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A COMPREHENSIVE STUDY ON WAREHOUSE OPERATIONS AND PROCESS OPTIMIZATION THROUGH OBSERVATIONAL ANALYSIS

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Abstract: The paper provides a practical examination of warehouse operations by reviewing actual workflow of ongoing transactions in three most common operational areas, inbound activity, outbound activity, and inventory management. The examination was conducted via on-site observations, without recourse to past records or standard questionnaires. The review focused on several key processes, which included order fulfilment, vendor-managed inventory (VMI), returns processing, and inventory accuracy to inform potential improvements as a measure of daily efficiencies. The analysis involved a structured (risk) approach, utilizing industry- standard analysis tools (e.g., Pareto Analysis, Fishbone Diagrams, 5S Audits, and conceptual applications of ABC/XYZ inventory classifications) that are intended to develop a process of prioritising often occurring issue, tip of the iceberg, causes, evaluation of operational constraints within a broad examination of layout and flow of material movement. The DMAIC process (Define/measure/analyse/improve/control) was the rationale for process evaluation and improvement recommendations. The empirical observations uncovered a potential for delays with current manual processes, overlapping activities in constrained spaces, unknown stock position and order placements, and inadequate or limited levels of collaboration. Using these observations to frame the study's conclusion, it concludes with practical, low-cost, improvement opportunities that can be a part of the improvement process without a total reliance on high level automation or systems change.

Keywords: warehouse operations, observational analysis, DMAIC, VMI, inventory management, inbound logistics, outbound logistics, warehouse efficiency.

I. INTRODUCTION

Warehousing is an integral component to the seamless flow of goods through the supply chain. Well executed warehousing operations contribute directly to customer satisfaction, timely deliveries, inventory accuracy, and cost control. In our current logistics environment, many companies are pursuing process optimization opportunities in the supply chain in an effort to lean operations and enhance responsiveness to customers. However, many of the studies that are conducted to optimize warehouse processes in supply chain management do so using historic data or survey data, neglecting the value of first-hand observations of realities for working systems.

This study sought to fulfil that gap through first-hand observations of warehouse operations. Beginning with observations of processes including order dispatch, vendor-managed inventory, asset recovery functions, and inbound and outbound logistics, this project captures the everyday realities of warehousing functions. The study aimed to identify common inefficiencies and to propose a solution based on the identified needs through process improvement products that apply analytical tools such as DMAIC, Pareto, 5S, and Fishbone diagrams.

Statement of the Problem

While basic warehouse systems and SOPs have been implemented after many years, many logistics operations continue to talk about issues with process inefficiencies (manual) throughout the order fulfilment process, poor-space utilization, lack of communication between departments, and lagging inventory updates. These small, repetitive challenges slow down operational flow, lead to increased lead time, and affect accuracy with warehouse management.

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The aim of this research is to identify, observe, analyse, and develop methods to combine structured observational study with improvement methodologies.

PRIMARY OBJECTIVE:
To analyse warehouse operations through observation and identify areas for process optimization.

SECONDARY OBJECTIVE:
- To identify recurring operational challenges and their root causes through direct observation.
- To assess warehouse process flow, space utilization, and coordination across functions.
- To apply tools like Pareto, 5S, and Fishbone analysis for process evaluation and suggest feasible improvements.

II. LITERATURE REVIEW

Michlowicz, E. (2024) – Suggested using lean tools to measure warehouse performance but focused only on standard lean metrics. This study complements his view by applying 5S and DMAIC in real-time observational settings. Michlowicz emphasized process standardization using lean methods, but did not explore live warehouse limitations where automation is limited. This paper extends the analysis to practical constraints within medium-sized logistics warehouses.

Osman et al. (2024) – Emphasized lean warehouse processes but did not detail manual, non-automated environments. This study addresses that gap by focusing on low-cost solutions in manual operations. Osman et al. also lacked specific examples on observational audit tools like 5S or root cause mapping, which were applied directly in this case.

Cosma et al. (2024) – Developed KPIs for environmental evaluation in warehouses. While this study did not focus on environment, it translated KPI tracking into practical metrics like turnaround time and space usage. Their research used simulation models, whereas this paper captured real-time data insights through staff interaction and field observation.

Manaviriyaphap, W. (2024) – Highlighted AI-based warehouse optimization. Unlike his tech-driven analysis, this study provides alternatives suitable for low-tech, observationally driven improvements. His emphasis on IoT and AI platforms is valuable for smart warehouses, but this paper shows improvements are still possible using lean techniques and staff involvement.

Lu & Li (2022) – Reviewed smart warehouse management but lacked ground-level application. This project offers hands-on, non-digital alternatives grounded in physical observations. Lu & Li focused heavily on system integration, whereas this study targeted the human-centric side of warehouse optimization in resource-limited conditions.

III. RESEARCH METHODOLOGY

Research Design: This study adopts a qualitative and descriptive research design. The purpose was to explore the existing warehouse operations, pinpoint inefficiencies, and make recommendations for better process-level improvements using observation methods instead of structured surveys or archival datasets.

Method of Data Collection: Primary data was gathered through a structured observational study in an internship setting (at a warehouse). It was supplemented by informal conversations with warehouse personnel, leaders, and heads of the processes under examination. No structured question PROTOCOLS, no interviews, and no automated data records were used in this study.

Sampling Method: Purposive sampling was used, as I selected a specific warehouse process context (which had various multiple workflows (VMI, ODM, BTS, ARB) happening simultaneously). My purposive sampling was concentrated on the processes with a duopoly of manual handling with system support.

Sample Size: The study did not have samples units (as surveys do) but evaluated the observed environments (warehouse) while looking at all primary warehouse zones or functional activities across shifts, ensuring the warehouse functions were viewed holistically.

Tools Used for Analysis:
- **Pareto Analysis** – to identify and prioritize frequently occurring operational issues.
- **Fishbone Diagram (Ishikawa)** – to trace root causes of problems

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- **5S Audit** – to assess the workspace in terms of organization, standardization, and visual management.
- **ABC/XYZ Inventory Concept** – applied conceptually to understand classification and potential for space optimization.
- **DMAIC Framework (Six Sigma)** – used to guide the improvement process systematically.

Ethical Considerations: All findings are reported anonymously. No sensitive or proprietary information was disclosed. Observations and opinions were recorded with discretion, and only generalized conclusions are published.

OBSERVATION REVIEW

- The warehouse observed for this study utilizes a tiered, racked structure, to provide highly efficient use of vertical space. The general warehouse layout was a U style flow that allowed for clear separation and direction of inbound and outbound activities. Separate zones were utilized for put away, staging, merging, repacking and returns processing, making for a well-organized area accommodating a variety of workflows.

- The inbound activities involved verifying received goods, regularly check-off items on delivered documents, unloading, sorting, scanning, and storing using a systematic place follow pallet movements in a tiered structure, for a reasonable turnaround time on inbound handling. There was limited visibility into what was generated in outputs related to shifts that presented as some limitations while assessing overall performance.

- Outbound logistics were observed to follow a first-in-first-out (FIFO) picking method, assisted by a warehouse management system and barcode scanning devices. Orders were picked, packed, labelled, and dispatched on a scheduled basis. However, outbound reporting was less consistent in later shifts, limiting end-to-end traceability.

- Value-added services were also carried out in the warehouse, such as order merging and post-sale returns. Returned items were manually sorted and inspected to determine what to do with them. Items were designated as repairable, resalable, or scrap. These practices-maintained control of reverse logistics but also introduced subjectivity and inconsistency in damage classification.

- Inventory was tracked using a digital WMS platform and was periodically verified through manual cycle counts. Inventory management practices were mostly reactive, and while accuracy was maintained in stable workflows, space optimization and visibility were noted as improvement areas.

- There was basic material handling equipment and safety practices in place, and operational practices were governed by documented procedures. There were indications that some areas were operating at or near full capability, and there could be constraints during peak load or with a future expansion of operations.

- These on-site observations were essential to ground lean tools and frameworks to determine inefficiencies and suggest improvements that did not require automation or costly technological investments.

LIMITATIONS OF THE STUDY

- The study was conducted at a single logistics warehouse, so the findings may not be applicable of generalizable to other site logistics environments.

- Time constraints imposed during an internship represented limitations on observations, whereas time may have influenced the consistency and accuracy of operational capacities in that particular warehouse.

- The study did not warrant quantitative Key Performance Indicators (KPIs) or system-based analytic, and therefore unable to provide deeper level statistical evaluation.

- Observations were limited to a short internship period, so it is likely that variations in operational practices existed over time and that variation was exacerbated during busy peak periods of operations.

- Due to the lack of quantitative key performance indicators (KPIs) or analytics generated by an information system, a detailed statistical evaluation could not be conducted for this study.

- Lean tools such as a Pareto Analysis and a Fishbone Analysis were used based on visual observation and subjectively inferred data, which will also impact upon accurately identifying the underlying root cause of a problem.

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ANALYSIS

The study used lean and quality improvement tools to assess inefficiencies identified during core warehouse operations. The analysis used the DMAIC (Define, Measure, Analyse, Improve, Control) structure so that it was systematic and could be acted upon.

The most frequent operational issues were prioritised through Pareto analysis, which analysed the operational data from the 80/20 principle. Specifically, based on our analysis, a small number of recurring issues is contributing to the operational bottlenecks (e.g., parts that take longer to be available, human error while updating stock, space limitations) has helped to focus the improvement work on the critical bottlenecks.

A Fishbone Diagram (Cause-and-Effect Analysis) was used to identify root causes associated with clave issues - outbound delay; stock mismatch; and reverse logistics is not optimal. Root causes frequently related to manual processes, no real-time systems alerts, little flexibility in storage, and no consistency in functions coordinating activities.

5S Audit Observations revealed that the warehouse generally adhered to organization and sorting standards, however more opportunities existed to develop standardized items and visual controls. Labels were missing or inconsistent in some locations and taking full advantage of space for re-use was not being accomplished for peak loads.

Furthermore, ABC/XYZ Inventory Classification was also operationally applied to illustrate potential gaps in depletion methods of placement. Fast-moving items were rarely placed in accessible areas leading to longer picking efforts which congested locations with the largest activity as well.

The analysis suggests that while the warehouse is likely being operated at mostly baseline efficiency, many micro-process inefficiencies have resulted in many low flow sequences. Manual updates and the lack of formal near real-time feedback loops lead to reactive problem solving as opposed to active daily process control.

DISCUSSIONS

The research met its original objectives of recognizing inefficiencies in warehouse practices through first-hand experience and Lean tools. Some areas recognized as problematic were stock visibility, manual coordination, and lead-times on parts, especially under the inbound and merge workflows. It was illustrated through all observations the need to provide structured and minimal cost solutions.

The use of a Pareto and Fishbone analyses allowed for the identification of the sources of persistent issues. Most issues with delays were due to manual handling, lack of real-time alerts, as well as inconsistent documentation processes. The 5S audit also further illustrated that that while the work area overall maintained a clean and somewhat organized state; many areas lacked standardization and visual control; which created obstacles to operational flow.

The findings may lend validation to previous research in terms of warehouse management, but some highlights were the ground level observational perspective not dependent on highly automated warehouses or system data. The research emphatically illustrated how even in a low-tech workplace measurable value can be demonstrated through observation, structured audits, and workforce interaction.

KEY FINDINGS

- Several warehouse processes relied heavily on manual coordination, leading to avoidable delays and inconsistencies in part availability and documentation.
- Stock visibility was often managed through manual checks, increasing the risk of delayed picking and part shortages, particularly in time-sensitive processes like VMI and outbound shipments.
- The 5S audit revealed underutilized space and inconsistent visual standards, especially in areas such as repackaging and commit picking zones.
- Analysis showed that a small number of recurring issues — identified using Pareto — caused the majority of operational disruptions.
- Root cause analysis (Fishbone) traced many inefficiencies to lack of real-time alerts, dependence on human intervention, and layout-related challenges.
- Despite limited system automation, the warehouse maintained functional performance, indicating strong potential for process improvement through simple, low-cost interventions.

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COMPARISON WITH REVIEW OF LITERATURE

The findings of this observational study are in alignment with insights drawn from the literature. As suggested by Michlowicz (2024), lean audits such as 5S are highly effective for measuring performance, and this project employed them to assess organization and workplace structure. Osman et al. (2024) notes that lean helps to explore process optimization. Their study captures many of the same aspects as this project taken from the DMAIC analysis on manual workflows. Cosma et al. (2024) argued KPI based evaluations are needed to assess environmental performance. This study applied those concepts to explore operational KPI's like handling inbound turnaround time, returns, and the utilisation of racks.

This study confirms that considerable effectiveness can be realized through human-centric behaviours and low-tech methods, even though as per Manaviriyaphap (2024) there was no inclusion of AI, as manual smart warehousing would suggest. Lu and Li's (2022) reference to smart warehouse management certainly aligns with this study's human-centric visual tools and structured frameworks that could be used as a basis for future digital use.

IV. CONCLUSIONS

This study provided a real-world evaluation of warehouse operations through professional observations using Lean tools including Pareto Analysis, Fishbone Diagram, and 5S Audit. This project was able to successfully identify operational inefficiencies in order processing, space allocation, and harmonization of activities without the use of historical data and automation techniques.

The analysis showed that the majority of identified operational inefficiencies were caused by manual processes, inadequate adoption of systems integration and poor organization across workspace areas. This study utilized Lean principles and guidelines to demonstrate low-cost action items can be successfully applied in austere settings.

Overall, the research validates the effectiveness of observational analysis in warehouse optimization. The insights gained offer a solid foundation for continuous improvement efforts and can guide similar facilities in refining their operations without major infrastructural changes.

REFERENCES

[1]. Cosma, A., Conte, R., Solina, V., & Ambrogio, G. (2024). Design of KPIs for evaluating the environmental impact of warehouse operations: A case study. *Procedia Computer Science, 232*, 2701–2708.
[2]. Lu, Z., & Li, H. (2022). A literature review of smart warehouse operations management. *Frontiers of Engineering Management, 9*(1), 31–55.
[3]. Manaviriyaphap, W. (2024). AI-driven optimization techniques in warehouse operations: Inventory, space, and workflow management. *Journal of Social Science and Multidisciplinary Research, 1*(4), 1–20.
[4]. Michlowicz, E. (2024). Methodology of evaluating finished goods warehouse performance through lean methods. *Archives of Transport, 70*(2), 43–64.
[5]. Osman, M. K., Mohamad, E., Kamarudin, N., & Rahman, A. A. (2024). Warehouse operations optimisation through the implementation of lean methodology: A comprehensive review. *Multidisciplinary Reviews, 8*(4), e2025110.
[6]. https://www.researchgate.net
[7]. https://www.ciilogistics.com
[8]. https://www.ych.com
[9]. https://en.wikipedia.org/wiki/Warehouse
[10]. https://www.logisticsbureau.com