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“ENHANCE FIFO IN TYRE STORAGE AND FEEDING” WITH SPECIAL REFERENCE TO ASHOK LEYLAND PVT LTD, AT HOSUR.

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ABSTRACT :

The objective of this project is to enhance the First-In-First-Out (FIFO) system within the tyre storage and feeding section of a tyre manufacturing plant, addressing persistent challenges such as tyre aging, inventory inaccuracies, and inefficient feeding cycles. The current scenario showed poor FIFO compliance due to non-standardized practices, space constraints, and manual material handling without robust traceability mechanisms.

To systematically identify and resolve these issues, a combination of **Lean Manufacturing** and **Industrial Engineering** tools was deployed. The process began with **Gemba Walks** and **Process Flow Mapping**, providing first-hand observation and visualization of the actual workflow, helping to identify non-value-added activities and storage bottlenecks. This was followed by the application of **Root Cause Analysis (RCA)** and **Ishikawa (Fishbone) Diagrams**, which highlighted key issues such as improper material placement, lack of real-time tracking, and operator dependency.

To ensure traceability and monitor FIFO adherence, a **Barcode Scanning System** integrated with the **Warehouse Management System (WMS)** was introduced, enabling real-time tracking of tyre batches and automated alerts for aged inventory. **Visual Management Tools**, such as FIFO lanes, color-coded labels, and aging charts, were applied to reinforce correct storage and feeding practices on the shop floor. Additionally, **Standard Operating Procedures (SOPs)** were developed and training sessions conducted to build operator awareness and ownership of FIFO practices.

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INTRODUCTION

Inventory management plays a crucial role in ensuring the smooth operation of supply chains, especially in industries dealing with perishable or degradable goods such as tyres. Tyres have a limited shelf life due to material degradation caused by factors like temperature, humidity, and exposure to light. Implementing an efficient First-In, First-Out (FIFO) system in tyre storage and feeding ensures that older inventory is used before newer stock, reducing the risk of quality deterioration and financial loss due to expired products. Inventory management is a fundamental aspect of operations in any organization.

RESEARCH BACKGROUND

In the automotive manufacturing industry, inventory management plays a vital role in ensuring uninterrupted production and maintaining the quality of critical components. One such component is the tyre, which, due to its rubber-based composition, is susceptible to degradation over time. Exposure to elements like temperature, humidity, and light can lead to material fatigue, reducing performance and safety. Therefore, the management of tyre inventory becomes not only an operational necessity but a quality control imperative.

COMPANY OVERVIEW: ASHOK LEYLAND UNIT-2

Ashok Leyland's Hosur Unit II, established in 1994, is a pivotal manufacturing facility for the company, a flagship of the Hinduja Group. Spanning 247 acres with 30 acres of built-up area, the plant boasts state-of-the-art finishing and assembling facilities, including advanced paint and press shops. In 2017, it earned the prestigious Deming Prize for Total Quality Management (TQM), making Ashok Leyland the only commercial vehicle manufacturer outside Japan to receive this honor consecutively for two plants, following the Pantnagar unit's win in 2016. This accolade underscores the company's

commitment to quality and customer-centric processes. Furthering its dedication to inclusive growth, Ashok Leyland inaugurated an all-women production line at the Hosur plant in 2023, employing 80 women trained in core manufacturing skills.

IDENTIFIED PROBLEM

To systematically identify and resolve these issues, a combination of **Lean Manufacturing** and **Industrial Engineering** tools was deployed. The process began with **Gemba Walks** and **Process Flow Mapping**, providing first-hand observation and visualization of the actual workflow, helping to identify non-value-added activities and storage bottlenecks. This was followed by the application of **Root Cause Analysis (RCA)** and **Ishikawa (Fishbone) Diagrams**, which highlighted key issues such as improper material placement, lack of real-time tracking, and operator dependency.

Using insights from these analyses, a set of corrective and preventive measures was developed. The layout was redesigned using **Plant Layout Optimization** principles to ensure linear and logical flow of tyres from curing to feeding. The implementation of **5S (Sort, Set in order, Shine, Standardize, Sustain)** brought visual order and discipline to the storage areas, reducing retrieval times and confusion. **Poka-Yoke (error-proofing)** mechanisms were introduced to minimize human error, particularly in the sequencing of tyres.

To ensure traceability and monitor FIFO adherence, a **Barcode Scanning System** integrated with the **Warehouse Management System (WMS)** was introduced, enabling real-time tracking of tyre batches and automated alerts for aged inventory. **Visual Management Tools**, such as FIFO lanes, color-coded labels, and aging charts, were applied to reinforce correct storage and feeding practices on the shop floor. Additionally, **Standard Operating Procedures (SOPs)** were developed and training sessions conducted to build operator awareness and ownership of FIFO practices.

- Inconsistent application of FIFO principles across departments
- Difficulty for forklift operators in locating specific tyre batches due to poor signage and layout irregularities.
- Improper alignment and unstructured placement of tyres leading to inefficient space utilization and confusion during feeding.

OBJECTIVES OF THE STUDY

- To study about assess Current FIFO Implementation
- To study a Propose an Optimized Warehouse Layout
- To study about Leverage Technology for FIFO Enhancement
- To study on Improve Workforce Training and Process
- To study the impact of enhanced FIFO implementation

INTRODUCTION

A literature review is a comprehensive summary of previous research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research.

REVIEW OF LITERATURE

In today's rapidly evolving workplace, the concepts of inventory management have garnered significant attention from researchers and practitioners alike.

1. Hari R. Swami (2015) in his research work materials management in public undertakings evaluates the performance of materials management in the central public undertakings in Rajasthan Viz
2. Ravindra Kumar (2016) describes materials management as a truly creative, productive and profit centre Renuka Raja Gopalan (2014) stresses the importance of productivity through efficient materials management in manufacturing enterprises.
3. Mukherjee (2017) expresses the view the material management would be a profit centre of great importance in industries where materials cost would correspond to 50 to 60 percent of the cost of production and where the entire working capital is in the form of inventory.
4. CAMELIA BURJA; VASILE BURJA (2018) in the Journal "Annals of the University of Petrosian: Economics" says –"The inventory represents an essential component for the assets of the enterprise and the economic analysis gives them special importance because their accurate management determines the achievement of the activity object and the financial results.
5. DILIP ROY; DEBDIP KHAN (2019) in the Journal "International Journal Of Industrial Engineering Computations" says –"we address the optimization of an integrated line balancing process with workstation inventory management. While doing so, we have studied the interconnection between line balancing and its conversion process
6. MICHALSKI GRZEGORZ (2020) in the Journal "Medjunarodni Problemi" says - "The basic financial purpose of the firm is maximization of its value. An inventory management should also contribute to realization of this basic aim
7. ALEKSANDRA MARCIKIC ; BORISRADOVANOV (2022) in the Journal "Perspectives Of Innovations, Economics And Business" says- "In this paper inventory management is analysed as an organic part of the supply chain managing process. In today's competitive economic environment traditional inventory policies should be improved
8. JIANZHONG CHEN (2021) in the Journal "International Journal of Business and Management" says-"In order to meet the dynamic demand in the reality, recent researches on inventory management issues have concentrated on the time-varying demand over a finite planning time horizon.

9. BRAGLIA. ANDREA GRASSI AND ROBER TO MONTANARI (2023) Inventory constraints, cost of cost production, safety and Environment objectives, strategies of maintenance adopted, logistics aspects of space parts classification is thus defined with respect to multiple attributes.
10. Bern at de William year 2021 This overview says that the primary center of stock administration is on transportation and warehousing. The choice received by administration relies on upon the conventional strategy for stock 25 control illustrations.
11. Jon Schreiberfeder 2020 In mid 1990"s numerous merchants perceive that they required help controlling and bringing off their biggest resource stock.
12. Wolf Bagby, managing stock As per this study organizations need to get brilliant about stock. Boosting money related execution is another advantage that originates from better stock administration.
13. Alfaqui Ahmed 2018 a large portion of the assembling organization merchants have arranging and booking item which accept either limitless creation limit for computing amounts of crude material and work in advancement (WIP) necessities or unending amounts of crude material and WIP materials for figuring generation limit.
14. D. Hoopman 2022 In this article he said that stock advancement perceive that distinctive industry have diverse stock profiles and prerequisites. Exploration has shown that arrangements are estimated in an expansive extent from a huge number of dollars to a large number of dollars.
15. Silver, Edward A 2019 This article considers the setting of a populace of things for which the presumption hidden the EOQ inference holds sensibly well. Then again, as is regularly the trade out the practices there is a total requirement.
16. Delaunay C, Sahin E, 2020 A great deal of work has been done, however now in the event that we need to proceed, we must have great perceivability upon this field of examination.
17. Ansal 2018 study on Materials Management: A case Study of Bharat Heavy Electricals Limited, Bhopal Unit, (BHEL), has evaluated the existing systems of inventory management. He emphasises.
18. Sambasivan Rao.R 20218 In his Study on Materials Management in Public Sector Ship Building Industry evaluates. The performance of materials management and identifies some problems faced by materials management in the heavy engineering industry.
19. Planisware Raju 2021 has conducted a research study on materials management in Andhra Pradesh State Road Transport Corporation (APSRTC) in 2021. In his study, he examines the materials management practices and purchasing systems in APSRTC on the basis of various parameters like material consumption.
20. Hari R. Swami(2015) in his research work materials management in public undertakings evaluates the performance of materials management in the central public undertakings in Rajasthan Viz., Instrumentation Limited, Kota Unit, HMT, Ajmer Unit, Hindustan Zinc Limited, Debari Unit, Hindustan Copper Limited, Khatri Unit and Sambhar salts limited.
21. Prem Virat 2023 highlights the importance of increasing materials productivity in Indian industries.
22. Renuka Raja Gopalan 2017 stresses the importance of productivity through efficient materials management in manufacturing enterprises.
23. Suresh Krishna 2022 advocates the need for professionalism in materials management to achieve the organizational goals.
24. Somayajulu 2024 highlights an integrated view of the role of materials management in improving the profitability of the undertakings.
25. Mahadavan 2023 M&M is vital to corporate management in achieving the set goals and in constitutes one of the 5M's of the corporate Sector viz.

RESEARCH GAP

The existing literature on materials management extensively covers its role in cost reduction, productivity enhancement, and Researchers such as Mukherjee (2017) and Michalski Grzegorz (2020) emphasize materials management as a critical profit centre, while studies like those by Aleksandra Marcikic & Boris Radovanov (2022) explore inventory management in the broader supply chain context. However, gaps remain in understanding the integration of digital technologies such as AI, IoT, and blockchain in materials management, which is crucial for real-time decision-making and operational efficiency.

RESEARCH METHODOLOGY

The research methodology forms the backbone of any systematic investigation, providing a structured approach to collect, analyse, and interpret data in order to achieve the objectives of the study. This section outlines the methods and procedures adopted to explore the effectiveness and enhancement of the **First-In-First-Out (FIFO)** system in **tyre storage and feeding** processes.

TYPE OF PROJECT

The current project is a **descriptive and applied research** initiative. Descriptive research is used to systematically describe the existing FIFO practices and challenges in tyre inventory systems. The applied nature of the study emphasizes practical implementation, as it aims to offer real-time solutions for enhancing FIFO adherence in an industrial setting.

TARGET RESPONDENTS

The study focuses on employees directly involved in tyre storage, feeding, packaging, delivery, and related inventory functions. The **target population comprises 300 employees**, from which a sample of **130 respondents** was drawn.

Departments involved include:

- Packaging
- Delivery
- Finance
- Purchase
- Consultancy

LIMITATION OF THE STUDY

1. Resistance to Change from Warehouse Staff
2. Infrastructure Constraints
3. Technology Adoption Challenges
4. Workforce Resistance and Training Gas
5. External Environmental Factors

ASSUMPTIONS, CONSTRAINTS, AND LIMITATIONS OF THE STUDY

Assumptions

- Respondents have a basic understanding of inventory principles and FIFO practices.
- Data collected through the questionnaire is accurate and unbiased.

Constraints

- Limited time for data collection and analysis due to operational schedules.
- Dependence on employee availability and willingness to participate.

Limitations of the study

- Physical space constraints in the tyre storage area limit full implementation of ideal FIFO layouts.
- Resistance to new technology or changes in workflow among some staff.

RESEARCH DESIGN

The research adopts a **descriptive design**, suitable for understanding and documenting existing conditions, challenges, and opportunities related to FIFO implementation. It involves collecting primary data from employees and secondary data from reports and industry sources. The **objectives** of this design are:

- To identify the current status of FIFO in tyre inventory.
- To measure employee knowledge and practices regarding FIFO.
- To highlight barriers and propose enhancements for efficient FIFO implementation.

SAMPLING METHODS

A **simple random sampling** method was employed to ensure that every employee had an equal chance of selection, thus minimizing selection bias.

- **Population size:** 300 employees
- **Sample size:** 130 respondents
- **Sampling technique rationale:** Random sampling improves the representativeness of the data and ensures that the results can be generalized across the entire operational workforce.

DATA PROCESSING

Data processing involved a systematic approach to prepare the raw data for analysis:

1. **Data Cleaning:** Incomplete, duplicate, or inconsistent responses were removed.
2. **Coding:** Qualitative responses and closed-ended options were numerically coded for statistical analysis.

3. **Tabulation:** Data was entered into Excel sheets for charting and basic summary calculations.
4. **Statistical Software Use:** MS Excel was used for preliminary charts and percentages, while SPSS (if used) helped with advanced analysis like chi-square and correlation testing.

SCALE DEVELOPMENT AND DATA COLLECTION

A structured questionnaire was developed for data collection. It consisted of:

- **Demographic questions** (gender, age, department, experience, qualification).
- **Closed-ended questions** (Yes/No, Likert scale, multiple-choice).
- **Ranking-type questions** to assess inventory performance factors.

Data Collection Methods:

- **Primary Data:** Collected from 130 employees via direct questionnaire distribution.
- **Secondary Data:** Sourced from company inventory records, ERP system snapshots (if permitted),

DATA ANALYSIS AND INTERPRETATION

TABLE NO : 4.1.1
THE METHOD USED TO CHECK INVENTORY IN COMPANY

S.NO	PARTICULAR	RESPONDENTS	PERCENTAGE
1	JIT	39	30
2	Kanban	26	20
3	pareto analysis	5	4
4	EOQ	47	36
5	Other	13	10
	Total	130	100

INTERPRETATION

From the above table it is interpreted that the 30% of the respondents are JIT method, 20% of the respondents are kanban method, 4% of the respondents are pareto analysis, 36% of the respondents are EOQ, 10% of the respondents are other. Majority, 36% of the respondents are using EOQ methods, 30% of the respondents are using JIT methods.

CHART NO: 4.1.1
THE METHOD USED TO CHECK INVENTORY IN COMPANY

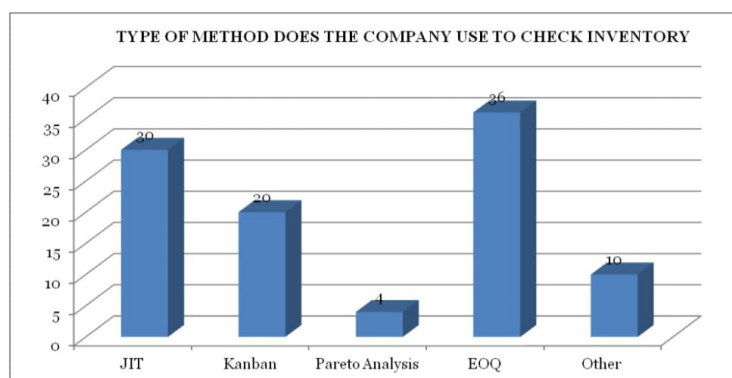


TABLE NO : 4.1.2
INVENTORY LOCATIONS ARE CUSTOMIZABLE

S.NO	PARTICULARS	RESPONDENTS	PERCENTAGE
1	YES	91	70
2	NO	39	30
	Total	130	100

INTERPRETATION

From the above table it is interpreted that the number of yes selected respondents are 70%, no selected respondents are 30%. Majority, 70% of the accepting that inventories are customizable and 30% of the respondents are not accepting it.

CHART NO : 4.1.2
INVENTORY LOCATIONS ARE CUSTOMIZABLE

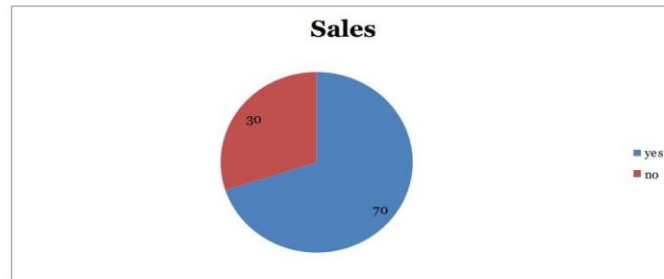


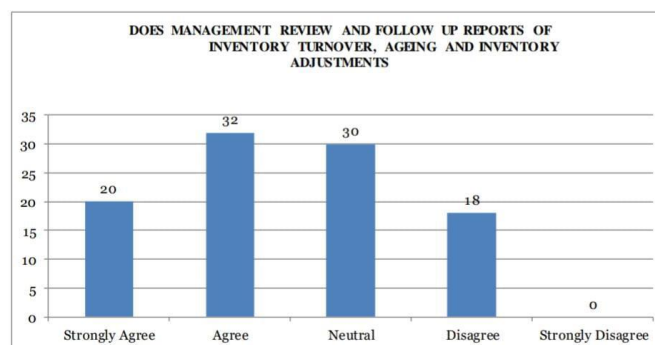
TABLE NO : 4.1.3
THE INVENTORY TURNOVER AND INVENTORY ADJUSTMENTS

S.NO	PARTICULARS	RESPONDENTS	PERCENTAGE
1	Strongly agree	26	20
2	Agree	42	32
3	Neutral	39	30
4	Disagree	23	18
5	Strongly disagree	0	0
	Total	130	100

INTERPRETATION

- It is interpreted that 20% of respondents are strongly agree with management reviews
- It is interpreted that 32% of respondents are agree with management reviews
- It is interpreted that 30% of respondents are neutral with management review

CHART NO: 4.1.3
THE INVENTORY TURNOVER AND INVENTORY ADJUSTMENTS

**SUMMARY OF FINDINGS****1. Demographic Insights**

The demographic profile of respondents reveals a predominance of **male employees**, comprising **70%** of the total sample. Age-wise, the majority of participants were concentrated in the **36–50 years range**, indicating a relatively experienced workforce

2. Departmental Representation

Among the departments surveyed, the **Packaging department** had the highest share of respondents (**24%**), followed by the **Consultancy department** with **18%**.

3. Current Inventory Practices

Regarding inventory management methods, **36%** of respondents indicated that their teams **Quantity (EOQ)** model, while **30%** mentioned the use of the **Just-In-Time (JIT)** approach. Interestingly, **48% of respondents confirmed the use of the FIFO system**, which is central to the study

4. Inventory Management Effectiveness

The internal infrastructure and layout of the inventory system appear to be moderately well-organized, with **80%** of respondents affirming the presence of a **proper layout for storage facilities**. Additionally, a strong **90%** of participants confirmed that **documented procedures for stock-taking** are followed.

5. Management Oversight

revealed regarding **obsolete inventory monitoring and write-offs**. Only **44% of respondents agreed** that management actively monitors and approves the disposal or reassignment of obsolete or inactive inventory items.

SUGGESTION

To enhance FIFO compliance and overall inventory efficiency, the following are recommended:

1. Strengthen Management Oversight:

- Establish a dedicated FIFO review team to audit adherence and review obsolete inventory write-offs regularly.

2. Invest in Technology:

- Introduce Warehouse Management Systems (WMS), barcode scanners, and real-time dashboards to automate FIFO and reduce manual tracking errors.

3. Enhance Employee Training:

- Conduct routine FIFO workshops and simulations, especially for new or junior employees, to ensure full compliance with standard procedures.

4. Layout Optimization:

- Redesign tyre storage zones with clear floor markings, directional flows, and dedicated FIFO lanes to reduce confusion and misplacement.

5. Increase Frequency of Quality Checks:

- Conduct weekly quality inspections instead of monthly to identify issues with tyre degradation or improper storage rotation.

6. Performance-Based Monitoring:

- Link FIFO compliance to individual/team KPIs and performance reviews to motivate accountability.

7. Create Digital Alerts:

- Use inventory management tools to generate alerts for ageing stock that is at risk of expiry or degradation.

CONCLUSION

The present study set out to examine and evaluate the implementation of the First-In-First-Out (FIFO) inventory management technique in the context of tyre storage and feeding operations at Ashok Leyland. As a major player in the automotive manufacturing industry, Ashok Leyland's success is tightly coupled with its ability to maintain optimal production flow, high-quality standards, and efficient inventory control systems. Tyres, being perishable components subject to material degradation over time, require precise and methodical handling. In this regard, FIFO is a vital mechanism to ensure that the oldest stock is utilized first, thereby preserving product quality and minimizing waste.

DIRECTIONS FOR FUTURE RESEARCH

To build on the insights from this study, future researchers are encouraged to explore the following areas:

1. Impact of AI and IoT on FIFO Execution:

- Evaluate how AI-powered systems and IoT sensors can predict tyre usage patterns and automate reordering, tracking, and rotation

2. Comparative Studies Across Units:

- Compare FIFO implementation effectiveness across different manufacturing plants within Ashok Leyland or across competitors.

3. Environmental and Sustainability Focus:

- Analyse the environmental benefits of enhanced FIFO in reducing rubber waste and improving recycling efficiency.

4. Simulation-Based FIFO Modelling:

- Develop digital twins or simulation models to test warehouse layout changes and their impact on inventory flow.

5. Cost-Benefit Analysis of Automation:

- Conduct ROI studies on investing in RFID, barcode systems, or conveyor-based feeding lines for tyre inventory management.

6. Employee Behaviour and Change Management:

- Study behavioural resistance to new systems and evaluate change management strategies that improve FIFO adoption at the grassroots level.

REFERENCE:**Journal Articles:**

1. "FIFO Toward Warehouse Performance Improvement: A Case Study of Automotive Parts Company"
Authors: Oranicha Buddhabhrom and Marisa Pombubpa
Journal: Journal of KMITL Business School, 2018
2. "Reducing The Number of Intermediate Stock by Implementing Just-In-Time & Pulling System"
Authors: Lisna Nuraini and Athina Sakina Ratum
Journal: Journal of Integrated System, 2024

Reference Books:

1. "Essentials of Inventory Management"
Author: Max Muller
2. "Inventory Management: Principles & Practices"
Authors: P. Narayan and J. Subramanian