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THE INFLUENCE OF WAREHOUSE MANAGEMENT SYSTEMS ON SUPPLY CHAIN EFFICIENCY: A CASE STUDY OF THE ONLINE GARMENT SUPPLIER'S EXPERIENCE

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Abstract

This case study examines the impact of implementing a Warehouse Management System (WMS) on the supply chain efficiency of an online garment supplier. Through an in-depth analysis of their experience, we explore how the adoption of WMS technology influenced various aspects of their supply chain, including inventory management, order fulfillment, accuracy, and overall operational efficiency. Key findings from the case study shed light on the benefits, challenges, and lessons learned during the implementation process. These insights provide valuable guidance for businesses considering the integration of WMS into their supply chain strategies to enhance efficiency and customer satisfaction.

Keywords: Warehouse Management system, Supply chain, Online garment, Case study, WMS implementation

INTRODUCTION

The online retail industry has experienced exponential growth in recent years, demanding a high level of efficiency and accuracy in supply chain operations. One critical element in achieving these goals is the adoption of Warehouse Management Systems (Andiyappillai 2020a). This case study delves into the experience of an online garment supplier that implemented a WMS to enhance its supply chain operations. The Online Garment Supplier, a leading player in the e-commerce fashion industry, faced several challenges in managing its growing inventory and fulfilling customer orders accurately and swiftly. These issues prompted them to invest in a Warehouse Management System (Mostafa, Hamdy, and Alawady 2019). In the realm of warehouse control systems, the literature categorizes three distinct types of warehouse management systems (Ramaa, Subramanya, and Rangaswamy 2012):

• Foundational WMS: This system is primarily designed to facilitate stock and location control, primarily serving as a data recording tool. It can generate storage and picking instructions, which may be displayed on RF-terminals. The warehouse management information it provides is straightforward and primarily centered on optimizing output.

• An Advanced WMS - Beyond the capabilities provided by a basic WMS, an advanced WMS possesses the capacity to strategize resource allocation and orchestrate operational activities to ensure the seamless flow of goods within the warehouse. This WMS places a strong emphasis on enhancing throughput, conducting thorough stock assessments, and optimizing capacity utilization.

• A Sophisticated WMS - In the case of a sophisticated WMS, it empowers warehouses, or even groups of warehouses, to achieve optimization. It equips users with comprehensive information regarding each product's precise location (tracking and tracing), its intended destination, and the rationale behind its movement (planning, execution, and control). Additionally, an intricate system offers supplementary functionalities such as transportation management, dock door coordination, and value-added logistics planning, all of which contribute to the holistic optimization of warehouse operations.

Warehouse management systems (WMS) can function as a standalone systems or can be integrated as modules within an Enterprise Resource Planning (ERP) system or a broader supply chain execution suite. The primary objective of a WMS is to regulate the handling and storage of materials within a warehouse. The deployment of a WMS can take various forms, including paper-based, RF/ wireless-based, or a combination of both technologies.

SUPPLY CHAIN STRATEGY BEFORE WMS IMPLEMENTATION

Before the implementation of a Warehouse Management System (WMS), the online garment supplier's supply chain operations operated in a manual and somewhat disjointed fashion.

- Inventory Management: The supplier managed inventory using manual methods and basic spreadsheets. This approach often resulted in inaccuracies in stock levels and made it challenging to keep track of product movement within the warehouse. Instances of stockouts and overstock situations were not uncommon, leading to customer service issues and increased carrying costs.
- Order Processing: Orders were primarily processed manually. Customer orders were received through various channels, such as the website, email, and phone calls. Order information was then entered into a rudimentary order management system, often leading to data entry errors and delayed order confirmations. This manual process occasionally resulted in incorrect order fulfillment and customer dissatisfaction.
- Warehouse Layout and Organization: The physical layout of the warehouse lacked optimization. Products were stored in a manner that was not systematically organized, making it challenging for warehouse staff to locate items efficiently. The absence of proper labeling and organization often led to delays in order picking and packing.
- Communication and Coordination: Communication and coordination among different departments involved in the supply chain were primarily reliant on email and phone calls. This lack of centralized communication channels occasionally resulted in miscommunication and delays in decision-making. Procurement, inventory management, and shipping teams did not have real-time visibility into each other's activities.
- Data and Reporting: Data collection and analysis were limited by the absence of a robust system. Reports were generated manually and were often time-consuming to create. This lack of real-time data made it challenging for management to make informed decisions about inventory replenishment, order prioritization, and overall supply chain optimization.

LITERATURE REVIEW

Warehousing constitutes a significant portion of a corporation's cost of sales, typically ranging from 10% to 20% (Min 2006). Given today's fiercely competitive global business landscape, organizations are increasingly focusing on maximizing Return on Assets, making the minimization of warehousing expenses a paramount business concern. To achieve cost-effective warehousing operations, many companies are automating fundamental warehouse functions to boost throughput rates and inventory turnover. Efficiently and effectively allocating warehouse resources is imperative for enhancing productivity and reducing operational costs

(Sainathuni et al. 2014). One critical aspect that significantly impacts warehouse efficiency is the allocation of suitable storage locations for potentially thousands of products within a warehouse. Numerous factors influencing storage assignment, such as order picking methods, storage system size and layout, material handling systems, product characteristics, demand patterns, turnover rates, and space requirements, have been subject to extensive examination. It has been proposed that the selection of appropriate storage assignment policies (e.g., random, dedicated, or class-based) and routing methods (e.g., transversal, return, or combined) in consideration of these factors offers a viable solution for improving efficiency (Jermsittiparsert, Sutduean, and Sriyakul 2019). Furthermore, a range of decision support models and solution algorithms has been developed to address planning challenges in warehouse operations (Atieh et al. 2016). Extensive research in the literature has delved into the utilization of information systems for the management of warehouses(Kumar and Aziz 2022). The complexity inherent in warehouse management is underscored by various factors, including the volume and diversity of managed products, the degree of overlap among these products, the quantity and types of technology employed, and the characteristics of associated processes. As this complexity escalates, the adoption of Warehouse Management Systems (WMS) becomes imperative for the efficient allocation of warehouse resources and the continuous monitoring of warehouse operations (Laosirihongthong et al. 2018). Warehouses dealing with a substantial number of processed order lines and a diverse array of stock-keeping units (SKUs) stand to benefit most from tailored software solutions. Attempting to maintain up-to-date information on inventory levels, forklift locations, and SKUs in real-time using barcode-based or manual warehouse management systems presents significant challenges (Sainathuni et al. 2014).

WAREHOUSE PERFORMANCE MANAGEMENT

Measuring warehouse performance is of utmost importance as it provides managers with a clear understanding of potential challenges and opportunities for enhancement. These metrics are directly linked to the organization's strategic objectives, and the effectiveness of warehouse operations directly impacts the financial outcomes of the company. To truly position warehouses as value-adding components in the supply chain, it is imperative to measure their performance using precise metrics. Performance measurement in a warehouse encompasses three primary categories: order fulfillment, inventory management, and warehouse productivity. These metrics serve as a foundation for assessing warehouse operations and evaluating the potential of Warehouse Management Systems (WMS) as a basis for justifying investments (Chen and Nguyen 2019). Identifying the appropriate metrics and improvement opportunities

can serve as initial validation for assessing potential returns (Andiyappillai 2020a). The following metrics complement this overarching process (Andiyappillai 2020b).

Table 1 Factors for measurement of warehouse performance

Factor	Measure	Explanation
Order fulfillment	Order Cycle Time	The time taken from the moment an order is placed until it is delivered to the customer. This measure assesses how quickly orders are processed and shipped.
	Order Accuracy:	The percentage of orders that are filled correctly without errors or inaccuracies, including the correct items, quantities, and shipping addresses.
	Fill Rate	The percentage of customer orders that are completely filled without backorders or out-of-stock items. A high fill rate indicates good inventory management.
	Order Lead Time:	The time it takes for an order to move through the entire fulfillment process, from order placement to shipping. Shorter lead times can lead to faster order processing.
Inventory Management measures	Inventory Turn Over	The number of times inventory is sold or used up within a specific period (usually annually). It measures how quickly inventory is moving and is calculated as Cost of Goods Sold (COGS) divided by Average Inventory.
	Safety stock level	The extra inventory kept on hand to account for variability in demand or lead time. Safety stock ensures that customer orders can be fulfilled even when unexpected events occur.
	Economic order quantity	The optimal order quantity that minimizes total inventory costs, including ordering and holding costs. EOQ helps determine how much to order at a time.
	ABC Analysis	Categorizing inventory items into categories (A, B, and C) based on their importance or value. Category A items are the most valuable and may require stricter inventory control.
	Dead Stock Management	Inventory items that have not been sold or used in a long time and are unlikely to be sold in the future. Managing and reducing dead stock helps free up capital.

Warehouse Productivity	Space Utilization	Evaluates how effectively storage space is used, including the number of pallets or products stored per square foot or meter.
	Dock-to-Stock Time	Measures the time it takes for products to go from the loading dock to being available for order fulfillment or storage.
	Cost as a % of sales	Total warehousing cost as a percent of total company sales.
	Orders per hour	Avg. number of orders picked and packed per person – hour

A CASE STUDY ANALYSIS

The Online Garment Supplier deployed a state-of-the-art WMS tailored to its specific needs. This system integrated seamlessly with their existing infrastructure, enabling real-time visibility into inventory levels and enhancing order processing efficiency. Table 1 The table summarizes the significant improvements in various supply chain factors for an online garment supplier following the implementation of a Warehouse Management System (WMS), including reduced processing times, enhanced accuracy, increased efficiency, and improved traceability.

Table 2 Performance improvement after implementation of WMS

Factor	Before WMS	AFTER WMS
Receiving of Goods	180 min	50 min
Stocking	95 min	30 min
Picking of Confirmed Orders	102 min	15 Min
Packing & Labeling	40 min	20 min
Dispatch	90 min	20 Min
Secluding of task i.e Receiving, appointment & Docking	No	Yes
Flow of Work	Manual	Digital
Inventory Updates	Time consuming	Real Time
Picking Accuracy	Low	High
Picking Sequence	Random	Automatic
Cluster fulfillment	No	Yes
Time of fulfillment per order	30 min	10 min
Capacity of order handling per day	400	2500
Manpower	105	70
Traceability	Poor	100% Tracking

Prior to implementing the WMS, the company struggled with stock-outs, overstocking, and inaccurate inventory records. With the new system in place, they achieved near-perfect inventory accuracy, reducing stockouts and minimizing overstock situations. Real-time tracking and automatic reorder triggers contributed to improved stock management. The WMS streamlined the order fulfillment process by optimizing picking routes and automating order prioritization. This resulted in faster order processing times and reduced errors, enhancing customer satisfaction and loyalty. Manual data entry and order processing errors were a significant concern for the Online Garment Supplier. The WMS virtually eliminated these errors by automating data capture and order validation processes. As a result, the rate of returns and customer complaints dropped significantly. The implementation of the WMS had a profound impact on the overall operational efficiency of the company. It enabled better resource allocation, reduced labor costs, and improved warehouse space utilization. These changes translated into cost savings and increased profitability.

Criteria for WMS software Selection

The figure 1 depicts the various factors for WMS software selection encompass evaluating functionality, scalability, integration capabilities, customization, mobile accessibility, inventory accuracy, performance, reporting, support, cost, security, vendor reputation, future updates, user training, and usability to align the software with specific warehouse management requirements. This case study also replicates the same factors while considering the selection of software.

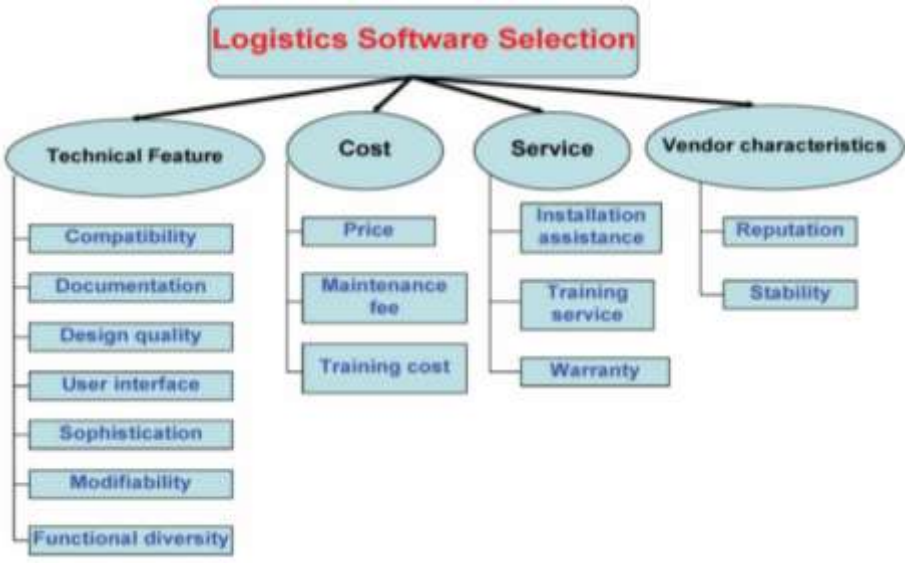

Figure 1 Generic criteria for selecting a software (Adopted from Min 2006)

Cost Benefit Analysis

The cost-benefit assessment for introducing a WMS into online garment has been done, investment in a WMS has resulted in observable and impressive returns in the form of enhanced operational efficiency, cost reduction, and increased customer satisfaction. These outcomes are not only benefiting the business in the short term but also positioning it for sustained growth and achievement in the future. The breakdown of the initial investment required for WMS implementation is illustrated in Table 3.

Table 3 Cost incurred in the implementation of WMS

Description	Amount
Software Licensing Fee	Rs. 1,650,000 (Rs. 110,000 / user) (15 users for 3 years)
Radio Frequency Infrastructure:	Rs. 1,100,000
Server and Workstations:	Rs. 1,600,000
Hand Held Terminals:	Rs. 3,000,000 (Rs. 80,000/terminal+ Rs. 20,000 for AMC/ terminal * 30 users)
Racking:	Rs. 12,000,000
Consultants:	Rs. 200,000
Training costs:	Rs. 1,000,000
Pallet Trucks:	Rs. 480,000 (Rs. 160,000/truck)
Pick to Light System:	Rs. 8,000,000
Total Investment:	**Rs. 29,030,000**

As stated by the proprietor of our online garment industry, subsequent to the investments 30 million in the implementation of our Warehouse Management System (WMS) has noted a return on investment that is not only substantial but also quite evident. This implies that the benefits derived from the investment are tangible and can be readily observed and quantified. The WMS implementation has led to cost reduction for the business. This can encompass various aspects, including reduced labor costs due to increased efficiency, lower inventory carrying costs due to improved inventory management, and potentially fewer errors that incur additional expenses. He further added that the cost incurred in the implementation of WMS has been recovered in the period of 12 months.

CONCLUSION

The case study of the Online Garment Supplier demonstrates the significant positive impact of adopting a Warehouse Management System on supply chain efficiency. The study provides tangible evidence of the transformative potential of Warehouse Management Systems

in enhancing supply chain efficiency. Beyond the theoretical advantages, this real-world example highlights the practical implications of adopting such technology. The company's experience of streamlined inventory management, error reduction, and heightened operational efficiency underscores that technology-driven solutions are not just an option but a necessity in contemporary supply chain management. This case study serves as a compelling reminder that businesses that harness technology effectively are better equipped to stay agile and competitive, ensuring their continued success in the dynamic marketplace. In conclusion, the Online Garment Supplier case study underscores the undeniable impact of Warehouse Management Systems on supply chain excellence. By following the practical recommendations derived from these findings, organizations can harness the power of technology to optimize their supply chain operations, reduce costs, enhance customer satisfaction, and remain adaptable in an increasingly dynamic business landscape. Embracing these strategies will not only boost efficiency but also position businesses for long-term growth and success in the modern market.

FUTURE CONSIDERATIONS

While this case study highlights the benefits of implementing a WMS, it also opens the door to further research. Future considerations may include examining the long-term sustainability of these improvements and assessing the scalability of WMS solutions as the online garment supplier continues to grow.

DATA AVAILABILITY STATEMENT

The data used in this study is available upon request. To obtain access to the data, please contact the corresponding author at prince.rajput06@gmail.com. We are committed to transparency and reproducibility in research, and we will make every effort to provide the data promptly and in a format that facilitates its use for further analysis and validation of our findings. Please note that certain data may be subject to legal or ethical restrictions, and access may be granted in accordance with applicable regulations and agreements governing the data's use. In cases where data cannot be provided due to such restrictions, we will strive to provide detailed information about the data sources, methodologies, and any relevant metadata to enable replication to the fullest extent possible. We encourage researchers and interested parties to reach out with any inquiries regarding the data, and we will make every reasonable effort to assist in facilitating access to the data in a responsible and compliant manner. Our commitment to data availability aligns with the principles of open science and the promotion of collaborative research efforts to advance scientific knowledge. We thank you for your interest in our work and for helping to uphold these ideals.

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