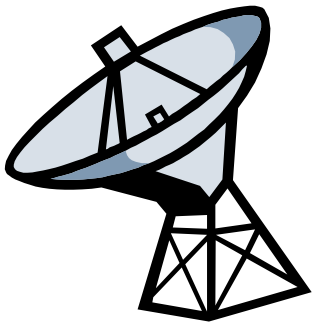
institute for supply management

Institute for Supply Management™ Satellite Seminar Series

Controlling Costs by Controlling Your Inventory

Program Handbook



Program No. SSS-03-0037

April 1, 2004

VCM38

The Institute for Supply Management welcomes you to this Satellite Seminar broadcast!

Thank you for participating in this ISM Satellite Seminar. We hope you find today's session to be a rewarding educational experience.

PLEASE GIVE US YOUR FEEDBACK!

Please remember to complete the program evaluation for today's program online via the ISM Web site at:

www.ism.ws/surveys/index.cfm?SurveyID=337

All materials contained in this *Program Handbook* are the property of the Institute for Supply Management (ISM), unless otherwise noted. Members of our seminar panel may have provided additional information and materials for your use. Please make sure that the proper source is credited if you use these materials when you return to your organization.

The statements and opinions expressed by the panelists in this program are solely those of the individuals, and are not necessarily endorsed by ISM.

Mark your Calendar and Plan to Join Us for ISM's Upcoming Satellite Seminars:

June 10, 2004: Improving Your Role with Effective Project Management

Business success often is the reward for effective project management. Superior project management methodology lays the groundwork for smooth navigation through each project phase. This program will explore the necessary skill sets, essential steps, and helpful techniques to enable you to incorporate project management into your job and meet challenges you may encounter along the "project management highway."

October 21, 2004: Best Practices for Negotiations and Contracting

Supply managers spend a substantial amount of time negotiating contracts and tackling matters related to contracts. This satellite seminar explores leading-edge ways to enhance the effectiveness of negotiating and contracting by focusing on the dynamic relationship between these activities. Discover strategies to enhance your organizational processes for negotiations and contract management, analyze team roles and essential elements of an effective negotiation, and learn how to draft and manage contracts to meet your organization's objectives.

February 10, 2005: Finding and Keeping the Best Sources

As supply mangers adapt to the impact of globalization and continual technological advances, sourcing is becoming more multi-faceted and critical. This program explores sourcing strategies, risk management, and how to use more sophisticated technology to streamline the sourcing process. Learn the essential factors to consider in determining which suppliers will be most effective in meeting your organization's needs. Hear supply management professionals discuss topics such as offshore sourcing, outsourcing, performance measurements, resources, and other management considerations to find the right sources and ensure long-term and successful supplier relationships.

April 14, 2005: Supply Chain Research Trends and Market Intelligence

What are the latest trends in the supply chain? How can supply professionals keep up with the rapidly changing procurement and supply environment? This satellite seminar focuses on the current state of the supply management profession and where it is heading, and includes a look at best practices and resources for effective decisionmaking. Supply chain experts will share their perspectives on market intelligence, including a discussion of how to recognize elements of market intelligence and its impact on today's business world.

June 9, 2005: Discovering Supply Management's Social Conscience

A supply professional needs only to look at the front page of the *Wall Street Journal* to be reminded of the importance of social responsibility. Ethical improprieties concerning accounting and finance, as well as safety, environmental, and human rights issues often make front-page news. Conversely, companies that have exemplary records in these areas of corporate social responsibility (CSR) can market their efforts to customers, shareholders, employees, and other stakeholders including suppliers. As a key interface with suppliers' service providers in supply chain areas such as transportation and logistics, the supply management function can play an important role in an organization's CSR efforts. This satellite seminar examines the types of activities that supply managers can engage in to support their organizations' CSR initiatives, and how to initiate, sustain and measure the results of a CSR program.

The information on these programs is preliminary and subject to change.

Table of Contents

SECTION 1:

PROGRAM AGENDA

Controlling Costs by Controlling Your Inventory

April 1, 2004

Recently published major purchasing and supply management textbooks estimate that an average company's inventory represents between 25 and 40 percent of its invested capital. Supply managers need to know how inventory impacts the bottomline and how reducing inventory costs frees up cash that can be used for business growth. This program is designed to provide tools and techniques for inventory management.

Who Should Attend?
This satellite seminar is geared for supply professionals:

- Seeking information on the impact of inventory on a company's bottomline or a government entity.
- Needing an understanding (or refresher) of inventory processes, tools, and techniques.
- Seeking to add more value to supply management through a better understanding of inventory issues.
- Wanting to gain an understanding of how inventory can affect customer service levels and an organization's competitive advantage.

Program Outline

I. The Role of Inventory in the Organization

A. What is Inventory?
B. Inventory's Link to Supply Chain Management
C. Creating an Inventory Consciousness

II. Exploring the Numbers

A. Tools to Understand Inventory
B. Inventory Carrying Costs
C. Inventory Integrity

III. Critical Decisionmaking for Inventory Control

A. Quantity Issues
B. Timing Issues
C. Systems for Inventory Control

IV. Inventory's Role in Supply Chain Management

A. Inventory and the supply chain
B. Reducing inventory within the chains
C. Purchasing as manager of the chain
D. A network of suppliers and the impact on inventory reduction and costs

April 1, 2004 Satellite Seminar Panelists

Main Presenter:

Marilyn Gettinger, C.P.M. owns and manages the consulting firm, New Directions Consulting Group, an organization she created in 1993. She designs customized training programs and consulting services to prepare organizations to meet the demands of the 21st century. Her clients include medical institutions, pharmaceutical, medical device, food, and cosmetic manufacturers, mold manufacturers, as well as warehouse and distribution companies. Marilyn is an adjunct professor in the Materials Management program degree and certificate program at Bloomfield College, and she coordinates and instructs the Materials Management certificate program offered by Union County College. She also teaches ISM certification preparation courses at Union County College and on site at company locations. Marilyn has presented workshops at ISM's Annual International Conferences for the past five years, and is scheduled to present again this year in Philadelphia. She also has presented workshops for ISM affiliates around the country, several APICS conferences, and she recently facilitated an ISM online course. Marilyn holds an MBA from Fairleigh Dickinson University and is certified in materials management from Bloomfield College.
E-Mail: mgettinger@aol.com

Panelists:

J. Steven Boyle is the director of global logistical development for SOLA International Inc., a multinational manufacturer and distributor of ophthalmic products located in Del Mar, California. His responsibilities encompass global inventory management including the setting and monitoring of inventory targets to achieve agreed inventory turns and customer service levels, and he personally designed the in-house global inventory management and distribution system that SOLA now employs at its 16 global locations. Steve has 20 years experience with multinational organizations in production management and the global logistics sectors. Prior to joining SOLA in 1996, he held positions as global operations director with American Optical in Tijuana, Mexico; materials director with UK Optical in London, England; and senior operation manager for Abbott Laboratories in Kent, England. Steve was born in England and obtained a Bachelor of Science degree in Applied Mathematics at a UK university. He has lived in the USA for ten years and now holds U.S. citizenship.
E-Mail: jsboyle@pacbell.net

Jeffrey Jackson, C.P.M. CPIM is director of materials for Sparton Electronics. He has 25 years experience in supply chain operations, working in positions where inventory control, matching inventory process with manufacturing processes and with sourcing processes was paramount. His career spans the automotive and electronics industries, having worked for Tenneco Automotive, SPX Corporation, Harris Corporation, and Schneider North America. He is a graduate of Michigan State University. Jeffrey is a former Pro-D chair for ISM's Florida Gulf Coast affiliate, and teaches C.P.M./A.P.P. review classes as well as a variety of supply chain management subjects.
E-Mail: jeffjackson@sparton.com

Darin Matthews, C.P.M., A.P.P., CPPO currently serves as director of procurement for Portland Public Schools in Portland, Oregon. He has over 15 years of purchasing and supply management experience in state and local government, as well as private industry. He is a past board member of the Oregon affiliates of the National Institute of Governmental Purchasing (NIGP) and ISM. Darin speaks throughout North America on a variety of procurement topics, and his writings have been featured in *Purchasing Today, The Procurement Professional, American City and County,* and the *Oregon Daily Journal of Commerce*, and is currently co-authoring two textbooks on supply management through Florida Atlantic University. His other published works include "Government Purchasing: An Evolving Profession" *(Journal of Public Budgeting, Accounting, & Financial Management*) and "Logistics and Transportation" (*Encyclopedia of Public Administration and Public Policy*). He holds a BS in business and political science is a Master Instructor for NIGP, and serves on their Board of Directors.
E-Mail: dmatthew@pps.k12.or.us

How to Call In a Question

You will have four opportunities during the course of the broadcast to submit questions to the satellite seminar panel. Questions of general interest that will appeal to a wide audience are encouraged. Our goal is to balance the amount of time spent on delivering valuable content to viewers and allowing interactive time via live Q&A. As we work within the program's time constraints to reach this balance, not all questions sent in can be answered during the broadcast. ISM program staff will work with the panelists to ensure that a wide variety of questions that are relevant to the program topic are addressed on the air.

Three Ways to Submit Questions:

- **Telephone.** Call in your question to **480/965-5712**. An ISM staff member will answer the telephone. You can ask your question "live" on the air, or (if time allows) ask to have your question written down and delivered to the program's host in the following Q&A segment. If you'd like to ask your question live on the air, you will be put on hold for a short time until the panelists are ready for the next question. When it's your turn, the program's host will ask you for your question. When you are finished asking the question, the host will thank you and present your question to the presenter(s). You then NEED TO HANG UP the phone to allow other calls to follow. **Please ask only one question per "live" call and, to allow others a chance to ask their questions, please call in only once if your question is used on the air.**

- **Fax**. You may fax your question in at any time during the program. ISM's special fax number at the television studio is **480/965-1998**. On the day of the program, please fax directly to this phone number. You may fax in as many questions as you wish, however depending on the volume of questions received, only one of your questions may be answered during the broadcast. **BEFORE THE PROGRAM DATE**, you may fax your question to ISM's headquarters, to the attention of Lara Wheeler at 480/752-7890. **Do not fax your questions to ISM headquarters on the day of the program.**

- **E-Mail**. Send your question via e-mail to **ISM@asu.edu**.

Question Call-in Form

Use the form on the reverse side of this page to call-in or fax your question. The form has three sections:

- **Section 1** is for your use to note the phone or fax location before the program begins. The telephone or fax machine at your downlink facility may be located in a room other than where you are viewing the program. The location will be pointed out to you by your local affiliate downlink site coordinator.

- **Section 2** shows the contact information for phone, fax, and e-mail, for easy reference.

- **Section 3** is for you to fill in your name, city or affiliate/organization name, and your question. Please indicate if the question is to be directed specifically to one of the panelists or the entire panel. If you call in your question, complete this form to use as your "script." If you fax in the question, simply fax in this completed form. **PLEASE PRINT CLEARLY.**

Procedures for "Live" Questions

If your question is selected and you choose to ask it "live" on the air, please follow these guidelines:

- Complete the "Question Call-in Form."

- Wait to be introduced by the satellite seminar host. You may be "on hold" for several minutes while other questions are being answered. While on hold, please remain on the line and do not talk.

- You will be introduced by the host when it is time to ask your question. Read the completed section of your form where you wrote the question. Speak slowly and clearly.

Question Call-In Form

Section 1: (for your reference)

Location of the call-in phone: _____

Location of the fax machine: _____

Section 2:

Call-in phone number: The phone number to use is **480/965-5712**.

Fax phone number: The fax number to use is **480/965-1998**.

E-mail: The e-mail address is **ISM@asu.edu**

Section 3: (Fill in the following information prior to making the phone call.)

"**Hello, my name is** _____

I'm calling from _____
(ISM affiliate, corporate site name, or city and state)

My question is for _____ ❑ the entire panel.
(name of specific presenter/panelist)

My question is (please print clearly): _____

_____

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SECTION 2:

PROGRAM GRAPHICS

ISM SATELLITE SEMINAR SERIES

CONTROLLING COSTS BY CONTROLLING YOUR INVENTORY

Thursday, April 1, 2004
7:00 a.m. Pacific
8:00 a.m. Mountain
9:00 a.m. Central
10:00 a.m. Eastern

1

ISM SATELLITE SEMINAR SERIES

CONTROLLING COSTS BY CONTROLLING YOUR INVENTORY

April 1, 2004

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Agenda: Segment 1

The Role of Inventory in the Organization

- What is inventory?
- Inventory's link to supply chain management
- Creating an inventory consciousness

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Agenda: Segment 2

Exploring the Numbers

- Tools to understand inventory
- Inventory carrying costs
- Inventory integrity

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Agenda: Segment 3

Critical Decision-Making for Inventory Control

- Quantity issues
- Timing issues
- Inventory Control Processes

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Agenda: Segment 4

The Role of Inventory in Supply Chain Management

- Inventory and the supply chain
- Reducing inventory within the chains
- Purchasing as manager of the chain
- Technology
- Suppliers' impact on inventory

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Please submit your Program Evaluation Online at:

www.ism.ws/surveys/index.cfm?SurveyID=337

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Controlling Costs by Controlling Your Inventory

Segment 1:

The Role of Inventory in the Organization

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What is Inventory?

- Inventories are materials and supplies that a business or institution carries to:
  - sell to other organizations
  - provide inputs into the manufacturing process
  - support the management of various functions within the organization
  - enable the production of goods (equipment)

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Inventory Management and Control

- Inventory management and control is the planning and controlling of all inventory within an organization.
  - Who sets the inventory policies within the organization?
  - Who is accountable for inventory results?

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Inventory Management and Control

- Flow and kinds of inventory needed
- Supply and demand patterns
- Functions that inventories perform
- Objectives of inventory management determined by the organization/institution
- Costs associated with inventories

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Inventory Classifications

- Raw materials
- Work-in-process (WIP)
- Finished goods
- Semi-finished goods
- Supplier-managed inventory
- Maintenance, repair, and operational supplies (MRO, expense items, M&O)

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Functions of Inventory – to:

- Meet customer demands
- Provide a designated level of customer service
- Manage the risk factors experienced in a global marketplace
- Take advantage of shifts in the marketplace
- Ensure operating efficiencies

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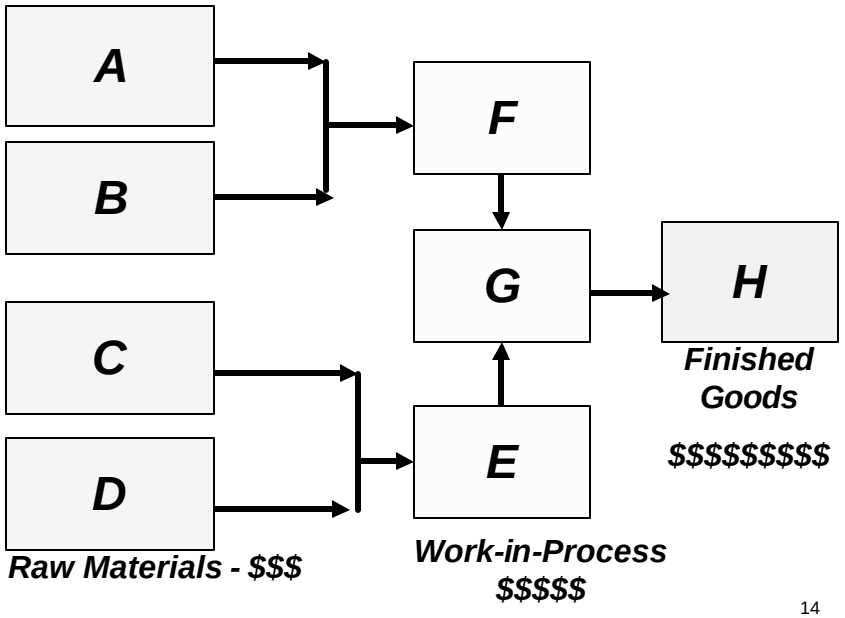

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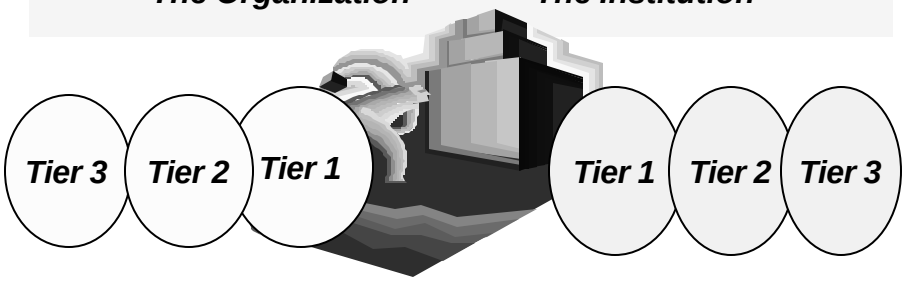
Inventory's Link to Supply Chain Management

The Organization ***The Institution***



Supply base – Upstream ***Customers - Downstream***

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Inventory's Link to Supply Chain Management

- Safety stock throughout the entire chain
- Waste throughout the entire chain
- Lack of concrete information
- Minimal visibility throughout the chain
- Minimal communication throughout the chain

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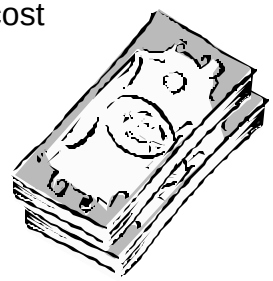
What Does It Cost Organizations to Manage Their Inventory?

Carrying costs

- Cost of capital or opportunity cost
- Overhead
- Insurance and taxes
- Salaries and benefits
- Handling
- Computer space
- Damage or obsolescence or shrinkage



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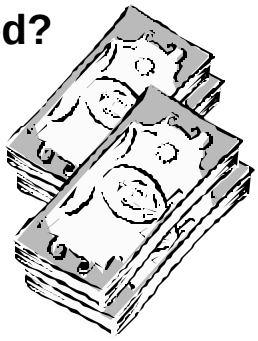
What Does It Cost If Inventory Is Not Managed?

- Stock outs
- Loss of customers
- Emergency shipments
- Machine downtime
- Ineffective use of administrative time



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Senior Management and Inventory

- Costs to implement an efficient inventory management system
- Identify and document all costs incurred due to
  - lack of inventory integrity
  - poor forecasts
  - lack of communication
  - ineffective internal processes
  - lack of training and understanding

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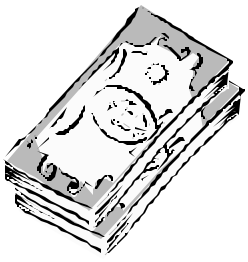
Senior Management and Inventory

- Opportunity costs
- Morale issues
- Lack of confidence in the organization or institution
- Employee turnover
- Supplier turnover



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Inventory Integrity

- Effective locator system
- Item coding system
- Well-trained receiving department
- Supplier performance
- Efficient documentation
- Effective space utilization
- Well-managed warehouse
- Sufficient space for inventory requirements
- Cycle count program that identifies the root cause of miscounts
- Limited access to inventory
- Well-trained staff
- Liquidation of obsolete, damaged, and/or surplus inventory

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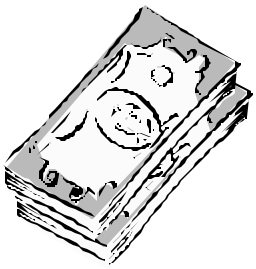
Return on Investment

- Savings / Investment
- Savings due to an efficient inventory process
- Investment in time and materials to implement a quality inventory management and control system



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Segment 1: Points to Remember

- An organization-wide awareness
- Every department impacts inventory
- Materials are ordered at one location to be received in a multi-location environment
- Materials are located within every site, division, sister-company, etc.

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Segment 1: Points to Remember

- It is not just the domain of the warehouse / stores
- Inventory management and control – informed cross-departmental communication and decisions
- Materials are located within co-op and consortium arrangements

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REMEMBER….

Inventory Is Everyone's Business!

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Controlling Costs by
Controlling Your Inventory

Segment 2:

Exploring the Numbers

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Financial Report Cards

- Balance Sheet – Captures the financial situation of the organization or institution as of a particular date in the prior month, usually the last day of the month
- Income Statement – Reflects the financial activities that have occurred during the prior month

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Inventory Turns…

A measure of how efficiently an organization / institution is managing its inventory.

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The Negative Impact of Inventory Levels on the Organization

- Loss of capital usage
- Stock evaluation and rating by investors and banking
- Space considerations
- Third-party storage fees
- Loss of productivity – increase in cycle times
- Damage, obsolescence and shrinkage
- Insurance and taxes

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The Positive Impact of Inventory Levels on the Organization

- Cash flow improvements
- Investment opportunities
- Supply opportunities
- Quality customer service
- Minimal down time
- Reduction in expedited shipments
- Reduction in rush orders
- Strategic sourcing opportunities

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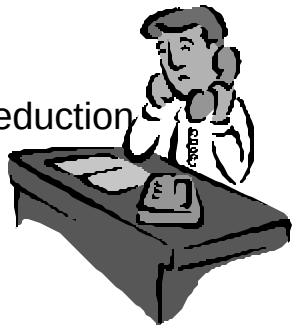
Purchasing's Impact on Carrying Costs



- Supply management efforts that cause a reduction in inventory
- Any reduction in inventory results in a reduction in carrying costs and an increase in cash flow

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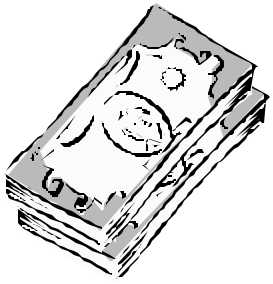
Purchasing's Impact on Carrying Costs

- Consignment arrangements
- Lead time management
- Supplier selection
- Supplier performance improvement efforts
- Electronic orders



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Purchasing's Impact on Carrying Costs

- The ability to make informed purchasing decisions based on global and economic data
- Supplier development and management
- A thorough understanding of international sourcing challenges
- Supplier-managed inventory
- Order maintenance

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Purchasing's Impact on Carrying Costs

- Strong internal relationships
- Early purchasing involvement
- Early supplier involvement
- Transportation efficiencies
- Marketplace knowledge

- Forecast management
- Communication
- Location considerations
- Supply leveraging opportunities
- Alliances and partnerships
- Standardization

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A Closer Look At Inventory Integrity

- The impact and cost of inaccurate inventory numbers
- Purchasing's role in maintaining inventory integrity
- Supplier selection
- Supplier performance evaluations
- Packaging and labeling
- Documentation

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The Impact and Cost of Inaccurate Inventory Numbers

- Stock outs
- Expedited freight charges
- Duplicate transaction costs
- Excess inventory
- Obsolete inventory
- Machine down time

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Purchasing's Role in Maintaining Inventory Integrity

- Early purchasing involvement gains time to source and evaluate the best suppliers
- The supplier selection process – choose wisely
- Clear supply guidelines to suppliers
- Continuous improvement initiatives
- Communication to the Receiving Department
- Order management

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Purchasing's Role in Maintaining Inventory Integrity

- Accurate and timely purchase order information in the system or made available on the receiving dock
- Collaboration between supply and inventory personnel
- Accountability for the swift movement of purchased materials through and off the receiving dock
- Elimination of rush orders and expediting efforts

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Inventory integrity and Awareness

Critical Factors in supplier:

1. selection
2. development
3. rating
4. continuous improvement

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Packaging and Labeling

- Same terminology
- Accuracy in coding
- Detailed description and information
- Markings match specified weights, measures, quantities on documents

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Documentation

Documentation must arrive with the shipment

- Packing slips
- Certificates of Analysis
- Certificates of Origin / international documentation
- Certificates of Materials
- Material Safety Data Sheets

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Segment 2: Points to Remember

Supply professionals:

- **play an important role in inventory control and management**
- through their ability to make informed purchasing decisions and manage the supply base, impact inventory --
  - carrying costs
  - levels
  - integrity

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Controlling Costs by Controlling Your Inventory

Segment 3:

Critical Decision-Making for Inventory Control

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Toolbox for Quantity Determinations

- Economic Order Quantity (EOQ)
- EOQ monetary model
- Quantity discount
- Days of supply
- Reorder point system
- Two-bin system
- Three-bin system

Safety Stock Determination:

- Historical data
- Standard Deviation
- Mean Absolute Deviation
- Service levels
- Maximum inventory level

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Just-in-Time

- Elimination of waste and continuous improvement of productivity
- Waste means no surplus, no safety stock, and minimal lead times.
- Long-term result is a cost-efficient, quality-oriented, fast-response organization that is responsive to customer needs.
- *"If you can't use it now, don't make it or buy it now."*

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Just-in-Time

Important sources of waste:

1. The process
2. Methods
3. Movement
4. Product defects
5. Waiting time
6. Overproduction
7. Inventory

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Flow Manufacturing

- A form of manufacturing that is concerned with the continuous flow of products
- Major characteristics:
  1. Routings are fixed and work centers are arranged according to the routing
  2. Work centers are dedicated to producing a limited range of similar products
  3. Material flows from one workstation to another using some form of mechanical transfer
  4. Capacity is fixed by the line

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Material Requirements Planning (MRP):

- Used to determine the quantity and timing requirements of Dependent Demand materials used in a manufacturing operation
- Materials can be purchased externally or produced in-house.
- The computer-based system utilizes a master production schedule, bill of materials, and current inventory data to determine current new requirements and timing.

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Material Requirements Planning

- Responsibility for:
  - setting inventory objectives and goals
  - maintenance of the MRP system software
  - lead time adjustments
- 95% inventory integrity
- 98% bill of material integrity

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Purchasing's Role in the Right Quantity Determination

- Supply relationships
- Marketplace knowledge
- Supply chain challenges
- Potential shortages or price increases
- Lead time management
- Security issues

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Product Life Cycle Management

- The analysis of the demand for a product and its market acceptance over the life of the product
- Product life-cycle management asks:
  - When will the various stages occur?
  - How must the organization accommodate those stages?
  - What facilities, materials, labor, and management systems are optimal for meeting anticipated demand?

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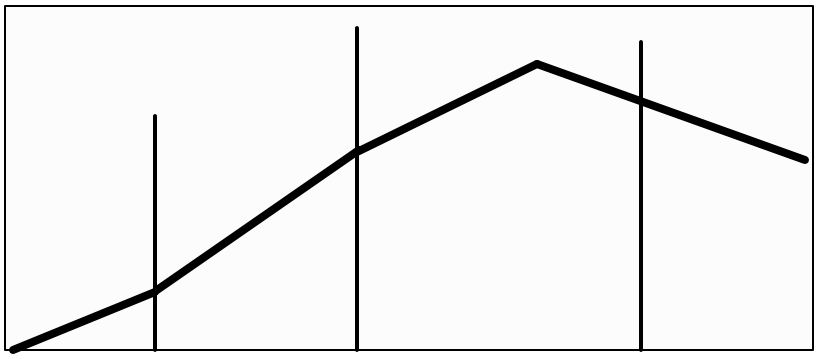
Product Life Cycle Management



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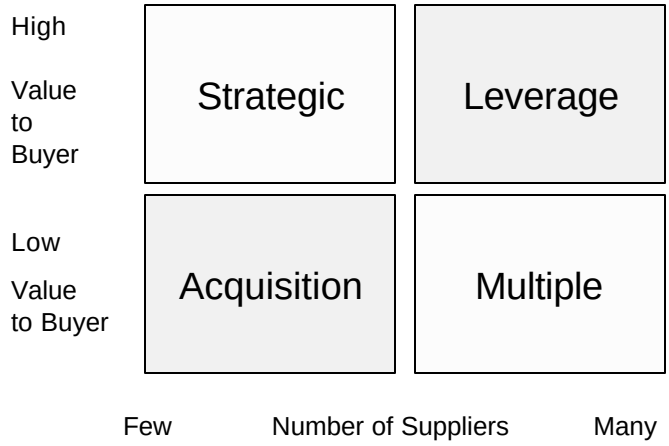
Strategic Management of Materials



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Timing Issues

- Toolbox for determining delivery schedule
- Time-phased concept and MRP
- Lead time issues
- Purchasing's role in delivery timing

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Toolbox for Determining Delivery Schedule:

Fixed order interval

Fixed period model

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Total Inventory View

- Effort to synchronize the receipt of all components or raw materials so that they arrive at approximately the same time, allowing for inspection requirements and other incoming efforts
- Supply sources qualified to take responsibility for the inspection process, allowing goods to move off receiving dock into inventory or into the production area

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Purchasing's Role in Delivery Timing

- Suppliers' slack times
- Transportation lead time
- Peak period transportation costs increases
- Fuel surcharges
- Trade-offs
- Business cycle
- Lead time management and system updates
- Supplier agreements to make and hold until released

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Purchasing's Role in Delivery Timing

- Security issues
- Weather conditions
- Incoming inspection requirements
- Flexibility of the supplier
- Multiple suppliers segmented to produce or hold inventory based on a forecast and other suppliers capable of handling rush orders
- Volatility of certain materials

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Inventory Control Processes

- Material Requirements Planning
- Replenishment systems
- Just-in-Time
- Visual inspection
- Supplier-managed inventory

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Segment 3: Points to Remember

- Supply professionals make critical quantity and timing decisions on the materials they buy
- Those decisions either build inventory or reduce inventory
- The ability to make informed supply decisions requires:
  - Skill in using quantitative tools
  - Understanding of manufacturing concepts
  - Use of software programs
  - Market-based knowledge
  - Supply base awareness

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Controlling Costs by Controlling Your Inventory

Segment 4:

The Role of Inventory in Supply Chain Management

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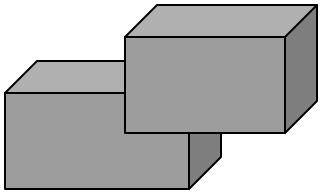
Inventory's Role In Supply Chain Management

- Reducing inventory within the chains
- Purchasing as manager of the chain
- A network of suppliers and the impact on inventory reduction and costs



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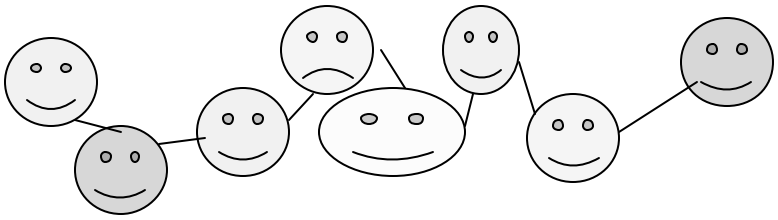
Inventory and the Supply Chain

The supply chain is composed of a network of customers and suppliers within which products and services are moved from the start-off supplier through the various tiers of suppliers to the organization/institution to the final customer.



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Inventory and the Supply Chain

- Inventory is at every level.
- Safety stock or just-in-case inventory is lurking within each link of the chain.

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Inventory's Role In Supply Chain Management

Total Cost of Ownership (TCO)

JKL Company		
Unit Cost		$ 10.00
On-time Performance 90% .10 x $10	$ 1.00	$ 11.00
Quality Performance 85% .15 x $10	$ 1.50	$ 12.50
Total Cost of Unit		$ 12.50

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Other TCO Factors	Value/%
Carrying Costs	
Taxes	
Scrap	
Repair	
Maintenance	
Shelf life	
Disposal	
Total	

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Inventory's Role in Supply Chain Management

Adding value to inventory

- Standard costing systems
- First-In, First-Out
- Last-In, First-Out
- Average Cost
- Replacement Cost
- Activity-Based Costing

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Reducing Inventory Within the Chains

- Improve communication at every level of the supply chain
- Create a supply chain awareness both upstream and downstream
- Create visibility of inventory at every level
- Just-in-Time II (JIT II)

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The Impact of Technology

- Supply chain software
- Electronic Data Interchange (EDI)
- Electronic Commerce
- Bar coding
- Radio Frequency Identification (RFID)
- Customer Relations Management (CRM) software

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A Network of Suppliers

The Impact on Inventory Reduction and Costs

- Early supplier involvement
- Technical bidding
- Tier suppliers working as a team
- Project suppliers working as a team
- In-house supplier brainstorming sessions
- Mission, objectives, goals, and challenges

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Segment 4: Points to Remember

- **Supply chains both upstream and downstream are untapped opportunities for:**
  - **Inventory reduction**
  - **Inventory integrity**
  - **Carrying cost reductions**
- Supply professionals who consider inventory awareness an important part of their jobs are going to see:
  - Reduced TCO
  - Improved cost of inventory
  - Reduced cycle times
  - Reduced supplier pricing
  - More efficient operations

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Don't forget to Complete your Program Evaluation Online at:

www.ism.ws/surveys/index.cfm?SurveyID=337

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Today's Presenters

Main Presenter:

- Marilyn Gettinger, C.P.M., New Directions Consulting Group

Panelists:

- Steve Boyle, SOLA International
- Jeffrey Jackson, C.P.M., CPIM, Sparton Corporation
- Darin Matthews, C.P.M., CPPO, Portland Public Schools

Moderator:

- Bill Andres, BJC Public Relations Consultants

Refer to your Program Handbook for contact information.

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SECTION 3:

INVENTORY RESOURCES

Glossary of Inventory Terms

ABC ANALYSIS – Application of Pareto's Law, or the 80/20 rule. ABC analysis is a determination of the relative ratios between the number of items and the dollar value of items purchased repetitively for stock. Typically 5-10 percent of the items (A items) account for 75-80 percent of the investment, 20-25 percent of the items (B items) account for 15-20 percent of the investment, and 70-75 percent of the items (C items) account for 5-10 percent of the investment.

ACQUISITION COST – In the context of Economic Order Quantity (EOQ) analysis, the acquisition cost includes all costs associated with generating and processing an order and its related paperwork.

ANTICIPATION INVENTORY – Anticipation stocks are accumulated for a well-defined, certain future need.

BAR CODE – A pattern of alternating parallel bars and spaces, representing numbers and other characters that are machine readable. Bar coding technology helps reduce error rate and improves entry speed and count accuracy in inventory operations.

BASE-STOCK SYSTEM – In its simplest form, a base-stock system (also called a par-stock system) is an inventory system in which a replenishment order is issued each time a withdrawal is made, and the order quantity is equal to the amount of the withdrawal.

BLANKET ORDER – A term commitment (usually one year or more) to a supplier for certain goods or services over a predetermined period of time at predetermined prices, most-favored customer prices, or prices to be revised due to market or other conditions. This practice is aimed at reducing the number of small orders, utilizing short-term releases to satisfy demand requirements.

CONSIGNMENT BUYING – A method of procurement in which a supplier maintains inventory on the premises of the purchaser. The purchaser's obligation to pay for the goods begins when goods are drawn from the stock for use.

CONTINUOUS-REVIEW SYSTEM – An inventory control system in which the remaining quantity of an item is reviewed either manually or by computer each time a withdrawal is made from inventory to determine whether it is time to reorder.

CRITICAL-VALUE ANALYSIS – A modification of the ABC analysis concept in which the subjective value of criticalness, as opposed to the actual dollar value, is assigned to each inventory item.

CYCLE COUNT (or Continuous Inventory) – A physical stock checking system in which the inventory is divided into 52 equal groups, one of which is physically counted each week. Thus, the physical inventory operation goes on continuously without interrupting operations or storeroom activities.

CYCLE STOCK – The active portion of an inventory, i.e., that part of inventory which is depleted through regular withdrawals or use, that is replenished through repetitive orders.

CYCLE TIME (See also Order Cycle) – The replenishment cycle represents the period of time required to order and make available the required stock (e.g., the time between receipt of the requisition and delivery of the material to the requisitioner).

DECOUPLING INVENTORY – Inventory retained to make possible the independent control of two operations, sometimes referred to as line-balancing stock. Also, inventory that is a form of buffer or safety stock that is held within the work-in-process flow to provide substitute work in case the production line goes down.

DEPENDENT DEMAND – Derived or contingent upon the demand for a component or a finished product; i.e., the demand for axles used in the assembly of automobiles is dependent on the demand for the finished automobiles.

DISTRIBUTION INVENTORY – Inventories located in the distribution system (manufacturers' warehouses, regional warehouses, and local warehouses).

ECONOMIC ORDER QUANTITY (EOQ) – An order quantity model used to determine the quantity of an item to be ordered or manufactured that minimizes total acquisition and inventory carrying costs. The most common use of EOQ is for independent demand items.

FILL RATE – The proportion of all stock requisitions that are filled from stock. The inverse of this is stock-out rate, which is the percentage of orders for which there is no stock on the shelves resulting in back orders. These measurements can be calculated for any time period; in some retail or distribution organizations it might be computed daily or weekly.

FIXED ORDER INTERVAL – a inventory system in which the inventory analyst reviews the inventory position at fixed time periods.

FLOOR-STOCK – inventory held in the production or assembly area near workstations or assembly lines to minimize the handling of frequently used items and to minimize movement.

HEDGE INVENTORY – inventory such as minerals and commodities, for example, grains, that are traded on the worldwide market.

INDEPENDENT DEMAND – Demand unrelated to the demands for other items or end items produced by the organization.

INVENTORY CONTROL – The effective management of inventories, including decisions about which items to stock at each location; how much stock to keep on hand at various levels of operation; when to buy; how much to buy; controlling pilferage and damage; and managing shortages and backorders.

INVENTORY HOLDING (CARRYING) COST – The cost of keeping inventory on hand, including the opportunity cost of invested funds; storage and handling costs; taxes, insurance, shrinkage, and obsolescence-risk costs. Organizations usually state an item's holding cost per time period as a percentage of the item's value. (Carrying Cost, Inventory Carrying Costs are additional terms used for Inventory Holding Cost)

INVENTORY IN TRANSIT – Physical inventory en route aboard a carrier. The term is also used to include the capital costs of materials, parts, and finished goods en route aboard a carrier. This cost is commonly computed by multiplying the opportunity cost rate, times the value of the inventory, times the percentage of time (annualized) the goods are en route, plus the cost of the material itself.

INVENTORY ORDERING COST – The total cost of generating and processing an order and its related paper work.

INVENTORY POSITION – A measure of an inventory item's ability to satisfy future demand, considering scheduled receipts and on-hand inventory.

INVENTORY TURNOVER – A measure of the velocity of total inventory movement through the organization, found by dividing annual sales (at cost) by the average aggregate inventory value maintained during the year. Many organizations calculate production inventory turnover rate as the annual inventory purchase value divided by the average production inventory value.

JUST-IN-TIME (JIT) SYSTEM – An operations management philosophy in which the dual objectives are to reduce waste and to increase productivity. Operationally, JIT minimizes inventory at all levels; materials are purchased, transported, and processed just in time for their use in a subsequent stage of the manufacturing process.

KANBAN SYSTEM – A system of production flow control that utilizes kanban cards to pull in-process inventories through a manufacturing process, where items are called for only as they are needed in the next step of the production process.

LOT-SIZE INVENTORY – Inventory that is purchased or manufactured in quantities greater than needed immediately. Lot-size inventory may be purchased to take advantage of quantity discounts and/or shipping, clerical, receiving, incoming inspection, or setup efficiencies

MATERIAL REQUIREMENTS PLANNING (MRP) – A computer-based system used to determine the quantity and timing requirements of dependent demand materials used in a manufacturing operation. Materials can be purchased externally or produced in-house. The system utilizes a master production schedule, a product bill of material, and current inventory data to determine requirements and timing.

MRP II (Manufacturing Resource Planning) – An expansion of a basic MRP system that includes the following additional capabilities: (1) capacity planning; (2) a financial interface that permits planning to be done in financial terms as well as operations planning terms; and (3) a simulation capability that can be used in doing alternatives planning work.

MINIMUM REORDER POINT – A predetermined inventory level that triggers a need to place an order. This minimum level (considering safety stock) provides inventory to meet anticipated demand during the time it takes to receive the order.

PERIODIC REVIEW SYSTEM – An inventory control system in which an item's inventory position is reviewed on a scheduled periodic (time) basis, versus a perpetual inventory control system which is reviewed continuously. An order is placed at the end of each review, and the order quantity usually varies.

PERPETUAL INVENTORY SYSTEM – An inventory control record system which requires immediate recording of transactions (receipts and withdrawals) for each item carried in inventory. If posted accurately, the inventory records are up to date and should agree with the actual stock count in the warehouse.

REORDER POINT SYSTEM – A continuous-review inventory control system in which an order is placed whenever a withdrawal brings the inventory to a predetermined reorder level.

SAFETY STOCK – Additional inventory held as a buffer against uncertainties in demand or in the supply system.

SHRINKAGE – Reduction in inventory that occurs when items are lost, stolen, or misplaced. Can also occur naturally through evaporation or age, etc.

SPECULATIVE INVENTORY – inventory other than commodities that is purchased or produced and held due to a potential price increase or shortage

STOCK – The materials and supplies kept in the storeroom/warehouse to satisfy the needs of the internal using departments or external purchasers.

STOCK LEVEL – The desired quantity of stock to be carried.

STOCK OUT – A condition that occurs when items normally carried in stock are unavailable.

STOCKLESS PURCHASING – A practice whereby the purchaser negotiates a purchasing arrangement, including price, for a group of items for a predetermined time period, and the supplier holds the inventory until the purchaser places orders for specific items. Blanket orders, open-end orders, and systems contracts can be used as stockless-purchasing techniques.

SYSTEMS CONTRACT – A contract generated by the purchasing department that authorizes designated employees of the buying organization, using a predetermined release system, to place orders directly with the supplier for specified materials during a given contract period. In the public sector, this type of contract is often called an indefinite-delivery type or term contract. A systems contract typically is an extension and a more sophisticated form of a blanket order.

TRANSPORTATION INVENTORY – Inventory that exists because of the time needed to move goods from one location to another. Also called pipeline or movement inventory.

TWO BIN SYSTEM – A simple, manual inventory system in which an item's inventory is stored in two different locations, with the first bin being the place where inventory is first withdrawn. When the first bin becomes empty (the signal to place a new order), the second bin provides backup to cover the demand until a replenishment order arrives.

Source: *ISM's Glossary of Key Purchasing and Supply Terms*; *NAPM InfoEdge®,* Vol. 2, No. 11, July 1997; additional terms provided by Marilyn Gettinger, C.P.M., New Directions Consulting Group.

Inventory Web Resources

- **www.apics.org** - APICS — The Educational Society for Resource Management is a not-for-profit international educational organization founded in 1957 as the American Production and Inventory Control Society.

- **www.iccwbo.org/index_incoterms.asp** - Incoterms 2000. This Web site provides information about the areas that the 13 Incoterms cover, how each one works and the answers to frequently asked questions. The site includes Preambles in full in read-only format, which are concise descriptions that explain the purpose of each term. Among the best known Incoterms are EXW (Ex works), FOB (Free on Board), CIF (Cost,Insurance and Freight), DDU (Delivered Duty Unpaid), and CPT (Carriage Paid To).

- **www.werc.org** - The Warehousing Education and Research Council (WERC) is the only professional organization focused exclusively on warehouse management, providing practical, how-to information to help members grow professionally as they improve warehouse and company performance.

Resources for Segment 2: Exploring the Numbers

The Income Statement

JKL Company, Income Statement March 31, 2004
Issued April 1, 2004

Sales		**$50,000,000**
Cost of Goods Sold:		
Material	$20,000,000	
Direct Labor	3,000,000	
Overhead	2,500,000	
General & Administrative Expenses	2,000,000	- 27,500,000
Gross Margin		**$22,500,000**
Operating Expense:		
Selling	1,000,000	
Research and Development	5,000,000	
Advertising	900,000	- 6,900,000
Operating Income		15,600,000
Interest Expense		- 1,200,000
Net Income before Tax		14,400,000
Federal Income Tax		- 800,000
NET INCOME/NET LOSS BOTTOM LINE		**$13,600,000**

The Balance Sheet

ABC Company
Balance Sheet, March 31, 2004 issued April 1, 2004

ASSETS		
Current Assets:		
Cash	$ 230,000	
Accounts Receivable	1,100,000	
Inventories	640,000	
Prepaid Expenses	46,000	
TOTAL CURRENT ASSETS		$2,016,000
Fixed Assets:		
Gross plant, building, Equipment	3,000,000	
Less: Depreciation	1,000,000	
NET FIXED ASSETS		2,000,000
TOTAL ASSETS		$4,016,000

LIABILITIES		
Current Liabilities:		
Accounts Payable	$ 1,000,000	
Notes Payable	300,000	
Provision federal tax	100,000	
TOTAL CURRENT LIABILITIES		$1,400,000
Long Term Liabilities:		
Mortgage	500,000	
Notes Payable	50,000	
LONG TERM LIABILITIES		550,000
TOTAL LIABILITIES		$1,950,000
NET WORTH		
Stock	$ 1,500,000	
Retained earnings	566,000	
TOTAL NET WORTH		$2,066,000
TOTAL LIABILITIES AND NET WORTH		$4,016,000

- **Inventory Turns**

  Gross Sales/Average Inventory $5,000,000 / $600,000 = 8.3 turns

  Cost of Goods/Average Inventory $2,600,000 / $600,000 = 4.3 turns

  Number of inventory turns should fall between an industry range.

Below the range	=	Poor management of inventory – dead stock
Above the range	=	Danger of stock outs

- **Inventory to Cash**

  Days in Year/Inventory Turns

  250/4.3 = 58 days from inventory to cash

- **Fill Rate**

  Number of lines items on the order filled / Total of line items on the order

  90 line items filled/105 total line items = 85.7% fill rate

  95 line items filled/105 total line items = 90.4% fill rate

  A high fill rate reduces operational costs by minimizing:
  - Back orders
  - Partial shipments
  - Handling
  - Transactions

- **The Cost to Maintain Inventory**

  Total Average Inventory in Dollars = $5,000,000

  1. Cost of Money (from the accounting department)
     We will use 10% for this problem.
     We could also use the short-term borrowing rate.
     $5,000,000 x 10% = $500,000

  2. There are 3 employees assigned to the warehouse.
     Average salary $32,000 per employee
     Fringe benefits 50% of salary = $16,000
     $48,000/year x 3 = $144,000

  3. Warehouse overhead includes equipment, racking, rent, or if owned, the annual value determined by using the total of all depreciation charges - $205,000

  4. Inventory related variable costs such as utilities, building maintenance, insurance, taxes, allowances for shrinkage, damage, deterioration, and obsolescence - $155,000

  5. The costs to maintain and upgrade inventory records annually - $92,000

Cost of Money	$ 500,000
Direct Inventory Labor	$ 144,000
Building and Capital Equipment	$ 205,000
Variable Costs	$ 155,000
Tracking Costs	$ 92,000
	$1,096,000

  TOTAL COSTS TO MAINTAIN $5,000,000 WORTH OF INVENTORY = $1,096,000

  $1,096,000 / $5,000,000 = 22% of the value of the inventory to manage it

Resources for Segment 3: Critical Decision-Making for Inventory Control

- **Quantity Discount**

X = Annual Demand = 25,000 x $10 = $250,000
Y = Unit Cost = $10
Z = Purchase Order Cost = $10
C = Carrying Cost = 20%

Buyer normally orders based on the EOQ, but supplier has offered a 2% discount on orders of 1000 units or more. EOQ quantity is 500 units per order.

EOQ = Square root of 2 x $250,000 x 10/0.2 = $5000

List of Costs	No Discount	Discount Lot Size
Unit Price	$10	$ 9.80
Lot Size	$6,324	$9800
Average Lot Size	$3,162	$4900
Number of Orders Per Year	32	25
Purchase Cost	$200,000	$196,000
Inventory-Carrying Cost (20%)	632	980
Order Preparation Cost ($10 each)	640	400
TOTAL COST	$201,272	$197,380

- **Days of Supply = inventory on hand/average daily usage**

Inventory on hand = 9,000 units
Annual usage = 85,000 units
Days in the year = 250 working days

Average daily usage = Annual usage/days in the year = 85,000 / 250 = 340 units

9000 / 340 units = 26.5 days

- **Quantity Determination Model**

Target level or maximum-level inventory

T + D(R+L) +SS

T = target or maximum inventory level
D = demand per unit of time
L = lead time duration
R = review period
SS = safety stock

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **Fixed Period Model – Determining the optimal order period**

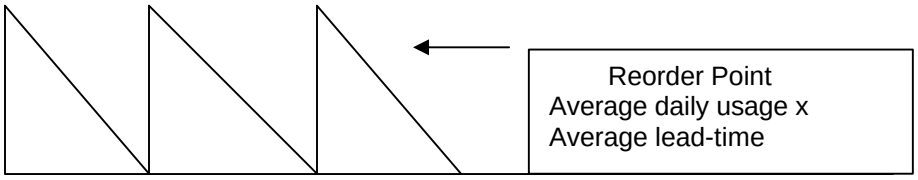
  Square root of 2 x order cost/annual demand x carrying cost x unit cost

  Order Cost = $50
  Annual Demand = 900
  Carrying Cost = 25%
  Unit Cost = $45

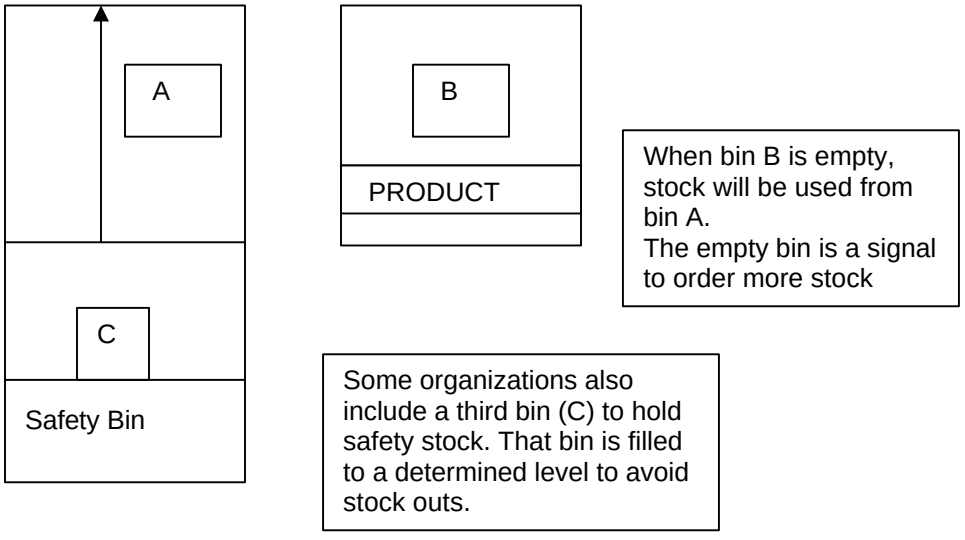
  Square root of 2 x $50 / 900 x 0.25 x $45 = 0.1 or 10 times per year

  250 working days/10 times a year = every 25 working days or about every 5 weeks

- **Reorder Point Model**



- **Two-bin Model**

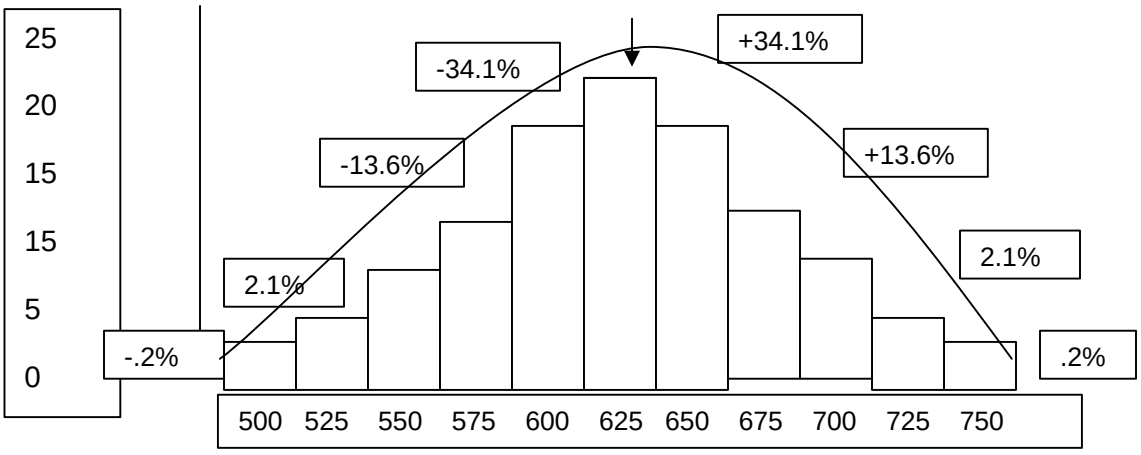


Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **Safety Stock Calculations**

Historical Data

Weekly Demand / Usage	Number of Weeks
500-524	2
525-549	3
550-574	7
575-599	12
600-624	17
625-649	20
650-674	17
675-699	12
700-724	7
725-749	3
750-774	2



Safety Stock Considerations: Based on the risk of losing a customer for one order or for all future orders, order quantity decision makers may determine how much safety stock to carry. The most frequently ordered/used quantity is between 625-649. The safety stock decision is whether to carry more than 649 units as safety stock or select another usage parameter such as noted for 17, 12, or 7 weeks as the normal usage. To ensure inventory availability for all possible requirements would require an inventory level of 774 units at all times.

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **Standard Deviation**

Period	Usage Demand	Actual Usage	Deviation	Deviation Squared
1	500	700	200	40,000
2	500	500	0	0
3	500	300	-200	40,000
4	500	400	-100	10,000
5	500	900	400	160,000
6	500	600	100	10,000
7	500	600	100	10,000
8	500	200	-300	90,000
9	500	500	0	0
10	500	300	-200	40,000
Total	5,000	5,000		400,000

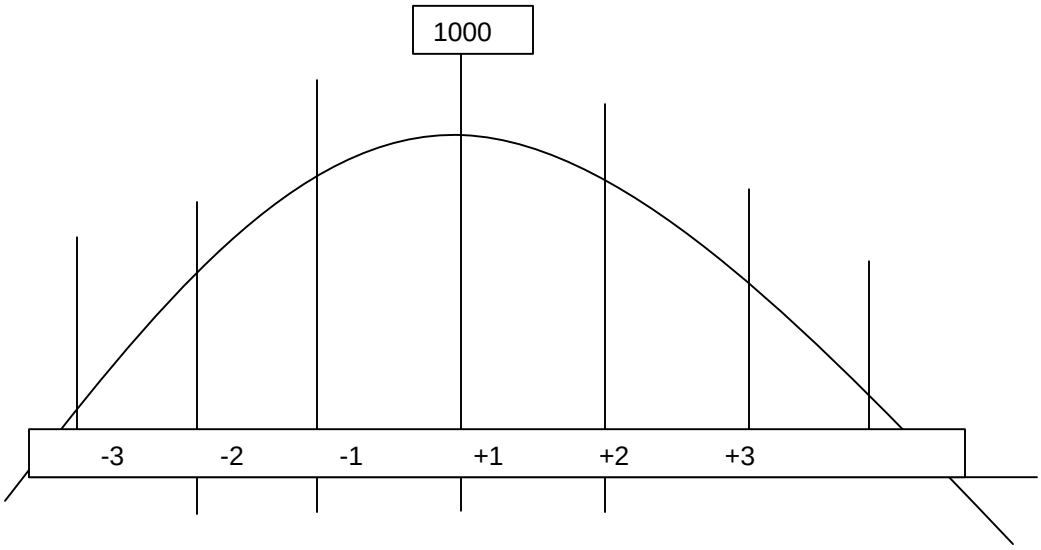
Sum of the squared deviations divided by the number of periods
Square root of that number = standard deviation
400,000 / 10 period samples = 40,000
Sigma / Standard Deviation = square root of 40,000 = 200 units

Period	Usage Demand	Actual Usage	Deviation	Absolute Deviation
1	500	700	200	200
2	500	500	0	0
3	500	300	-200	200
4	500	400	-100	100
5	500	900	400	400
6	500	600	100	100
7	500	600	100	100
8	500	200	-300	300
9	500	500	0	0
10	500	300	-200	200
Total	5,000	5,000		1,600

Sum of the absolute deviations divided by the number of periods = Mean Absolute Deviation (MAD)

Mean Absolute Deviation = 1600 / 10 period examples = 160

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued



The actual demand/usage will be +/- 1 Standard Deviation or MAD approximately 68% of the time.

The actual demand/usage will be +/- 2 Standard Deviation or MAD approximately 98% of the time.

The actual demand/usage will be +/- 3 Standard Deviation or MAD approximately 99.88% of the time.

Order/Inventory Level = Order point + Standard Deviation/MAD x 1, 2, 3 STD or MAD

80% service level	= 1000 + 200 x 1 STD	= 1200
80% service level	= 1000 + 160 x 1MAD	= 1160
98% service level	= 1000 + 200 x 2 STD	= 1400
98% service level	= 1000 + 160 x 2 MAD	= 1320
99.88% service level	= 1000 + 200 x 3 STD	= 1600
99.88% service level	= 1000 + 160 x 3 MAD	= 1480

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

Table of Service Levels	Safety Factor
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
99.98	4.00

1. Find the Standard Deviation or Mean Absolute Deviation
2. Determine the service level of choice
3. Locate the safety factor for that service level
4. Multiply the Standard Deviation or Mean Absolute Deviation by that safety factor to determine safety stock levels.

96% service level = 1.75 x 200 = 350
85% service level = 1.04 x 160 = 166

- **Stockout Allowance**

1. Number of orders per year = annual demand / order quantity

2. Service Level = number of allowable stock outs per year / total number of orders per year

3. Safety Stock = Safety Stock (above table) x Standard Deviation or Mean Absolute Deviation

4. Demand during lead time = annual demand / number of weeks

5. Order Point = Demand during lead time + safety stock

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **Lot-size Decision Rules**

  - **Economic Order Quantity**
    The square root of 2 x yearly volume x purchase order cost/annual carrying cost x unit cost

    2 x 100,000 x $50 / 25% x $45 = Square root of 888,889 = 943 units

  - **Economic Order Quantity in Dollars**
    The square root of 2 x yearly volume x purchase order cost/carrying cost

    2 x $4,500,000 x $50 / 25% = $42,426

  - **Lot-for-Lot -** a decision rule that recommends to order exactly what is needed; No more-no less

  - **Fixed Order Quantity** - a specific quantity is ordered each time an order is placed for an individual item or SKU (stock-keeping unit)

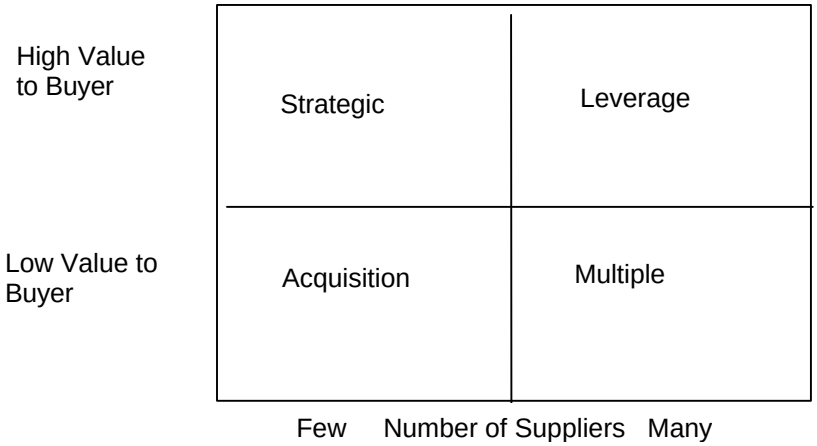
  - **Min-Max** - the quantity ordered is the difference between the actual quantity available at the time of order and the maximum designated inventory level on that item

  - **Order "n" Periods Supply** – order enough to satisfy future demand for a given period of time

  - **Period-Order Quantity** = $\frac{\text{EOQ (Economic Order Quantity)}}{\text{Average Weekly Usage}}$

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **Commodity Segmentation –**
  The process of dividing an organization's total spend into categories of goods and services in order to leverage spending and increase purchasing efficiencies. Common practice involves a matrix to divide the commodities into four quadrants.



Acquisition Materials	Materials for which there are few capable suppliers. Materials that are of low value.
Multiple Materials	Materials with low to medium value. There are a great number of suppliers capable of providing the product or service.
Leverage Materials	Materials for which there are a large number of capable suppliers. There is a medium to high annual expenditure for these materials.
Strategic Materials	Materials that are critical to success with few suppliers capable of supplying the them. Items may be unique or customized. They may also be of high-dollar value.

- **Transportation and Inventory**

Common Carrier Terms

Terms of Sale	**Buyer**	**Seller**
F.O.B. Origin/Shipping Point **Freight Collect**	Pays freight charges Bears freight charges Owns goods in transit Files claims (if necessary)	
F.O.B. Origin/Shipping Point **Freight Allowed**	Owns goods in transit Files claims (if necessary)	Pays freight charges Bears freight charges
F.O.B. Origin/Shipping Point **Freight Prepaid and Charged Back** Freight charges are paid by seller then collected from buyer by adding amount to the invoice.	Bears freight charges Owns goods in transit Files claims (if necessary)	Pays freight charges
F.O.B. Destination **Freight Collect**	Pays freight charges Bears freight charges	Owns goods in transit Files claims (if necessary)
F.O.B. Destination **Freight Prepaid**		Pays freight charges Bears freight charges Owns goods in transit Files claims (if necessary)
F.O.B. Destination **Freight Collect and Allowed** Freight charges paid by buyer then charged to seller by deducting amount from invoice	Pays freight charges	Bears freight charges Owns goods in transit Files claims (if necessary)

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **Adding Value To Inventory**

Accounting Method	**Description**	**Cost of unit Product X**	**Cost of Goods Model - For product which requires 100 of product X**
Standard Cost	Cost determined by prior cost plus additional factors selected by finance	100 x $10.50 = $1050	Direct Labor $ 5000 Overhead 1500 Administrative 1200 **Direct Material 1050** $ 8750
FIFO	First-in, First-Out	100 x $8 = $ 800 100 x $10= $1000 100 x $12= $1200	Direct Labor $ 5000 Overhead 1500 Administrative 1200 **Direct Material 800** $ 8500
LIFO	Last-in, First-Out	100 x $8 = $ 800 100 x $10= $1000 100 x $12= $1200	Direct Labor $ 5000 Overhead 1500 Administrative 1200 **Direct Material 1200** $ 8900
Average Cost	Average Cost	100 x $8 = $ 800 100 x $10= $1000 100 x $12= $1200 300 $3000 $3000/300 = $10 $10 x $100 = $1000	Direct Labor $ 5000 Overhead 1500 Administrative 1200 **Direct Material 1000** $ 8700
Standard Cost	Cost determined by prior cost plus additional factors selected by finance	100 x $10.50 = $1050	Direct Labor $ 5000 Overhead 1500 Administrative 1200 **Direct Material 1050** $ 8750
Replacement Cost	The cost to replace the used materials based on the market value at the time of use.	100 x $13 = $1300	Direct Labor $ 5000 Overhead 1500 Administrative 1200 **Direct Material 1300** $ 9000

Activity-Based Costing – A method for attributing indirect costs based on the activities that drive cost. This approach is in contrast to traditional accounting methods that pool and arbitrarily allocate indirect costs.

Absorption Costing – An approach to inventory valuation in which variable costs and a portion of fixed costs are assigned to each unit of production. The fixed costs are usually allocated to units of output on the basis of direct labor hours, machine hours, or material costs.

Resources for Segment 3: Critical Decision-Making for Inventory Control - continued

- **ABC Analysis**

  - The process of segmenting inventory into specific classifications for management purposes based on the strategic, cost, and risk of the particular material or product.

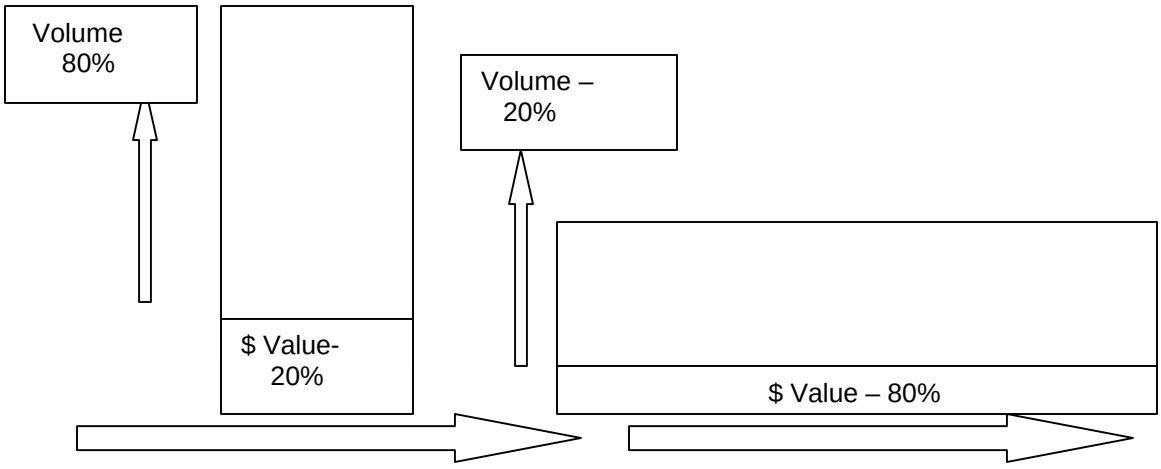
  - Pareto's Theory:
    80% of the inventory is worth 20% of the value of the entire inventory
    20% of the inventory is worth 80% of the value of the entire inventory

  - Ranking Decisions
    - Dollar value per item
    - Dollar value per total yearly purchase
    - Strategic importance
    - The normal number of units or the amount of raw material/component that is normally used at a time or sold or released at a time (the normal lot size)

Part Number	Annual Unit Usage	Unit Cost $	Annual $ Usage
AB	15,000	15	$225,500
DF	4,000	20	$ 80,000
GH	10,000	7.50	$ 75,000
LM	1,000	50	$ 50,000
FX	900	20	$ 18,000
WV	1,000	10	$ 10,000

  - ABC analysis ranking is not set in stone. Due to business conditions, global shortages, erratic customer demand, etc. items may move from B items to A items or A items to B items.

  - Pareto's Theory and Inventory Management



SECTION 4:

REFERENCE ARTICLES

ISM Articles Related to Inventory Control

The following articles support the content of today's satellite seminar. ISM members can use the links shown to access some of these articles -- and many more -- directly from the Articles Database in the Members Only area of the ISM Web site.

Page 4-1: Noe, Tony, **"Inventory Control -- An Oxymoron?"** *Inside Supply Management®,* August 2002, p. 10. www.ism.ws/ResourceArticles/2002/080210.cfm

Page 4-3: Harding, Mary Lu, **"Total Cost of Ownership -- Inventory Materials,"** *Purchasing Today®,* June 2001, p. 18. www.ism.ws/ResourceArticles/2001/060118.cfm

Page 4-6: Miller, Mark S. and Thomas M. Graddy, **"Cost Reduction Using Ten Inventory Management Techniques,"** *85th Annual International Supply Management Conference Proceedings, May 2000.* www.ism.ws/ResourceArticles/2000/cp00MillerGraddy.cfm

Page 4-9: Caulk, Steve, **"Warehouse Changes are Just In Time,"** Supplement to *Purchasing Today®,* March 2000. www.ism.ws/ResourceArticles/2000/030001PTSupplement.cfm

Page 4-14: "Carry On," *Purchasing Today®,* February 1999, p. 14. www.ism.ws/ResourceArticles/1999/29914.cfm

Page 4-16: Oreskovich, Richard, **"Where Purchasing Fits In,"** *NAPM InfoEdge®, Vol. 2, No. 11,* July 1997, www.ism.ws/ResourceArticles/1997/IE079701.cfm

Page 4-20: Oreskovich, Richard, **"The Tools of Inventory Management,"** *NAPM InfoEdge®, Vol. 2, No. 11,* July 1997, www.ism.ws/ResourceArticles/1997/IE079711.cfm

Article Reprints

Inventory Control - An Oxymoron?

By Tony Noe, C.P.M., A.P.P., CIRM

Reprinted from *Inside Supply Management*®, August 2002, page 10.

Does your supply management plan include a lean, mean inventory-minimizing system? Use this approach for greater inventory control.

he need for accurate inventory and accurate information, as well as a process used to meet the need, exists in every organization and must be met by supply managers. The military spends time planning for its needs — flow planning of every troop movement to ensure supplies are available to meet the requirements of a mission — sometimes just-in-time. In a simple, real-life example within your own kitchen, you check the recipe (the bill of materials), then check the ingredients in the pantry (inventory in the warehouse), to see what you need from the grocery store (the supplier).

No matter what type of items you are talking about — raw materials, components, assemblies, MRO items, or finished goods for resale — you are involved in this process of not only purchasing the items but also being correctly informed about your inventory on-hand. In fact, it matters little if you are running a Just-In-Time (JIT), Just-In-Case (JIC), Just-About-Time (JAT), or even a Just-Past-Time (JPT) operation. For any organization that maintains an inventory, realistic planning will require that you know where you are in terms of inventory control and that you are continuously improving. This is achieved through a simple three-part approach: know what you have, know what you need, and get other stakeholders involved.

What Do You Have?
The accuracy of your inventory records can enhance your ability to find the needed inventory information. There are many variations in the method of measurement, but most are modifications of the simple calculations for the percentage of the items checked that had accurate counts and were in the listed location in an inventory system. In other words, if you use a cycle counting method to maintain accuracy, what percentage of 10 items do you find in the place and in the correct amount that your locator system says it should be? (Cycle counting is a physical stock checking system in which the inventory is divided into random or specified groups that are physically counted at predetermined intervals or cycles, depending upon the strategic value of the item.) Methods used in cycle counting include:

- Manually taking a list, counting a few items each day, and comparing with online counts, after reconciling the actions that might not yet be reflected in the system
- Using an ABC analysis of your key items to establish a frequency of checking inventory levels — "A" items are checked more frequently than "C" items

The manpower involved and the level of complexity to reconciling the counts with the system are the primary considerations in determining which inventory methods are best for your organization. Very simply, this becomes a return on investment issue. How much will you invest to keep the numbers accurate? The level of problems created by past inventory discrepancies will give you an idea of the criticality of accurate inventory data to help guide the decision of what method to use.

What Do You Need?
Conduct periodic reviews, based on the latest sales and production data and internal insights, of all minimums, maximums, and other order rules. Business shifts, customer demand changes, seasonality, engineering changes, obsolete items, and other events that can affect the demand for any item are all critical to be aware of and current on. Though this type of data refers primarily to volume requirements, other aspects to consider include cost of holding inventories, replenishment leadtimes, order processing costs, and transportation costs. These can all have a direct effect on where you have your inventory dollars tied up versus where you need them. Because the data can change over time, periodic reviews are important.

Developing a regular sales and operation planning meeting provides the opportunity to ask others in the organization about the events that affect demand from the people closest to the end customer. These meetings might even include discussion about how close inventory should correlate to the forecasted numbers. Couple these meetings with regular discussions with engineering to stay informed of major changes that are coming. This will provide the forewarning needed to avoid most major inventory obsolescence problems.

Beyond that, the supply manager can review the history of such data to detect changes that should be investigated for impact on inventory. Many changes are slow and shift slightly over time. Because there is no rocket across the sky to alert a supply manager to changing needs, reviewing inventory history will help supply managers notice the slow slipping of volume that points to a shift in business or usage — impacting the need for inventory.

Working Together
The first two parts of this simple three-part approach are focused on making the best inventory control decisions possible for a given operating environment. In other words, considering forecasts, leadtimes, cost structure, etc., what is the most cost-effective way to manage inventory? The third part of the approach focuses more on process improvement — an area rich with opportunity for supply managers to impact their inventories. It is within this area that supply managers can look for creative ways to work with suppliers and internal customers to find unique solutions to inventory issues.

Start by getting ideas, solutions, and suggestions from your suppliers and internal departments about inventory. Are you a world-class customer to your suppliers? Is your internal customer being served in the most efficient way? Can your supplier ship in a different way, in different packaging, or in counts per box/pallet rather than higher or lower, which better matches the demand of your use or sale point? Are

your internal requirements based on current needs or "how we always did it"? These are questions you can ask to find a better solution. This better solution might be waiting for your openness to it.

Most suppliers' objectives are the same as yours — to make a profit. Most have come to the realization that as your sales increase, their sales can increase. To get suppliers to participate in better inventory management, explain openly that you are looking for ways to decrease the cost of goods sold through better inventory management so that you eventually can capture a larger share of the market with lower costs and higher volume. Suppliers understand that this is synonymous with volume increases for them and increased profit.

If your organization has the resources to do it, another strong method for motivating suppliers to work with you to achieve better inventory control is to offer business improvement consulting to help them grow and be more profitable. Typically, this offer is best directed at smaller suppliers. The concept of supplier development can increase inventory control by identifying ways to create a more efficient inventory flow as well as improving costs for the entire supply chain — as one supply chain member's costs impact each member's costs.

Bottomline, control inventory in real time. Do not let a past decision that may have been valid at the time drive you deeper into a problem. Ensure your inventory records are accurate, review your order rules, and ask other stakeholders, including the supplier, for help while you work on a solution to best meet your organization's needs.

Total Cost of Ownership — Inventory Materials

By Mary Lu Harding, C.P.M., CPIM, CIRM, president of Harding and Associates, Lincoln, Vermont.

Reprinted from June 2001 *Purchasing Today*®, page 18.

Typically, inventory items are of low-to-moderate dollar value per unit but purchased in high volume and move through the business.

Total cost of ownership (TCO) is an assessment of all costs involved with an item over its useful life and that of the products into which it goes. Many cost factors are visible to others in the organization but not to supply management. The most complete analysis is compiled by a team that includes supply management, in addition to technical and quality staff and manufacturing. All involved parties should have a chance to include their issues.

The Ground Rules

Start by defining the ground rules and assumptions, including:

- Definition of the suppliers, the items, and where they are used
- Estimate of how long the items will be in use
- Assumptions for quantities or usage rate
- Identification of the areas of cost to be included
- Definitions of the formulas for calculating costs

Typically, TCO data is used to make selection decisions for suppliers or items.

It compares Supplier A to Supplier B or Item X to Item Y. These are relative comparisons. Estimates are acceptable as long as they are relatively valid. Two criteria are important in calculating relative costs:

- The formula makes sense. It is relevant to the issue and can be calculated.
- The formula can be applied across suppliers and used to validly differentiate them.

Categories of Ownership
Ownership costs can be divided into three categories: cost factors, performance factors, and policy factors. Cost factors are in dollars and can be calculated with reasonable accuracy. They include freight, discounts, and surcharges such as setup costs.

Performance factors include delivery and quality performance and leadtime. Performance factors are relative. As long as the data is valid for comparison, it is less important that it be an absolutely accurate cost.

Policy factors include any issue that reflects business or social policy directives, such as recycled content of materials, minority- and women-owned suppliers, and consensual reciprocity. These factors are yes/no factors. Typically, a supplier or an item either does or does not meet the policy criterion. Establishing a dollar value for these factors rests with the policy makers in your organization.

To create a fair comparison between suppliers or items, both credits and costs should be included. If a supplier offers something of value, then the "cost" of that should be calculated and subtracted from its TCO calculations.

Defining Inventory
Typically, inventory items are of low-to-moderate dollar value per unit but purchased in high volume. Inventory items also are moving through the business. They are being regularly turned over. Typical areas included in the total cost of ownership for inventory are:

- Cost of nondelivery
- Cost of non-quality
- Cost of freight and packaging
- Availability/flexibility/leadtime
- Cost of carrying inventory
- Production-related costs
- Administration costs per part number
- Technical assistance

Cost of Nondelivery
If a supplier delivers early, you pay for the items sooner and carry the inventory longer. If a supplier delivers late, you consume people's time to replan the production schedule and/or expedite the delivery. If lateness is chronic, you may carry safety stock. A simple method to calculate a relative cost of nondelivery is to use the nondelivery performance percentage as a price adder. For example, if Supplier A delivers on time 85 percent of the time, then it is not on time 15 percent of the time. Multiply its quoted price by 15 percent and add that amount to the base price as a cost factor for nondelivery. The better the delivery performance, the lower the cost factor.

Cost of Non-Quality
This includes the overhead expense of incoming-materials inspection and reject-materials stockroom, the administrative expense of materials review, and the work involved with returns. It also includes quality fallout or rework in production due to defective materials. If you use activity-based costing, then the cost of quality may be an identified cost pool. If so, you may know what those costs actually are, and you can apply those numbers in TCO calculations.

Without actual cost numbers, use the measure of percent defective components as a price adder. For example, if 8 percent of Supplier B's material is rejected, then its price is multiplied by 0.08 and that amount is added to the base price to compensate for your costs of handling non-quality goods. The higher the supplier's quality, the lower the cost factor.

If you pay freight or packaging costs, these should be included in TCO calculations. For freight, obtain the invoice amounts (from either the supplier's or the carrier's invoices) for several typical shipments. Add these costs and divide the total dollars by the total number of units shipped. This is the average transportation cost per unit. Ask suppliers if there are any packaging costs in their quotations. You may

want to pull them out and list them separately so they keep their identity. Packaging costs may be an area for cost reduction in negotiations.

Inventory is Expensive
Inventory carrying cost becomes a significant factor in TCO calculations when new item numbers are added or when choice of supplier will have different inventory implications (such as a choice between a domestic supplier and an international supplier or between any two suppliers with significantly different leadtimes). To include inventory costs in TCO, determine your annual cost to carry inventory (percentage). Multiply the price of the item by that percentage. This is the carrying cost per unit per year. Multiply that number by the average number of units in inventory to determine the total dollars of carrying cost per year. To amortize the carrying cost over the total quantity purchased, divide the total dollars of carrying cost per year by the total quantity purchased per year.

Production-Related Costs
Production-related costs include ease of assembly, effect on final product yield, ability to automate, and any other measurable effect that the item has on the manufacturing process. Time factors (i.e., assembly time) can be translated into a total cost factor by multiplying the difference in time between the alternatives by the labor rate used to establish product cost. The cost difference can be applied to TCO. Differences in product yield can be costed by calculating the dollar value of the lost products.

Balancing Organizational Values
The use of a formal TCO process to select and measure suppliers places clearly defined emphasis on performance and policy issues as well as price and allows supply management to easily balance them. The process of defining cost factors will force the organization to become clear about what it values. By giving everyone in your organization access to the process, other functions that have a vested interest in the supply base can state their concerns and define appropriate ways to represent them.

Unit Total Cost Calculation Example

Factor	Supplier A	Supplier B	Supplier C
Cost Factors			
Quoted Price	$10	$11.50	$12
Shipping	+0.09	+0.07	0
(cost/quantity)	($8.95/100)	($7/100)	0
Discounts	-0.20	-0.06	-0.12
(prompt pay)	(2% 10 net 30)	(0.5% 10 net 30)	(1% 10 net 30)
Performance Factors			
On-Time Delivery	+1.50	+1.27	0
(1 percent on-time)	(85%)	(89%)	(100%)
Quality	+1.30	+0.92	0
(percent reject)	(13%)	(8%)	(0%)
Leadtime	+1.00	+1.04	+0.84
(1 percent/week)	(10 weeks)	(9 weeks)	(7 weeks)
Policy Factors			
Recycle	does not apply	-0.58	-0.60
(-5 percent)	No	Yes	Yes
Unit Total Cost	$13.49	$13.81	$11.52

Cost Reduction Using Ten Inventory Management Techniques

By Mark S. Miller, C.P.M., CIRM, Purchasing Manager and Thomas M. Graddy, C.P.M., CIRM, Manager, Supply Chain Management, Case Corporation

Reprinted from the 85th *Annual International Purchasing Conference Proceedings,* May 2000.

Abstract. The annual investment our companies make in inventory represent between 20% and 40% of invested capital. Inventory ties up cash, takes up space, requires handling, deteriorates and is sometimes lost or stolen. Purchasing can play a major role in managing the investment in inventory. We will discuss how inventory reduction impacts bottom line costs and outline ten inventory management techniques that the buyer can use to reduce inventory costs.

Impact on the bottom line.
It is critical that purchasing management recognize the financial impact that inventory plays. For purchasing to get the proper credit cost for reducing inventory it is important to recognize its impact to the balance sheet, the income statement and cash flow.

Impact to the balance sheet.
Inventories can be found under the current asset section of the balance sheet. Inventories are often also broken down into segments: raw material, work in process and finished goods. Financial analysts carefully watch changes in the year to year inventory balances.

Impact to the income statement.
Inventory is included on the income statement in the calculation of cost of goods sold. If the inventory investment is reduced, the net income is increased. The table below shows that for every dollar that the inventory is reduced, net income is increased by the same dollar.

Sample Income statement			
		Base	$10 less Inventory
Sales		300	300
Cost of goods sold			
	Material purchases	100	100
	Labor	50	50
	Overhead	40	40
	Change in Inventory	0	(10)
Total COGS		190	180
Gross profit from sales		110	120
Expenses		50	50
Net Income		$60	$70

Impact to cash flow.
Good inventory management frees up cash that your company can use to invest in future growth opportunities. Cash flow is a calculation that measures the amount of cash available. Factors that are included in the calculation of cash flow are: change in inventory, change in accounts receivables and change in accounts payable.

In determining inventory management strategy, it is important to determine the balance between customer service and inventory investment. You can reduce inventory but if customer service and sales are also reduced profits will be adversely affected. The goal is to find ways to reduce inventories without affecting customer service. The following are ten techniques that can be used to reduce inventory costs.
Ten inventory Reduction Techniques (Cavinato)

1. **Improve communications in the supply chain.** The supply chain is the network by which products and services are moved to the customer. Historically there is duplicate safety stock (back up inventory) carried at each level of the supply chain. By improving communications safety stock can be reduced without impacting customer service. There are many tools that purchasing can use to foster better communication in the supply chain. Two of these tools are:
   - Electronic commerce -- Exchange information throughout the supply chain electronically. Purchasing can work with suppliers to establish electronic links. Information can also be passed electronically from customers to suppliers.
   - In house supplier personnel -- Another tactic purchasing can use to help communication is to locate supplier personnel at different levels of your supply chain.

   Some non-traditional ways the supplier can be involved are:
   - Supplier personnel in house in your office to expedite orders and manage schedules.
   - Supplier systems personnel working with our retail locations to capture retail sales.
   - Suppliers help in selling and promoting products to increase sales.

2. **Reduce supplier leadtimes.** Leadtimes have a direct impact on the amount of inventory that is carried. The shorter the leadtime, the less backup stock that needs to be carried. Leadtimes consists of as much as 95 percent of idle time and 5 percent of actual production time needed to make the product. The challenge for purchasing is to work with suppliers to reduce the idle time. These are steps to take to reduce supplier leadtimes:
   - Track and measure leadtimes -- Measure how long it takes for each step of the supply chains. Track supplier leadtimes, inbound transportation time, transport time to the customer, manufacturing leadtimes and distribution cycle times. Recognize which suppliers and which commodities have the longest leadtimes and start with these.
   - Negotiate lower lead times -- The buyer must challenge supplier leadtimes. Ask for a break down of the components of the leadtime. Compare one supplier leadtime to others. Challenge the supplier to reduce his idle time. For some products utilizing distributors is another method to reduce leadtimes.

3. **Standardize.** Purchasing should work with suppliers to reduce the number of items carried. The number of parts can be reduced by:
   - Substitute for standard parts
   - Consolidate common part numbers

   Fewer items with greater quantities makes forecasting more accurate. The lower the number of items to buy means less safety stock is needed and inventory is lowered. By standardizing the buyer will also: lower costs, lower process costs and often have less quality problems.

4. **Reduce surplus/obsolete inventory.** Surplus or obsolete inventory can be reduced without risk to customer service. Purchasing should be active members of the committee to review and dispose of surplus. The following are methods that can be used to dispose of surplus or obsolete inventory:
   - Use it elsewhere within your firm.
   - Negotiate to return it to the supplier.
   - Sell the inventory to other companies
   - Promote and sell at a discounted price to customers.
   - Donate the inventory to a local charity.
   - As a last resort scrap the parts.

5. **Improve supplier quality.** Poor supplier quality will result in added costs in many areas including additional inventory as well as the cost of rejections, rework, warranty, inspection and excessive expediting. The challenge for purchasing is to select suppliers with superior quality. The buyer should be involved in the supplier quality audit process or push the supplier to become ISO certified. When

suppliers have quality problems, the buyer should initiate a corrective action plan and make sure it is followed. By improving supplier quality the amount of safety stock inventory can be reduced.

6. **Challenge MOQ's and price quantity breaks.** Supplier minimum order quantities and price quantity breaks can cause surplus inventory. Suppliers require MOQ's or quantity price breaks to compensate for their costs of setting up a job. The goal is to work with supplier to reduce set-ups. Another option is to propose an annual commitment agreement with the supplier so he can build the entire MOQ, but agrees to hold the inventory and ship it in small quantities.

7. **Have parts delivered more frequently.** The more often a part is delivered the lower the investment in inventory. The chart below displays how increasing the order frequency of your high volume, A and B class items, will reduce your average weeks supply of inventory from 3.7 weeks to 1.9 weeks.

Class	Frequency Ave.	Inventory	New Frequency	New Ave. Inventory
A	Monthly	2 weeks	Weekly	.5 weeks
B	Quarterly	6 weeks	Monthly	2 weeks
C	6 Months	24 weeks	6 Months	24 weeks
Average Inventory		3.7 weeks		1.9 weeks

The cost of ordering and receiving. For most companies the correct strategy in to increase the order frequency of the high dollar "A" items only.

8. **Improve on time delivery.** One of the reasons that extra inventory is carried is to compensate for suppliers who can't be counted on to deliver on time. Recent surveys of purchasing professionals indicate that the average on time delivery percentage is about 70%. With such poor delivery performance, our choices are either: 1) carry great amounts of safety stock, or 2) drain purchasing manpower by expediting parts to keep the production line going. Either choice adds costs to our operations. The following are steps the buyer can take to improve supplier delivery:

    - If you don't measure on-time delivery, you won't improve it -There are many different methods to measure on-time delivery. The method you select doesn't matter as long as supplier on-time performance is tracked.
    - Make sure the supplier understands - Talk to suppliers and make sure they are aware how you measure their delivery performance. Some of the items to clarify include: the window used, ship date or receipt date, how calculated and how short-lead-time orders are counted.
    - Set supplier goals- Set on-time delivery goals with supplier. Make delivery one of the key measures in your supplier rating program.
    - Reward superior performance - Recognize supplier who achieve their on-time goals. Give annual awards for suppliers who exhibit world class performance.

9. **Set up a supplier managed inventory program.** Purchasing has the opportunity with work with key suppliers to develop a program to manage and hold inventory for you. The idea is to reduce the amount of total inventory not just transfer inventory to the supplier. There are many popular programs used today including:
    - Vendor managed inventory (VMI) - The supplier performs the inventory function for the customer.
    - Point of sale (POS) - The supplier reacts to customer demand and replenishes the inventory level.
    - Consignment stocking - The supplier owns the inventory when it is in your facility. Payment is made when the inventory is used.
    - Supplier stocking - The supplier carries safety stock and ships Just-in-Time.

10. **Give credit for inventory reduction.** Inventory reduction has a direct impact to your company's financial success. Recognize the importance of inventory reduction by:

- Get everyone involved - Teach the impact inventory has on the bottom line. Form a team to focus on inventory reduction projects. Get suppliers, engineering, manufacturing, finance, and marketing involved in the team.
- Count inventory reduction as a cost reduction - In many companies, inventory reduction is not counted as a cost reduction. Inventory reduction is important and should be recognized as a cost reduction.

Summary
Purchasing can make a major impact on the amount of inventory invested. The Japanese have taught us well that it is evil to tie up cash in inventory. Every dollar saved in inventory has a direct impact to the bottom line profits of our companies. Use these ten inventory management techniques to save your company money:

- Work with suppliers to improve communications in the supply chain.
- Negotiate lower lead times with suppliers.
- Reduce the number of part numbers carried.
- Find ways to reduce surplus and obsolete inventory.
- Improve supplier's quality to reduce costs.
- Challenge and reduce minimum order quantities and price quantity breaks.
- Have high impact parts delivered more frequently.
- Improve suppliers on time delivery performance.
- Set up a supplier managed inventory program.
- Take credit and track your efforts to reduce inventory.

REFERENCE
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Warehouse Changes Are Just In Time

By Steve Caulk, former purchasing manager for Rocky Mountain News, Denver.

Reprinted from the supplement to the March 2000 *Purchasing Today*®

Today's warehouses are not the silent storage facilities of the past, but bustling assembly centers for today's competitive organizations.

People a half-century from now will remember the old warehouse as a giant monument to dust and inactivity, a place where money sat unproductively on shelves in the form of obsolete inventory. A few sentimental warehouse owners will leave the ancient buildings intact, and open them as museums.

Here's what the surprised tourists will not see:

- Computer terminals in the middle of the floor
- Fiber-optic lines
- Cell phones or radios
- Small unit quantities of anything
- Conveyor belts to transport those small units
- Sense of organization of parts prior to assembly
- College degrees hanging on the former occupants' walls

The advent of computerization and the Internet, forming the bright new age of e-commerce, sure has gone a long way toward shedding some light in the darkest corners of the industry. Technology allows

warehouse managers to receive orders more expeditiously and allows them to track the inventory connected with those orders. And as long as the warehouse managers have such a clear grasp of orders and inventory, they are altering their operations to assemble and prepackage products right on the warehouse floor, providing the quickest kind of customization since the two-tone automobile.

As information becomes increasingly available, the value-added activities on the warehouse floor will continue to expand, says Mike Jenkins, former president and CEO of the Park Ridge, Illinois-based International Warehouse Logistics Association. "I see it growing at 15 to 20 percent per year for the foreseeable future," he says. "And I see all warehousing growing at a rate of 10 to 15 percent per year." Warehouses will look the same from the outside, but a close look on the inside will reveal multiple computer hook-ups, cables that accommodate high-speed modem transmission, and communication devices everywhere.

How It Started

Businesses discovered that the Internet contributes two basic evolutionary drivers: it provides more information than businesses ever had available in the past and it provides the information faster than anyone could have imagined. The first bit of information arrives in the form of the computerized purchase order, which no longer needs to go through three other departments before it hits the warehouse. And as long as that order is already computerized, the information from the order is readily available to other computer programs, such as inventory management, right away. That efficiency gives warehouse managers an ability to track the inventory on a more immediate basis, without piecing together stacks of receipts and reports. Better yet, the new efficiency creates a degree of accuracy that never existed. "The more people, the more steps you put in a process, the more chances you have for mistakes," says Tim Beauchamp, vice president of operations for Broomfield, Colorado-based Corporate Express office supplies company. "When you reduce the number of hands, it helps the accuracy, and there's less dissatisfaction for the customer."

Inventory tracking has become so advanced, an organization such as Amazon.com can inform its customer about the availability of books, tapes, and other merchandise while the customer is placing the order. Amazon.com accomplishes this feat even as it tracks seven distribution centers and 3 million square feet of warehouse space. That's an increase from 295,000 square feet only a year ago.

Warehouse Categories

To be sure, there will always be a place for the standard store-'em-and-forget-'em warehouse, where a business can keep that old motor that it might need someday (but probably not). "It might be a repair part for an oil well, and you might only use it once a year, but it has to be stored," Jenkins says. "And it has to be positioned in an area near the oil wells. Nobody does anything to change the character (of the item)."

The second basic type of warehouse, says Jenkins, is the one that turns its inventory more rapidly, an increasingly common function. "An example would be the warehouses receiving product for PetSmart (a pet supplies retailer)," he says. "Saturday is PetSmart's busiest day of the week. So during the week, the warehouses receive truckloads of pet supplies, and by Thursday they're assembling store load quantities in anticipation of that Saturday business. The product is literally pausing only for a day or two, then going right out to the stores."

The third category of warehouse is the one derived from the emphasis on e-commerce and other operational efficiencies. This warehouse assembles products, repackages for retailer suitability, and even applies final brand imaging. "I characterize it as product transformation activities," Jenkins says. "At Sam's Club, you don't purchase just one bottle of Gatorade. It's a cardboard tray of a dozen bottles. A warehouse somewhere is repackaging 16 million cases in four months, putting them in those trays of mixed products. They get bundled in the warehouse.

"A high-end women's clothing organization in New Jersey might have 20 miles of garments on racks," he continues. "If Nordstrom (a department store) places an order, the Nordstrom label is sewn in and the clothing is put in a Nordstrom's box. It gets sent to my wife, and she thinks Nordstrom did it, but in fact it was the warehouse." And if Jenkins' wife is confused, Jim Tompkins of Tompkins Associates in Raleigh,

North Carolina can empathize. "I used to know what manufacturing was and what warehousing was, but now I'm not sure," he says.

Hazy Distinctions

One of the most well-known crossover organizations in the area of manufacturing and warehousing is Round Rock, Texas-based Dell Computer Corp., which does everything in one place. Product goes in and out of Dell so fast, there's barely any time to distinguish whether it's in the warehousing or manufacturing mode. Dell refers to this correctly as a Just-In-Time (JIT) process, and that's nothing new. The hot bulletin comes with the revelation that e-commerce made this JIT operation successful to such a high degree. Dell started in 1984 as a build-to-order organization based on telephone call orders, and the inventory was always low but nothing compared with today. Typically, material arrives at Dell two hours prior to assembly. "We've continually improved our operations over the years to reduce our days of supply in inventory," says Neisha Frank, company spokesperson for Dell.

Dell has evolved so far from the traditional warehousing business, says Rich Sherman, senior vice president, visioneering for EXE Technologies in Dallas, that one cannot even call it a warehouse anymore. He prefers the term "e-fulfillment center." "Dell is the classic example, but in every industry, people are going to try to keep product in its component stage as long as possible before it becomes assembled into the final product," he says.

The organization can't credit the Internet entirely, but it has been a huge contributor, allowing Dell to eliminate the paper trail and develop efficiencies in the organization's transactions. Dell began selling on the Internet a little more than three years ago, and by spring 1997, the organization was doing $1 million of business on the Internet daily. Today, that figure is at $34 million, good for 43 percent of the organization's revenues.

Any more efficiencies gained via the Internet will require Dell to abandon the days of supply in inventory measurement of success, relying instead on a minute-by-minute supply. "The Internet can be used to compress time and that's what you're talking about when you talk about reducing inventory," Frank says. "With the Internet, we can get a better pulse on what our customers' needs are at any given time and feed that information back to our suppliers."

Those suppliers have become fewer in number and, more importantly, much closer to Dell's Round Rock, Texas operations. The proximity contributes to Dell's Just-In-Time emphasis and its ability to assemble computers right in the location that receives the parts. So who's really doing the warehousing? In this case, Dell has essentially moved that function to a different spot in the supply chain, the same approach that Wal-Mart retail stores made famous. "It's all part of the supply chain efficiencies," says Jenkins, "where manufacturers recognize that a major component of cost is the cost of carrying inventory."

A Cambridge, Massachusetts organization called Syncra Systems specializes in identifying supply chain efficiencies – or inefficiencies – and then fixing them. The organization estimates that 20 to 30 percent of all inventory in a typical supply chain is "mis-deployed." "At the points of interactions, there are inefficiencies," says Mike Cassettari, senior vice president of marketing for Syncra Systems. He holds accountable the individual parties along the supply chain that have traditionally focused on their own problems with their own solutions, never approaching suppliers or customers for help. Now that businesses are more willing to forge partnerships, they can receive materials in the kind of form or packaging that makes their operations more efficient.

The Ramifications

So for all their efficiencies and all their cost savings, these changes in warehouse operations make suppliers and customers swoon with delight, right? Well, not necessarily. There are some drawbacks, even with the perception that the Internet itself creates. End users especially have come to expect more because they perceive that the efficiencies are built right into the system. In other words, if the ordering process is as simple as a touch of a button, then the delivery process must be equally miraculous. "Even though the ordering process is quicker and done in real time, manufacturers must still build and ship the

product in their traditional timeframe," says Sam Winfrey, sales representative for Corporate Express. "We need to recognize the timeframe of the manufacturers and work together to meet the customers' needs."

Sure, it might be a little faster because there's no paper order on a customer service representative's desk waiting to get to the manufacturing operations. But what the customer is most likely to notice is the favorable change in price, assuming the organization has passed along at least part of the cost savings in the transaction processing.

And that brings up another reason for warehouses not to love the Internet. As the cost of placing an order declines, organizations tend to make more of them, in smaller increments. At least, that's one theory. Beauchamp of Corporate Express disagrees, saying the Internet has actually increased the size of his customers' orders because the customers tend to keep an order on the computer screen, adding to it at intervals throughout the day as the inclination strikes them. But the more prevalent belief is that customers tend to transmit orders more quickly, in smaller amounts, because it's so easy. When an organization had $100 in administrative costs to process a purchase order, the organization made fewer of them, ordering larger amounts of the material at a time. But if the Internet makes that purchase order incredibly easy, at virtually no cost, it makes sense for a purchaser to place more orders and to hold far less inventory.

Cross-Training

Assuming the distributor is pulling these orders from a nearby warehouse, the distributor has to have smaller increments available. That's where all the package transformation and assembly comes in. And who's going to do all this, the same employees who have always operated the forklift for the organization? Well, maybe. But not without a lot of training first.

As for the forklift driver, he or she is going to have to learn how to operate a computer, decipher the customer order that appears on the screen in the middle of the floor, pick the items from around the warehouse, possibly assemble those items into a new product, and then make sure that he or she has recorded all this activity into the computer. At some point, it's likely he or she will have to set up inventory in a sequence that facilitates assembly.

As for the forklift machine, the warehouse probably doesn't need it as much because the inventory is arriving in smaller increments, heading to specific areas on computerized conveyor belts. "The warehouse workers need advanced training to build orders," says Arnold Maltz, assistant professor of supply chain management at Arizona State University in Tempe, Arizona. "They need to be able to look at the computer and be semi-production workers. That takes a higher skill level than just moving a box from here to there. And that's created a strain on some organizations. Wage levels are going up (in pure warehousing organizations) and people are coming to grips with the idea that they're going to have a very diverse workforce because they have to hire people when they can." That translates into cultural differences and sometimes even language barriers, as organizations recruit throughout the world.

Finally, organizations that jump on the e-commerce bandwagon have to keep in mind the annoying tendency of orders to arrive at all hours of the day and night. The Internet never sleeps. Organizations can hold those orders until a more convenient processing time, but that essentially defeats the purpose (or at least part of the purpose) of going to e-commerce.

Changes Up and Down the Line

Despite the obstacles, the movement toward "value-added" activities in the warehouse makes a huge amount of sense, says Kenneth Ackerman, president of K.B. Ackerman Co. warehouse management advisors in Columbus, Ohio. The more directly an organization can respond to an order, the more it eliminates the potential for disastrous mistakes in strategy. "More and more products are made to order, such as Dell now does with computers," he says. "This reduces the need for the manufacturer to speculate about demand."

Even the insurance business is getting into the order fulfillment act. Jenkins, formerly of the International Warehouse Logistics Association, knows of one insurance organization that keeps no manuals on hand for policy holders. Instead, the organization produces and customizes the manual on demand at the

distribution center. "They print it, bind it, and distribute it on an individual unit basis," he says. "So if you're in Chicago, you receive the sheets that identify the doctors in Chicago."

And imagine how a process like that can affect an organization's inventory turn. One order, one turn. Even the businesses that don't store their inventory digitally can improve their inventory turn with value-added enhancements at the warehouse stage. "We used to get 40 inventory turns (in the grocery industry) and think we were doing well," says Tompkins of Tompkins Associates. "For stores that are fixed in size but need to offer a wide variety, we're flowing more product through those locations, which is demanding better replacement. If we have 14 items on a shelf and somebody uses three, that's not a problem; but if we have four of those items on the shelf and somebody uses three, that's a problem. So now the inventory turn is in the 60s. They're doing it because they have the information upon which to make the decisions to make that flow."

What It Means to the Purchaser

Businesses have been adding value at various points along the supply chain for eternity. They didn't need the Internet to do that. Nor did they need the Internet specifically to add value at the point of mass collection, otherwise known as the warehouse. Consider the auto industry. "The auto dealer puts accessories on the car at the dealership," Maltz notes.

In essence, that's what the clothing manufacturer does when it puts its products on hangers, rather than in boxes, at the warehouse. But that process has become more pervasive and, as Dell has shown, more complex. The auto manufacturers have improved the supply chain by insisting that suppliers hold parts until the moment that the manufacturers need them. When the parts arrive, they go right to assembly. The auto manufacturers make this possible by connecting themselves with their suppliers by computer and by using "common" parts more frequently. Those are parts that the suppliers hold for use by more than one manufacturer. "The tier-one suppliers are doing more and more of the final assembly," says Sherman of EXE Technologies. "A supplier might provide a complete seating compartment for whomever, and they'll use common parts. It's the final assembly, however, that might have the unique component of that particular auto brand."

The value-added functions at the warehouse level mean that the purchasers are going to get items in the form that they need them, perhaps a bit sooner than they had in the past. And although the warehouse owners stand to benefit more directly from their own efficiencies, the purchasers are likely to inherit a share of those benefits in the form of cost reductions.

Presumably, the cost savings connected with the processes listed here will offset the cost of increased wages for more highly skilled workers. If labor costs get out of hand, they would naturally put the brakes on the evolution of value-added warehouse activities. But the big organizations that have found these e-commerce applications are likely to find ways to make them work. The applications are too valuable to abandon. The average out-of-stock statistics at any given time in the retail industry are 6 to 8 percent, says Cassettari of Syncra Systems. But as Wal-Mart, Federated Department Stores, Best Buy, and others concentrate on supply chain efficiencies, the out-of-stock statistics shrink by half, and there's no reason this can't apply to any point in the supply chain.

As industry leaders set supply chain standards, insisting that items arrive just in time for sale or assembly, purchasers at lower levels with far less leverage could easily find themselves the beneficiaries, insisting that suppliers manage those supplies in a similar manner for them.

Carry On!

By H. Ervin Lewis, C.P.M., director of purchasing at Wellman Inc., in Johnsonville, South Carolina.

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Identify and include six key elements when figuring inventory carrying costs.

Within your organization, who truly knows the cost of carrying inventory? Sharon Methods does. She's responsible for management of an inventory with an average value of $6 million which supports a 7 days a week, 24 hours a day manufacturing operation. Methods wishes to know all the costs associated with holding inventory. She knows she must first determine all the elements of cost and then perform the calculation by inserting her specific figures.

Elements of Cost
Methods' investigation identified the following elements of cost.

Facilities. This typically includes capital facilities which house and store inventory, plus any capitalized material handling equipment. Expense for capital goods is shown as depreciation in accordance with tax laws and, in the current period, after the tax effect, depreciation will be $300,000, or 5 percent of the inventory value.

Personnel. Personnel charges include expenses for management plus a staff to receive, store, monitor, and issue inventoried goods. Current inventory staff expense is $378,000 per year, or 6.3 percent of the inventory value.

Insurance. A firm's property is typically insured at some rate, perhaps $0.04 to $0.06 per $100 of value, and is based on average inventory over a year. Methods' organization has a rate of $0.04 per $100. For $6 million, the total annual premium would be $2,400, or 0.04 percent.

Shrinkage. Shrinkage is an annual percentage of loss in value resulting from various activities, such as pilferage and theft, breakage, obsolescence (including economic and technological), the effect of discontinued use, or surplus. Methods' accounting department advised that annual shrinkage of this inventory is $18,000, or 0.3 percent.

Taxes. Some states levy taxes on inventories. Within the states that do, tax rates vary depending on whether the inventory is finished goods or spare parts and support supplies. Within the parts and supplies category, tax rates will vary depending on whether or not the goods will be used in production of finished product. In Methods' state, this inventory will be taxed at a 1 percent rate ($6,000,000 x 0.01 = $60,000).

Opportunity cost of capital. The opportunity cost of capital is the value of returns on the next best use of the capital. In discussing the issue with her organization's financial analysts, Methods learned that there are three ways to view this. She recognized that she must use the same cost of capital as her organization's financial managers, which meant she must use a weighted average cost of capital (WACC). (For more details on the two other ways to view opportunity costs of capital, see the box on page 15.) WACC recognizes the cost of capital tied up in inventory as the organization's weighted average cost of capital from all sources including all forms of borrowed funds, preferred stock, and common stockholder expectations of return. In speaking with her analysts, Methods learned that her organization's total capital consists of 15 percent borrowed funds at 5.4 percent interest after taxes, 15 percent of preferred stock at an 8 percent rate, and 70 percent of common stock at a stockholder expectation of 10 percent return. Given this information, Methods calculated the weighted average cost of capital as shown in the box below. At 9 percent, the annual cost of tying up capital in inventory is $6,000,000 x 0.09 = $540,000.

Calculating the Costs
Methods recognizes that to calculate fully loaded holding costs as a percentage of total average inventory value, she must include all the costs above. That would be calculated as follows.
HFL = F + P + I + S + T + CC

Average Inventory Value x 100

Where:
HFL = Fully loaded cost to carry inventory, expressed as a percentage
F = Depreciation of capital facilities
P = Cost of personnel
I = Cost of insurance
S = Shrinkage factor
T = Cost of taxes
CC = Cost of capital

When Methods plugs in her known figures, she gets the following calculation:

HFL = $300,000 + $378,000 + $2,400
+$18,000 + $60,000 + $540,000 x 100
$6,000,000
= $1,296,000

$6,000,000 x 100
= .2164 x 100
= 21.64%

This calculation shows that Methods used dollars of cost in figuring her cost of inventory. Alternatively, she could have used percentages of total inventory value and arrived at the same conclusion:
HFL = 5% + 6.3% + 0.04% + 0.3% + 1%
+ 9% = 21.64%

Looking for Savings
Methods recently improved her purchasing process in ways that permitted lowering inventories by $200,000 and she wishes to calculate the savings this represents. She knows that the full 21.6 percent would be saved only if she were able to proportionally decrease costs associated with personnel, the building, shelving, and materials handling equipment. In reality, the $200,000 reduction in inventory value will not result in a lower depreciation cost for capital facilities and, given that remaining workloads will change little, staff will not be reduced.

Methods recognizes that costs eliminated by this inventory value reduction include only the shrinkage factor, inventory specific taxes, and the weighted average cost of capital. Since the cost of insurance as reflected in average inventory is so small, it is left out of the calculation. So, as a percentage, the calculation is as follows.

HAL = S + T + CC = 0.3% + 1% + 9%
= 10.3%

Where: (All expressed as a percentage)
HAL = Avoidable load (cost) to carry inventory
S = Shrinkage factor
T = Cost of taxes
CC = Cost of capital

Reportable savings, then, are 0.103 x $200,000, or $20,600.

Methods was quick to point out that these calculations represent the entire inventory. If calculating the cost of holding (H) for use in the EOQ formula, one would simply multiply the unit cost of the item by 10.3 percent to get the cost of holding one unit for one year.

By examining the appropriate costs associated with the six key elements, Methods was able to figure her true inventory carrying costs. She then used this information as a tool for lowering costs because she knows exactly how much each factor figures into her total costs. In the end, she learned that reducing the dollar value of inventory is not the only factor to consider when trying to lower inventory carrying costs.

Source of Funds	Effective Rate	Weight	Contribution to WACC
Bank Loans	0.09 x (1 - 0.40) = 0.054*	0.15	0.0081
Preferred Stock	0.08	0.15	0.0120
Common	0.10	0.70	0.0700

Weighted Average Cost of Capital = 0.0900 or 9% (sum of above)
*after tax rate, assuming a 40% corporate rate
Two Other Options

Sharon Methods learned there are three different ways to view opportunity cost of capital. The one she used in the scenario on weighted average cost of capital (WACC), to match the method used by her organization's financial managers. Here are the other two methods.

1. If an investment in inventory is considered relatively risk-free, management may value the dollars tied up in inventory at the organization's bank borrowing rate of interest. As interest is a deductible expense on income tax returns, the actual cash outflow associated with interest payments must be reduced by the tax rate. In other words, the real outflow is the after tax cost of borrowed funds. Methods' organization borrows operating capital at 9.00 percent interest (i) and pays income taxes at a rate of 40 percent (t). She calculated the after tax cost of borrowed funds at [i x (1-t)] or [0.09 x (1-0.40)] = 0.054. The after tax cost of borrowed funds is 5.4 percent.

2. In some organizations, management values the opportunity cost of capital tied up in inventory at the "hurdle" rate of return for investment. That is, it's valued at the minimum rate of return management will accept from investments. Depending on the level of risk inherent in an organization's industry and markets, that may be significantly higher than the WACC.

Where Purchasing Fits In

By Richard Oreskovich, C.P.M.

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As organizations implement supply chain operations, applications such as inventory management *must* evolve to support the creation of a "value chain," where true value is measured in terms of the ability to meet changing customer requirements. Inventory management is a total enterprise concern, a business issue that requires cross functional involvement to assess the needs of the organization and its internal customers.

Purchasing and supply management can have a significant impact on the control of inventory. For example, the shrinking materials control function and the trend to outsourcing in the value chain gives purchasers a prime opportunity lead this effort. To accomplish this end, purchasers should enhance their knowledge with specific inventory skills.

Effective inventory management is essential to the successful operation of most organizations (see box right). Yet, inventory management often has been a business based on judgment rather than on scientific

pursuit. There is also no one catch all method to control inventory; several approaches may be needed. However, the trend toward inventory reduction has been changing inventory management practices, particularly in this era of downsizing, reengineering, and critical competition. Managers are realizing that their judgment can and should be based on effective forecasts and mathematically-based tools.

INVENTORY FACTS OF LIFE

Here are several of the most important reasons why inventory needs to be controlled, reduced, or eliminated:

- Owning and controlling inventory requires a substantial capital outlay.
- Financial resources spent on inventory are stagnant, since organizations replace as much inventory as they use, when it comes to the overall dollars in inventory.
- Inventory produces no income.
- Inventory produces an overhead burden which is incorporated into the cost of the product or item.
- Inventory maintenance (personnel to manage, receive, issue, store, and control it) costs money.

Even with strategies to control inventory, unnecessary stocks often accumulate in stores. Two main reasons are:

- **Bulk Procurement Practices –** This practice is based on the notion that bulk purchasing achieves cost savings through reduced unit prices. While this may be true, the philosophy doesn't account for the additional costs of holding inventory and its delivery. Purchasers who buy in bulk should negotiate unit price with suppliers and reduce overall costs by procuring such items on an as required basis, if possible.

- **Inefficient Disposal Procedures –** Obsolete, dumped, or surplus items often wind up in warehouses, occupying costly space. This is often due to the fact that inventory requirements are not periodically reviewed for obsolescence, or because the responsibility for disposal resides in a position where it is of low priority.

Be Aware of the Objectives

The two main objectives of inventory management are to:

1. optimize the level of customer service (i.e., have the right goods, in sufficient quantities, in the right place and at the right time)
2. minimize the cost of providing a certain level of customer service

The internal policies and procedures for inventory management should satisfy customer needs (either internal or external) at the lowest total cost. Although the total cost curve (see box below) depicts the optimum inventory service level (with the combined cost of shortages and excesses kept to a minimum), it can also be used to show the decision-making process which determines what items and materials should be carried in inventory.

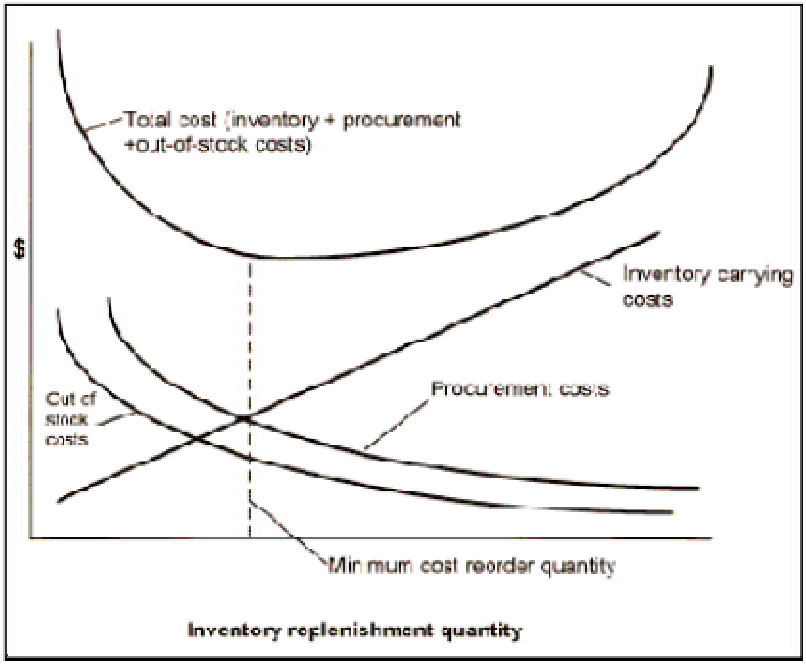
INVENTORY MANAGEMENT FOR THE SMALL ORGANIZATION

When it comes to inventory management, perhaps the single most relevant issue that separates small organizations from larger ones is cash flow and the availability of resources. The relative size (and negotiating leverage) of the organization is important, as is the need for creativity and innovation, to keep inventories controlled. Some of the most effective methods of managing inventory for small organizations are:

- MRPII installations for inventory reduction
- accurate forecasts of "A" and "B" inventory items
- moving inventory back to the suppliers
- systems contracting
- supplier consolidation, partnering, and reduction
- consortium buying (may not be effective for very small organizations)

Take the Initiative in Teaming
A team should be created to develop and execute an action plan. (The team should consist of all functions that influence inventory decisions, such as purchasing, logistics, materials management, marketing, sales, finance, engineering, operations, manufacturing, stores/warehousing, and management. Purchasing can have a key role in this process through involvement with supplier base consolidation; assessment and analysis of supplier organizations including quality systems, inventory management, process control, reliability, and financial strength; selection, development, and management of suppliers; supplier partnerships; standardization of parts and materials; certified parts programs, and lead and cycle time reduction. For example, purchasing, through improved supplier management and negotiation, can shorten lead times and reduce variability by gaining control of the delivery process and/or require the supplier to maintain a dedicated back-up stock.

EXHIBIT A



Aim for Inventory Accuracy
Inventory accuracy is elusive. The inaccuracy of inventory records is one of the greatest problems of inventory management. A minimum acceptable accuracy level is 95 percent accuracy, according to APICS (American Production and Inventory Control Society, Inc.) with "world class" accuracy at levels of 98 percent or better. However, many organizations are far from attaining 95 percent accuracy. Efforts to increase accuracy should include such techniques as cycle counting, automatic identification, and bar coding.

Inventory accuracy criteria should include the following:

- accuracy in quantity of book to reconciled physical inventory (within certain tolerances)
- correct item identification
- items physically in the exact "book" location
- transactions posted by a strict deadline
- accuracy in metrics, such as the number of items sampled

INVENTORY MANAGEMENT PLANNING: 15 STEPS TO SUCCESS

Instituting an effective inventory management system takes careful planning. The following steps are recommended:

- **Step One: UNDERSTAND THE GENERAL STATISTICS –** Know how inventory is handled in your organization, including historical background, budget, forecast, inventory turns, sales practices, working capital, industry profiles, competition profiles, customer shipments performance, and marketing forecast performance.
- **Step Two: CLASSIFY THE INVENTORY –** Start with the broad areas of demand or independent demand and then classify further, such as MRO, work in process, or raw material.
- **Step Three: PUT A TEAM TOGETHER –** Focus the team so that all members (those who have the ability to affect inventory) know what they must do and why it's important to execute the new procedures.
- **Step Four: REVIEW CURRENT INVENTORY POLICIES –** This is a review of organization philosophies and past and present "attitude" toward inventory.
- **Step Five: COLLECT DATA –** This step is about understanding current inventory levels and what impact it has on the business of the organization. For example, collect data on order entry and purchasing practices, as well as service, warranty, and repair data. Be sure the collection process is complete: this step is the foundation for all the steps that follow.
- **Step Six: ANALYZE THE DATA –** The data collected should be thorough enough to reflect on a variety of organizational operations, such as whether to produce more of a product or item, or cut back production; where to cut prices; add features; advertise more; or even discontinue the item or introduce a new or improved one. For inventory purposes, this data should be analyzed using computers with executive reporting modules that can take raw data and graph and chart it in many different ways. Work with the data to find the most effective and understandable format for it.
- **Step Seven: DEFINE CUSTOMER NEEDS –** This should be done in terms of the analyzed data. For example, the data should allow you to design control points so that stockrooms and point-of-use areas provide the same level of service and transaction integrity at all times during the day.
- **Step Eight: DEVELOP AN ACTION PLAN –** This should include setting goals and the means to implement them, as well as assigning accountabilities and provisions for measuring the plan. Formalize the responsibility and authority for inventory integrity; this should be clearly defined throughout the organization.
- **Step Nine: INTEGRATE THE PLAN –** This step involves factoring the plan into the organization's annual budget and forecast process.
- **Step Ten: OBTAIN APPROVAL –** It is at this point that the complete plan should be formally presented to senior management for approval. Tie the plan, including inventory goals, performance, and budget, into the organization's strategic plan (i.e., improve working capital, improve customer service levels, eliminate waste) otherwise senior management may not relate to it.
- **Step Eleven: FORMALIZE THE PLAN –** Establish policies and procedures, and publish them.
- **Step Twelve: INSTITUTE THE PLAN –** This phase should be done quickly yet competently to maintain inventory integrity. For example, notify suppliers immediately, or risk having them perform to old schedules. Care should be taken to ensure that systems and processes work effectively and efficiently.
- **Step Thirteen: MEASURE THE RESULTS –** Metrics should be established to measure progress and assess continuous improvement.
- **Step Fourteen: SHARE THE RESULTS –** Publicizing the results reinforces the importance of the plan and the necessity of maintaining its integrity.
- **Step Fifteen: CONTINUE MONITORING –** Review the plan periodically. Make any changes, adjustments or modifications as needed.

The Tools of Inventory Management

By Richard Oreskovich, C.P.M.

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Inventory management is not an isolated function. Many inventory issues are scheduling issues. Inventory is tied into the procurement cycle, and is affected by functions such as logistics and stores management. Within this greater context, there are a number of specific methods to manage and control inventories. The most prevalent are described below.

Economic Order Quantity
Economic order quantity (EOQ) models have long been established but are yielding to newer methods, such as MRP II (note, however, that MRP II may not be applicable to all inventories, such as MRO). Nonetheless, EOQ is valuable, and practitioners should know the principles behind the EOQ model.

Several assumptions and limitations should be noted before analyzing the basic EOQ model.

1. To be effective, an item must have a constant, known usage rate (i.e., not seasonal).
2. Lead time should be constant.
3. Price fluctuations and quantity discounts are not applicable.

The principle driving the basic EOQ model is the minimization of the total costs required to procure (ordering costs) and maintain (carrying costs) an item in inventory. For example, examine a total cost curve as depicted in the box on page 2. The lowest total cost will occur at the intersection of the ordering cost curve and the carrying cost curve. If a straight line is drawn from the "x" axis through the intersection, it will intersect the total cost curve at the minimum point. The total cost curve is made up of both the ordering costs and the carrying costs. The total cost curve is primarily level near the EOQ. This equates to a range of acceptable values for the EOQ which will be within (5 percent of the minimum total cost. This flexibility of the EOQ model is beneficial for smoothing out errors and for the utilization of approximate versus calculated ordering costs and carryings costs.

EOQ can result in reduction of reorder quantities (small lot size) and increased order frequency for "A" class items; and increased order quantities (large lot size) with decreased order frequency for low-value, "C" class items. The result is reduction and minimization of total inventory investment. Another outcome is that automatic stratification will occur, which is similar to the manual ABC stratification system.

The ordering costs and carrying costs typically used to calculate their respective factors are as follows:

- **Ordering Costs**
  - Labor (procurement)
  - Interest costs
  - Insurance costs

- **Carrying Costs**
  - Opportunity cost (the lost opportunity to invest dollars tied up in inventory in other income producing investments)
  - Supplies
  - Receiving labor
  - Taxes
  - Handling costs
  - Storage costs
  - Obsolescence and deterioration
  - Shrinkage
  - Accounts payable labor

Some typical industry wide ranges for ordering and carrying costs are as follows:

- ordering costs – from as low as $10 to as high as $100 per purchase order
- carrying costs – 15 percent to 40 percent of inventory value

The flexibility of the EOQ model makes it possible to estimate the *values* for ordering costs and carrying costs instead of requiring a *precise* determination. This does not mean that these costs are not important to know from an operational standpoint, but that the process of utilizing the EOQ for effective lot sizing of an inventory can proceed with less than exact values for carrying and ordering costs. Select the factor values and implement the EOQ process on your inventory which best meets your organization's objective and philosophy.

ABC Classification

The ABC classification system is derived from the Pareto principle, which states that 20 percent of the items in an inventory will account for 80 percent of the inventory total value, while the remaining 80 percent of the line items will account for only 20 percent of the total inventory value. In reality the percentage breakdown for each class varies depending on the stratification selected. Typically 5-10 percent of A items account for 75-80 percent of the investment, 20-25 percent of the B items account for 15-20 percent of the investment, and 70-75 percent of the C items account for 5-10 percent of the investment.

Management of "A" class inventory items can have a significant effect on the average total inventory dollar value. "A" class inventory items should be tightly controlled by implementing perpetual record keeping for issues, receipts, and balance-on-hand; frequent cycle counting, shrinkage control; application of purchasing and inventory control techniques in order to reduce the ROP (reorder point), and ROQ (reorder quantity) whenever possible.

Note: Average inventory is one half of the order quantity (lot-size), and depends on its order quantity size – the quantity on hand can vary from a low, just prior to the creation of an order for replenishment, to a maximum amount following receipt of the new order. The average inventory of each individual item added together equals the average total inventory value.

"C" class inventory items should be managed with reduced control methods, such as:

1. simplified or no record keeping
2. less frequent or no physical inventories
3. utilization of simple reorder techniques
4. Charge to an overhead account

One example is the two bin system.

"B" class inventory items can be managed by methods such as maintaining accurate records, cycle counting, and periodic review of the reorder point.

MRP and MRP II

Material Requirements Planning (MRP) is a computer-based system used to determine the quantity and timing requirements of dependent demand materials used in a manufacturing operation. Materials can be purchased externally or produced in-house. The system utilizes a master production schedule, a product bill of material, and current inventory data to determine new requirements and timing.

The production plan is broken down into a planned schedule by date and quantity; the master production schedule is then exploded into time-phased material requirements by analyzing the final product bills of material that make up the final product, the amount of inventory on hand for each material/part/component required, and the lead time required for the replenishment cycle. The program calculates the gross requirements for each time period, deducts the balance-on-hand and on-order for each item, and determines the net required. From the net requirements, lead times are factored in to determine the exact date to release orders to ensure receipt at the exact time required for final item production.

Manufacturing Resource Planning (MRP II) expands the basic MRP system to include:

1. a capacity planning capability
2. a financial interface that permits planning to be done in financial terms as well as operations planning terms
3. a simulation ("what if") capability that can be used in alternatives planning work

MRP II encompasses the total production process; it not only provides an effective means for synchronizing the base information of an enterprise, but is a tool that balances critical production resources, traditionally for medium- to long-range planning.

However, MRP II is on a threshold in development because of the needs generated by supply chain concepts, increased competitive demands, and quick customer responsiveness (see box below). Newer generations of MRP II will include object-oriented programming (OOP) – small "building blocks," which are reused throughout the application. Allowing easy modification and customization. Newer MRP II models will also permit both internal and external users to receive information over a shorter planning horizon in addition to longer term planning information.

Reorder Point

Another tool is to lower the reorder point (ROP) and safety stock levels required to maintain selected service levels. The reorder point is a continuous-review inventory control system in which an order is placed whenever a withdrawal brings the inventory position to a predetermined reorder point level. These levels can be lowered by reducing the replenishment cycle time and supplier lead times. The inventory replenishment process should be examined for non-essential, nonproductive, non-value adding steps that slow down and delay the review, ordering, receiving, and handling of the inventory.

TECHNOLOGY, INVENTORY MANAGEMENT, AND THE SUPPLIER CONNECTION

Innovations in technology have advanced the use of MRP II systems into supply chain environments, in much the same way that electronic data interchange (EDI) has helped to create supply chain bonds with suppliers. Integrated fax capability is another technology that brings customers and suppliers closer, although this technology lacks the database update capability of EDI. Still, fax on demand provides an immediate information exchange that promotes high levels of customer responsiveness, which has positively affected the way organizations conduct business.

The Internet is a technology that is shaping the organization's approach to supply chain integration. Where the Internet is now primarily a means to exchange information, its potential for extended commercial transactions is vast. With improvements in security and performance, the Internet will be used, in part, to allow customers direct access to a supplier's MRP II system, which are themselves in a state of continuous improvement. For example, MRP II applications will provide more information based upon transactions that users enter; and greater inquiry and analysis will be available over local and wide area networks. The Internet will be able to provide "on demand" access, so that customers can perform any number of functions such as checking order status, inquiring about availability, and verifying pricing. Organizations can offer this capability either by allowing direct access into the MRP II database, or by equipping MRP II with a parallel "data warehouse" for inquiry and reporting.

Consignment

Consignment is a method of procurement in which a supplier maintains inventory on the purchaser's premises. The supplier retains title (ownership) of items that are warehoused by the customer, with payment due upon use of the item. If consignment is used for items with a high dollar value, or for entire OEM (original equipment manufacturer) lines, it can significantly reduce inventory investment. Consignment is also effective for items with long and variable lead times. The disadvantage to consignment stock is that if it's not maintained by the supplier it requires more detailed management and control, including:

- clear identification as consignment stock
- storage in a separate location
- increased security
- frequent reconciliation
- frequent status reports to the supplier

Note: Consignment stock influences inventory value, but doesn't necessarily mean that you will reduce the cost of an item.

CASE STUDIES

The following cases are real-life examples of how various organizations have instituted effective inventory management systems.

- In the Midwest, an established retail office supply business found costs increasing mainly due to slow sales and the costs associated with maintaining high levels of inventory. After exploring several options, including opening a large retail outlet to house inventory, the firm decided to join a buying group. In addition to the purchasing leverage potential, the organization was able to obtain factory direct service which cut inventories on bulk items, such as paper goods.

- A bank holding organization in New England had recently installed an automated reporting system and acquired a smaller bank at the same time. Reports began to show that inventory investment had skyrocketed through an increase in total materials and supplies expenditures. Each of the organization's 80 branches stocked its own forms and supplies, which were replaced, on request, from a central warehouse. Because this resupply was fairly stable, the bank decided to investigate supplier managed inventory (VMI) as a solution.

- A West Coast bakery products organization has begun using bar codes to track its inbound inventory of raw materials. The company negotiated a consignment inventory strategy with major suppliers; the bakery warehouses raw ingredients and packaging, with bar codes added by the suppliers. This permits more effective control and tracking into the production process. The bakery manager reports a noticeable improvement in inventory accuracy and operator efficiency, even during start-up.

- In New England, a small manufacturing enterprise has installed a bar code/RF system. The organization has had an acknowledged poor history of inventory performance. Management's goal is to correct this situation and reduce inventory levels by 20 percent over the first year.

- Shifting inventory back to suppliers has been the major inventory reduction success story for a large Texas organization. The company tied its job planning system directly into the inventory system and now orders material for specific jobs via EDI for JIT delivery.

- A southern auto parts maker has done away with time-consuming (and costly) annual physical inventory which shut the enterprise down for three days each year. A new system features RF laser guns and cycle counting capability which will permit better tracking and no shut-down.

- At a major pharmaceutical operation in California, RF/bar coding feeds data directly into the MRP systems. The bar code readers, which are used from receiving dock to the production line, saves a significant amount of time in tracking inventory, which is crucial in the company's industry.

- A large specialty chemical manufacturer is continuing a consolidation of stocking points at their distribution center locations while bringing in the basics of inventory fill rate strategy and safety stock consolidation to reduce inventory levels by 15 percent.

- A nationwide discount retailer uses a system of order entry and tracking which directly affects the retailer's suppliers. The system has grown from an order entry process into one that helps the retailer and its suppliers to better manage customer relations and new product development.

Just-In-Time, Kanban, and JIT II
Production demands and the management of supplies are linked strategically and operationally. The following systems operate on this principle.

Just-In-Time. Just-In-Time (JIT) is an operation aimed at reducing waste and increasing productivity. JIT minimizes inventory at all levels, including materials purchased, transported, and processed – just in time for their use in a subsequent stage of the manufacturing or production process (note: JIT use is increasing for MRO items).

To achieve its goals, JIT requires:

1. Production of only what is needed to satisfy actual demand. This relates to both final product and all intermediate production operations (pull production – used to describe production operations that produce only in response to consumption at the next immediate downstream operation. In contrast, push production relies on economies of scale with long runs and usually higher inventories).
2. Materials/parts/components delivered directly to the point of use, at the exact time required.
3. A synchronized production system.

Kanban. Kanban is a "pull" system of production/materials control associated with JIT, using tickets or cards. The "up-stream" station (the server) receives ticket calls for small, fixed quantities from a "down-stream" user (the client). On sending the supplies, a production "kanban" is generated requesting the previous upstream server to make/supply a replacement quantity. This results in rapid feedback allowing quick response to changes.

JIT II. JIT II is a term used to signify an "in-plant" or "in-facility" store maintained by a supplier. It is a computer-based system intended to eliminate the inventory traditionally kept for nonproduction supplies, design/engineering components, and general maintenance stocks required to maintain building/physical plant operation.

With the elimination of this inventory comes the elimination of staff necessary to maintain it, and the costs associated with it. Some of the main benefits of JIT II are:

- automatic inventory replenishment (on an as-needed basis)
- consolidated monthly invoicing
- reduction in the number of customer ordering transactions

Supplier Managed Inventory
Supplier managed inventory (called VMI) is a result of the move toward strategic alliances in which production plans/schedules are shared with suppliers. VMI is a demand forecasting and inventory replenishment method that monitors sales data and inventory levels to maintain them at their optimum position. This data allows organizations to plan more effectively and react quickly to changes in market conditions, customer requirements, and improved inventory deployment. VMI allows:

- distribution planning to calculate cost-effective shipment schedules
- inventory management to optimize stock allocation and plan safety stock
- the ability to balance customer demands against inventory availability
- higher service levels to customers
- lower operational costs through distribution planning and production scheduling
- lower inventory levels to reduce inventory carrying costs

RF Data Communication
A relatively new technology is radio frequency (RF) data communication, which is usually integrated with bar code scanning and hand-held computers (see box on page 13). RF systems provide real time data collection, which can improve the flow of goods and materials through a facility, from receiving through shipping, in addition to cycle counting. The system can also increase inventory accuracy and ,therefore, the potential for reduced inventory levels.

For example, RF systems support inventory by location and quantity, so that items can be stored in random locations and still be located when needed, resulting in more efficient use of space. This level of tracking allows measurement of individual processes, closer scrutiny of the processes, and the potential to increase overall productivity.

In considering an RF system, the inventory management team should actively involve users such as supervisors, forklift operators, pickers, packers and other stores personnel. The RF supplier should also do a site survey to determine how many transmitters (and of what type) are required in the installation and where they should be placed. The survey should be scheduled, if possible, on a day with high activity, which would represent a "worst case" scenario.

MORE TOOLS FOR INVENTORY MANAGEMENT

Other tools and techniques being utilized to minimize and reduce inventories are:

- **co-location,** the trend toward suppliers locating close to the buying organization
- **co-production,** where a supplier shares the same production floor space with its customer
- **in-plant stores,** where a supplier locates a stocking store within the buying organization, often replacing warehouse and inventory control functions, and targeting high turnover consumable items
- **multi-functional distribution centers,** such as an industrial park and Just-In-Time airport combined; value-adding manufacturing facilities receive materials and parts by air and then ship the converted product on to the next destination
- **warehouse management systems** (including order processing and automatic collection systems): bar-coding, stock keeping units (sku), universal product codes (UPC) have been found to increase inventory accuracy, increase inventory turns, and lower inventory levels by improving supply chain efficiency
- **stockless purchasing,** including blanket order, open-end orders, and systems contracts – whereby the purchaser negotiates a purchasing arrangement, including price, for a group of items for a predetermined time period, and the supplier holds the inventory until the purchaser places orders for specific items
- **total cost of ownership,** a tool that has reduced the place of EOQ in inventory management; it allows analysis of all cost factors involved for the purchase of an item, such as delivery performance, quality, transportation/packaging and lead time; these costs are calculated and added to the respective supplier's base price for comparison
- **procurement cards,** which help lower processing costs for low dollar purchases (this is especially true for the large number of low cost purchases typical of MRO inventories); many organizations have found that MRO inventories can be reduced through the use of procurement cards/programs

Additional Reading Materials

In addition to the Reference Articles in Section 4 of this Program Handbook, our satellite seminar panelists also recommend the following materials:

Articles:

Note: ISM members can access these articles online using the URLs given below.

- "Sustaining Supply's Contribution," *Inside Supply Management®,* December 2003 (cost management) www.ism.ws/ResourceArticles/2003/120326.cfm

- Crimi, Thomas A. and Ralph G. Kauffman, "Looking for Cost Savings in the Supply Chain" *Inside Supply Management®,* March 2003 (cost reduction) www.ism.ws/ResourceArticles/2003/030306.cfm

- "Joining Forces for Technology Initiatives," *Inside Supply Management®,* December 2002 (use of technology) www.ism.ws/ResourceArticles/2002/120217.cfm

- Dozbaba, Mary Siegfried, "Critical Supplier Relationships: Generating Higher Performance," *Purchasing Today®*, February 1999 (reliance on suppliers) www.ism.ws/ResourceArticles/1999/29922.cfm

- Ramstad, Theodore R., "Make a Play for 2nd & 3rd, " *Purchasing Today®*, June 1999 (tiered suppliers) www.ism.ws/ResourceArticles/1999/69912.cfm

Books:

- Piasecki, David J., *Inventory Accuracy: People, Processes and Technology*, OPS Publishing, 2003 Publishers, Inc., 1999 (www.accuracybook.com)
- Muller, Max, *Essentials of Inventory Management*, Amacom, 2003
- Arnold, J.R. Tony, and Stephen N. Chapman, *Introduction to Materials Management,* 5th Edition, Prentice-Hall, 2004