Managing Inventory Investment Effectively

By Robert J. Trent, Ph.D. -- Supply Chain Management Review, 3/30/2002

In the mid-1990s, Apple Computer was on the verge of bankruptcy. After accumulating close to $2 billion in losses over a two-year period, the company began a turnaround by bringing back one of its legendary founders, Steve Jobs, and introducing a bold new product, the iMac.[1] These actions, however, accounted for only part of Apple's renewal. The company also put in place an impressive array of supply chain activities to manage product demand, inventory investment, channel distribution, and supply chain relationships. In an effort to manage its inventory better, the company reduced its product line by almost half, forecast sales on a weekly instead of monthly basis with daily adjustments to production, and asked suppliers to manage inventory for standard parts and components. Apple also formalized a partnership with a supplier to build components close to Apple facilities with just-in-time (JIT) delivery, created a direct ship distribution network through the Web, and simplified its finished-goods distribution channel.

The impact of these efforts has been impressive. The company now operates with six days of inventory, compared with 23 days in the mid-1990s. Furthermore, inventory turns have increased from 10 to 180, creating a much higher return on investment. And, perhaps most importantly, gross profit margins increased almost 40 percent over a two-year period. Though Apple struggles in a difficult economy, it is safe to conclude the company would not have survived if it had not aggressively managed its supply chain, including its investment in inventory.

The effective management of inventory investment should be a primary objective when searching for ways to manage costs, improve profitability, and enhance shareholder value. This article addresses the critical topic of inventory management from several perspectives. First, it highlights the impact that better inventory management can have on key performance indicators. The article next presents a model for assessing inventory management activities and approaches from three dimensions—inventory volume, velocity, and value. Third, it outlines various ways to manage inventory investment better, including best-practice examples. The article concludes with a discussion of how one company is using inventory management to achieve a superior return on assets.

Translating Data Into Financial Returns

As Apple discovered, the opportunity to improve financial performance through effective inventory management practices is great and, at many companies, largely unrealized. A study by Bain & Company and the U.S. Department of Commerce found that inventory turns, a key reflection of inventory management efforts, have not improved by any significant degree in the metal fabrication, paper manufacturing, retail apparel, and retail food industries from 1988 to 1998. Only the auto industry showed an appreciable improvement with turns increasing to 22.3 per year in 1998 from 18.3 in 1988. A majority of the companies in Bain & Company's study expressed dissatisfaction with their supply chain results, while other research has shown that most companies lack an overall strategy for improving this situation.[2]

Why has there been so little progress in managing inventory? Part of the reason may be that, from a financial accounting perspective, inventory is categorized as a current asset. When inventory resides in the same category as cash and marketable securities (which truly are current or liquid assets), one cannot help but feel that there is something good about inventory. And, for many years, this is precisely how most U.S. managers have viewed this special kind of asset. Unless executive managers begin to appreciate how the funds committed to inventory affect cash flow, working capital requirements, and profitability, it is unlikely that they will undertake serious efforts to manage inventory as an asset.[3] Investments in inventory simply do not undergo the same rigor and analysis as investments in other types of assets, particularly plant and equipment.

Any discussion of inventory management needs to identify its impact on key financial measures. A CEO of an industrial company is not likely to get overly excited when he or she hears that total inventory turns increased from 8 to 10 because of better inventory practices. Executive managers simply do not think about, nor are they evaluated by, the performance criteria used to evaluate the typical supply chain manager. However, these

executives will appreciate the importance of effective inventory management once the financial impact of increased turns is translated into their impact on key financial indicators.

Exhibit 1 on the following page illustrates one way to link improved inventory turns (which is the visible outcome of inventory management practices) and a key performance indicator, return on investment. The two companies in Exhibit 1 are identical in every way but two—Firm B has half the amount of inventory on its balance sheet as Firm A, and Firm B has a slightly higher profit margin than Firm A. It is reasonable to assume that Firm B has a higher profit margin because of the lower average carrying charges resulting from shorter periods of storage, less inventory handling, and reduced cycle-counting requirements. Margins should have also improved because of the elimination of nonvalue-adding activities and unnecessary transaction costs that are associated with maintaining physical inventory.

EXHIBIT 1

Assessing the Effect of Inventory Management on Key Performance Indicators

	Firm A	Firm B
Assets: (millions of $)		
Cash	$10	$10
Securities	$15	$15
Receivables	$8	$8
Inventories	$20	$10
Plant and Equipment	$75	$75
Total Assets	$128	$118
Inventory Turnover	$200/$20 = 10 turns/year	$200/$10 = 20 turns/year
Asset Turnover	$200/$128 = 1.56 turns/year	$200/$118 = 1.69 turns/year
Return on Investment	6% x 1.56 = 9.36%	7% x 1.69 = 11.55%

Formulas:
Inventory Turns = Sales/Inventories
Asset Turnover = Sales/Total Assets
Return on Investment = Profit Margin x Asset Turnover

This exhibit shows how better inventory management affects return on investment. A doubling of inventory turns, combined with the benefit of lower inventory-related expenses that contribute to a higher profit margin, increases return on investment from 9.36 percent to 11.55 percent, or an increase of almost 25 percent. Executives will begin to understand the importance of effective inventory management once they can view inventory management activities in terms of their effect on financial performance.

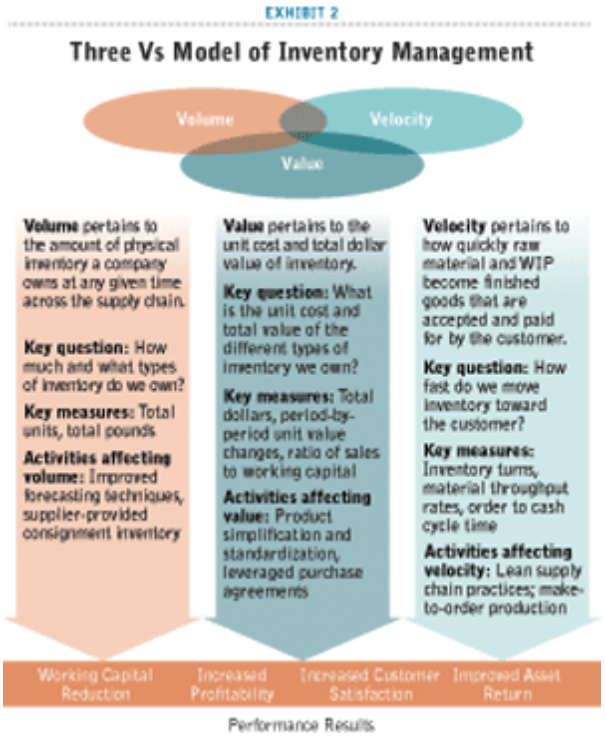
Identifying the impact of inventory management activities on return on investment is not the only way to demonstrate the value of such efforts. Inventory management activities can be translated to reflect their impact on earnings per share, economic value-add, return on assets, working capital, cash flow, and profit margin. The point here is that effective inventory management is critical to managing assets and controlling expenses. Demonstrating how inventory actions affect key performance indicators is essential for capturing executive management's attention.

The Three Vs Model

How managers view inventory can differ depending on where one resides in the value chain. While financial planners view inventory in terms of dollars, which is reported on the balance sheet, supply chain planners typically view inventory in terms of units. What is the right viewpoint if we want to manage this investment effectively? Actually, assuming multiple perspectives about inventory is a worthwhile way to approach this topic.

Companies that are serious about managing inventory must visualize how their practices and approaches will affect the three Vs of inventory management—the volume, velocity, and value of inventory. Exhibit 2 highlights the "Three Vs Model of Inventory Management," including key objectives, measures, and examples of activities that relate to each dimension.

Volume relates to the amount of inventory that a company owns at any given time. Key volume measures will relate to total units on hand, including safety-stock levels. *Velocity* refers to how quickly raw material and work-in-process (WIP) inventory can be transformed into finished goods that are accepted and paid for by the customer. As the rate at which inventory moves from suppliers, through operations, and on to customers accelerates, the average amount of inventory on hand at any given time is reduced. Higher velocity requires a lower commitment of working capital and improves cash flow. Key velocity measures include material throughput rates, inventory turns, and order-to-cash cycle times. Finally, *value* pertains to the unit cost of the inventory. Key measures include standard costs and the total value of inventory, including raw materials, components, subassemblies, and finished goods.



While certain actions can predominantly affect a specific variable (velocity, volume, or value), there is often interdependence among these variables. The point here is that organizations must pursue activities and approaches that positively influence the volume, value, and velocity of inventory through and across the supply chain.

Investment Management Tactics

The activities that a company pursues to influence the three Vs will depend on the resources available to implement an approach along with how well inventory is currently managed. Though dozens of activities, approaches, and actions can affect inventory, the following set represents powerful ways to capture the operational and financial benefits offered by effective inventory management. This set of approaches is based on extensive research and experience with many different industries. The payback from these activities will be found in better management of working capital, improved customer service levels, increased profitability, and improved return on assets.

Improve Inventory Record Integrity

A logical place to begin when managing inventory investment is to make sure there is agreement between physical and electronic inventory. Companies often compensate for error and variability in supply chains with excess inventory, usually in the form of safety stock and safety leadtimes. This also applies when there is excessive error in record integrity systems. Perfect record integrity must become a key inventory management objective.

Record integrity is the result of various activities and procedures designed to ensure that the amount of physical material on hand (POH) is equal to the computerized record of material on hand (ROH). In short, record integrity exists when the physical inventory on hand equals the electronic record on hand (POH = ROH), regardless of the quantity of inventory. Any difference between POH and ROH represents error. This error can be the result of operationally mismanaging inventory, which affects the physical (POH) side of record integrity. Error can also result from systems-related sources, which affect the computerized side (ROH) of record integrity. Concern over managing the actual volume, value, and velocity of inventory should arise only after we have confidence in the integrity of inventory records.

The effects of poor record integrity on supply chain operations can be severe. When physical inventory exceeds the amount the computerized system believes is available (POH>ROH), the physical inventory cannot be sold or used to satisfy customer demand. An investment has been made in a nonproducing asset. When the record on hand is larger than what is physically available (ROH>POH), the company risks scheduling an

item for production or even selling it to a customer, when in fact it is not available. This inevitably leads to backorder situations and dissatisfied customers.

When record integrity is lacking (that is, discrepancies exist between physical quantities and electronic records), steps must be taken to identify and correct the sources of error. This will require asking and answering a range of questions. For example, are record errors displaying a random or systematic pattern across SKUs? How severe are the differences between physical stock and electronic records? Are proper receiving, stock-keeping, and withdrawal procedures and systems in place? Is theft a problem? Are suppliers shipping quantities that match their documentation? Are effective cycle-counting procedures used? Is inventory scrap and obsolescence accounted for correctly? Are employees trained to properly move, handle, and disperse material?

These questions highlight the many areas that can be explored when pursuing improved record integrity. Unfortunately, record integrity is an essential but often overlooked part of inventory management. It is difficult to manage inventory when we lack confidence in knowing what we own or physically have on hand.

Improve Product Forecasting

Perhaps the most important piece of information that moves across a supply chain is the forecast of end-customer demand. Many companies, however, fail to recognize the effect that inaccurate forecasting has on inventory volume and velocity. The downside of poor forecasting includes higher inventory volumes and carrying charges, poor customer service as inventory is misallocated across locations and products, and excessive safety stock levels. For companies that are serious about better inventory management, improving the quality of product forecasts, like improving record integrity, is an ideal place to start.

Consider the case of an East Coast confectioner that issues forecasts monthly in a make-to-stock environment. The supply chain group at this company recently analyzed finished-product forecasting errors in its efforts to manage inventory investment better.[4] The company found that its SKUs had an average error of 45 percent when comparing actual and predicted monthly demand using the mean absolute deviation (MAD) technique of error assessment. A closer investigation revealed some disturbing findings. Material planners believed that a four-week safety stock for all items would alleviate the impact of poor forecasting, thereby reducing the need to be concerned with forecast accuracy. Furthermore, no single manager or group was accountable for forecast integrity. Marketing, which technically is responsible for generating monthly forecasts, admitted that forecasting was a "nuisance" and not the best use of its time. Finally, an analysis across the company's 900 SKUs found that inventory was sometimes severely misallocated across geographic locations and product lines, creating problems in meeting the delivery dates for key customer orders. As a result, this company has created a cross-functional sales and operations planning group to address product forecasting and finished-goods distribution.

An example of the benefits of better forecasting and product placement can be found at Longs Drug Stores.[5] This company has improved its ability to identify the best possible combination of when to order prescription drugs, how to ship them, and how much to carry in a retail outlet on any given day. The company worked with a third party to develop a system that pulls data each day from point-of-sale terminals at hundreds of stores. It then determines finished-goods requirements for its retail outlets on a daily basis by using two years' worth of historical data and a forecasting algorithm. The algorithm includes 150 variables per product and effectively predicts consumer demand out to 91 days. The system also determines the amount to order from upstream suppliers (that is, from pharmaceutical companies).

This system is a major improvement over Longs' previous forecasting methods, which were not much different from the system established in 1938 by the two founding brothers. Pharmacists at the retail stores and buyers at the distribution centers have always had a general understanding of demand peaks and valleys and top sellers. They used to consider these manually when placing orders. Unfortunately, it was impossible to consider manually all the variables that affected demand.

To cover forecasting inadequacies, stores routinely ordered higher than necessary quantities of expensive drugs, many of which sat on the pharmacist's shelf for months at a time.

What effect has improved forecasting had on inventory and capital requirements? Longs says that its new system has allowed the store to reduce systemwide inventory requirements by 26 percent, leading to $30 million in savings. This system has also freed $60 million in working capital, which the company has used to acquire a 20-store drug chain. The results are so encouraging that Longs signed a five-year extension with its third-party forecaster and expects to extend the system to include the nonprescription products in the front of its stores. This example draws an explicit link between better forecasting, reduced inventory requirements, and improved financial performance.

Create a Planning System and Structure

An emerging organizational trend is to view the supply chain from an integrated or holistic perspective rather than as a collection of independent activities. In response to this trend, some organizations have created new positions and developed systems to support a balanced and continuous flow of inventory from supplier to end customer. Perhaps no company has taken a more holistic view of the supply chain than Eastman Chemical, a division spun off by Kodak in 1994. In its efforts to better manage its investment in inventory, the company has created a process it calls *stream inventory management*.[6]

The supply chain planning group at Eastman Chemical, known as Customer Service and Materials Management, includes all the activities involved with supply chain planning and execution except production. This group reports to an executive who has responsibility for managing inventory investment. All incoming orders and outgoing purchase orders must pass through this group, which maintains specific targets for all major inventory categories. This group manages inventory as a companywide number rather than as separate amounts spread across the supply chain. Customer Service and Materials Management has sole responsibility and accountability for inventory management.

To maintain a total view of inventory, Eastman Chemical developed an information technology system called Globiis, or Global Business Integrated Information System. Along with improving forecasts, this system receives all customer orders and then applies algorithms to translate finished-goods requirements into material requirements. Upstream inventory (that is, raw material) enters the system to replenish finished-goods inventory that moved out of the system to satisfy customer orders. Hence, stream inventory management balances inventory inflows with finished-goods outflows.

Stream inventory management has proven itself by reducing inventory while still satisfying customer demand. Eastman's total inventories are now 7 to 8 percent of sales compared with almost 12 percent of sales in 1989. For example, 20 years ago Eastman kept 20 million pounds of the raw material paraxylene on hand to support an annual production of 520 million pounds of material for soda bottles. The company now maintains 14 million pounds of paraxylene to support 1.5 billion pounds of annual production. Comparable results have been achieved for other purchased inventory.

Exhibit 3 illustrates one way to use organizational design to assume a total supply chain perspective. Under this structure, which is used by a leading U.S. company, a single executive has responsibility for all demand and supply planning activities, including total inventory investment.[7] The primary objective of this structure is to satisfy end-customer requirements at the lowest total cost, including the effective management of inventory across the supply chain. This structure, like the one in place at Eastman Chemical, recognizes that effective inventory management requires taking a holistic view of the supply chain.

Pursue a Lean Supply Chain

Any discussion of inventory management must include a reference to lean supply chain practices. Lean supply chain management has as its primary objective the shortening of time between a customer order and shipment to the customer by eliminating waste, including waste that manifests itself in higher than necessary inventory.[8] James Womack, an expert on lean techniques, argues that lean operations stress three principles—flow, pull, and striving for excellence.[9] A recently published study concluded that more than 80 percent of small manufacturers and almost 90 percent of large manufacturers improved their material throughput rates and lowered their average inventory levels after implementing lean supply chain practices.[10] *Industry Week's* 2001 Census of Manufacturers confirmed the trend toward the adoption of lean practices, many of which result in greater inventory turns when implemented properly.[11]

Not all companies have the resources to become totally lean or to compete in industries that support lean supply chain practices. However, most organizations should pursue at least some of the principles and practices that underlie a lean supply chain by focusing on three major elements—lean purchasing, lean logistics, and lean operations.

Some key features of lean purchasing include a drastically reduced supply base, frequent shipments of small lot sizes according to strict quality and delivery standards, and close, even collaborative, buyer-seller relationships featuring longer-term agreements. Lean purchasing also requires stable production schedules that are matched to final product requirements (rather than economic lot sizes at the supplier), extensive sharing of demand information, and well-developed electronic data interchange (EDI) systems.

On the inbound logistics side of the supply chain, being lean requires using a reduced number of transportation carriers, longer-term contracts to secure dedicated services, and electronic linkages with carriers. Lean logistics also demands the use of specialized vehicles and handling equipment to accommodate frequent deliveries of smaller quantities within a closed-loop pickup and delivery system.

In the operations arena, lean techniques include process redesign with cellular layouts, continuous flow production, level build schedules, inventory pull systems with visible signals, equipment set-up reduction, preventive maintenance, and total quality practices. Most observers agree, however, that U.S. companies have a long way to go before they fully capture the benefits, including the inventory-related benefits, offered by a lean supply chain. Womack maintains, "I'm not a defeatist or pessimist, but I think we're still in the early days with regard to figuring out how to do this lean stuff."[12] Given this assessment, we can conclude that opportunities abound to manage inventory investment better through the application of lean principles and approaches.

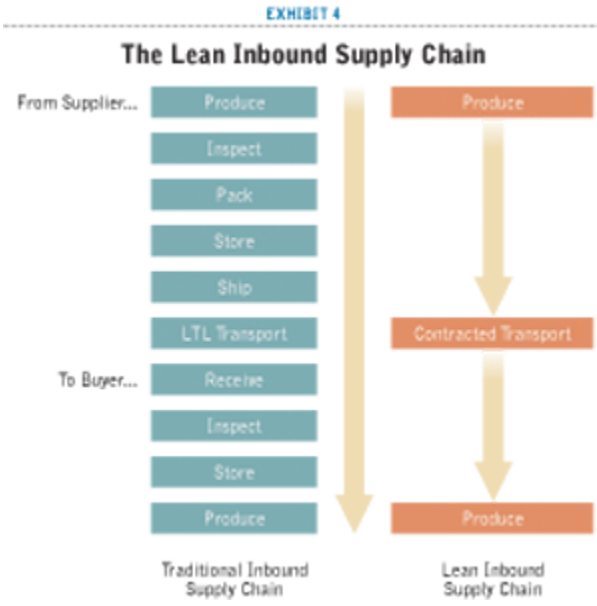


Exhibit 4 compares the major upstream elements for a traditional supply chain with those for a lean supply chain. A supply chain mapping exercise performed at one leading company (details not featured here) revealed that a traditional inbound supply chain using less-than-truckload (LTL) shipments can require as many as 27 major steps or activities to move an item from the end of a supplier's production process to the start of the buyer's production process. The redesigned supply chain, featuring a just-in-time closed-loop network, requires only six steps or activities.

We can conclude that 21 of the 27 steps in a traditional supply chain constitute waste, including inventory waste caused by slower inventory velocity through the upstream portion of the chain. This exhibit shows only a single supply link between a single first-tier supplier and buyer. Imagine the inventory waste that takes place for a complex item that has hundreds of first-tier suppliers and potentially thousands of sub-tier suppliers, all operating within a traditional production and logistics network. Lean supply chain practices clearly offer the potential to provide

dramatic inventory improvements.

Standardize and Simplify Design

In 1995, McDonnell Douglas (now part of Boeing) introduced the latest version of its F/A-18 fighter-attack jet. The company stated that the new F/A-18 was capable of carrying greater payloads but with 33 percent fewer parts than its predecessor. In the late 1990s, Toyota announced that its new Camry was being delivered to showrooms with 25 percent fewer parts than the previous model. And in 2001, a key Toyota supplier, Tokia Tika, said it was being asked to develop standardized parts, such as dashboard knobs and turn signal levers, that could be used across four different Toyota models.[13] Historically Toyota would have had a separate design for each model.

Why should companies be concerned with standardizing and simplifying product designs, and what is the relationship to inventory management? A simplified design almost always requires fewer part numbers, resulting in fewer suppliers, reduced transactions to support the inventory, and lower inventory management costs. The elimination of unnecessary components also reduces a product's cost, which lowers the value of the inventory required to support customer demand and service requirements. A primary objective at the beginning of any new product development project should be to simplify product designs and standardize them where possible.

Product design is the appropriate time to consider simplification and standardization, although continuous improvement efforts can later alter existing designs. Many companies use value-engineering techniques during product design to reduce part count and cost by asking the following questions:

- Can any part of the design be eliminated without impairing performance and functionality?
- Can the design be changed to permit the use of simplified and less costly production methods?
- Can less expensive but equally effective materials be used?
- Are standardized items available that can replace customized parts and components?

A thorough review of product complexity and customized vs. standardized requirements during product development can reduce the working capital required to support new product inventory requirements.

Leverage Companywide Procurement

The consolidation or leveraging of common items and services across buying locations has increased significantly during the last 10 years, including across worldwide units. This increase has resulted in major savings as leveraged agreements led to lower material costs. Lower material costs can significantly reduce the amount of capital committed to inventory during the life of an agreement.

Santek Chemicals, a U.S.-based company that designs, builds, and operates chemical facilities worldwide, is an example of how leveraged agreements dramatically affect the value of materials and spare parts.[14] In its search for improved financial performance, Santek has determined that leveraging its material volumes across its worldwide design and procurement centers offers extensive and "untapped" opportunities.

Santek has historically operated in an engineer-to-order environment using regional design and procurement centers. This has resulted in design and procurement efforts customized to each new project along with a lack of coordination between North American, European, and Asian units. In many cases, regional centers required the same or a similar item or designed the same facility in terms of process technology. Each center, however, would have separate material specifications and contracts developed by engineers and procurement specialists who did not coordinate their efforts. Executive management now recognizes that the company has to coordinate its worldwide design and procurement efforts to manage inventory and costs better.

Each project now involves an extensive analysis of both U.S. and European centers to identify areas of commonality and synergy in procurement and design. Procurement is then responsible for negotiating long-term agreements with global suppliers for materials and spare parts. After three years of developing globally

leveraged agreements, the company reports that it is averaging a 20-percent reduction in unit cost savings when compared to its previous nonleveraged agreements. Besides the obvious benefit of lower inventory values, supply chain managers now work with marketing to include expected future savings when responding to customer proposals. The bottom line is that leveraged agreements, which result in lower inventory and facility costs, are helping a company in a mature industry become more competitive.

As these approaches show, dedicated efforts to manage inventory better can have an enormous impact on financial performance. The following section describes how one company relies on improved inventory management techniques to achieve stringent corporate performance targets.

A Best Practice

In addition to seeking a lower unit cost through leveraged agreements, buyers often pursue other nonprice issues that affect inventory investment. One such issue is consignment, which the APICS dictionary defines as the process of a supplier's placing goods at a customer location without receiving payment until after the goods are used or sold. In certain instances, the supplier may even manage that inventory at the buyer's site. Consignment allows the buyer to defer ownership and avoid committing working capital and incurring carrying charges. This reduces the average amount of inventory a buyer owns as well as improving its velocity. The following case describes how consignment works and why a supplier might be willing to enter into this type of arrangement.

Several years ago, a major U.S. steel producer stated that all operating units must focus on return on net assets (RONA) as a key financial performance indicator.[15] As a corporation, all units (including the parent company) were expected to achieve a return on net assets of at least 16 percent or risk being divested. Among the groups ordered to achieve this RONA target were six railroads that the steel company owned.

After several months of research, a centralized purchasing group responsible for supporting the individual railroads concluded that they could greatly improve return on net assets by effectively managing the inventory that supported their operations and maintenance. Purchasing's strategy for improving asset returns involved the development of *leveraged systems contracts featuring consignment inventory*. A systems contract includes multiple items with specific requirements defined through contract clauses. Inventory consignment involves deferring payment for an item until a user physically takes an item from a railroad yard or warehouse and receives or "posts" the material into the railroad's inventory.[16] Suppliers deliver all items during the first quarter of each year and are responsible for unloading and physically placing the inventory in a yard or warehouse. These services are included in the negotiated price.

Although the railroads operate as separate entities, the central purchasing group works directly with each railroad to develop and negotiate leveraged contracts. Purchasing identifies potential items for systems contracts, determines each railroad's requirements, identifies and analyzes potential suppliers, coordinates the calculation of annual demand estimates, and represents each railroad during negotiations.

The railroads initially established 30 systems contracts. Each contract covers approximately 25 items, with renewal or renegotiation occurring every three years. While contract items are primarily higher-value items, the purchasing group now applies systems contracting to lower-unit-value items (less than $500) that have higher volume requirements. Because the items covered by these contracts are standard to the rail industry and are usually readily available, suppliers must also agree to deliver any systems contract item for which the railroad has a shortage within 24 hours.

The benefits from systems contracting with consignment have far exceeded management's expectations. Compared with a base year of 1997, average inventory has decreased 38 percent over a three-year period, cash flow has improved significantly because of reduced inventory investment, and the fixed three-year agreements have allowed the railroads to avoid or defer price increases. Inventory acquisition costs are also lower because users submit only annual orders for items covered by systems contracts.

Why would suppliers agree to assume inventory-carrying costs with three-year fixed prices?[17] Many suppliers now receive substantially higher volumes because they receive contracts that include the combined volumes of all six railroads. Greater volumes offset most, if not all, the costs of consignment. Furthermore, the railroad has agreed to take ownership of unused consigned material at the end of each year, which reduces some risk exposure for the suppliers.

Although the parent company has failed to achieve its own RONA target, the subsidiary railroads are achieving annual net asset returns of 50 to 60 percent. In light of their success, some managers suggest, only half-jokingly, that perhaps the railroads should divest themselves of the parent company, which continues to underperform in earnings, asset returns, and stock price. This case shows how creative inventory management techniques can help a company achieve its strategic performance objectives.

Today's competitive environment, perhaps more than at any other time in history, demands continuous improvement at increasingly dramatic levels.[18] As organizations search for new sources of competitive advantage, innovative or improved ways to manage inventory investment become increasingly attractive. The approaches presented here for managing inventory investment certainly do not represent an exhaustive list. These approaches, however, will have a major impact on how well an organization manages its investment in inventory. And, in a globally competitive environment, effectively managing this investment is essential to long-term success.

Author Information

Robert J. Trent is the supply chain management program director and the Eugene Mercy Associate Professor of Management at Lehigh University. He is co-author of the book Purchasing and Supply Chain Management, now in its second printing.

Footnotes

[1]This example is adapted from Doug Bartholomew, "What's Really Driving Apple's Recovery?" *Industry Week*, March 15, 1999, 34–40.
[2] Cook, Miles and Rob Tyndall. "Lessons From the Leaders," *Supply Chain Management Review*, Nov./Dec. 2001, 23.
[3]Financial managers rightfully argue that inventory is a major consumer of working capital, which represents the funds employed to operate a business. Technically speaking, we know that working capital represents the difference between current assets and current liabilities. However, a more workable definition from a supply chain perspective is that working capital includes the value of raw materials, work-in-process, finished-goods inventory, and accounts receivable less accounts payable. We also know that there is an opportunity cost to investing in inventory. Funds that are committed to unnecessary, excess, or slow-moving inventory cannot be employed to more productive uses.
[4]This example is based on interviews with company managers.
[5]Adapted from Amy Doan, "Vitamin Efficiency," *Forbes*, Nov. 1, 1999, 179–186.
[6]Adapted from Eryn Brown, "The Push to Streamline Supply Chains," *Fortune*, March 3, 1997, 108(C)-108(R).
[7]This exhibit is based on interviews with company managers.
[8]John Shook, as cited in *Becoming Lean*, Productivity Press: Portland, Oregon, 1998, 7.
[9] Womack, James P. and Daniel T. Jones, *Lean Thinking*, Simon & Shuster: New York, 1996.
[10] White, Robert E., John N. Pearson, and Jeffrey Wilson, "JIT Manufacturing: A Survey of Implementations in Small and Large U.S. Manufacturers," *Management Science*, Vol. 45, No. 1 (January 1999), 1–15.
[11] Strozniak, Peter. "Rising to the Challenge," *Industry Week*, Vol. 250, No. 14 (Nov. 2001), 30–36.
[12]Strozniak, 31.
[13] Dawson, Chester. "Machete Time: In a Cost-Cutting War With Nissan, Toyota Leans on Suppliers," *Business Week*, April 9, 2001, 43.
[14]This example is based on interviews with company managers. The company has requested that its true identity be kept confidential.
[15]This case is based on interviews with company managers. The RONA formula applied across each profit center or subsidiary is:
[16]Determining at what point inventory ownership transfers and payment is issued is a vital part of the consignment system. As railroad employees remove inventory for use, the local railroad posts these items as a receipt into a computerized control system. The railroads forward monthly usage reports to purchasing, which consolidates the usage into a single report. The report is then forwarded to suppliers for billing purposes. Each supplier submits a single invoice for the total usage, not a separate invoice for each railroad.
Earnings Before Interest and Taxes
Return on Net Assets = [(Inventory + Accounts Receivable + Plant Property Equipment) - Accounts Payable] + Other Current Liabilities
[17]Prices for some items that have a high raw material content are reviewed quarterly according to agreed-upon adjustment formulas.
[18]Based on data collected annually from companies attending the *Executive Purchasing and Supply Chain Management Seminar*, Michigan State University, East Lansing, Mich., 1990–2000.