Leveraging WMS Barcode Technology for Enhanced Inventory Performance and Cost Efficiency

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ABSTRACT

In today's competitive logistics environment, efficient inventory management is a cornerstone of operational success and cost efficiency. Manual systems, once reliant on physical labels and handwritten records, remain prone to errors, miscounts, and delays, which undermine productivity and customer satisfaction. This study investigates the adoption of Warehouse Management System (WMS) barcode technology at XYZ Company, which transitioned from a manual inventory system to a barcode-enabled framework to address inefficiencies in accuracy, speed, and cost control. The research evaluates whether barcode-enabled WMS can significantly enhance inventory visibility, operational productivity, and cost effectiveness. Data were collected through structured questionnaires administered to 60 warehouse employees directly involved in inventory operations, comparing the legacy manual system (LCat) with the newly implemented WMS barcode system. Secondary data from inventory records and warehouse reports were also analysed to validate the findings. Results show that processing time was the most critical factor influencing system effectiveness, with 70% of respondents reporting faster task completion through barcode scanning. The transition led to an 80% improvement in inventory accuracy, a 20% reduction in operating costs, and more efficient utilization of warehouse space. Additionally, enhanced inventory control minimized stock discrepancies, reduced labour-intensive tasks, and enabled employees to focus on higher-value activities. This research contributes to both theory and practice by demonstrating how digital transformation in inventory systems improves operational efficiency, strengthens customer trust, and supports long-term profitability. For practitioners, particularly in emerging markets with limited technological adoption, the study offers a practical blueprint for implementing barcode-enabled WMS to streamline warehouse processes. Overall, the findings underscore the strategic importance of WMS technology in achieving cost efficiency, real-time inventory visibility, and sustainable logistics performance.

Keywords: WMS Barcode, Inventory management, Warehouse, Cost-effective

INTRODUCTION

In today's dynamic logistics environment, accurate and real-time visibility of inventory locations is a critical requirement for efficient warehouse operations. While manual systems once relied on clipboard records and physical label checks, modern warehouses increasingly adopt barcode-enabled Warehouse Management Systems (WMS). These systems allow rapid scanning, real-time updates, and integration into broader supply chain operations, thereby optimizing inbound and outbound flows, minimizing human errors, and accelerating order processing.

This advanced technology has greatly influenced operational efficiency, delivering up to a 20% reduction in operating costs and a 50% improvement in warehouse space utilization. However, Malaysia's logistics and supply chain sectors still lag in adopting advanced technologies such as barcode readers and RFID scanners.

Many firms continue to rely on simple physical labels, where each rack and shelf carries a unique address recorded in a database. Any shortage of inventory items required for production has critical implications for warehouse management. Dobler (2000) argues that efficiently controlled inventories contribute significantly to effective firm operations and overall profitability. Proper and systematic inventory management supports smooth execution of other functions such as purchasing, production, sales, marketing, and financial management.

For instance, Brand XX's stock handling previously relied on a manual system, requiring workers to count items one by one. While such systems may reduce costs for small companies, they are inefficient and unsuitable for long-term operations. Manual practices often result in discrepancies, stock misplacement, and delays. The adoption of WMS barcode technology at XYZ Company significantly improved inventory management efficiency by up to 80%, making operations faster and more accurate. Manual inventory systems, still common in some small firms or regions with limited technology adoption, are error-prone and labor-intensive. They often lead to miscounts, misplaced items, and inflated labor costs (Istiqomah et al., 2020). At XYZ Company, these inefficiencies placed a burden on management and lengthened inventory checks. For example, counting over 50 product variants under Brand XX often required an entire day, with recounts needed to correct human errors. Workers frequently had to repeat stock counts to verify results, further consuming time and resources.

Given these persistent challenges, this study investigates whether transitioning from legacy systems to barcode-enabled WMS can improve inventory accuracy, operational speed, and cost control. It particularly focuses on environments with limited adoption of high-tech warehouse tools. The study is expected to provide actionable insights for both academia and industry. For researchers, it will expand the literature on digital transformation in inventory control by offering empirical evidence of WMS barcode outcomes. For practitioners, especially in emerging markets, it provides a practical blueprint for technology adoption, implementation strategies, and performance benchmarks. Decision-makers may also use these findings to evaluate return on investment (ROI) and justify transitions from manual to automated systems.

By adopting barcode-enabled WMS, warehouse operators can achieve substantial improvements in inventory tracking accuracy, streamlined processes, and reduced labor and operating costs. Enhanced data flow supports automation in receiving, put-away, picking, and order fulfillment, while integration with IoT and AI can further strengthen predictive inventory control and decision-making. Ultimately, these improvements drive higher customer satisfaction, reduced waste and improved profitability.

The findings of this study provide well-researched insights valuable to both academia and industry. For XYZ Company, WMS adoption improved inventory management, particularly for complex and fragile products such as Product A. It also enhanced staff capabilities in the Stores and Procurement departments, enabling better control over inventory. Furthermore, the research offers guidance for transitioning from manual to automated systems, helping organizations design effective inventory management policies. For management, these recommendations promote smoother operations, improved customer satisfaction, and reduced operational costs. In the long term, adopting WMS technology is expected to strengthen warehouse productivity, efficiency, and profitability.

DISCUSSION ON RELATED STUDY

Recent empirical and industry research increasingly shows that both barcode and item-level RFID technologies substantially improve inventory accuracy, while reducing discrepancies and mitigating stockouts across backrooms and sales floors. Barcode-enabled Warehouse Management Systems (WMS) can deliver remarkable accuracy in inventory management, with some studies reporting improvements from manual levels of around 63% to as high as 99.9% through barcode scanning (Finale, 2025). Another report notes that implementing barcode systems in warehouse operations can reduce inventory errors by up to 30%, resulting in fewer stockouts and better alignment between recorded and actual inventory (Cyzerg, 2024).

Equally compelling, simulations and field evidence highlight RFID's advantages. Comparative studies consistently show that RFID outperforms barcode systems regardless of demand patterns or order frequencies,

generating performance gains and supporting a strong rationale for adoption despite higher setup costs such as hardware and tags. One study shows that RFID enables batch, contactless scanning, thereby boosting reading speed and accuracy in complex environments compared to one-by-one barcode scans (Cykeo, 2025). A corporate case even documented a fivefold increase in pallet and item processing per operator when switching from barcode to RFID systems (Kubáňová et al., 2022).

Moreover, combining RFID and barcode technologies in a complementary manner enhances supply chain visibility, accuracy, and cost effectiveness. Automated data capture using both approaches minimizes human entry errors and enables real-time tracking from production to retail floors, facilitating better forecasting, reduced stockouts, and higher customer satisfaction (IJNRD, 2024). In omnichannel and large-scale operations, RFID's touchless, high-throughput capabilities provide a transformative advantage. In terms of cost-effectiveness, barcode systems remain budget-friendly and simpler to deploy the ideal for smaller operations, while RFID's long-term benefits in labor savings and scalability make it a compelling strategic investment for complex, high-velocity environments (Omniful, 2025).

Taken together, this evidence affirms that while barcode-enabled WMS remains highly effective and far superior to manual methods, leveraging RFID alongside barcode technology can unlock an even higher level of accuracy, efficiency, and throughput. For organizations like XYZ Company, adopting an RFID-enabled WMS to augment existing barcode processes promises to close visibility gaps, expedite cycle counts, reduce labor burdens, and deliver measurable gains in both operational performance and cost control.

Process of Inventory Management

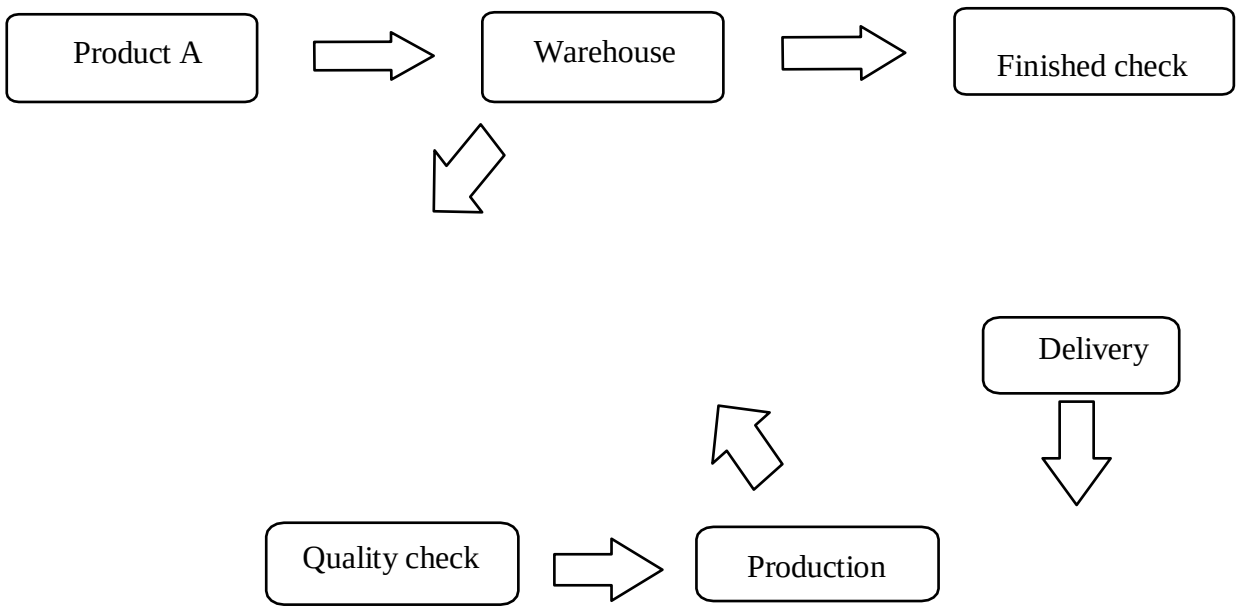


Figure 1: Inventory Process at XYZ Company Warehouse

Figure 1 illustrates the step-by-step process of inventory management in XYZ Company's warehouse operations, covering the flow from incoming stock to outgoing products. Effective inventory management is essential to ensure zero discrepancies during monthly stock takes. The process must be highly systematic to guarantee that the data recorded in the system matches the total order quantity. For example, incoming stocks of Product A are recorded and stored in a cold room to maintain quality, as the product requires low-temperature storage. Storekeepers and their team conduct quality checks and recounts to minimize discrepancies.

While these procedures reflect a conventional barcode-based warehouse management system, stronger integration of RFID within the research framework could make the study more cohesive. This is because RFID

provides real-time tracking, automated data capture and improved visibility of goods across the entire supply chain, reducing manual intervention and error. Furthermore, if XYZ Company outlines concrete future adoption plans for RFID such as phased implementation in high-volume product lines or integration with existing WMS, the research would present a clearer roadmap for technological advancement. Such inclusion not only strengthens the theoretical foundation but also demonstrates practical foresight, making the study more relevant for both academics and industry practitioners.

Production activities proceed daily to meet customer demand and satisfaction. During this stage, workers pick Product A through single picking, followed by quality checking, paper wrapping, bubble wrapping and finally attaching the waybill to the parcels. Once completed, all parcels are sent to the distribution hub, where they are sorted by state for easier delivery to customers. Another system is used to scan the waybills, ensuring that customer orders align precisely with the number of parcels prepared. Cost control plays a strategic role in enabling both efficiency and business growth. Future models for measuring third-party logistics (3PL) performance should therefore incorporate cost-related metrics such as cost per unit, capital avoidance and reinvestment of savings to provide a holistic evaluation of outsourcing effectiveness.

DISCUSSION OF THE FACTORS

Processing of Time

A company's financial performance is closely linked to the efficiency of its inventory management processes. Ineffective practices often lead to greater losses, operational delays, and wasted time, ultimately reducing competitiveness. In the logistics industry, where speed and precision are critical, delays in daily operations can escalate costs and erode customer satisfaction (Cyzerg, 2024). Poor time management in inventory operations not only disrupts workflows but also heightens risks associated with weak internal controls. Without timely corrective action, such inefficiencies may result in significant financial and operational setbacks.

Improving inventory management systems is therefore essential for reducing lead time, mitigating stock discrepancies, and enhancing overall efficiency. Technological innovation plays a vital role by streamlining operations and enabling firms to deliver faster, more reliable services an advantage that attracts and retains customers (Finale Inventory, 2025). For instance, XYZ Company previously relied on a manual inventory system (LCat System), which was prone to errors, slow cycle counts, and extended working hours. This manual approach not only delayed daily operations but also contributed to inventory losses.

To overcome these challenges, XYZ Company adopted a Warehouse Management System (WMS) integrated with barcode technology. This upgrade significantly improved operational speed by automating item identification and reducing reliance on manual counts. Consequently, daily workflows became more productive, working hours were optimized, and inventory control was strengthened. Evidence from recent studies supports these outcomes, showing that barcode-enabled WMS can enhance processing efficiency, reduce labor requirements, and improve time management in logistics operations (Kubáňová et al., 2022; Omniful, 2025).

Time efficiency thus emerges as a key factor influencing the effectiveness of WMS in inventory management. By leveraging barcode-enabled systems, companies can minimize delays while strengthening competitiveness in today's dynamic logistics environment.

Inventory Control Management

Inventory control management is broadly defined as the systematic application of policies, procedures, and monitoring mechanisms to regulate stock levels, determine replenishment timing, and optimize order quantities (Aydin & Tiryaki, 2021). It is a continuous process of planning, organizing, and controlling inventory with the dual aim of ensuring product availability while minimizing capital tied up in stock. Effective planning and control not only balance supply and demand but also enhance operational responsiveness and decision-making (Bortolini et al., 2020).

A robust inventory control system enables real-time tracking, data collection, and analysis, all of which are critical for demand forecasting and warehouse optimization. Technologies such as barcoding and RFID support this process by ensuring accurate identification and efficient recording of inventory items (Cyzerg, 2024). Beyond item identification, the integration of centralized databases within Warehouse Management System (WMS) platforms provides organizations with tools to generate analytical reports, apply methodologies such as ABC analysis, and implement strategies like just-in-time (JIT), first-in-first-out (FIFO), or last-in-first-out (LIFO), depending on operational requirements (Singh et al., 2023).

Previously, XYZ Company relied on fragmented systems without a centralized database, limiting its ability to control inventory effectively. Weak stock tracking and reporting processes led to inefficiencies in daily operations. To address these challenges, management implemented a barcode-enabled WMS. The adoption of this system introduced structured documentation, systematic labeling, and real-time visibility, which significantly improved inventory accuracy and reduced operational delays. Consistent with broader industry findings, WMS adoption at XYZ Company has strengthened control, improved stock traceability, and aligned warehouse operations with best practices in modern logistics (Omniful, 2025).

Cost Effective

Managing inventory effectively requires careful consideration of multiple cost components, including purchasing, holding, and handling expenses. Research indicates that inventory-related costs can represent a substantial portion of total product or service costs, often accounting for the majority of operational expenditures in logistics and supply chains (Prasetyo et al., 2022). This underscores the importance of adopting modern warehouse management practices and technologies that enhance inventory visibility, minimize waste, and optimize cost structures.

Warehouses play a central role in revenue generation, as they directly influence service quality and customer satisfaction. When customers rely on warehouse facilities to safeguard inventory and support production, maintaining accuracy and product quality becomes critical. Inefficient inventory practices, such as misplaced or lost items, not only increase operational costs but also risk customer dissatisfaction and potential defection to competitors (Kamble et al., 2020). Consequently, effective cost management in warehouse operations is essential for sustaining competitiveness and customer loyalty.

At XYZ Company, warehouse racking systems were organized according to customer products. However, increasing customer demand required investments in racking adjustments to align with the newly implemented WMS barcode system. Although initially costly, such investments are essential for supporting operational scalability, streamlining processes, and accommodating high-volume clients like Brand XX, whose continuous production cycles generate consistent inventory inflows. Aligning racking systems with WMS technology reduces misplacements, shortens retrieval times, and supports better space utilization, thereby lowering long-term costs and improving service efficiency (Sharma & Bhatia, 2023). Failure to manage these cost factors effectively can lead to inefficiencies, revenue loss, and weakened competitive positioning. By contrast, adopting modern WMS technology enables companies like XYZ to achieve cost-effectiveness through reduced inventory errors, optimized space utilization, and stronger customer satisfaction, ultimately reinforcing financial performance (Omniful, 2025).

RESEARCH METHODOLOGY

Research Approach

This study employed a quantitative research approach to evaluate the effectiveness of WMS barcode technology in enhancing inventory management at XYZ Company. Quantitative methods were selected for their ability to support structured data collection through standardized questionnaires. These questionnaires were designed based on gaps identified in the existing literature, enabling the collection of respondents' perspectives on whether the current system is more effective than the previously used manual system (Nusa et al., 2022). Moreover, the use of questionnaires facilitated statistical analysis and objective comparison between the legacy manual system (LCat) and the newly implemented WMS barcode system. Unlike qualitative

methods, which rely on open-ended responses, interviews, or observations, the quantitative approach generates measurable outcomes that are critical for assessing operational improvements and cost efficiency.

Research Design

The research design provided a structured framework for data collection, measurement, and analysis. This study examined the transition from a manual inventory tracking system (LCat) to a WMS barcode-based system. To support this evaluation, a one-week trial of the new system was conducted to address inventory discrepancies and assess its readiness for full-scale implementation. Following the trial, questionnaires were distributed to 60 warehouse employees to capture their insights and experiences with both systems. The design aimed to determine whether the WMS barcode system improved key daily operations, including stock receiving, storage, and dispatching, compared to the previous manual approach.

Population and Sampling

The target population for this study comprised staff at XYZ Company who were directly involved in warehouse operations, including officers, operators, and storekeepers. Although the company employs more than 200 staff across various departments such as Accounts, Marketing, and Administration, only the 70 employees within the warehouse department were considered relevant to this research. This focus was intentional, as warehouse staff play a central role in inventory allocation and management (Adlan et al., 2020). From this population, the appropriate sample size was determined using Raosoft's sample size calculator, which indicated that 60 respondents would provide sufficient data for reliable analysis while maintaining practicality in collection. Convenience sampling was then employed to gather primary data from the most accessible respondents capable of providing the required information (Tarudin & Adlan, 2021).

Data Collection Methods

This study utilized both primary and secondary data sources. Primary data were collected through structured questionnaires administered to warehouse staff, capturing feedback on warehouse operations before and after the implementation of the WMS barcode system. Secondary data were drawn from company directories and inventory records, offering contextual insights into the organizational structure and operational workflows. Combined, these data sources provided a comprehensive understanding of both employee perspectives and key operational metrics.

Research Instruments, Validity, and Reliability

The primary data collection tool was a structured questionnaire consisting of two sections. Section A captured respondents' demographic information, while Section B assessed their perceptions of warehouse inventory management, focusing on accuracy, efficiency, and system reliability. Responses were measured on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). To ensure content validity, the questionnaire was reviewed by subject matter experts and piloted with a small group of warehouse staff. The pilot test confirmed the clarity and appropriateness of the instrument for the target respondents (Tarudin et al., 2021). Reliability was evaluated using Cronbach's alpha, yielding a coefficient of 0.67 across 20 items. As this value exceeds the minimum acceptable threshold of 0.60, the instrument was deemed reliable, and the data collected were considered suitable for further analysis.

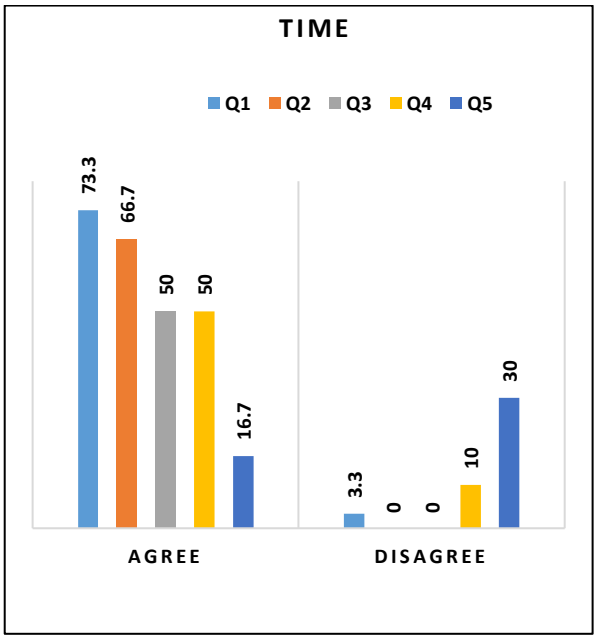
Table 1: Reliability Statistics

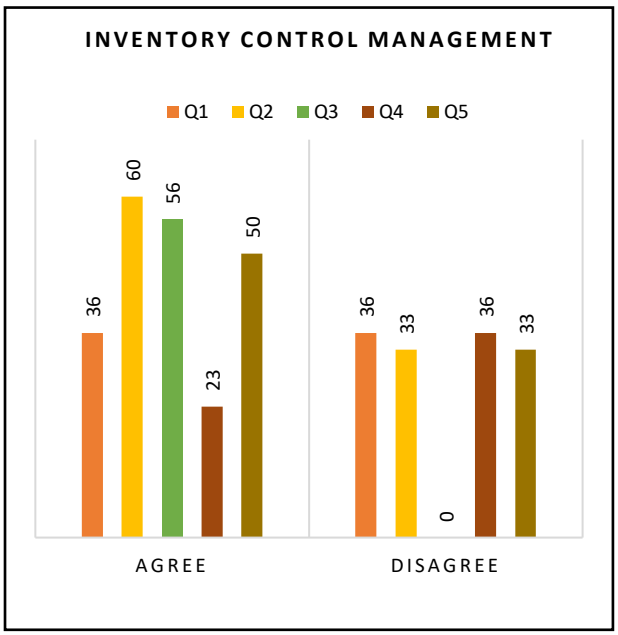
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N Of Items
0.624	0.667	20

FINDINGS

The analysis highlights how WMS barcode implementation improved time efficiency and strengthened inventory control management, leading to enhanced accuracy, reduced operational errors, and more systematic

warehouse processes.





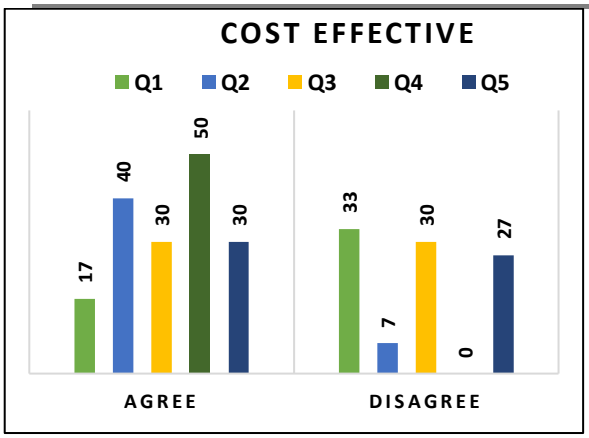
Q1	Work can be finished on time by using WMS barcode scanner.
Q2	Working hour become more productive by using WMS barcode system.
Q3	Work is more efficient by using barcode system.
Q4	Time can be fully utilized with other job scope.
Q5	WMS barcode system always lead to over time working hour.

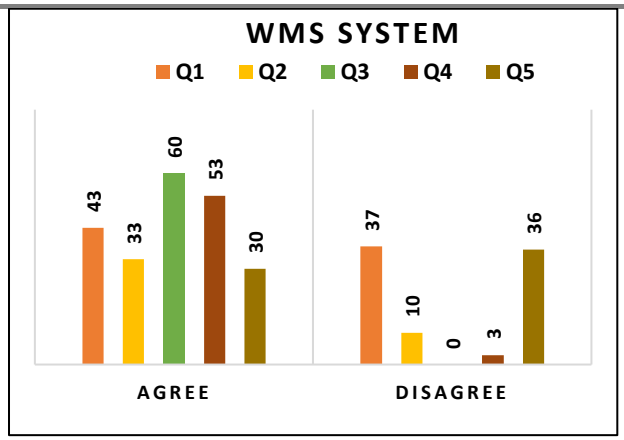
Q1	Counting stocks every day is reasonable for daily operation.
Q2	Searching inventory at location is easier by using WMS software than LCat.
Q3	Inventory at warehouse is more systematic by using WMS barcode system.
Q4	Company use high technology to control inventory.
Q5	Discrepancy inventory always occur during counting stocks.

Figure 2: Time and Inventory Control Management

Figure 2 presents respondents' perceptions of two key factors influenced by the implementation of the WMS barcode system: Time Management and Inventory Control Management. The bar chart on the left shows that most respondents agreed the WMS barcode system positively impacted time management in warehouse operations. Specifically, over 70% agreed that tasks could be completed on time using the WMS barcode scanner (Q1), while 66.7% reported that working hours became more productive (Q2). Additionally, 50% observed improvements in work efficiency (Q3) and time utilization (Q4). However, 33% disagreed that the WMS system consistently prevents overtime (Q5), suggesting that although the system enhances time optimization, some operational inefficiencies remain.

In terms of Inventory Control Management, the bar chart on the right indicates a favorable perception of the WMS barcode system's role in improving inventory accuracy and control. For example, 60% of respondents agreed that searching for inventory became easier with WMS compared to the previous LCat system (Q2), and 50% perceived inventory tracking as more systematic (Q3). A smaller yet notable proportion, approximately 33%, agreed that daily stock counting and the use of technology enhanced inventory control (Q1 and Q4). Nevertheless, responses to Q5 reveal persistent challenges, with 33% of respondents acknowledging that inventory discrepancies still occur during stock counts. These findings suggest that while the WMS barcode system has strengthened several aspects of inventory management, further refinements are needed to fully eliminate discrepancies and residual inefficiencies.





Q1	Company payment for overtime salary is suitable with the job.
Q2	Labour cost operation can be reduced by using WMS barcode system.
Q3	WMS barcode system can reduce equipment cost such as paper, billing notes, and office equipment.
Q4	WMS barcode system can reduce error cost in daily operation.
Q5	Company should reduce man power cost and invest more barcode scanner.

Q1	WMS barcode is complicated to implement.
Q2	WMS barcode is more efficient than LCat.
Q3	WMS barcode scanner is easy to handle.
Q4	WMS scanner always lost internet connection.
Q5	Two scan handler is enough for fast operation.

Figure 3: Cost Effective & WMS System

Figure 3 illustrates respondents' comparative perceptions of the cost-effectiveness and operational efficiency of Warehouse Management System (WMS) barcode technology. The left section highlights cost-related aspects, where a considerable proportion of respondents agreed that WMS implementation helps reduce company overtime payments (40%) and labor costs (30%), underscoring its potential to optimize workforce expenses. Additionally, 40% acknowledged that the system reduces the use of office supplies such as paper and billing notes, further contributing to cost savings. The system was also recognized for minimizing operational errors, with 33% agreement, thereby reducing cost leakage from mistakes. However, only 27% supported reducing manual costs in favor of greater investment in barcode scanners, while many respondents remained neutral or disagreed, suggesting cautious attitudes toward capital investment.

The right section of the figure evaluates WMS from a usability and system performance perspective. A majority of respondents (43%) agreed that WMS is more efficient than manual systems, while 33% indicated that barcode scanners are easy to handle, reflecting strong user acceptance and ease of use. Nonetheless, operational concerns emerged, with 30% of participants noting that scanners may become ineffective without internet connectivity, highlighting dependence on digital infrastructure. Furthermore, while 36% agreed that two scanners are sufficient to support fast operations, the remaining respondents expressed reservations, suggesting the need for improved equipment planning to meet operational demands.

Table 2: Regression Coefficient

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.694	.387		1.794	.078
ProcessingTime	.278	.093	.415	2.977	.004

Inventory Control	-.016	.079	-.025	-.202	.841
CostEffective	-.024	.084	-.038	-.279	.781

Dependent Variable: Warehouse System

The regression analysis presented in Table 2 was conducted to evaluate the critical factors of WMS barcode technology that contribute to improved warehouse and inventory management. According to Pallant (2010), if the significance value is less than 0.05 ($p < 0.05$), the variable makes a statistically significant unique contribution to predicting the dependent variable. In this study, Processing Time was the only factor found to have a statistically significant effect on the dependent variable, Warehouse System, with a p-value of 0.004. This finding indicates that reducing processing time through the implementation of WMS barcode systems significantly enhances warehouse performance and inventory accuracy.

In contrast, Inventory Control ($p = 0.841$) and Cost Effectiveness ($p = 0.781$) did not demonstrate a statistically significant influence on the dependent variable. The negative standardized beta coefficients for these two variables (–0.025 and –0.038, respectively) suggest a weak inverse relationship, though these results were not statistically meaningful. Despite their relatively high t-values (8.41 for Inventory Control and 7.81 for Cost Effectiveness), the absence of statistical significance indicates that these factors did not contribute meaningfully to warehouse system effectiveness in this model.

Overall, the findings highlight Processing Time as the most critical factor in leveraging WMS barcode technology for improved warehouse and inventory performance. The standardized beta coefficient for Processing Time (0.415) further confirms its strong positive influence. This implies that organizations seeking to optimize warehouse operations through WMS barcode systems should prioritize reducing processing time, as it delivers the most direct and measurable impact on performance outcomes.

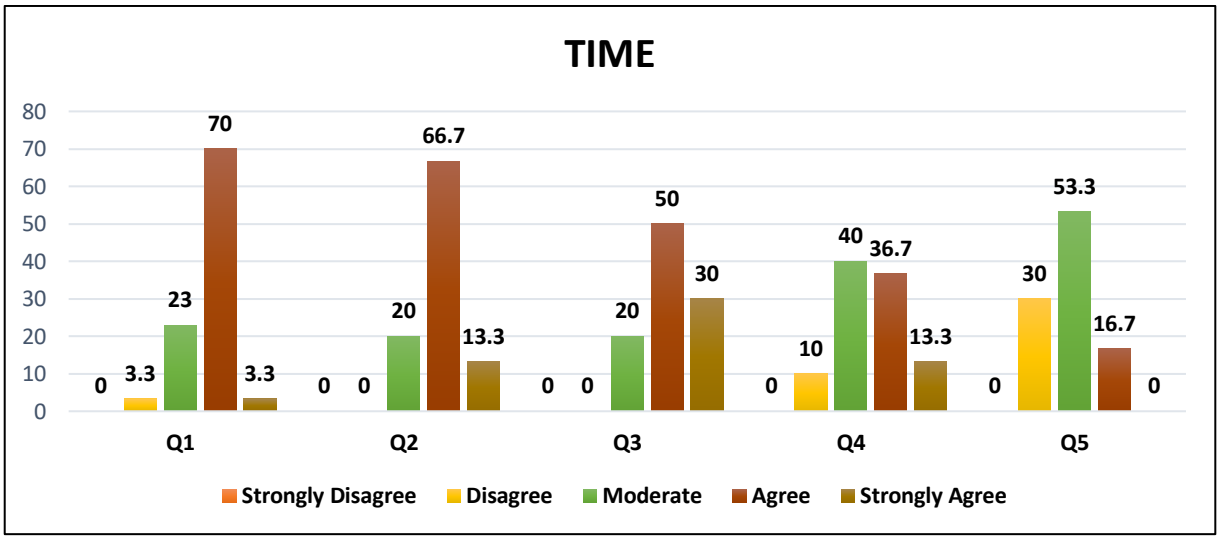


Figure 4: Critical Factor - Time

Time was identified as the most critical factor influencing warehouse and inventory management when compared to inventory control and cost. The analysis clearly indicates that processing time significantly impacted the effectiveness of WMS barcode implementation in improving inventory operations. A majority of respondents reported that time management became more efficient in their daily tasks following the adoption of WMS barcode systems. Notably, none of the respondents strongly disagreed with the statement that time efficiency improved, highlighting widespread acceptance of the technology's benefits in this area.

The results further show that 70% of respondents agreed and 3.3% strongly agreed that tasks could be completed on time with the use of WMS barcode scanners. This supports the conclusion that advanced technology in warehouse operations can substantially reduce processing time. Some respondents reported only moderate agreement, often due to occasional overtime required for handling incomplete tasks or resolving

inventory discrepancies—issues commonly observed during transition periods or in complex inventory environments.

Additionally, respondents agreed that their working hours became more productive and that they experienced improved workflow and task satisfaction after the implementation of WMS barcode systems. Overall, the data suggest that the integration of WMS technology made warehouse tasks more efficient, structured, and systematic, demonstrating that time efficiency is a key driver in enhancing overall inventory management performance.

CONCLUSION

This study aimed to assess the effectiveness of the Warehouse Management System (WMS) Barcode in enhancing inventory management at XYZ Company. The results indicate that the shift from the manual LCat system to the WMS Barcode system significantly improved operational efficiency, with processing time emerging as the most influential factor. The new system reduced inventory discrepancies and improved stock control, enabling the company to align with international logistics standards and strengthen its competitiveness. These findings reaffirm the importance of robust inventory systems in supporting faster decision-making, minimizing costs, and maintaining seamless production flows.

Despite the positive outcomes, the study faced several limitations. The limited timeframe of the researcher's internship constrained the depth of analysis. Additionally, challenges in data collection arose due to the demanding schedules of warehouse staff, which made it difficult to secure full participation. Language barriers also influenced some responses, as varying educational backgrounds among employees affected their understanding of the survey questions. Nonetheless, the data collected were sufficient to provide a reliable snapshot of current inventory management practices.

These limitations suggest valuable directions for future research. Extending the study period would allow for a deeper exploration of the long-term impact of WMS Barcode systems. Developing multilingual survey tools could enhance clarity and response accuracy, especially in diverse workplaces. Moreover, adopting a mixed-method approach that integrates quantitative surveys with qualitative interviews or focus groups could yield richer and more nuanced insights into warehouse management practices.

Based on the findings, several practical recommendations are proposed to enhance inventory management at XYZ Company. These include creating a centralized inventory database for real-time tracking, implementing a stock retention schedule, and classifying items based on attributes such as size, brand, or expiration date. Additionally, reorganizing warehouse racking systems and setting up automated low-stock alerts could further optimize daily operations. By adopting these strategies, XYZ Company can improve accuracy, operational efficiency, and long-term performance in an increasingly competitive logistics sector.

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