cost; Supplier Loc List Price; Supplier Loc Cost; or Value as defined in Purchase Price Page. G.L. Huyett's current practice is to use Value as defined in the Purchase Price Page if available, otherwise use Supplier Cost.)*
- **Landed Cost,** sometimes referred to as *Laid-In Cost*, is Standard Cost plus direct value-added costs and logistical costs. Examples of value-added costs include plating, heat treatment, and packaging. Logistical costs, also known as *soft costs*, include freight, duties, and preparation and forwarding charges from international freight brokers.
- **Soft Costs** are all direct non-product costs associated with bringing parts to our dock.
- **Model Cost** is an estimated Standard Cost for a given item, based on other similar items. Model Cost is used for lightly traded items, where the effort to maintain or procure such cost is deemed prohibitive, and experience suggests that a cost estimate is accurate to management's satisfaction.

Transaction Costs

Technically, transaction costs are a "cost" embedded in inventory. Because transaction costs are normally managed at a supplier or PO level, they are segregated for analysis here.

Ordering Cost is the cost associated with procuring a purchase order. It includes review costs; issuance and acknowledgement costs; receiving costs; inspection costs; and putaway costs. It is the direct labor in Purchasing and Warehouse operations associated with procuring an order.

Packaging Costs are costs associated with repacking, relabeling, or in some way modifying boxes received to integrate with boxes shipped in a distribution scheme. Such costs should be managed in replenishment.

Stock-Out Costs are costs associated with lost sales, back-order issuances, and expedited fees. While lost sales are managed typically on the sell side, by matching service level to customer requirements; on the buy side, backorders typically create exceptions to conventional replenishment. Higher freight costs and transaction costs are normally associated with backorders.

Transportation Costs, while directly related to inventory costs, are often managed at an order level and from a replenishment design scheme standpoint, should be considered part of transaction costs. It is cheaper to ship a container than a pallet, which is cheaper to ship than a box. A freight forwarder charges the same fees regardless of shipment size in many cases.

System Management Costs

Aside from direct and indirect product costs, another aspect of replenishment system design is management of the system variables. One limitation of Epicor software's use of MIN/MAX and OP/OQ replenishment methods is that order points and order quantities are static numbers, as opposed to dynamic numbers based on actual usage. Thus an order quantity that is equal to one month of supply today might be equal to six months tomorrow. In developing a replenishment scheme, the cost of repetitive review of system variables must be accounted for in system design.

Please note that system management costs not only consist of labor to analyze and manage the variables that comprise Order Point (OP) and Order Quantity (OQ), but when not monitored effectively they can create Structural Inventory. Such inventory is created when demand slows or a part becomes obsolete and the replenishment system does not recognize such dynamic until inventory is already accumulated. Or in cases where demand is increasing, processing costs are increased due to rush orders and backorder processing as service level decreases.

A replenishment system that uses dynamic data to calculate OP and OQ as such data is occurring will generally result in far lower system management costs versus replenishment systems that use static variables.

CHAPTER 3

INVENTORY CONTROL

Inventory Control

Control of inventory is executed by managing the activity of **stock keeping units** (**SKUs**). In controlling inventory, four questions must be answered:

1. What is the importance of each item?
2. How are they to be controlled?
3. How much should be ordered at one time (**OQ** or **Order Quantity**)?
4. When should an order be placed (**OP** or **Order Point**)?

The subject matter of this paper will aid in design of a system to address #3 and #4. To properly manage inventory and replenishment, management must determine a proper Service Level based on market orientation and customer requirements.

ABC Inventory Class Codes

ABC Class Codes are an important tool used to facilitate inventory control. Think of ABC Class Codes as a "family" of parts that are identified by how important the item is, and how tightly such item should be controlled. Normally ABC Class Codes are assigned based on annual sales value, cost, or from mission critical definitions submitted by customers.

The ABC principle is based on the observation that a small number of items often dominate the results achieved in any situation. Also known as the "80/20 rule", the Italian economist, Vilfredo Paretto, first defined this pattern, which is coined "Paretto's Law". The Law suggests that in most situations, 80% of activity is driven by 20% of the items (Class A); 15% by the next 30% (Class B); and 5% by the last 50% (Class C). The use of ABC Class Codes can be used in replenishment, so as to create a visibility and priority in Purchasing (look at "A" items most often); and in Inventory Control, for purposes of cycle counting.

Service Level

Service level is the fill rate measured on a stockout or on a backorder basis. It is important to know which basis is used in calculation. (Stockout and backorder basis are referred to as "Customer Service Measure" in P21). In a stockout basis, a 97% service level means that for the given sales order, the lines on the order will be filled on some basis 97% of the time. On a backorder basis, an order does not adversely affect service level unless an item is backordered. 97% of the time, the lines on the order ship complete (no partial lines).

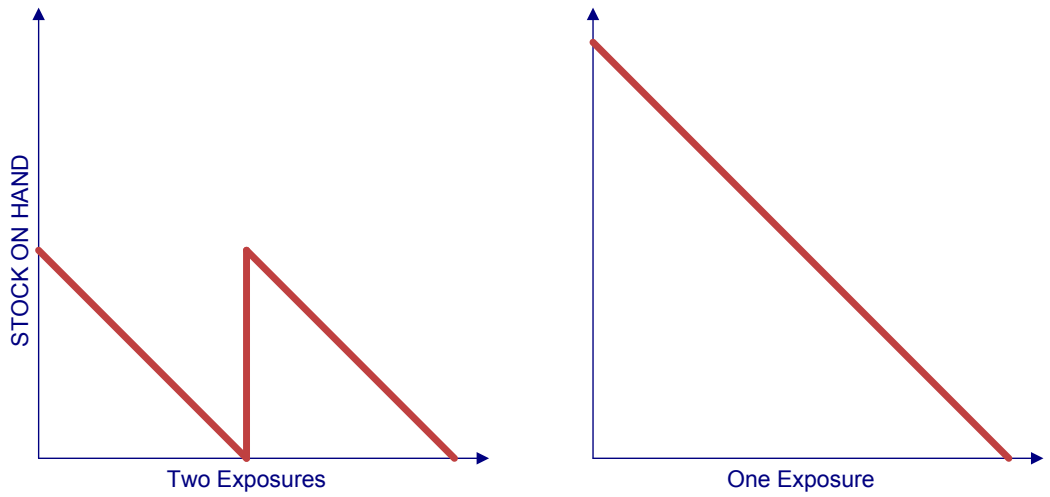
If you think about it, measuring service level on a backorder basis will stimulate a higher level of safety stock in that inventory would have to be maintained at levels that account for the maximum pick size for the item, as opposed to the typical pick size. Thus in determining service level, the cost of a partial-line backorder needs to be compared to the excess cost of inventory to prevent the backorder. The amount of extra inventory needed to manage on a backorder basis will be affected by the variance in pick quantity. Items with consistent pick quantities will have virtually no change in inventory requirement using the stockout or backorder service level measurement basis. Items with wide fluctuations will have a greater disparity in inventory requirements between the two systems.

Service level is obviously affected by both demand (frequency and size of sales orders) and supply (interruptions or delayed receipts from supplier). Service levels are normally a senior management or sell side decision. Decision makers will consider the market served, customer requirements, and competition in determining a service level. Service level can be positively affected on the sell side by observing the customer's operation and business activity, reviewing the customer's own inventory control practices, and by communicating changes in demand in a timely manner.

On the buy side, service level can be controlled by selecting good suppliers who ship timely and notify Purchasing when a production order will be late so that necessary countermeasures can be engaged. Short of these actions, service level is often managed through the use of Safety Stock, which increases inventory.

A mathematic principle of stockouts, and therefore service level, is that frequency of replenishment increases the chances of a stockout. The more often an item is replenished, the greater the chance of a stockout. The downside is that reducing order frequency increases inventory. The table below illustrates the effects of reorder frequency on stockouts, and the adverse effect on inventory.

EXPOSURES TO STOCKOUT



The assigned service level by management can have a profound effect on inventory value. Service level is directly related to the number of standard deviations provided as safety stock.

Service Level (%)	Std Deviations
50	0.00
75	0.67
80	0.84
85	1.04
90	1.28
94	1.56
95	1.65
96	1.75
97	1.88
98	2.05
99	2.33
99.86	3.00
99.99	4.00

The table suggests that one would have to double safety stock to realize a service level increase from 85% to 98%. One would have to double safety stock again to get from 98% to 99.99%. (Source: Introduction to Materials Management, page 291, J.R. Tony Arnold and Stephen N. Chapman, ©2004 Pearson Prentice Hall).

Inventory Ranking

Inventory Ranking stimulates the analyst to prioritize inventory items by cost or units for purposes of assigning management control in Purchasing. In such actions, inventory usage is multiplied by product cost or average sale price. The totals are accounted for as accumulations, so that the top ***x*** number of items account for ***y%*** of annual activity.

You can assign ABC Class Codes to the rankings, and then use such codes to appoint inventory or service levels. Paretto would have predicted that the top 20% of items account for 80% of business activity. Inventory Ranking quantifies the reality of the business mix so that Class Codes are more reliable and unique to the application.

Listed below is an example of how such ranking can be used to determine Order Quantity (OQ) in a Period Order replenishment scheme:

ABC Class:	Months Supply:	Turns Per Year:
A	1.5	8
B	3	4
C	6	2
D	12	1

A similar ranking scheme could be used to assign other inventory control policies:

- **Service Level**
- **Review Cycle** (How often do we run PORG for the ABC Class?)
- **Putaway Priority**
- **Cycle Counting**
- **Bin Slotting** ("A" items are not higher than 48 and closest to Ship Line. "D" items are stored high above and near the back.)

CHAPTER 4

METRICS AND STANDARDS

Metrics and Standards

While each company and each industry is unique, we must establish some metrics and performance standards that will govern the design of a replenishment system. Some of the more important and relevant metrics to inventory include the following:

Qty Available, as in "Quantity Available", is the amount of goods "available" for sale (in the warehouse, less open sales orders that are due now, PLUS prepaid invoices). Note: P21 does not show inventory on hand or available until the PO is received. In some cases, certain suppliers require orders to be paid for at the time of dispatch from factory or port. While such goods are in transit and are not salable, such prepaid invoices consume cash and should be considered inventory. This structural inventory can be eliminated through aggressive supplier negotiation and selection. In addition, by measuring inventory in such manner, Purchasing is incentivized to carefully time purchase order receipts with future sales orders.

Turnover is calculated by taking annualized sales in units or value, and dividing into average OH Inventory. To be more precise, in our operation we calculate it using 12 month moving averages (12/12) so that the seasonality and trends are somewhat smoothed out, and the number reflects a base trend. Conventional wisdom suggests that for a wholesaler, inventory turns should be 5-6 times annually. Because a central value proposition of our market orientation is to have a fill rate in excess of 99%, and because of longer lead times from imported shipments, such turnover is not practical. Generally, we should see eight (8) turns annually on in-house manufactured goods; three turns for imported goods; and five turns for domestically purchased goods. Raw material turns will be much lower due to the lot size requirements for much of our steel.

Carrying Costs vary from firm to firm. Generally our carrying costs will trend lower than our industry peers. We have a low real estate tax rate, low building and real estate cost, average utilities cost, below average insurance costs, and average costs for labor and benefits. Most of our custom manufactured product is made to order. Most of our entire inventory is non-customer specific and non-perishable, thus risk costs are low. **Our carrying cost was calculated by EIM to be 27%.**

Ordering Costs also vary from firm to firm. Most enterprise software systems only allow one cost of order. The cost of order varies depending on lot size, inspection requirements, and typical number of lines processed per purchase order. In April, 2010, Jim Bond performed a cost analysis using the formulas set forth in Appendix B, "*Calculating the Cost of Reordering Inventory*", on page 263 of the book, Achieving Effective Inventory Management, Fifth Edition, written by Jon Schreibfeder, and published by Effective Inventory Management, Inc., copyright 2010. The calculation indicated a Cost to Order of $8.60 at G.L. Huyett. **An $8.60 cost to order per item will be used on replenishment schemes.** Note that this calculus is implied at an item level, so a

one line receipt would assume an $8.60 order processing cost, while a ten line would be $86.00.

ROII (Return On Inventory Investment) is calculated by dividing annual gross profit into invested inventory dollars. **A minimum 50% ROII is recommended** to put an item into stock. Such minimum covers the cost of carrying – as well as indirect costs to market, sell, pick, and pack the item.

"Turns and Earns" (P21 Turn and Earn report) is a concept that integrates turnover with ROII, so that cash flow impacts of invested inventory can be considered as well. It is calculated by taking (Annualized COGS/Average Inventory)*(Annualized Gross Profit/Sales). This is a developing statistical consideration for G.L. Huyett that requires more analysis for standardization.

Statistical Analysis

In calculating order point (OP), order quantity (OQ), and other replenishment variables, the use of statistics can enrich the calculus and predictability of results. Some of the following statistical concepts are used in replenishment design.

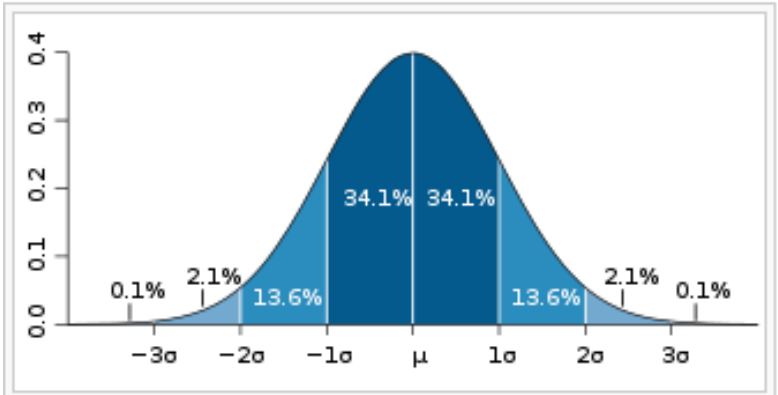
Mean, commonly referred to as "average", is the sum of a list of numbers, divided by the number of items in the list. The Greek letter **μ** (mew) signifies mean.

$$\mu = \sum(a,b,c\ldots)/z, \text{ where } z = \#\text{ items}$$

Median is the number separating the higher half of a sample, from the lower half. It will be denoted herein by the symbol, **ў**. Median is a preferred method of finding the middle of a range when end values are not known, or less importance is given to outliers.

$$\breve{y} = b, \text{ where } a < b < c < d; \text{ or } \breve{y} = (b + c)/2, \text{ where } a < b < c < d$$

Standard Deviation is a measure of the variability or dispersion of a statistical population. It is a measurement of how close a range of numbers is to the mean. A low standard deviation suggests data points are close to the mean, while a large standard deviation indicates that data is spread out over a large range. A normal distribution looks like a conventional Bell Curve:



A plot of a normal distribution (or bell curve). Each colored band has a width of one standard deviation.

Thus in a normal Bell Curve, 68.2% of data points are within one standard deviation of the mean, μ. If data distribution is not normally plotted, the "tails" in the above Bell curve can swing out (known as "skew"), and the "Bell" can move to one side of the graph or the other. Kurtosis measures the height and the width of the Bell shape.

For the Purchasing analyst, statistics are a valuable tool in two key areas – demand forecasting and pick size forecasting. When pick size is predictable, OP and OQ can be set at predetermined pick sizes in relationship to lot size. In such a model, structural inventory can be minimized. In demand forecasting, standard deviation can be used to test the reliability of forecasting. A highly reliable demand forecast can result in a substantively lower OP and Safety Stock because of greater predictability.

CHAPTER 5

REPLENISHMENT OVERVIEW

Principal Actions in Replenishment

Replenishment is not simply a process of buying, but is rather a deliberate set of steps that result in customer fulfillment at minimal processing, product, and landed costs, while minimizing inventory investment. The principal actions in an effective replenishment scheme include the following.

Recognition is the process of proposing parts that MIGHT be in need of replenishment, based on reorder point. Recognition is most often created when one or more items for a supplier drop below reorder point. An effective program of recognition identifies only those items that are actually needed. If the buyer has to look at numerous items that are not purchased, then extra processing costs are incurred. This can also be referred to as a "noise" problem, similar to trying to listen to a conversation in a loud room. If there is a stockout or service level problem, then assuming that the buyer is following procedure, there is probably an under-recognition problem.

Evaluation consists of looking at recognized parts and deciding if the parts should be bought. Evaluation is fairly automatic in an effective recognition system. In other words, what is recognized is bought. When evaluation begins to consume a buyer's time, it is either because the system has a recognition problem (too much noise), or a configuration problem. A configuration problem occurs when a given item is recognized and deemed worthy of purchase, but extra processing time is invested in configuring an economic purchase order to the supplier. Typical examples are buyers trying to make a supplier's order minimum, or in trying to qualify for freight discounts.

***Buying* i**s the process of making quantity decisions among those items deemed worthy of purchase. Buying should be relatively automatic. The system should stimulate the buyer to purchase in packaged quantities and in quantities that qualify for discounts that optimize **ROII** (**Return on Inventory Investment**). Buying is made complicated by changes in demand, or by dynamic (quantity-sensitive) supplier cost arrangements. Purchasing processes need to provide recognition to a buyer when changes in demand are occurring. Dynamic cost lists need to be visible, such that buyers can "see" volume discounts that might be practical to buy.

Configuring is the development of an economic purchase order consisting of those items to be bought from a given supplier. Configuring is normally a progressive process of "order building", where individual items are recognized, evaluated, and bought, until a purchase order reaches a predetermined target value for weight or cost, relative to procurement costs. In some purchasing systems, items for a given supplier may reside in a queue, awaiting the addition of other economic buys until an order is made economic. The waiting time for such queues needs to be considered in developing lead time.

Order Execution includes the development of the purchase order, replete with proper terms and conditions in a manner that the supplier understands; and the transmission of said order. Once configured, order execution should be automatic. A typical interference to automated order execution is the absence of established costs for the supplier, in which case an RFQ is created; or where lead time of better than normal is required, and such lead time has to be negotiated with the supplier. An integral part of order execution is order acknowledgement, so that the purchase order contract is bound between the company and the supplier.

The primary objective of this paper is to define parameters and guidelines such that an effective replenishment system can be designed that manages these actions efficiently, accurately, and timely.

RFQ

"Request for Quote" is not noted in the above steps. It is the opinion of this writer that RFQ as a conventional replenishment scheme is a wasteful processing effort. Typically RFQ is used to perform one of four functions:

1. To confirm Item Cost.
2. To gain a reduced Item Cost by seeking out an alternative supplier.
3. To confirm Lead Time.
4. Confirm supplier capability to meet the item and order requirements.

Only #1 and #3 above are replenishment actions. #2 and #4 are sourcing actions and are a separate responsibility of Purchasing or Product Development. RFQ can largely be eliminated as a replenishment function if Purchasing manages Standard Cost, and if they pay attention to the Service Level of the supplier. P21 averages Lead Time at the item level for the last "x" lead times. "X" is the number of lead times defined in System Settings. G.L. Huyett averages the last four lead times. Such Lead Time is based on the difference of PO Order Date and actual Receipt Date. If Purchasing schedules orders according to normal production schedules, maintains contact with the supplier, and watches Service Level, the Lead Time is self-managed in the replenishment scheme. Note: Individual Purchase Orders can be excluded from lead time calculations for extraordinary reasons (air freight, snow storm, etc.). Purchase orders that use release schedules are automatically eliminated from lead time calculations.

On top of Service Level, there are Safety Stock levels sitting in inventory to buffer against stock interruptions. By noting exceptions in Supplier Order Acknowledgements, Purchasing can manage exceptions, which is far more efficient than trying to manage each and every line item using RFQ. Generally, send the order. Do not send an RFQ for standard repetitively purchased items.

RFQ should only be performed when there are spikes in demand and product is needed sooner than Lead Time, or when there is a mission-critical order defined in Sales.

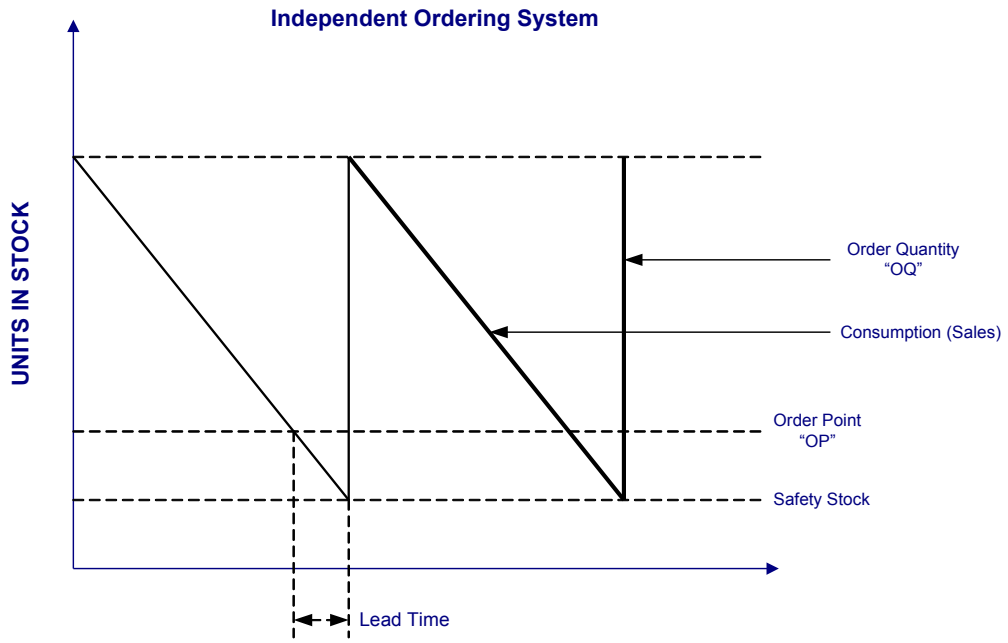
Important Definitions

Here are some important definitions that are used often in replenishment system design, within the P21 environment. The definitions are user-friendly edited and not technically complete, so as to facilitate ease in comprehension.

- **OP** (**Order Point**). This is the net stock level at which an OQ is recommended.
- **OQ** (**Order Quantity**). The recommended quantity for reorder.
- **Net Stock**. Equal to Inventory + Purchase Orders – Sales Orders.
- **On Hand**. The amount of inventory in the warehouse at any given time. On Hand does not recognize items on purchase orders or allocations.
- **Average Lead Time**. The period in days from the date you enter a PO to the date of first receipt against a PO. P21 averages actual history for the last four receipts as determined by a system setting. If no receipts have been made, the user can specify a value. If less than 4 receipts have been made, P21 will average the actual data presented (thus one actual receipt would be equal to the average).
- **Review Cycle**. The time in days that economic purchase orders can be accumulated for a supplier under normal circumstances. This is set to one day.
- **Safety Stock Days**. The time in days that management commits to in inventory to protect against stockouts caused by changes in demand or interruptions in supply.
- **Safety Stock Factor**. This is a multiplier that allows Safety Stock days to be altered based on the velocity and importance of a particular item.
- **Usage Factor**. A Purchase Criteria factor that adjusts Average Period Usage (APU), which is used to calculate Order Point and Order Quantity in the EOQ replenishment method. It may be set from 0.0 to 2.0. (Also known as "Period Usage Factor").
- **Lead Time Factor**. A supplier-level variable that is imposed based on temporary or seasonal changes in the supplier's operation that alters Lead Time accordingly. The Safety Factor is 0.0 to 2.0.
- **MAPE%**. (Mean Absolute Percent Error). This is a running historical error rate based on the last completed demand period in the system. The error rate is equal to the deviation in forecast (system generated) and actual demand. Consider it as a forecast accuracy rating. If the MAPE for an item is >1,000, we have set the item to use safety stock days as shown in the supplier record.
- **APU** (Average Period Usage). This is an actual usage (demand) number based on history.
- **Days Early**. The number of days allowed for a shipment to arrive before the required date before it is counted as early by the system. This value is set to 10 for domestic, 10 for International, and 5 for the Huyett shop.
- **Days Late**. The number of days allowed for a shipment to be past the required date before it is counted as late by the system. This value is set to 2 for domestic, 5 for International, and 1 for the Huyett shop.

Replenishment Systems

P21 supports four replenishment systems – Min/Max; Order Point/Order Quantity; Up To; and EOQ ("Economic Order Quantity"). These systems are all known as "independent demand ordering systems". That is, the replenishment scheme is independent of demand. To understand replenishment systems, one must understand the variables of each system. The graph below illustrates how replenishment works in an independent ordering system.



MIN/MAX is perhaps the most common system, largely because it is simple to understand. The Minimum (OP) and Maximum stock quantity for an item are specified. When minimum stock quantity is reached, the system will recommend a reorder quantity to take stock back to the maximum level. In theory, **OQ = MAX - MIN**. Unfortunately these values remain fixed. Thus when demand increases or decreases, the system administrator must change values individually at the item level in order to ensure that stock levels match demand.

Order Point/Order Quantity is a modified version of MIN/MAX. Order Point is established in the same way as MIN. The difference is that Order Quantity is an integral unit of purchase, often equal to a vendor's container or lot size, or perhaps a multiple of a typical sale quantity. When stock drops below OP, the system will recommend an OQ in specified increments until stock level exceeds OP. As in MIN/MAX, while this system is simple, the values are fixed and must be reevaluated when demand increases or decreases.

Up To is a dynamic replenishment method that uses data accumulating in the system from actual transaction history to calculate OQ and OP "on the fly". There are two choices to calculate OP:

Configuration:	Calculation:
Safety Stock Days	The order point for Up To items is determined using the following calculation: Order Point = (APU / 30) (Lead Time + Review Cycle +Safety Stock Days)
Service Level % Goals	Order Point = (APU / 30) ((Lead Time * Lead Time Safety Factor) + Review Cycle + ((1 + (MAPE%/100)) (1.25*Standard Deviation) (Safety Stock Factor)))

The **Safety Stock Days** method considers simple prior usage (Average Period Usage/30 or Usage per Day), and simple (but dynamically driven) data that encompass Lead Time, Review Time, and Safety Stock.

The **Service Level % Goal** method uses simple usage and then applies demand forecast and a management-assigned Service Level. This is a more complicated and more sophisticated technique that is better used on higher volume items (12 or more picks annually). The higher activity level will yield greater predictability of future results.

OQ in the Up To method is established by management, on the basis of how many periods' supply is desired to be the maximum. (APU = "Average Period Usage").

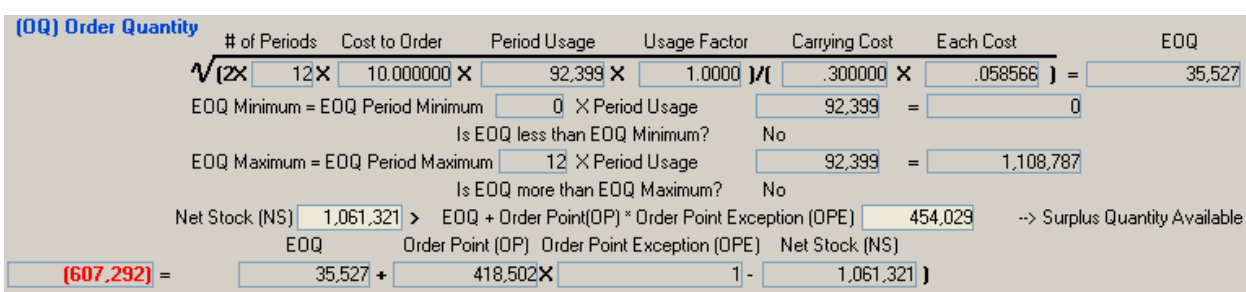
OQ = (APU * *X*) – Net Stock, *where X = # Periods of Supply*

This system can allow management to define turnover and on-hand parameters. The advantage of Up To is that variables are dynamic, and maintaining the system in periods of increasing or decreasing demand is minimized. The system is known as **Period Order Quantity** in academia.

EOQ (Economic Order Quantity) is dynamically driven and is considered by materials management experts to be a superior replenishment system. OP is calculated in the same manner in EOQ as it is for Up To. See above for specifics. OQ is calculated as follows:

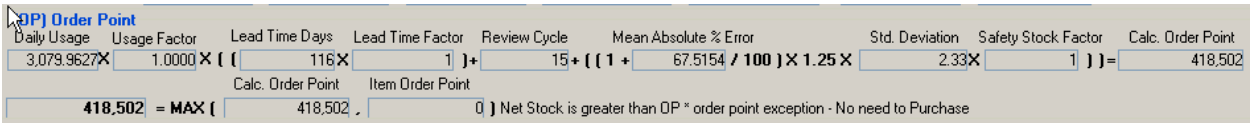
OQ = Square Root: (2 x 12 (periods) x Cost to Order x APU)/(Carry Cost * Cost/Each)

In practice, here is what the formula looks like for an actual item:



The calculation is based on years of academic research and is intended to quantify the intersection of lot size, with the point at which ordering costs equal carrying costs. Notice that company-assigned Cost to Order and Carrying Costs are embedded into the formula.

Order Point (OP) in EOQ looks like this:



EOQ systems work well with items that have annual picks of greater than six. It works better with higher volume items with lots of pick activity, where the Service Level % Goals method can be used to calculate OP. EOQ is not as effective when demand is “lumpy” (high standard deviation in pick quantities). Period Order Quantity (Up To in P21) is better for lumpy-demand situations.

P21 has tools to improve the effectiveness of EOQ when demand is “lumpy”. Specifically, the tools allow the user to set EOQ period MIN’s and MAX’s, so that upper and lower limits can be placed for order quantity. This system is not used at G.L. Huyett.

One will note that in both the OQ and OP calculation for the EOQ method, there are a series of factors that can influence portions of the calculus. They are:

- **Period Usage Factor** (listed as “Usage Factor”). Can be used to calibrate demand.
- **Lead Time Factor**. Used to calibrate supply disruptions and long lead times.

The specific use of these tools is reviewed in Chapter 10, “Yield Management”. EOQ is the preferred method of replenishment at G.L. Huyett. **For G.L. Huyett, we will use a Cost to Order of $8.60 and a Carry Cost rate of 27%.**

CHAPTER 6

EPICOR P21 OVERVIEW

Epicor P21® has a variety of tools and processes that can supplement an effective replenishment system. Before considering such tools, it is important to have a working understanding of the system's sales order management, so that the impacts of scheduled orders and backorders can be considered in terms of creating visibility in Purchasing.

Sales Order Management

In P21, order status can be managed and manipulated in order entry at the line item level. Sales Order line item status includes regular ("blank" disposition); special (S); and backorder (B). The Sales Order line item disposition affects visibility in Purchasing. Unfortunately, ship date and allocation of a line item are decoupled, and thus must be managed independently. Furthermore, because there is no packing basis at the line level, allocation and ship dates must be managed exclusively in Sales Order Entry, as opposed to having such opportunities in Warehouse operations.

Linking is a technique to ensure that specific stock is allotted from specific purchase orders to specific sales orders. Such actions are used to facilitate cross-dock orders (where the inventory is not binned, but rather is routed from Receiving to Shipping directly, at receipt); and for stock protection, to prevent a sales order that is deemed to have a lower priority to be picked, thus denying the filling of a linked order. Linked sales orders always have first and highest priority for allocation.

In P21, the oldest required date backorders are always allocated first (after linked items). Furthermore, because allocation and ship date are independent, for scheduled release orders, such orders must be linked to specific purchase orders to ensure priority on arrival over other backorders. Keep in mind that there are two kinds of scheduled release orders – orders in which a customer approves a sales order with release dates that the customer specifies ("*Ship me a 1,000 per month for 12 months.*"), and orders that Sales schedules based on completed production or receipt of a PO (*Shop completes order in one week. Sales order is scheduled to ship on the scheduled available for sale date)*. The customer wants the parts as soon as possible.

While this might be confusing, here are some complications and implications:

A. **Unfilled Sales Orders**. If a customer is waiting for a backorder, and the backordered item is available for sale earlier than anticipated, the order will sit until it is dated to ship, because allocation and dating are decoupled. To remedy this, a fill report is run daily as an extra routine to "see" waiting sales orders.
B. **Unnecessary Back Orders**. The alternative is to link a PO to a sales order release. The problem here is that once linked, the items are not available for sale, even if a different customer wants parts sooner. Assume that you have a scheduled set of shipments from a supplier. Parts of the releases are linked to sales order scheduled releases. In a given month demand spikes and you move to a negative on hand (but positive Net Stock, due to future PO releases). Back orders might accumulate in the system, even though you have stock, because the stock is allocated to scheduled releases on the sell side, even though such releases are not due until sometime in the future.

Both of these scenarios can adversely impact customer service, and yet fixing one will impair the other. What is important for Purchasing to know is the importance of understanding sales order management and understanding how sales orders hit the system. One final and very important note – **scheduled orders in P21 are not accounted for in usage, within the EOQ formula.** (However, they are considered when P21 uses EOQ, OP, and Net Stock to determine the recommended quantity to purchase). G.L. Huyett has developed a SQL script that will add scheduled usage to a previously P21 calculated filtered usage. Running "demand year maintenance" on this updated filter usage will raise the forecast for the next period using P21 calculations.

The month end process involves running "demand year maintenance" for the current period, the G.L. Huyett script for the current period and a second pass of "demand year maintenance".

Only items that had any scheduled usage in the current period will potentially see any effect from this procedure. Only items that use a dynamic replenishment method (EOQ or Up To), will see any actual change to their PORG calculations. The procedure is run on all items to keep the P21 data consistent.

The data since 1/1/2010 was updated on 8/16/10 by J. Bond. This process will be followed for the current and future period during end of month processing starting at the end of August 2010.

PORG

The term "PORG" stands for "**Purchase Order Requirements Generation**". PORG is the recognition step to replenishment in the software. This step involves reviewing a supplier, or array of suppliers, according to a **Purchase Criteria**.

PO Requirements/Generation

Backorder | Supplier Summary | Direct Ships | Special | Lot Billing | Price | Timestamp

Criteria | Factor | Purchase Group Location | Item | Supplier | Calculation | Item Note | PO Line Note | Document Links | Order Note | Order Line

Purchasing Criteria ID: 310 Supplier

Company ID: GLH G.L. Huyett

Buyer ID: 1020 Nordyke, Lori

Purchase By: Location ID / Purchase Group ID

Purchase Group Options: Location Based / Individual Locations / Regional Distribution Center

Location ID: 100001 G.L. Huyett

Purchase Group ID:

Supplier ID: 101014 To: 101014

ABC Class ID: To:

Product Group ID: To:

Look Ahead Days: 90

Replenishment Method: All

Item ID:

Item Description:

Requirement Types: Direct Ships; Stock including Backorders; Backorders Only; Non-Stocks; Specials; Requisition

Delete; Summary Only (For RDC); Include unapproved POs; Approved; Show all items; Include Production Orders

Generate Requirement | Print Requirement

As one can observe, the Purchase Criteria can be established by unique sets and combinations of Buyer ID; Locations; Purchase Groups; Suppliers; ABC Classes; and Product Groups. The Purchase Criteria can be qualified to look at future sales orders (Look Ahead Days); common Replenishment Methods; Sales Order types; or Purchase Order types. Quite important is the fact that you can look at only those items recommended for purchase, or you can "Show All Items". Think of Purchase Criteria as a "canned" set of review parameters that group together common buy strategies to the listed suppliers.

There are some system limitations in PORG that will affect the development of a replenishment system. Among them:

1. **Only one ABC Class Code is permitted per item**. There are often competing interests in segregating SKUs by various selection criteria (class codes). The technical definition and intent of an ABC code is to control inventory replenishment review and cycle counting. But there are other interests. For example, suppose you have a group of suppliers clustered in and around Ningbo in China. Suppose you wish to review such items collectively for purposes of assembling a full container. An inventory class code would be a good method in

which to perform this function, in addition to using a different set of codes to manage cycle counting. If you could review items by class codes with various interests, it would allow for more refined inventory analysis. Thus ABC Class Codes must be appointed with a "highest and best use" orientation.

2. **PORG looks only at the supplier(s) specifically identified, and only to the Purchase Criteria queried.** Suppliers can be entered in a numerical sequence range, or via a list. Because Supplier ID is system-generated and random, it CANNOT be assumed that consecutive Supplier ID numbers have similar consideration in PORG. In 12.0, you can select specific lists of suppliers. In the older 11.5 version, G.L. Huyett used ABC Class Codes to cluster together combinations of suppliers that have similar buying strategies. The Manufacturing division is listed under many different "suppliers" in the system, based on manufacturing process, so that similar jobs can be clustered to enrich plant efficiency. The use of an ABC Class Code, as opposed to listing nonconsecutive suppliers in a Purchase Criteria, allows similar suppliers to be scheduled together in replenishment so that procurement can be aligned with production strategy. Because the "suppliers" assigned to the Manufacturing division are numerically nonconsecutive, the use of a clustering class code allows the buyer to view as one PORG routine, versus running each supplier individually.
3. **PORG IS AN ACTION AND NOT A REACTION.** This system is not going to tell you what you need to buy. You need to query the system in a manner that logically delivers a list of items that MIGHT be needed to be purchased. It is very important for the analyst to know what they are asking the system to look at, and better, what you are NOT looking at. The use of Class Codes and Purchase Criteria in PORG are the "filters" through which a buyer views inventory requirements in PORG.
4. **Look Ahead Days only looks at future sales orders, not future usage**. Look Ahead Days *could* be a great tool in the Configuration step of replenishment if it looked at forecasted usage. For example, you could progressively extend Look Ahead Days to add to an order to make a full container. But as configured, the system's definition of Look Ahead Days only contemplates future sales orders.
5. **PORG is a human generated activity and not a system generated activity**. Thus you only are going to review inventory items as often as you decide. This puts fill rate and service level at risk from absenteeism, timely review, procedural control, and follow through. To remedy this, G.L. Huyett runs a simple PORG review of all 95,000 SKUs every week. Through continued refinement of replenishment schemes, the amount of Evaluation and Configuration time is decreasing, so that only those items that need to be bought appear in PORG.

Recognition

PORG is the tool that creates recognition and visibility in the system as to what MIGHT need to be ordered. If you check "Show All Items", all items for the supplier range will appear, regardless of whether replenishment is needed or not. In most cases, you want to only look at the items that are below reorder point (OP).

Such items are designated on the “Item” screen in PORG in one of three ways:

- A quantity is noted in “Recommended Quantity to Order” with no further designation. These items simply have drawn down below OP and are in need of consideration.
- A blue “S” is noted at the far left. System documentation refers to these items as “Critical Shortage”. In this definition, the Net Stock measured in days on hand is sufficiently less than Lead Time such that there is risk of a stockout prior to replenishment being completed.
- A red “C” is noted as “Customer Requirement”. This notation is driven either because Net Stock is less than zero (you have a negative inventory level on the item), or the item has stock that has not been allocated to an approved and open sales order.

Generally, the items are more critical since “C” items are impairing service level as the report is written. For items, an aggressive procurement of parts can limit and in many cases avoid a stockout problem. Please note that if you use Look Ahead Days longer than 1 day, any future booked sales orders can make items look more urgent than they are. Sometimes if there is a large presence of future orders with releases, the analyst may want to rerun PORG using lower Look Ahead days.

In general, the following guidelines are recommended with respect to Look Ahead Days:

1. For domestic and manufactured goods, use a Look Ahead Days of 90 days.
2. For imported goods, use Look Ahead Days of 180 days.

These values will allow Purchasing to “see” future sales orders that may need inventory coverage, or which can supplement the development of economic lot sizes in Purchase Order configuration.

When PORG is run, it will deliver a report in this format:

PO Requirements/Generation

C S	Supplier ID	Purchase Item	Item ID	Replenishment Method	Net Stock	Open RFQ	Period Usage	RFQ	PORG Quantity	Extended Cost	Source Reference	PO Quantity	Item Description
	101014	☐	C-018	EOQ	543	☐	346	☐	4,152	.00	25000 Box RC-ftp File Eff 2/1/2010	0	Crescent Ring 3/16 Inch
S	101014	☐	DHO-135	Min/Max	-5	☐	3	☐	5	.00	25 Box RC-ftp File Eff 2/1/2010	0	Int Housing Ring 135mm DIN472
	101014	☐	DSH-080	EOQ	53	☑	46	☐	353	.00	250 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 80mm DIN471
C	101014	☐	HO-056-ZD	Min/Max	-71	☐	3	☐	71	.00	1000 MOQ RC-ftp File Eff 2/1/2010	0	Int Housing Ring 9/16 Inch Z/Y
S	101014	☐	HO-175	EOQ	10,764	☐	4,761	☐	6,361	.00	1000 Box RC-ftp File Eff 2/1/2010	0	Int Housing Ring 1-3/4 Inch
	101014	☐	HO-525	EOQ	12	☑	9	☐	46	.00	1MOQ\25BOX RC-ftp File Eff 2/1/	0	Int Housing Ring 5-1/4 Inch
S	101014	☐	SE-074	EOQ	1,740	☐	5,838	☐	14,436	.00	5000 Box RC-ftp File Eff 2/1/2010	0	Spec E-Clip 3/4 Inch
	101014	☐	SH-037	EOQ	17,561	☐	11,656	☐	26,026	.00	25000 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 3/8 Inch
	101014	☐	SH-059	EOQ	750	☐	770	☐	5,646	.00	15000 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 19/32 Inch
	101014	☐	SH-112	EOQ	3,250	☐	2,889	☐	7,281	.00	5000 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 1-1/8 Inch
	101014	☐	SH-225	EOQ	10,146	☐	5,841	☐	4,997	.00	500 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 2-1/4 Inch
	101014	☐	SH-237	EOQ	319	☐	301	☐	1,097	.00	500 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 2-3/8 Inch
	101014	☐	SH-275-ZD	EOQ	298	☐	201	☐	599	.00	500 Box RC-ftp File Eff 2/1/2010	0	Ext Snap Ring 2-3/4 Inch Z/Y
	101014	☐	SHR-062	EOQ	1,221	☐	2,104	☐	7,375	.00	5000 Box RC-ftp File Eff 2/1/2010	0	Ext HD Snap 5/8 Inch
	101014	☐	SHR-075	EOQ	2,735	☐	2,933	☐	7,463	.00	5000 Box RC-ftp File Eff 2/1/2010	0	Ext HD Snap 3/4 Inch
	101014	☐	SHR-150-ZD	EOQ	650	☐	500	☐	1,134	.00	1000 Box RC-ftp File Eff 2/1/2010	0	Ext HD Snap 1-1/2 Inch Z/Y
C	101014	☐	TR-025	Min/Max	-25,000	☑		☐	25,000	.00	NonStocking Call for Quote Eff 12-	0	Triangle Push-On 1/4 Inch
										.00			

Please note that this report was run where “Show All Items” was NOT checked, and therefore the above list are those items where Net Stock is less than OP. Note the “Recommended Quantity to Order” column, and the urgency disposition at the left.

Evaluation

The system provides tools to evaluate the purchase recommendations. Such tools are found in the tabs at the top of the screen, and by looking at data within a line item. The above screen shot is only part of the total available columnar data. In addition, a shortcut to IMI (Item Master Inquiry), where one can quickly drill down into the system to look at an SKU, can be made by clicking F2. Some of the more important tool tabs are:

- **Item History**, where you can see recent usage data on the item, by period.
- **Calculation**, where the Purchase Stock Card summarizes Order Point (OP).

By using these tools, the evaluation process can usually be quickly and efficiently executed. If the Purchasing team is diligent in managing OP, then processing time in Recognition and Evaluation should be minimized, and the team should be buying a high percentage of recognized items with minimal time invested in evaluation. If certain items are repetitively recognized but not purchased, the OP and the Replenishment Method should be reevaluated.

Another opportunity to improve replenishment efficiency is to automate Standard Cost. Many organizations will RFQ nearly every item to be purchased. Such activity is either driven to lower invoice cost or to establish lead time.

Mindful that the system is maintaining Lead Time at the item level for items frequently purchased, the system has inherently calculated an item lead time. Thus rather than sending an RFQ, send a PO to the supplier and note only the exceptions. RFQ action to lower invoice cost needs to consider the cost of the RFQ process. The establishment of contract costing with a supplier can make the replenishment process far more efficient.

To create visibility for the Purchasing team for the development and management of Standard Cost, the **Source Reference Field** (DynaChange from the Supplier Contract Number field) in the Cost tab of IMI (Item Master inquiry) is used:

Item ID: HOI-100 | Int Inverted 1 Inch
Location ID: 100001 | G.L. Huyett | ☑ Stockable
Start Date: 01/19/02

Moving Average Cost: .039120 | Avg Lot Cost: .039120
Primary Supplier Laid In Cost: .039903

Primary Supplier Cost Information:
Supplier: 101014 | Rotor Clip Co, Inc
Supplier Laid In Cost: .039903 | Supplier Standard Cost: .039120
Cost Source Reference: 5000 Box RC-ftp File Eff 2/1/2010

In the example above, a duly noted contract number and effective date are noted. If Purchasing encounters resistance from the supplier while buying, there is a quick and easy reference.

At G.L. Huyett, we also use the Source Reference field, coupled with a Non-Mandatory Item Note, to tender sourcing guidance for standard items that might not be sourced or have obsolete costs. For such items, the words “NOT SOURCED” will appear as Primary Supplier. The Source Reference Field will either contain recommended suppliers or will make reference to a Source Note that is sitting in the Non-Mandatory Note. To reference such note, simply click on the “Item Note” tab at the top of an Inventory Inquiry.

You may wonder why Not Sourced items would even be populated in the system. Such parts are usually thinly traded or are difficult to procure parts that round out a product line. Often we have a good idea of how to source such items, but such supplier and cost information is only current for a brief time. Thus given the choice of not offering ANY information for the item, or offering sourcing information, the latter pathway has been chosen and is the method of execution for such items.

Buying

As items are identified, the agent must determine purchase quantity. Purchase quantity is affected by one or more of the following:

- OQ calculations from replenishment.
- Box or lot sizes from the supplier.
- Order or line minimums from the supplier.
- Quantity discounts or freight incentives from the supplier.

Not all of these variables are manageable in the system. To make them more manageable, it is important to segregate quantity considerations at the item level from quantity considerations at the order level. At this point we are considering setting buying variables at the item level.

The system has several limitations that inhibit automated buying. First and foremost is the maintenance required to manage Cost Pages. On the sell side, P21 has great tools and ease of use in managing customer-specific or market-segmented pricing pages. On the buy side we are not so fortunate. While there is a data import feature, Cost Pages consume more resources to implement and manage in P21, and thus must be used with some discretion.

A Cost Page provides visibility to Purchasing for volume buying, and will provide automatic cost changes at Purchase Order Entry if an agent enters a quantity that qualifies for a lower cost. Cost Pages can also be used to manage order minimums, where such minimums are different than box quantities.

The most important tool available to manage box or lot quantity sizes is **Conversion**. When established in Item Maintenance, conversion will stimulate purchases (or on the sell side, sales) in even unit increments. Thus if a box size is 100, and conversion is established on the item, the system will require the buyer to purchase in increments of 100, **independent of OQ**.

Conversion not only eliminates a buyer's time invested in reconciling OQ with a supplier's box size, but it can also automate and streamline warehouse operations by stimulating supplier-compliant packaging even when a supplier has no standard pack size (common for offshore suppliers). Thus Conversion is an integral and important part of an effective replenishment scheme. To illustrate, here is PORG for a supplier for which there is no Conversion:

PO Requirements/Generation

C S	Supplier ID	Item ID	Purchase Item	Net Stock	Replenishment Method	Open RFQ	RFQ	Period Usage	PORG Quantity	PO Quantity	Extended Cost	Source Reference	Unit Cost	Item Description
C	101014	DE-080	☑	-192	Min/Max	☑	☐	19	192	192	2.19	1000 MOQ RC-ftp File Eff 2/1/2010	.011400	E-Clip 8mm DIN6799
	101014	DHO-040	☑	472	EOQ	☑	☐	201	1,464	1,464	108.04	1000 Box RC-ftp File Eff 2/1/2010	.073800	Int Housing Ring 40mm DIN
S	101014	DHO-135	☑	-5	Min/Max	☐	☐	3	5	5	4.45	25 Box RC-ftp File Eff 2/1/2010	.890000	Int Housing Ring 135mm DIN
	101014	E-062	☑	7,178	EOQ	☐	☐	11,488	21,085	20,000	414.80	5000 Box RC-ftp File Eff 2/1/2010	.020740	E-Clip 5/8 Inch
S	101014	HO-175	☑	11,072	EOQ	☐	☐	4,761	6,361	6,361	598.95	1000 Box RC-ftp File Eff 2/1/2010	.094160	Int Housing Ring 1-3/4 Inch

Notice the nonstandard quantities in the "PO Quantity" column, among those items checked to buy in the "Purchase Item" column. When the buyer moves to convert this to a purchase order, extra time will be invested in configuring the order to match the supplier's box quantities or production minimums.

Here is another supplier in which Conversion has been completed. The values in the "PO Quantity" column were tabulated automatically with no buyer effort. You will note that they are even numbers and that they deviate from the "PORG Quantity":

PO Requirements/Generation

C S	Supplier ID	Item ID	Purchase Item	Net Stock	Replenishment Method	Open RFQ	RFQ	Period Usage	PORG Quantity	PO Quantity	Extended Cost	Source Reference	Unit Cost	Item Description
	100915	BP-2105	☑	27,207	EOQ	☐	☐	17,775	27,879	28,000	554.40	25000pc Min RFQ 1032334 Eff 3-2	.019800	Bridge Pin .0915 x 1-7/8 Zin
	100915	BP-2109	☑	2,069	EOQ	☑	☐	868	2,019	2,000	.00	25000pc Min RFQ 1032335 Eff 3-2	.000001	Bridge Pin .2430 x 5 Zinc
S	100922	H2103	☑	49,074	EOQ	☐	☐	6,765	10,213	10,000	528.00	180000MOQ Incr eff 04-22-08 per	.052800	Fitting M8 x 1.0 Straight
	100922	H2111	☑	20,459	EOQ	☐	☐	2,697	4,404	4,000	449.60	91000MOQ Incr eff 04-22-08 per T	.112400	Fitting M10 x 1.0 90 DEG
S	100922	H328224	☑	27,939	EOQ	☐	☐	4,810	8,683	10,000	532.00	50000MOQ Incr eff 04-22-08 per T	.053200	Fitting 1/4-28 Plug Slot Hexh

There are limitations to the use of conversion. Among them:

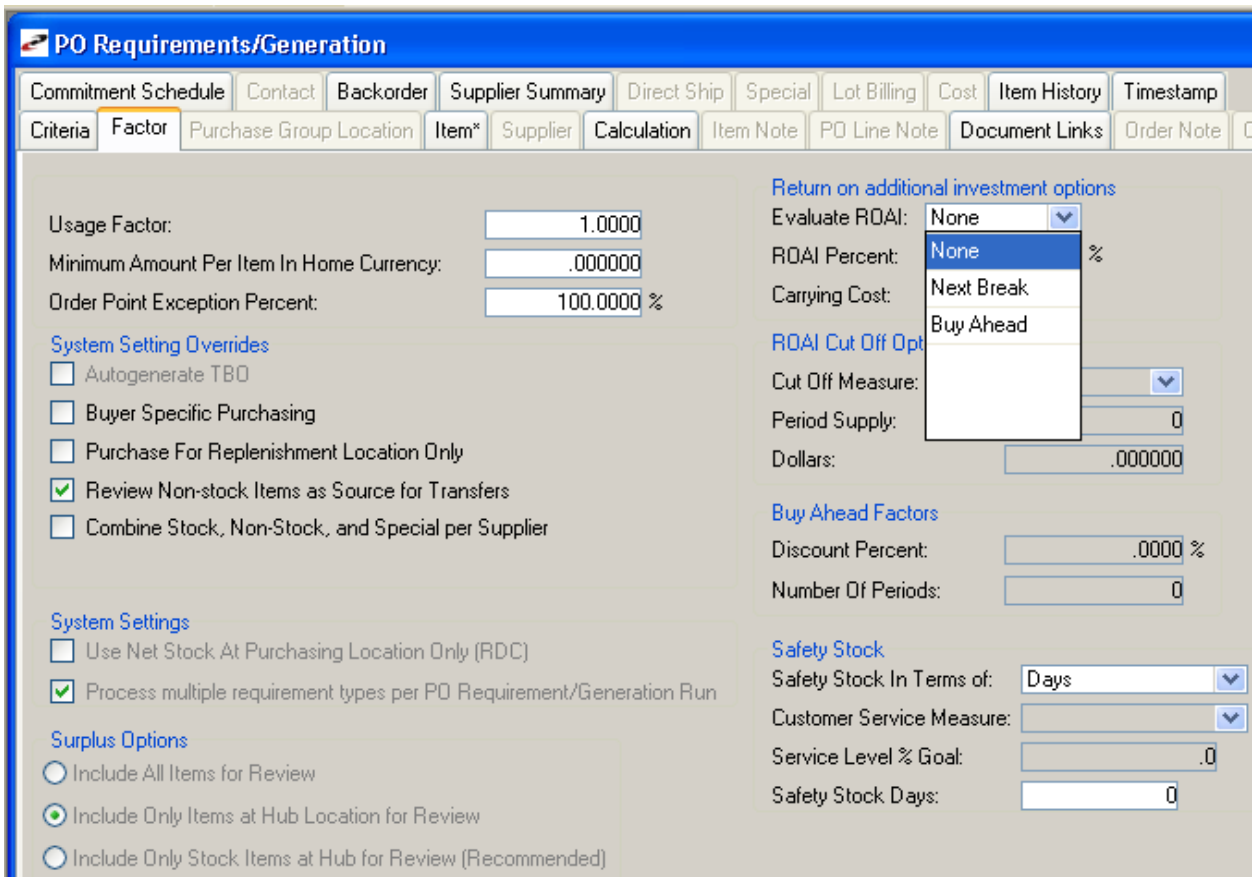
A. **Conversion cannot be overridden**. The buyer MUST buy in conversion increments. G.L. Huyett has purchased a system modification that allows overriding in both Sales and Purchasing. Such overrides will only be allowed by permission; and will be tracked to the user level. At purchase or sales order entry, the system will have a pop-up box that notates if a user is overriding the conversion value.
B. **Conversion does not account for minimum order or line requirements**. If a supplier has a minimum of 1,000 and a box quantity of 250, the minimum needs to be visible elsewhere. We will use Cost Pages to provide such function.

Once Conversion is established at the item level, a decision needs to be made on whether to print Conversion on purchase orders. If the Conversion is indeed equal to or compatible with a supplier standard pack quantity, Conversion SHOULD be printed. If the Conversion is not equal to a standard pack, and the value is established to facilitate buyer quantity decisions and avoid manual rounding at purchase order entry, the Conversion should generally NOT be printed. Such printing could send an undesirable message to the supplier. Some suppliers might actually seek to assess charges for packing nonstandard quantities according to the Conversion values set.

Hoarding

From time to time vendors will implement price increases (known internally as “cost increases”). Often such increases are provided with advanced warning, and the supplier will allow accelerated buying in advance of the cost increase. Depending on the percentage of cost increase as compared to Carrying Cost, which is a function of both item sales (“velocity”) and the cost of money (30% annualized in our operation), it may be advisable and profitable to buy more than needed so as to take advantage of lower costs, against higher prices and future demand. The system provides a tool to make informed and economic purchases (called “hoarding” in economics).

Known as Return on Added Investment (ROAI), this feature is located in the Factor tab of PORG:

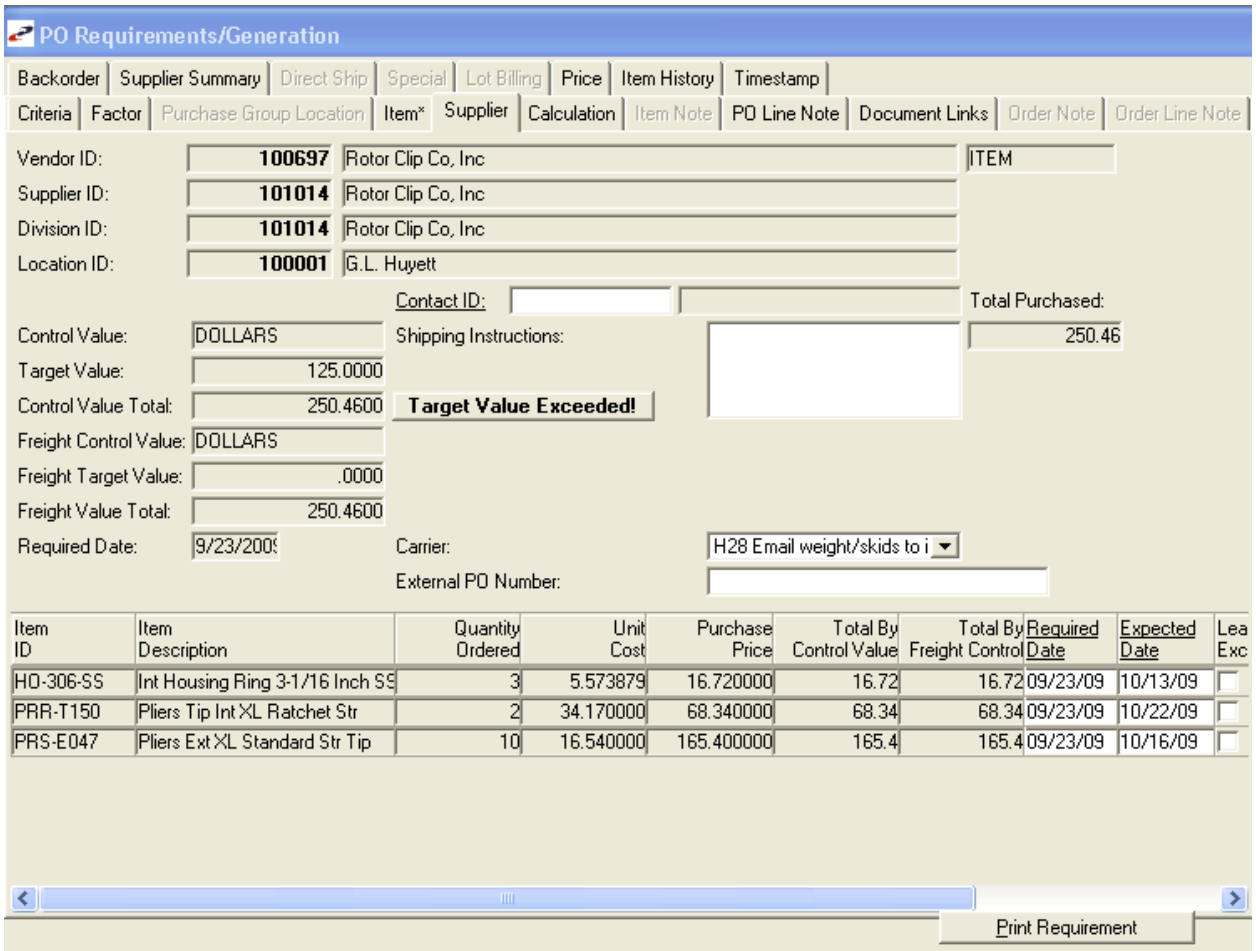


Notice in the drop down box at the right, that such tool can be used to evaluate a cost increase, or a next break, if one exists on a Cost Page (think of it as a volume discount). The Factor is set at each PORG session and will adjust Recommended Quantity to Purchase if the benefits of hoarding in accelerating new inventory exceed Carrying Costs.

Once a Factor set is established, it will default for that Purchase Criteria and thus it is best to establish hoarding parameters using new and dedicated Purchase Criteria, as opposed to revising an existing criteria.

Configuration

Now that items and quantities have been selected from PORG for a supplier, the next action is to configure a purchase order to the supplier. This action is automated through the use of a Purchase Target Value. Purchase Target Value is set at the order level and may be expressed in either weight or value. The value may be monitored by the buyer during PORG by clicking on the “Supplier” tab as items are purchased. Here is an example:



In this example, the supplier has a $125.00 order minimum. The system is alerting the buyer that the target value has been exceeded (Target Value Exceeded). The buyer may want to reduce order size and "save" order capacity for the next buy, PROVIDED THAT such buy does not imperil service level. If a buyer is short of target value, then the buyer can progressively add items to realize target value. *Note – the buyer will receive a pop-up warning if they do not exceed the target value. They must acknowledge the pop-up before proceeding.*

The buyer must be careful to realize that Look Ahead Days are not of any significant analytical value in configuring a purchase order that is below Target Value, UNLESS the system has future open sales orders. **Look Ahead Days looks at future sales orders and not future forecasted usage.**

Order Execution

Once an order is configured it is ready for execution. If Standard Cost is properly populated, negotiated, and executed, cost should populate into the PO without having to perform an RFQ. The PO Form sets forth standard terms and conditions, and the use of special notes should be minimized:

Home of "The Pack List that Will Change Your Life"™

PURCHASE ORDER

G.L.HUYETT

P.O. Box 232
Exit 49, GL Huyett Expressway
Minneapolis, KS 67467
Phone: 785.392.1080
Fax: 785-392-9021
E-mail: davidc@huyett.com
Web: http://www.huyett.com

PURCHASE ORDER NUMBER:	1034645
Date & Time:	05/13/09 09:03AM
RFQ Reference:	40987hd34
Supplier #:	4759334

ORDERED FROM	ORDERED BY	SHIP TO
Dichtomatik Americas 14445 Heathrow Forest Parkway Houston, TX 77032 UNITED STATES	Buyer: David Chavarria Phone: 785-392-1000 Fax: 785-392-9021 E-mail: davidc@huyett.com	G.L. Huyett Exit 49, G.L. Huyett Expressway PO Box 232 Minneapolis, KS 67467 UNITED STATES 785-392-1000
Terms: 1% 10, Net 30	Supplier Representative:	FOB: Minneapolis, Kansas
OUR CUSTOMER # 8675309	Jonathan Romangroogle Phone: 800-527-3151 Fax: 800-682-9103 E-mail: jromangroogle@dichtomatik.com	SHIPPING METHOD UPS Freight

REQUIRED CONDITIONS

1. This order shall conform to the G.L. Hiryett Terms of Purchase, a copy of which is attached to and incorporated herein.
2. Huyett Purchase Order Number; Item ID; Weight; Lot Number; Country of Origin; and Quantity shall appear on each container and Pack List.
3. Huyett Item ID; PO Number; Lot Number; and Quantity shall be bar coded on each container.
4. Supplier shall provide a Certificate of Compliance to all specifications for each item with each purchase order release at no extra cost. Such certificates may be embedded into Supplier's Pack List with each shipment release.
5. Parts must be packed suitable for the shipping method, in accordance with the policies and packaging standards set forth by the freight carrier(s), customs enforcement, inspection, and insurance carrier(s).
6. Consolidate lots so that as few lots ship as possible for each line item of product.
7. Identify boxes with mixed parts in them, and prominently identify which box has the Pack List inside.

RECOMMENDED BEST PRACTICES

8. Supplier shall ship multiple boxes of one item in constant quantity increments (i.e. 100 per box).
9. Identify parts and parcels with the line number on the Pack List and the corresponding line item on our Purchase Order.
10. Use desiccant bags and sealed containers with inner bag liners for plain finished parts.
11. Barcode the Pack List with Hiryett Item ID; PO Number; Lot Number; and Quantity for each line item shipped.

REQUIRED DATE:	05/13/09	THIS IS THE DATE WE EXPECT PARTS ON OUR DOCK. PLEASE SHIP ON A DATE TO INSURE TIMELY ARRIVAL.

Unless specified otherwise, the Required Date is based on your quoted production lead time, a standard transit time, and on your shipping the order pursuant to pre-established order consolidation dates. On time shipping is a serious matter and should be executed accordingly. Please note that a Required Date is listed at the line item level for each item in the order. Please ship items possessing the same Required Date together in the same shipment. Do not ship early unless agreed to in advance.

CONSOLIDATION DATE:	05/24/09	If a consolidation date is listed, this order must ship with all other orders in a complete manner on the consolidation date. Please note that the consolidation date is a ship date, not a required date. Consolidation date is the date we expect parts to leave your dock.

FOR OCEAN BOUND & INTERNATIONAL SHIPMENTS

HUYETT CUSTOMS BROKER	INTERNATIONAL SHIPPING PROCEDURES
Custom Shipping Company Inc. c/o Gary Smithsonian Phone: 800-381-3811 Fax: 800-381-3811 E-mail: gsmith@csc.com	A. All parts must be packed in plastic or oiled paper and properly prepared for sea transport to prevent possible damage or deterioration. B. All packages must be shipped in export-worthy, double-walled plain cartons, with banding as needed. C. Enclose a Commercial Invoice and Pack List with HTS numbers as noted herein for each item. D. Complete a Shipper's Export Declaration and Insurance Policy for each release.
Submit Importer's Statement if fumigation required.	

All documents must be in English, or have an English translation provided. Please fax all documents or send a scanned version via email as soon as available. Send original documents, via courier, to Huyett, and copies each to the Freight Forwarder, if one is listed in the "Ship To" box above, and one copy to the Huyett Customs Broker.

In addition to the Purchase Order form, the following other system-managed tools are available to assist in order execution and management:

A. **Document Links**. Allows the submission of a print and specifications at the item level with the PO (under development).
B. **Vessel Tracking**. Provides visibility to all departments as to the progress of an imported or domestically consolidated release to our dock.

Here is Vessel Detail, from IMI, to illustrate the value of Vessel tracking in order execution:

Item Master Inquiry: LP-187-1250 (100001) (New)

Criteria | Inventory | Transfer | Substitute | Process | Cost | Open Order | Open PO | Replenishment | Usage | Purchase Stock Card | Part Number | Contract | Lot Bill | Sales History | Open Quote | Open RGA | Prod Order | Open RFQ | Commitment Schedule
Bin | Tag Detail | Purchase History | Lot | WBW Lot | Vessel Detail | Item Notes | Open Inventory Return | Document Links

Item ID: LP-187-1250 Lynch Pin 3/16 x 1-1/4 Zinc Ye
Location ID: 100001 G.L. Huyett ☑ Stockable

PO Number	Vessel Receipt Number	Vessel Name	Container Number	Quantity In Container	UOM	Unit Size	Port of Loading	Country	Departure Date	Port of Discharge	Country	Est Date of Arrival	Est Date Avail for Ship	Container Date Expected
1035784	10349	1035784 ANG	1035784 ANG	100,500	EA	1.0000	NHAVA SHEVA	INDIA	09/05/09	NEW YORK	USA	09/28/09	10/19/09	10/12/09

Order Management

The most important post PO action that occurs in replenishment is date management. Among the primary purposes of enterprise software is to create common visibility of business processes to all functional areas. Order dating is of critical importance so that Sales can accurately quote customers new business, and Warehouse operations can plan for delivery, inspection, and putaway using efficient planning techniques.

The following are date definitions for use in the system:

- **Required Date**: The date that parts are required on our dock. This date includes manufacturing time and transportation time.
- **Expected Date** is the first date parts can ship from our dock. Expected Date is the sum of days in Required Date, plus inspection, outside process, packaging, and putaway time at our facility.
- **Consolidation Date**. This is a date that parts are supposed to leave our supplier's facility. With many of our suppliers, we consolidate orders into "sailing days" for purposes of reducing freight costs and processing costs.

Important: If you realize a "special" lead time from a supplier (use of air or express transport), be sure to check the "Exclude from Lead Time" box in PO Entry. Such action will ensure that integrity of realistic lead times is maintained in the system for future replenishment.

It is important for the Purchasing team to understand the relationships and usage of the above dates by our suppliers, the Sales team, and Warehouse operations. It is important that suppliers understand what the ship date expectation is, as it relates to Required Date. While thoroughly spelled out on the Purchase Order form, it is important that the customer service functions of our suppliers understand dating and on-time expectation as part of a comprehensive supplier orientation process.

It has been observed among our developing-world suppliers, that order management appears to be a challenge. Not very many Pacific Rim suppliers appear to have enterprise software systems that link order management to the factory floor. The result is that there are often delays at packing as the supplier has to pause, account for, and quickly make a handful of items to finish a dispatch. It is important that the Purchasing team applies constant gentle pressure and provides on-order visibility to these suppliers so that packing and dispatch time can be compressed.

In addition, it is critical that Purchasing continue to work to compress transportation time so as to minimize structural inventory resulting from parts in transit. The Expected Date is a critical date for use in Sales and must be accurate. At the same time, Purchasing must manage transportation costs. The company goal for freight in costs, including soft costs is 2% of Sales. This is a low number by industry comparison, but reflects efforts to consolidate shipments, use of creative backhaul tactics, and an FCL orientation in overseas transit.

When dates are changed, all dates must be changed so that the enterprise software is properly visible in Sales for planning and customer alert. Phone calls between Sales and Purchasing are generally wasteful efforts that result in extra processing time from distraction and repetitive action.

There are two reports available to the Purchasing team to assist in order management. **The Late Item Purchased Parts** (**LIPPS**) Report is a report that is run by purchase order and by supplier. The report will list open sales orders for a given line item if the item is stockout. The purpose of the report is to create visibility between Purchasing and the Supplier, and between Purchasing and Sales, when an item is past due or is needed sooner. Here are some general guidelines for using the LIPPS Report:

1. Run the report when a date is changed on a PO, or when Sales informs the need to gain parts more quickly than what is listed in the system. Run the report by supplier.
2. Hide the Open Sales Orders in the report and use the edited report to facilitate economic partial orders or expedited service from the supplier. Note that there are extended weights at the line level to aid in expedited freight cost calculations.
3. Send the report to Sales with the open sales orders noted, so as to coordinate priorities, costs, and planning with the Sales team that optimize service and minimize costs.

The **Open Purchase Order Report** is an additional tool for use in managing open orders. If the Purchasing team does a timely and effective job of order management, the contents of such report should be minimal.

When expediting parts, the orientation should focus on behavior modification, as opposed to computer status checking. If a customer or a Sales team member calls about a part, the caller is not interested in what it says in the computer. They want a better date. And thus the orientation of Purchasing must be to deploy a results-oriented sense of urgency to move up production, to modify behavior at a supplier, or to seek out alternatives. Time invested in date management is best served when oriented to exceptions and improvements, as opposed to reading information. Thus date management in the enterprise software is critical.

Currency Conversion
Some suppliers trade (sell) in local currencies only. With the increasing weakness of the dollar and reduction of its relevance in world trade, the practice of buying in non-dollar denominated currencies will likely increase in the coming years. Regretfully, at this time, there is no sound means to make currency conversions in P21. The system is awkward and requires much training and maintenance to be used properly. Changing currency exchange rates will also challenge the accounting department.

The current practice is to enter and send the PO to the supplier in the supplier's currency. The PO is then recalculated in dollars based on the exchange rate on the date sent. The PO rests in the system in dollars. At receipt, the PO is received and Accounts Payable reconciles the PO to the supplier invoice based on the exchange rate at invoice, and such difference is booked to an exchange rate differential account in the General Ledger.

Opportunity for error, extra processing time, and the non-automatic nature of this process makes the matter a high priority for future enterprise development. Amending such purchase orders is an even greater nightmare. Currency conversion should be a high priority for Purchasing moving forward and this document should be amended as developments occur. The Company has a system modification proposal from P21 software engineers dated March 2009, but it was postponed due to other corporate priorities.

Demand Forecasting
P21 has demand forecasting capabilities to facilitate the system's ability to forecast accurately by providing a "curve fit" to actual usage. The system actually tracks its own ability to forecast using a MAPE% (Mean Absolute Percentage Error), which is part of the calculus to determine Service Level Percentage Goals.

There are other features in P21 that enrich replenishment. Advanced demand forecasting is available but outside the scope of work at this time.

DynaChange and Color Coding
While this paper focuses on replenishment system design, it should be mentioned that there are at least two other substantive tools that can facilitate buyer recognition and ease of use of the P21 platform by users, both of which affect the appearance and presentation of data.

-**DynaChange** is the ability to affect screen appearance changes to a user level. Certain tabs can be added or deleted, tab sequence and order can be altered, and certain tabs and fields can be renamed to make more consistent with organizational legacy practice.
-**Color Coding** is part of DynaChange and can be used both at the tab and field level. Certain data can be color-coded (red for a Required Field; green for financial, etc.). Color coding cannot be set up using conditional statements – i.e. the value in the field stipulates the color. Like DynaChange, color coding can be assigned down to the unique user level.

Use of these tools at the user level is not recommended. For organizational consistency, ease in training, and for consistent recognition among different users, it is recommended that such tools are "canned" to a User Role (Buyer, Planner, Expeditor, Sales Representative). The User Roles should be documented and trained to ensure consistency of execution and interpretation.

Summary of Best Practices and Opportunities

Using the P21 platform, here is a summary of execution of replenishment using the tools available:

A. Date Management

a. Dates must be visible and accurate in the enterprise software to all stakeholders.
b. Exclude from Lead Time any nonstandard receipts so that system-calculated Lead Time represents a normal and ordinary condition.
c. Use Vessel Tracking to enhance date visibility and to ease the management of container shipping.
d. Train suppliers and stakeholders on date definitions and comprehension.

B. Sales Order Management

a. Manage early receipts using a Daily Fill Report so as to optimize customer service.
b. Avoid backorders of allocated stock by looking at hard allocated stock when new demand arises.
c. Apply accountability to the Sales team for reliable and timely demand forecasting and sales order date management.

C. Purchase Order Requirements Generation (PORG)

a. Realize it is a recognition tool and not an autopilot.
b. Run a companywide "Show All Items Daily" to identify stockouts and urgent needs. PORG any suppliers that have "C" or "S" urgent items so as to replenish to Purchase Target Values. Ignore all others.
c. Use 90 days Look Ahead for domestic and 180 days for import.
d. Know that Look Ahead recognizes orders and not forecasted usage.
e. Manage the noise, i.e. revise OP or Replenishment Method for recognized items that are not bought, so that you buy nearly all items that are recognized.

D. **ABC Class Codes**

a. Assign codes using Inventory Ranking.
b. Use cost-based or usage-based ranking in Purchasing; and hits-based ranking in Receiving and Inventory Control.
c. See the chart in Chapter 8 for more detail on ABC class set up.

E. Buying

a. Generally buy all "C" and "S" items in PORG.
b. Generally buy recommended items (below OP) up to Purchase Target Value (PTV).
c. "Save" PTV capacity for the next PO.
d. Buy in excess of PTV if item is at risk of stockout or service level interruption. This can be calculated by comparing Lead Time (in days) to the sum of Review Cycle and On Hand.
e. Exclude from Lead Time if the item has special or unique manufacturing or transportation tactics that alter the Lead Time from normal.

f. Avoid RFQs as a normal and ordinary replenishment action, unless a special delivery date or cost is needed.

F. Replenishment System Design

a. Select replenishment strategy conducive to activity level (the more the transactions, the greater the predictability) and ABC Class. Up To and EOQ are preferred methods because the variables are system-managed and thus minimize system management costs.
b. Use a Cost to Order of $10.00 and a Carrying Cost of 30%.
c. Use Conversion to stimulate purchases in box increments.
d. Use Cost Pages to manage order line minimums and dynamic (volume sensitive) supplier price lists.
e. Manage Supplier Cost so that Item Cost in Purchase Order Entry is automated.
f. Create visibility to Purchasing of Supplier Cost by displaying Supplier Cost source in the Source Reference field.
g. Assign Purchaser Target Values (PTVs) at the Supplier level.
h. Use Vessel Tracking to create visibility of complicated order and container progress.
i. Use Document Links to automate the transmission of prints and specifications.

G. Purchase Order Management

a. Accurate and timely date visibility is critical to success.
b. Manage order quantity at Receiving.
c. Use the LIPPS Report to communicate with suppliers and the Sales team on exceptions and date changes.
d. Use the Open Purchase Order Report to ensure that all open purchase orders are desirable, accurate, and timely. The report should have nearly no listings for POs dated prior to the report date.

These practices suggest that there must be separate actions to manage replenishment at a supplier and item level. We shall explore such concepts next.

CHAPTER 7

SUPPLIER LEVEL REPLENISHMENT DESIGN

Introduction

Supplier level replenishment is primarily designed to stimulate economic orders. Economic purchase orders are purchase orders that possess value or weight that qualify them for freight incentives, discounts, or will result in our meeting conventional goals and objectives to manage transportation costs. An effective supplier level replenishment system will result in reduced transportation costs and reduced processing time in order configuration and order execution, as a buyer is stimulated to buy an economic order using Purchase Target Values, and ordering rules are auto-populated into Default Carrier ID, so that the buyer can minimize the use of custom notes and instructions.

Caveat

There is one caveat to supplier replenishment system development. The system works for stockable and standard items. Special order and made-to-print items are usually bought only against demand and thus such items will normally not be part of order consolidations or grouped on one purchase order.

Definitions

Here are some important terms and tools as they pertain to supplier level replenishment:

-**Purchase Target Value (PTV)**: A value set at the supplier level in value or weight that stimulates a buyer to purchase an economic order. The Purchase Target Value appears in the Supplier tab in PORG, and when the order value does not exceed the target, a warning is displayed to the buyer with a query box to continue. A non-query warning is noted in the Supplier tab of PORG when PTV is exceeded.

-**Carrier ID**: A default setting at the supplier level that can be overridden. The Carrier ID, if configured properly, can be assigned based on supplier replenishment schemes so that a freight management scheme auto-populates at Purchase Order Entry, and the Buyer does not have to add notes, and the supplier does not have to read through interpretative lists based on PO parameters.

-**Vessel Tracking**: A system whereby multiple POs from different suppliers can be assigned to a single or multiple "containers", with multiple containers assigned to a "vessel". The system provides visibility of the progress of imported shipments as they proceed from factory to loading port, to origin port, to dock. The system also provides visibility to suppliers and brokers who manage consolidations. A "vessel" commences at the time a Bill of Lading is received.

-**LTL** (Less than Truck-Load): A freight term for shipments greater than 70 pounds but less than truck load when the goods are shipped by common carrier truck line.

-**FCL** (Full Container Load): For Kansas shipments, FCL is equal to 35,000 pounds, so that there is excess capacity for pallets, packaging, and trailer weight to stay within a 40,000 pound overall maximum load.

-**LCL** (Less than Container Load)

-**UPS** (United Parcel Service): Used for conventional shipments of 70 pounds or less. By attaching a service level code ("NDA" or "Red" for "Next Day Air"; "Blue" for "Second Day Air"; "Orange" for three day guaranteed), you can provide specific instructions.

-**Prepaid**: Supplier pays freight to our dock.

-**Prepaid and Add**: Supplier pays freight and bills us the cost. Usually used where suppliers exercise some additional bargaining power with freight companies, or where the supplier uses freight as

a profit center, by billing at retail freight prices and paying wholesale. Generally Prepaid and Add should be avoided.

-**Collect**: Huyett pays the carrier directly. The freight costs are "collected" by the carrier from the customer.

-**CWT** (Hundredweight): Refers to LTL shipments and a LTL program from UPS.

-**COD** (Collect on Delivery): Freight costs and parts costs are collected at the time of delivery, at the dock. Usually used for new accounts, or with customers possessing questionable credit history. COD on the buy side should be avoided due to the process interruptions in Receiving to process a payment.

-**FOB** (Free on Board): Freight costs are accrued to the buyer from the supplier's dock.

-**EXW** (Ex Works): The Seller simply makes goods available at its dock. Technically there could be loading charges at the supplier's dock that accrue to the buyer, but typically this term works the same as FOB. This is common in European trade.

-**CIF** (Costs, Insurance, Freight): The seller pays for carriage and freight to the named destination, as in "CIF Kansas City".

-**Broker** (as in Customs Broker): A paid agent or agency of G.L. Huyett that facilitates the transportation and clearance of goods through United States Customs. Brokers are bonded and have the right, granted through a written Power of Attorney, to represent the company in matters of trade and insurance claims for damaged goods from transit.

-**Freight Forwarder**: An agency or transportation company that usually takes possession of goods for purposes of consolidating multiple shipments from different suppliers within a geographic cluster into a single container.

-**Duties**: A tax or tariff that is assessed on goods based on the HTS number. Duties are used to manage trade between nations and to restrict the flow of imported goods for purposes of protecting domestic suppliers from foreign competition.

-**HTS** (Harmonized Tariff Schedule): A numbering system assigned by the United States International Trade Commission that is based on part type and style so that there is uniformity in customs and duty enforcement.

-**Brokerage Fees**: An important component of soft costs. Such fees are based on set document preparation fee schedules or in billable hours assessed by the Broker. Can include temporary warehouse storage costs, inspection costs, and other costs associated with the freight forwarding process. Are typically billed on the same invoice as duties, which are typically prepaid and added by the broker as a shipment is approved through U.S. Customs.

-**BOL** (Bill of Lading): A transfer document written by a carrier to a buyer and seller that sets forth the carrier's responsibility for the goods. It is critical that the Bill of Lading be accurate for quantity and quality of goods.

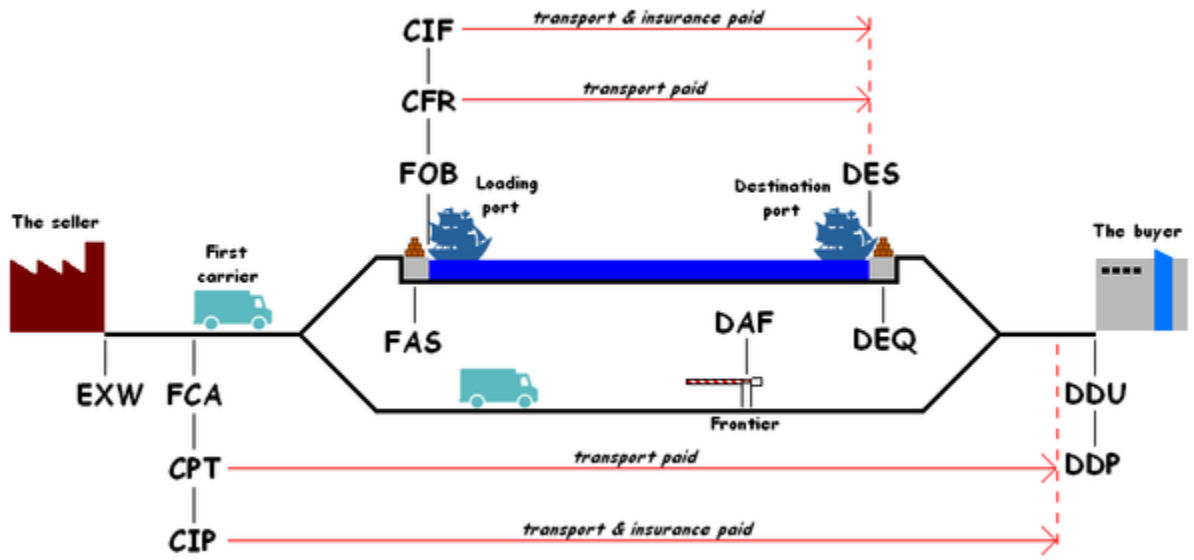
-**Pack List**: A listing by the seller of goods for what items are contained in a given shipment.

-**Pro Forma Invoice**: An invoice that is created and presented for orders that require some sort of prepayment. The invoice is a forecast of what goods are to be made and in what quantities, subject to actual production.

-**FAX** (Facsimile): A copy of an original document. Facsimiles allow for quicker engagement of commerce but should be avoided with new untested or unreliable suppliers.

These definitions are used to configure purchase orders and can be integrated into the construction of default Carrier IDs. A working knowledge is important in developing a replenishment system.

The following diagram provides a brief overview of the overseas transportation process, as well as cost components (Source: International Chamber of Commerce Incoterm List).



Economic Order

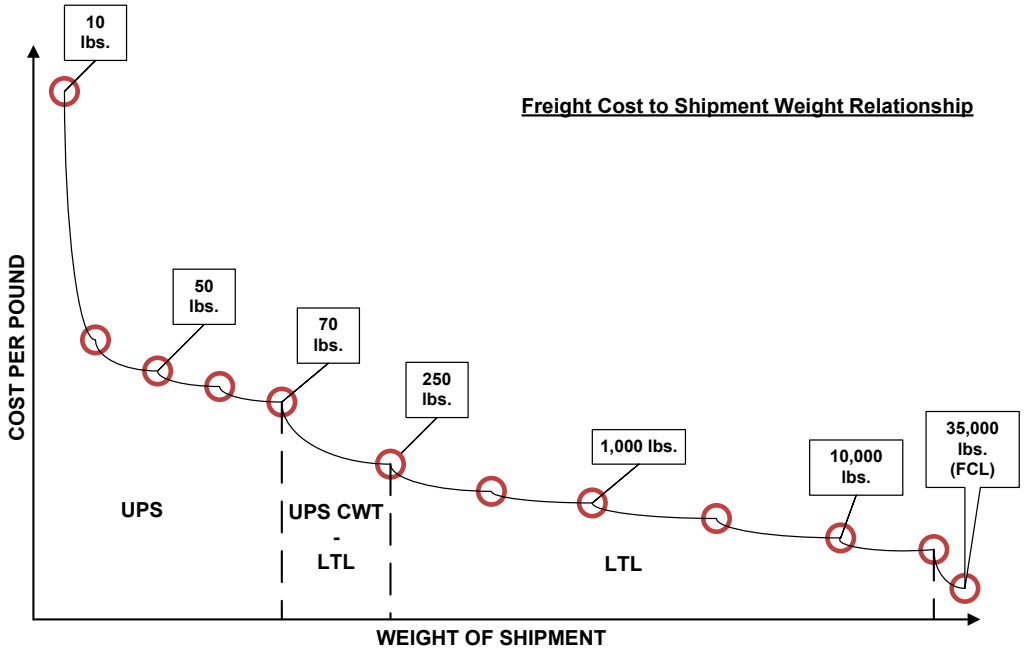
The first step in development of Supplier Level Replenishment **is to establish economic purchase order values at the supplier level**. These values may be established in weight or in value, and are known as "Purchase Target Values" or PTVs in the system. The values will be uploaded into the system to automatically stimulate and provide visibility to the buyer to purchase in economic order increments.

There are four primary considerations in developing economic order. First are **incentives**. Some suppliers offer prepaid freight, discounts, or incentives based on purchase order size. These incentives must be listed and accounted for.

The second consideration is **order cost**. Purchase orders cost money to produce in the form of processing time in the Purchasing department and in Warehouse operations. While we have defined a globally-based ordering cost of $8.60 per line in the operation, at the order level, costs should likewise be considered. Ideally, Purchasing and Receiving should develop an estimated order cost at the supplier level based on conventional shipment configurations for weight; the quality and integrity of inbound containers and labeling conditions; inspection level; and the frequency of receiving exceptions. Logically, suppliers that have conforming packages that arrive in sound condition with proper labeling; documentation and shipment mapping that is user friendly to the Receiving team for check in; and with

few exceptions, cost far less to do business with than suppliers who require a lot of inspection and extra processing.

The largest component of cost is **freight**. Freight costs measured as a rate per pound tend to drop incrementally at certain shipment weights. The chart below illustrates such a dynamic:



Notice the drop off's at 70 pounds; 250 pounds, and 35,000 pounds. Typically the rate per pound is relatively constant between these values.

Finally, **order frequency** factors into setting economic purchase order values. As we saw in Chapter 3, order frequency has a direct correlation to service level and inventory on hand. Fewer replenishments mean lower stockouts, but also higher inventory. Fewer replenishments will also likely lead to heavier shipments thus the cost of order is amortized over more parts, and freight costs are more likely to be a lower percentage of product cost. The key is to find a way to calculate an estimated 30% carrying cost of extra inventory, against the cost savings with less frequent ordering.

To calculate economic order, you need to know the annual spend, annual weight purchased, number of active SKUs, turnover objective, typical freight class code, order cost, and ship from zip code (for domestic shipments). Using this information, you will populate the **Economic Purchase Order Calculator**. The Calculator stimulates the analyst to consider frequency of purchase (Where 360 = "every day", 52 = "every week", 12 = "monthly", etc.), against order profile and order cost.

While the science is not entirely exact, most experienced buyers have a sense of what order frequency is needed to satisfy management specified service levels. The buyer will also have a sense as to order profile, i.e. the number of SKUs per purchase order, and the average weight per SKU. Most suppliers ship in 30-50 pound cartons, so an order profile that yields an average weight per SKU below such level is probably not economic.

A hypothetical example of a supplier using the Economic Purchase Order Calculator is located below:

ECONOMIC PURCHASE ORDER CALCULATOR								
SUPPLIER:	Acme Manufacturing				FREIGHT CLASS:	50	ZIP CODE:	60044
Purchase Frequency	360	52	26	12	6	4	2	1
Ave. Shipment Weight	65	447	893	1,935	3,871	5,806	11,613	23,225
Average Order Value	$67	$466	$932	$2,019	$4,037	$6,056	$12,112	$24,223
SKU's Per Order	0.60	4.15	8.31	18.00	36.00	54.00	108.00	216.00
Freight Cost	$18.69	$83.52	$120.33	$0.00	$0.00	$0.00	$0.00	$0.00
Order Cost	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00	$30.00
Total Cost	$48.69	$113.52	$150.33	$30.00	$30.00	$30.00	$30.00	$30.00
Cost as % of Value	72.36%	24.37%	16.14%	1.49%	0.74%	0.50%	0.25%	0.12%
Carrying Cost (30%)		$119.56	$139.75	$326.08	$605.58	$605.58	$1,816.73	$3,633.45
Cost Per Pound	$0.75	$0.25	$0.17	$0.02	$0.01	$0.01	$0.00	$0.00
Supplier Incentive	1000	1000	1000	1000	1000	1000	1000	1000
Unit of Measure	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Annual Spend:	$24,223.00		Annual Weight:	23,225	Total SKU's:	54	Turns:	4.00

PERIOD DATA:	12 months ended 12/31/08

EVALUATION DATE:	09/30/09

The chart yields a fairly obvious order frequency of 12 times per year (or monthly), based on a substantive drop in order costs. Such order frequency projects an average of 18 SKUs per order. In this case, the supplier offers a prepaid freight incentive at 1,000 pounds. Thus the economic purchase order value should be set at 1,000 pounds. Such order value, known as Purchase Target Value (PTV), will allow the buyer to purchase roughly every 3 weeks, with an average SKU count of 15 SKUs. While the calculator is not exact, it provides a sound guideline to develop economic order.

Default Carrier ID Code

Once Purchase Target Value is established, the Default Carrier ID Code needs to be set that reflects the freight management practice that the PTV contemplates. In doing so, the Default will appear automatically in Purchase Order Entry and thus the buyer does not have to enter special notes and shipping instructions UNLESS THERE IS AN EXCEPTION.

Please remember that we do not use Shipping and Delivery Instructions from the system. We use Carrier ID Codes. For the example above, the Carrier ID would simply state "Prepaid". Here is a list of our more common Carrier ID Codes:

100093	**Prepaid**
116570	**Customer**
100094	**CIF Kansas City, MO USA**
100095	**CIF Chicago, IL USA**
117512	**CIF Chicago, IL USA (PPD & ADD)**
117513	**Skyline Express International Gmbh**
117511	**CIF Laredo, TX USA**
100096	**CIF Minneapolis, MN USA**
117598	**UPS Collect #691-964**
117599	**UPS Prepaid and Add**
117600	**Email weight/skids to inbound@huyett.com**

It is important to pay attention to order policy exceptions. When such exceptions are made, the buyer must override the default Carrier ID code, and usually, it makes sense to exclude the order from Lead Time calculations by checking the appropriate exemption box in Purchase Order Entry.

Capacity Constraints and Limitations

The use of Purchase Target Values can also be geared to capacity constraints (maximums), in addition to minimums. Suppose a weekly trip is made to a plating company for outside services. Suppose that the company truck can only carry 20,000 pounds. A PTV could be used in this circumstance to define a maximum load capacity, as opposed to the more conventional minimum definition.

Payment Terms

With a wide number of suppliers, both domestic and international, and with a variance in payment terms, it is important to develop Default Payment Terms at the Supplier level for auto-population at Purchase Order Entry. Here is a list of some of the Default Payment Terms in the system:

1% 10, Net 15	**2% 20, Net 60**	**Net 120**
1% 10, Net 30	**2% 30, Net 45**	**Net 14**
1% 10, Net 60	**25% PO/75% Inv & BOL**	**Net 15**
1% 15, Net 30	**3% 10, Net 30**	**Net 15th Prox**
1% 20, Net 20	**3% 8, Net 30**	**Net 20**
1/2% 10, Net 30	**30% Invoice/70% BOL**	**Net 30**
100% at Invoice/BOL	**50% Invoice/50% BOL**	**Net 30 at BOL**
100% at Rec of Inv	**At Invoice Receipt**	**Net 30 at Invoice**
1-1/2% 10, Net 30	**At Receipt of Parts**	**Net 45**
2% 10, Net 30	**Boeing Terms**	**Net 60**
2% 10, Net 45	**COD**	**Net 65 Days**
2% 10, Net 60	**Credit Card**	**Net 7**
2% 14 at Invoice	**Inactive**	**Net 90**
2% 15 at Invoice	**Net 10**	**No Orders**

2% 15, Net 30	**Net 10, Invoice/BOL**	**Pre Payment Received**
2% 15, Net 45	**Net 10, Upon Inspect**	**Prepay**
2% 15, Net 60	**Net 10th Prox**	**To Be Reviewed**

If there are policy exceptions, the buyer must override manually. The extra processing cost of exceptions is less than the cost of managing payment terms manually, thus the creation of Default Payment Terms is desirable and more accurate.

Summary of Best Practice – **Supplier Level Replenishment System Design**

1. **Use the Economic Order Calculator** to determine an economic purchase order value in weight or in value at the Supplier level.
2. **Populate the Economic Order Value** into the system as a Purchase Target Value (PTV) so that the Purchasing team realizes visibility in order-level management during Purchase Order Entry.
3. **Populate Default Carrier ID Codes** so that suppliers do not have to interpret conditional carrier statements or make inferences at purchase order receipt and so that buyers do not have to manually write shipping instructions into purchase orders at purchase order entry.
4. **Populate Default Payment Terms**.

The above actions will reduce processing time and increase accuracy at purchase order entry. Freight and other soft costs will be reduced. Buyers will invest less time in purchase order configuration, purchase order entry, and have more time to manage exceptions.

CHAPTER 8

ITEM LEVEL REPLENISHMENT DESIGN

Using a "Best Practices" approach, structured within the resource limitations of G.L. Huyett and the enterprise software, we will now try to identify a system of replenishment that defines parameters **to the item level** in a manner that optimizes service level, and minimizes transaction inventory and system management costs. The **resource constraints and objectives of the replenishment system** are the following:

-**Cost to Order** is $8.60 per item as determined via the EIM (Effective Inventory Management) worksheet.

-**Carrying Cost** is 27% per annum as determined via the EIM survey.

-**Service Level** objective is 99% for standard items.

-**Turnover** objective companywide is 3.0 minimum, with a 4.0 goal.

-**Customer service measure**s are based on stockouts (not backorders).

Replenishment Method Determination

To determine replenishment method for an item, you need to know the following:

-**Forecasted pick frequency**. A higher business activity usually yields greater predictability of results, and for high-pick items, system maintenance costs can become prohibitive when OP and OQ values are static.

-**Standard deviation of pick quantity**. Items that are picked in the same quantity can be managed more easily in static models, and thus provide more options for system design. Items possessing wide variances in pick quantity require more dynamic replenishment.

-**Inventory Risk Orientation**. If the item is custom-manufactured or unique, and inventory is committed only when sold, the replenishment system should minimize inventory risk. MIN/MAX is the only known system (in Epicor) where OP can be set to a negative value. By making MIN and MAX 0, the item only is recommended to purchase when Net Stock is negative.

-**Annual Sales at Item Level.** This statistic will be used for Inventory Ranking and ABC Class Code assignment.

Inventory Ranking

As opposed to assigning replenishment methods at an item level, which would be quite laborious, such assignments can be made using inventory classes. Inventory Ranking is a process of defining classes of items based on common replenishment attributes. Replenishment method and other parameters can then be assigned at a class level, which is far more efficient than item level designation.

There are some so-called pre-assigned classes in the firm, including:

-"PSP". These are items that have secondary processing and are replenished according to parameters that integrate with contractor requirements.

-"PPROD". Assemblies, kits, and assortments that contain more than one SKU are replenished from finished goods using this class code.

-"PPLATE" and **"PPLATENEG"** are plated items replenished according to contractor and pricing rules.

These class codes are assigned based on what the item is, as opposed to how the item is consumed and utilized. Assignment of these items is fairly automatic and outside the scope of this paper.

Using the above four Replenishment method determination factors, rank unclassified inventory using these steps:

1. Assign those items that will not be stocked (high risk to own) to **Class Code D**. These items will be ordered only when negative and OQ will usually be equal to Sale Quantity unless there is a Lot Cost opportunity to overbuy (little or no extra cost). These items are typically specially manufactured items made by outside contractors and other vendors.
2. Assign globally-sourced items with two picks or less annually to **Class Code E**. These items will be ordered only when negative. They are stock items, so OQ will be equal to Lot Size used to establish Standard Cost.
3. Assign items that are domestically-sourced with four picks or less annually to **Class Code F**. These items will be replenished in the same manner as Class E items.
4. Assign stockable items that have very predictable pick quantities to **Class G**. These items will use an OP/OQ replenishment scheme, and will be replenished in increments that reconcile to sales quantities. Such items also include labels, tags, and imprints produced by G.L. Huyett Advertising for approved and stocked kits and assortments.
5. Assign high dollar value items, high margin items, or "special situation" items for unique customers to **Class H**.
6. Rank the remaining items by annual Sales, which is a measurement of the importance of the item to the organization.
    a. Assign to **Class Code A**, those items that account for a preponderance of annual cost. We are inclined to suggest a threshold of 80% of annual cost, based on Paretto's Law. You will need to study the statistical "Bell Curve" of pick frequency and annual cost to determine where to actually draw a statistical line separating A and B items. Class AD is domestic items only
    b. Assign to **Class Code B**, three fourths of the remaining items. If, for example, you use an 80% threshold for Class A, assign the next 15% (three fourths of 20%) to Class Code B. Class BD is domestic items only.
    c. Assign the remaining items to **Class C**.

We may have other inventory class codes in the system for other purposes. The scope of inventory ranking here applies to those items that are purchased for inventory in regular operations. There are class codes for secondary processes (PSP); kits containing multiple SKUs (PPROD); plated; and non-stocked items. Note that the primary difference between Class Code "PPLATE" items and "PPLATNEG" items are that the latter are negatively replenished only. This is a product development/marketing assignment based on market orientation and product line management.

Following Inventory Class Code assignment, the analyst should consider low pick frequency items that are high margin, high value or possess strategic customer value, and which might possess high sanctions for stockouts. Class H items should use an OP/OQ replenishment method. The Order Point should be set

at a multiple of standard pick sizes that is roughly equal to the Primary Supplier Lead Time. These items will be thinly traded and often a pick pattern is recognizable. If, for example, an item is picked six times annually at 100 per, and the lead time is 90 days, then an OP of 200 makes sense (assumes 100 every other month, so 200 is four months' usage). The Order Quantity will usually be set at the supplier's minimum order for the item.

Some of this analysis is discretionary and will be affected by the orientation of the analyst. Because the OP/OQ system is static, a change in demand can quickly make the variable obsolete. For these reasons, extra attention needs to be paid to the Service Level and Turnover of these items. Class Code H items should be reviewed NOT LESS than annually, or whenever Service Level and Turnover do not conform to management objectives.

Once you have completed the ranking process, the items will be assigned to the Replenishment Methods set forth in the chart below.

ABC Class	A and AD	B and BD	C	D	E	F	G	H
Description	items which comprise the majority of the annual costs paid by Huyett for inventory	items which comprise the middle of the annual costs paid by Huyett for inventory	items which comprise the lower end of the annual costs paid by Huyett for inventory	Only order when net stock is negative, mainly per print items (c-items)	International stock items with two picks or less annually	Domestic stock items with four picks or less annually, G.L. Huyett shop items	stock items with predictable pick quantities, min 10 annual picks, 90% of time pick the mode qty, Huyett Advertisement items	low pick, high margin, high value, or strategic customer value
Used in P21 ranking - sort by sales	Y	Y	Y	N	N	N	Y	N
Reclassified by P21	Y	Y	Y	N	N	N	N	N
Annual threshold	80%	95%	100%	N/A	N/A	N/A	N/A	N/A
ABC Class Safety Stock in Terms of	days	days	service level	N/A	N/A	N/A	N/A	N/A
Normal safety stock factor	1.0	1.0	1.0	N/A	N/A	N/A	N/A	N/A
Moderate safety stock factor	1.0	1.0	1.0	N/A	N/A	N/A	N/A	N/A
Slow safety stock factor	1.0	1.0	1.0	N/A	N/A	N/A	N/A	N/A
Customer service measure	N/A	N/A	stockout	N/A	N/A	N/A	N/A	N/A
Service level % goal	N/A	N/A	85.00%	N/A	N/A	N/A	N/A	N/A
Item Maintenance								
safety stock in terms of	Days (1 lead time period)	Days (1 lead time period)	By ABC Class	By ABC Class	By ABC Class	By ABC Class	By ABC Class	By ABC Class
ABC Class code	N/A	N/A	C	D	E	F	G	H
Replenishment method	EOQ	EOQ	EOQ	MIN/MAX	MIN/MAX	MIN/MAX	MOSTLY OP/OQ	OP/OQ
Min / OP value	0	0	0	0	0	0	set by user	set by user
Max / OQ value	0	0	0	0	0	0	set by user	set by user
Purchase order qty (PO conversion values may apply)	SEE ABOVE	SEE ABOVE	SEE ABOVE	equals the std cost qty	equals the std cost qty	equals the std cost qty	SEE ABOVE	SEE ABOVE
Purchase Order Point	calculated by P21	calculated by P21	calculated by P21	Negative Net Stock	Negative Net Stock	Negative Net Stock	SEE ABOVE	SEE ABOVE

ABC Class	PSP	PROD	PPLATE	PPLATNEG	Blank OR Null
Description	secondary process items (excludes plating)	Production order items	Plating items (subset of PSP)	Plating Items (subset of PSP) Only order when net stock is negative	Other charge, discontinued, not buyable items
Used in P21 ranking - sort by sales	N	N	N	N	N
Reclassified by P21	N	N	N	N	N
Annual threshold	N/A	N/A	N/A	N/A	N/A
ABC Class Safety Stock in Terms of	N/A	N/A	N/A	N/A	N/A
Normal safety stock factor	N/A	N/A	N/A	N/A	N/A
Moderate safety stock factor	N/A	N/A	N/A	N/A	N/A
Slow safety stock factor	N/A	N/A	N/A	N/A	N/A
Customer service measure	N/A	N/A	N/A	N/A	N/A
Service level % goal	N/A	N/A	N/A	N/A	N/A
Item Maintenance					
safety stock in terms of	By ABC Class	By ABC Class	By ABC Class	By ABC Class	By ABC Class
ABC Class code	PSP	PPROD	PPLATE	PPLATNEG	N/A
Replenishment method	generally MIN/MAX	generally MIN/MAX	OP/OQ	generally MIN/MAX	MIN/MAX
Min / OP value	0	0	0	0	0
Max / OQ value	0	0	0	0	0
Purchase order qty (PO conversion values may apply)	AS REQUIRED	AS REQUIRED	AS REQUIRED	AS REQUIRED	N/A
Purchase Order Point	Negative Net Stock	Negative Net Stock	Negative Net Stock	Negative Net Stock	N/A

Order Point (OP) and Order Quantity (OQ) Assignment

The **MIN/MAX** items all have OP and OQ of 0. This will result in the item appearing in PORG only when in a negative stock card condition. We call these items **negatively replenished items**.

Such items are unique made to print items (Class D); or are slow moving (Class E and F). Notice that for these items, other than inventory ranking, there is no system maintenance requirement for the variables. Note also that if the Item is Class Code E, it will not appear until the stock card is negative, and the item is globally-sourced, resulting in a long conventional lead time. In such situations, Purchasing will coordinate with Sales a cost-effective countermeasure, which might include use of high cost air freight. Such costs and low anticipated experiences are deemed to yield an overall cost savings as opposed to elevating safety stock of these items. OQ for these items will be equal to the Lot Size required to realize Standard Cost and should be visible in Conversion, Cost Pages, and in the Source Reference field.

For **EOQ** items, all of the variables are system maintained. Through time, we will monitor companywide service level to ensure that a 99% or greater fill rate (overall) is maintained on stock items. The EOQ assigned items can be calibrated by Purchasing using the techniques set forth in Chapter 10.

The **Service Level in EOQ** was thoroughly tested by Timothy O'Keeffe and James Bond of G.L. Huyett in October 2009. A series of items were reviewed using various service levels, as well as to simulate differences in Order Point calculations assuming different Safety Stock Factors. The **Service Level %** method to calculate OP in the EOQ replenishment method means that there are no system maintenance costs for OP and OQ. The OP calculation can be calibrated by altering Lead Time Factor and Usage Factor as set forth in Chapter 10. Such calibrations can be done globally at a company, purchase criteria, class code, or supplier level (in addition to at the Item level). Item level overrides should be avoided due to the unique administrative challenges and having to maintain exceptions.

The Service Level % OP calculations were also tested against the manually-maintained Safety Stock Days method, and no noticeable increase or decrease in service level reliability was noted. Thus this method was deemed quite reliable, with virtually no system maintenance costs, and a global calibration feature to adjust to temporary supply and demand changes.

Safety Stock Days – policy change as of 9/1/2010

For EOQ replenishment type items, setting the safety stock in terms of "service level, 99%" causes P21 to calculate minimal safety stock days in PORG. For G.L. Huyett, this is typically 10 days. Because of vendor performance issues and demand spikes, G.L. Huyett wants to maintain 1.0 lead time period of safety stock for foreign items and two lead time periods of safety stock for domestic items in ABC classes A and B. (Note: because of the excessive lead times for foreign items setting the safety stock days to 2 lead time periods would cause an abnormally large financial output that can't be totally justified). This requires the safety stock in terms of field in item maintenance be set to days and the number of days be set to one lead time period. In addition, domestic items will need to be placed into different ABC classes from foreign items. This allows for future flexibility. This allows the safety stock factor to be set to 2.0 (as opposed to 1.0 for foreign items). Accordingly, classes AD and BD were created for domestic items.

The **OP/OQ** items require the most maintenance. **Order Point**, designated as X, is calculated by dividing lead time into typical order pick, plus estimated safety stock. Suppose a customer buys 100 units every week. Suppose that the lead time for the item is four weeks and management elects to maintain two weeks of safety stock. OP in this case would be 600 pieces. This method will result in the best supply-demand match, but is also the costliest to maintain. If supply or demand changes, the OP (and possibly OQ) must be amended at the item level.

Order Quantity in OP/OQ is the higher of Lot Size or the number of periods of supply deemed acceptable to meet management's goal for inventory turns, divided into typical order pick. Suppose the lot size is 1150 for the above example, and management wants to limit purchases to two months' stock. In this case the OQ would be 1200.

Buy Increment (Conversion Value)

Recall that we wish to populate the system with conversion, so that buy quantity is automatically generated in supplier-compatible increments in Purchase Order Entry. The Buy Increment is the minimum of a supplier's line minimum and an even box quantity.

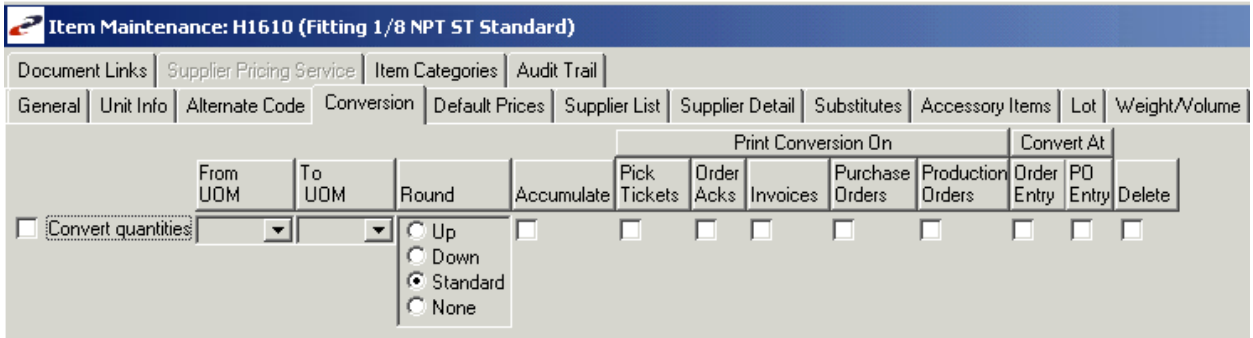
Buy Increment = MIN [Box Quantity, Supplier Line Minimum]

In most cases, the supplier's line minimum will be equal to one box of parts. In situations where the minimum exceeds one box, we will set up a Cost Page with a cost of $0.00 for all quantities until the supplier minimum is realized. *(Due to the nature of P21 Purchase Pricing Pages, we have to enter a value of $0.000001 to prevent the system from reverting to I/M supplier costs fields.)*

Some suppliers do not have established box quantities. For such suppliers, a box quantity can be established by one or more of the following actions:

A. Check existing stock to see what the package increments are set at presently.
B. Contact the supplier.
C. Create a packaging scheme that considers lot size, usage, turns, and a 35 pound upper limit per box.
D. For thinly traded items, where typical box quantities are not known and are anticipated to be well under 35 pounds, the value of Conversion is to eliminate rounding by the Buyer at Purchase Order Entry. In such cases, select a Conversion value that is divisible into normal buy and sell quantities (example: 25, 50, 100, 1,000).

Once box quantities are established, they need to be set up as Conversions, and visibility needs to be determined for the Pack List. Visibility is created in the Conversion tab of Item Maintenance in the Inventory Module:



Conversions that are equal to the supplier's package quantity, or are provided by the supplier SHOULD be printed. Conversions that are extrapolated or are well under economic package quantities should NOT print so that the supplier is not stimulated to ask questions or assess additional packaging charges.

Cost

With Conversion in place, now populate Standard Cost and document the source in the Source Reference field. Order minimums, if different than box quantity, need to be put together as a Cost Page, where the cost is $0.00 until the minimum is reached. *(Due to the nature of P21 Purchase Pricing Pages, we would have to enter a value of $0.000001 to prevent the system from reverting to I/M supplier cost fields.)* If the Supplier's costs are volume sensitive, such lists should be established in the Pricing Page and the buy increment used for Standard Cost should be identified in the Source Reference field.

On completing Inventory Ranking; Replenishment Assignment; OP and OQ Calculation for Class G and H items; Conversion; and Cost Pages, we are now ready to execute World Class replenishment.

CHAPTER 9

HOW IT ALL WORKS

With a comprehensive replenishment system in place at the supplier and item level, here is how the system works.

Note: Purchasing Agents have the ability to log into P21 using different roles. This allows them to perform foreign buying, domestic buying, and Manufacturing buying as required. This is done by holding down the SHIFT key while clicking on the P21 desktop icon. Select the desired role and proceed.

Daily

Run a companywide PORG and DO NOT "Show All Items".

A. **Look only at items with critical shortages** (marked or S).
B. PORG suppliers for the critical shortage items.
C. Buy up to Purchase Target Value (PTV) for such suppliers and schedule to consolidate on prescheduled ship days, unless there is an urgent need exception.
D. Exclude from Lead Time any POs that have urgent-need nontraditional logistics.
E. Override Carrier ID if a nontraditional freight method is used. Buy all items below their OP, even if not critical, up to the PTV. Schedule shipment for the next supplier consolidation date. Buy over the PTV only if the next review date would imperil service level on noncritical items that are below OP.
F. Review domestic items with a negative net stock. RFQ those items with the supplier to get the current lead time.
G. Review import items and only order when one item has a negative net stock.

Note any items or suppliers where there is a preponderance of non-purchased items in PORG. Such items and suppliers should be reviewed so as to amend replenishment and eliminate system noise.

Review the **Late Items Purchased Parts (LIPPS)** report and work with suppliers to see that past due purchase orders arrive as soon as possible.

Weekly

Run supplier-specific PORG using Purchase Criteria designed for conventional "stock status" analysis. Generally such PORG is run WITHOUT "Showing All Items", unless the supplier traditionally is challenging to meet the PTV. Buy all items with Recommended Purchase and schedule using preplanned transportation schemes.

As a safety measure, a Purchase Criteria known as **"PORGWIDEOPEN" is run weekly** that does NOT show all items but might reveal items that are in need of purchase that might fall through the cracks in the system design in some manner. Items on this report should be reviewed not only for replenishment, but also to identify system faults that need corrective attention.

Monthly

Review the Service Level Report and identify suppliers, ABC Classes, or item groups where the Service Level is below company standards. Perform cause and affect analysis. If the ABC Class is not properly matched to the item, change the ABC Class.

For Class A, B, and C items, adjust **Usage Factor** if the cause is deemed a demand side issue. Initiate and maintain contact with the Sales team to monitor market conditions. If supply side, adjust **Lead Time Factor**. Work with the supplier or find a new supplier as needed to minimize structural inventory caused by poor supply side execution. Please refer to Chapter 10 for specific information on how to manage Service Level while optimizing inventory costs.

Review the Inventory Turnover Report at a product line, ABC Class Code, and Supplier level. Review ABC Classes for correct appointment. Change as deemed logical.

Among A, B, and C items, if turns are less than company prescribed standards, review Service Level for the items. If Service Level is poor, it is probably a supplier or structural problem. If Service Level is sound, inventory is possibly high because of replenishment variables. Execute countermeasures as needed.

Periodic

Perform continuous improvements for Service Level, **Inventory Turnover, and system noise.** Identify any extra processing or workarounds that any team member is enduring due to poor execution or bad system design.

Review the Soft Cost Management Tool to verify that freight and logistical costs are in line with objectives and standards. Consider amending Purchase Target Value at the Supplier level if there is extra processing time in order configuration, or if freight and other soft costs are increasing beyond permitted limitations.

Maintain accurate and up to date Standard Costs, with proper documentation in the Source Reference Field. Implement Cost Pages and review buy quantities as deemed necessary to realize proper lot costs and lot sizes.

Annual

Perform Inventory Ranking and Class Code assignments as set forth in Chapter 8. Reassign replenishment methods based on revised rankings. One nice feature about P21 is the ability to rank inventory and reclassify in “live” and to be able to selectively identify items for re-ranking.

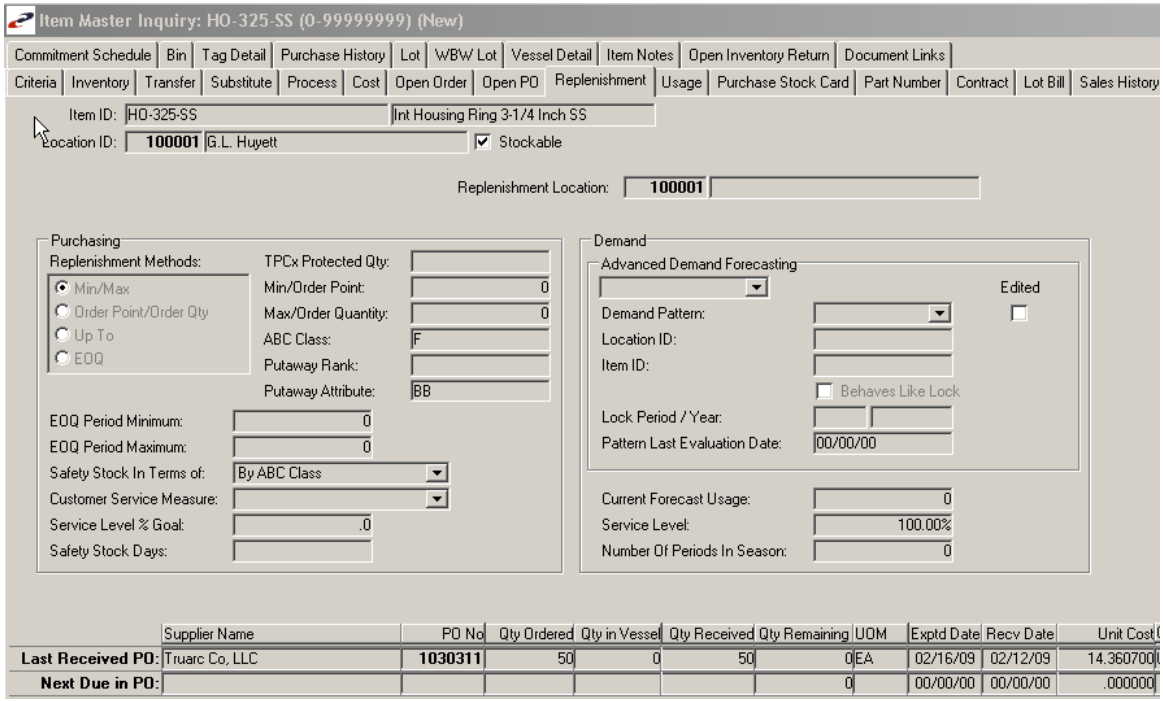
Identify slow and obsolete inventory for liquidation, write down, discontinuation or special marketing campaigns. Communicate issues and opportunities with contemporaries in Sales, Warehouse Operations, and Accounting.

Visibility

There are a number of places to view various replenishment system attributes at the item level. Navigation to such places should become second nature to all relevant users. Here is a summary of some of the most important locations.

The **Replenishment tab in IMI** displays several system defaults for the replenishment method and related matters. The **Purchase Stock Card**, also located in IMI, sets forth OP and OQ calculations for the item, using the assigned settings, and based on real time usage and stock levels.

Here is an example of an item assigned MIN/MAX:



Item Master Inquiry: HO-325-SS (0-99999999) (New)

Commitment Schedule | Bin | Tag Detail | Purchase History | Lot | WBW Lot | Vessel Detail | Item Notes | Open Inventory Return | Document Links

Criteria | Inventory | Transfer | Substitute | Process | Cost | Open Order | Open PO | Replenishment | Usage | Purchase Stock Card | Part Number | Contract

Item ID: HO-325-SS — Int Housing Ring 3-1/4 Inch SS

Location ID: 100001 G.L. Huyett — ☑ Stockable

Method: Min/Max

(NS) Net Stock

	Qty On Hand		Allocated		Tot. Backordered		Pending Backorders		Release Schedule		Qty In Transit
29 =	29	-	0	-	0	+	0	-	0	+	0

	Qty In Process		Reserved Due In		Qty on PO		Blanket PO		Unapproved PO		Qty on Prod Order
+	0	-	0	+	0	-	0	+	0	+	0

(OP) Order Point

(OP) Order Point = 0 (Piece Qty) — (OQ) Order Quantity = 0 (Piece Qty)

0 — Net Stock greater than Order Point - No Need to Purchase
Surplus Quantity Available

Purchase Quantity

	Order Quantity		Net Stock
(29) =	0	-	29

Surplus Quantity in EA

		Surplus Quantity		Buy Ahead Qty		Unit Size		Rounding Factor	
(29) =	Truncate [{(	-29		0	)/	1.0000	} -	.5000	]

Now here is a similar item assigned to EOQ:

Item Master Inquiry: HO-325 (0-99999999) (New)

Commitment Schedule | Bin | Tag Detail | Purchase History | Lot | WBW Lot | Vessel Detail | Item Notes | Open Inventory Return | Document Links

Criteria | Inventory | Transfer | Substitute | Process | Cost | Open Order | Open PO | Replenishment | Usage | Purchase Stock Card | Part Number | Contract | Lot Bill | Sales History

Item ID: HO-325 — Int Housing Ring 3-1/4 Inch

Location ID: 100001 G.L. Huyett — ☑ Stockable

Replenishment Location: 100001

Purchasing

Replenishment Methods:
- ○ Min/Max
- ○ Order Point/Order Qty
- ○ Up To
- ◉ EOQ

TPCx Protected Qty:
Min/Order Point: 0
Max/Order Quantity: 0
ABC Class: A
Putaway Rank:
Putaway Attribute: HH

EOQ Period Minimum: 0
EOQ Period Maximum: 0
Safety Stock In Terms of: By ABC Class
Customer Service Measure:
Service Level % Goal: .0
Safety Stock Days:

Demand

Advanced Demand Forecasting

Edited ☐

Demand Pattern:
Location ID:
Item ID:
☐ Behaves Like Lock
Lock Period / Year:
Pattern Last Evaluation Date: 00/00/00

Current Forecast Usage: 124
Service Level: 100.00%
Number Of Periods In Season: 0

	Supplier Name	PO No	Qty Ordered	Qty in Vessel	Qty Received	Qty Remaining	UOM	Exptd Date	Recv Date	Unit Cost
Last Received PO:	Rotor Clip Co, Inc	1042609	1,000	0	1,000	0	EA	11/23/09	12/02/09	.389148
Next Due in PO:						0		00/00/00	00/00/00	.000000

Item Master Inquiry: HO-325 (0-99999999) (New)

Commitment Schedule | Bin | Tag Detail | Purchase History | Lot | WBW Lot | Vessel Detail | Item Notes | Open Inventory Return | Document Links

Criteria | Inventory | Transfer | Substitute | Process | Cost | Open Order | Open PO | Replenishment | Usage | Purchase Stock Card | Part Number | Contract | Lot Bill | Sales H

Item ID: HO-325 Nut Housing Ring 3-1/4 Inch

Location ID: 100001 G.L. Huyett ☑ Stockable

Method: EOQ

(NS) Net Stock

Qty On Hand	Allocated	Tot. Backordered	Pending Backorders	Release Schedule	Qty In Transit
929 = 929 -	0 -	0 +	0 -	0 +	0

Qty In Process	Reserved Due In	Qty on PO	Blanket PO	Unapproved PO	Qty on Prod Order
+ 0 -	0 +	0 -	0 +	0 +	0

(OP) Order Point

Daily Usage	Usage Factor	Lead Time Days	Lead Time Factor	Review Cycle	Mean Absolute % Error	Std. Deviation	Safety Stock Factor
3.9997 X	1.0000 X ((	28 X	2)+	1 + ((1 +	83.2938 / 100) X 1.25 X	2.33 X	1)) =

Calc. Order Point	Item Order Point
193 = MAX (193 ,	0) Net Stock is greater than OP * order point exception - No need to Purchase

(OQ) Order Quantity

# of Periods	Cost to Order	Period Usage	Usage Factor	Carrying Cost	Each Cost	EOQ
√(2X 12 X	10.000000 X	124 X	1.0000)/(	.300000 X	.389148) =	505

EOQ Minimum = EOQ Period Minimum 0 X Period Usage 124 = 0

Is EOQ less than EOQ Minimum? No

EOQ Maximum = EOQ Period Maximum 12 X Period Usage 124 = 1,488

Is EOQ more than EOQ Maximum? No

Net Stock (NS) 929 > EOQ + Order Point(OP) * Order Point Exception (OPE) 698 --> Surplus Quantity Available

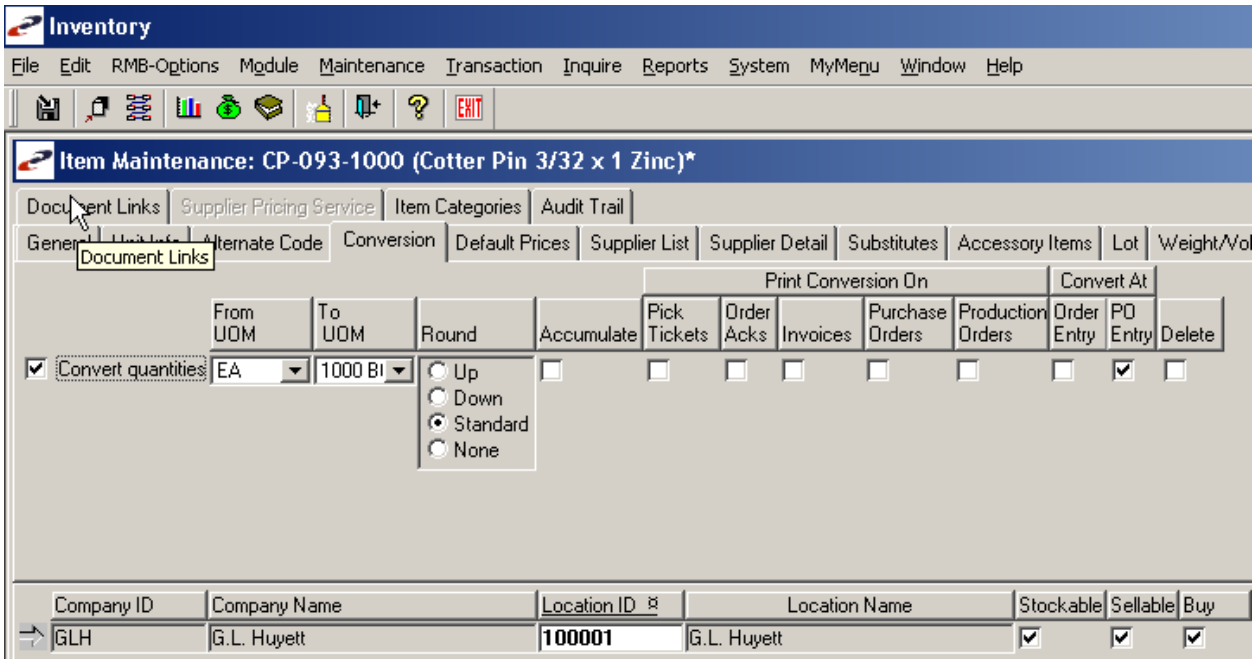
	EOQ	Order Point (OP)	Order Point Exception (OPE)	Net Stock (NS)
(231) =	505 +	193 X	1 -	929)

Surplus Quantity in EA

Surplus Quantity	Buy Ahead Qty	Unit Size	Rounding Factor
(231) = Truncate [{(-231	0)/	1.0000 } -	.5000]

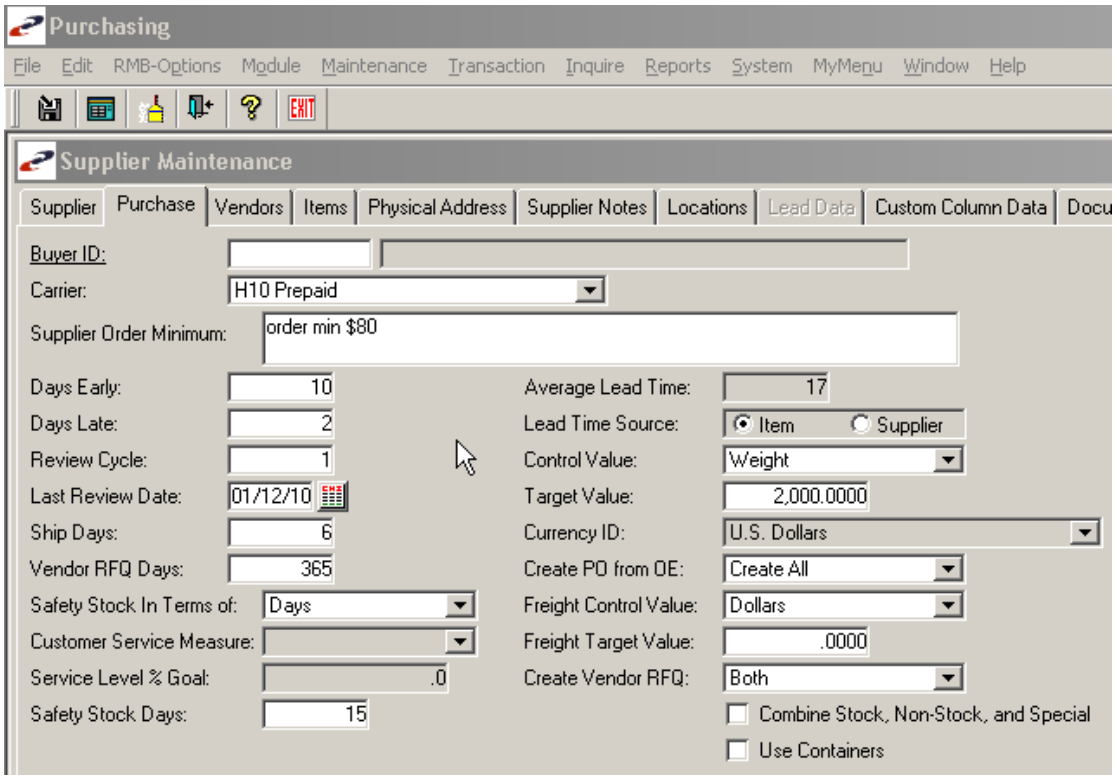
Notice the difference in Purchase Stock Card calculations for the MIN/MAX item as opposed to the EOQ. If a user encounters a noneconomic order recommendation during the Recognition or Evaluation steps, by evaluating these tabs, a cause and effect can be established and the item's replenishment scheme can be enhanced to yield better results.

Conversion is visible in the Inventory module, in the Item Maintenance section, under the "Conversion" tab. Here is an example:



Notice that there are check boxes and assignments for how Conversion is rounded, and where it is printed on reports and documents. If Conversion matches a supplier's box configuration, then it would be printed. If Conversion is used to eliminate rounding by the buyer, the Conversion would not be printed.

Purchase Target Value or PTV, is visible in Supplier Maintenance within the Purchasing module, but is most often recognized in PORG. Here it is in Supplier Maintenance (under the "Purchase" tab):



Notice that the PTV is technically referred to as “Freight Control Value”, and in the example above, the value is 2,000 pounds per purchase order. For a screen shot of PTV in PORG, see page 40.

Summary

As the Purchasing team perfects the system, the process of standard replenishment should become more automated. Rudimentary tasks should be completed with ease, absent of system noise and extra processing. Accurate available for sale dates should be visible in real time to all interested stakeholders. Extra correspondence to confirm or revise dates should be minimized.

The team’s orientation should become more proactive and less reactive. Efforts should be more business-building and less administrative. The Purchasing team’s time should shift to sourcing and improving the supplier base with a comprehensive system of communication, ratings, and feedback.

Enterprise software is designed to optimize resources and to “get everyone onto the same page”. That is why it is called “enterprise” software. For an enterprise to be effective there needs to be a culture of ownership and execution, and of accountability and action. We hope that replenishment can be at the forefront of our enterprise development efforts.

CHAPTER 10

YIELD MANAGEMENT

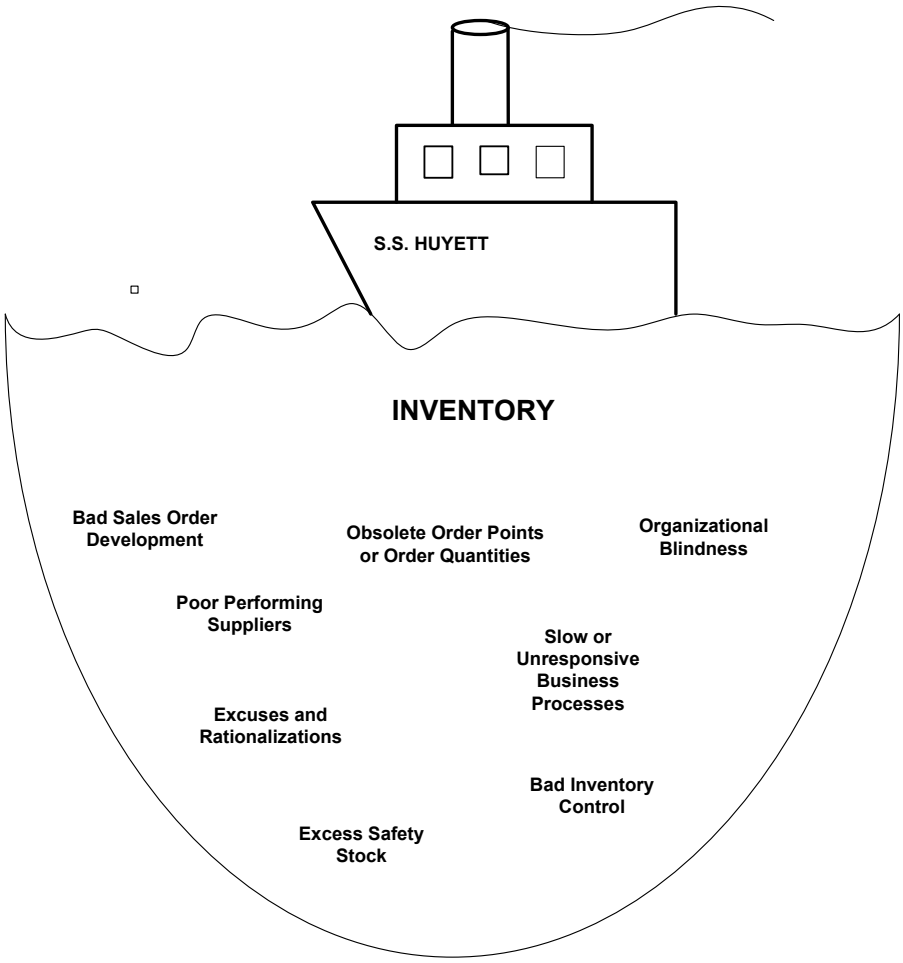
Introduction

While daily and periodic activity can be predictable and fairly routine, as with any system, reacting to ever-changing business conditions and making small adjustments should be considered normal and ordinary. There is no such thing as "autopilot" in replenishment. An ongoing responsibility of Purchasing is to ensure that the Company's objective for Service Level is maintained while minimizing inventory level (and therefore optimizing turnover). We call this "**Yield Management**".

Because most replenishment schemes are independent ordering systems, where supply and demand are managed independently, inventory serves as a buffer to account for variances between supply and demand. In a perfect world, no inventory would be needed. Such is the advantage of demand pull systems, where stock is created only when there is demand.

Organizations have a tendency to rely upon inventory that conceals opportunities to be leaner. The organization is lulled asleep in a sea of inventory, oblivious to the cost of inventory. The drawing below illustrates such a dynamic:

"SAILING ALONG WITH SERVICE LEVEL"



In Chapter 1, process-oriented inventory was referred to as **Structurally Created Inventory**, or inventory created by business processes. In the above diagram such inventory would be created by bad sales order development, organizational blindness, poor performing suppliers, unresponsiveness, rationalizations, and bad inventory control.

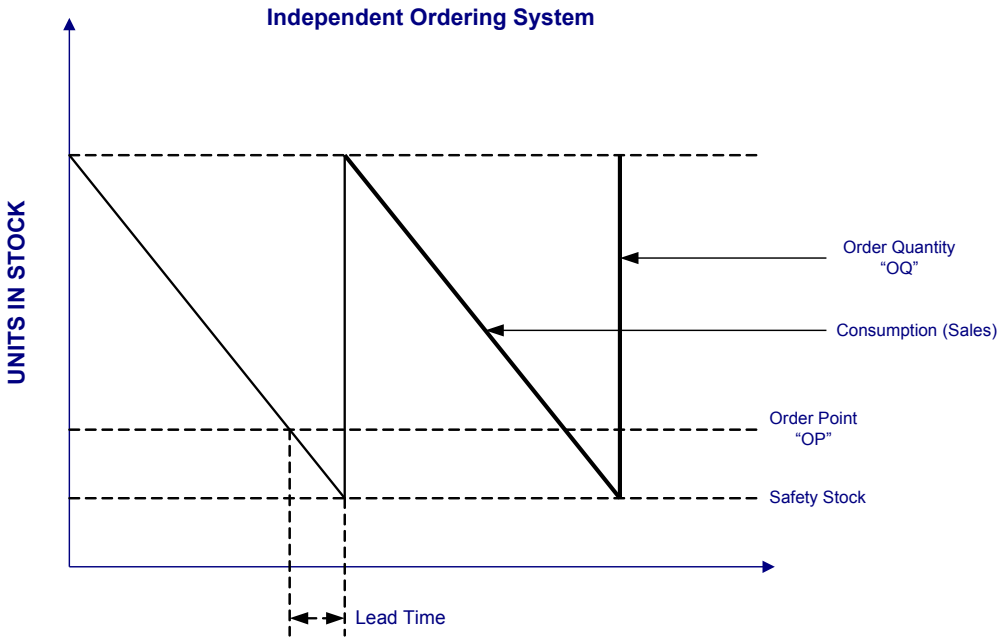
Transaction Created Inventory includes obsolete order points or order quantities, excess safety stock, and unresponsiveness. Replenishment system design is the theme of this paper, and as such, reducing transaction-created inventory is a major paradigm.

The idea of the above diagram is to seek out ways to lower the inventory level without running into the "rocks" in the water.

Theoretical Inventory Value

It is common in any business to forecast sales and expenses. While inventory is a major investment for distribution firms, few companies bother to forecast inventory, or to ask: What *should* our inventory be? Inventory turns may be measured and the yardstick of performance is to increase such number. But is an increase in turns *possible* given the existing replenishment system parameters?

Calculating Theoretical Inventory Value (TIV) is the process of determining what your inventory could be, based on existing models. To calculate such value, one must consider what "makes" inventory. Inventory is created in part by Safety Stock, which in theory, is never or rarely used. It is there for "safety". This is illustrated in the following diagram from Chapter 3:



The impetus is on an organization to reduce Safety Stock by making supply and demand more predictable. Better forecasting and reliable suppliers will lead to lower Safety Stock, and therefore, lower inventory. The remainder of TIV is Order Point and Order Quantity, as illustrated above, with the vertical straight line.

Order Point includes some structural issues such as organizational blindness. The bulk of Order Point and Order Quantity are driven by the replenishment system. Assuming a constant depletion of stock, at any given time, TIV should equal one half (or the midway point on the graph) of Order Point plus Order Quantity.

Theoretical Inventory Value (TIV) = [(Order Point + Order Quantity)*Average Cost] / 2

In the book, Achieving Effective Inventory Management, Jon Schreibfeder argues that the above formula should also take into account one half of Safety Stock. While we agree with the view that SOME Safety Stock is ALWAYS consumed, in theory, it should never be used. We believe that 50% of Safety Stock, enterprise-wide, is NEVER used.

Potential Inventory Turnover

Inventory is affected by sales, and a higher sales level will require a higher inventory level. To better gauge management effectiveness, measuring inventory in turnover is useful. As discussed earlier, focusing on turnover exclusively does not take into account what is possible. By dividing Theoretical Inventory Value into current sales, a Potential Inventory Turnover can be calculated:

Potential Inventory Turnover = Cost of Goods Sold / Theoretical Inventory Value
Potential Inventory Turnover = COGS / TIV

In March 2010, Jim Bond and Tim O'Keeffe performed such analysis on company operations. Such calculation yielded a Potential Inventory Turnover value of 4.27, which should serve as a management benchmark for the foreseeable future.

Service Level Management

The other side of generating yield in inventory management is to ensure Service Level. Loss of sales from poor service levels and the extra cost of back-orders can often trump the savings gained in aggressively managing inventory turnover. The purchasing professional has to balance the financial objectives of low inventory against the business necessity of providing good service.

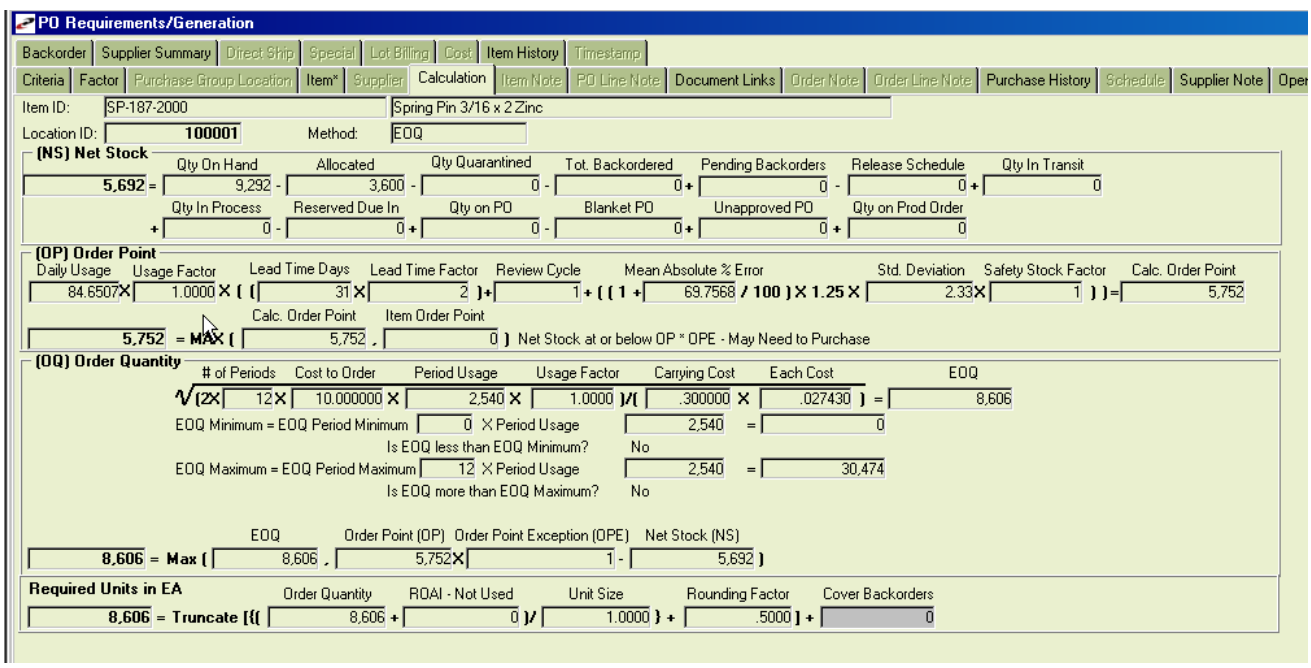
The replenishment system has several features that allow for globalized calibrations to design, which can in turn reduce both transaction and structurally created inventory. Such features allow **supply side adjustment** or **demand side adjustment** within the EOQ replenishment method. Given that the significant majority of items that comprise the majority of sales volume are in Class Codes A, B, or C, which have EOQ as the replenishment method, these tools can have a profound and immediate impact on service level if implemented aggressively.

These features manage and allow calibration of Order Point (OP) and Order Quantity (OQ) at global levels. There are two ways to calculate OP in the EOQ method in P21:

Configuration:	Calculation:
Safety Stock Days	The order point for EOQ items is determined using the following calculation: Order Point = (APU / 30) (Lead Time + Review Cycle +Safety Stock Days)
Service Level % Goals	Order Point = (APU / 30) ((Lead Time * Lead Time Safety Factor) + Review Cycle + ((1 + (MAPE%/100)) (1.25*Standard Deviation) (Safety Stock Factor)))

The Safety Stock Days method uses a static variable, Safety Stock Days, to assist managers in affecting OP. The static nature of such variable implies a higher management cost because as supply or demand changes, the variable must be changed manually. In addition, there is no precise means to calculate Safety Stock. Even among academics; its' very definition is debated. Thus any calculation of Safety Stock is at best, an educated guess. Because of the cost to manage and the obtuse nature of Safety Stock calculations, the Service Level Goal % is the desired means to calculate OP in the EOQ model.

Listed below is a shot of the Purchase Stock Card for an item, showing specific calculations for both OP and OQ:



Notice there are several "factors" in calculating OP and OQ. It is these factors that form the tools to calibrate Service Level. **Usage Factor** allows for calibration of demand-side changes, while **Lead Time Factor** can be used to account for supply-side changes.

Safety Stock Factor is used to account for risk in forecasting for EOQ items.

Re-Ranking Inventory

As we shall see, Lead Time Factor and Usage Factor are effective tools to globally calibrate supply and demand changes. But in reality they only affect EOQ items, which are only in inventory classes A, B, and C. From Chapter 8, recall that inventory was ranked according to the number of picks. In short, any domestically-sourced item with 4 picks or more annually, and any globally-sourced item with 2 picks or more, is assigned to classes A, B, and C.

What happens when business conditions change?

Predictably, in times when business is going down, there would be fewer items that would meet the EOQ class assignments. In times of business expansion, more items would make the cut. Thus when conditions change, the Purchasing team must review and re-rank inventory according to the standards set forth in Chapter 8 for inventory ranking. Such effort will ensure that the calibration of Usage Factor and lead Time Factor will affect the right items.

Items that might move from a negatively-replenished class code to classes A-B-C, should receive additional scrutiny. Sometimes such items have very predictable trading patterns with just a single customer. Thus the re-ranking process should also consider reassignment to Class G, a class designated for items that have very predictable pick patterns.

Finally, each month the **MAPE % Report** should be run. Items sitting in classes A, B, and C which is implied have an EOQ replenishment method, and which have an MAPE% greater than 1,000% should be adjusted to the Safety Stock Days method for calculating Order Point (as opposed to the Service Level % Method).

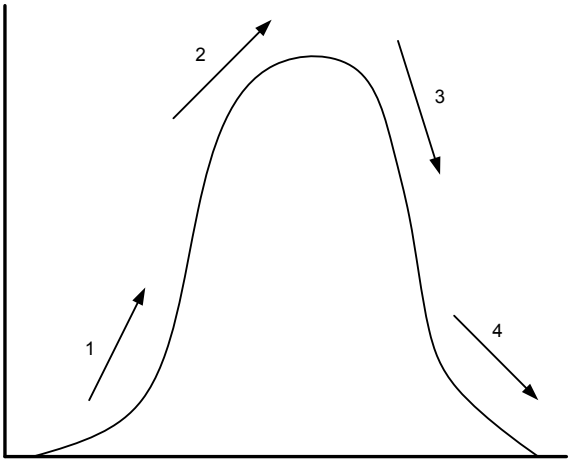
Lead Time Factor

Business cycles are a relatively common part of manufacturing activity and the Purchasing team should be attuned to macro-economic conditions of the general world economy, as well as the micro-economic conditions within the industry. Business cycles are caused by changes in the money supply, management efforts made by the Federal Reserve Bank with respect to the money supply; consumer and business spending; and government policy.

Financial periodicals are a good source of information, as is a quarterly bulletin published by the Institute for Trend Research (ITR), an economics research firm that is retained by the National Fastener Distributor's Association (NFDA), of which G.L. Huyett is a member. The ITR report is sent to the Chief Financial Officer and is available by request.

Careful discussions with trade and suppliers are important. Regular contact with leading suppliers is desirable so as to determine not only the production capacity and capacity utilization of the supplier, but also to gauge the availability of raw materials and steel production. Reviewing Purchase Order Acknowledgements will also provide insight into conditions that can potentially alter a supplier's lead time.

Listed below is a depiction of economic activity and what a business cycle might look like:



BUSINESS CYCLE

In **Phase 1**, interest rates are low and steady; unemployment is high; and there might only be preliminary indications that economic activity is increasing, as evidenced by GDP (Gross Domestic Product); retail sales; industrial production; and other factors. In this phase, manufacturers have trimmed staff, expenses, and have cut production to the bare minimum. In this phase, shortages in supply can occur and lead times from manufacturers can increase very quickly. As manufacturers begin to recognize this, they will increase production and add capacity.

Phase 2 depicts the high growth phase. In this phase, unemployment is decreasing, interest rates are steady to increasing, prices are starting to increase, and production lead times are longer but holding steady.

Phase 3 usually begins long before anyone recognizes it. In this phase, employment and economic activity are at their highest levels. Interest rates are increasing, prices are increasing and starting to level off, and production times are going down. In this phase, manufacturers traditionally overreact and actually have more capacity than they need.

Phase 4 is when recession occurs. Interest rates top out and the Federal Reserve starts to lower interest rates. Prices start to come down as manufacturers seek to sell extra capacity and production lead times shorten.

The Purchasing team must use macro-economic study and micro-economic discussion with suppliers to understand what production lead times are, and what the impacts are on Service Level. The Lead Time Factor (LTF) can be used to alter Order Point (OP) for items assigned to EOQ. **Note that the LTF will not impact items with MIN/MAX or OP/OQ replenishment systems.**

The LTF uses a multiplier from 0.0 to 2.0, with 1.0 being a normal setting. The LTF is assigned at a supplier level, but is applied at the item level. Thus if Lead Time is 20 days at the item level, and the LTF is set at 2.0, Order Point will be 40 days (20 x 2.0) usage, plus the assigned Review Cycle. Note: An LTF setting of null in the P21 supplier maintenance locations tab is equivalent to 1 in the PORG EOQ calculation. Thus, lead time is ALWAYS used as part of the EOQ Order Point (OP) calculation, unless intentionally set at 0.0.

Remembering that Lead Time is established after four receipts in the system, the Lead Time for a given item will lag real time if production lead times are changing at a supplier. Thus the LTF can be used to manage Order Point (OP) during times of change. **It is critical to manage LTF both when production times are increasing and when they are decreasing.** Usually such activity will occur in Phases 1, 3, and 4 of a business cycle.

In short, LTF would be moved **above 1.0 in Phase 1**; returned to **1.0 in Phase 3**; and moved to values **under 1.0 in Phase 4**. **ANY change to LTF needs to be documented using the Lead Time Factor Log Sheet in Purchasing**. To determine if a LTF needs to be changed, use the following analysis:

A. Determine what phase of the business cycle we are in.
B. Talk to the supplier if a change in supplier service level is noted.
C. Review Purchase Order Acknowledgments to verify frequency of date changes and the time elapsed from such changes.
D. Review the Lead Time at the supplier level, and compare to the time elapsed, as well as quoted production times.
E. Review the Lead Time Factor Log Sheet. Look at lead times for each previous LTF change and compare to experience. Were the LTF changes accurate?

Based on the above analysis, a change to LTF can be recommended. As such changes are made, they must be logged. The Lead Time Factor Log Sheet should be reviewed every thirty days as long as there are suppliers in the system that have LTFs that are different than 1.0. Such review will ensure that Service Level is not compromised when Lead Times are increasing (Phase 1 and 2); and unnecessary inventory is being accumulated when Lead Times are decreasing (Phase 3 and 4).

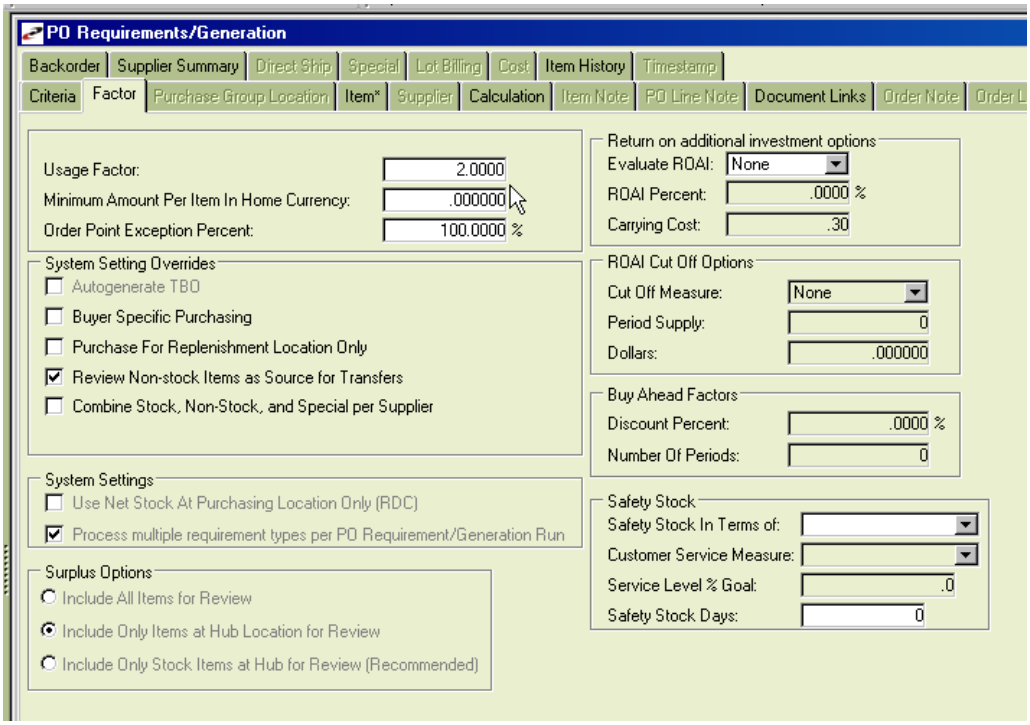
Usage Factor

The analyst can manage demand side changes using Usage Factor, which as seen in the above screen shot, affects both Order Point and Order Quantity. The Usage Factor directly impacts Period Usage in a directly proportionate manner (1.20 factor would add 20% to Period Usage).

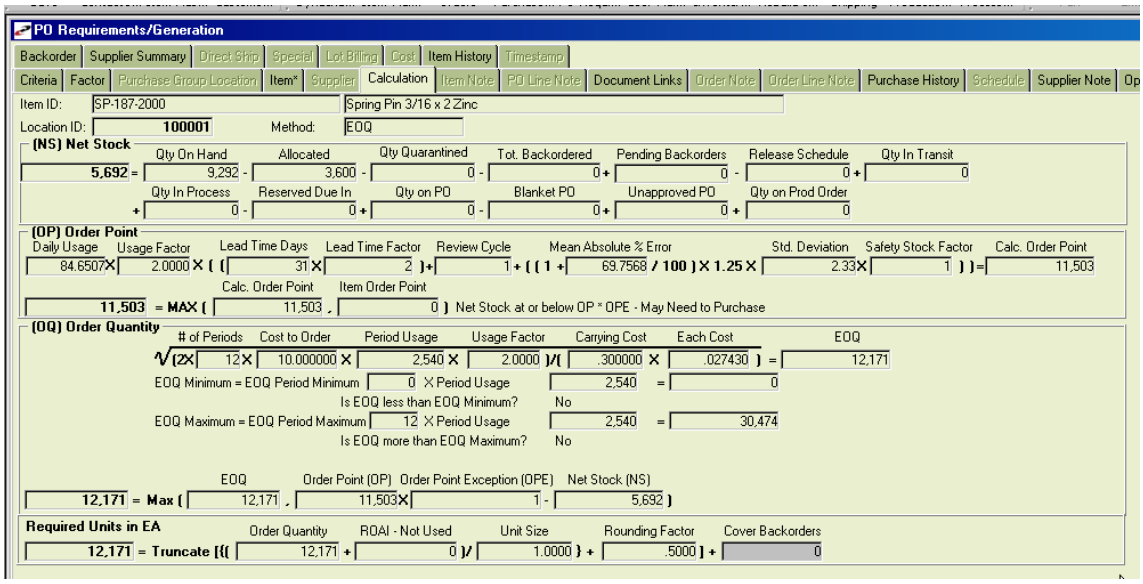
Usage Factor would be used when there are temporary demand spikes at an item or product line level, or if there are general macro-economic changes in sales, at a product line or Company Level. **The key to effective deployment of Usage Factor is an accurate forecast of demand**. Demand must be forecasted both in up and down markets.

As markets and forecasts change, the analyst must be careful to monitor such changes. The business cycle analysis above applies to demand as well as supply. In up markets, Usage Factor would typically be increased in Phase 1; returned to 1.0 in Phase 3; and reduced in Phase 4.

The Usage Factor is changed in Purchase Criteria:



The value can be changed from 0.0 to 2.0. Notice in the example above, Usage Factor is changed to 2.0 and see the impact in the Purchase Stock Card:



Any changes should be noted in the Usage Factor Log Sheet. The analysis to assess changes to Usage Factor is similar to those used in assessing Lead Time Factor on the supply side:

A. Determine what phase of the business cycle we are in.
B. Talk to the Sales team and note specific item, product line, or general business trends.
C. Review Sales Reports, including monthly financial statements and daily sales reports.
D. Review the Usage Factor Log Sheet. Compare forecasts to experience. Were prior Usage Factor changes accurate?

The Usage Factor and Lead Time Factor log sheets should be well maintained and reviewed monthly. By executing these strategies timely and consistently, and by learning from experience, the Purchasing team should see an improvement in effective service level management while maintaining solid turnover in inventory.

Replenishment is defined as "*the deliberate process of ordering inventory using efficient practices that optimize Service Level and Inventory Turnover*".

GLOSSARY

Replenishment is defined as "*the deliberate process of ordering inventory using efficient practices that optimize Service Level and Inventory Turnover*".

-**80/20 Rule**. See *Paretto's Law*.

-**ABC Class Code**. A system of grouping parts by common management scheme.

-**Anticipation Inventory**. Inventory that is built or created in anticipation of future sales. Sometimes referred to as "just in case" inventory.

-**APU**. See *Average Period Usage*.

-**Average Period Usage**. Actual demand averaged on a per period basis, with the number of periods defined by the analyst. Also known as "APU".

-**Back Order**. A portion of a sales order or a purchase order that is created when a portion of such order ships and a balance of parts due is leftover.

-**Back Order Basis**. A method of measuring Service Level that calculates fill rate based on complete lines shipped against lines ordered.

-**Bell Curve**. The graphical shape of a normal statistical distribution of numbers. Such graph looks like a bell when plotted.

-**Business Cycle**. A charted pattern of business activity, usually measured in output or gross domestic product (GDP) that accounts for the economic production of a country or national economy. Business activity tends to "cycle" up and down based on private investment, government spending, and monetary policy.

-**BOL** (Bill of Lading). A transfer document written by a carrier to a buyer and seller that sets forth the carrier's responsibility for the goods.

-**Broker.** A paid agent who facilitates the transportation and clearance of goods through United States Customs.

-**Brokerage Fees**. Fees and charges assessed by a broker that are associated with the processing of a shipment, with the broker serving as agent for the customer.

-**Buy Increment**. A calculated Conversion value. Equal to the minimum of a determined box quantity or a supplier's order minimum at the item level.

-**Buying**. The process of determining purchase quantities for items that will be bought.

-**Capacity Constraint**. A condition such that the available supply of production capacity is less than the demand for such production.

-**Carrier ID**. A setting that displays a desired carrier and freight method for a shipment based on the Supplier.

-**Carrying Cost**. The cost of owning inventory. It is the actual Landed Cost of the inventory, plus the Cost of Capital.

-**CIF** (Costs, Insurance, Freight). Freight term in which the seller pays for carriage and freight to the named destination, as in "CIF Kansas City".

-**COD** (Collect on Delivery). Freight cost and parts cost is collected at the time of delivery, at the dock.

-**Collect.** Freight term that means that the freight costs are "collected" by the carrier from the customer (at the destination).

-**Configuration**. The process of building a purchase order that is cost effective and meets objectives for inventory turnover and Item Cost management.

-**Consolidation Date**. The date parts are required to ship from the supplier's facility.

-**Conversion**. A system setting that consists of assigning a buy-quantity value to an item. The system will automatically round Order Quantity to the Conversion value in purchase order and sales order entry.

-**Cost**. The value at which goods or services are purchased.

-**Cost List**. See *Cost Page*.

-**Cost of Capital**. The cost of money to a given organization or company. It is usually the higher of the borrowing rate of the firm or the firm's return on assets.

-**Cost Page**. A Cost List that is established in P21 that assigns costs in purchase order entry based on Supplier and quantity. Also known as a Cost List.

-**Cost to Order**. See *Ordering Cost*.

-**Critical Shortage**. A condition created when Net Stock, expressed in days, is less than the Lead Time of a part.

-**Currency Conversion**. The process of converting non-dollar denominated contracts, to a common dollar value, based on exchange rate guidelines and system parameters.

-**Customer Requirement**. A condition created when Net Stock is negative, and a customer who wants parts is waiting, and such parts are not available.

-**Customer Service Measure**. The term used to refer to Service Level in the P21 enterprise software.

-**CWT** (Hundredweight). Refers to LTL shipments and a LTL program from UPS.

-**Daily Fill Report**. A report run from the supplemental database that lists items received in a given day that have open sales orders dated later. The report can be used to allocate and fill sales orders on an "as stock is available" basis, and to allocate inventory that is in short supply among several sales orders based on priority.

-**Days Early**. The number of days allowed for a shipment to arrive prior to the Required Date before it is counted as early by the system.

-**Days Late**. The number of days allowed for a shipment to arrive after the Required Date before it is counted as late by the system.

-**Default**. A condition for a system variable such that the variable assigned as a default, automatically appears first in any field that needs population in a form, document, or processing action.

-**Default Carrier ID**. Numerical codes that are assigned to a carrier and method, and which are "pre-assigned" to suppliers for auto-population at Purchase Order entry.

-**Demand Forecasting**. A process of predicting future sales and usage by surveying customers, reviewing market data, and accounting for variables that affect the use or demand of a product or service.

-**Demand Planning Horizon**. The time period for which demand planning is conducted. Generally the greater the time period and the more distant into the future, the lesser the accuracy.

-**Demand Pull**. A production system in which inventory is created when needed, as opposed to a push system where anticipation inventory is created in advance of demand.

-**Document Links**. Not to be confused with "Linking". A technology feature that "hooks" supporting documents, such as a blueprint or specifications, to an SKU electronically, such that the document can be submitted to a recipient coincidental to a transaction.

-**Duties**. A tax or tariff that is assessed on goods based on the HTS number.

-**DynaChange**. A technology process in P21 that allows the custom alteration of screen content, placement, and Required Fields assignment.

-**Dynamic Cost**. An operating framework where the Item Cost is determined by the purchase quantity. Dynamic Cost can be managed automatically with a Cost Page.

-**Economic Order Value**. The value in dollars or weight that optimizes cost and inventory carrying cost objectives.

-**Economic Purchase Order Calculator**. A table that assists an analyst in determining optimal and minimum purchase order values. May be expressed in value or weight.

-**EOQ** (Economic Order Quantity). An Independent Ordering System where Order Point and Order Quantity are calculated based on dynamic variables.

-**ERP** (Enterprise Resource Planning). A system that uses a technology platform such that all functional areas of an organization are able to communicate and collaboratively plan resource requirements in real time; and from that to develop resource allocation decisions in an efficient and "common language" framework, absent of numerous manual processes.

-**Evaluation**. The process of reviewing parts that are recommended for reorder, and deciding if such reorder is a desirable action.

-**Expected Date**. The date that parts are expected to be available for sale.

-**Exposures to Stockout**. The risk of stockout associated with frequency of replenishment. An "exposure" is a replenishment action. The more actions in a period of time, the lesser the inventory required, but the greater of stockout risk.

-**EXW** (Ex Works). The Seller simply makes goods available at its dock.

-**FAX** (Facsimile). A copy of an original document.

-**FCL**. A freight term that means "Full Container Load", which is a maximum of 40,000 pounds, including packing material and the container itself.

-**Fluctuation Inventory**. Inventory that is held to cover random changes in supply or demand. A manufacturer of portable power generators might hold extra stock to cover unforeseen demand from ice storms.

-**FOB** (Free on Board). Freight costs are accrued to the buyer from the supplier's dock.

-**Freight Forwarder**. An agency or transportation company that usually takes possession of goods for purposes of consolidating multiple shipments from different suppliers within a geographic cluster into a single container.

-**Gross Margin**. Also known as "Gross Profit Margin". Is a percentage calculation taken by dividing Gross Profit into Sales.

-**Gross Profit**. Sales less Cost. Usually expressed in dollars.

-**Handoff**. A business process, typically manual, which requires deliberate cause and affect decisions from the originator to the recipient. Handoffs often slow processes and can create extra processing (and therefore inventory) because they are often batch processed, as opposed to continuously processed.

-**Hedge Inventory**. Inventory that is held in anticipation of changing prices. By holding inventory, the user has a definitive cost of doing business in the future.

-**Hoard Inventory**. Inventory accumulated in advance of rising prices. If a Kansas farmer has 1,000 bushels of wheat in his combine, and wheat is $4.00 per bushel, but the farmer hears of a bad storm system in Oklahoma that might destroy the wheat crop there, the farmer will store the wheat rather than selling it, in anticipation of higher prices.

-**HTS** (Harmonized Tariff Schedule). A numbering system assigned by the United States International Trade Commission that is based on part type and style so that there is uniformity in customs and duty enforcement.

-**IMI** (Item Master Inquiry). A screen view of a given SKU whereby using tab queries, virtually any procurement attribute or stock status component can be viewed for analysis.

-**Incentive**. An economic condition created to stimulate a particular behavior, as in "to incent". A typical incentive is free freight for a purchase order if the value exceeds a target weight or value.

-**Independent Ordering System**. An inventory replenishment system that is managed independent of demand.

-**Integrated Supply**. An inventory management system that uses the principles of demand pull such that inventory is made available on a "Just In Time" (JIT) basis. The advantages of integrated supply are lower inventory, less warehouse space, and fewer warehouse assets. Such capital can be deployed by the user into other assets, such as more production equipment.

-**Inventory**. An asset that is used to decouple supply and demand, so that supply and demand can be managed as independent functions.

-**Inventory Control**. The process of managing inventory and decisions such that investment returns from inventory are optimized.

-**Inventory Ranking**. A process of evaluating inventory by common denominators and then assigning such common groups "ranks" for purposes of managing, such as in assigning ABC Class Codes.

-**Invoice Cost**. The price charged for a good or service. For inventory, this cost is also referred to as Item Cost. This cost is most often the value listed on a Purchase Order at the item level.

-**Item Cost**. See *Invoice Cost*.

-**Kurtosis.** The statistical concept that measures the width and height of the bell shape, in a Bell Curve.

-**Laid In Cost**. See *Landed Cost*.

-**Landed Cost**. Invoice Cost plus the cost of procurement. Procurement costs, also known as "soft costs", include freight, duties, brokerage fees, insurance, and other direct procurement costs.

-**LCL.** A freight term referring to “Less than Container Load”. A freight shipment that has a gross weight of less than 40,000 pounds.

-**Lead Time**. The amount of time, in days, from when a part is ordered, to when a part is received and available for sale.

-**Lead Time Factor**. A supplier-level variable that is imposed based on temporary or seasonal changes in the supplier’s operation which alters Lead Time accordingly.

-**Linking.** A technique to ensure that specific stock is allotted from specific purchase orders to specific sales orders.

-**LIPPS Report** (Late Item Purchased Parts). Report used to identify problems in Service Level and order fill when a purchase order date is changed at an item level, or greater.

-**Look Ahead Days**. A P21 setting that instructs the system to review open sales orders and purchase orders into the future that is equal to the number of days established. The setting does NOT consider forecasted usage. Only open Sales Orders and Purchase Orders are considered.

-**Lost Opportunity Cost**. A cost, usually expressed based on a comparative return on investment, which considers the investment in a given asset, if invested in a different asset. For example, if you have money invested in inventory, but you could instead have invested in real estate or stock, the Lost Opportunity Cost would be the difference between the return on investment in real estate as opposed to inventory. Lost Opportunity Cost is a test often used to ensure that resources are being deployed to their highest and best use.

-**Lot-Size Inventory**. Inventory that is created by production lot sizes. If a package of hot dogs contains 12 hot dogs, and a bag of hot dog buns contains 8 buns, four hot dogs of lot-size inventory will be created because of the differences in lot size at the meat packing plant versus the bakery.

-**LTL** (Less than Truck-Load). A freight term for shipments greater than 70 pounds but less than truck load, such that the goods are shipped by common carrier truck line.

-**Mandatory Note**. A note that pops up in IMI automatically for reference by a user. Mandatory Notes are usually warnings, as opposed to references for users (see Non-Mandatory Notes).

-**MAPE%** (Mean Absolute Percent Error). This is a running historical error rate based on the last completed demand period in the system. The error rate is equal to the deviation in forecast (system generated) and actual demand. Consider it a forecast accuracy rating.

-**Mean**. Commonly referred to as “average”, is the sum of a list of numbers, divided by the number of items in the list. The Greek letter μ (mew) signifies mean.

-**Median**. The number separating the higher half of a sample, from the lower half. It is denoted herein by the symbol Ў.

-**MIN/MAX**. Independent Ordering System in which Order Point is a fixed value (MIN) and the Order Quantity is equal to the number of items required to move inventory level back to a fixed level (MAX).

In MIN/MAX, Order Quantity is equal to MAX minus Net Stock.

-**Model Cost**. An estimated Standard Cost for a given item based on other similar items. Model Cost is used for lightly traded items, where the effort to maintain or procure such cost is deemed prohibitive, and experience suggests that a cost estimate is accurate to management's satisfaction.

-**Net Stock**. Inventory calculation that is equal to Inventory + Purchase Orders – Sales Orders.

-**Non-Mandatory Note**. A note that rests in the "Notes" tab of IMI, for reference by users in making decisions.

-**Not Sourced**. A status assigned to an item by populating the Primary Supplier field. "Not Sourced" refers to standard items that do not have an established Standard Cost, but which may have a predictable cost based on experience and market information.

-**Obsolescence.** A condition when a product is no longer in common use, or which useful life has expired.

-**On Hand**. The amount of inventory in the warehouse at any given time. On Hand does not recognize items in purchase orders or allocations.

-**OP.** See *Order Point*.

-**OP/OQ** (Order Point/Order Quantity). An Independent Ordering System in which there is a fixed Order Point and a fixed Order Quantity. Order Point and Order Quantity are often a multiple of production lot size or customer order quantity.

-**Open Purchase Order Report**. A report that lists all open items and orders that is used to audit, manage, and account for purchase order contracts in the system.

-**OQ**. See *Order Quantity*.

-**Order Acknowledgment**. The process of a recipient of an order replying back to the sender, while noting agreement or disagreement of any terms and conditions. An order is not a perfected contract until either after acknowledgement or shipment.

-**Order Execution**. The development of an actual purchase order and the transmission of said order to a supplier.

-**Order Management**. A process of communicating proper performance and delivery expectations between suppliers and users, such that information in the system is accurate, timely, and complete. Also includes an arbitration process of affecting changes to meet the need of users and customers.

-**Order Point** (OP). The stock level at which a purchase order should be created.

-**Order Quantity** (OQ). The number of items to be ordered on purchase orders when on-hand stock is less than Order Point (OP).

-**Ordering Cost**. The cost associated with procuring a purchase order. It includes review costs; issuance and acknowledgement costs; receiving costs; inspection costs; and putaway costs. It is the direct labor in Purchasing and Warehouse operations associated with procuring an order.

-**Pack List**. A listing by the seller of goods for what items are contained in a given shipment.

-**Packaging Costs**. Costs allocated to an item for repacking, relabeling, or in some way modifying boxes received to integrate with boxes shipped in a distribution scheme.

-**Paretto's Law**. A theory proposed by Italian economist, Vilfredo Paretto, that suggests that 80% of business activity is generated by 20% of the elements; and 20% of activity is generated by 80% of the elements. Also known as the "80/20 Rule".

-**Payment Terms**. The terms that a supplier requires for payment of goods. This is a separate and distinct concept from freight terms.

-**Pick Size Forecasting**. The processes of predicting future pick size. Often used to establish Order Point and Order Quantity so that replenishment is completed in pick size increments, thus eliminating Lot Size Inventory.

-**PORG (**Purchase Order Requirements Generation). A P21 process whereby the system calculates items that are below Order Point, or for which there is no apparent available stock, for purchase or review based on Purchase Criteria.

-**Potential Inventory Turnover**. The theoretical turns realized in the present replenishment system, if fully compliant. Equal to Theoretical Inventory Value divided into annual Cost of Goods Sold.

-**Prepaid**. Freight terms in which the supplier pays freight to the customer's dock.

-**Prepaid and Add**. Freight term meaning that supplier pays freight and bills the customer for the cost.

-**Price.** The value that a customer pays for goods or services. It is the value at which parts are sold.

-**Price List**. See *Pricing Page*.

-**Pricing Page**. A Price List that is established in a table in P21 that assigns prices to sale quantities based on customer and quantity. Also known as a Price List.

-**Pro Forma Invoice**. An invoice that is created and presented for orders that require some sort of prepayment.

-**Processing Time Inventory**. Inventory that is held to cover processing time. If you use 100 parts per day, and you expend one day to order parts and one day to receive in parts, then 200 parts must be held in stock to cover the processing time to procure new stock.

-**PTV**. See *Purchase Target Value*.

-**Purchase Criteria**. A setting that groups items by a common denominator or denominators for PORG calculation.

-**Purchase Order**. An offer to purchase to a supplier, that when accepted, becomes a binding contract between the parties.

-**Purchase Order Calculator**. See *Economic Purchase Order Calculator*.

-**Purchase Price Page**. See *Cost Page*.

-**Purchase Stock Card**. A display in P21 that summarizes the Order Point status for a given item. It allows an analyst to view the OP calculus and Net Stock of the item.

-**Purchase Target Value**. A value, expressed in either weight or quantity, at the Supplier level, that provides visibility to a buyer in purchase order entry of a desired purchase order value. Also known as "PTV".

-**Quantity Available**. Shown in P21 as "Qty Available", which is the amount of goods "available" for sale (in the warehouse, less open sales orders that are due now, PLUS prepaid invoices).

-**Real Time**. A technology concept whereby business processes and transactions are completed and made visible to all users as they occur, simultaneously.

-**Recognition**. The process of proposing parts that MIGHT be in need of replenishment, based on reorder point.

-**Reorder Point**. See *Order Point*.

-**Required Date**. The date that parts are required to be on our dock from a supplier.

-**Return on Assets**. Net Income divided by Average Total Assets. ROA is a measurement of a company's financial return of the money it has invested in its assets.

-**Return on Inventory Investment**. Also known as "ROII", calculated by dividing the annual gross profit into the investment. Measures the return on investment of inventory.

-**Review Cycle**. The time in days that economic purchase orders can be accumulated for a supplier under normal circumstances.

-**RFQ** (Request for Quote). A solicitation request to a supplier to quote parts with prices, terms, and availability.

-**Risk Costs**. The cost associated with inventory from damage, spoilage, waste, or obsolescence.

-**ROII**. See *Return on Inventory Investment*.

-**ROAI** (*Return on Added Investment*). A calculation used to determine if hoarding decisions are wise. Calculation is made based on settings established in the PORG "Factor" tab.

-**Safety Factor**. A mathematical calculation of proportionate inventory requirements to realize a given Service Level, based on the number of standard deviations provided as safety stock.

-**Safety Stock**. Inventory that is held to reduce stockout risk from unforeseen changes in demand or supply. Similar to Fluctuation Inventory.

-**Safety Stock Factor**. A multiplier that allows Safety Stock days to be altered based on the velocity and importance of a particular item.

-**Sales Order**. An acceptance of an offer to buy (purchase order) from a customer, that when accepted, becomes a binding contract.

-**Scheduled Order**. Also known as a "scheduled release". Refers to a Purchase Order or Sales Order that is intentionally scheduled to ship in multiple dispatches.

-**Service Level**. The fill rate percentage of line items sold. Service Level can be expressed on a stockout basis (a partial line filled is counted toward Service Level); or a back-order basis (a line must be filled completely to count toward Service Level).

-**Skew**. The statistical concept that refers to data distribution when data points cause the tails of a Bell Curve to swing out.

-**SKU** (Stock Keeping Unit). A unique part number that possesses unique attributes in an inventory control system that is identifiable.

-**Soft Cost**. Non-product, non-invoiced direct costs associated with a given item. Such costs include freight, duties, and other fees and expenses associated with shipping parts to our dock.

-**Soft Cost Management Tool**. A data-driven supplemental tool designed and built by G.L. Huyett engineers that collects soft costs from purchase orders received and allows analysis and summation of such costs at the supplier and product line level. Used in making Landed Cost calculations.

-**Source Note**. A special Non-Mandatory Note that specifically provides sourcing information to a user.

-**Source Reference Field**. A data field primarily used in the Cost tab of IMI, that displays sourcing information to users for the purpose of negotiating cost with the approved supplier, or for identifying potential suppliers of un-sourced items.

-**Standard Cost**. A cost that is populated into P21 that is a pre-negotiated cost from a supplier based on negotiation, a quote, or a Supplier's Price List. Standard Cost will auto-populate into purchase order entry with proper system settings.

-**Standard Deviation**. A statistical concept that measures the variability of a group of values. In simple terms, it is the measurement of the variation of numbers from their mean. A low standard deviation suggests that the numbers are all closely grouped (and more predictable), where a high standard deviation suggests that numbers are spread out over a wide range of values.

-**Stockout**. An inventory condition created when an order is received and there is not stock to fill the order on the desired date due.

-**Stockout Basis**. A method of measuring Service Level that calculates fill rate based on partial lines shipped against lines ordered.

-**Stockout Cost**. Organizational costs associated with lost sales, backorder issuances, and expedited fees when inventory is not available when needed.

-**Storage Costs**. The costs in real estate, warehouse storage, and warehouse transportation for having inventory.

-**Structurally Created Inventory**. Inventory that is held by an organization due to the organization's own inefficient processes. The inventory is usually created by processes that are wrong (the process yields errors in judgment by decision makers) or from processing time (the organization is slow to respond to changes in supply and demand).

-**System Management Costs**. Costs incurred from the investment of time and resources into reviewing and modifying system settings to ensure accurate results.

-**Theoretical Inventory Value.** The hypothetical value of inventory if the replenishment system has full compliance. It is the value "in theory" of inventory on hand. Equal to one half of Order Point plus Order Quantity.

-**TIV**. See "*Theoretical Inventory Value*".

-**Transaction Costs**. Costs incurred to process a transaction. In replenishment, such costs might include buyer time, receiver time, putaway time, Accounts payable time, and freight costs. Such costs are normally fixed to a pallet level (Transaction costs are the same to process a box or pallet of the same goods).

-**Transaction Created Inventory**. Inventory that is created and held as a result of inefficient or incorrect order points and order quantities in a replenishment system.

-**Transportation Costs**. Costs in freight and handling to ship parts to our dock. Transportation costs do not include duties or other nonshipping costs associated with soft costs.

-**Transportation Inventory**. Inventory that is held to cover transportation time between producer and distributor, or producer and consumer. If the milk man only stops once per week, and the household uses a gallon of milk per day, six gallons of transportation inventory will be held in stock on the first day, and as depleted, will result in no stock on the last day. Average inventory would be three gallons for the week, which is equal to Transportation Inventory.

-**Turnover**. Also known as “turns” or “inventory turnover”. Calculated by taking annualized sales in units or value, and dividing into average on hand inventory.

-**Turns and Earns**. A financial calculation consisting of multiplying Gross Margin by Inventory Turnover. The calculation links the Balance Sheet to the Operating Statement and provides an analyst a comparative result for management purposes.

-**Up To**. An Independent Ordering System where Order Point is calculated using dynamic data, and Order Quantity is calculated based on a maximum on-hand value, often expressed as a multiple of APU. The order quantity is sometimes referred to as Period Order Quantity.

-**Usage Factor**. A multiplier used in Op and OQ calculations in the EOQ replenishment method that allows for calibration of Average Period Usage based on forecasted changes in demand. By adjusting the Usage Factor from 1.0, a direct multiplier effect is made on APU. The Usage Factor may be set from 0.0 to 2.0.

-**UPS**. A freight term that is the abbreviation for “United Parcel Service”. By attaching a service level code (“NDA” or “Red” for “Next Day Air”; “Blue” for “Second Day Air”; “Orange” for three day guaranteed), specific instructions can be provided.

-**Vessel Tracking**. A P21 feature that allows multiple purchase orders to be grouped together and managed as “vessels” in the system. Allows for container building from multiple suppliers with multiple purchase orders.

-**VMI** (Vendor Managed Inventory). This is the trade reference and sales jargon for integrated supply management.

-**Yield Management**. The process of using system variables, reporting, and analysis so as to properly balance high inventory turnover against high service level.

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