A Analysis on the Traditional and Modern Techniques of Inventory Management with Special Reference to Aruna Enterprises, Banglore

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ABSTRACT

This study examines the traditional and modern techniques of inventory management with a specific focus on Aruna Enterprises, Bangalore. Inventory management is critical for ensuring operational efficiency, minimizing costs, and meeting customer demand in manufacturing sectors. The research delves into Economic Order Quantity (EOQ) and ABC analysis as traditional techniques while highlighting modern tools like HML analysis. It examines the challenges faced by manufacturers, including inventory optimization, material handling, and procurement, and evaluates the company's practices over three years. Key insights emphasize the role of advanced inventory practices in enhancing productivity, reducing waste, and maintaining cost-effectiveness. Recommendations are proposed to bridge gaps in inventory handling and integrate sustainable practices. This study aims to serve as a guide for improving inventory management strategies in manufacturing industries, thereby ensuring competitiveness and profitability in the global market. In this study the Statistical tests, such as the Chi-Square test, t-test, and ANOVA, were employed to assess the significance of observed data compared to expected distributions, ensuring robust and accurate conclusions. The findings underscore the importance of prioritizing high-priority and high-value items while optimizing costs and refining inventory strategies in response to evolving demand.

Keywords: Inventory Management, Components Industry, Traditional Techniques, Modern Techniques, Economic Order Quantity (EOQ), ABC Analysis, Just-In-Time (JIT).

1.INTRODUCTION

Inventory management is a critical aspect of supply chain operations, particularly in manufacturing sectors where efficiency, cost control, and customer satisfaction are paramount. It involves the systematic coordination of procurement, storage, and distribution of raw materials and finished goods to ensure optimal stock levels. Effective inventory management minimizes costs associated with overstocking or understocking while ensuring the smooth flow of production and timely delivery to customers.

This study focuses on analyzing inventory management practices at Aruna Enterprises, Bangalore, a company specializing in press tools, components, and molding tools. With raw materials constituting a significant portion of production costs, maintaining an optimal balance between holding costs and procurement efficiency is essential for achieving profitability. Traditional inventory control techniques such as Economic Order Quantity (EOQ) and ABC analysis are examined alongside modern practices like Just-In-Time (JIT) and Enterprise Resource Planning (ERP). These approaches help streamline operations, reduce waste, and improve overall supply chain performance.

The Indian manufacturing industry, driven by increasing demands in automotive, aerospace, and electronics sectors, faces growing challenges in inventory optimization. This research identifies these challenges, evaluates current practices, and proposes strategies for improving inventory management. By leveraging primary and secondary data, the study aims to provide actionable insights for enhancing inventory control mechanisms, enabling companies to achieve sustainable growth in a competitive market.

2.RESEARCH METHODOLOGY

This study utilizes a combination of qualitative and quantitative methods to analyze inventory management practices at Aruna Enterprises. The methodology includes a detailed exploration of both primary and secondary data sources to understand the effectiveness of inventory techniques such as Economic Order Quantity (EOQ) and ABC analysis.

1. Research Design : The research follows a descriptive research design to explore current inventory practices, challenges, and improvement opportunities. The design provides a structured approach for data collection, analysis, and interpretation.

2. Sources of Data :

a) **Primary Data :** Primary data was collected through:

- Personal interactions with finance managers and inventory managers.
- Observations of inventory handling procedures, storage systems, and inspection methods.

b) **Secondary Data :** Secondary data sources included:

- Published materials such as company records, inventory reports, journals, and books.
- Computerized databases and online sources for industry trends and comparisons.

3. Analytical Tools :

- **Tables and Graphs:** To visually represent inventory trends, ABC categorization, and EOQ calculations.
- **Percentage Analysis:** To measure the relative significance of inventory categories.
- **Cost-Benefit Analysis:** To compare holding and ordering costs.

4. Sampling Design : The study employs a descriptive sampling technique, focusing on key inventory items categorized under raw materials, work-in-progress (WIP), and finished goods. These categories were chosen to evaluate their contribution to overall operational efficiency.

3.OBJECTIVE OF THE STUDY

- ➢ To study on the evolution of manufacturing industry
- ➢ To study the inventory management based on ABC Analysis.
- ➢ To analyze the inventory levels those are sufficient to perform production and sales activities smoothly.
- ➢ To study the inventory position for the period of 3 years & and to examine the consumption level of raw materials, WIP, and finished goods for 3 years.
- ➢ To suggest and recommend techniques of Inventory Management to the company.

4.REVIEW OF LITERATURE :

- **Bansal (2016):** Bansal's study emphasizes the significance of inventory management systems in preventing overstocking and stockouts. He focuses on traditional inventory control techniques such as ABC analysis and Economic Order Quantity (EOQ) to balance stock levels. Bansal argues that regular monitoring through methods like monthly inventory statements can help control unnecessary stock usage, which in turn reduces wastage and helps in efficient capital allocation. He further highlights the need for an automatic replenishment system to maintain optimal inventory levels.
- **Pratap Chandra Kumar & Gomathi Shankar (2016):** In this study, the authors identify the common problem of inventory shortages caused by poor forecasting practices. They suggest the use of ABC analysis to classify inventory based on its importance, thereby allowing companies to focus on critical items that impact production and sales. Additionally, they discuss the limitations of traditional forecasting methods and advocate for the adoption of advanced technology to enhance accuracy in demand forecasting and inventory tracking, ensuring that companies can meet customer demands without overstocking.
- **Handan Hal Ravinder (2016):** Ravinder explores strategies for improving inventory management, especially in industries that require efficient storage solutions. He proposes priority scheduling and the use of flow racks to optimize inventory flow and reduce storage space requirements. He also recommends using XYZ analysis, a method for forecasting demand based on item classification. The study stresses the importance of using ABC analysis to prioritize inventory according to its financial impact on the business, ensuring that essential items are readily available while less critical inventory is kept to a minimum.
- **Surabhi Dwivedi et al. (2017):** Dwivedi and colleagues emphasize the role of ABC analysis in both raw material and finished goods inventory management. They highlight that proper inventory control techniques like ABC analysis can improve resource allocation and product availability. The study also suggests implementing stricter controls on high-value and high-demand inventory items to minimize the risk of stockouts and excess inventory. This approach ensures that resources are utilized efficiently, supporting smooth production processes and timely deliveries.
- **Dave Piasecki (2018):** Piasecki's work delves into the Economic Order Quantity (EOQ) model, which determines the optimal order quantity to minimize both ordering and holding costs. He highlights the importance of EOQ in traditional inventory management, though he also acknowledges its limitations due to reliance on accurate data inputs. Piasecki suggests that many companies struggle with EOQ's effectiveness due to errors in data collection and forecasting. He proposes integrating EOQ with Just-In-Time (JIT) practices to streamline inventory processes, reduce lead times, and lower operational costs.

5. DATA ANALYSIS AND INTERPRETATION

5.1 Table : Showing HML Analysis Summary

Category	% Of Rate
H	98.9346
M	0.45409
L	0.62135

(Source : Financial Advisory of AE)

Data from the Document

Category	**Observed Frequency (O)**	**Percentage (%)**
High (H)	98.93%	989
Medium (M)	0.45%	5
Low (L)	0.62%	6
Total	**100%**	**1000**

(Source: Financial Advisory of AE)

We assume an **expected uniform distribution**

Step 1: Define Hypotheses

- **Null Hypothesis (H0)**: The observed distribution matches the expected distribution.
- **Alternative Hypothesis (H1)**: The observed distribution does not match the expected distribution.

Step 2: Calculate Expected Frequencies

For a uniform distribution:

E=Total Frequency / Number of Categories = 1000 / 3 = 333.33

Category	**Observed Frequency (O)**	**Expected Frequency (E)**
High (H)	989	333.33
Medium (M)	5	333.33
Low (L)	6	333.33

Step 3: Calculate Chi-Square Statistic

The formula for the chi-square statistic is:

$$\chi 2 = \sum (O-E)2 / E$$

Calculation:

1. High (H): $\chi H2 = (989-333.33)2 / 333.33 = 429784.87 / 333.33 = 1289.36$
2. Medium (M): $\chi M2 = (5-333.33)2 / 333.33 = 108236.89 / 333.33=324.71$
3. Low (L): $\chi L2= (6-333.33)2 / 333.33 = 107091.11 / 333.33 = 321.27$

Total Chi-Square Value:

$\chi 2 = \chi H2+\chi M2+\chi L2 = 1289.36 + 324.71 + 321.27=1935.34$

Step 4: Degrees of Freedom

Df = Number of Categories −1 = 3−1 = 2

Step 5: Critical Value

For df = 2 and α=0.05, the critical value from the chi-square table is χ critical 2 = 5.991.

Step 6: Make a Decision

- χ2 = 1935.34 is much greater than χ critical 2 = 5.991.
- **Decision**: Reject H0. The observed distribution significantly differs from the expected uniform distribution.

Summary Table

Category	O	E	O−E	(O−E)2	(O−E)2 / E
High (H)	989	333.33	655.67	429784.87	1289.36
Medium (M)	5	333.33	-328.33	108236.89	324.71
Low (L)	6	333.33	-327.33	107091.11	321.27
Total	1000	1000			**1935.34**

Conclusion

The results show a significant difference between the observed and expected distributions of the HML categories. This suggests that inventory is heavily skewed toward the High (H) priority category, confirming the need to focus management efforts on high-priority items.

Interpretation : The results of the HML (High, Medium, Low) analysis indicate that 98.93% of the inventory falls under the high-priority category, signifying that the majority of inventory items are either of high value or experience high usage. As such, these items require close monitoring and efficient management to prevent stockouts and ensure continuity in operations. In comparison, 0.45% of the inventory is classified as medium priority, representing items of moderate importance that should be managed with periodic reviews and replenishment. The remaining 0.62% falls into the low-priority category, referring to low-value or low-usage items that can be managed with less frequent checks. This distribution underscores the importance of focusing inventory management efforts on high-priority items, while allowing more flexibility and less frequent monitoring for less critical inventory.

5.2 Table Showing the EOQ Analysis

YEAR	EOQ (UNITS)	ORDERS PER YEAR	ORDERING COST (₹)	CARRYING COST (₹)	TOTAL COST (₹)
2019	1095	11	6600	6570	13170
2020	1147	12	7440	7570.8	15010.8
2021	1174	13	8320	8452.8	16772.8
2022	1198	14	9240	9352.8	18592.8
2023	1225	15	10200	10290	20490

(Source : financial advisory of AE)

Hypothetical Mean ($\mu 0$): 1150 units.

Step 1: Define Hypotheses

- **Null Hypothesis (H0)**: The mean EOQ is equal to 1150. :- $H0: \mu = 1150$
- **Alternative Hypothesis (H1)**: The mean EOQ is not equal to 1150. :- $H1: \mu \neq 1150$

Step 2: Calculate Summary Statistics

1. **Sample Size (n)** : 5
2. **Sample Mean ($\bar{x}$)**: $\bar{x}$ = Sum of EOQ value /n =1095+1147+1174+1198+1225 /5 = 1167.8
3. **Sample Standard Deviation (s)**: $s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$

Steps:

- **Deviations: $x_i - \bar{x}$:-** −72.8,−20.8,6.2,30.2,57.2
- **Squared Deviations:-** 5296.64, 432.64, 38.44, 912.04, 3273.84
- **Variance (S2):-** 5296.64+432.64+38.44+912.04+3273.84 / 4 =2488.9
- **Standard Deviation (s):-** $\sqrt{2488.9} \approx 49.89$

Step 3: Compute the t-Statistic

$$t = \frac{\bar{x} - \mu 0}{s / \sqrt{n}}$$

Substitute values:

$$t = \frac{1167.8 - 1150}{49.89 / \sqrt{5}} = \frac{17.8}{22.3} \approx 0.798$$

Step 4: Determine Degrees of Freedom

d f = n – 1 = 5−1= 4

Step 5: Find the Critical Value

- For a two-tailed test at α = 0.05 and d f = 4,the critical t-value is approximately ±2.776

Step 6: Make a Decision

- Compare |t| = 0.798 with t critical = 2.776.
- Since |t| < t critical, we **fail to reject the null hypothesis**. The mean EOQ is not significantly different from 1150.

Summary Table

Statistic	**Value**
Sample Mean ($\bar{x}$)	1167.8
Sample Standard Deviation (s)	49.89
t-statistic	0.798
Degrees of Freedom (df)	4
Critical t-value (α = 0.05)	±2.776
Decision	Fail to Reject H0

This analysis suggests no significant difference between the EOQ values and the hypothetical mean of 1150 units.

Interpretation : The EOQ (Economic Order Quantity) analysis from 2019 to 2023 shows a steady increase in the optimal order quantity, from 1,095 units in 2019 to 1,225 units in 2023, reflecting adjustments to higher demand or cost structures. As a result, the number of orders per year rises from 11 in 2019 to 15 in 2023, leading to a corresponding increase in the ordering cost, which grows from ₹6,600 in 2019 to ₹10,200 in 2023. Similarly, carrying costs also rise, from ₹6,570 in 2019 to ₹10,290 in 2023, as more inventory is held at any given time. Consequently, the total cost, combining both ordering and carrying costs, increases from ₹13,170 in 2019 to ₹20,490 in 2023. This trend highlights the trade-off between ordering and carrying costs as order quantities increase, emphasizing the need for effective inventory management to balance these costs efficiently as demand grows.

5.3 Summary Table For 5-Year ABC Analysis

YEAR	**A CATEGORY (₹)**	**B CATEGORY (₹)**	**C CATEGORY (₹)**	**TOTAL ACV (₹)**
2019	960000	180000	60000	1200000
2020	1232000	231000	77000	1540000
2021	1488000	279000	93000	1860000
2022	1768000	331500	110500	2210000
2023	2072000	388500	129500	2590000

(source : form the financial advisory of AE)

To perform **ANOVA** (Analysis of Variance) for the **ABC analysis**, we compare the means of the three categories (A, B, and C) to determine if there is a significant difference between them. Here's a step-by-step calculation using the data provided.

Data from the Document

The annual consumption values (ACV) of A, B, and C categories for 5 years are:

Year	A Category (₹)	B Category (₹)	C Category (₹)
2019	960000	180000	60000
2020	1232000	231000	77000
2021	1488000	279000	93000
2022	1768000	331500	110500
2023	2072000	388500	129500

Step 1: Define Hypotheses

- **Null Hypothesis (H0)**: The mean ACV of the A, B, and C categories are equal.
- **Alternative Hypothesis (H1)**: At least one category has a different mean ACV.

Step 2: Compute Group Means

1. **Mean for A Category ($\bar{X}A$)**:

$\bar{X}A$ = 960000+1232000+1488000+1768000+2072000 / 5=1509600

2. **Mean for B Category ($\bar{X}B$)**:

$\bar{X}B$ = 180000+231000+279000+331500+388500 / 5 = 282000

3. **Mean for C Category ($\bar{X}C$)**:

$\bar{X}C$ = 60000+77000+93000+110500+129500 / 5 = 94000

Step 3: Compute the Overall Mean

$\bar{X}$overall = Sum of all ACVs / Total observations = 1509600+282000+94000 / 3 = 630533.33

Step 4: Calculate the ANOVA Components

1. **Between-Group Sum of Squares (SSb)**:

$SSB=n\sum(\bar{X}i-\bar{X}overall)^2$

Where n=5n = 5 (number of years).

For A: (X¯A−X¯overall) ^ 2 = (1509600−630533.33) ^2=777679491733.33

For B:(X¯B−X¯overall) ^2= (282000 - 630533.33)^2 = 121773635555.56

For C: (X¯C−X¯overall)^2 = (94000 - 630533.33)^2 = 287413602222.22

Total:SSB=5×(777679491733.33+121773635555.56+287413602222.22)=5934336367555.56

2. **Within-Group Sum of Squares (SSWSS_W)**:

SSW=∑∑(Xij − X¯i)^2

Calculate deviations for each group and sum them.

For A: Deviations: (960000−1509600) ^2+(2072000−1509600) ^2 = 439968000000

For B: Deviations: (180000−282000) ^2+(388500−282000) ^ 2=64032000000

For C: Deviations: (60000 - 94000)^2 + (129500 - 94000)^2 = 744900000

Total: SSW = 439968000000+64032000000+744900000 = 504420900000

3. **Degrees of Freedom**:
   - Between Groups (dfb): k−1=3−1=2
   - Within Groups (dfw): N−k=15−3=12
4. **Mean Squares**:
   - Between Groups (M S B): MSB=SSB / dfb =5934336367555.56 / 2 = 2967168183777.78
   - Within Groups (MSw): SSW / dfW = 504420900000 / 12 = 42035075000
5. **F-Statistic**:

F = MS B / MS W = 2967168183777.78 / 42035075000 = 70.59

Step 5: Determine the Critical Value

For df B = 2 and d f W = 12 and α=0.05, the critical value of F from the F-distribution table is approximately 3.89.

Step 6: Make a Decision

- Since F=70.59 is much greater than F critical = 3.89, **reject the null hypothesis**.

Conclusion

There is a significant difference in the mean values of the A, B, and C categories. This suggests that inventory value is heavily skewed toward the A category, emphasizing the need for focused management.

Interpretation : The 5-year ABC analysis shows a steady increase in the annual consumption value (ACV) across all categories from 2019 to 2023. The A category, representing high-value items, grows from ₹960,000 in 2019 to ₹2,072,000 in 2023, indicating an increasing reliance on these critical items, which require focused inventory management. The B category items, with moderate value, also see growth, from ₹180,000 in 2019 to ₹388,500 in 2023, suggesting their growing importance. The C category, consisting of low-value items, rises from ₹60,000 in 2019 to ₹129,500 in 2023, reflecting an increased need for these items despite their lower cost. Overall, the total ACV rises from ₹1,200,000 in 2019 to ₹2,590,000 in 2023, signaling a general increase in inventory value. The analysis underscores the need for prioritizing the management of high-value A category items, while also considering the growing significance of B and C category items as inventory value continues to rise.

6. FINDINGS, SUGGESTIONS & CONCLUSION

6.1 Findings:

- The HML analysis reveals a significant skew in inventory distribution, with 98.93% classified as high-priority, necessitating focused management on these critical items to ensure operational continuity.
- The EOQ analysis shows a steady rise in order quantities and associated costs (ordering, carrying, and total), reflecting increased demand and cost adjustments from 2019 to 2023, emphasizing the importance of balancing inventory costs effectively.
- The ABC analysis reveals a significant rise in inventory value across all categories, with A category items dominating, necessitating focused management while acknowledging the increasing importance of B and C categories.

6.2 Suggestions :

- Focus inventory management efforts on high-priority items (98.93%) to ensure availability, while adopting periodic reviews for medium-priority items (0.45%) and minimal monitoring for low-priority items (0.62%).
- Optimize inventory management by balancing increasing ordering and carrying costs to maintain cost efficiency amid growing demand.
- Focus on managing high-value A items, optimize strategies for B and C categories, and regularly review inventory trends.

6.3 Conclusion :

The analysis across HML, EOQ, and ABC categories highlights key insights for inventory management. The HML analysis demonstrates a clear skew toward high-priority items (98.93%), which necessitates focused attention to ensure operational efficiency. The EOQ analysis shows an upward trend in both order quantities and associated costs, emphasizing the need for efficient cost management in the face of rising demand. Meanwhile, the ABC analysis indicates a steady increase in inventory value, with a particular emphasis on A category items, requiring strategic management. In summary, the findings stress the importance of prioritizing high-value, high-priority items, optimizing cost efficiency in inventory processes, and consistently reviewing inventory trends to align with growing demand and evolving priorities.

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