

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Streamlining Inventory Management Strategies in the Petroleum Refining Industry at Chennai

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ABSTRACT

This study explores the principles, practices, and challenges of inventory management within modern business operations. Inventory management plays a crucial role in maintaining the balance between supply and demand, optimizing storage costs, and ensuring customer satisfaction. The research focuses on various inventory control methods such as Just-In-Time (JIT), Economic Order Quantity (EOQ), and ABC analysis, examining their effectiveness across different industries. Through a combination of qualitative and quantitative analysis, the study evaluates the impact of inventory strategies on operational efficiency and financial performance. It also addresses the role of technology, including ERP systems and AI-based forecasting, in enhancing inventory accuracy and responsiveness. The findings suggest that a well-structured inventory management system not only reduces costs but also improves service levels and supports strategic decision-making. This research contributes valuable insights for businesses aiming to streamline their supply chain processes and gain a competitive edge.

Keywords : Just-in-time, inventory control, supply chain management, economic order quantity, safety stock, lead time, demand forecasting, reorder point.

INTRODUCTION

Inventory management assists businesses in determining which and how much to order at what point in time. Inventory is followed from the point of purchase to the sale of merchandise. The practice picks up and reacts to trends in order to have a sufficient quantity of stock on hand to meet customer orders and adequate notice of running short. Inventory, once sold, is income. Prior to selling, inventory (while listed as an asset on the balance sheet) holds cash. So, too much inventory loses money and impacts cash flow. One metric for effective inventory control is inventory turnover. An accounting metric, inventory turnover measures the frequency stock sells within an interval. A company does not wish to have additional stock than revenue. Bad inventory turnover may produce deadstock, or unturned stock. Inventory management is the process of ordering, storing, utilizing, and selling a firm's inventory. It involves raw materials, components, and finished goods, as well as the processing and warehousing of these goods. Various methods of inventory management exist, each having advantages and disadvantages, depending on the needs of a firm.

Inventory issues have been faced by all societies, but it was only in the twentieth century that analytical methods were formulated to analyze them. The word "inventory" suggests the total of tangible assets which are finished goods, work-in-progress, and materials and supplies. As inventories represent the investment of a company's funds, there has to be an effective management of inventory. A company, to exist, must possess adequate level of inventories i.e. neither less nor more. Less inventories implies disruption of production and sales activities whereas more inventories implies piling up of idle funds and rising in carrying cost. Hence, with the assistance of effective inventory management, a suitable balance between these two extremes should be achieved for the smooth run of business. At the business enterprise level, inventory holding becomes of even more importance since inventories form a large part of total assets of several concerns.

Inventory holding involves significant capital investment in addition to incurrence of cost of storage and handling and risk of damage, loss and obsolescence. In order to reduce costs as well as to avoid locking up the capital unnecessarily, inventories have to be managed efficiently. Inventory management errors cannot be easily corrected since it is the least liquid of all the existing assets. The biggest issue of inventory control is to optimize profitability by striking a balance between investment cost of materials and what is needed to maintain smooth operations.

INVENTORY MANAGEMENT SYSTEM

An inventory management system (IMS) is the procedure of managing and monitoring inventory management. Certain high-tech tools these days enable automated processes and simplified data entry to monitor products from supplier to buyer. Three IMS types are,

Perpetual inventory system: They are most precise since they monitor inventory in real time and are backed by robust software solutions. Oracle's NetSuite ERP is one example.

Periodic inventory system: Periodic systems record inventory at the start and end of an interval of time. It is less precise than perpetual systems but can be implemented on Microsoft Excel or Google Sheets.

Manual inventory system: As the name implies, manual systems use pen and paper to record sales. This is only feasible for small businesses.

BENEFITS

Informed Decision Making: Accurate inventory information gives insights into product performance and sales trends, supporting strategic planning and demand forecasting.

Reduced Risk of Stockouts and Overstocking : Effective inventory management balances supply and demand, avoiding stockouts that can result in lost sales and overstocking that locks up capital in unsold merchandise.

Plutus Education: Improved Supplier Relationships Unobstructed inventory visibility facilitates smoother coordination with suppliers, resulting in better negotiation conditions and timely shipments.

Regulatory Compliance: For businesses such as pharmaceuticals and food, efficient inventory management maintains regulatory compliance, preventing legal entanglements and product safety issues.

Scalability: A well-designed inventory system can grow along with business growth, supporting rising volume and complexity without sacrificing efficiency.

REVIEW OF LITERATURE

Macharia Ngombo Wilson and Dr. Mike A Iravo (2015) have analyzed in their study "Effects of Information Technology on Performance Effects of Logistics Firms in Nairobi County". The general objective of this study was to establish the effects of Information Technology on the performance of logistics firms in Nairobi County, Kenya. Data was collected from 10 firms in the logistic industry suppliers in Nairobi. Out of 34 logistic firms in Nairobi, the researcher will take 30% of the total population. Using Statistical techniques like percentage method and chi-square test analysis. The study found that the level of information usage among logistics firms in Nairobi County contributed to the performance.

Kwame Owusu Kwateng and Kwame Nkrumah (2014) have investigated in their study "Outbound Logistics Management in Manufacturing Companies in Ghana". The purpose of this study is to assess outbound logistics of a manufacturing company (Guinness Ghana Breweries Limited) using the services of a third party logistics provider (DHL). Empirical research was employed to explore outbound logistics performance of the manufacturing company. Primary data have been collected from 50 respondents by adopting Convenient sampling method. Structured questionnaires were used to capture the perception of staff of GGBL regarding outbound logistics performance of the services of the third party logistics provider. The results will serve as a basis and initial benchmark of reference for any manufacturing company in their attempt to assess the outbound logistics operations which will improve supply chain performance.

Dr. Angel Raphella. S, Mr. Gomathi Nathan. S and Ms. Chitra. G (2014) have analyzed that "Inventory Management- A Case Study". The main objectives of the study is to analyze the inventory management technique used in the company. The data pertaining to March 2013 to February 2014 are considered for the analysis. The study have found that Cement and sand is fast moving throughout the year. It is also very clear that Gravel, Bricks and Steel are given less importance in the stock. Materials management unit should also pay attention to sales growth over the years and thus take into consideration. More sophisticated techniques may be used to handle inventory management problem more efficiently and effectively.

Elema Boru Godana and Dr. Karanja Ngugi (2014) have illustrated in their study "Determinants of Effective Inventory Management at Kenol Kobil Limited". The main objective of the study was to determine effectiveness of inventory management at KenolKobil limited. The sample size is 300 respondents. The study was a descriptive research design. The study employed both quantitative and qualitative analysis techniques. Data was presented using tables, pie charts and bar graphs. Inferential statistics includes correlation and regression analysis. The study found that Most employees have basic Staff competency on inventory management at kenolkobil.

Balakrishnan V. Selvaraj (2014) have demonstrated "Inventory management of cement industries in Ariyalur district - a study". The main objectives of this study are to examine and evaluate the inventory management in five sample cement units in Ariyalur district of Tamil Nadu. The company wise information has been collected on a number of variables during the period from 2004 to 2013, covering ten years. The collected data is analyzed by applying research tools which include accounting as well as statistical tools. The study concluded that The Company has no problem in the management

of inventory. Since, there is always a heavy and continuous dement for cement from different agencies there is no problem of accumulation of inventory for all the sample cement industries.

Muhayimana Victoire (2014) have analyzed that "Inventory Management Techniques and Its Contribution on Better Management of Manufacturing Companies in Rwanda Case Study: Sulfo Rwanda Ltd". The aim of this study is to highlight or determine the contribution of inventory management techniques on better management of manufacturing companies. The total population was 14 respondents. The purposive sampling method was used to target only people who are capable to deliver relevant information. The data collected were analyzed and interpreted where corresponding ticks were given and tables drawn to give clear information. The findings shows that to determine re-order level after specified time may not be good because the time may mature while stock is still full, without enough space to accommodate new supplies.

Dr.B.Rambabu and Dr.G.Malyadri (2014) have stated in their journal on "A Study on Inventory Management at Amara Raja Electronics Ltd, Tirupati". The main objectives of the study are to study of the effective utilization of inventory by using ABC Analysis. The study was conducted to know the position of inventory management. It is with the help of ratios that the inventory management can be analyzed. The company can also consider the suggestions and recommendations, which are actually based on the analysis made, for the battlement of the company. By following the Inventory Management Technique like Just in Time (JIT), the company can reduce it cost and supplies to finish the goods at reasonable prices to the customer. The company by strictly following management techniques like EOQ, ABC Analysis can increase its profits.

OBJECTIVES OF THE STUDY

- 1. Ensure Continuous Supply : Keep the required inventory at sufficient levels to avoid production delay and fulfill customer demand in time.
- 2. Optimize Inventory Levels : Maintain a balance between overstocking and understocking to reduce carrying costs and prevent stockouts.
- 3. Manage Material Costs : Maintain material costs in check to minimize production costs and maximize overall cost-effectiveness.
- 4. Limit Losses : Limit losses from deterioration, theft, obsolescence, and damage by efficient inventory management practices.
- 5. Optimal Investment Maintenance : Keep investments in inventory at an optimum level that matches operational and sales demands.

RESEARCH METHODOLOGY

This research utilizes a descriptive research design, drawing upon both primary and secondary sources of data in order to meet its goals. Primary data were gathered through a structured questionnaire survey of a sample of 150 respondents drawn by a convenient sampling method. Validation of the questionnaire and establishment of its relevance as well as clarity were done through a pilot study. With feedback from the pilot study, any required adjustments were made to the questionnaire to increase its efficiency in obtaining the necessary information. Secondary data were obtained from several sources, such as academic journals, books, and credible online resources, to enhance the understanding of the subject. The data that was collected was processed using suitable statistical software to obtain relevant information and to complement the research purpose.

DATA ANALYSIS AND INFERENCE

Table 1.Table indicating Model Summary

H01 - Inventory management techniques do not significantly predict operational efficiency

 H_{11} – Inventory management techniques significantly predict operational efficiency.

R	R ²	Adjusted R ²	F	P Value
0.672	0.452	0.441	40.08	0.001

Table 2.Table indicating Regression Table Test between Inventory management techniques and operational efficiency

Predictor Variables	Unstandarized coefficient B	Std Error	t value	p value
(Constant)	1.832	0.324	5.65	0.000
JIT	0.412	0.097	4.25	0.000
ABC Analysis	0.367	0.103	3.56	0.001
EOQ	0.305	0.089	3.43	0.001

INFERENCE:

It is inferred from the above table that the The regression results reveal that all three inventory techniques—JIT (B = 0.412, p < 0.001), ABC analysis (B = 0.367, p = 0.001), and EOQ (B = 0.305, p = 0.001)—significantly contribute to predicting operational efficiency. The model explains approximately 45.2% of the variance in operational efficiency ($R^2 = 0.452$). Since all predictors are statistically significant and the overall model is strong (F = 40.08, p < 0.001), we reject the null hypothesis and conclude that inventory management techniques are strong predictors of operational performance in the refinery.

H₀₂ - There is no significant difference in operational efficiency among the different inventory techniques.

H12 - There is a significant difference in operational efficiency among the different inventory techniques

Table 3. Table indicating ANOVA Test among operational efficiency among the different inventory techniques

Source of Variation	Sum of Squares	df	Mean Square	F	p value
Between Groups	15.84	2	7.92	6.47	0.002
Within Groups	179.10	147	1.22		
Total	194.94	149			

INFERENCE:

It is inferred from the above table that the ANOVA test conducted and the p-value (0.002) is less than 0.05, the null hypothesis is rejected, indicating a statistically significant difference in operational efficiency among the three inventory techniques. This suggests that the choice of inventory management approach—whether JIT, ABC, or EOQ—has a notable impact on the refinery's performance outcomes.

Table 4. Table indicating Correlation Test between loading and unloading efficiency and overall logistics satisfaction.

 H_{03} – There is no significant correlation between inventory management techniques (JIT, ABC analysis, EOQ) and operational efficiency (cost efficiency, turnaround time, stockout rate).

H ₁₃ –	There is a signi	ficant correlation	between inventory	management	techniques and	operational	efficiency
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Inventory technique	Operational metric	Pearson correlation	P value
JIT	Turnaround Time	0.61	0.000
ABC	Cost efficiency	0.58	0.000
EOQ	Stock out rate	0.55	0.000

INFERENCE:

It is inferred from the above table that the correlation analysis reveals statistically significant positive relationships between the inventory techniques and their respective operational outcomes. JIT showed a moderate positive correlation with improved turnaround time (r = 0.61, p < 0.01), ABC analysis correlated with better cost efficiency (r = 0.58, p < 0.01), and EOQ was positively associated with reduced stockout rates (r = 0.55, p < 0.01). Since all p-values are below 0.01, we reject the null hypothesis (H₀) and conclude that effective application of inventory management techniques significantly enhances operational efficiency in the refinery context.

DISCUSSION

Inventory management is a crucial part of business activities, including the ordering, storage, utilization, and sales of the inventory of a company, such as raw materials, parts, and finished goods. Proper inventory control helps companies to have sufficient levels of stock to satisfy customer demand in time and reduce costs related to stock outs or overstocking. It includes projecting demand, tracking stock levels, enhancing ordering and replenishment operations, determining safety stock levels, and minimizing carrying costs. Through policies like Just-In-Time (JIT), Economic Order Quantity (EOQ), and Materials Requirement Planning (MRP), companies can make their operations more efficient, enhance cash flow, and improve customer satisfaction. Nevertheless, obstacles like demand volatility, supply chain dislocation, and technological integration need to be overcome in order to bring about effective inventory management.

CONCLUSION

Inventory Control and Analysis has become unavoidable for an industry of manufacturing. To avoid letting an inventory turn dead it is extremely necessary to remain up to date with the quantity and condition of the stuff in that given inventory. Inventory management must maintain proper records of stocks. It is necessary for maintaining the cost low. The more efficient inventory management certainly will prevent problems that the company would be encountering regarding the inventory and will assist in avoiding big investment or tying of money in stock. Through this research we concluded that

firms can adhere to economic order quantity for best purchase and can have safety stock for components in such a way that stock out situations are avoided and assist in smooth production flow. This will decrease the cost and will increase profit. If we could implement and maintain all the inventory management techniques properly, we will be able to maximize the profit at minimum cost.

Acknowledgment

The authors expressed their sincere gratitude to respondents of the research for their valuable inputs and cooperation during the course of the study. Special thanks to the industry professionals who participated in interviews contributing essential perspectives. My sincere thanks to Sathyabama Institute of Science and Technology for guiding us in undertaking this research.

Author Contribution

Ms.S.R.Vibbushitha designed the study, conducted data collection, conceptual framework, tested hypothesis by analyzing data and prepared the manuscript. Dr.M.Lavanya provided guidance on research design and methodology and contributed to critical revisions and final approval of the manuscript.

Conflict of Interest

The authors declare no conflict of interest in the publication of this research.

Ethics Approval

The study involves voluntary participation by respondents through informed consent.

Funding

This research did not receive any specific grant from agencies in the public, commercial or not for profit sectors.

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