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Risk Assessment metrics and mitigation strategies in materials management function with reference to manufacturing industry.

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Abstract

Materials management has received an increasing interest and development since last few decades. In a manufacturing context no production or assembly is possible without required materials,Materials management is the major function of organization which constitutes major costs associated with production of goods and services, where many authors outline the expenditure in material function ranges from 50% to 70% of the total expenditure. Thus looking at the criticality in terms of material availability, customer service&related cost factors, it is important to have tight control on materials planning, procurement, storage, movement and consumption which is the key importance of today's enterprises.

Inventory management is one of the corepillars of materials functionwhich specifically deals with investment decisions of inventory, while financial models refer inventory as a current asset, and lean wastes refer inventory as one of the waste. Thus inventory being classified as a point between asset which helps to fulfill customer needs and customer service while on other side it is waste for organization if not well managed.

As all organizations are focused to work on solving real time complex problems concerned with reducing costs, improve products and services improve production with supply continuity and mainly improving customer satisfaction as a major goals in mind, Inventory decisions plays an important role and touching to all the aspects mentioned above.

Stocking high level of inventory than actual requirement is not a good situation because organization can face challenges like inventory storage space, storage costs, obsolescence andspoilage cost. However on other side stocking fewer inventories than actual demand isn't again a good situation as business may run into risks of losing sales or valued customers.

Recently materials management also includes forecasting and capacity planning as one of the strategic areaswith certain commonly known performance indicators to understand where we are and where we wan to go and till when?

This paper is purely focused on secondary data collected from journals, articles, reference books, and research papers. Paper focus on three major parameters including risks in materials function, performance indicators used to measure materials management and key strategies being used to mitigate risks or to sustain proper scientific planning.

Moreover this paper also highlights on industry trends & some recently done research outcomes from similar area.

Keywords – *Materials Management, Inventory Management, Business Risk, Supply Chain risk, Supply chain performance metrics, Materials management strategies.*

Abbreviations in research paper

S&OP –Sales and operations planning.
PFEP – Plan for every part
ROP – Re order point
ROQ – Reorder quantity
EDI – Electronic data interchange
RFID – Radio Frequency Identification
BI – Business Intelligence
SIOP – Sales, Inventory and operations planning
MM- Materials Management
ICT – Internet and communication Technology
SCOR – Supply chain operational reference
OTD – On time delivery
DOH – Days on Hand
ITR – Inventory turnover ratio

Introduction

Materials management function includes planning, purchasing, receiving, stores, inventory control, scrap and surplus disposal (Gopalkrishnan P. and Sundaresan M, 2011).

Dr. A.K Singhdefines materials management as a function that is concerned with managing supply of something (Example – raw material, suppliers, parts, items, final products) to meet the anticipated demands, thus materials management is also defined in a way to manage supply of materials at Right time, place, quantity, source and Right price. In other way materials management manages flow of materials into, through & out of the system.
Materials management is one department which is responsible for managing flow of materials from supplier through production to consumer. (J. R. Tony Arnold et. all 2008).Materials management is planning center of manufacturing organization, while material management is at center of planning and success. (Donald H. Sheldon, 2008)

In February 2013, ARC Advisory group addressed analysis that shows manufacturing industry in India is expected to grow by 9.5% CAGR despite this positive economic outlook, analysis also shows that India's inefficient supply chain is costing 65 Billion USD loss every year, where demand and supply side challenges are the major constraints. In addition many other constraints like tax structure, poor distribution & infrastructure facilities and lack of technology adoption has impact on keeping more inventories. Moreover analysis also highlights that most of the challenges of India's supply chain can be met by adopting Information Technology as a key enabler.

Scope of the study

1. This research paper is focused in area of manufacturing segment only.
2. Study is concerned with materials management function and also extended to certain functions of supply chain function of the organization.
3. Materials management is vast area of study which includes planning, purchasing, Inventory management, Sales and Operations planning, materials handling, part of logistics, stores. But study is purely focused on planning parameters viz. inventory management, materials planning and sales and operations planning (S&OP).
4. Risks are identified as two types of risks – Internal to organization and external to organization. For this study risks concerned internal to organization are only considered and external risks like supplier bankruptcy, Labor issues, natural calamities are not taken in the scope

Review of Literatures

This Paper has been divided in specific categories of explanation as mentioned below
1. Why it is important to focus on materials management as a strategic area with reference to organization goal profit and cost control?
2. Risks associated or faced by materials department for overall organizations success concerned with meeting objectives and goals.
4. Risk mitigation methods and strategies that are discussed in similar areas of literatures, reference books and different articles.
5. Finally Importance of integrated materials management is discussed in the later part of literature review.

Importance of materials management in manufacturing setup:

Economic theory makes fundamental assumption that profit maximizations is the basic objective of every firm, and profit making situation ensures that organization has supply of future capital for expansion, growth and innovation (Peter F. Drucker, 1955).

Whether business concerns are small or big, all they need is finance to fulfill their business activities, and in the modern world all the activities are very particular to earn Profit (C.Paramasivan and T. Subramanian).

Economist Milton Friedman concludes that main purpose of a business is to maximize profit for its owners, stockholder and for the company.

Most significant objective of all organization is operate at a profit, where minimum expense on resources and materials is the primary consideration, in a strict sense materials manager don't have responsibility of profit but all materials management employee must have a clear understanding of the profit (Eugene L. Magad and John M. Amos, 1989).

Eugene L. Magad and John M. Amos also mentioned that the bottom line of company's profit and loss is considerably improved by materials management by identifying and successfully implementing cost reduction programs, while author also emphasizes on Profit improvement programs and integration of sub functions to optimize company's profit objective is one of the objective of materials management team.

Thus profit is one amongst the primary goals of every organization.It is very important to understand criticality of materials management in terms of this goal. If one interlinks materials management with one of the primary goals of organization as a profit, then…

Profit (%) = [(Selling Price – Cost Price) / (Cost Price)] X 100

From above mathematical formula it is simple to understand that cost has to be as low as possible toearn as more as profit margins.In this complex and challenging economy every organization has major focus on cost reduction, if they are successful to reduce the costs by any of the strategies available then they are well set to earn and enjoy profit margins, while they are well deserved to compete in this global competition. As cost reduction is the major focus of every organization to earn more profits, it is important to understand materials management contribution in the cost of organizations working capital.

Average expenditure in materials management.

Today, as production is becoming more & more complex in this competition, while materials cost and technology costs are increasing day by day, there is always a challenge for supply chain department to reduce the materials cost. Material cost includes around 60% and may be more of the total cost (Bernald&Treseler 1991, Stukhart 2007)

According to Author Jhamb L.C, in his famous book "Materials and Logistics Management", Materials constitutes one of the key resources of an organization. Material cost, in the manufacturing organization, averages around 50-60% which means efficiency and effectiveness of materials function, to a large extent, virtually determines profitability and success (or failure) of the firm. Since every rupees saved contributes directly to profit, hence it is equivalent to increase in sales.

Prasanna Kumar Dey has conducted a research study on Re-engineering materials management where he studied materials planning & procurement process of Indian refineries in 2001. In his studies he examines materials average cost as average 60% of total working capital cost.
There is always a challenge of increased cost of input, and cost of input constitutes around 60% of the total cost. Meanwhile from another side there are many constraints to increase sales price due to cut to cut competition and this has left with no choice than using input resources more efficiently with controlled manner. Inventory Management is one of the scientific and analytical approaches to overcome on such challenges. (D. Chandra Bose, 2006).

All citations discussed above are the literatures that support to understand that material cost lies from average 40% to 60% of total working capital and hence this is one of the critical area of every organization where cost reductions, service improvement, on time deliveries plays an important role for organizations success.

Looking at different challenges like cost reduction and focus towards profit &growth we can realize that materials management is the critical function where major focus has been given by all organizations. Major challenge of supply chain managers is mitigation of risks by intelligently positioning and sizing supply chain reserves without decreasing profits. (Sunil Chopra &ManmohanSodhi, 2004)

Risks associated in materials management:

Supply chain risk is potential occurrence of incidence or failure to seize opportunities with inbound supply in which outcome results in financial loss for the firm (Zsidisin, 2005).
Risk is also defined as negative but uncertain impact on business which is normally beyond the control ((Dr. Dawei Lu,2011). Thus generally risk can be defined as an event that may or may not occur in future, which is usually not under control and this event has direct impact on operating cost either directly or indirectly.

Donald J. Bowersoxin his book "Supply chain logistics management, 2nd edition, p.130" emphasized that inventory decisions are highly risky throughout a supply chain. He also mentioned customer loss and dissatisfaction occurs due to improper inventory assortments, this also creates inventory shortage and affects whole cycle where marketing and manufacturing plans get disrupt, production schedules get modified and if machines and workers are idle then it adds up

huge cost for the organization. On the other side Donald illustrated on inventory overstock issues like overstock increases cost in terms of storage cost, spoiling cost, insurance & taxes, obsolescence cost. It helps to understand it is very important to have tight inventory control, no less and no more inventory so the cost is at optimum.

Building reserves or stock of the inventory in an undisciplined fashion also drives up the costs and that hurts bottom line of organization (Sunil Chopra, ManMohanSodhi, 2004)

Prasanna Kumar Dey studied materials management in Indian refineries as a case study in 2001. He mentioned common issues associated with materials management function are receiving materials earlier than requirement, receiving material later than actual requirement, damage and loss of material, inventory control, excess and surplus material. All those issues are either in combination or individually faced by organizations.

APICS (American production and inventory control society) and Protiviti (Global consulting firm) in their research paper concerned with risks associated in supply chain and some solutions, described many risks in overall supply chain activity and some of them concerned with core areas of materials management are Information integrity and availability risks, demand supply planning risk and integration, inventory and obsolescence risks, customer satisfaction risks and service risks, process inefficiency risks. Looking at above risks it is clearly visible that there are scattered areas where risks are associated in materials management and each risk has different impact on overall performance of materials function, supply chain and hence enterprise.
Moreover this research paper is a robust foundation of understanding each risks category and top three risks associated are categorized in this research paper are as below.

1. 66% respondents in survey feel that Supply Interruption is major risk –it means we could not fulfill customer demand due to supply are improper. This can be one of the reasons because of continuous supply and demand variations and improper management of supply demand in advance.
2. 55% respondents rated - Lack of senior's effectiveness in sales and operations planning (S&OP) process. If one see point 1 and point 2 discussed here then those interlink in terms of improper supply and demand management well in advance.
3. While looking at many scenarios in complex business and large data 49% respondents highlighted Lack of timely and accurate information for strategic initiatives is one of the major risks.

Again as mentioned above in point 1, another research article focused on same approach of risk is delays in material flow are frequently happening due to one of major reason that supplier cannot quickly respond to changes in demand and is one of the major risks associated in materials flow (Sunil Chopra &ManMohanSodhi, 2004). Materials Planning purely works on supply & demand alignment concept where primary focus is alignment of supply & demand. Anything excess creates problem. If demand is more than supply then organization cannot fulfill demand of the customer and results into loss of customer or customer's satisfaction is into trouble, on other side if supply is more than demand, then cost again hurts bottom line in terms of excess inventory, storage, handling, obsolescence, spoilage and many indirect cost factors.

Continuous demand volatility poses serious challenges in asset configuration of supply chain, responsiveness, capacity management, lead time management and moreover it triggers a bullwhip effect results into higher operating costs and unsatisfactory services and deliveries to end customer (Dr. Dawei Lu,2011)

SuhairShumali in his research study in 1999 focused on Materials management issues in developing countries like India, Researcher studied construction industry from Gujarat and highlights on selective inventory control techniques like ABC, XYZ, HML Analysis, while study also shows ABC Analysis is not followed in true spirit by construction industry. Later part of the study highlights on method of fixation of inventory levels like minimum order quantity, maximum order quantity, safety stock, replenishment level, reorder level and EOQ Model where researcher mentioned EOQ model was not used by construction industry due to many constraints and lack of information is one of the major constraints to fix EOQ model.

Inventory decisions are both high risk and high impact throughout the supply chain. Inventory committed to support future sales drives a number of anticipatory supply chain activities. Without the proper inventory assortment, lost sales and customer dissatisfaction may occur. Likewise inventory planning is critical to manufacturing. Material or component shortages can shut down a manufacturing line or force production schedule modification, added cost and potential finished goods shortages. Just as shortages can disrupt marketing and manufacturing plans, inventory overstocks also create operating problems. Overstocks increase cost and reduce profitability as a result of added warehousing, working capital,

insurance, taxes, and obsolescence. Management of inventory resources requires an understanding of functionality, principles, cost, impact, and dynamics.
Inventory management is risky, and risk varies depending upon a firm's position in the distribution channel. The typical measures of inventory exposure are time duration, depth, and width of commitment.
For a manufacturer, inventory risk is long term. The manufacturer's inventory commitment begins with raw material and component parts purchase, includes work in process and ends with finished goods.

In below table type of risks and its drivers are mentioned in detail

Category of Risk	Drivers of Risk
Disruptions	■ Natural disaster ■ Labor dispute ■ Supplier bankruptcy ■ War and terrorism ■ Dependency on a single source of supply as well as the capacity and responsiveness of alternative suppliers
Delays	■ High capacity utilization at supply source ■ Inflexibility of supply source ■ Poor quality or yield at supply source ■ Excessive handling due to border crossings or to change in transportation modes
Systems	■ Information infrastructure breakdown ■ System integration or extensive systems networking ■ E-commerce
Forecast	■ Inaccurate forecasts due to long lead times, seasonality, product variety, short life cycles, small customer base ■ "Bullwhip effect" or information distortion due to sales promotions, incentives, lack of supply-chain visibility and exaggeration of demand in times of product shortage
Intellectual Property	■ Vertical integration of supply chain ■ Global outsourcing and markets
Procurement	■ Exchange rate risk ■ Percentage of a key component or raw material procured from a single source ■ Industrywide capacity utilization ■ Long-term versus short-term contracts
Receivables	■ Number of customers ■ Financial strength of customers
Inventory	■ Rate of product obsolescence ■ Inventory holding cost ■ Product value ■ Demand and supply uncertainty
Capacity	■ Cost of capacity ■ Capacity flexibility

Reference - Research Paper by Sunil Chopra and ManMohanSodhi, "Managing Risk to avoid supply chain breakdown", MIT Sloan Management review, Fall 2004, Vol.46. No.1.

Measuring materials management performance

Introduction –

Each Business function of an organization is measured with certain indicators to see where we need real time improvements and where we are on track, this is very important for organization to check those performance indicators on timely basis, where timelines to monitor different indicators vary depending on their impact and usefulness in business environment.

Having processes set in the function is a start, but organization members should also know how better processes are doing to achieve business objectives (Duke Okes, 2013). Performance measurements are fundamental part of business management because it allows business members to understand where we were, where we are, where we want to go and when we will get there (Luca Quagini, Stefano Tonchia, 2010).

While designing Performance indicators it is necessary to start with firms objectives then it has to be decided what needs to be measured while it is always better to have fewer performance indicators than having number of them which overlapped measurements (Daniel McLean, 2013). If this statement is linked with materials management function then materials function has certain objectives which include key objectives like

- Low cost operations throughout to support profit margin,
- Cost reduction,
- Supply continuity,
- Ensure material quality,
- Maintain good relationships with inter departments and external suppliers,
- Ensure customer satisfaction,
- to manage the risks of possible disruptions and maintain balanced demand and supply and other objectives like maintain proper records, error free work and putting intelligence to tight control on inventory.

In a global organizations there are multiple performance indicators to measure materials and inventory management performance, all those performance indicators may not be necessary to be applicable for every business, product lines but many of them are common, useful, effective and derives business performance in true sense and those are almost used by top firms.

Commonly used Performance indicators throughout the supply chain cycle where materials management team has involved directly and indirectly are defined in this chapter.

This chapter has major interlink with the part of research title identification of risk assessment tools in materials management.

On Time Delivery (OTD) of supplier

This indicator is calculated as total number of shipments (some time order lines) shipped by supplier on committed date out of total number of shipments (Order lines) committed to ship on that day by supplier.

This indicator is usually measured in period like weekly bucket or monthly buckets. There is a tolerance limit of few days before and after committed date which may be different with different firms.

On Time Delivery (OTD) of customer orders

This indicator is calculated as total number of shipments (some time order lines) shipped against customer orders on committed date to customer out of total number of shipments (Order lines) committed to ship on that day to the customer.

This is also similar kind of indicator mentioned above only supplier and customer relationship changes from front end to back end. This indicator is also usually measured in period like weekly bucket or monthly buckets. There is a tolerance limit of few days before and after the committed date which may be different with different firms.

Inventory Turnover ratio (ITR) & Days on Hand (DOH)

This is one of the crucial indicators which show performance of inventory in true sense, this indicator indicates how many times company's inventory is being sold or replaced in particular time period.

ITR = Cost of Goods Sold (COGS) / Average Inventory

Where Cost of goods sold is not the sales value of the goods or service but it is the total of all costs used to create a product or service which is sold.

COGS calculation includesdirect material cost, direct labor, factory overhead, freight in and freight out, it also includes commission expense but does not include any administrative or selling expenses.

Many a time it is calculated in alternate way to avoid major complexities as per below method.

Cost of goods sold = Beginning inventory + Purchases - Ending inventory

So if we have to calculate COGS for Year 2015 and If we have below figures

Beginning inventory – inventory on 1st Jan = 20000 INR

Purchase in the Year 2015 = 25000 INR

And if ending inventory – Inventory on 31st Dec = 10000

Then COGS = 20000 + 25000 – 10000 = 35000 INR

Average Inventory –

Average inventory is taken as there is high level of fluctuation in inventory throughout the year, Average inventory is calculated as

Average inventory = (Beginning inventory – Ending inventory) / 2

……. It is divided by 2 because we take inventory of only 2 days (beginning day and end day of that period)

It may be more accurate for firm to calculate Average inventory by taking multiple point inventory value and take a mean, like for all 12 months ending period inventory and divided by 12

So if we have to calculate Average inventory for Year 2015 and if we have above figures mentioned in COGS calculation then

Average inventory = (20000 – 10000) / 2 = 5000 INR

Thus Inventory Turnover ratio = COGS / Average Inventory

= 35000 / 5000 = 7 times

Thus company sells average inventory 7 times in a year or in other way average inventory is turned into sales for 7 times in a year.

Days on Hand (DOH)

Taking above example in continuation, DOH provides how many days inventory was on hand before it is being sold.

For a yearly overview, Average selling period is computed by dividing 365 by inventory turnover ratio, This indicator is measured in days as a unit.

Therefore average selling period = 367 / 7 = 52 Days.

Thus firm takes average 52 days to sale average inventory.

Inventory turnover ratio varies with industry and in ideal scenario; high ratio indicated fast moving inventories and low ratio is less movement of inventory.

While high number of days on hand indicates low inventory movement and vice versa.

So ideally ITR should be more and DOH should be less to improve firm's performance.

There is an analysis on Indian manufacturing firm's inventory turnover performance by **Janat Shah**which shows Indian manufacturing industry performance has grown from 1990 to 2001 while after 2001 firms have moreover maintained inventory turnover and has not shown significant improvements due to some reasons like taxation structure and poor logistics infrastructure in the country, while on other hand when Indian firms are compared with best international firms then international have improved inventory performance in much faster pace.

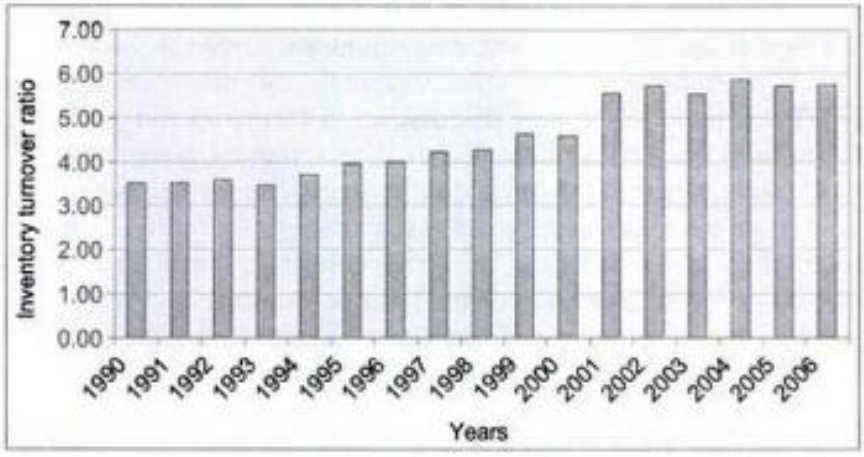

Figure 1 Performance of ITR in Indian industry - source Janat Shah, "Supply Chain Management: Text and Cases" Pearson Education, 2009, P-16 - Primary source was Prowess (CMIE)

Undamaged Supplier shipment rate –

This is ratio of total number of shipments received from supplier without damaged condition to the total number of supplier shipments received in that particular time period.

This ratio also provided overview on the performance of supplier in terms of quality but on other side this also supports performance of logistics or freight forwarder in terms of materials handling if this is damage happened in transit.

Customer Backorder rate

This indicator helps to understand how good customer order delivery is, this indicator can also be applicable on firms supplier (explained in next point).

This is some time also referred as Past due or due orders.

The indicator is calculated as total number of customer order lines delayed to wrong or insufficient internal planning or stock out divided by total number of customer order lines received in the particular period of time. This indicator can be calculated in terms of number of order lines or even cost of order lines.

This is usually measured in percentage.

Low the number of customer backorder good the performance of the materials and over all supply chain planning.

Supplier backorder rate

This indicator helps to understand how good supplier performance in on time delivery is, This indicator is overlapping of Suppliers OTD indicator.

This is some time also referred as Past due or due orders.

The indicator is calculated as total number of order lines delayed by supplier divided by total number of order lines placed on supplier in the particular period of time.

This is usually measured in percentage.

Low the number of customer backorder good the performance of the materials and over all supply chain planning.

Distribution Expense

All expenses vary with varied requirement of the firm, similarly distribution expense also varies based on the shipments received or sent to customer

So distribution expense can be calculated in two ways as

- Distribution expense for inbound shipments and
- Distribution expense for outbound shipments

It is better to take COGS value to understand the performance of distribution as this gives justification on cost variations if any and also provides shipment wise cost or unit wise costs if taken in more detail

Distribution expense is thus calculated as total distribution expense divided by the total cost of goods sold (COGS) in particular time frame.

This indicator helps to identify possibilities of improvements in packaging, shipping, network designs and many options to get cost avoidance and cost saving outcomes.

Warehouse Capacity Used-

Warehouse or stores space is a crunch in many firms, the capacity available may not be the sufficient to support manufacturing activities, as business is growing cost reduction focus should be more aggressive and warehouse space utilized turns into the cost in terms of rent, labor, electricity, material handling equipment, scrap , obsolescence and theft.

This indicator gives idea of how effectively warehouse space is utilized and can give more action plans for improvement in terms of reducing inventory or store layout change to be more efficient in storing materials

This indicator is measured in percentage of the ratio of warehouse space used (in square feet or other units) divided by total warehouse space (in similar unit).

Order and Documentation Accuracy Rate

This performance is moreover on Purchasing or buying role, where total number of orders sent to supplier with complete and correct information divided by total number of orders sent to supplier in particular time frame.

This indicator helps to understand internal administrative issues like changes on orders in terms of quantity, prices, terms and conditions, delivery schedules.

Percentage of Sales Lost Due to Supply Issues

From the customer satisfaction point of view, when customer cancels order due to insufficient capacity of the firm or shortages or back orders or any other reasons which are related to wrong planning from supply department.

This indicator is calculated as loss of sales in currency divided by total order value from customer in same currency in particular time frame. This ratio can also be calculated as percentage but some time it is more effective to show it in currency.

Material Handling Damage

This indicator defines material handling performance of manufacturing firm, this gives action on improvement like setting or re designing material handling processes, equipment's used to handle material, special attentions to be taken in the process.

This indicator is calculated as taking cost of materials damaged in handling and dividing it by cost of goods sold, this indicator is measured in percentage.

Inventory Accuracy

Real time inventory across stores and distribution centers is identified as one of the operational challenge and critical process **(Shailja Dixit, 1975)**[1]. Inventory accuracy is measured as counting physical inventory (in counts or cost) and then checking actual recorded inventory in system (in counts or cost). Once both values are available then calculate mean absolute error

MAE = | Physical inventory – Recorded inventory |

The inventory accuracy then calculated as

$$\text{Inventory accuracy} = \frac{\text{MAE}}{\text{Accuate inventory}} \text{ X } 100$$

Many firms integrate ABC analysis method with Inventory accuracy or cycle counting, In a simple way ABC includes

A Items – high value and low volume

B Items – Medium value and medium items

C items – Low value and high volume.

Many firms do cycle counting more often to the A parts, at medium frequency to B Parts and less frequency for C parts. On other side due to high value A parts inventory accuracy has very minimum tolerance like 1%, B Parts have little more tolerance like 3% and C parts have more tolerance like 5%.

Forecast error

Forecast error is the indicator used to understand the performance of previously done forecasting of consumption pattern when compared to actual consumption happened in particular period of time.

Forecast error is difference between actual consumption and forecasted consumption.

$$\text{Thus forecast error} = \frac{|\text{Actual demand} - \text{Forecasted demand}|}{\text{Actual demand}} X\ 100$$

Risk mitigation strategies in materials management:

P.S. Rathai in his research titled "A Study on Inventory Management of central public enterprises in Salem" in 2012 stressed on inventory control aspects and majorly focused on purchasing methods of selected enterprises, study of lead times (administrative lead time and material delivery lead time), meanwhile P.S Rathai also studied stores management procedures and different costs associated with inventories. In a conclusion part researchermentionsthat inventory management is not perfection but it is a part of improvement while proper inventory control is moreover minimizing complexities in planning, executing and controlling a supply chain. Researcher also stresses thatfor proper and structured inventory management it is necessary to take inventory decisions based on quantitative evaluations.

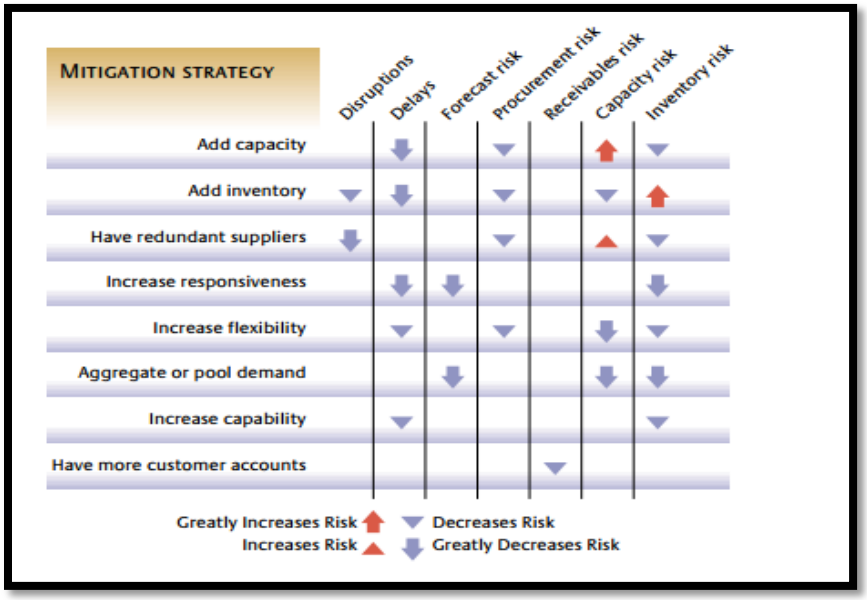

Figure Reference - Research Paper by Sunil Chopra and ManMohanSodhi, "Managing Risk to avoid supply chain breakdown", MIT Sloan Management review, Fall 2004, Vol.46. No.1. P 4

[1]Shailja Dixit, "E-Retailing Challenges and Opportunities in the Global Marketplace", Business science reference", 1975, P-254

Forecasts are never accurate, but organization dealing with multiple products and multiple customers it is important to forecast the material.
Forecast inaccuracies can be result of lack of information distortion within supply chain, Forecast risks can be reduced by selectively holding inventory for those products where holding cost is relatively lowand increasing responsiveness of production or delivery for the products which are expensive. (Sunil Chopra &ManMohanSodhi, 2004).

More inventories are always a hurdle and controlling right inventory at right time has no silver bullet method defined.

Top management meets weekly to review supply and demand positions for risk assessment and this process id referred as Sales and operations planning (S&OP) or some organizations also refer it as Sales, Inventory and operations planning (SIOP).In this meeting metrics are reviewed to understand previous plans and actuals, this process helps to improve predictability, to increase proactive actions and to minimize risks (Donald H. Sheldon, 2008)

P. Gopalkrishan in his book Purchasing and Materials Management defined the terminology titled "Materials Research" where he concluded that materials intelligence is a systematic approach of dealing with right information to right person in the defined hierarchy, and this approach is assisting profit centered goals. Author also mentions information is a power which should be considered as development activity in materials department. He also writes that information required for planning, budgeting and controlling materials function should be followed through MIS, in addition to this materials information is defined by Gopalkrishnan as network of information flow aimed at supporting materials management activities by having relevant, reliable and timely information, Further Gopalkrishnan in his another book titled Materials management an integrated approach highlighted materials management with MBO Approach, MBO that is management by objective is an approach of establishing effectiveness areas and effectiveness standards for management and those defined standards shall be measured timely with future planning approach, in the same context author expresses areas of effectiveness in materials management as inventory levels, inventory ratio, scrap and others related to supplier management.

APICS (American production and inventory control society) and Protiviti (Global consulting firm) in their research paper concerned with risks associated in supply chain and some solutions, described many risks in overall supply chain activity and in the same paper they outline few top solutions which are concerned with integration of cross functional teams.

Amount of obsolete inventory always prevents manufacturing plant to attain their goals; on other side many plants are reluctant to present total amount of obsolete inventory available with them as their performance is being monitored based on this amount. Obsolete inventory directly affects the profit margins of organization and consequently materials management department are faced with unrealistic inventory reduction goals (Stan C. McDonald, 2009). It is also important that right information flow has to be there in overall chain of manufacturing processes, if information is duplicated or manipulated it directly has impact on organization or function of organizations performance measurement.

Information plays an important role and there shall be structured, defined and frequent communication amongst all supply chain partners. As there are multiple partners within the chain, it is difficult to understand actual requirement of end customer, the term is coined as Bullwhip effect. APICS (American Production and Inventory control society) defines Bullwhip effect as "An extreme change in the supply position upstream in a supply chain generated by a small change in demand downstream in the supply chain. Inventory can quickly move from being backordered to being excess"
Bullwhip effect can also be considered as distortion of demand along the supply chain which goes upstream in an amplified form (Abhilash Reddy Kothi, 2007).

Companies can reduce the bullwhip effect by increasing more visibility of demand information amongst partners and planning collaboratively with the effort of CPFR (Collaborative planning, forecasting & replenishment) (Sunil Chopra &ManMohanSodhi, 2004).

Farahani and Reza Zanjiraniconcluded in their famous book titled "Supply chain sustainability and raw material management, concepts and processes" that "for supply chain sustainability it is important to have stochastic models in place and decisions has to be made based on the available information than random consideration,while decision makers can be able to make some decisions related to effect of uncertainty on system performance.

NenadStefanovic discusses in his research paper that performance management is all about monitoring, measurement and analysis of operational performance data and collaborative decision making. He highlights that many organizations have

existing KPI for supply chain performance that are backward looking, it means those are monitored and analyzed to see what has happened? How and why this happened?Further Nenad guides on a performance measurement model with help of world known SCOR model concept where he advocates that Business intelligence tools and technologies are the best options to enable to react timely, to predict what will happen (Forward looking) and this helps supply chain team to have better responsiveness and less risks.On the similar topic Kiran S. Patil in his research paper studied brief on SCOR model and its benefit for the organization, Kiran feels that current KPI, scorecard and dashboards used to measure supply chain performance are not interlinked to strategy.

Integrated Materials Management

Various functions performed by materials management department include the materials planning, Procurement or Purchasing, receiving, stores Management, inventory control, Obsolete, scrap and surplus disposal. All mentioned functions needs efficient management. This requires well-coordinated approach towards various issues, activities, decision making with respect to materials.
All the materials related activities such as material planning, purchase systems & procedure, variety reduction through standardization, codification& rationalization, reducing uncertainties in demand & supply, handling & transportation, inspection, proper storage & issue of materials to the internal customers, inventory management, vendor management & finally disposal of obsolete, surplus & scrap materials etc. taken together is termed as Integrated Materials Management

While inventory manager would like to have minimum level of inventory to show off his performance, purchasing manager would like to place bulk orders in order to lessen his work load and show discounts as reductions. Both of these acts may be little contradictory from the organizational point of view. That is if some of the functions were to be handled separately, a conflict of interests may occur.

Therefore, the conflicting objectives need to be balanced and intertwined from a total organizational viewpoint so as to achieve optimum results for the organization as a whole.
In an integrated set up, one materials manager (usually the chief) is responsible for all related functions and he is in a position to exercise control and coordinate all the activities with a view to ensure proper balance of the conflicting objectives of the individual functions.
Integration also attains the synergetic advantage in terms of eliminating water tight compartments that set in a disjointed environment of working. The resulting benefits can be seen in terms of rapid transfer of data, through effective and informal communication channels.
This is crucial as the materials management function involves handling vast amount of data. Therefore, integrating the various functions identify themselves to a common materials management department which in turn results in greater coordination and better control.
Now days, in many traditions bound companies too, even the spare part planning which hitherto was done by the operation people has been brought under the umbrella of an integrated materials Management.

Better accountability, better coordination, better performance, better adaptability to manage centralized information are some of the tangible advantages of the Integrated Materials Management besides a perceptible team spirit ,morale and cooperation are the intangible gains.
Training and development of staff and executive through rotation of people is another great advantage because of a bigger canvas produced by integration of Materials function. To carry out these functions efficiently, it is essential to have a very good supplier base, order booking process & inventory management system as well as expert Materials Management (MM) professionals.
"5ME" is an organization which is consulting manufacturing solutions concludes that Man, Material, Machines, Methods and Money are the 5M's of efficiency in production management. So out of five M's mentioned above, Materials has become a keen interest of industrial management to support cost reduction and increase in sales and profit for organization.

As Materials Management involves decision making at various areas, it is important to follow well-coordinated and integrated approach. For example - for keeping safety stock is simply an investment in inventories, which can also be overcome by reducing lead times, minimizing uncertainties in supply & demand, reducing variety through standardization & modification, developing reliable sources of supply. So to follow this coordinated process it needs to have proper & timely co-ordination between customer scheduling, Sales & Operation Planning, Materials Planning, Inventory managers, stores, Production, Engineering, Purchasing, distribution and finance team to co-ordinate in well manner.

Findings &Conclusion

Although there is no silver bullet method to identify, assess and mitigate risk in any manufacturing setup, but there are many strategies, tools and techniques available. Proper use of right method at right time will definitely help an organization to identify, assess, mitigate, transfer or reduce the risks.

Below are three tables being a conclusion of research paper, those three tables' shows

1. Primary risks identified in materials management function.
2. Basic methods to be used to assess the materials functions risk.
3. Mitigation strategies to be implemented to mitigate, reduce or transfer the risks.

Risks in Materials Management	Risk identification & Assessment	Risk Mitigation strategies
• Inconsistent flow of material / On time delivery. • Safety stock, ROP & ROQ decisions. • **Lack of Integration and process approach.** • **Lack of Information flow within the chain.** • Inventory accuracy • Excess and Obsolete materials	• **Forecasting models** • Inventory classification techniques – (Eg. ABC, HML, FSN) • Inventory assortment model (Eg. PFEP) • **S&OP Process** • Utility of Quality & Lean tools ◦ FMEA, Fishbone, Control charts • **Utility of Data analytics / BI Tools**	• **CPFR** (Collaborative planning forecasting & replenishment) • **VMI** (Vendor managed Inventory) • Predictive analytics • **ICT** (EDI, RFID, Barcoding & scanning) • Cooperative approach (With internal stakeholder – Sales & marketing, production, purchase as well as external stakeholders – Suppliers, customers)

Research Gap.

Many of the studies are conducted in different manufacturing setups and it has been identified that research is conducted mainly on improving, innovating, exploring gaps of traditional approach of materials management and inventory control, while there are very few research identified in the areas of risk assessment and risk mitigation strategies in materials & inventory area.

While there is significant trend outlined in manufacturing industries with new methods like analytics, PFEP, S&OP, extensive computerization where very few researchers have focused and it has been understood that research in above mentioned areas are becomingmore popular topics for upcoming researchers.

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