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INVENTORY TURNOVER RATIO AS A SUPPLY CHAIN PERFORMANCE MEASURE

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Abstract

Inventory management is vital in supply chain performance of a firm. The inventory turnover ratio measures the number of times a company sells its inventory during the year. A high inventory turnover ratio indicated how best the firm is operating economically in selling its products. Inventory turnover is a measure of management's ability to use resources effectively and efficiently. Precise control and safeguarding of inventory is an essential task for a successful and well organized company. Business requires timely and accurate information on inventory location, movement and valuation. ERP systems provide data pertaining to receipt of goods, movement within and between locations, the sale, removal or disposition of goods, lot and serial tracking, precise valuation and status of goods remaining in inventory at any point of time. As a part of its continuous improvement program (CIP), firms can focus on inventory turn ratio as a means of improving its supply chain performance. In this context, present research is aimed to measure effect of inventory turn over ratio on supply chain performance in a leading battery manufacturing organization in India.

Keywords: Inventory turn over ratio, supply chain performance, Radio Frequency Identification

1. INTRODUCTION

The success of any firm basically depends on how efficiently it is controlling its inventories existing in various forms at different stages of the operations of the firm. In a manufacturing firm there is need for maintaining inventories to accommodate unexpected fluctuations in demand and supply. In SCM, much of the recent debate has centered on the ability of the supply chain to be either "lean" (Womack & Jones, 1996) or "agile" (Goldman & Nagel, 1995). Lean supply chains on one hand focus on

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doing “more with less” by reducing waste or “muda” through inventory reduction, lean manufacturing, and a just-in-time approach. A lean approach is said to be suitable for markets characterized by predictable demand, high volume and low requirements for product variety. Agile supply chains, on the other hand, are designed for flexibility, emphasizing the supply chain’s ability to respond rapidly to changes in demand, both in terms of volume and variety. CRM, SCM and New Product Development (NPD) identified by Shrivastava et al. (1999) reflect the demand and the supply side. Similarly, Payne and Christopher (2002) argue that CRM and SCM processes have to be integrated in order to “provide high levels of product availability and variety, yet which are low cost and reliability”. Those contributions conceptualizing SCM from a process perspective have also stressed the need to integrate the key business processes within and between organizations (e.g. Cooper et al., 1997; Lambert & Cooper, 2000; Mentzer et al., 2001). Firstly, the integration of the customer into the value creation process was proposed by Vargo and Lusch (2004). Secondly, in line with the conceptualizations of relationship marketing and CRM, the buying cycle acknowledges the dynamics in customer relationships (Zablah et al., 2004). Thirdly, by linking the activities in the demand process with those in the supply process, guidance to implementing the process integration can be derived.

2. LITERATURE REVIEW

The volume of inventories depends on procurement lead times, the firm’s purchasing strategies such as taking advantage of price discounts on bulk purchases, geographical location of suppliers, scarcity of raw materials, expected rise in prices, the accuracy of demand forecast, extent of subcontracting and service level of the firm. By formulation of strategic partnership with suppliers, adapting vendor managed inventory strategies (Madhusudhana Rao et al., 2005), strategic sourcing decisions such as make or buy or sub-contracting, developing supplier relations (shared vision and objectives), tracking of inventory (Ashwani Kumar, 2007), minimizing inventory inaccuracies (record keeping errors) (Elgar Fleisch, Christian Tellkamp, 2005), customer relationship management (CRM) and so on, the firm can operate with minimum levels of inventory. In this paper, an attempt is made to study the effect of Inventory Turnover Ratio (ITR) on supply chain performance in a leading battery manufacturing firm in India. The data required to calculate inventory turn over ratio is obtained from sales data, and inventory levels of raw materials, work in process and finished goods including those in transit and available at ware houses/market outlets. As a part of its continuous improvement program(CIP), by closely monitoring the inventory turn over ratio, the firm can continuously improve its capability to rotate money as many times as possible in a year.

Inventory turnover is best thought of as the number of times that an inventory "turns over" or cycles through the firm in a year. Inventory turnover of 12 means the average inventory moves through the firm once per month. For a number of years top-class companies have been focusing on supply chain management and improving their competitiveness (Supply Chain Technology news, March, 2002). They are able to

demonstrate their success through improved revenue, profit margins and decreased costs. Lean is a great method to help organize work areas, reduce WIP (Work-In-Process), and speedup material flow through the entire manufacturing process. Successful Lean initiatives yield lower inventory cost, higher productivity and flexibility and faster response time to the customer. ITR is also an important measure of performance that indicates the effective utilization of financial resources of the firm. The inventory turnover ratio should be done by inventory categories or by individual product. ITR is defined as the ratio of sales to average inventory with both numerator and denominator being valued at either selling price or original cost.

Inventory for customer use is an expensive investment of company money. Instead of investing in people, technology, or other important assets that can potentially assist in growing a business faster, companies who invest in inventory have no return on net assets (RONA) until they sell the inventory. In many businesses, inventory is turning at the lowest levels in history and below industry averages. Studies have shown that manufacturers and wholesalers have over 60 days of inventory and that retailers have over 90 days of inventory capital tied up. These times do not include inbound inventory in the supply chain. Real supply chain inventory is 25 % higher. This is a very significant amount of capital tied up in inventory. We live in a world and culture today where we want everything now. Information on alternative supply sources is easily available on the internet. Vendor loyalty is fleeting. Stated another way, when a customer wants to buy something, they want it now. "Just-in-time" manufacturing and the internet has helped all of us access product information and alternative suppliers. A supplier's worst nightmare is not finding the product in stock that the customer wants to buy. The results are both a lost business opportunity associated with the sale of the inventory and the poor customer service associated with not meeting the customer's immediate needs. Rapid advancements in technology and communication speed, wide use of the internet as a communicative medium, and factory automation embracing Ethernet and real-time data collection suggest that now might be the time to invest in an inventory management system, or IMS (Sexton, 2004).

The following table provides some insight on the basics of inventory control. The information was complied by Timothy Van Mieghem of the Proaction Group. (http://www.proactiongroup.com)

Various Causes for Inventory:

- Revisions and variance in Supply Chain Management Inputs
- Inadequate process norms
- Non moving stocks
- High lead times & batch quantities
- Variance in material receipt
- Variance in consumption with actual versus Bill of Material
- Design and type changes without valid lead time.

3. THE INVENTORY TURNOVER FORMULAE

Inventory turnover is a critical performance metric to assess the effectiveness of inventory management. Because it is so extensively used as a diagnostic tool, it is imperative that inventory turnover be calculated using appropriate and valid techniques.

Table 1. Invertory control and management function

Inventory Control and Management Function	Description
Mindset and education	Understand the impact of accurate inventory, visual controls, and cycle counting have on operations
Match accountability & responsibility	Inventory clerks probably shouldn't record transactions or reconcile counts. This task should rest solely with those responsible for the inventory. For example, finished goods in the shipping department are the responsibility of the shipping clerk. WIP by the departmental supervisor.
Role of technology	Recognize that technology will only work as well as the business processes and disciplines that feed it the information. A receipt entered one day after the shipment arrives will cause the system to think it is out of an item when it actually could be on the shelf. An invoice entered 48 hours after an item has been shipped will prevent you from having an accurate inventory. The internet provides us the ability to share info at the speed of thought. Thus, real time data is the panacea.
View inventory accuracy in absolute terms	If you count ten (10) items and five (5) are written down and five (5) are written up in the same dollar amount, view that as 0% accuracy. For operational purposes, inventory must be accurate in item level quantity, not total dollar value. Often, companies try to operate with 60% accuracy in perpetual inventory. 60%! Consider the impact on customer service, production scheduling and material handling.
Counting	Setup a daily cycle count program. Do the following: • Stratify the inventory into A/B/C categories based on value and velocity. • Setup a program to randomly count enough items to address "A" items monthly; "B" items every quarter and "C" items once per year. • Have each department cycle count the items it handles or stores. • Document all exceptions on an absolute basis including: • Quantity (does the perpetual inventory match the absolute quantity in stock?) • Bin location (is the stock where the computer says it is?) • Different types of inventory require different levels of tolerance. High value discrete items (normally "A: items) should be 98% accurate or more at the quantity level, while lower dollar bulk items have an acceptable tolerance of +/- 3% to 7% • Research every exception and understand the root cause for the inaccuracy • Routinely address the root cause problems to eliminate the source of the inaccuracy
Don't sample on a counting scale. Bar code the bin with the part number, bin location, unit weight and quantity.	It is relatively inexpensive to bar code scan a part and its associated unit weight instead of sampling. Sampling can introduce unwanted clerical errors associated with the wrong numerical entry of the sample size, etc. Bar coding results in more predictable counts and consistency. Update according to the stratification identified above (A/B/C)
Location	Bin locate your inventory being careful to control the granularity. In other words, avoid one (1) gigantic bin location for 10,000 parts or avoid creating a unique bin location for each part. "A" items should be in the most accessible locations progressing through "C" items in the back.

Process rules	Remember these basics: • No finished product leaves a location without an invoice or inventory transaction • Receive inbound shipments into the system before using the products and optimally at the same time they are put away • Do not substitute components or products without updating the bill-of-material to reflect the actual units used. For long-term changes, be sure to initiate an ECO • Setup your warehouse with simple guides to make it easy to find product; for example, use row and column labels, symbols or label your bins per the bar coding section above.
The computerized system in place "shows" sufficient inventory, but upon actual physical inspection, it's simply not there.	In some instances it is impractical or inefficient to move the product to the scale or the scale to the product (in the case of portable scales with optional wireless connections to the network). If a large shipment of a bulky item is received (for example, crates of dozens of parts, where each part weighs over 100 lbs.), these parts may be entered manually, but this method reverts to the use of pencil and paper. This can result in the product being entered incorrectly or not entered at all. No inventory control system can overcome this unless there is a check-and-balance system in place that uses cycle and spot-check inventory methods, or if the data can be entered remotely from the scales. The spot-check method is unreliable since the data entry problem has not been solved. The solution is a portable data collector. A portable data collector may be required to fulfill the requirements of a Management Execution System (MES). The ability to track Work In Process as it travels on the shop floor is a requirement, not only for MES but also for any thorough Inventory Management System application. Portable data collectors are available in many different styles, capabilities and costs. They fall into two basic categories: 1. RF wireless collectors that communicate on a real-time basis with the network 2. Batch collectors that are periodically uploaded to the network by placing them in a "cradle" or "docking station" which allows a periodic communication with the rest of the network The suitability and applicability of each rests on their own merits.To determine which category of portable data collector best suits a specific application, it is important to know where in the system and which parts require their use. Determine if the information is vital on a real-time basis and if the information requires instantaneous input to the operator from the system at the time of entry. If either is true, RF is probably required. If not, then the "batch processing" method will fill the need. The ability of the scanner to scan barcodes is important, and even portable bar-code printing may be required to establish your system's numbering at receipt of the part. This printing can also be done using RF if the system and printers are compatible with RF data transmission.
The computerized system in place "shows" sufficient inventory, but upon actual physical inspection, it's simply not there.	One very important issue is compatibility with the existing system. The vendor should be aware of the capabilities of both types and be well-versed in their integration into the inventory management system as well as integration into your application. This will include application stratagems in terms of use and training, custom programming if necessary, and performing the site audit (especially in the case of and RF application) to determine the placement for antennas, repeaters, and docking stations for batch units. In some instances, both types of units may be required. Once again, the capabilities of the vendor to assimilate and correlate all of the information required from your application and match it to an efficient and suitable solution for your needs is paramount to a successful project implementation.

Inventory turnover is calculated using the following formula:

$$\frac{\text{Cost of Goods Sold from Stock Sales during the Past 12 Months}}{\text{Average Inventory Investment during the Past 12 Months}} \quad (1)$$

When product flow varies throughout the year and inventories expand and contract during different periods, more frequent measures of the inventory level need to be taken to generate an accurate measure of the average inventory.

The inventory turnover often is reported as the inventory period, which is the number of the days worth of inventory on hand, calculated by dividing the inventory by the average daily cost of goods sold:

$$\text{Inventory Period} = \frac{\text{Average Inventory}}{\text{Annual Cost of Goods Sold}} \times 365 \quad (2)$$

There are several things to keep in mind when calculating turnover ratio:

- Only consider cost of goods sold from stock sales which are filled from warehouse inventory. Non-stock items and direct shipments are not included. Sure, these sales are important, but don't involve your warehouse stock (i.e. your investment in inventory).
- The cost of goods sold figure in the formula includes transfers of stocked products to other branches and quantities of these products used for internal purposes such as repairs and assemblies.
- Inventory turnover is based on the cost of items (what you paid for them) not sales dollars (what you sold them for).

Inventory turnover depends on the average value of stocked inventory. To determine your average inventory investment:

- Calculate the total value of every product in inventory (quantity on-hand times cost) every month, on the same day of the month. Be sure to be consistent in using the same cost basis (average cost, last cost, replacement cost, etc.) in calculating both the cost of goods sold and average inventory investment.
- If your inventory levels tend to fluctuate throughout the month, calculate your total inventory value on the first and fifteenth of every month.
- Determine the average inventory value by averaging of all of inventory valuations recorded during the past 12 months.

Turnover Goals:

- As you determine your inventory turnover goals, consider the average gross margin you receive on the sale of products. Most distributors who have 20% - 30% gross margins should strive to achieve an overall turnover rate of five to six turns per year. Distributors with lower margins require higher stock turnover. If your company enjoys high gross margins, you can afford to turn your inventory less often.
- A turnover rate of six turns per year doesn't mean that the stock of every item will turn six times. The stock of popular, fast moving items should turn more often (up to 12 times per year). Slow moving items may turn only once, or not at all.
- Finally, calculate inventory turnover separately for every product line in every warehouse. This will allow you to identify situations in which your inventory is not providing an adequate return on your investment. To improve inventory turnover, consider reducing the quantity you normally buy from the supplier. Inventory turns improve when you buy less of product, more

often.

- Firms have limited funds available to invest in inventory. They cannot stock a lifetime supply of every item. In order to generate the cash necessary to pay the bills and return a profit, firms must sell the materials they've bought. The inventory turnover rate measures how quickly they are moving inventory through the warehouse. Combined with other measurements such as customer service level and return on investment, inventory turnover can provide an accurate barometer of firm's success.

4. ITR IN INDUSTRIAL BATTERY DIVISION

The firm aimed at increasing ITR by reducing raw material inventory. It was worthwhile because it is "critical to cost" increase in ITR will directly influence the company profits, reduce working capital and improve cash flow. As competition is severe and product sale price is falling, it is important to focus on cost reduction so that the firm can offer at competitive price in order to keep the market share. The goal was to increase ITR to 14.2 by reducing 25% raw material inventory of present level.

4.1.Selected Solutions

After finding the gaps in performance in terms of ITR, the firm has identified a set of alternatives to increase ITR. The alternatives adapted for implementation are furnished below:

a) Revision of stocking policy of A class materials so as to maintain stocks for 15 to 20 days of consumption.

b) Revision of ordering policy for B & C class items as per lead time and EOQ of purchase department.

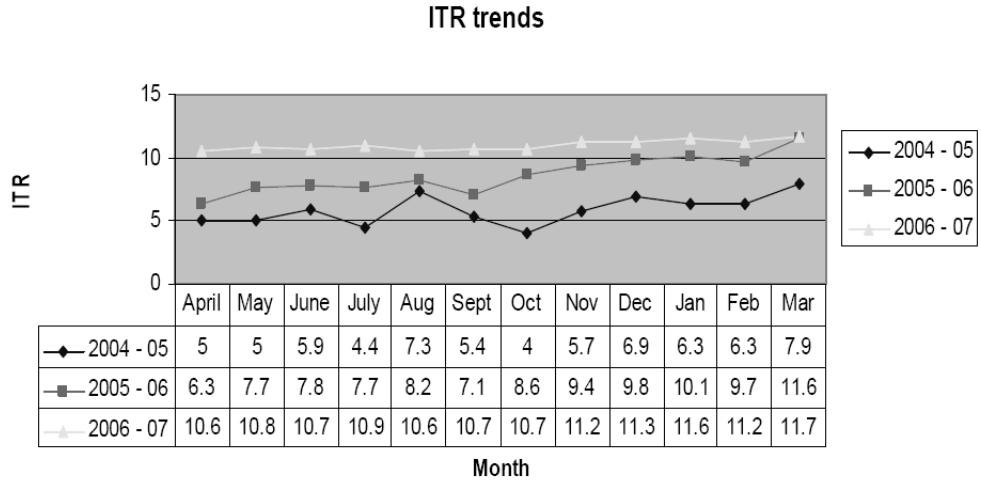
c) MRP computation as per 1 + 2 months production plan

d) To reduce the forecast variance of marketing (Market Research Information)

e) Information on design and type changes with valid lead time and clear action to dilute existing stocks.

Implementation of the above alternatives has improved the ITR of battery division tremendously in the past three years. The ITR trend of battery division for the past three financial years is shown in the following graph (Figure 1).

From the above chart, it is clear that the



	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
2004 - 05	5	5	5.9	4.4	7.3	5.4	4	5.7	6.9	6.3	6.3	7.9
2005 - 06	6.3	7.7	7.8	7.7	8.2	7.1	8.6	9.4	9.8	10.1	9.7	11.6
2006 - 07	10.6	10.8	10.7	10.9	10.6	10.7	10.7	11.2	11.3	11.6	11.2	11.7

Figure 1. ITR trends for the period 2004-2006

ITR is increasing continuously in the past three years. We have one more measure of performance called Inventory Days of Supply (IDS). The expression for IDS is given (Pandey, 2000):

Inventory Days of Supply = 365 / ITR (3)

Using the above relation if we calculate the IDS values for the past three years, we can find out how the inventory days of supply is decreasing with increased ITR values.

The following table (Table 2) shows the improvement in IDS with corresponding ITR values.

Table 2. Improvement in IDS with corresponding ITR values

Month	2004 - 2005		2005 - 2006		2006 - 2007	
	ITR	IDS	ITR	IDS	ITR	IDS
April	5.0	73.00	6.3	57.94	10.6	34.43
May	5.0	73.00	7.7	47.40	10.8	33.80
June	5.9	61.86	7.8	46.79	10.7	34.11
July	4.4	82.95	7.7	47.40	10.9	33.49
August	7.3	50.00	8.2	44.51	10.6	34.43
September	5.4	67.59	7.1	51.41	10.7	34.11
October	4.0	91.25	8.6	42.44	10.7	34.11
November	5.7	64.04	9.4	38.83	11.2	32.59
December	6.9	52.90	9.8	37.24	11.3	32.30
January	6.3	57.94	10.1	36.14	11.6	31.47
February	6.3	57.94	9.7	37.63	11.2	32.59
March	7.9	46.20	11.6	31.47	11.7	31.20

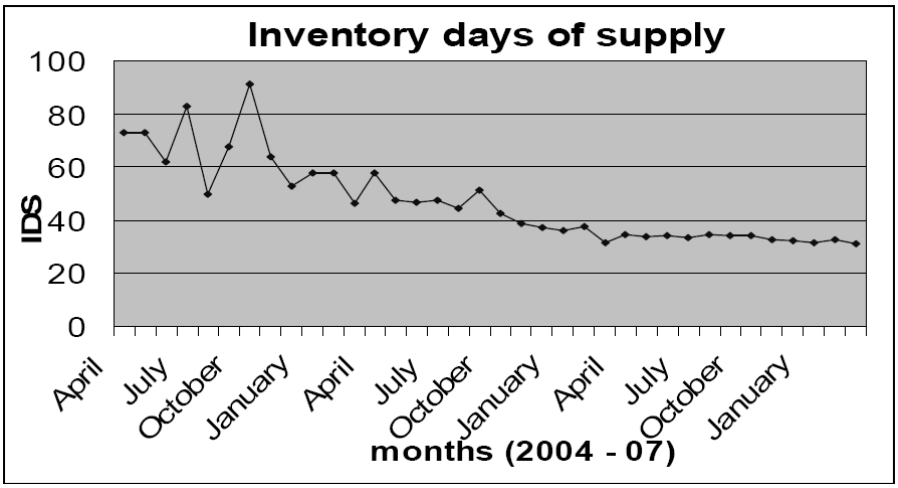


Figure 2. IDS values change by months during 2004

5. CONCLUSION AND FUTURE SCOPE

Many researches revealed that Information Technology, internal operations, customer and supplier relationship and information sharing significantly influenced inventory turnover performance. To achieve high inventory turnover companies need to improve their internal efficiency through elimination of non value added activities and excessive inventories. This can be achieved by effectively implementing IT in all operational activities. In addition, companies also need to go beyond their internal operations to work closely with their external counterpart both upstream and downstream their supply chain. Close coordination amongst members of a supply chain is facilitated by high level of information sharing. Through EDI, firms can integrate their activities and work hand in hand with collaborative forecasting and replenishment to maintain minimum level of inventory throughout the supply chain for the competitive advantage of all companies along the chain.

КОЕФИЦИЈЕНТ ТРОШЕЊА ЗАЛИХА КАО МЕРА ПЕРФОРМАНСИ ЛАНЦА СНАБДЕВАЊА

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Извод

Управљање залихама је витално за перформансе ланаца снабдевања у компанији. Коефицијент обрта залиха мери колико пута компанија прода своје целокупне залихе током године. Висок ниво обрта залиха говори да фирма ради економски добро у смислу продаје сопствених производа. Обрт залиха је мера могућности менаџмента да ефикасно и ефектно користи ресурсе. Прецизна контрола и евиденција је суштински задатак успешне и добро организоване компаније. Пословне операције захтевају тачне и прецизне информације о локацији, кретању и вредности залиха у компанији. ЕРП системи се користе у сврхе евидентирања пријема робе, покретања унутар или између локација, о продаји, уклањању или диспозицији роба, праћењу, прецизним вредностима и статусу робе која је преостала у сваком моменту времена. Као део свог програма континуалних побољшања, фирме се могу фокусирати на коефицијент обрта залиха као средство за побољшање својих ланаца снабдевања. У овом контексту, ово истраживање има за циљ меру ефекта коефицијента обрта залиха на перформансе ланца снабдевања у једној од водећих компанија за производњу акумулатора у Индији.

Кључне речи: Коефицијент обрта залиха, перформансе ланаца снабдевања, Идентификација радио фреквенцијом

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